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MINERAL INDUSTRIES OF

ASIA AND THE PACIFIC

U.S.
DEPARTMENT
OF THE
INTERIOR

BUREAU
OF
MINES

1989

UNITED STATES DEPARTMENT OF THE INTERIOR • Manuel Lujan, Jr., Secretary

BUREAU OF MINES • T S Ary, Director

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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Preface

This edition of the Minerals Yearbook records the performance of the worldwide minerals industry during 1989 and provides background information to assist in interpreting that performance. Content of the individual Yearbook volumes follows:

Volume I, Metals and Minerals, contains chapters on virtually all metallic and industrial mineral commodities important to the U.S. economy. In addition, a chapter on survey methods used in data collection with a statistical summary of nonfuel minerals and a chapter on trends in mining and quarrying in the metals and industrial mineral industries are included.

Volume II, Area Reports: Domestic, contains chapters on the minerals industry of each of the 50 States and Puerto Rico, Northern Marianas, Island Possessions, and Trust Territory. This volume also has a chapter on survey methods used in data collection including a statistical summary of domestic nonfuel minerals.

Volume III, International Review, contains the latest available mineral data on more than 150 foreign countries and discusses the importance of minerals to the economies of these nations. The 1989 review is presented as 5 area reports and one world overview: Mineral Industries of Africa, Mineral Industries of Asia and the Pacific, Mineral Industries of Latin America and Canada, Mineral Industries of Europe and U.S.S.R., Mineral Industries of the Middle East, and Minerals in the World Economy. This year's reports incorporate location maps, industry structure tables, and an outlook section previously incorporated in our Minerals Perspectives Series quinquennial regional books, which have been discontinued. The Bureau of Mines continually strives to improve the value of its publications to users. Constructive comments and suggestions by readers of the Yearbook are welcomed.

T S Ary, *Director*

Acknowledgments

The Bureau of Mines, in preparing these Volume III Minerals Yearbook Reports, extensively utilized statistics and data on mineral production, consumption, and trade provided by various foreign government minerals and statistical agencies through various official publications. The cooperation and assistance of these organizations is gratefully acknowledged. Statistical and informational material was also obtained from reports of the U.S. Department of State, from United Nations publications, and from the domestic and foreign technical and trade press. Of particular assistance were the routine and special reports submitted by the 10 Regional Resource Officers assigned to minerals and petroleum reporting and by economic and commercial officers and other officials of the Department of State located in American Embassies worldwide. Their contributions are sincerely appreciated.

The text and production, structure of the mineral industry, and reserve tables of this volume were prepared by the respective country authors on the staff of the Division of International Minerals, Information and Analysis Directorate. The mineral export and import trade tables were prepared by the International Data Section of the Division of Statistics and Information Services, Information and Analysis Directorate.

The regimes of some countries reviewed in this volume may not be recognized by the U.S. Government. The information contained herein is technical and statistical in nature and is not to be construed as conflicting with or being contradictory of U.S. foreign policy.

George J. Coakley
Chief, Division of International Minerals

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Vitae

David B. Doan, geologist, has had 14 years of experience with the U.S. Geological Survey and more than 25 years as a consulting geologist to industry, including field work in East and Southeast Asia and 6 years as visiting professor at the University of Maryland. He is a senior country analyst in the Branch of Asia and the Pacific, specializing in countries of Indochina and the subcontinent, and has authored Bureau publications on Burma, India, and Thailand, as well as Bangladesh, Bhutan, Brunei, Cambodia, Laos, Nepal, Sri Lanka, and Vietnam.

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Pui-Kwan Tse, chemist, completed 2 years as a postdoctoral fellow at Ames Laboratory (Iowa) and Brigham Young University and 5 years as a research chemist at Argonne National Laboratory and Naval Research Laboratory before joining the U.S. Bureau of Mines in 1990. Dr. Tse's research activities have topically included environmental waste treatment, solvent extraction, and chromatography. He has authored more than 20 papers on these subjects either in international journals or in technical publications of Argonne National Laboratory. Dr. Tse is a senior analyst for China, and his debut presentations for the Branch of Asia and the Pacific are on Afghanistan, China, Hong Kong, Pakistan, and Taiwan.

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MINERAL INDUSTRIES OF

ASIA AND THE PACIFIC

By Staff, Branch of Asia and the Pacific

INTRODUCTION[1]

The area encompassed by the political entities included in this study comprises 11 million square miles or about 15 percent of the total Earth's land area. The bulk of the region is contained on the Asian continental land mass. Australia, the world's largest island or the world's smallest continent, alone is almost as large as the continental United States. The islands of New Zealand, New Guinea, Borneo, Sumatra, and Honshu are among the largest in the world. Collectively, they constitute a land area of 1.1 million square miles or an area about one-fourth the size of the United States.

The region is noted for its great rivers. The Chang, Huang, Amur, and Mekong are respectively the fifth, sixth, eighth, and eleventh longest rivers in the world. The Ganges-Brahmaputra has created the world's largest delta, which covers 30,000 square miles. Abutting East Asia are the Sea of Japan, Dong Hai, Nan Hai, Bay of Bengal, and Arabian Sea. In the Southern Hemisphere, there is the Indian Ocean and the South Pacific Ocean. The Continental Shelf adjacent to the region constitutes a large proportion of the world's readily accessible shelf area. On the other hand, the Philippine and Java trenches and, further out, the Mariana Trench reach to formidable, abyssal depths, downward to 6,000 fathoms. Contrasting to this is Mount Everest, which reaches a lofty height of 29,028 feet. And then there is Xizang, whose high plateaus have been called the roof of the world.

The Asia and the Pacific region has large resources of tin, tungsten, antimony, bismuth, mica, fluorspar, magnesite, talc, bauxite, copper, gold, iron ore, nickel, zinc, rare earths, titanium, zirconium, and graphite. Tin occurs in the Malay peninsula granite ranges—from southwest China south through Burma, Thailand, and Malaysia to Indonesia's tin islands. Tungsten and associated bismuth come from southeast China (mainly Guangxi), the central Korean peninsula, and isolated spots in Thailand and Burma. India and the Republic of Korea are well known for their graphite and mica. Korean graphite is associated with anthracite. Talc and magnesite occur in the mafic rocks of the Liaodong and Korean peninsulas.

There are world-class deposits of lead, nickel, and uranium in the Precambrian Shield areas of Australia in addition to the volcanogenic zinc and copper. There are also massive sedimentary formations of coal, iron ore, bauxite, and titanium in Australia. Nickel is associated with the weathering of the large ultramafic complexes of Indonesia, New Caledonia, and the Philippines. Copper and gold are widely associated with the young porphyry deposits of the island arcs of the southwest Pacific. There is complex metallogenesis of iron, rare earths, titanium, and vanadium in China.

In the face of expanding energy demand, the region is generally very short of oil. However, China's fuel position is strong across the board, and Indonesia has oil and is developing coal resources. The two Koreas have no oil, but have major anthracite deposits. India's coal position is good, and oil output shows promise. Thailand relies on foreign oil, although oil shale is present, and gas has been found. The Philippines has little energy resources. Offshore oil and gas in the region, however, show promise in many areas.

In terms of exploitation, many minerals, metals, and fuels are produced in significant quantities in Asia and the Pacific. The area provides significant amounts of the world's output of tin, tungsten, copper, nickel, uranium, graphite, mica, talc, pyrophyllite, coal, salt, fluorspar, magnesite, antimony, and titanium, iron ore, zinc, bauxite, manganese, columbite-tantalite, barite, and rare-earth minerals. See table 1 for mineral commodities for which the region has a high percentage of world output.

The production of crude oil throughout Asia was close to 2.3 million barrels in 1989. China and Indonesia together account for about 67% of the total output. The remainder is primarily from Brunei, India, Malaysia, and Burma, in that order.

Indonesia is the largest producer of natural gas in the area, with an output of 40 million cubic meters in 1989, followed by Malaysia and Australia each with about 17 billion cubic meters and China with around 15 billion cubic meters.

Total coal production of the region now exceeds 1.6 billion metric tons. The production of bituminous coal accounts for nearly 90% of the total output. China is the largest producer, with an output of 1.1 billion tons in 1989. Other major producers are India and Australia. In 1989, the combined production by China, India, and Australia was about 1.5 billion tons or 92% of the area's output. Other coal production is nominal, coming from Afghanistan, Indonesia, Japan, the Koreas, Mongolia, Taiwan, and Vietnam.

Only Brunei and Indonesia can be considered self-reliant in terms of domestic energy production. While China is a large fuels producer, its demand exceeds domestic supply. Conversely, Hong Kong, Macao, the Philippines, and Singapore import virtually all of their energy requirements. In addition to these, countries that import 70% or more of the energy they consume include Japan, Nepal, Sri Lanka, Thailand, and Taiwan.

To meet fast-growing energy requirements, nuclear powerplants have been constructed in India, Japan, Pakistan, Philippines, Republic of Korea, and Taiwan. China's nuclear power program is presently limited to the construction of three modest-size powerplants.

The most immediate challenge to the nations of Asia and the Pacific is to establish their industrial strength individually. The natural resources of the area are in general still underdeveloped. Only Japan compares well commercially and industrially with the United States and the countries of Western Europe. Its industries are large and integrated and geared to world commerce.

The newly industrializing countries of the region include Hong Kong, India, Indonesia, Malaysia, Republic of Korea, Taiwan, and Thailand, several of which have large trade surpluses with the United States. The output data on cement and steel reflect the general industrial activity of these countries.

The outlook for mineral development in Asia and the Pacific is uneven: there is good potential for oil in coastal Asia; hard-rock mining is not particularly attractive, except in Australia, Philippines, Papua New Guniea, Indonesia, China, and India. The industry and mineral markets of the region are sizable and expanding. Finally, there are good opportunities in regard to introducing mineral and metal and fuel technology; consulting and plant construction; and business and manufacturing related to mineral and metal processing and fabrication, chemicals and fertilizers, and general engineering.

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[1] Edmond Chin, Chief, Branch of Asia and the Pacific, Division of International Minerals.

SELECTED GENERAL SOURCES OF REGIONAL INFORMATION

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TABLE 1

ASIA AND THE PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1989

(Thousand metric tons unless otherwise specified)

Country	Aluminum			Barite	Cement	Coal		Copper	
	Bauxite	Alumina	Metal			Anthracite	Bituminous	Mine, Cu content	Refined, primary
Afghanistan	—	—	—	2	100	—	150	5	—
Australia	38,584	10,800	1,244	11	7,000	—	190,084	295	230
Bangladesh	—	—	—	—	313	—	—	—	—
Bhutan	—	—	—	—	75	—	—	—	—
Brunei	—	—	—	—	—	—	—	—	—
Burma	—	—	—	20	300	—	—	5	—
Cambodia	—	—	—	—	—	—	—	—	—
China	4,000	1,400	850	1,750	207,000	190,000	850,000	375	550
Christmas Island	—	—	—	—	—	—	—	—	—
Fiji	—	—	—	—	90	—	—	—	—
Hong Kong	—	—	—	—	2,141	—	—	—	—
India	4,768	927	423	548	42,100	—	206,000	57	42
Indonesia	862	394	197	—	14,099	—	8,812	144	—
Japan	—	466	35	—	79,717	8	10,179	15	882
Korea, North	—	20	10	100	16,000	65,000	—	12	25
Korea, Republic of	—	36	18	4	30,474	20,785	—	—	179
Laos	—	—	—	—	7	—	—	—	—
Malaysia	350	—	—	37	4,640	—	116	24	—
Mongolia	—	—	—	—	500	—	800	165	—
Nauru	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	218	—	—	—	—
New Caledonia	—	—	—	—	67	—	—	—	—
New Zealand	—	—	260	—	950	([1])	2,150	—	—
Pakistan	2	—	—	30	7,000	—	2,642	—	—
Papua New Guinea	—	—	—	—	—	—	—	201	—
Philippines	—	—	—	([1])	6,000	—	1,343	190	132
Singapore	—	—	—	—	1,706	—	—	—	—
Solomon Islands	—	—	—	—	—	—	—	—	—
Sri Lanka	—	—	—	—	400	—	—	—	—
Taiwan	—	—	—	—	18,043	—	784	—	43
Thailand	—	—	—	76	15,024	9	—	—	—
Vietnam	—	—	—	—	1,800	5,500	—	—	—
Total	44,566	14,043	3,037	2,578	455,764	281,302	1,273,060	1,488	2,083
Share of world total, percent	[5]42	36	17	45	41	95	41	17	25
United States	W	4,670	4,030	290	71,268	3,368	269,794	1,498	1,477

See footnotes at end of table.

TABLE 1

ASIA AND THE PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1989—Continued

(Thousand metric tons unless otherwise specified)

Country	Fluorspar	Gold Mine, Au content[2]	Graphite[2]	Iodine	Iron: Ore, gross weight	Iron: Pig	Iron: Steel, crude	Lead: Mine, Pb content	Lead: Refined, primary	Magnesite	Manganese, mine, Mn content
Afghanistan	—	—	—	—	—	—	—	—	—	—	—
Australia	—	202	—	—	105,810	6,094	6,761	495	376	60	1,008
Bangladesh	—	—	—	—	—	—	86	—	—	—	—
Bhutan	—	—	—	—	—	—	—	—	—	—	—
Brunei	—	—	—	—	—	—	—	—	—	—	—
Burma	—	—	—	—	—	—	—	12	4	—	—
Cambodia	—	—	—	—	—	—	—	—	—	—	—
China	1,750	90	200	—	100,000	57,800	61,200	330	270	2,000	550
Christmas Island	—	—	—	—	—	—	—	—	—	—	—
Fiji	—	4	—	—	—	—	—	—	—	—	—
Hong Kong	—	—	—	—	—	—	120	—	—	—	—
India	23	—	48	—	51,424	12,080	12,452	27	21	480	521
Indonesia	—	6	—	([1])	143	—	2,000	—	—	—	5
Japan	—	6	—	8	253	80,196	107,909	19	208	—	([1])
Korea, North	40	5	35	—	9,500	6,500	7,300	80	70	1,500	—
Korea, Republic of	1	—	101	—	334	14,846	21,873	17	60	—	—
Laos	—	—	—	—	—	—	—	—	—	—	—
Malaysia	—	3	—	—	102	—	550	—	—	—	—
Mongolia	800	—	—	—	—	—	—	—	—	—	—
Nauru	—	—	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	—	—	—	—	—	28	—
New Caledonia	—	—	—	—	—	—	—	—	—	—	—
New Zealand	—	3	—	—	2,000	200	250	—	—	—	—
Pakistan	5	—	—	—	—	1,000	1,000	—	—	9	—
Papua New Guinea	—	31	—	—	—	—	—	—	—	—	—
Philippines	—	35	—	—	—	—	300	—	—	1	([1])
Singapore	—	—	—	—	—	—	430	—	—	—	—
Solomon Islands	—	([1])	—	—	—	—	—	—	—	—	—
Sri Lanka	—	—	4	—	—	—	—	—	—	—	—
Taiwan	—	—	—	—	—	6,000	9,047	—	—	—	—
Thailand	98	—	—	—	177	—	689	25	—	—	—
Vietnam	—	—	—	—	—	—	115	—	—	—	—
Total	2,717	385	388	8	269,753	184,716	232,082	1,005	1,009	4,078	2,084
Share of world total, percent	47	20	[5]61	50	29	33	30	30	31	[5]34	25
United States	66	266	W	2	59,032	50,977	88,852	419	397	W	—

See footnotes at end of table.

TABLE 1

ASIA AND THE PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1989—Continued

(Thousand metric tons unless otherwise specified)

Country	Mercury, Mine, Hg content[2]	Mica	Nickel: Mine, Ni content	Nickel: Refined[3]	Petroleum crude[4]	Salt	Tin[2]: Mine, Sn content	Tin[2]: Refined, primary
Afghanistan	—	—	—	—	—	35	—	—
Australia	—	—	—	—	179	7,200	7,709	424
Bangladesh	—	—	65	41	—	415	—	—
Bhutan	—	—	—	—	—	—	—	—
Brunei	—	—	—	—	52	—	—	—
Burma	—	—	([1])	—	4	250	400	300
Cambodia	—	—	—	—	—	40	—	—
China	900	—	25	25	1,000	28,000	29,500	29,500
Christmas Island	—	—	—	—	—	—	—	—
Fiji	—	—	—	—	—	—	—	—
Hong Kong	—	—	—	—	—	—	—	—
India	—	26	—	—	241	9,603	—	—
Indonesia	—	—	63	29	514	600	31,263	29,916
Japan	—	—	—	44	4	1,367	—	808
Korea, North	—	—	—	—	—	570	—	—
Korea, Republic of	—	30	—	—	—	830	—	—
Laos	—	—	—	—	—	8	281	—
Malaysia	—	—	—	—	205	16	31,000	50,000
Mongolia	—	—	—	—	—	—	1,200	—
Nauru	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	—	7	—	—
New Caledonia	—	—	100	10	—	—	—	—
New Zealand	—	—	—	—	10	60	—	—
Pakistan	—	—	—	—	17	971	—	—
Papua New Guinea	—	—	—	—	—	—	—	—
Philippines	—	—	13	—	2	500	—	—
Singapore	—	—	—	—	—	—	—	3,000
Solomon Islands	—	—	—	—	—	—	—	—
Sri Lanka	—	—	—	—	—	100	—	—
Taiwan	—	4	—	8	1	170	—	—
Thailand	—	—	—	—	8	180	14,922	14,571
Vietnam	—	—	—	—	11	300	850	800
Total	900	60	266	157	2,248	51,187	117,125	129,319
Share of world total, percent	[5]15	23	29	20	10	27	[5]54	58
United States	W	119	—	—	2,802	35,291	W	1,000

See footnotes at end of table.

TABLE 1

ASIA AND THE PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1989—Continued

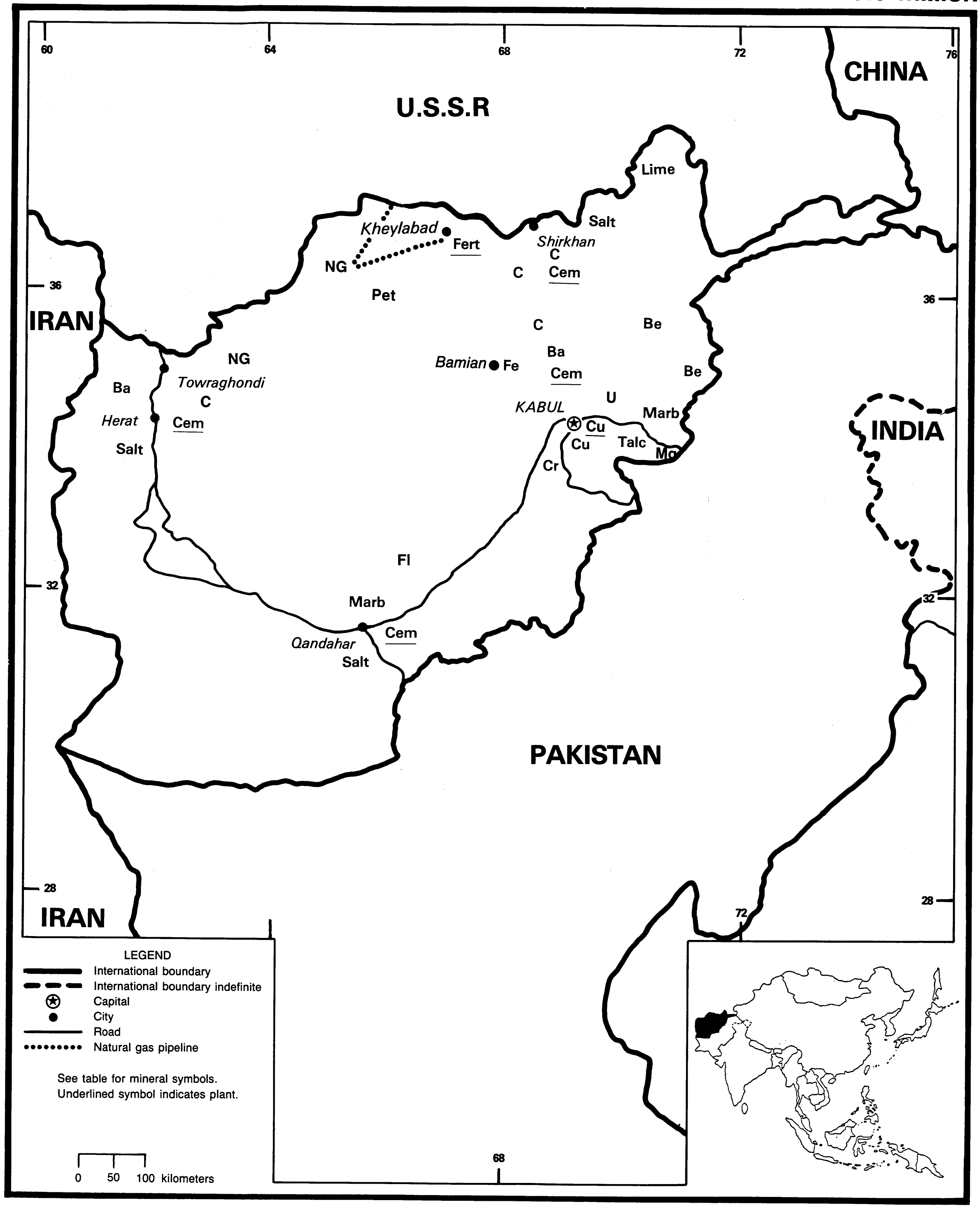
(Thousand metric tons unless otherwise specified)

Country	Titanium		Tungsten, Mine, W content[2]	Zinc	
	Ilmenite	Rutile		Mine, Zn content	Refined, primary
Afghanistan	—	—	—	—	—
Australia	1,696	243	1,371	803	294
Bangladesh	—	—	—	—	—
Bhutan	—	—	—	—	—
Brunei	—	—	—	—	—
Burma	—	—	300	2	—
Cambodia	—	—	—	—	—
China	—	—	25,000	460	460
Christmas Island	—	—	—	—	—
Fiji	—	—	—	—	—
Hong Kong	—	—	—	—	—
India	160	5	25	66	71
Indonesia	—	—	—	—	—
Japan	—	—	296	132	590
Korea, North	—	—	500	230	210
Korea, Republic of	—	—	1,701	23	240
Laos	—	—	—	—	—
Malaysia	497	—	—	—	—
Mongolia	—	—	2,200	—	—
Nauru	—	—	—	—	—
Nepal	—	—	—	—	—
New Caledonia	—	—	—	—	—
New Zealand	—	—	5	—	—
Pakistan	—	—	—	—	—
Papua New Guinea	—	—	—	—	—
Philippines	—	—	—	1	—
Singapore	—	—	—	—	—
Solomon Islands	—	—	—	—	—
Sri Lanka	75	5	—	—	—
Taiwan	—	—	—	—	—
Thailand	17	—	603	63	68
Vietnam	—	—	—	5	4
Total	2,445	253	32,001	1,785	1,937
Share of world total, percent	[5]58	[5]53	[5]74	25	40
United States	W	W	W	288	263

W Withheld to avoid disclosing company proprietary data.
[1] Less than 1/2 unit.
[2] Metric tons.
[3] Includes Ni content of intermediate products but excludes ferroalloy.
[4] Million 42-gallon barrels.
[5] Excludes U.S. production.

AFGHANISTAN

AREA 647,500 km² **POPULATION 15.9 million**



THE MINERAL INDUSTRY OF

AFGHANISTAN

By Pui-Kwan Tse

Afghanistan is a poor landlocked country. The one economically significant mineral production is natural gas, which was important for the domestic industry as well as a commodity for external barter. However, official Soviet trade data sources suggest that gas deliveries to the U.S.SR. were sharply curtailed in 1988 and nonexistent in 1989. This is equivalent to a loss in credit of as much as $200 million based on natural gas shipments to the U.S.S.R. in 1987. Overall, the country relies on largely subsistence farming and nomadic animal husbandry. The economy also may be boosted by shipments of papaver and cannabis in illicit international trade and by reexports of merchandise to the black markets in Pakistan.

During the past two decades, there were dramatic changes in Government, beginning with the abolition of the monarchy in July of 1973 and extending to the ensconcement of the Soviet-backed Najbullah regime in May 1986. Under the timetable negotiated under the Geneva Accord, the withdrawal of Soviet troops from Afghanistan was completed in February 15, 1989.

The best known Afghan mineral export perhaps is the jewelry stone lapis lazuli, by value a small earner of foreign exchange and of small economic significance.

Other mineral industry activities included the mining of modest amounts of barite, coal, gypsum, and salt; the quarrying of clays, sand and gravel, and stone; and the manufacture of cement and nitrogenous fertilizers, all primarily for internal markets. Copper and uranium operations may have been developed by Soviet interests, but there is no evidence to suggest that these ventures have had any significant impact on the national economy.

GOVERNMENT POLICIES AND PROGRAMS

Because of the country's political and military turmoil, there has been no historically consistent Government mineral policy, aside from that of Government ownership. As long as the present Government remains in place, Afghanistan's organized mineral industry assuredly will remain wholly in the hands of Government. Continued operations of the existing mineral industry, expansion of these operations, and new developments face obstacles in the forms of sabotage and armed resistance by a significant part of the indigenous population to the present Government.

PRODUCTION

Civil disorder has been pervasive throughout the country during the decade, and the Government and rebel insurgents continued to vie for control of widespread areas of Afghanistan. Because of the strife among the Government forces, tribal and ethnic groups, and moderate and revolutionary factions, the country's industrial production per se had inevitably suffered. Prior to the pull-out of their troops, the U.S.S.R. gave large-scale aid. Subsequently, the Government was forced to deploy the military just to safeguard industrial production levels just to meet the needs of the urban areas.

Afghanistan's most valuable mineral products are fossil fuels. A substantial amount of the country's output of natural gas was piped to the U.S.S.R. However, according to Soviet information cited by the press, much of Afghanistan's natural gas production was shut down by midyear to avoid permanent damage to the gasfields by possible sabotage. Moreover, Soviet trade sources reported no imports of Afghan natural gas in 1989.

As the result of civil turmoil, there are no official Government-issued statistics on minerals output. However, the press reports have mentioned coal production and cement manufacture. Most of the construction priority was for Government public works, such as building the 57-kilometer (km) highway linking Kabul and Bamian, allowing transport to avoid rebel territory. Presumably a modicum of salt continued to be produced to meet domestic consumption, and some nitrogenous fertilizer was produced for application to farmlands controlled by the Government.

TRADE

There is no dissemination of official Afghan trade information, and the conduct of trade is purportedly handled in a peculiar fashion. The Government reportedly sold imported goods entering via larger industrial centers in the west and the north, such as Herat, Mazar-i-Sharif, and Towraghondi, to private enterprises that acted as carriers to transport goods to the capital and the larger southern cities. The carriers transporting such goods as cement, coal, fertilizers, kerosene, and pharmaceuticals that successfully avoided rebel capture or destruction could sell the goods at the consuming destinations for a large profit. Moreover, a flourishing black-market economy was reportedly operating on electronic goods crossing by rail from the U.S.S.R. and covertly carried into Pakistan for sale.

STRUCTURE OF THE MINERAL INDUSTRY

The organized mineral industry of Afghanistan is completely Government owned and/or controlled. Some local, non-Government-controlled production of construction quarry products, and probably of lapis lazuli, has continued, but in the latter case efforts are surely made to regulate exports, thereby ensuring that profits accrue to the Government. Details on the governmental structure that administered the mining and mineral processing activities are not available. There is no reliable information available regarding the entities involved in mineral exploration and/or development.

TABLE 1

AFGHANISTAN: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989[p]
Barite		2,000	2,000	2,000	2,000	2,000
Cement, hydraulic		77,000	85,000	100,000	100,000	100,000
Coal, bituminous		151,000	160,000	[r]167,000	[r]138,000	125,000
Copper: Mine output, Cu content		5,000	5,000	5,000	5,000	5,000
Gas, natural:						
Gross	million cubic meters	[r]2,900	3,000	3,000	3,000	2,100
Marketed	do.	2,600	2,600	2,600	2,600	1,800
Gypsum		3,000	3,000	3,000	3,000	3,000
Natural gas liquids	thousand 42-gallon barrels	93	81	[r]70	[r]35	30
Nitrogen: N content of ammonia		45,000	40,000	40,000	40,000	40,000
Salt, rock		10,000	10,000	10,000	10,000	10,000

[p]Preliminary. [r]Revised.

[1]Table includes data available through Dec. 4, 1990.

[2]In addition to the commodities listed, asbestos, lapis lazuli, uranium, and a variety of crude construction materials (clays, stone, and sand and gravel) presumably have been produced. However, output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

COMMODITY REVIEW

Metals

Chromite.—Since the 1940's, deposits of chromite have been known to exist in the Logar Valley south of Kabul in eastern Afghanistan. There is no indication of any commercial-scale mining. Of the total reserve of about 181,000 tons, only about 28,000 tons was regarded as high grade and about 16,000 tons as intermediate grade, with the remaining tonnage regarded as somewhat below marketable quality.

Copper.—There has been no confirmation that the Ainak copper mine and beneficiation plant and the associated smelter at Kabul has ever achieved commercial production, despite press reports dating back to 1985 indicating that mine development and plant construction was completed in that year. Copper was to be delivered to the U.S.S.R. in repayment for the project's development cost, but there has been no indication of Soviet receipts of metal from Afghanistan. Moreover, no copper believed to be of Afghanistanian origin has been found in import statistics of other countries during 1985–89. The smelter, if operated, may presumably have produced only test batches of metal. However, it has been assumed that some mine production has been accomplished. The rated annual capacity of the mine and benefication plant has been variously reported between 114,000 tons and 150,000 tons and that of the smelter as between 25,000 tons and 30,000 tons of blister copper.

Iron Ore, Iron and Steel.—Despite the presence of considerable reserves and/or resources of iron ore in an area not far from Kabul, there has been no move to establish a domestic steel industry. The Hajigak iron ore deposits west-northwest of Kabul would offer the best opportunity for development in a favorable investment climate. Its development would seem feasible to meet only local market demand.

Uranium.—There has been no recent reporting of activities, if any, at the uranium mine in the Khwaja Rawash Mountains northeast of Kabul. This property was rather widely reported in past years as being operated entirely by Soviet personnel, with its product delivered to the U.S.S.R.

Industrial Minerals

Cement.—There are no recent details on the operation of Afghanistan's cement plants. The largest of the four plants is that at Qaudahor, with a rated annual capacity of 500,000 tons, followed by the 400,000-ton-per-year Ghori cement factory at Pol-i-Khomri, about 175 km north-northwest of Kabul. There is also the 210,000-ton-per-year cement factory in the town of Herat in western Afghanistan and the 30,000-ton-per-year Jabul Saraj facility, 77 km north of Kabul.

Other Industrial Minerals.—The low level of industrial development in Afghanistan, coupled with its relative inaccessibility, has mitigated against development of most industrial minerals. Limestone and other necessary raw materials for cement have continued to be produced in quantities adequate to meet domestic needs. Ornamental and jewelry materials, most notably lapis lazuli and onyx, have presumably continued to be extracted, contributing only modestly to foreign exchange earnings. Some barite is believed to be produced to meet internal needs for use in drilling mud. Known resources of commodities such as asbestos, fluorspar, magnesite, strontium minerals, and sulfur apparently have remained undeveloped.

Mineral Fuels

Afghanistan's energy production at 4.1 million-metric-ton (MMmt) standard coal equivalent (SCE) in 1988 was about 10% higher than the consumption level of 3.8 MMmt SCE; but of the total output, nearly 1.2 MMmt SCE, all in the form of natural gas, was exported to the U.S.S.R. Of the country's consumption, in terms of its SCE values, 138,000 tons was solid fuel, 2.68 MMmt was natural gas, 844,000 tons was liquid fuel, and 92,000 tons was hydropower. The solid and gaseous fuels as well as the hydropower consumed were of domestic origin, but only 5,000 tons of the liquid fuel was produced in Afghanistan, this as natural gas liquids. The remaining 839,000 tons was imported, together with 12,000 tons for aviation bunkers. Thus, although more than self-sufficient in terms of the total amount of energy produced, Afghanistan relied on imports to meet nearly 22% of its energy demand, while at the same time exporting more than 30% of its natural gas production.

With regard to electric power production, 68% of total 1988 output of 1,109 million kilowatt hour came from hydroelectric plants, the remaining 32% being supplied by conventional thermal plants.

Coal.—So far as can be determined, the Darra-Suf coal mine, 120 km north-northwest of Kabul, remained the country's leading coal producer. Other coal miners are the Ispushta and the Karkar, both about 200 km to the north of Kabul, and Medzhidi-Clubi, northeast of Herat.

Natural Gas.—For the first time since the inception of natural gas exports from northern Afghanistan to the U.S.S.R., there was no recorded export in 1989. The Soviet imports of natural gas from Afghanistan accounted for more than 43% of the value of all Soviet imports from that country in 1988. Data published by the United Nations suggests that the exported gas in 1988 totaled only 883 million cubic meters, far lower than the 2,255 million cubic meters exported in 1987.

The United Nations indicates a substantial increase in Afghanistan's internal consumption of natural gas in 1988, to 2,038 million cubic meters from only 638 million cubic meters in 1987.

Petroleum.—Although there are known occurrences of oil in an area southwest of Kheylabad in the north-central area of the country, there is no evidence of production. Three fields, Kashkari, Augot, and Ak-Darya, are identified in Soviet literature, but their combined reserves total only about 95 million barrels.

Reserves

There are no official Afghanistanian data on the country's mineral reserves. Most of the coal deposits being exploited are in the north. The country's coal resources were estimated at 400 MMmt, of which 100 MMmt was considered proven reserves. Natural gas is the country's most valuable fossil fuel.

TABLE 2

AFGHANISTAN: RESERVES AND/OR RESOURCES OF SELECTED COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	Reserve/resource
Asbestos	[2]89
Barite	[3]1.6
Beryllium ore	15,669
Chromite, gross weight, grading 35.8% to 57.5% Cr_2O_3[4]	[2]181
Coal, bituminous:	
Proved reserves	[2]100
Other reserves and resources	[2]400
Copper ore, gross weight, grading 0.7% to 1.5% Cu	[2]360
Fluorspar	[3]8.76
Gas, natural	[5]142
Iron ore, gross weight	[3]428
Lapis lazuli (lazurite)	207
Lithium minerals	3,972
Magnesite	[3]25
Petroleum, crude	[6]95
Strontium mineral (celestite)	1,086
Sulfur	[3]580

[1]Estimates as reported by the U.S.S.R.
[2]Thousand metric tons.
[3]Million metric tons.
[4]Bureau of Mines evaluation of 1957.
[5]Billion cubic meters.
[6]Million barrels.

INFRASTRUCTURE

Afghanistan has only a rudimentary infrastructure for its mineral industry. A single-track, 1.534-meter-gauge, 9.6-km rail spur links Kushka in the U.S.S.R. to Towraghondi, and another 15-km line joins Termez, U.S.S.R., to the Kheyrabad transshipment point. Additional rail lines were reportedly to be built with Soviet assistance, but there is no evidence of the completion of them. At last report, the country's 21,000-km highway system consisted of 2,800 km of hard-surface roads, 1,650 km of bituminous-treated gravel and improved earth roads, and 16,550 km of improved earth roads and tracks. Afghanistan has 1,200 km of navigable waterways. There are three minor ports on the river, the largest being Shir Khan. With limited rail, highway, and waterborne transit, air transport was significant. At last report, there were 38 airfields, of which 34 were classified as "usable," including 10 with runways 2,440 to 2,569 meters in length and 15 with runways of 1,220 to 2,439 kilometers. Notably, only nine of the airfields had permanent-surface runways.

Afghan natural gas is piped to the U.S.S.R. by a 180-km line, and the thermal power station and nitrogen fertilizer plant at Mazar-e-Sharif also receive gas piped from the fields in the Shibarghan area. The country had a rated net installed electrical generating capacity in 1988 of 489,000 kilowatts, 59% hydroelectric and 41% conventional thermal. Of the total, 14% was reported by the United Nations to be controlled by industrial self-producers, while 86% was controlled by public utility plants. Of the industrial producer capacity, about 10% was hydroelectric, and 90% was conventional thermal; of the public utility capacity, roughly one-third was conventional thermal and two-thirds hydroelectric.

OUTLOOK

As a result of its political instability, the development outlook for Afghanistan's minerals sector is bleak. Despite predictions that the Najibullah regime would be severely weakened or perhaps even collapse after the withdrawal of Soviet troops, the Government declared a state of emergency and has continued to survive major resistance attacks. Afghanistan is unlikely to register much mineral industry growth unless there is nationwide unity, halcyon times, and availability of foreign assistance. Any major industrial facility, as well as infrastructural links such as pipelines, powerlines, and roads can be rendered inoperative by actions short of total destruction.

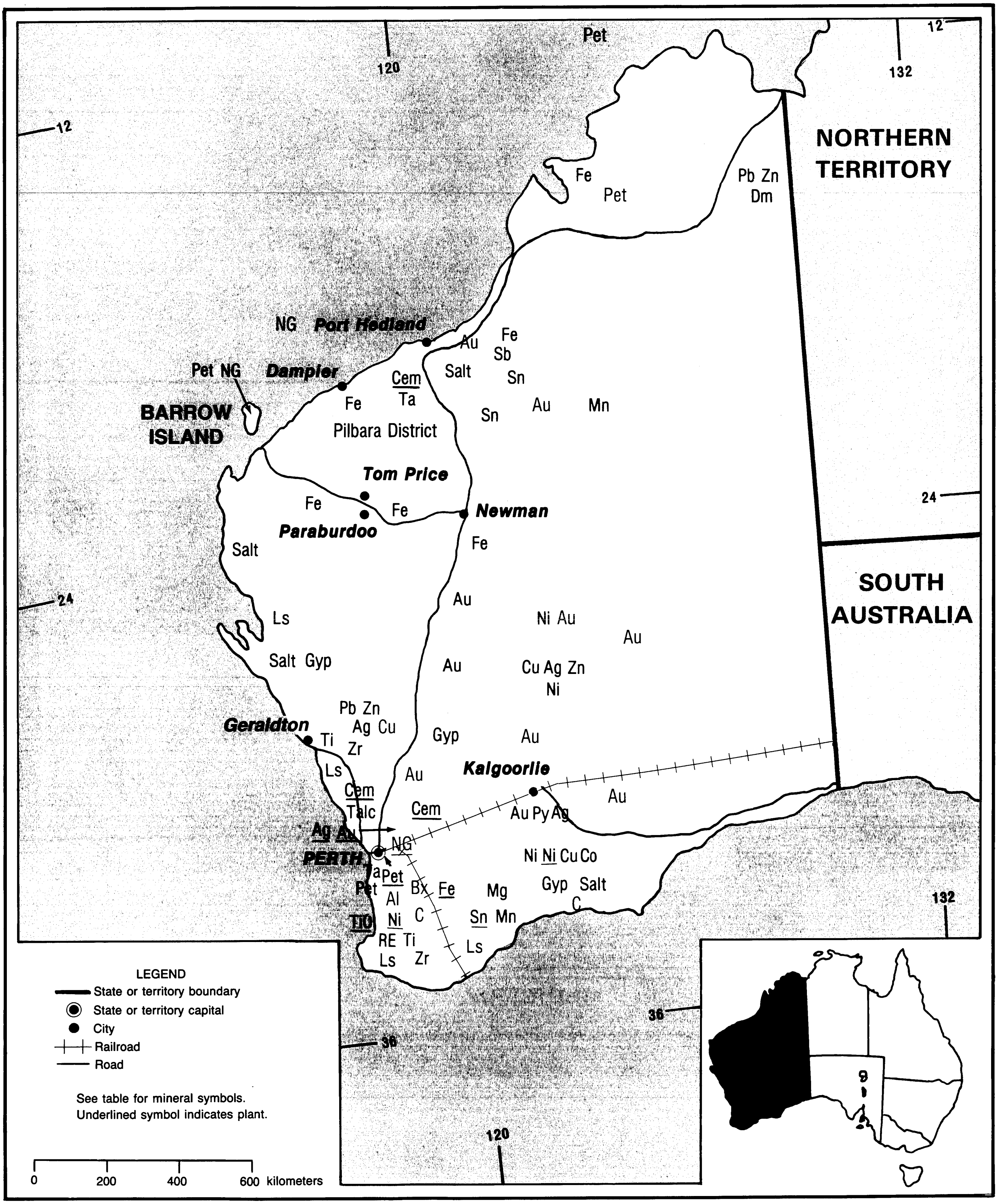
OTHER SOURCES OF INFORMATION

Agencies

Ministry of Commerce
Kabul, Afghanistan
Ministry of Construction
Kabul, Afghanistan
Ministry of Mines and Industries
Kabul, Afghanistan
Ministry of Planning
Kabul, Afghanistan
Ministry of Transport
Kabul, Afghanistan
Ministry of Water and Electricity
Kabul, Afghanistan

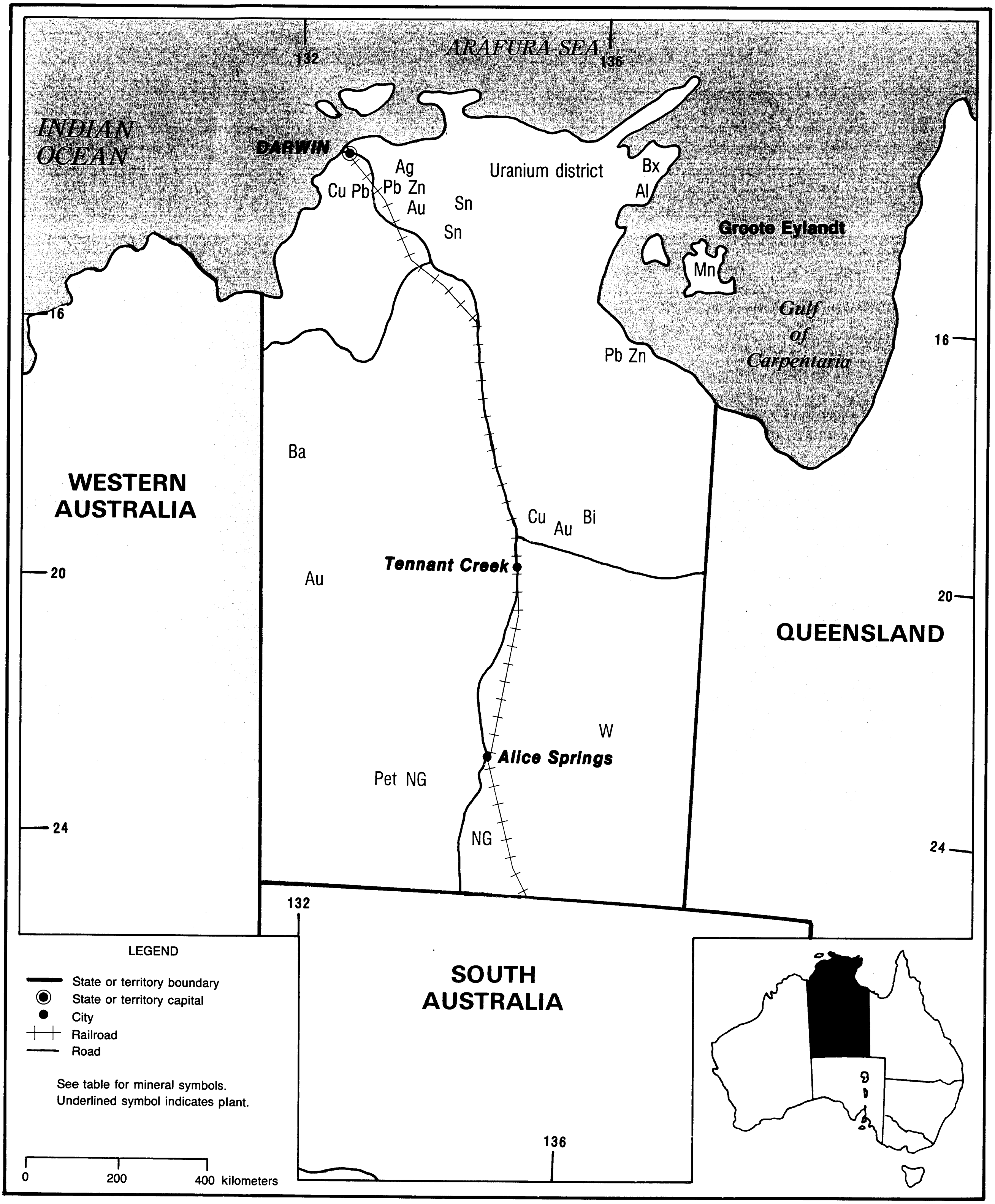
WESTERN AUSTRALIA

AREA 2,525,500 km² **POPULATION 1.6 million**



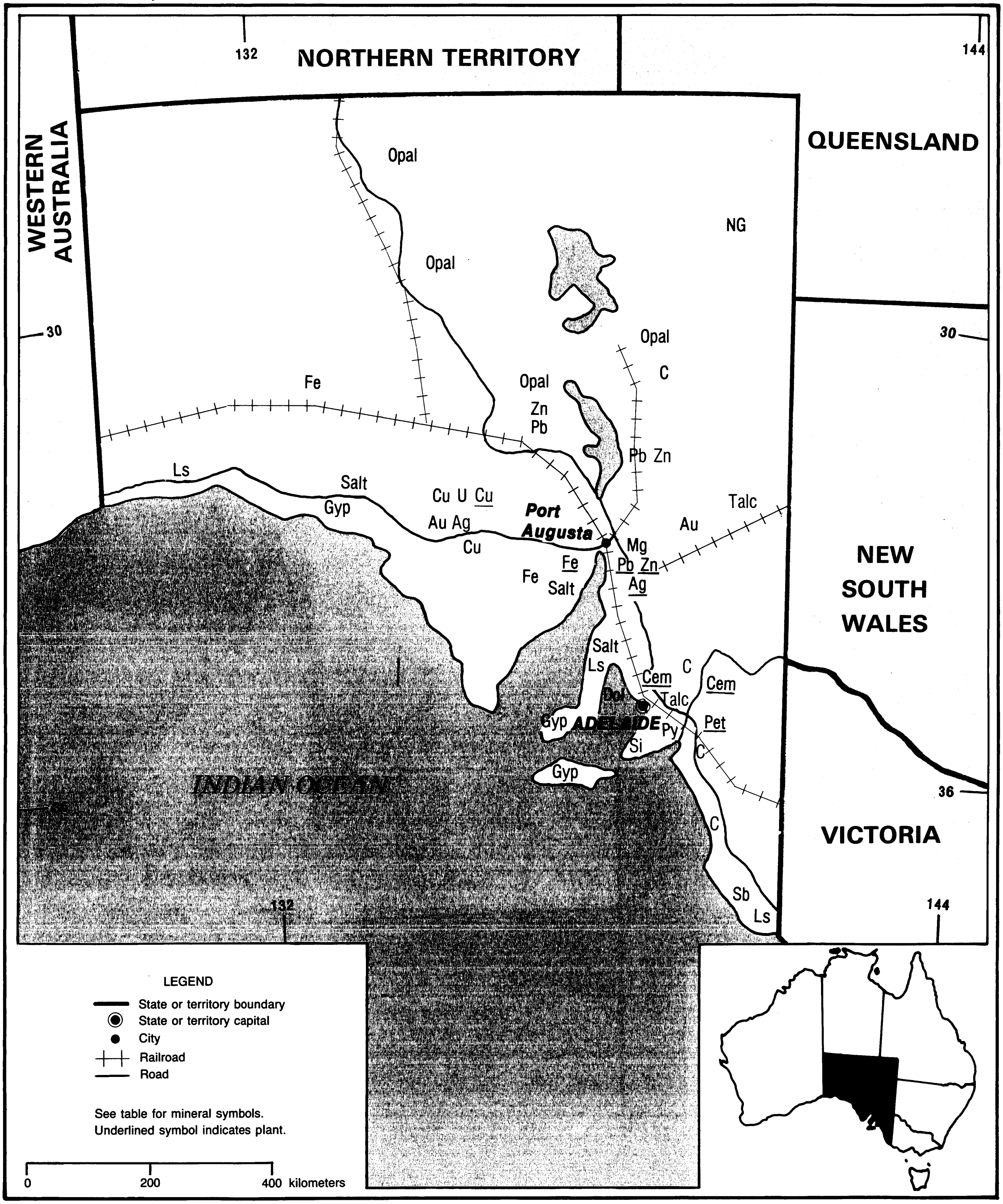
NORTHERN TERRITORY

AREA 1,346,200 km² **POPULATION 156,100**



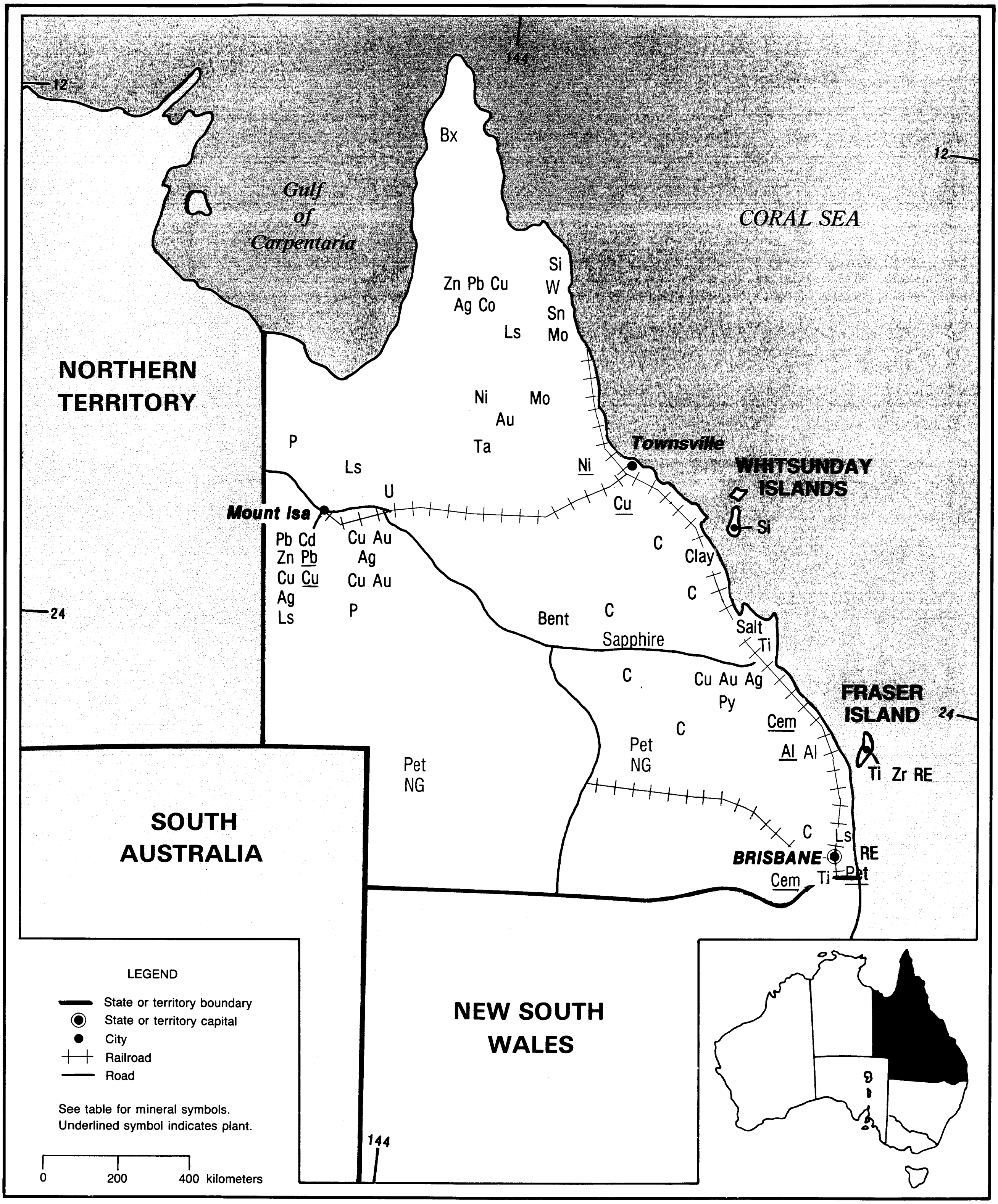
SOUTH AUSTRALIA

AREA 984,000 km² **POPULATION 1.4 million**



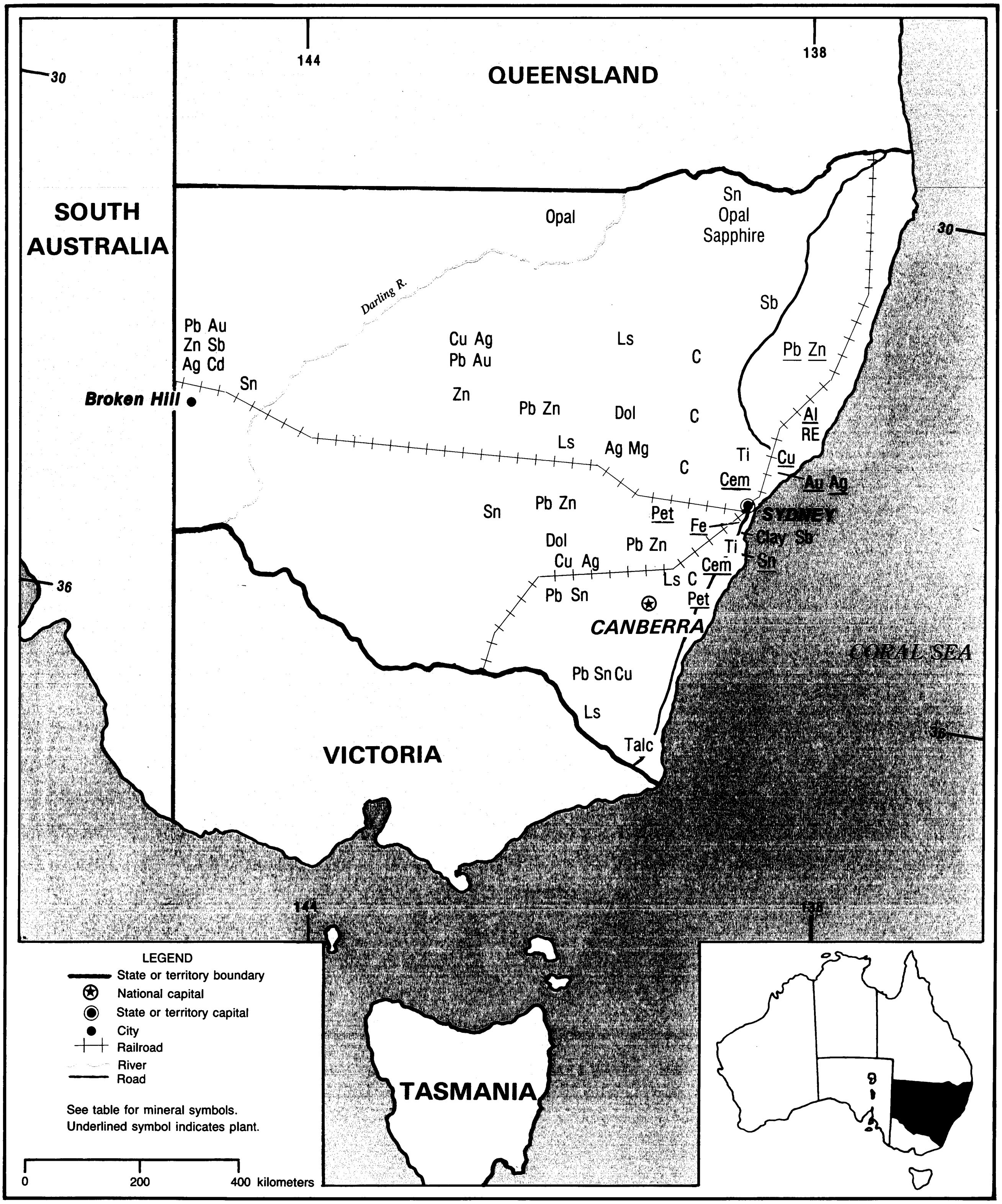
QUEENSLAND

AREA 1,727,200 km² **POPULATION 2.8 million**



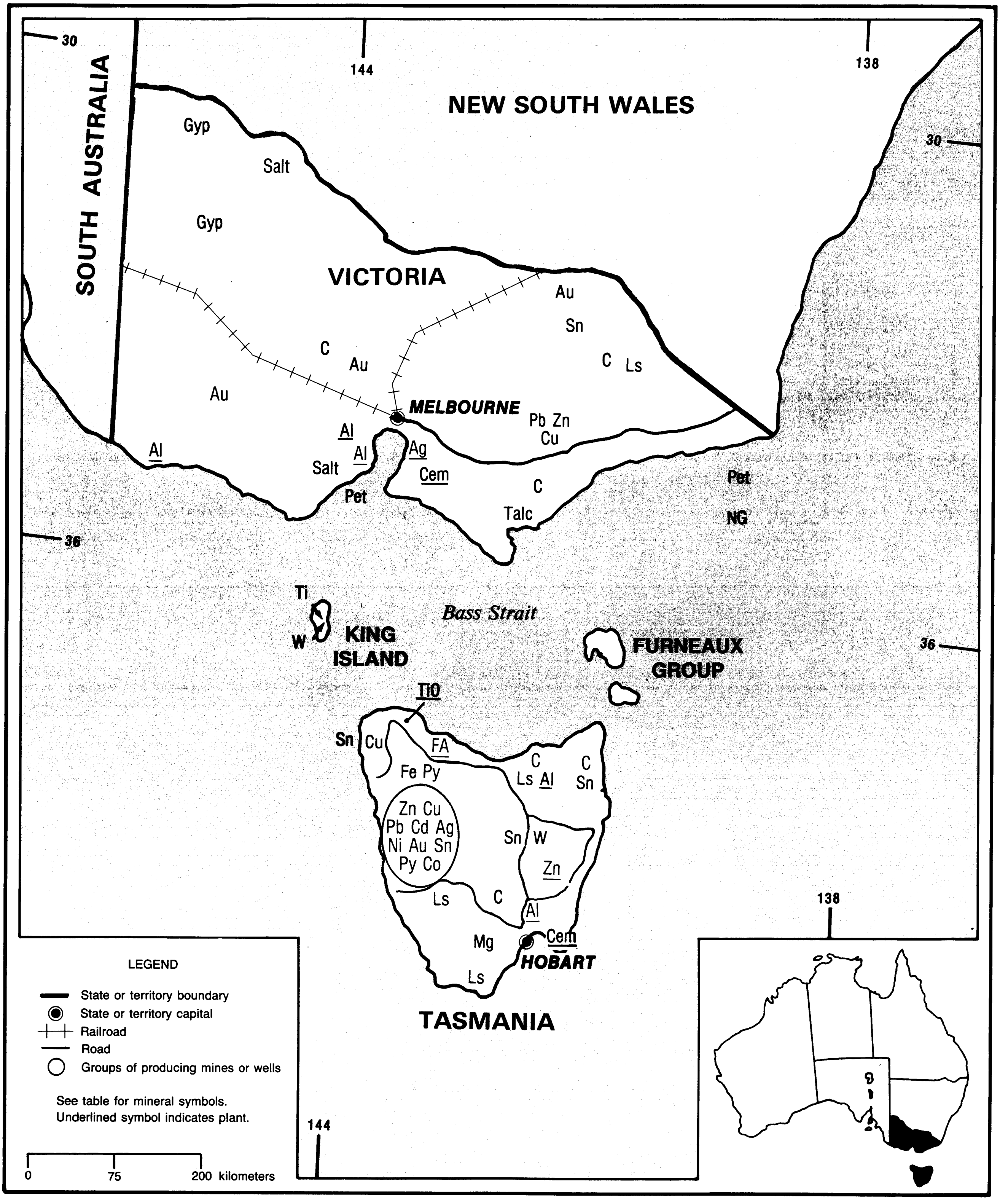
NEW SOUTH WALES

AREA 801,600 km² **POPULATION 5.8 million**



TASMANIA AND VICTORIA

AREA 295,400 km² **POPULATION 4.8 million**



THE MINERAL INDUSTRY OF

AUSTRALIA

By Travis Q. Lyday

GOVERNMENT POLICIES AND PROGRAMS

The Commonwealth Government made a long-awaited decision late in the year regarding any future mining in the Northern Territory's mineral-rich Kakadu National Park. The Government was faced with the choice of prohibiting mining altogether within a zone of the park that had previously been set aside specifically for mining or permitting mining at sites within the park in which The Broken Hill Co. Pty. Ltd. (BHP) and its partners Pioneer International and North Broken Hill Peko Ltd. had spent 5 years and $9 million[1] developing. The area in question contains an estimated $4.5 billion to $5.5 billion of mineral wealth, primarily gold, platinum, and palladium in a world-class size deposit.[2]

On October 5, siding with the environmental lobby, the Government chose to reduce the area authorized for mining from 2,257 square kilometers (km^2) to 37 km^2. Although this reduced area still encompasses BHP's Coronation Hill precious-metal mine, the question of granting mining at this site was further delayed for another year, until yet another series of environmental impact studies is completed on the entire local river (South Alligator River) catchment area, before final approval for mining will be considered.[3]

PRODUCTION

In 1989, Australia was the world's leading producer of alumina, bauxite, diamond, ilmenite, mined lead, monazite, opal, rutile, sapphire, and zircon; second in mined zinc; third in mined nickel; fourth in iron and manganese ores; and among the top 10 in the production of aluminum, coal, copper, gold, lithium, salt, tin, and tungsten.

The output of minerals produced in 1989 increased, especially bauxite, coal, copper, gold, iron ore, tin, and zinc. Moderate increases were recorded in the production of manganese and uranium. In the smelting and refining area, primary aluminum production continued to expand, with all smelters running above their rated capacity. Synthetic rutile production rose by about 20%, and copper and zinc metal registered significant growth.

The value of minerals produced in Australia was estimated to be $17.4 billion, 6.5% of the $267 billion gross domestic product. Petroleum (crude oil, natural gas, and natural gas liquids) contributed about one-third of this total, followed by black coal with about one-fifth of the total value.

TRADE

Australia relies heavily on the export of the majority of its mineral production to bolster economic growth. It continued to be the premier exporter of alumina, coal, ilmenite, refined lead, monazite, rutile, and zircon, and remained the second leading exporter of coal (all grades). Using plentiful resources of coal, liquefied natural gas, and uranium, Australia remained one of the few market economy countries to be a net exporter of mineral fuels, enabling the country to retain a favorable trade balance in energy products.

Total mineral export revenues for fiscal year 1989[4] were estimated to be almost $11 billion, about 30% of total foreign exchange earnings.

STRUCTURE OF THE MINERAL INDUSTRY

The Australian minerals industry covers just about the whole spectrum of minerals, from major industrial minerals (ilmenite, rutile, and zircon), base metals (copper, lead, and zinc), ferrous metals (iron ore and manganese), nonferrous metals (aluminum and nickel), precious metals (gold and silver), and fuel minerals (coal and uranium), to gem stones (diamond, opal, and sapphire). It is one of the world's principal producers and suppliers of ores, concentrates, and refined metals. Australia is estimated to rank fifth in the value of nonfuel mineral production after the U.S.S.R., the United States, the Republic of South Africa, and Canada. The value of mineral production, including fuels, was estimated to rank 10th in the world.

The Australian mining industry is based on a system of free enterprise, with private companies involved in exploration, mine development, production, mineral processing, and marketing. A number of foreign companies in mineral ventures in Australia are affiliates or subsidiaries of U.S. companies. Foreign companies currently control a majority of the mining, smelting, and refining sectors and a significant portion of the petroleum and natural gas sectors.

Most of Australia's mineral industries are fully integrated, producing ores, concentrates and other intermediate products (e.g., alumina), and refined metal or other end product (e.g., cut-and-polished gem diamond) within the country. In 1989, there were six alumina refineries and aluminum smelters each; four copper smelters and refineries each; two principal gold refineries; three principal primary lead-zinc smelters/refineries; and one manganese ferroalloy plant. Also included were one nickel smelter and two nickel refineries; three principal crude steel plants; one primary tin smelter and refinery each and two secondary tin refineries; and two silver refineries.

TABLE 1

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	31,839	32,384	34,102	36,192	[2]38,584
Alumina	do.	8,792	9,423	10,109	10,511	[2]10,800
Metal, refined:						
Primary	do.	851	882	1,004	1,150	[2]1,244
Secondary		45,600	55,000	39,000	88,400	[2]76,100
Antimony, Sb content of ores and concentrates		1,458	1,131	1,231	1,320	[2]1,360
Bismuth, mine output, Bi content[e 3]		[4]1,400	1,000	350	400	500
Cadmium:						
Mine output, Cd content		2,776	2,079	2,249	1,709	[2]1,685
Metal, smelter (refined)		910	915	950	855	[2]696
Cobalt:						
Mine output, analytic content of:						
Nickel ore		2,456	2,389	2,274	2,104	2,000
Nickel concentrate		508	484	368	[e]400	300
Zinc concentrate		72	41	73	70	75
Total		3,036	2,914	2,715	[e]2,574	2,375
Recoverable cobalt		1,134	[e]1,237	[e]1,261	[e]1,200	1,000
Columbium-tantalum concentrate, gross weight		110	88	159	226	[2]555
Copper:						
Mine output, Cu content	thousand tons	260	248	233	238	[2]295
Metal:						
Smelter:						
Primary	do.	168	170	173	178	[2]203
Secondary		7,687	9,178	[e]8,500	10,506	[2]10,000
Refined:						
Primary	thousand tons	164	164	179	196	[2]230
Secondary		30,506	21,113	28,843	26,667	[2]25,000
Gold:						
Mine output, Au content	kilograms	[5]58,521	75,079	110,696	156,951	[2]202,217
Metal:						
Refined:						
Primary	do.	54,223	82,186	116,272	140,384	[2]197,041
Secondary	do.	1,770	1,911	[e]3,110	10,235	[2]18,220
Iron and steel:						
Iron ore:						
Gross weight	thousand tons	97,447	94,015	101,748	96,064	[2]105,810
Fe content	do.	62,042	60,082	64,798	61,244	[2]67,313
Metal:						
Pig iron	do.	5,607	5,889	5,569	5,730	[2]6,094
Ferroalloys:[6]						
Ferromanganese		70,368	[r]60,870	51,465	58,000	60,000
Ferrosilicon[e]		[2]18,951	19,000	18,000	18,000	20,000
Silicomanganese		25,669	22,590	42,725	[e]44,000	45,000
Total		114,988	[e]102,460	[e]112,190	[e]120,000	125,000
Steel, crude	thousand tons	6,578	6,703	6,129	6,399	[2]6,761
Semimanufactures[e]		6,000	6,250	6,000	6,000	6,500

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
METALS—Continued						
Lead:						
Mine output, Pb content	thousand tons	498	448	489	465	[2]495
Metal:						
Primary:						
Bullion, for export	do.	183	188	197	191	[2]183
Refined	do.	200	156	202	163	[2]193
Total	do.	383	344	399	354	[2]376
Secondary excluding remelt	do.	16	15	15	17	[2]18
Manganese ore (metallurgical):						
Gross weight	do.	2,003	1,649	1,853	1,985	[2]2,124
Mn content	do.	958	786	881	945	[2]1,011
Nickel:						
Mine output, Ni content	do.	86	77	75	62	[2]65
Metal, smelter (refined Ni and Ni content of oxide)	do.	41	42	45	37	[2]41
Platinum-group metals:[7]						
Palladium, Pd content	kilograms	476	428	490	412	400
Platinum, Pt content	do.	95	115	130	107	100
Total	do.	571	543	620	519	500
Rare-earth metals, monazite concentrate:						
Gross weight		18,735	14,822	12,813	11,872	13,500
Monazite content		17,394	13,783	[e]11,900	11,039	12,550
Silver:						
Mine output, Ag content		1,086	1,023	1,119	1,117	[2]1,075
Metal, refined		329	336	309	297	[2]376
Tin:						
Mine output, Sn content[8]		6,363	8,508	7,691	7,009	[2]7,709
Metal, refined:						
Primary		2,683	1,399	563	439	[2]424
Secondary		409	320	[e]300	[e]300	300
Titanium concentrates, gross weight:						
Ilmenite	thousand tons	1,419	1,238	1,498	1,610	[2]1,696
Leucoxene		13,809	14,143	11,290	11,742	[2]18,000
Rutile		211,615	215,774	246,263	230,637	[2]243,000
Tungsten, mine output, W content		1,971	1,600	1,150	1,616	[2]1,371
Uranium, mine output, U content		3,206	4,154	3,780	3,531	[2]3,656
Zinc:						
Mine output, Zn content	thousand tons	759	712	778	759	[2]803
Metal, smelter:						
Primary	do.	289	303	308	302	[2]294
Secondary[e]		4,500	4,500	4,500	[r]3,700	[2]5,500
Zirconium concentrates, gross weight	thousand tons	501	452	457	480	[2]511
INDUSTRIAL MINERALS						
Abrasives, natural:						
Beach pebble		972	1,127	1,036	[e]1,000	1,000
Garnet		5,835	9,724	16,837	[r e]16,000	16,000
Barite		22,423	5,819	10,363	10,970	11,000

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
INDUSTRIAL MINERALS—Continued						
Cement, hydraulic	thousand tons	5,887	5,928	5,880	6,620	7,000
Clays:						
Bentonite and bentonitic clay		29,070	39,933	30,392	[e]35,000	35,000
Brick clay and shale[3]	thousand tons	[9]6,196	6,918	[9]6,105	8,483	8,500
Cement clay and shale[3]	do.	[9]419	460	[9]450	[e]450	500
Damourite clay		1,574	24	106	[e]100	100
Fire clay[3 9]		39,482	30,547	24,215	[e]25,000	25,000
Kaolin and ball clay[9]		165,827	187,617	176,958	[e]180,000	180,000
Other[9]	thousand tons	1,750	1,746	717	[e]1,000	1,000
Diamond:						
Gem	thousand carats	4,242	13,145	13,650	17,277	[2]17,200
Industrial	do.	2,828	16,066	16,683	17,277	[2]17,200
Total	do.	7,070	29,211	30,333	34,554	[2]34,400
Diatomite		7,587	9,048	13,512	11,117	12,000
Feldspar including nepheline syenite		6,704	10,006	11,418	15,877	15,000
Gem stones, other than diamond:[e]						
Opal	value, thousands	$32,305	$36,914	$62,010	$50,000	$60,000
Sapphire	do.	$5,342	$8,359	$13,500	$15,000	$15,000
Other	do.	$3,326	$2,316	$2,500	$2,500	$3,000
Total	do.	$40,973	$47,589	$78,010	$67,500	$78,000
Gypsum	thousand tons	1,744	1,671	1,580	1,634	1,800
Kyanite		222	768	[e]65	[e]500	500
Lime[3 e]		1,203,000	1,100,000	1,100,000	1,100,000	1,500,000
Magnesite		57,535	41,441	53,941	56,446	60,000
Nitrogen: N content of ammonia		404,500	340,000	413,400	385,800	[2]343,600
Perlite, crude		[e]2,740	3,838	[e]3,500	4,736	5,000
Phosphate rock		33,116	[r]35,200	9,900	6,000	5,000
Salt	thousand tons	5,835	6,130	6,486	7,165	7,200
Sillimanite[10]		428	133	77	75	80
Spodumene, concentrate		11,835	12,703	22,279	[r e]25,000	25,000
Stone, sand and gravel:						
Construction sand[11]	thousand tons	26,640	27,892	28,067	[e]28,000	30,000
Gravel[11]	do.	18,393	15,900	15,365	[e]15,000	15,000
Dolomite	do.	626	720	788	859	1,000
Limestone:[e]						
For cement	do.	5,750	7,200	7,250	[2]5,512	6,000
For other uses	do.	2,800	3,550	3,550	[2]5,294	6,000
Silica in the form of quartz, quartzite, glass sand	do.	2,091	2,091	2,361	1,969	2,000
Other:[11]						
Crushed and broken stone	do.	67,474	70,255	65,278	[e]65,000	65,000
Dimension stone	do.	167	106	99	[e]100	100
Unspecified	do.	33,808	30,663	29,203	[e]30,000	30,000
Sulfur: Byproduct:						
Metallurgy		435,313	453,012	507,357	449,127	500,000
Petroleum		11,718	10,285	8,697	[e]9,000	10,000
Total		447,031	463,297	516,054	458,127	510,000
Talc, chlorite, pyrophyllite, steatite		139,391	188,055	212,901	205,381	200,000

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous and subbituminous	thousand tons	158,256	170,031	178,567	176,604	[2]190,084
Lignite	do.	37,320	37,637	43,517	43,450	[2]48,252
Total	do.	195,576	207,668	222,084	220,054	[2]238,336
Coke, metallurgical	do.	3,610	3,745	3,778	3,866	[2]4,073
Fuel briquets	do.	789	833	814	750	750
Gas, natural, marketed	million cubic meters	13,466	14,710	15,025	15,386	[2]17,806
Natural gas liquids	thousand 42-gallon barrels	25,939	24,723	24,426	24,649	[2]23,706
Peat[11]		15,707	7,265	9,042	[e]9,000	10,000
Petroleum:						
Crude	thousand 42-gallon barrels	209,939	187,196	200,478	189,564	[2]178,637
Refinery products:						
Gasoline:						
Aviation	do.	1,177	1,077	1,437	1,210	[2]1,321
Motor	do.	99,702	96,456	97,636	100,529	[2]101,109
Jet fuel	do.	16,373	17,225	18,387	20,627	[2]20,039
Kerosene	do.	611	597	382	456	500
Distillate fuel oil	do.	54,673	53,896	58,104	62,424	[2]64,621
Residual fuel oil	do.	18,019	13,162	14,031	13,237	[2]15,108
Lubricants	do.	3,692	3,358	3,873	3,902	[2]3,969
Liquefied petroleum gas	do.	6,069	4,848	4,844	4,942	[2]5,107
Bitumen	do.	3,220	3,412	3,157	3,372	[2]3,780
Unspecified	do.	7,476	5,716	7,013	7,078	[2]6,686
Refinery fuel and losses	do.	11,739	10,976	9,569	[e]9,500	10,500
Total	do.	222,751	210,723	218,433	227,277	232,740

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Nov. 15, 1990.
[2]Reported figure.
[3]Data are for years ending June 30 of that stated.
[4]Bismuth-rich residues reportedly were stockpiled owing to weak demand and low prices.
[5]Excludes gold in gold ore and concentrate for South Australia.
[6]Data are for years ending Nov. 30 of that stated for plants owned by The Broken Hill Pty. Co. Ltd.
[7]Western Australia only. Platinum-group metals content of nickel ore.
[8]Excludes tin content of copper-tin and tin-tungsten concentrates.
[9]Excludes production from Western Australia.
[10]In addition, about 7,000 tons of sillimanite clay, also known as kaolinized sillimanite, is produced, containing 40% to 48% Al_2O_3.
[11]Excludes data from some States.

The Australian Constitution contains no specific reference to natural resources, and like the U.S. Constitution, all powers not specifically assigned to the Commonwealth automatically reside with the States. Therefore, the ownership of mineral resources in Australia generally resides with the State or Territory in which they occur. The major exception concerns offshore resources beyond the 3-mile territorial limit, where Commonwealth jurisdiction prevails. Thus, the individual States and Territories administer the minerals industries within their borders, including issuing exploration and development permits; overseeing mining operations; ensuring compliance with health, safety, and environmental regulations; and levying royalties and taxes. However, the Federal Government can restrict mineral exports for the good of the country, and therefore has de facto control over mineral production.

COMMODITY REVIEW

Metals

Bauxite, Alumina, and Aluminum.—The mining and export of bauxite and export of the value added products alumina and aluminum contributed substantially to Australia's foreign exchange earnings in 1989, becoming the nation's second most important export after

TABLE 2

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities [1]	Capacity
Alumina	Alcoa of Australia Ltd.	Kwinana Refinery, WA	1,600
Do.	do.	Pinjarra Refinery, WA	2,800
Do.	do.	Wagerup Refinery, WA	[2] 1,500
Do.	Nabalco Pty. Ltd.	Gove Refinery, NT	1,100
Do.	Queensland Alumina Ltd.	Gladstone Refinery, QLD	3,000
Do.	Worsley Alumina Pty. Ltd.	Worsley Refinery, WA	1,000
Aluminum	Alcan Australia Ltd.	Kurri Kurri Smelter, NSW	150
Do.	Tomago Aluminium Co. Pty. Ltd.	Tomago Smelter, NSW	240
Do.	Boyne Island Smelters Ltd.	Boyne Island Smelter, QLD	206
Do.	Comalco Aluminium (Bell Bay) Ltd.	Bell Bay Smelter, TAS	117
Do.	Alcoa of Australia Ltd.	Point Henry Smelter, VIC	165
Do.	do.	Portland Smelter, VI	300
Bauxite	Nabalco Pty. Ltd.	Gove Mine, NT	5,100
Do.	Comalco Pty. Ltd.	Weipa operations, QLD	11,000
Do.	Alcoa of Australia Ltd.	Del Park, Huntly, Jarrahdale, and Willowdale Mines, WA	19,000
Do.	Reynolds Australia Alumina Ltd.	Mount Saddleback Mine, WA	3,500
Cement	Adelaide Brighton Cement Ltd.	Birkenhead Plant, SA	1,000
Do.	Australian Portland Cement Ltd.	Geelong Plant, VIC	800
Do.	Blue Circle Southern Cement Works	Berrima Plant, NSW	1,200
Do.	Cockburn Cement Ltd.	South Coogee Plant, WA	1,000
Do.	Goliath Cement Holdings Ltd.	Railton Plant, TAS	1,000
Do.	The Queensland Cement and Lime Co. Ltd.	Darra Plant, QLD	700
Coal	BHP-Utah Coal Ltd.	Blackwater and Gregory Mines, QLD	10,000
Do.	The Broken Hill Pty. Co. Ltd.	Various, NSW	10,000
Do.	Central Queensland Coal Associates	Goonyella, Peak Downs, Saraji, and Norwich Park Open Cuts, QLD	25,000
Do.	Coal and Allied Industries	Various, NSW	15,000
Do.	The Electricity Commission of New South Wales	Various, NSW	11,000
Do.	The Electricity Trust of South Australia	Leigh Creek Mine, SA	3,000
Coal, brown	State Electricity Commission of Victoria	Latrobe Valley Mines, VIC	45,000
Copper	Copper Refineries Pty. Ltd.	Townsville Refinery, QLD	[3] 155
Copper, gold, silver	Renison Goldfields Consolidated Ltd.	Mount Lyell Mine, TAS	[4] 1,500
Copper, gold, palladium, platinum, selenium	Electrolytic Refining and Smelting Co. of Australia Pty. Ltd.	Port Kembla refinery-smelter, NSW	[5] 80
Copper, lead, zinc, gold	Aberfoyle Ltd.	Hellyer Mine, TAS	1,000
Do.	Denehurst Ltd.	Woodlawn Mine, NSW	[4] 875
Copper, lead, zinc, silver	Macquarie Resources NL	Benambra Mine, VIC	[4] 850
Copper, gold, silver, uranium	Western Mining Corp. Holdings Ltd.	Olympic Dam Mine, Smelter, and Refinery, SA	[6] 45 [7] 850 [8] 555 [9] 1.9
Diamond	Argyle Diamond Mines Pty. Ltd.	Ak-1 Pipe, WA	[10] 35,000
Ferroalloys	Tasmanian Electro Metallurgical Co. Pty. Ltd.	Bell Bay Smelter, TAS	160

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities[1]	Capacity
Gold[7]	Alcoa of Australia Ltd.	Hedges Mine, WA	4,043
Do.	Australian Consolidated Minerals Ltd.	Golden Crown Mine, WA	1,150
Do.	do.	Wirralie Mine, QLD	1,550
Do.	Australian Gold Refineries	Kalgoorlie Refinery, WA	46,000
Do.	Australmin Holdings Ltd.	Tuckabianna Mine, WA	2,250
Do.	Brunswick Oil Ltd.	Galtee Mine, WA	1,150
Do.	Central Coast Exploration NL	Croydon Mine, QLD	1,500
Do.	City Resources (Asia) Ltd.	Harbour Lights Mine, WA	2,000
Do.	Costain Securities (NSW) Pty. Ltd.	Golden Plateau Mine, QLD	1,500
Do.	Dominion Gold Mines NL	Cosmo Howley Mine, NT	3,100
Do.	do.	Gabanintha Mine, WA	2,300
Do.	do.	Woolwanga Mine, NT	3,100
Do.	Elders Resources Ltd.	Red Dome Mine, QLD	2,300
Do.	Forsayth Oil NL	Lawlers Mine, WA	900
Do.	Golconda Minerals NL	Duketon Mine, WA	6,200
Do.	Hill Minerals NL	Cork Tree Well Mine, WA	1,000
Do.	Kalgoorlie Mining Associates	Fimiston Leases, WA	2,200
Do.	do.	Mount Charlotte Mine, WA	3,600
Do.	Kidston Gold Mines Ltd.	Kidston Mine, QLD	1,500
Do.	Metana Minerals NL	Mount Magnet Mine, WA	1,600
Do.	Newmont Australia Ltd.	Telfer Mine, WA	12,500
Do.	North Flinders Mines Ltd.	Granites Mine, NT	1,900
Do.	North Kalgurli Mines Ltd.	Jubilee Mine, WA	2,300
Do.	do.	New Celebration Mine, WA	5,000
Do.	Pajingo Gold Mines Pty.	Pajingo Mine, QLD	1,900
Do.	Pan Australian Mining Ltd.	Mount Leyshon Mine, QLD	4,700
Do.	Perth International Refinery	Perth Refinery, WA	12,400
Do.	Pine Creek Goldfields Ltd.	Pine Creek Mine, NT	2,800
Do.	Placer Pacific Ltd.	Big Bell Mine, WA	4,400
Do.	do.	Granny Smith Mine, WA	[11]7,300
Do.	Queen Margaret Gold Mines NL	Bellevue Mine, WA	1,700
Do.	Renison Goldfields Consolidated Ltd.	Lucky Draw Mine, NSW	1,300
Do.	Sons of Gwalia NL	Sons of Gwalia Mine, WA	1,700
Do.	Southern Resources Ltd.	Mount Pleasant Mine, WA	2,000
Do.	Australian Gold Refineries	Perth Mint/Newburn Refinery, WA	95,000
Do.	Western Mining Corp. Holdings Ltd.	Emu Mine, WA	2,200
Do.	do.	Lady Bountiful Mine, WA	2,200
Do.	do.	Stawell Mine, VIC	1,100
Do.	Worsley Joint Venture	Boddington Mine, WA	12,400
Gold, copper	Cyprus Minerals Australia Co.	Starra (Selwyn) Mine, QLD	2,000 3,000
Gold, copper, silver	Barrack Mines Ltd.	Horseshoe Lights Mine, WA	800 [12]17
Gold, silver	MIM Holdings Ltd.	Pacific Precious Metals Refinery, NSW	1,900 [8]500
Do.	Paragon Resources Ltd.	Temora Mine, NSW	1,700 [8]70

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities [1]	Capacity
Iron ore	BHP Steel International Group	Koolan Island Mine	4,000
Do.	do.	Iron Baron Group, SA	8,000
Do.	CRA Ltd.	Channar Mine, WA	3,000
Do.	Hamersley Iron Pty. Ltd.	Mount Tom Price and Parabur doo Mines, WA	46,000
Do.	Goldsworthy Mining Ltd.	Shay Gap and Sunrise Hill Mines, WA	6,000
Do.	Mount Newman Mining Co. Pty. Ltd.	Mount Whaleback and Ore Body 29 Mines, WA	35,000
Do.	Robe River Iron Associates	Eastern Deepdale Mine, WA	20,000
Lead	Mount Isa Mines Ltd.	Mount Isa Smelters, QLD	210
Lead, zinc, copper	Pancontinental Mining Ltd.	Lady Luck and Thalanga Mines, QLD	[4] 550
Lead, zinc, silver	Mount Isa Mines Ltd.	Hilton and Mount Isa Mines, QLD	[13] 231 [14] 275
Lead, zinc, silver, copper, gold	Pacific Smelting and Refining Co. Ltd.	New Broken Hill, North, ZC Mines, Broken Hill, NSW	[4] 2,900
Lead, zinc, silver, gold, cadmium	Pacific Smelting and Refining Co. Ltd.	Port Pirie refinery-smelter, SA	[15] 45 [16] 235
Manganese	Groote Eylandt Mining Co. Pty. Ltd.	Groote Eylandt Mine, NT	[4] 2,300
Mineral sands	Associated Minerals Consolidated Ltd.	Capel South Mine and associated Capel dry and synthetic rutile plants, WA. Eneabba North and Eneabba South Mines, Eneabba West Mine (under development), and associated Eneabba dry and Narngulu dry and synthetic rutile plants, WA	[17] 384 [18] 120 [19] 140 [20] 301
Do.	Australmin Holdings Ltd.	Newrybar Mine and associated Woodburn dry plant, NSW	[18] 12 [20] 10
Do.	Cable Sands Pty. Ltd.	Minninup, Waroona South, and Wonnerup Mines, and associated Bunbury dry plant, WA	(21)
Do.	R.Z. Mines (Newcastle) Ltd.	Nabiac Mine and associated Harrington dry plant and four mines in Tomago area and associated Tomago dry plant, NSW	[18] 30 [20] 29
Do.	Tiwest Joint Venture	Cooljarloo Mine and associated Chandala dry and synthetic rutile plants, WA	[17] 90 [22] 3 [23] 2 [18] 18 [19] 130
Do.	Westralian Sands Pty. Ltd.	North Capel, Yoganup Extended, and Yoganup North Mines and associated Capel dry and synthetic rutile and North Capel dry plants, WA	[17] 369 [22] 146 [23] 2 [19] 98 [20] 50
Nickel	Queensland Nickel Pty. Ltd.	Greenvale Mine, QLD	[24] 25
Do.	do.	Yabulu Smelter, QLD	[25] 24
Do.	Western Mining Corp. Ltd.	Kambalda-St. Ives District mines, WA	[24] 47
Do.	do.	Kalgoorlie Smelter, WA	[26] 450
Do.	do.	Leinster (Agnew) Mine, WA	[24] 10
Do.	do.	Mount Windarra, WA	[24] 4
Opal	Many small producers	Andamooka and Coober Pedy areas, SA; Lightening Ridge, NSW	NA
Petroleum products	BP Oil Refinery (Kwinana) Pty. Ltd.	Kwinana Refinery, WA	[27] 19
Do.	Caltex Refining Co. Pty. Ltd.	Kurnell Refinery, NSW	[27] 17
Do.	Petroleum Refineries (Australia) Pty. Ltd.	Altona Refinery, VIC	[27] 17
Do.	Shell Refining (Australia) Pty. Ltd.	Geelong, VIC	[27] 21

See footnotes at end of table.

TABLE 2—Continued

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities [1]	Capacity
Salt	Dampier Salt Ltd.	Dampier and Lake McCleod Fields, WA	4,000
Steel, pig iron	BHP Steel Ltd.	Newcastle Steelworks, NSW	[28] 2,000 [29] 2,000
Do.	do.	Port Kembla Steelworks, NSW	[28] 4,200 [29] 5,000
Do.	do.	Whyalla Steelworks, SA	[28] 1,300 [29] 1,000
Tin	Renison Goldfields Consolidated Ltd.	Renison Bell Mine, TAS	850
Tin, tantalum,	Greenbushes Ltd.	Greenbushes Mine-Smelter, WA	[30] 5
Uranium	Energy Resources of Australia Ltd.	Ranger Mine, NT	[9] 4,500
Zinc	Pacific Mining and Smelting Co.	Risdon Refinery, TAS	220
Do.	Mount Isa Mines Ltd.	Mount Isa Smelter, QLD	70
Do.	Sulphide Corp. Pty. Ltd.	Cockle Creek Refinery-Smelter, NSW	70
Zinc, copper	Murchison Zinc Ltd.	Golden Grove (Scuddles) Mine, WA	[4 11] 800
Zinc, lead	BHP-Utah Minerals Inc.	Cadjebut Mine, WA	[4] 320
Zinc, lead, silver, copper, gold	Cobar Mines Pty. Ltd.	CSA Mine, Cobar, NSW	[4] 900
Zinc, lead, silver, copper	Electrolytic Zinc Co. of Australasia Ltd.	Elura Mine, NSW	[4] 1,100
Zinc, lead, silver, copper, gold	Aberfoyle Ltd.	Que River Mine, TAS	[4] 135
Do.	Electrolytic Zinc Co. of Australasia Ltd.	Rosebery Mine, TAS	[4] 505
Zirconia	Z-Tech Pty. Ltd.	Rockingham, WA	[31] 450

NA Not available.
[1] NSW New South Wales; NT Northern Territory; QLD Queensland; SA South Australia; TAS Tasmania; VIC Victoria; WA Western Australia.
[2] Capacity scheduled for mid-1992; 1989 capacity was 900,000 tons of alumina.
[3] Refined Copper.
[4] Ore.
[5] Electrolytic copper.
[6] Copper cathode.
[7] Kilograms gold.
[8] Kilograms silver.
[9] Metric tons U_3O_8.
[10] Carats.
[11] Scheduled to start in 1990.
[12] Copper-in-concentrate.
[13] Crude lead containing silver.
[14] Contained zinc in concentrate.
[15] Lead.
[16] Zinc.
[17] Ilmenite.
[18] Rutile.
[19] Synthetic rutile.
[20] Zircon.
[21] Produces ilmenite, leucoxene, monazite, rutile, synthetic rutile, and zircon; capacity NA.
[22] Leucoxene.
[23] Monazite.
[24] Nickel-in-concentrate.
[25] Nickel oxide.
[26] Nickel concentrate throughput.
[27] Liters per day.
[28] Steel.
[29] Pig iron.
[30] Concentrate.
[31] Metric tons high-purity zirconia powder.

wool. Australia was the world's largest bauxite producer in 1989, for the 19th consecutive year, with mines at Weipa, Cape York Peninsula, North Queensland (Comalco Pty. Ltd.); at Gove, Northern Territory (Nabalco Pty. Ltd.); and in the Darling Ranges, Western Australia (Alcoa of Australia Ltd. and Reynolds Australia Alumina Ltd.).

In February, Alcoa announced plans to spend $60 million to upgrade its Kwinana, Pinjarra, and Wagerup refineries in Western Australia, an expansion that will increase Australia's refining capacity 10% by early 1990. Alcoa also announced the start of negotiations with the Victorian State government to increase the capacity of the existing potlines at its Portland smelter from 300,000 metric tons per year (mt/yr) to 330,000 mt/yr at a cost estimated to be $96 million. These plans represent a withdrawal from the earlier proposal to build a $400 million third potline, which would have raised the smelter's capacity to 450,000 mt/yr.[5] In addition, Alcoa completed technical and engineering studies for an expansion of its Wagerup refinery from 900,000 tons (mt) of alumina per year to 1.5 million (MM) mt/yr. The expansion was due to come on-stream in 1992.[6]

Encouraged by record profits the previous year, Comalco announced plans in March to increase capacity at its 30%-owned Boyne Island smelter, Queensland, by 150,000 mt/yr to a total of about 360,000 mt of aluminum per year. Capacity at its nearby 30.3%-owned Gladstone refinery was also likely to be increased by 10%, to 3.3 million metric tons (MMmt) of alumina per year.[7]

Tomago Aluminium Co. Pty. Ltd. was planning to add a $400 million third potline at its Tomago smelter, New South Wales, which would raise output from 240,000 mt/yr to 360,000 mt/yr. The proposed potline will depend on successful negotiations with the New South Wales Electricity Commission for competitive power rates. These negotiations began in late 1988.[8]

Gove Aluminium Ltd., a wholly owned subsidiary of CSR Ltd., signed an agreement in April with Saudi Arabia's Alujain Corp. to supply alumina to the proposed new Saudi smelter Alusa. The contract provides for Gove Aluminium to supply 100,000 mt of alumina per year for 10 years, beginning in 1992.[9] Gove Aluminium has a 30% interest in the bauxite mine and alumina refinery at Gove, Northern Territory.

Kemerton Aluminium Ltd. completed a feasibility study for the construction of a 235,000-mt/yr aluminum smelter in Western Australia. The smelter, not given a go-ahead by yearend, would use locally produced alumina and power. If the proposed smelter goes ahead, it is expected to be commissioned in late 1994 or early 1995.[10]

Copper.—The Electrolytic Refining and Smelting Co. of Australia Pty. Ltd. began in March a $120 million modernization and expansion program at its Port Kembla smelter in New South Wales. The core of the new investment was installation of a Noranda flash smelting reactor that will convert in one step copper concentrate to high-grade matte. It will replace the older two step technology and will double the capacity of the smelter to 80,000 mt of electrolytic copper per year. In addition, a 175,000-mt/yr sulfuric acid plant was being constructed to supply the New South Wales fertilizer industry. The anode casting plant and tankhouse were also undergoing modernization. Production from the new plant was due to commence during the second half of 1990.[11]

A $16 million development project at the Mount Lyell Mine in Tasmania extended its mine life to the mid-1990's. The mine, owned and managed by Renison Goldfields Consolidated Ltd. (RGC), was slated to close at yearend, but improved copper prices led to the decision to install an underground crusher and other facilities to mine an additional 9 MMmt of ore grading 1.9% copper.[12]

Mount Isa Mines Ltd. (MIM) completed a new underground ore-handling system at Mount Isa, Queensland, in midyear at a cost of $30 million with the commissioning of a crusher station, the last link in the 2-year project. The system will allow better access to the Southern 1100 ore body, the main copper production area underground at Mount Isa, and will ensure the continuity of the mine's copper output until development of the 3000 and 3500 ore bodies is completed and full production begins in the mid-1990's.[13]

North Broken Hill Peko was nearing a decision for developing the Parkes copper-gold deposit in New South Wales at yearend. Final feasibility studies were completed, and detailed engineering design work was progressing. Reportedly, construction was to start early in 1990. Production for the first 3 years of mining was being planned at a rate of 1 MMmt of ore per year to produce about 2,200 kilograms (kg) of gold per year. Total mine life was estimated to be 12 years.[14]

Gold.—Australia's gold production, which increased for the ninth consecutive year, was estimated to be a little more than 200 mt, an increase of 32%, which surpassed the previous record high set the previous year. The Boddington Mine in Western Australia, which began production in late 1986, remained Australia's largest producer. The mine was owned by the Worsley joint-venture partners; namely, Reynolds Australia, 40%; Shell Australia Ltd., 30%; BHP Gold Mines Ltd., 20%; and Kobe Alumina Associates, 10%. The Temora Mine (Paragon Resources Ltd.) remained New South Wales' leading producer. The Granites Mine (North Flinders Mines Ltd.) remained the leader in the Northern Territory. The Kidston Mine (Canada's Placer Development Ltd., 70%; Elders IXL Ltd., 15%; and Australian public shares, 15%) was still the leading producer in Queensland and ranked sixth overall in Australia. The Stawell Mine (Western Mining Corp. (WMC), 75%, and Central Norseman Gold Corp., 25%) was the major producer in Victoria. Gold production in South Australia was dominated by the Olympic Dam Mine at Roxby Downs Station, which began gold production in mid-1988. Olympic Dam is managed by WMC, which has a 51% interest. The remaining 49% is held by BP Minerals Ltd., although that equity was up for sale at yearend after BP Minerals sold almost all of its mineral interests early in 1989. Gold output from Tasmania remained almost entirely a byproduct of base metal smelting.

Croesus Mining NL, to circumvent the impending gold tax, brought its Wombola open pit in Western Australia into production in January, well ahead of schedule. Wombola's moderate grade made it gold-tax sensitive to the point where it would not be a viable operation when tax on gold-mining profits takes effect on January 1, 1991.[15] Ore is trucked 60 kilometers (km) to Croesus' carbon-in-pulp treatment plant at Hannan South. Australmin Holdings Ltd. also started gold production in January from its wholly owned Tuckabianna open pit near Cue, Western Australia. Initial production was expected to be at a rate of about 2,250 kg of gold per year, rising to 3,100 kg per year by 1990.[16]

The Big Bell opencast mine near Cue in Western Australia's Murchison gold field was commissioned in January, 2 months ahead of schedule and almost $10 million under budget. The mine, equally owned by Placer Pacific Ltd. through its wholly owned subsidiary Placer (Western Australia) Pty. Ltd. and ACM Gold Ltd. through its wholly owned subsidiary Wirralle Gold Mines Pty. Ltd., was scheduled to produce 5,000 kg of gold per year for 6 years from free-milling ore using conventional carbon-in-pulp technology.[17] After this, an underground operation is planned that will produce at a rate of about 3,700 kg of gold per year for at least 7 years.[18]

Underground mining began in April at Metana Minerals NL's Rothsay Mine, southwest of Mount Magnet in Western Australia. Output was expected to be 1,100 kg of gold per year. Rothsay will be a combined open cut and underground operation, with ore from four open pits to be mined following completion of underground mining.[19]

Ballarat Goldfields Ltd. installed a water treatment and monitoring system in preparation to dewater the Llanberris shaft in the Ballarat East gold fields, Victoria. A new $255 million shaft and associated decline is planned to evaluate gold ore resources that have been outlined by diamond drilling. Underground mining ceased at Ballarat in 1916 after more than 281 mt of gold had been produced. Dewatering of the 12 old mines in the area is expected to take 12 months.[20]

In April, RGC opened the open pit Lucky Draw Mine at Burraga near Bathurst, New South Wales, in an area with no previous history of gold mining. The mine will produce 1,350 kg of gold per year.[21]

A precious-metals recovery and refining plant came on-stream in midyear in Alexandria, an inner-city suburb of Sydney, New South Wales. The plant is managed by Pacific Precious Metals Ltd. (PPM), a joint venture of MIM Holdings Ltd. (40%), Noranda Minerals Inc. of Canada (40%), and Tolltreck Systems Ltd. of the United Kingdom (20%). The plant has a capacity to treat 1,500 mt of feedstock per year, a large proportion of which is low-grade material such as electronics and telecommunications scrap, recovering up to 9,300 kg of gold and 93,300 kg of silver per year. A large portion of the scrap feedstock is to be refined on a toll basis, but PPM will also purchase scrap locally and overseas and sell the refined gold and silver as an independent trader.[22] The refinery also uses mine products such as dore bullion, the first in the country to use both types of materials.[23]

Burmine Ltd. reopened in midyear the Copperhead open pit, previously worked by WMC, at Bullfinch in Western Australia's Yilgarn Field. Planned production at the standard carbon-in-leach operation is 1,250 kg of gold per year.[24]

The Bounty gold mine near Southern Cross in Western Australia, a joint venture between Aztec Mining Co. Ltd., 62%, and Forrestania Gold NL, 38%, with Aztec acting as the operator, was commissioned in June. The 450,000-mt/yr treatment plant will be fed initially from the Bounty and Bounty North open pits, producing 1,200 kg of gold per year. After the underground resource is accessed through a decline from the open pit operation, scheduled for mid-1990, production will increase to 2,200 kg of gold per year.[25]

Fine Metals Corp. announced during the second quarter plans to build a $10 million gold and silver processing plant at Townsville, north Queensland. Production was expected to begin in early 1990 at an initial annual capacity of 23,350 kg of fine gold. Although Queensland's gold production ranks second in Australia, it was refined in Japan or Western Australia.[26] DuPont (Australia) Ltd. announced plans to build a $45 million plant at Kwinana, Western Australia, for the manufacture of sodium cyanide (NaCN). The site at Kwinana was selected because of the ready availability of the necessary raw materials—natural gas, ammonia, and sodium hydroxide—an existing skilled work force, and its proximity to the Western Australia gold mining industry. Construction was planned to begin in early 1990, with the plant coming on-stream in early 1991.[27] The 20,000-ton NaCN plant being constructed near Gladstone, Queensland, was scheduled to start production in June 1990. The plant is owned by ICI Australia Ltd. and will be Australia's second after a 50,000-mt/yr plant that was commissioned in Kwinana in December 1988.

The development of Australia's largest open pit mining operation, the "super pit" project on Kalgoorlie's Golden Mile in Western Australia, proceeded on schedule during the year. By yearend, the previous North Kalgurli Mines Ltd.'s South pit was linked with the Kalgoorlie Mining Associates' (KMA) Judd pit. The project was owned by the KMA partnership, a 50-50 joint venture between Gold Mines of Kalgoorlie Ltd. and Homestake Gold of Australia Ltd. The 2.1-MMmt/yr Fimiston gold treatment plant and the Gidgi roaster north of Kalgoorlie were operating at near-design capacity. The Fimiston facility was expected to increase milling capacity at the combined Kalgoorlie operations to 6.3 million mt/yr when design capacity is achieved.[28]

Iron Ore.—The iron ore industry in Australia was dominated by four large companies operating in the Pilbara District of Western Australia. They together accounted for about 90% of Australia's iron ore production, which in 1989 was almost 106 MMmt, an increase of 10% over that of 1988. Two companies, Hamersley Iron Pty. Ltd., wholly owned by CRA Ltd., and the Mount Newman joint venture, managed by Mount Newman Mining Co. Pty. Ltd., were predominant in the industry. Two others, Robe River Iron Associates and Goldsworthy Mining Ltd., also had significant mining operations. Robe River was 53% owned by North Broken Hill Peko, the operator, and 47% by Japanese interests. Ownership of Goldsworthy was split between the British investment firm Hanson Trust PLC, purchased in July 1989 from Consolidated Gold Fields of the United Kingdom, 70%, and BHP-Utah International Inc., 30%. Only BHP, also the parent company of Mount Newman, mined iron ore before 1960. These four companies produced 88% of all iron ore mined in Australia and 98% of the iron ore mined in Western Australia.

The remainder of the industry consisted of older mines in New South

Wales, Queensland, South Australia, and Tasmania, whose production was primarily for the domestic market. The two most prominent operations were BHP's from the Iron Baron Group of mines in the Middleback Ranges of South Australia and Savage River Mines Ltd.'s mine in Tasmania.[29]

Australia was the world's fourth largest iron ore producer after the U.S.S.R., China, and Brazil. It was the world's second largest exporter of iron ore after Brazil. Ironically, because the Commonwealth Government believed the country had insufficient iron ore reserves to meet the needs of the country, an export restriction was imposed between 1938 and 1960. In 1989, the iron ore industry was more valuable for its exports than for the employment that it generated or for its contribution to State and local development—the industry is extraordinarily capital-intensive. Iron ore was Australia's seventh largest export by value.

Production of iron ore at Mount Newman's Mount Whaleback Mine was hampered by the collapse of a pit wall on August 30, which effectively isolated more than one-half of the mine, and required the removal of large amounts of overburden in new production areas. The mine produced at the rate of about 30 MMmt/yr for the remainder of the year; in its last year of full production, 1987—a crippling, prolonged, and bitter strike occurred at yearend 1988—the mine's output was 34 MMmt. The collapse was expected to affect production for up to 18 months because of the necessary revisions to the stripping and mining plans.

The first shipment of Western Australian iron ore was sent to Romania in September as part of a barter deal. A total of 53 MMmt of ore will be shipped from the Mount Newman Mine during the next 11 years.

The Channar iron ore mine, 20 km east of Hamersley Iron's Paraburdoo Mine in the Pilbara region of Western Australia and the first new mine development in the Pilbara since 1973, came on-stream during the last quarter of 1989. The mine produced 300,000 mt during a 3-month trial, with all the ore scheduled to be shipped to China early in 1990. The project was owned by Hamersley Iron through its wholly owned subsidiary Channar Mining Pty. Ltd., 60%, and China Metallurgical Import and Export Corp. (CMIEC) through CMIEC (Channar) Pty. Ltd., 40%. The mine is one of China's largest overseas projects.[30] The mine's initial production rate will be 3 MMmt of iron ore per year, increasing to achieve a full capacity of 10 MMmt of iron ore per year during a 9-year period to meet the supply requirements of the Chinese steel industry.

Lead and Zinc.—The 1-MMmt/yr Hellyer Mine was inaugurated on April 10. The mine, owned by Aberfoyle Ltd., is in the rugged mountain terrain of northwestern Tasmania. At full production, output from the concentrating mill will be 50,000 mt of contained lead and 110,000 mt of contained zinc.

Pancontinental Mining Ltd., 50%, Outokumpu Australia Pty. Ltd., 25%, and Agip Australia Pty. Ltd., 25%, were nearing completion on the development of the Thalanga Mine near Charters Towers, Queensland, at yearend. The joint-venture partners were planning to commission the 550,000-mt/yr concentrator early in 1990. The concentrator was relocated from the Teutonic Bore Mine in Western Australia. The mine initially will be an open pit, going underground during the second year of operation. Separate copper, lead, and zinc concentrates will be transported by rail to Townsville for shipment to smelters in the Pacific Rim area and Europe. Some concentrate sales to smelters in Australia, however, were also anticipated. Thalanga also contains about 200,000 mt of gold and silver ore grading 0.5 grams of gold and 83 grams of silver per ton.

Construction of the Scuddles zinc-copper mine at Golden Grove near Geraldton, Western Australia, was proceeding slightly behind schedule at yearend, although the joint-venture partners were confident that the 800,000-mt/yr underground mine would be commissioned on time in the third quarter of 1990.[31] The development was managed by Murchison Zinc Ltd., which had a 45% interest in the project. Murchison Zinc in turn was 50% owned by gold producer ACM Gold, a subsidiary of Australian Consolidated Minerals Ltd. (ACM). The other partners were Exxon Corp.'s wholly owned subsidiary Esso Exploration and Production Australia Inc. with a 35% interest, and Amax Resources Australia Ltd.'s subsidiary Aztec Mining Co. Ltd. with a 20% interest.

The upgrading of Pacific Mining and Smelting Co.'s (Pasminco) Risdon zinc refinery in Tasmania was well advanced at yearend following the commissioning of the purification plant in November. The purification plant will extract by-products from the refinery stream before electrolysis and will reduce power consumption as well as lift production by about 10%, to 220,000 mt/yr, when the total upgrading is completed. Pasminco was also studying the feasibility of lifting plant capacity at Risdon to 320,000 mt/yr, but a decision would not be made until mid-1990.[32]

The underground crushing station was commissioned, and commercial production of ore commenced at MIM's Hilton Mine, 20 km north of the Mount Isa Mine, Queensland. A 750,000-mt/yr concentrating mill was expected to begin operations early in 1990.

Manganese.—Production of manganese ore, all from Groote Eylandt in the Northern Territory by Groote Eylandt Mining Co. Pty. Ltd. (GEMCO), a wholly owned subsidiary of BHP, was interrupted by a 14-day strike in September. The dispute, which delayed the loading of four ships' cargoes totaling 145,000 mt, concerned a rash of burglaries in the company town of Alyangula on the island. The workers were protesting lax security measures.[33] The delayed shipments were bound for Japan, Norway, Yugoslavia, and BHP itself for its wholly owned Tasmanian Electro Metallurgical Co. Pty. Ltd.'s Bell Bay, Tasmania, ferroalloy smelter.

BHP was completing its facility in Newcastle, New South Wales, for the production of electrolytic manganese dioxide (EMD) for use in dry cell batteries at yearend. The plant, scheduled for commissioning early in 1990, will use only a fraction of GEMCO's output—about 30,000 mt/yr—from which it will produce about 18,000 mt of EMD.[34]

Nickel.—Near yearend, Finland's Outokumpu detailed plans for a project based on the low-grade Mount Keith nickel deposit in Western Australia. The Mount Keith project will involve a 5-MMmt capacity open pit, mill, and concentrator to supply feed for Outokumpu's Kokkola smelter in Finland. The Mount Keith deposit is owned by ACM.

Two years after it was closed owing to poor market conditions, the Agnew nickel mine was recommissioned with the new name of Leinster, owned by WMC. The project was reopened through a new open cut, Rocky's Reward, where mining first began in May.[35]

Italy's Australian subsidiary Agip Australia, with a 66.67% interest, and Dominion Mining Ltd., 33.33%, completed a mine development plan for the Radio Hill nickel project near Karratha in Western Australia's Pilbara region. The plan, based on an underground mine, concentrator, and MIM's Isasmelt process, was to treat 150,000 mt/yr of ore per year to produce a matte containing 2,500 mt of nickel, as well as 2,000 mt of copper.

Queensland Nickel Pty. Ltd. was planning to upgrade its hydrometallurgical Yabulu nickel refinery near Townsville, Queensland, which would boost production from 24,000 mt/yr to 35,000 mt/yr. Queensland Nickel was owned 87.5% by Dallhold Nickel Management Pty. Ltd. and 12.5% by the Queensland government through State-owned Nickel Resources North Queensland.

Two nickel ore supply contracts were signed by the Indonesian Government mining company Aneka Tambang and Queensland Nickel. One contract extended the existing arrangement supplying lateritic nickel ore for a further 8 years from Gebe Island, off Indonesia's Irian Jaya coast. It also provided for shipments of 7 MMmt of ore for processing at the Yabulu refinery. The second contract was an agreement to study the possibility of mining lateritic ore on Gag Island, also off the coast of Irian Jaya, and supplying the Townsville refinery for up to 30 years.[36]

Steel.—BHP Steel Ltd. was constructing a 200,000-mt/yr electric arc furnace steel minimill for the production of rod and bar in the Rooty Hill suburb of Sydney, New South Wales. The plant will free 200,000 mt/yr of capacity at the Newcastle integrated plant, which will be used to make steel for the export market.[37]

Brazil was preparing at yearend to negotiate annual contract prices with BHP Steel for the first time with the Australian steel industry, with annual sales of Brazilian ore to Australia reaching the vicinity of 2 million mt/yr. It was expected, however, that the Brazil-Australia contract negotiations would take place only after the round of negotiations for the 1990 contract year with other buyers were concluded, and would consequently follow world price trends. The Brazilian suppliers Cia. Vale do Rio Doce and S.A. Mineracao da Tridade sold iron ore and pellets to BHP during 1989 owing to a lack of Australian stocks and for quality reasons—the Brazilian ore had low silica phosphor and alumina.[38]

Industrial Minerals

Diamond.—Argyle Diamond Mines Pty. Ltd. easily retained, for the fourth consecutive year, its position as the largest single source of diamonds in the world in 1989. Argyle is a joint venture of CRA, 58.3%, Ashton Mining Ltd., 38.7%, and the Western Australian Diamond Trust (WADT), 5%. The WADT was originally set up by the Western Australian government with a 5% share in Argyle and was entitled to a random selection of the stones produced at the mine. Argyle's annual production supplied about 30% by volume of the world's diamonds from its AK-1 lamproite pipe mine in the Kimberley District of Western Australia, but ranked sixth in terms of value of production. The stones mined at Argyle were about 5% gem quality, earning about 40% of revenues; 40% near-gem quality, earning 45% to 50% of revenue; and 55% were industrial quality, earning 10% to 15% of revenue.

Argyle resumed mining of its associated alluvial deposits in the lower reaches of the Smoke and Limestone Creeks that drain the AK-1 pipe. These deposits were previously mined by Argyle in 1983-85 while the main process plant for the diamond pipe was being commissioned.[39]

Cluff Resources Pacific Ltd., a 47% associate of Great Britain's Cluff Resources, raised its expectations for an economic diamond deposit at its Copeton Project in New South Wales. The company revealed near yearend that the historically important Copeton diamonds are sourced from previously unrecognized lamproite pipes forming the Mount Ross volcanic complex, rather than as occurring in alluvial deposits transported from a distant but unknown primary source. Cluff Resources also moved to obtain 100% title over an area of 2,000 km^2, which includes all the recorded diamond occurrences in the Copeton-Bingare diamond region in the northern part of the State. The Copeton area produced about 170,000 carats of diamonds of gem and near-gem quality around the turn of the century.[40]

At the Bow River Mine, 25 km northeast of Argyle and owned by Freeport-McMoRan Australia Ltd. (FMA), 80%, and Gem Exploration and Minerals Ltd., 20%, plans were being prepared to increase treatment capacity by 50%, to 6,000 mt of diamondiferous gravel per day.[41]

Gem Stones.—Australia continued to be the world's leading producer of natural sapphire, which was mined in the New England (Inverell-Glen Innes) District of New South Wales and near the town of Anakie in Queensland. It produced about 70% of the world's output, with about 90% of the uncut gems being exported to Thailand, the recognized world leader, for cutting and marketing. Australia processed only about 1% of its production.[42]

TJ & PV Nunan Pty. Ltd. began mining in September at the Truro Mine, its fourth sapphire mine in the Inverell region. The gravity treatment plant will treat 600 mt of sapphire-bearing placer material per day, producing about 6 kg of corundum.

Australia produced between 80% and 90% of the world's natural opal, mostly from three fields in South Australia at Andamooka, Coober Pedy, and Mintabie. In New South Wales, Lightening Ridge was the world's sole source of black opal. A small quantity of opal also was produced in central Queensland.

The world's largest resource of nephrite jade was at Cowell on the Eyre Peninsula in South Australia. In addition to the important deposits of opal and sapphire, Australia also produced a variety of other gem stones, including amethyst, aquamarine, chrysoprase, emerald, garnet, rhodonite, topaz, and zircon.

Mineral Fuels

Coal.—The coal industry remained Australia's largest foreign-exchange earner, accounting for more than one-third of export revenues from the minerals sector and about 12% of the country's export earnings. Australia remained the world's seventh largest producer of coal (all grades) in 1989, ranking behind China, the United States, the U.S.S.R., the German Democratic Republic, Poland, and the Federal Republic of Germany. Australia also remained the world's largest exporter. The coal industry was the country's single largest employer and accounted for about 30% of the country's mineral industry employment. New South Wales and Queensland accounted for more than 96% of the country's coal production and virtually all of the country's coal exports.

CRA agreed in October to purchase BP Minerals' Australian coal interests, which will increase CRA's annual coal production to more than 20 MMmt. The acquisition included three New South Wales mines—Howick, Tahmoor, and Western Main—plus BP Minerals' 49% interest in the Clarence Colliery, New South Wales, and the undeveloped Winchester South deposit in Queensland, 50%.[43]

Uranium.—Australia was the Western World's third largest producer of uranium, producing about 10% of the world's market economy countries' production. The Commonwealth Government's uranium mining policy restricts mining to three sites, two of which, the Olympic Dam Mine in South Australia and the Ranger Mine in the Alligator Rivers region of the Northern Territory, were in operation during the year. The third, the Nabarlek Mine, also in the Alligator Rivers region, was depleted in 1988. In addition, the Government's policy prohibits further downstream involvement in the nuclear fuel cycle. This extends to enrichment facilities or any other process to add value to the exported uranium.[44]

WMC Holding Corp. Ltd., 51% owner of Olympic Dam, took legal action against BP Minerals to block BP Minerals' sale of its 49% share to Great Britain's RTZ Corp. WMC filed at the end of July in the Supreme Court of Victoria for an injunction to stop the sale, announced by BP Minerals on the 12th of the month. Under WMC's and BP Minerals' joint-venture agreement, WMC has preemptive rights over BP Minerals' share.[45] BP Minerals withdrew in September, at least temporarily, its offer to sell its stake to RTZ.[46]

WMC renamed in August its operating company for the mine, previously Roxby Management Services Pty. Ltd., to WMC (Olympic Dam Operations) Pty. Ltd. In addition, Roxby Mining Corp. Pty. Ltd., which held WMC's 51% equity in the project, was renamed WMC (Olympic Dam Corp.) Pty. Ltd.[47]

An exploration program on a 560-km^2 exploration license area adjacent to Queensland Mines Ltd.'s Nabarlek Mine began during the last quarter. Sydney-based consultant Surtec Geosystems was conducting the program, which was planned to be spread over two dry seasons of 6 months each.[48]

Energy Resources of Australia Ltd. (ERA) continued planning to increase production of uranium oxide (U_3O_8) at its Ranger opencut mine to 4,500 mt/yr by 1991, with a further increase to 6,000 mt/yr by yearend 1992.

Reserves

Australia has a sound resource base of a diverse range of minerals. It is self-sufficient in most minerals of economic importance. Major minerals with known reserves adequate for domestic demand and exports include bauxite, clays, coal, copper, diamond, gold, iron ore, lead, manganese, mineral sands, natural gas, nickel, salt, silver, tin, uranium, and zinc.

INFRASTRUCTURE

The communications and transportation infrastructure of Australia was well developed. There were 837,872 km of roads, including 243,750 km paved; 228,396 km gravel, crushed stone, or stabilized-soil surface; and 365,726 km unimproved earth. Inland waterways, of which there were about 8,368 km usable for mainly small, shallow-draft craft, were of little importance to the transportation industry.

The Government-owned railway system consisted of 40,478 km of track, 16,307 km of which was standard gauge. There were 1,130 km of electrified rail. A few hundred km of rail was privately owned, most of which served the iron ore industry in Western Australia. There were 231 principal airports with permanent-surface runways out of an aggregate of 524 in the country. International shipping ports included Adelaide, Brisbane, Cairns, Darwin, Devon-

TABLE 3

AUSTRALIA: RESERVES OF MAJOR MINERALS AND FUELS[1]

Commodity	Economic demonstrated reserves (thousand metric tons unless otherwise specified)
Antimony	15.2
Bauxite	[2]5,543
Black coal	
in situ	[3]71.2
recoverable	[3]50.8
Brown coal	
in situ	[3]46.4
recoverable	[3]41.8
Cadmium	58.4
Cobalt	18
Columbium	5.8
Copper	[2]6.5
Diamond	
Gem and near gem	[4]179
Industrial	[4]214
Gold	[5]1,486
Iron ore	[3]14.3
Lead	[2]11.5
Lithium	359.1
Manganese ore	[2]118
Mineral sands	
Ilmenite	[2]64.2
Monazite	360
Rutile	[2]9.4
Zircon	[2]15.2
Nickel	[2]1.1
Petroleum, recoverable	
Condensate	[6]122
Crude	[6]255
Liquid petroleum gas	[6]130
Natural gas	[7]1,033
Silver	21.8
Tantalum	11.4
Tin	191.4
Tungsten	18.5
Uranium, recoverable	474
Vanadium	10
Zinc	[2]20.4

[1]As of Dec. 31, 1989.
[2]Million metric tons.
[3]Billion metric tons.
[4]Million carats.
[5]Metric tons.
[6]Billion liters.
[7]Billion cubic meters.

Source: Minerals Resource Assessment Branch, Bureau of Mineral Resources, Geology & Geophysics, Canberra, Australia.

port, Fremantle, Geelong, Hobart, Launceston, Mackay, Melbourne, Sydney, and Townsville. The merchant marine fleet included 15 petroleum, oils, and lubricant tankers; 2 chemical tankers; 2 liquefied gas tankers; 2 combination ore-oil tankers; and 30 bulk ore ships.

Pipelines included 5,600 km for natural gas, 2,500 km for crude oil, and 500 km for refined oil products. Electric generating capacity in 1988 was 36,588,000 kilowatts.

In remote areas where mines, mills, or smelters usually are located, an individual mining company must provide its own infrastructure, such as housing, roads, railways, port facilities, and various community services.

OUTLOOK

With a growing worldwide need for mineral and energy supplies, with especial emphasis on those in which Australia is abundantly endowed and for which Australia is among the world leaders in world supply—bauxite for aluminum production, coal, copper, diamond, gold, iron ore, lead, natural gas, manganese, mineral sands, and zinc—Australia will continue to be a significant world resource supplier well into the 21st century. Overall mineral production is expected to increase by more than 10% in 1990, with most of this additional output going to exports, particularly in the alumina, coal, liquefied natural gas, and mineral sands sectors.[49]

Probably the largest single potential detriment to the resource sector in the years ahead is the strong environmental movement in the country. Although minerals and minerals processing has been accounting for about one-half of export income, increasingly strong antimining sentiment is beginning to impede investment in the mining and minerals sector, with the result that exploration and development activities are decreasing as they become more difficult to conduct. This will have a very significant effect on the discoveries of large greenfield projects that will be needed to maintain the impetus of the mining and processing sectors.

The trend in new investment in the minerals industry in Australia is toward value added rather than primary mining operations. A prime example of this is the increasing investment in synthetic rutile plants that various mineral sands operators are bringing on-stream.

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[1] Where necessary, values have been converted from Australian dollars (A$) to U.S. dollars at the rate of A$1.26 = US$1.00.

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[3] U.S. Embassy, Canberra, Australia. State Dep. Telegram 09380, P130802Z, Oct. 1989.

[4] Australia's fiscal year begins on July 1 and ends on June 30 of the year stated.

[5] U.S. Embassy, Canberra, Australia. State Dep. Airgram A-23, Dec. 11, 1989.

[6] Metal Bulletin (London). No. 7403, July 24, 1989, p. 5.

[7] Mining Journal (London). V. 312, No. 8009, Mar. 3, 1989, p. 161.

[8] Metal Bulletin (London). No. 7400, July 13, 1989, p. 2.

[9] American Metal Market (New York). V. 97, No. 82, Apr. 27, 1989, p. 2.

[10] Metal Bulletin (London). No. 7450, Jan. 18, 1990, p. 5.

[11] International Mining (London). V. 6, No. 2, Feb. 1989, p. 38.

[12] Metal Bulletin (London). No. 7393, June 19, 1989, p. 11.

[13] Mining Journal (London). V. 312, No. 8025, June 23, 1989, p. 489.

[14] Metal Bulletin (London). No. 7443, Dec. 18, 1989, p. 9.

[15] The Miner (Sydney). Feb. 1989, p. 2.

[16] Mining Journal (London). V. 312, No. 8014, Apr. 7, 1989, p. 262.

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[18] Metal Bulletin (London). No. 7377, Apr. 20, 1989, p. 13.

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[26] Mining Journal (London). V. 313, No. 8027, July 7, 1989, p. 6.

[27] ———. V. 313, No. 8028, July 14, 1989, p. 26.

[28] International Mining (London). V. 6, No. 9, Sept. 1989, p. 74.

[29] U.S. Embassy, Canberra, Australia. State Dep. Airgram A-22, Dec. 4, 1989.

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[31] Metal Bulletin (London). No. 7430, Nov. 2, 1989, p. 9.

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[38] ———. No. 7444, Dec. 21, 1989, p. 27.

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[40] Work cited in footnote 35.

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[43] ———. V. 4, No. 39, Dec. 1989, p. 45.

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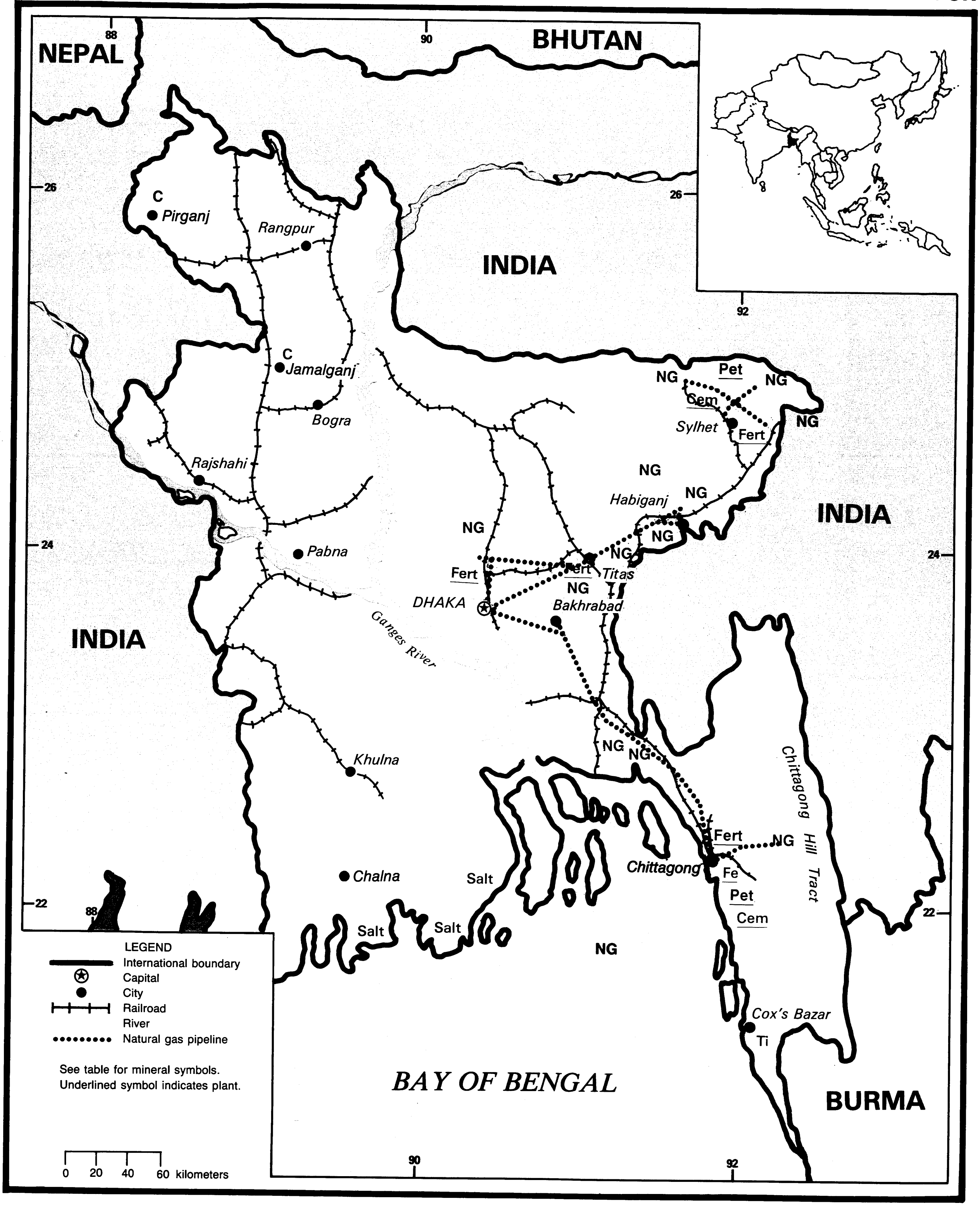
BANGLADESH

AREA 144,000 km² **POPULATION 115 million**



THE MINERAL INDUSTRY OF

BANGLADESH

By David B. Doan

One of the poorest and most densely populated agrarian nations in the world, Bangladesh continued its recovery from devastating storms and floods in 1987 and 1988. Although 1989 production of natural gas and derivative products was up from the previous year, as was the output of ingot steel, other mineral commodities seemed to represent individual industries that had not yet regained their former productivity. With an annual per capita income of less than $200,[1] unemployment more than 30%, an average population density of 736 persons per square kilometer (km^2), and an annual population growth rate of 2.4%, the country had a rapidly growing labor force that tended to spill across the borders into India in search of work. The agricultural sector led the national recovery, but there was little, if any, land not in tenure. The country's need for mineral and industrial development, as well as reconstruction and new construction, was critical. Unfortunately, a chronic shortage of capital mitigated against improvement.

The World Bank extended new loans totaling $338 million in 1989, bringing the total of loans provided to Bangladesh to $2.8 billion as funding for a total of 77 capital projects. Of the six loans approved in 1989, two were in the agricultural sector and one each in energy, transport industry, nonfuel minerals, and urban development.

GOVERNMENT POLICIES AND PROGRAMS

The Government unhesitatingly promoted productivity as the key to economic progress by striving to increase exports versus imports. One important measure was the offering of petroleum concessions or production-sharing agreements to foreign entities as a way of stimulating exploration and development. A total of 22 blocks or leaseholds, onshore and offshore, were offered during promotional seminars in Houston, Texas; London, United Kingdom; and Dhaka, Bangladesh. Considerable interest was aroused in the basic exploration possibilities as well as the details of the proposed production-sharing arrangements. Initial leasehold rentals asked by the Government were said to be high, some of them in the range of $700,000, but for what term was not clear. In general, the Government's terms for agreement were seen as very demanding, but the prospects for new discoveries were also thought to be good.

PRODUCTION

Production of natural gas, ingot steel, nitrogen-base fertilizers, and petroleum refinery products was higher in 1989 than in the previous year. The fertilizer group led the list with a 12% rise, based on the increasing availability of domestic natural gas. However, Bangladesh was recovering from the cyclonic storms and floods that ranged from destructive to nearly catastrophic depending on which parts of the country were hit. Roads and railroads were damaged, leading to failures of transport and supply. Production of cement, kaolin clays, limestone for the manufacture of cement, and steel products was less than the previous year in each category, ostensibly because of the slow progress of recovery from damage to both the physical and economic infrastructure. It is likely that various surface workings and open pits were flooded, the latter remaining so while ground water levels gradually receded.

TRADE

Bangladesh's monthly trade deficit narrowed to $167.5 million in April 1989 from $233.6 million in the previous month when exports rose and imports declined. However, this hoped-for turning point in the monthly trade deficit was nonetheless large compared with that of $65.3 million 1 year before in April 1988. Blame could be ascribed to problems of recovery from the storms and floods, in that exports were hindered but imports were in many cases all the more necessary. The Minister of Commerce called on all quarters of industry to increase production as a way to boost export earnings, saying that "export or perish" should be the nation's slogan in overcoming balance-of-payments problems.

In November, the Islamic Development Bank, based in Saudi Arabia, signed an agreement with Bangladesh granting a loan of $15 million to cover costs for imports of crude oil. Late in the 1989 fiscal year the Government devalued the Bangladesh taka approximately 5% against the U.S. dollar in an effort, among other things, to enhance the flow of Bangladesh's exports into world markets after experiencing difficulty in cutting imports and foreign-exchange obligations.

During the year a trade agreement was reached with neighboring Burma for import of, among other products, cement clinker, limestone, marble, and pig iron, in return for which Bangladesh would export clothing and other manufactured goods. The two countries, both having serious foreign-exchange problems, would conserve hard-currency credits by balanced countertrade programs not involving currency.

STRUCTURE OF THE MINERAL INDUSTRY

All mineral production, other than foreign interests in petroleum joint ventures, was owned by the Government.

TABLE 1

BANGLADESH: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989[p]
Cement, hydraulic[3]		240,176	292,000	310,000	310,800	312,911
Clays: Kaolin[3]		4,178	2,695	12,272	10,097	7,092
Gas, natural, marketed[3 4]	million cubic meters	2,577	2,866	3,371	4,297	4,416
Iron and steel: Metal:[3]						
Steel, crude (ingot only)		101,419	95,514	82,081	81,285	86,274
Steel products		126,582	111,593	129,986	121,865	107,979
Nitrogen: N content of ammonia and ammonium sulfate		358,480	390,515	435,900	673,400	752,972
Petroleum refinery products	thousand 42-gallon barrels	7,357	7,405	[e]7,610	7,411	7,688
Salt, marine[e 3]		[5]489,000	500,000	416,000	409,000	415,000
Stone: Limestone[3]		40,392	22,082	[r]45,667	32,933	29,457

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Table includes data available through Aug. 1, 1990.

[2]In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

[3]Data are for years ending June 30 of that stated.

[4]Gross production is not reported; the quantity vented, flared, or reinjected is believed to be negligible.

[5]Reported figure.

The mineral industry of Bangladesh, still in an early stage, was dominated by the significant discoveries in petroleum that have led to development of thermal power generation and the manufacture of fertilizer for the country's largely agrarian economy. On further exploration and development, the petroleum industry will claim a growing share of the labor force and contribute increasingly to the gross domestic product and export earnings. With the present arrangement of production-sharing ventures, foreign drilling and production technology will be gradually assumed by Bangladeshi workers and technicians.

COMMODITY REVIEW

Metals

Mineral Sands.—After reconsideration in the light of both domestic needs and the potential for earning increased foreign-exchange credits, the Government reactivated a dormant project for exploiting heavy minerals in beach sands. Previously, an exploratory survey by the Bangladesh Atomic Energy Commission disclosed that the country possessed roughly 240 km^2 of beach sands, believed to be between Chittagong and Cox's Bazar, containing about 420,000 tons of heavy minerals. The latter included, in order of importance, monazite, zircon, ilmenite, rutile, and leucoxene. These

TABLE 2

BANGLADESH: STRUCTURE OF THE MINERAL INDUSTRY[1]

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[2]
Cement	Bangladesh Oil, Gas and Mineral Corp. (Government, 100%)	Chittagong	[3]200
Do.	do.	Sylhet	210
Fertilizer	Bangladesh Chemical Fertilizer Corp. (Government, 100%)	Ashuganj, near Titas Gasfield	560
Do.	do.	Fenchuganj, near Sylhet	100
Do.	do.	Ghorasal, north of Dhaka (2 plants)	600
Gas, natural	Bangladesh Oil, Gas and Mineral Corp. (Government, 100%)	Bakhrabad	[4]2.85
Do.	do.	Habiganj	[4]4.25
Do.	do.	Titas	[4]5.70
Petroleum, refined	Eastern Refinery Ltd. (Government, 100%)	Chittagong	[5]30,000
Steel	Bangladesh Steel and Engineering Corp (Government, 100%)	do.	200

[1]All mineral production is owned by the Government of Bangladesh, other than for foreign interests in petroleum joint ventures, not yet stabilized.

[2]Thousand metric tons per year unless otherwise specified.

[3]Grinding of imported clinker.

[4]Million cubic meters per day.

[5]Barrels per day.

minerals contained thorium, zirconium, and titanium, respectively, and probably lanthanum and yttrium, altogether having a total value of approximately $400 million, according to Government sources.

Industrial Minerals

Fertilizer Materials.—Startup of the $490 million, 890,000-ton-per-year natural-gas processing Chittagong fertilizer plant, producing both urea and ammonia, was expected to increase Bangladesh's fertilizer capacity to 1.6 million tons per year. At 752,972 tons of nitrogen content in 1989, production was up 12% compared with the previous year.

Mineral Fuels

Coal.—Newly drilled coal discoveries in the Pirganj area of west Bangladesh have brought total reserves up to between 1.85 and 2.0 billion tons, according to local officials. Recalling that the very large reserves of natural gas are in east Bangladesh, the Minister of Energy indicated that the Government had decided to move quickly to develop these energy resources in the western part of the country. This would ease the present problem of long-distance transmission of electricity from eastern gas-fired powerplants.

About 850 million tons of reserves lie within 150 meters (m) of the surface and consist of high-grade bituminous coal suitable for coking. An additional 1 billion tons of reserves in the Jamalganj area lie 400 to 500 m below the surface but are thought to be as much as 40 m thick, which could compensate to some degree for potential problems of mining depth and mine drainage.

Natural Gas.—Although production of natural gas in 1989 was up only about 3% compared with the previous year, there was progress in both exploration and infrastructure.

Scimitar Exploration Ltd., a Canadian company, drilled two dry holes and then drilled No. 1 Jalalabad, a new-field strike of impressive proportion. This third well flowed just less than 2 million cubic meters per day and about 1,050 barrels per day of associated 45° to 52° gravity condensate from three of five gas-bearing sands. With a total depth of 2,876 m, the discovery was thought to represent new reserves of 42.5 cubic meters of gas and about 39.8 million barrels of condensate. Observers expected that Scimitar would put an additional $20 million into further drilling of this 1,650 km^2 production-sharing tract after submitting a development plan to the state-owned Bangladesh Oil, Gas and Minerals Corp. The new field is in extreme northeastern Bangladesh near Haripur (the site of Bangladesh's only oil well) in Sylhet District, 25 to 30 km north of the town of Sylhet.

Meanwhile, during the year a total of 570 km of new pipeline was built for natural-gas transmission and distribution for both fuel and fertilizer manufacturing. Development financing has been provided by multinational development loans from Canada, the World Bank, United Kingdom, Netherlands, and the Asian Development Bank, roughly in that order.

Reserves

The most significant mineral commodity in Bangladesh was natural gas, of which the country's reserves had been estimated to exceed 400 billion cubic meters by Government officials. Reserves of petroleum crude had been projected[2] at 500,000 barrels. Totally conjectural guesses by third parties have been frequently made of another 40 million barrels offshore in undefined locations, as yet undiscovered. Although these guesses were given some publicity, they cannot be included in any tabulation of reserves.

Limestone reserves were probably large but not yet known in detail. The steel industry of Bangladesh subsisted entirely on scrap rather than domestic resources. Reserves of kaolin clay were undefined but probably large. Marine salt reserves were unlimited.

TABLE 3

BANGLADESH: ESTIMATED MAJOR MINERAL RESERVES

Commodity		
Natural gas	billion cubic meters	400
Petroleum, crude	thousand barrels	500

INFRASTRUCTURE

Bangladesh had 3,840 km of paved roads and 3,400 km of unpaved, gravel-surface roads. In addition, there were several thousands of cart tracks or improved-earth roads connecting rural villages, but these were not passable to heavy truck traffic. Railroads included a total of 2,892 km of trackage—1,914 km of 1.000-m gauge track and 978 km of 1.676-m broad-gauge track. Inland waterways, a prominent venue of transportation with 7,000 km suitable for navigation by river steamer, carried almost as much freight as the rail and road systems combined. Principal seaports were Chittagong and Chalna.

The country had 16 airports, 13 of them usable and having paved runways. Of these, four had runways 2,440 to 3,659 m long and seven had runways 1,220 to 2,439 m long. Civil air equipment in Bangladesh included 15 major transport aircraft.

Electric power was generated by relatively low-cost natural-gas-fired plants in the eastern part of the country. Oil-fueled thermal plants in western Bangladesh generated power at about 18 times the cost of the gas-fired plants. In an effort to balance costs, an east-west interconnector power transmission system had been built that can accomodate 400 megawatts of electricity. Total generating capacity in 1988 was 1,570 megawatts from which 4,800 million kilowatt hours was produced during that year. This was equivalent to 45 kilowatt hours per capita.

Near the end of the year, the Bangladesh Power Development Board and China National Machinery and Equipment Import/Export Corp. (CMEC) signed an agreement to establish a 210-megawatt gas-based thermal power station in Chittagong. CMEC will provide credit on a deferred-payment basis comprising 90% of the cost of equipment as well as 35% of the cost of erection of the plant.

OUTLOOK

With a very low rate of capital formation, and sapped by repeated natural flooding disasters, the country's economy makes little or no progress in the face of a burgeoning population reflecting widespread poverty and unemployment. Imported capital in the form of loans can make a difference, but must be wisely and effectively used to promote mineral production, maintain agricultural productivity, and build infrastructure supporting those objectives.

Petroleum resources may possibly make the critical difference to the future of the country. As both an energy source and raw material for chemical products such as fertilizer, natural gas is growing significantly in economic importance. Exploration is discovering new reserves of gas and more recently has targeted petroleum crude both onshore and offshore. The country is approaching an export capability for natural gas and hydrocarbon derivatives.

If foreign-exchange credits can be husbanded by barter or other arrangements for maintaining trade balances sufficient for economic survival, and if beyond this some specific high-value exports such as petroleum products can be offered into world markets, Bangladesh may possess the recipe for progress.

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[1] Where necessary, the Bangladesh taka (T) has been converted into U.S. dollars at the rate T32.50 = US$1.00. This is a predevaluation rate.

[2] The Petroleum Encyclopedia, 1990. Pennwell Publ. Co., p. 284.

OTHER SOURCES OF INFORMATION

Agencies

Ministry of Energy and Mineral Resources
Government of the Peoples' Republic of Bangladesh
Bangladesh Secretariat
Dhaka, Bangladesh

Bangladesh Oil, Gas and Mineral Corp.
Chamber Building
122–124 Motijheel Commercial Area
Dhaka, Bangladesh
Telex: 65725 HNXN BJ

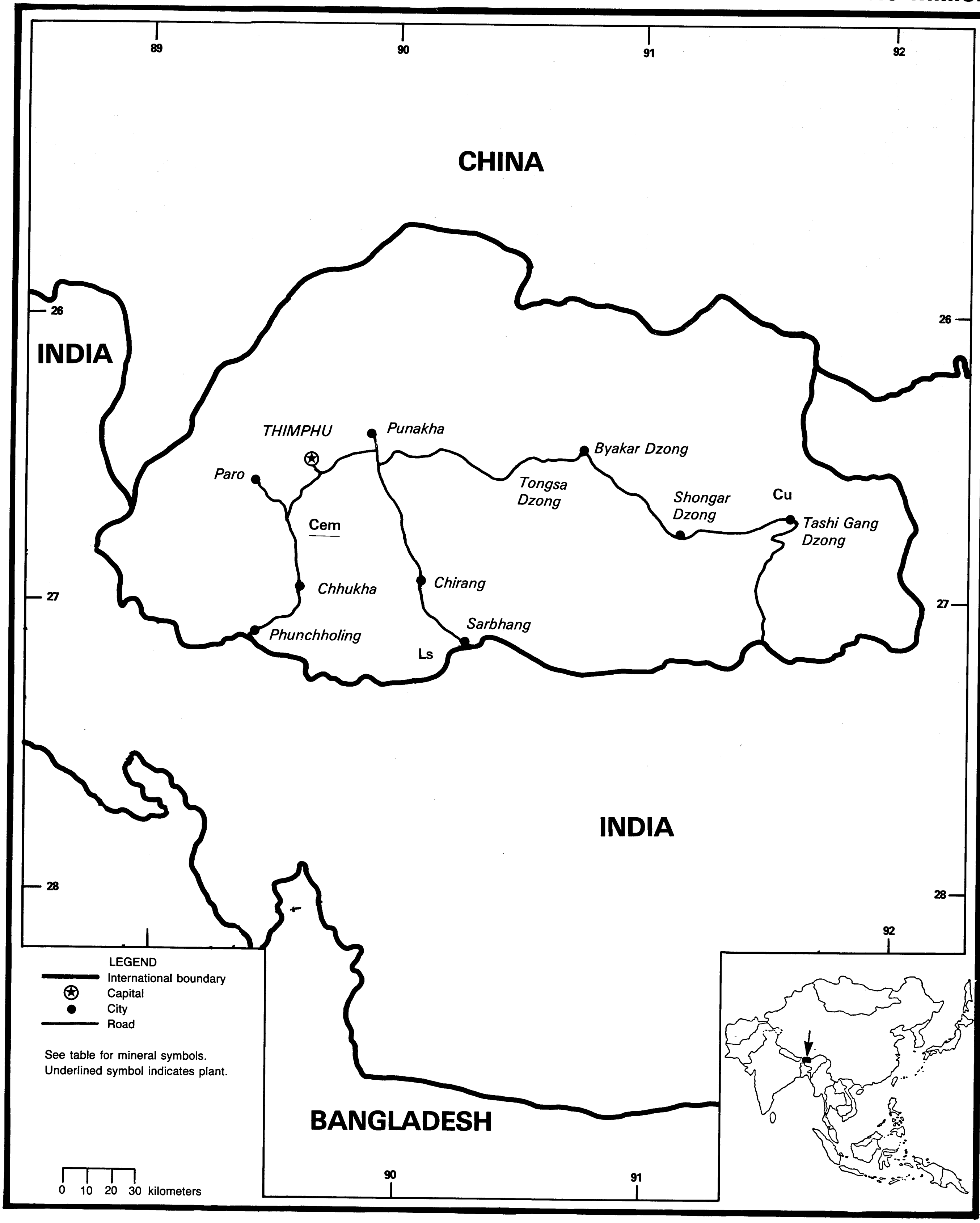
Bangladesh Petroleum Corp.
GPO Box 2003
Dhaka, Bangladesh
Telex: 702 DHAKA

Publication

Bangladesh Bureau of Statistics, Dhaka: Monthly Statistical Bulletin of Bangladesh.

BHUTAN

AREA 47,000 km² **POPULATION 1.5 million**



THE MINERAL INDUSTRY OF

BHUTAN

By David B. Doan

The Kingdom of Bhutan, a mountainous, landlocked buffer state between India and China, comprises a largely agrarian economy buttressed by technical and financial support from India. To date, the mineral production of Bhutan has not been notable for quantity, quality, nor continuity. A Himalayan country of very great physiographic relief, Bhutan offers spectacular scenery for tourists as well as excellent sites for development of dams and hydroelectric power. The country is almost totally dependent on India for support in terms of technology, financial aid, and general economic development.

GOVERNMENT POLICIES AND PROGRAMS

Starting in 1961, the Government of Bhutan had undertaken a series of 5-year plans that had been largely underwritten by India. No specific plans were known for development of resources, although organized attempts are underway in forestry and certain other agricultural activities. Mineral exploration has been carried on by the Geological Survey of India under some form of cooperative arrangement.

PRODUCTION

Bhutan produced hydraulic cement essentially for its own use, thought to be mainly for construction of dams and related structures for the generation of electric power. Limestone and dolomite have been mined but the rates of extraction were not reported. The same was true for gypsum and construction materials such as sand, gravel, and crushed stone.

TRADE

Dolomite has been listed in the past as an export commodity, but destinations were not reported. For geographic reasons, any bulk material exported from Bhutan would be expected to go through India, which is presumed also to be the buyer of any low-unit-value good that Bhutan ships outside the country. Gypsum was said to be exported to India,[1] but import data from India have not mentioned Bhutan as a source for this commodity.

STRUCTURE OF THE MINERAL INDUSTRY

Although cement, clay, coal, dolomite, graphite, gypsum, limestone, and slate were all thought to have been produced in Bhutan in the past, little was known of the mining districts, quantities extracted, or consumption, other than for cement.

Copper, lead, tin, tungsten, and zinc deposits of unknown quality and quantity had been discovered by the Geological Survey of India in Bhutan, but locations of deposits were obscure other than for copper, found about 20 kilometers (km) north of Tashi Gang.

COMMODITY REVIEW

Industrial Minerals

The one exception to the general dearth of information on mineral commodities in Bhutan was cement, which was known to be produced in Gomptu, about 50 km south of the capital, Thimphu. The Gomptu plant was estimated to have a capacity of 300 tons per day, or about 100,000 tons per year, but actual output was not reported.

Reserves

No information was available on reserves. It was probable that geologic mapping and exploration were still largely in an incipient stage. In part, this reflected the difficulty of access to much of the country, with its high relief and lack of roads. Because the Himalayas are known to include thick sequences of carbonate rocks, unlocated reserves of limestone and dolomite may be large.

TABLE 1

BHUTAN: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1985	1986	1987	1988	1989
INDUSTRIAL MINERALS					
Cement	75,000	75,000	75,000	75,000	75,000
Dolomite	100,000	100,000	75,000	50,000	50,000
Gypsum	10,000	10,000	10,000	10,000	10,000
Limestone	50,000	50,000	100,000	100,000	100,000

[1] Table includes data available through July 23, 1990.
[2] In addition to the commodities listed, construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate for reliable estimates of output levels.

INFRASTRUCTURE

Bhutan has a total of 1,704 km of highways, including 418 km surfaced, 515 km improved, and 371 km unimproved-earth or loose-surface roads. The country has two airports, both with runways 1,220 to 2,439 meters long but only one with permanent-surface runways, probably at Paro.

With an installed capacity totaling 353 megawatts, power generation for the country is by two hydroelectric plants at Chhukha and Punchholing, respectively. Actual power produced has been at about 65% of capacity.

OUTLOOK

Bhutan is gradually developing, but at whatever pace is suitable to India so far as financial and technical aid are concerned. It is presumed that more roads will be constructed, followed by more dams, powerplants, and related infrastructure. At the same time, further mineral exploration would be expected to result in discoveries that could initiate mining and industrial growth.

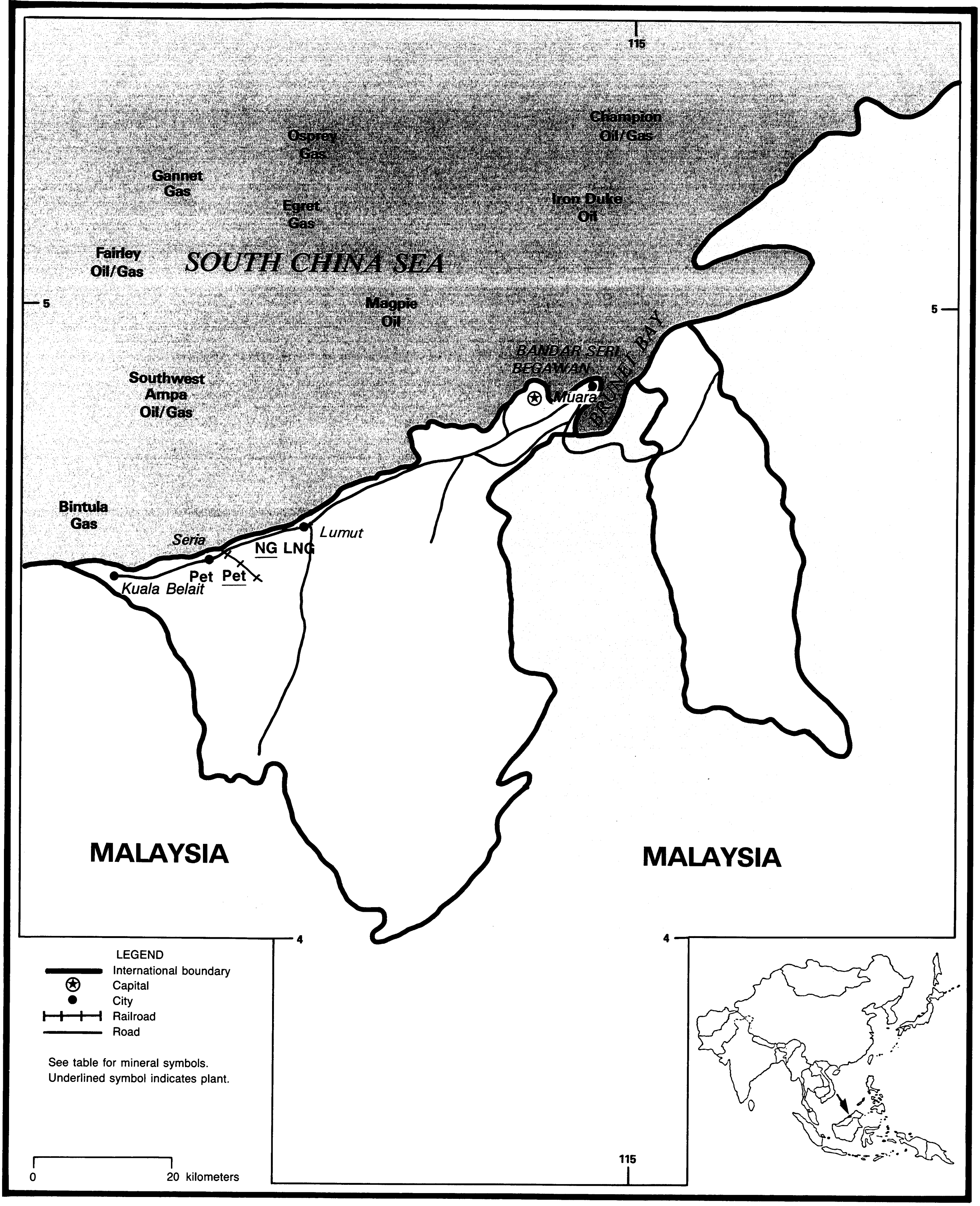
[1] The World Factbook 1989. Central Intelligence Agency, May 1989, p. 34.

OTHER SOURCES OF INFORMATION

Ministry of Trade, Industry, and Forests
Thimpu, Bhutan

BRUNEI

AREA 5,770 km² **POPULATION 345,000**



THE MINERAL INDUSTRY OF

BRUNEI

By David B. Doan

The State of Brunei Darussalem is a one-industry country (petroleum) in a world that places great value on hydrocarbon mineral fuels as a source of energy. Having probably the most mineral-dominated economy of any Asian country, Brunei was politically stable and made use of its export earnings by social programs that included the provision of health services and free primary and secondary education to its citizens. It afforded a variety of subsidies for services, soft loans for purchase of consumer goods, and had no personal income tax. Worldwide fluctuations in crude and natural gas prices have been accomodated without serious disruption to the economy of Brunei. On a per capita basis, the gross domestic product (GDP) approached \$15,000,[1] in striking contrast to most of Asia. However, with a population of 345,000 growing at 8% per year, it would seem unlikely that this per capita GDP based on petroleum alone could match the projected increase in the number of people after several decades. Over a period of years, Brunei has invested in a variety of overseas assets and now can count on them as an alternative, or at least as a supplementary, source of revenue. Realizing its dependence on petroleum, the Government began positive steps to diversify the country's industry, occupations, and sources of income. The new Ministry of Industry and Primary Resources will work on the development of pioneer industries in cement, pharmaceuticals, ceramics, aluminum, chemicals, and steel, in that approximate order. Ultimately, the Government hopes to establish a manufacturing sector possessing high technology.

GOVERNMENT POLICIES AND PROGRAMS

The Brunei Government instituted a policy of conserving its petroleum resources by bringing its previously much-higher production rates down to little more than one-half of their peak values 10 years in the past. The Government's Brunei Petroleum Unit, established in

TABLE 1

BRUNEI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989[p]
Gas, natural:						
Gross[e]	million cubic meters	9,351	9,068	9,209	9,153	9,068
Marketed	do.	8,718	8,064	8,501	8,444	8,337
Natural gas liquids:[e]						
Condensate	thousand 42-gallon barrels	5,500	5,400	5,500	5,460	5,400
Natural gasoline	do.	300	290	300	295	290
Liquefied petroleum gas	do.	110	100	100	95	100
Total	do.	5,910	5,790	5,900	5,850	5,790
Petroleum:						
Crude	do.	54,300	59,860	50,808	50,480	51,830
Refinery products:[e]						
Gasoline	do.	[3]600	600	650	625	650
Distillate fuel oil	do.	[3]400	400	450	432	450
Residual fuel oil	do.	[3]8	10	10	9	10
Other including refinery fuel and losses	do.	[3]300	300	350	336	355
Total	do.	1,308	1,310	1,460	1,400	1,465

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Aug. 1, 1990.
[2] In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.
[3] Reported figure.

1982 for monitoring domestic operations as well as international developments, kept track of local production levels and changes in world pricing structure to ensure that Brunei conformed to industry norms. This included the management of production in support of quotas established by the Organization of Petroleum Exporting Countries (OPEC), although Brunei is not a member. Moreover, the Government's aim was to foster the discovery of new reserves at only the same rate that existing reserves were consumed by production.

In mid-1989, the Sultan's annual birthday speech to his people made specific reference to the need for cutting waste in Government departments and reducing budgetary allocations for 1990.

PRODUCTION

The output of crude oil and natural gas seemed clearly to be controlled so as to fluctuate only within a relatively narrow range, probably not exceeding plus or minus 3%, as demonstrated during the past few years. Brunei enjoyed the advantage, if not the luxury, of having enough energy for its domestic needs and no urgent requirement for more, unlike many countries in Asia. Assuming an average price of $15 per barrel, the value of 1989 crude production would be not less than $775 million and significantly more if Brunei took advantage of any of the world price increases to the $20 level.

The total value of natural gas extracted and marketed in 1989, assuming the industry-common thermal equivalent of 1,000 British thermal units per cubic foot and an average price of $3.85 per million British thermal units, would equal $1.13 billion. While price fluctuations and sales agreements were necessarily privileged information, there can be little doubt that Brunei was financially well positioned in the world petroleum industry.

TRADE

Brunei had traditionally maintained a trade surplus, although yearly revenues have declined along with lowered production rates and softness in world petroleum prices. Export earnings in 1989 probably were in the range between $1.5 billion and $2.0 billion, with Japan a principal buyer, followed by Singapore, the Republic of Korea, and Thailand.

The principal import categories normally were manufactured goods, food, machinery and transport equipment, and chemical products, primarily from the United Kingdom, Malaysia, and Singapore, in order of value.

STRUCTURE OF THE MINERAL INDUSTRY

Other than for locally consumed construction materials, Brunei's mineral industry consisted exclusively of petroleum and natural gas production. Brunei Shell Petroleum Co. Sendirian Berhad (BSP) was the principal operator and main producer, although Elf Aquitaine Offshore BV Asia, a subsidiary of Elf Aquitaine S.A. of France, became active as a producer. Three additional companies, Sunray Oil Co. and Woods Petroleum Co. of the United States and Jasra Jackson (a joint venture of locally owned Jasra Pte. Ltd. and the Jackson Petroleum Co. of the United States) held petroleum concessions both onshore and offshore Brunei. Jasra was allied with Elf Aquitaine in an entity called Elf-Jasra, and it was not clear whether Jackson Petroleum Co. was still involved.

COMMODITY REVIEW

Mineral Fuels

Petroleum Crude.—Although production had been decreasing continually from the peak production of 1979, which saw production of 95 million barrels, 1989 estimated production of approximately 51.8 million barrels was up slightly compared with the previous year's estimated 50.5 million barrels. In general, the Government has adopted a posture of stretching production into future years.

Natural Gas.—Down slightly from the previous year, production of marketed natural gas was 8.337 billion cubic meters (m^3) in 1989 versus 8.444 billion m^3 in 1988. Total production was thought to be approximately 9.069 billion m^3, but reliable data on flaring and other losses were not readily available, nor was information on the proportion of associated condensate, so total production must remain only an estimate. About 72.542 billion m^3 of natural gas was thought to have been liquefied for export in 1988, and probably slightly more in 1989.

Reserves

The Brunei Petroleum Unit, which oversaw exploration and development within the country and its offshore jurisdiction, estimated in 1989 that the country's reserves included about 1.6 billion barrels of crude and 340 billion m^3 of natural gas. The country had untested prospects that will be drilled in good time, but the Government showed little concern as to increasing its reserve values. Observers expected that current production rates could be sustained for at least 25 years.

INFRASTRUCTURE

Brunei had 370 kilometers (km) of paved roads plus another 52 km under construction, 800 km of loose-surface or unimproved roads, and a 13-km narrow-gauge railroad that was privately owned. About 209 km of inland waterways was suitable for boats drawing less than 1.2 meters. Though shallow by world standards, these waterways were a major factor in both freight and passenger transport. The country had two airports, one with paved runways more than 3,959 meter long, the other with natural-surface runways between 1,220 and 2,439 meter long. Principal seaports were at Kuala Belait and Muara. Brunei was served by three pipelines, one for crude oil (135 km), another for natural gas (920 km), and the third for refined petroleum products (418 km).

OUTLOOK

Brunei gives every sign of managing its resources and its economy in such a way as to be of solid benefit to its people, now and in the future. With the growth of its petroleum industry and the ensuing domestic prosperity, the population has drifted away from agricultural activity to the point that nearly 80% of its food is imported. The Government is promoting a return to total self-sufficiency in food production that should eventually succeed as modern techniques of cultivation and husbandry are introduced. Very few countries are positioned economically as favorably as Brunei.

[1]Where necessary, the Brunei dollar (B$) has been converted into U.S. dollars at the rate B$1.97 = US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

Brunei Petroleum Unit
State Secretariat
Bandar Seri Begawan, Brunei

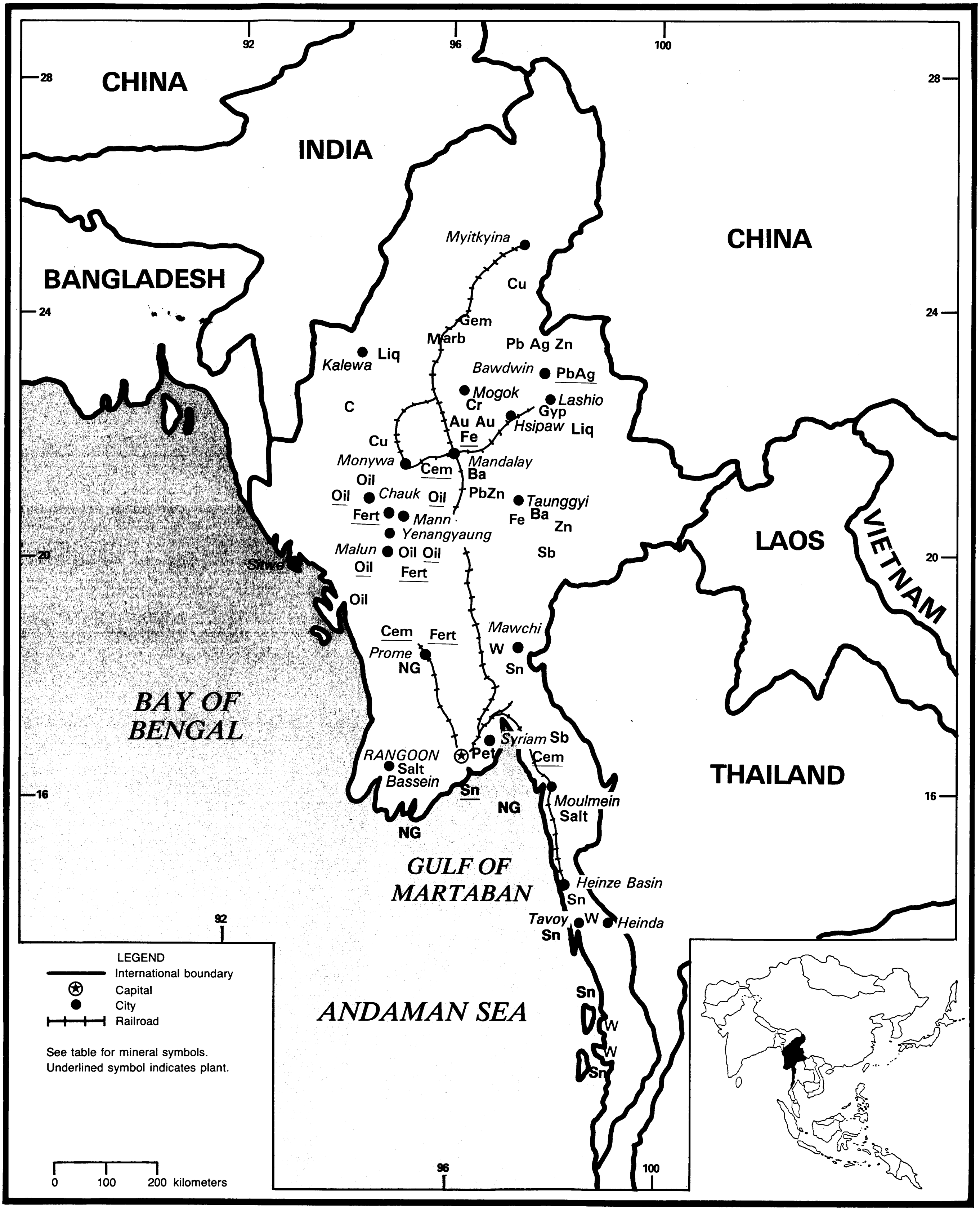
American Embassy
P.O. Box 2991
Bandar Seri Begawan, Brunei

Publication

Annual Report on Brunei's Petroleum Industry.

BURMA

AREA 678,600 km² **POPULATION 40 million**



THE MINERAL INDUSTRY OF

BURMA

By David B. Doan

Amidst growing political and social turmoil in many parts of the country, Burma's various mineral industries shrank, weakened or, in some cases, even disappeared as investment capital, technical expertise, equipment replacement, and labor availability all became increasingly scarce.

After years of self-imposed isolation from the mainstream of international investment, development, and trade, Burma's centrally planned economy unraveled to the point of crisis in 1987 when the Government repudiated and demonetized all banknotes over 15 kyat, nominally about $2.34. The real or black-market rate was about $0.30 to $0.35, however, and the citizens of Burma found their savings destroyed.

This was the final event in General Ne Win's "Burmese Way To Socialism," begun in 1962, which turned a comparatively rich nation into one of the world's poorest. Amidst intense civil unrest and brutal suppression of demonstrations, Ne Win stepped down in July 1988. By September of that year, after chaos and bloodshed, General Saw Maung emerged as the leader of a military junta that established itself as the Government of Burma.

With an economy in shambles, a 30% inflation rate, a foreign debt of $5.3 billion, and a debt-service ratio of nearly 100%, the various ethnic areas such as the Shan State[1] of eastern Burma and the Kachin State of northern Burma took issue with the junta's attempts to govern and began to behave independently. Karen rebels, for example, announced the prohibition of mining or logging by the Government in Rangoon or its contractors in Karen territory. A provisional alliance of several ethnic and territorial groups has joined forces, such as they are, to resist the Rangoon junta.

Meanwhile the Government, after announcing that democratic elections were to be held in May 1990, had not only detained and imprisoned prominent opposition leaders and supporters, but so proscribed the conditions of the election as to probably throw the results into limbo.

The single factor for potential redemption of the country was finally invoked by the junta in 1989, more or less as a last-ditch attempt to retain power by abruptly abandoning its isolationist policies. With little or no idea as to how business actually works, the leaders of the junta were reported as believing Burma to be rich on the basis of its natural resources. This belief was without regard to the fact that in the ground such resources produce no wealth, no capital flow, and no prosperity.[2]

GOVERNMENT POLICIES AND PROGRAMS

In the light of the conspicuous failure of previous isolationist and statist policies, the Government decided to invite foreign capital, technology, and expertise to come to Burma and develop its mineral resources, both onshore and offshore. The new foreign-investment law is worded to permit enterprises with between 35% and 100% foreign ownership, income-tax holidays of at least 3 years, accelerated depreciation, relief from customs duties and other internal taxes, credit foreign-country research and development expenses, and the repatriation of profits in hard currency.

As a practical matter, foreign investments were to be approved by the new Burmese Foreign Investment Commission, which was given wide latitude in arbitrating questions and disputes and extending discretionary benefits. Many operational, technical, and legal details were not yet addressed by the new law, but it was a major step in the direction of a market economy and a business environment that the other nations of the world could understand.[3]

PRODUCTION

Over the longer term, Burma's production of mineral commodities has declined to a point at which, in 1988, it was believed to have reached between 10% and 20% of pre-World War II output. In spite of adequate mineral reserves and plentiful labor, the problem involved overall deterioration of the country's infrastructure and facilities required to mine, process, refine, and transport mineral products. Lack of up-to-date technology, a shortage of fuels, and an increasing problem of foreign exchange have progressively crippled Burma's mineral industry. A point was reached at which it was likely that final collapse could be avoided only by abandoning its characteristic xenophobia and opening the country to foreign capital, technology, and exploration in the form of joint venturing with selected non-Burmese companies or other entities.

TRADE

Notwithstanding the fact that trade data concerning Burma have traditionally been elusive, they are virtually nonexistent for mineral commodities in 1989. For years Burma exported crude oil and varying quantities of refinery products. In 1988, with crude production at less than one-half of internal demand, no petroleum or refinery products were sold outside the country. Normally Burma has been a significant

TABLE 1

BURMA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1985	1986	1987	1988[p]	1989[e]
METALS					
Chromium: Chromite, gross weight	—	—	1,000	5,000	5,000
Copper:					
Mine output, Cu content	16,700	11,368	17,312	13,808	5,000
Matte, gross weight	173	144	234	[e]200	100
Iron and steel: Pig iron	—	2,669	—	—	—
Lead:					
Mine output, Pb content	21,935	18,156	27,132	16,728	12,000
Metal:					
Refined	9,585	5,359	3,985	4,402	3,500
Antimonial lead (18% to 20% Sb)	[e]300	299	305	153	100
Nickel:					
Mine output, Ni content[e]	20	20	20	26	25
Speiss, gross weight	[r]54	[r]47	50	104	100
Silver, mine output kilograms	17,667	16,392	26,096	9,207	7,500
Tin, mine output, Sn content:					
Of tin concentrate	622	600	256	102	80
Of tin-tungsten concentrate	1,129	895	683	427	320
Total	1,751	1,495	939	529	400
Metal: Refined	388	322	649	300	300
Tungsten, mine output, W content:					
Of tungsten concentrate	171	102	25	14	10
Of tin-tungsten concentrate	774	613	468	293	200
Total	945	715	493	307	300
Zinc, mine output, Zn content	4,353	4,643	2,561	2,743	2,000
INDUSTRIAL MINERALS					
Barite[3]	8,100	8,149	17,273	13,000	20,000
Cement, hydraulic	477,000	433,811	389,605	348,981	300,000
Clays:[3]					
Ball clay	110	496	203	203	150
Bentonite	710	851	406	508	400
Fire clay[4]	1,370	2,040	1,422	2,845	1,500
Industrial white clay	610	203	610	610	500
Feldspar[3]	2,446	2,861	1,916	2,626	2,500
Graphite[3]	234	722	—	—	—
Gypsum[3]	38,594	38,889	23,135	31,675	32,000
Nitrogen: N content of ammonia[5]	125,795	133,130	117,501	112,178	120,000
Precious and semiprecious stones: Jadeite[3] kilograms	43,145	12,804	13,529	[e]12,000	12,000
Salt[6] thousand tons	320	321	341	249	250
Stone:[3]					
Dolomite	2,383	5,253	5,952	4,403	4,000
Limestone, crushed and broken thousand tons	1,541	1,329	1,411	785	500
Talc and related materials: Soapstone[3]	128	56	22	25	20
MINERAL FUELS AND RELATED MATERIALS					
Coal, lignite	43,000	43,848	45,700	32,514	35,000

See footnotes at end of table.

TABLE 1—Continued

BURMA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Gas, natural:						
Gross[e]	million cubic meters	963	1,133	[7]1,190	[r]907	1,034
Marketed[3]	do.	934	1,085	[e]1,133	[e]873	995
Petroleum:						
Crude (gross wellhead)[3]	thousand 42-gallon barrels	10,253	10,103	6,351	4,612	4,300
Refinery products[e] [3]	do.	8,000	7,500	5,800	[7]4,305	5,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through May 3, 1990.
[2]In addition to the commodities listed, pottery clay, common sand, glass sand, other varieties of crude construction stone, and other varieties of gem stones are produced, but available information is inadequate to make reliable estimates of output levels.
[3]Data are for fiscal years beginning Apr. 1 of that stated.
[4]Includes fireclay powder.
[5]Computed at 46% of reported fertilizer production.
[6]Brine salt production (in metric tons) as reported by the Burmese Government was as follows: 1985—44,508; 1986—52,084; 1987—63,700; 1988—66,460; and 1989—65,000 (estimated).
[7]Reported figure.

producer and exporter of gem stones, tin, and tungsten, but it is probable that in 1989 most of the traffic in gem stones and jade was by smuggling them out of the country and, thus, without benefit to the Government. By this means, insurgent groups have raised capital to finance weapons and operations against the central Government. Tin, likewise, was believed to have been smuggled into Thailand and other neighboring countries. Otherwise, it is known from Japanese sources that the latter country was able to import 10,477 tons of chromite, worth approximately $1.99 million, from Burma during the year.

Critically short of foreign-exchange credits, Burma exported what it could, but its trade situation had declined from previous years. In 1988, the total value of mineral commodities exported was estimated at about $20 million. In 1989, this value was believed to have been significantly less.[4]

STRUCTURE OF THE MINERAL INDUSTRY

The Government controls all mineral exploration, extraction, regulation, and planning through the Ministry of Mines, which includes six enterprises and two departments, all headquartered in Rangoon. Specifically, as listed by the Government, they are Mining Enterprise No. 1 (ME1)—lead, zinc, silver, copper; Mining Enterprise No. 2 (ME2)—tin, tungsten, gold; Mining Enterprise No. 3 (ME3)—iron, steel, coal, nickel, industrial minerals; Myanma Gems Enterprise—precious and semiprecious gem stones, jade; Myanma Salt and Marine Enterprise—salt, potash; Myanma Pearl Enterprise—pearls; Department of Geological Survey & Exploration (DGSE); and Department of Planning & Inspectorate—planning, mine survey, licensing.

Each of the various enterprises is responsible for the development of its respective minerals throughout Burma. Each receives a yearly operating budget from the central Government, and all revenues from production revert to the latter. Individual enterprises have some latitude in administration of their own operations, but the central Government sets policy and authorizes major decisions such as the approval of foreign participation and joint-venture partners.

COMMODITY REVIEW

Metals

Antimony.—Although Burma has several significant deposits of antimony, the largest mine is controlled by insurgents in the Thabyu locality south of Moulmein. All production was diverted to Thailand, and production data were not available. The existing (1988) Government had built a small antimony concentrating plant at Kalaw, near Taunggyi, for treating ore received from various small-scale workings in the general area. Ore grade in these deposits runs about 20% to 25% antimony sulfide, Sb_2S_3.[5]

Chromite.—During exploration for nickel, a foreign (West German) team discovered a small chromite deposit at Dagaung, just north of Mogok.[6] Production was roughly 6,000 tons in 1988 and was expected to continue at that volume for the ensuing 2 years, at least. Grading 48% Cr_2O_3 with a chromium-iron ratio of 1:3 and sized between 1 and 6 inches, the entire output was exported to Japan.

Copper.—Burma's only copper mine and concentration plant, built with Yugoslavian assistance in the Monywa District in the 1980's, has continually produced at a rate significantly below capacity. It was intended to process 8,000 tons per day of ore to yield 200 tons per day of concentrates, equal to 2.4 million tons per year of ore and 60,000 metric tons per year (mt/yr) of concentrates. Actual production for the 3-year period from 1985 to 1986 through 1987-88 approximated 1.42 million tons per year of ore to yield about

TABLE 2

BURMA: STRUCTURE OF THE MINERAL INDUSTRY

(Thousand metric tons per year unless otherwise specified)

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity
Cement	Ceramic Industries Corp. China Hsin Cement Corp. (Government, 100%)	Kyangin, southern outskirts of Mandalay	240.
Do.	do.	Pa-an, 160 kilometers east of Rangoon (under repair)	240.
Do.	do.	Thayetmyo, 300 kilometers north-northeast of Rangoon on Irrawaddy River	200.
Copper, in concentrate	Mining Enterprise No. 1 (Government, 100%)	Monywa	12.
Fertilizer, N content	Petrochemical Industries Corp. (Government, 100%)	Kyaw Zwa, 230 kilometers north-northwest of Rangoon	91.
Do.	do.	Pagan, south of Yenangyuang	31.
Do.	do.	Sale, 190 kilometers southwest of Mandalay	31.
Iron and steel	Mining Enterprise No. 3 (Government, 100%)	Anisakan, 15 kilometers from Maymyo, 45 kilometers east of Mandalay	40.
Lead, silver, and zinc ore	Mining Enterprise No. 1 (Government, 100%)	Bawdwin	390.
Lead and silver metal	do.	do.	10 lead.
Do.	do.	do.	121,775[e] [1] silver.
Petroleum, refined	Petrochemical Industries Corp. (Government, 100%)	Mann	225,000.[2]
Do.	do.	Syriam, across river east of Rangoon	226,000.[2]
Tin	Mining Enterprise No. 2 (Government, 100%)	Heinda	1 concentrate.
Do.	do.	Syriam, across river east of Rangoon	1 metal.
Tin and tungsten concentrate	do.	Heinze Basin	0.6 tin.
Do.	do.	Tavoy	1 tin.
Do.	do.	Tenasserin Division coastline (5 mines under development)	0.9 tin.
Do.	do.	Heinze Basin	NA (tungsten).
Do.	do.	Tavoy	1 tungsten.
Do.	do.	Tenasserin Division coastline (5 mines under development)	NA (tungsten).
Tungsten and tin concentrate	do.	Mawchi	0.2 tungsten.
Do.	do.	do.	NA (tin).

[e] Estimated. NA Not available.
[1] Kilograms.
[2] Barrels per day.

40,000 mt/yr of copper concentrates. Preliminary information for the year 1988-89 shows that although ore production increased to 1.75 million metric tons (MMmt), the resulting concentrates decreased to about 24,700 tons. It was not known if the ore quality diminished, problems developed in the concentration process, or whether lack of availability of skilled labor played a role. Normally the concentrate specifications were as follows: copper 19% to 22%, sulfur 40.6%, iron 32%, water 6% to 8%, silver 23.4 grams per dry metric ton, and gold 0.9 to 2.2 grams per dry metric ton. Reserves at Monywa were projected at 130 MMmt grading 0.75% to 0.78% copper.

About 5 kilometers (km) from the Monywa Mine a second reserve, estimated at 160 MMmt grading 0.66% copper, was identified at Letpadaung, 80 km west of Mandalay. In return for rights to handle and export the entire production of the Monywa and Letpadaung deposits, the Republic of Korea trading company, Daewoo, agreed to furnish $20 million in mining, support, and processing equipment. Support was to include training in a mining, exploration, and technical assistance program aimed at improving the quality and volume of Monywa concentrates as well as the development of the Letpadaung site. The district is supported by a main rail line to Mandalay and Rangoon.[7]

Gold.—Although widely distributed deposits of gold, mostly placer, have been known in Burma virtually throughout historical times, exploitation has taken the form of small operations mainly stimulated by the need for gold leaf in temples or pagodas as distinguished from monetization requirements. In the past few years, official interest has grown to a point at which efforts were planned and undertaken for systematic development, particularly of "hard-rock" or lode deposits requiring organized exploration and extraction. With an eye toward gold exports and foreign-exchange credits, the Government initiated four separate projects aimed at major production. After a feasibility study assisted by Australia, development was begun of the Kyaukpahtoe gold mine in Sagaing Division with technical help from Yugoslavia. With a projected startup of actual extraction in March 1990, the Government aimed at production of 2 mt/yr year of gold from Kyaukpahtoe alone.

Three other gold pilot projects were offered to foreign coventurers. Two involved lode mineralization at Phayaung Taung deposit in Patheingyi Township, about 35 km north-northeast of Mandalay, and Thayet Khone deposit in Pyinmana Township, about 40 km northwest of Mandalay. Elsewhere, in Pegu Division at Shwegyin (location uncertain but thought to be less than 160 km north-northwest of Rangoon), a placer prospect was offered. Several foreign companies expressed interest in joint-venture or production-sharing arrangements. Many other prospects, perhaps as many as 300, were known along a geological zone trending northward through Sagaing Division into North Burma. Although only a few prospects were being worked, the Government had 2,000 technical personnel involved in gold exploration. Gold production in 1988-89 was reported at 124 kilograms, up sixfold over that of the previous year and presumed to be headed even higher.[8]

Iron and Steel.—The lack of coking coal had discouraged smelting of ore from Burma's extensive iron deposits until 1981, when direct-reduced iron (DRI) was invoked and a 20,000-mt/yr sponge-iron plant was constructed at Anisakan, a few km east of Mandalay. By 1983, the capacity was expanded to 40,000 mt/yr. The DRI furnaces produced sponge that was separated magnetically and then fed to two electric arc furnaces for production of either pig iron or steel. By continuous casting, the Anisakan plant could produce 30,000 mt/yr of steel billets for the Ywama rolling mill and 5,000 mt/yr of steel balls for grinding copper and lead-zinc ores. The Anisakan plant also had a 10-ton rolling mill capable of producing up to 12.5-millimeter reinforcing bars at 30,000-mt/yr capacity.

Since 1957, the Ywama mill, near Rangoon, processed World War II steel scrap. Having both melting and rolling facilities, Ywama switched to the consumption of imported steel billets when the supply of scrap ran out. In the early 1980's, Ywama began consuming domestic billets from the Anisakan works.

Total capacity for steel production was thus 30,000 mt/yr of billets and 15,000 mt/yr of scrap melting. Total rolling mill capacity was 80,000 mt/yr. Although Burmese officials claimed operations were at 80% of capacity, Government statistics showed only 10,000 tons of billets and 2,000 tons of grinding balls produced for the year 1988. Problems included transportation of coal and, increasingly, a lack of foreign exchange for purchase of the 15% (or so) of consumables required from outside the country. In that demand for steel was at least twice the current production, construction in general was severely hampered.[9]

Lead, Zinc, and Silver.—Before World War II, the lead-silver deposits of Bawdwin and adjacent Namtu, in the northern part of the Shan State, were considered the richest in the world. Together with less extensive zinc deposits, these ores have enabled an open pit mining operation at Bawdwin for the past 80 years. Nationalization from British interests in 1965 put everything in the hands of the Burmese.

A concentrator and lead smelter were built at nearby Namtu during the 1930's that in 1989 were not much changed from their original configuration. A concentrator of comparatively modern design was built at Bawdwin in 1981, but with no process-control equipment. The lack of such equipment has led to a variety of metallurgical problems in treating the highly oxidized ores. Australian Government help was forthcoming for the installation of in-stream analyzers and other equipment as a step toward increasing recovery rates. However, a plan by the Burmese Government to double the capacity of the concentrator would have required technical and financial support that was not available. A lack of spare parts has impaired Namtu and Bawdwin production to such a degree that it was reported to be 10% of pre-World War II output and about 60% of present capacity of 10,000 tons of concentrates per year. Although the Namtu and Bawdwin operations each employs about 3,000 workers, those that left were not being replaced so as to avoid layoffs. Despite the large work forces, high fuel costs, and rising costs of other local inputs to the overall mining and concentrating efforts, one Burmese official described the operation as not profitable but useful in creating foreign-exchange credits. Even the exports were essentially unprofitable, however, because of the overvalued Burmese exchange rate. A move toward increased open pit mining was invoked as a cost-reduction measure.

At the Namtu underground mine, the reserves were stipulated at 3.5 MMmt grading 7.5% lead, 3.5% zinc, and approximately 93 to 124 grams per metric ton (g/mt) of silver. The open pit mine at Bawdwin had an estimated 10 MMmt grading 5.1% lead, 4% zinc, and 93 g/mt of silver. Further reserves comprised roughly 2.6 MMmt of slag extracted since 1911 from the Bawdwin blast furnace and containing 17.2% zinc, 2.5% lead, and 591 g/mt of silver. Tailings dumped along a riverbank were estimated to contain 3% to 4% lead, 2% to 3% zinc, and 85 g/mt of silver.

The Government sought foreign participation in the recovery of these metals but, for reasons of health, rejected a German suggestion to use cyanide leaching. Other approaches were being entertained.[10]

Nickel.—Although Burma has been a very small producer of nickel, on the order of 100 mt/yr or less, two new deposits were discovered that may signal improvement provided the development capability could be organized, particularly in terms of capital. One of the newly found deposits was at Dagaungtaung, of uncertain location but probably 50 km or less north of Mogok, comprising 40 MMmt grading approximately 2% nickel in lateritic material. The other deposit was found near Kalewa with an estimated 80 MMmt grading 1.2% to 2% nickel combined with silicates. Although this second deposit was in a remote area, it was known that coal for power and limestone for flux to produce ferronickel occur in the vicinity. The Government asked the United Nations Development Program to study the feasibility of extraction and processing of the Kalewa deposit and sought foreign participation in project development.[11]

Tin.—Further to the Government's intention to seek interest from foreign entities in tin extraction, one Malaysian and three Thai companies met a deadline in September 1989 for consideration as production-sharing contractors to the State's ME2 to work tin deposits in certain offshore areas. Tentatively, the Government's contract called for a 3-month geological exploration program culminating in a technical report by the contractor with the decision as to whether to proceed to a 3-year development and production program. Tin concentrates recovered from any programs that were to go forward would be shared between the contractor (60%) and ME2 (40%) after deduction of a 10% royalty. During the life of the contract, the contractor would be exempt from most ordinary taxes and duties payable to Burma.

The ME2 managing director also indicated official interest in opening inland areas to tin mining by foreign companies through proposals by the latter rather than formal open bidding. Foreign investors would be required to have a Burmese partner, but variously structured joint ventures were open to negotiation.[12]

Industrial Minerals

Barite.—In spite of official statements that barite production amounted to 60,000 mt/yr at some time in the past, recent years have seen only a small proportion of that great an output. Generally ranging from 8,100 to about 17,300 mt/yr, such lowered production may reflect a decline in demand of barite for oil-drilling mud as well as social disruption in the country itself. In any case, 1989 production, at midyear, was thought to be at approximately the 20,000-mt/yr level from workings near Maymyo and Kyaukse, outside of the town of Mandalay, and Taunggyi, 150 km to the southeast, all in central Burma. The renewed interest in oil exploration in Burma might be expected to increase barite demand and, hence, production.

Cement and Gypsum.—Burma's three plants have a combined capacity of 4,000 tons per day of hydraulic cement. Gypsum requirements for these plants total at least 30,000 and as much as 40,000 mt/yr; production at midyear was thought to be at roughly the 32,000-mt/yr level, all of this from the mine at Hsipaw, 160 km northeast of Mandalay.[13]

Mineral Fuels

Lignite.—Coal deposits thus far discovered in Burma are of relatively low thermal value in the subbituminous or lignite category. In northwest Burma, the Kalewa Mine, including 1- to 3-meter (m) seams dipping steeply at 45°, was thought to include reserves of about 87 MMmt. This underground mine was producing at the rate of only 20,000 mt/yr with 500 workers, but in September of 1989 its operations were described as stagnant. Its noncoking coal had been used for power generation, tobacco drying, and for the Bawdwin lead-zinc smelter. The country's other mine is at Namma, 50 km south of Lashio, where its flat-lying seams are amenable to opencast mining. Production has been less than 40,000 mt/yr although utilizing 50 workers and mechanized equipment. Namma lignite is used in the Anisakan iron and steel plant, but reserves have dwindled to about 1.8 MMmt. Officials believe that exploration will locate other coals in the general area.[14]

Petroleum, Crude.—By early 1989, Burma's petroleum industry had nearly disintegrated after the collapse of agreements with the Japanese National Oil Co. to, among other projects, bring natural gas on-stream from the Bay of Bengal. The 1988 September Coup likewise discouraged pending agreements with China for exploration in the Irrawaddy Valley, discussions with Malaysia and Indonesia for other development programs, and both United Nations and Asian Development Bank projects for enhanced recovery in central Burma's Mann and Htaukshabin fields. After months of prodemocracy strikes and a lack of crude feedstock for operation, the Mann oil refinery was able to resume production. But with a domestic demand of 35,000 barrels per day of crude and production of probably less than 15,000 barrels per day, the country was far from satisfying its needs.[15]

Recognizing its position, the country abruptly departed from years of tradition and decided to negotiate with foreign companies interested in exploration onshore, an area previously denied to any but domestic and Government-operated programs. Nearly 40 foreign companies responded to Burma's announcement that rather than issue tenders it would entertain proposals for exploration drilling that specified location and amount of capital investment as well as suggested coventure agreements.[16]

By the end of the year, agreements had been signed by Myanma (Burma) Oil and Gas Enterprise (MOGE) with (1) Yu Kong Ltd. of the Republic of Korea to explore and produce petroleum in onshore block C in the Chindwin basin about 970 km north of Rangoon, (2) Dutch Shell Exploration BV for a joint venture in onshore block G (location not specified), (3) BHP of Australia in onshore block H (location not specified), (4) Amoco in onshore block B of the northern Chindwin basin, and (5) Britain's Clyde and Croft for onshore block 1 in the Irrawaddy Valley. Other signed agreements involved Japan's Idemitsu, Petro-Canada, and Unocal. Agreement was expected with Kirkland of Britain, thus totaling nine by December.[17] The chief source of exploration interest is a major crustal rift basin extending from the upper Chindwin River, in the Hukawng Valley of northern Burma, southward through west-central Burma past Mandalay to Moulmein at the beginning of the southern peninsula.

Evidently encouraged by the response to onshore concessions, MOGE then invited tenders for 37 offshore concession areas in October to discover that several companies were interested, particularly those already having rigs in the Gulf of Thailand. The offshore blocks virtually lined the entire coastline of Burma.[18]

Natural Gas.—Despite the 1988 decrease in natural gas production to roughly 87.7 million cubic feet per day, it was anticipated that 1989 production would rise to exceed 100 million cubic feet per day. Prome gasfield, about 225 km north-northwest of Rangoon, has been the principal producer in Burma, delivering approximately 22.8 million cubic feet per day.[19]

Reserves

Data on mineral reserves are from local sources at various times and are not uniformly current. Moreover, some reserves may increase manyfold in the next few years as exploration, assisted by foreign capital and expertise, concentrates on new target areas.

INFRASTRUCTURE

Burma's road network, comprising 3,200 km of hard-surface and 18,000 km of improved secondary roads, affords fair access to most of the country. In many areas, however, tracks or trails must be utilized for the final 10 to 60 km of travel to remote sites, as might be necessary for mineral exploration. The country has slightly more than 4,300 km of meter-gauge railroad providing access northward from Rangoon through Mandalay to Bawdwin, and also from Mandalay farther north to the Namponmao area, more than 1,000 km north of Rangoon. Not the least part of Burma's transportation system is the 3,200 km or so of inland waterways maintained for large commercial vessels. These navigable waters are utilized for moving petroleum crude to refineries and the resulting refinery products back into the hinterland. Some crude is moved by pipeline, but their present condition is not known.

TABLE 3

BURMA: ESTIMATED MAJOR MINERAL RESERVES

(Thousand metric tons unless otherwise noted)

Copper, in concentrate		20,000
Gem stones:[1] Jadeite	kilograms	NA
Lead, in ore		300
Lignite		30,000
Nickel, in ore		22,000
Petroleum, crude	thousand barrels	51,300
Petroleum, natural gas	million cubic meters	267,215
Silver, in ore	kilograms	750
Tin, in ore		20
Tungsten, in ore		NA
Zinc, in ore		500

NA Not available.

[1]Other gem stones include amethyst, aquamarine, citrine, peridot, ruby, sapphire, spinel, and zircon. Meaningful reserve figures are not available for these stones.

Major seaports are Rangoon; Bassein, more than 150 km west of Rangoon in the Irrawaddy Delta; and Sitwe, roughly 100 km south of the Bangladesh border. The principal air facilities are at Rangoon; Meiktila in Mandalay State, about 100 km south of the town of Mandalay; and at Namponmau, about 10 km southwest of Myitkyina.

Burma was negotiating with the World Bank for support of infrastructure rehabilitation and upgrading, including a high earth-filled dam, canals, and irrigation distribution systems. Significantly, the plans involved inland-waterway improvement, upgrading of locomotives and railway cars, improved maintenance of trucks and buses, and also water supply, sewerage, and road facilities in Rangoon and as many as 40 other towns. Projects were being reappraised in October 1989 by the Bank in view of the current country situation.[20]

OUTLOOK

Centrally planned economies do not work very well because the decision-making is concentrated in the hands of the few rather than allowed to be exercised by the many, the latter qualified by the fact that they will bet their own capital on the success of a venture. The Burmese Government has no previous experience and no record of accomplishment in dealing with foreign investors, which injects a factor of uncertainty into negotiations.

Foreign capital investment in mineral exploration and development entails major costs and long payback periods, requiring a stable and predictable economic and political environment. This situation has not yet been obtained in Burma, and there is the categorical question of how long any government will or can endure. Unrealistic exchange rates combined with an inconvertible currency do not attract even short-term projects. Arbitration procedures suitable to independent capital sources are yet to be promulgated.

Otherwise, the Burmese as a nation are poor, and the present Government is essentially "broke" to put it in colloquial terms. There are no domestic financial resources, let alone technology and expertise, to develop the resources with which this country has been endowed. The door that has been opened to the world cannot now be closed if Burma is to survive as a viable economy and as a nation. Problems undoubtedly remain, but the first and most important step has been taken. It is not straining the point to predict that this could be one of Asia's richest mineral economies, benefiting from petroleum, coal, base metals, and precious metals, if the means of development can be arranged on mutually agreeable terms.

[1]Burma is divided into mutually exclusive **States** (Shan, Kayah, Kachin, and Kawthule), **Districts** (Sagaing, Arakan, Magwe, Mandalay, Irriwaddy, Pegu, Tenasserim), and one other, the Chin Special District. States tend to be ethnically distinguished whereas districts are not recognizably so.

[2]White, H. E. The Junta Struggles to Lift Burma's Economy, The Asian Wall Street Journal, June 13, 1989, pp. 1 and 14.

[3]U.S. Embassy, Rangoon, Burma. State Dep. Telegram 01564, Mar. 20, 1989, p. 1.

[4]U.S. Embassy, Rangoon, Burma. State Dep. Telegram 05910, Oct. 24, 1989, p. 1.

[5]Page 8 of source cited in footnote 3.

[6]Source cited in footnote 4.

[7]Page 4 of source cited in footnote 3.

[8]Page 5 of source cited in footnote 3.

[9]Page 6 of source cited in footnote 3.

[10]Page 3 of source cited in footnote 3.

[11]Page 6 of source cited in footnote 3.

[12]U.S. Embassy, Rangoon, Burma. State Dep. Telegram 05732, Oct. 13, 1989, p. 1.

[13]Source cited in footnote 4.

[14]Source cited in footnote 8.

[15]Petroleum News. V. 19, No. 11 & 12, Jan./Feb. 1989, p. 22.

[16]The Wall Street Journal. June 20, 1989, p. A8.

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Agency

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Rangoon 1108, Burma

Publications

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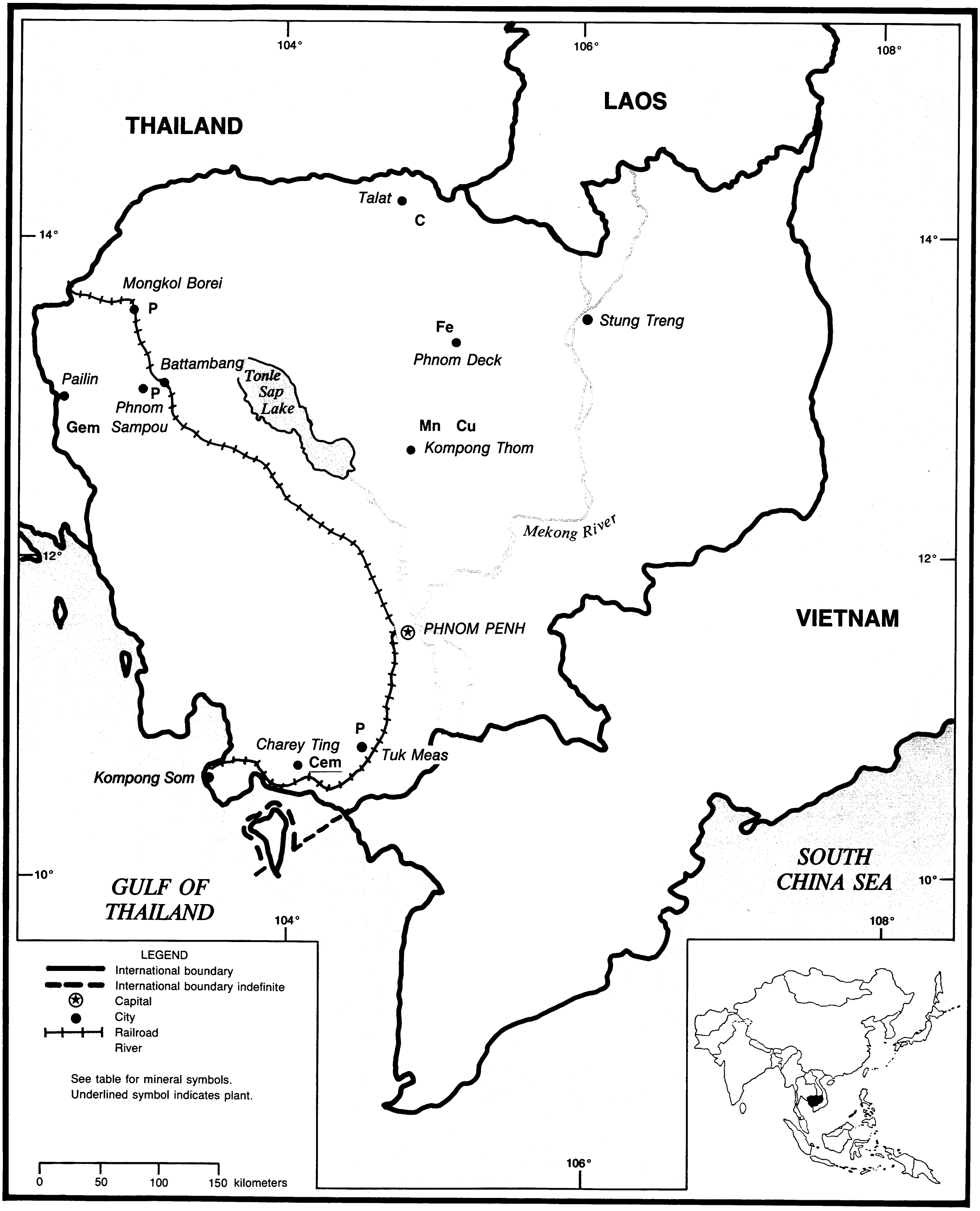
CAMBODIA

AREA 181,000 km² **POPULATION 6.8 million**



THE MINERAL INDUSTRY OF

CAMBODIA

By David B. Doan

Despite attempts by the Government, acting under the aegis of the State of Cambodia, to hold the country together, warfare increased and industrial mineral production was almost nil in 1989. The exception was for localized efforts to satisfy needs for construction materials, fertilizer, and salt.

After driving the Khmer Rouge across Cambodia's western border into Thailand, Vietnam's army forces withdrew from Cambodia in the early autumn of 1989. Following this, the Khmer Rouge reinvaded and dominated much of the northwestern part of the country by the end of the year. Other non-communist factions with their own military forces asserted a moral right to govern the country, but no one military force could overcome all of the other contenders.

The Government announced a 26% increase in 1989 industrial production versus that of 1988, which consisted primarily of textiles, consumer goods, and items of handicraft. Cambodia was critically short of energy for electric power, without which the development of basic industry appropriate to the country's needs was not within reach. The national infrastructure was inadequate and deteriorating. During the year the National Bank of Cambodia announced that 218 riels were equivalent to the U.S. $1.00, but it was not clear that the riel had much in the way of backing, nor that the exchange rate was valid.

GOVERNMENT POLICIES AND PROGRAMS

Attempts have been made to organize new geologic mapping and exploration for mineral resources in Cambodia, but military campaigns have continually interfered with resource mapping. Representatives of the U.S.S.R. agreed with Cambodian Government officials to a joint assessment of oil and gas reserves in the country as well as the compilation of a geological map of all of Cambodia. This in turn was to be used for further mineral exploration and eventually the commercial development of gem stones, gold, phosphate, and other mineral prospects. Ground warfare in various parts of the country undoubtedly has delayed or precluded any significant results of these agreements.

Geological conferences attended by Vietnamese, Lao, and Cambodian delegations have been held from year to year on a rotating basis between the three countries. Beyond expressions of friendship and solidarity, little of interest has been reported in terms of accomplishments.

PRODUCTION

Salt production has been estimated at 40,000 tons per year. Cement has been produced intermittently from one small plant having a capacity probably not exceeding a few tons per day. Brick clays, gravel, and stone for construction were produced ad hoc and taken up locally as needed. Phosphate rock was also believed to have been produced at a rate of a very few tons per day.

TRADE

No Cambodian mineral commodities were exported, with the possible exception of gem stones. What little production occurred was consumed locally. Imports included petroleum products and, from time to time, clinker for cement manufacture. Trade has been primarily with Vietnam and the U.S.S.R. and, not uncommonly, on a barter basis.

STRUCTURE OF THE MINERAL INDUSTRY

Cambodia's sporadically distributed and intermittently operating mineral industry had no structure in the strictest sense. Stone and gravel were extracted locally for building materials, especially for roads. Clays were used for making brick. Cement and treated phosphate rock were each produced in one locality in the country. Salt was produced in many places for domestic consumption. Only the mining of gem stones yielded a product that could be upgraded and either exported or sold domestically at a significant profit. However, in spite of weak Government attempts, no organization of the industry at the important district of Pailin has been possible in the midst of battles between the Khmer Rouge and contending forces. The Khmer Rouge contributed its own degree of organization by charging about $40 each to Thai, Lao, Burmese, and even Cambodians for 1 week's mining privileges and guide service through the minefields to the gem localities.[1]

COMMODITY REVIEW

Industrial Minerals

Cement.—One small plant of unknown capacity at Charey Ting, about 70 kilometers (km) southwest of Phnom Penh, was thought to produce cement intermittently during the cessation of military or terrorist activities that occurred from time to time. The quantity of production was not known, but all of it went to local consumption.

Clays.—Highly localized utilization of clays for brickmaking testified to an industry of sorts, but the quality of the clays and the clay articles produced were not known. The technology was simple and widely applied in many districts and provinces. There was probably no particular exchange of information on the type and the quality of the clay deposits, nor any on the techniques of mixing, shaping, and firing of the clay products.

Gem Stones.—Cambodia has gem-quality corundum mineralization in several parts of the country, ranging from Pailin near the western border with Thailand to the eastern border area north of Route 19 between Stung Treng in Cambodia and Pleiku in Vietnam. Rubies have been known, but true cornflower-blue sapphires of highest quality may have been the most valuable gem stone mined thus far in Cambodia. Unfortunately, no organized industry was established. Stones were mined haphazardly, as opportunities arose, by Cambodian civilians, soldiers from various contending forces, and some Thai, Lao, Burmese, and Vietnamese bootleggers and vagabonds.

Phosphate.—A low-technology phosphate plant at Tuk Meas, in Kampot Province, was essentially a grinding and roasting operation for locally dug phosphate rock. The treatment enhanced the solubility of the phosphate and made it suitable for application as fertilizer. It was at best only a very poor substitute for what the country needed: a capital-intensive and technologically sophisticated superphosphate plant.

Salt.—Little information was available on salt production; it was believed that the country produced at about the 40,000-ton-per-year level from a large number of small operations.

Reserves

During the past several years, there have been discussions with the U.S.S.R. concerning assistance in exploring for mineral deposits in Cambodia, but any progress in the negotiations was not known. Although Cambodia had at least some coal, copper, iron, and manganese deposits, their quality and quantity have not been determined. It was likely that the country also had deposits of gold, lead, and zinc to the east and northeast of Stung Treng, but many prospects reported years ago have never been evaluated.

INFRASTRUCTURE

Cambodia had 13,351 km of roads. Of this total, 2,622 km had bituminous pavement; 7,105 had crushed stone, gravel, or other loose surface; and 3,624 km had unimproved earth or dirt track. Roads in many places were in disrepair from both neglect and the results of fighting. The country also had a little more than 600 km of 1.000-meter gauge railroad, Government-owned, but of uncertain operating condition. Inland waterways included 282 km navigable to craft drawing 1.8 meters (m), and 3,700 km navigable to craft drawing 0.6 m. Principal ports were Kompong Som, on the coast of the Gulf of Thailand, and Phnom Penh, inland on the Mekong River.

The country had 25 airports, but only 12 of them in operating condition. Of these, seven had paved runways. Two of them had runways 2,440 to 3,659 m in length, and six of them had runways 1,220 to 2,439 m long.

Cambodia had electric-power generating capacity of 125 megawatts and produced power at the approximate level of 21 kilowatt hours per capita.

OUTLOOK

Cambodia is likely to remain one of the poorest countries in the world until peace and political stability are achieved. The immediate need for any modernization of the country will be mineral fuels and power generation, accompanied by improvement of the national infrastructure. Construction of roads, railroads, and a power grid would then support industrial development and domestic prosperity.

Cambodia is well situated to develop agricultural production and fisheries. The Southeast Asian peninsula is geologically well endowed with various minerals, and no reason exists why Cambodia should not benefit accordingly in the production of mineral commodities. Coal, petroleum, metals, and industrial minerals are all likely prospects and could help to make the country economically self-sufficient and even an exporter of mineral commodities.

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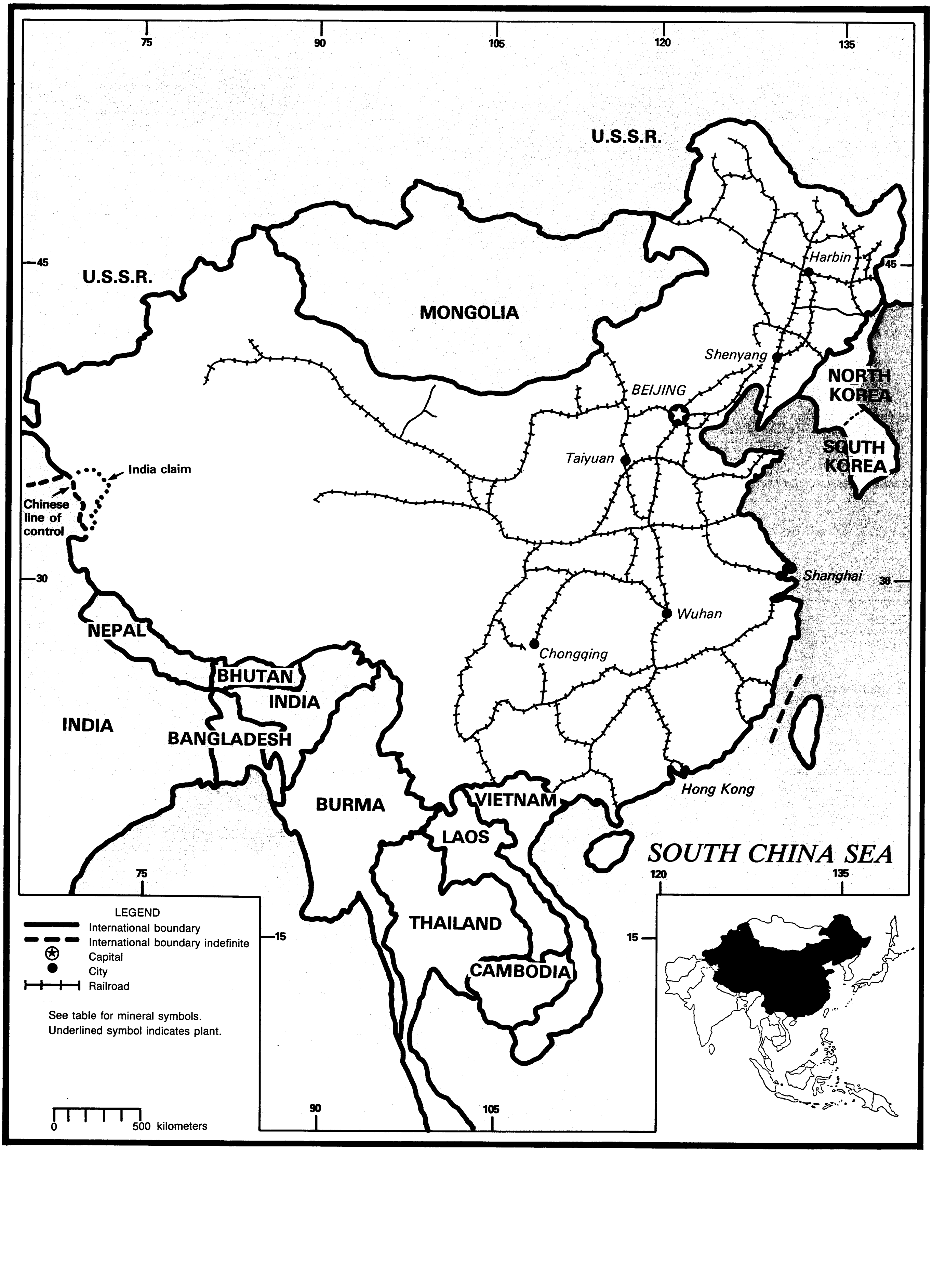
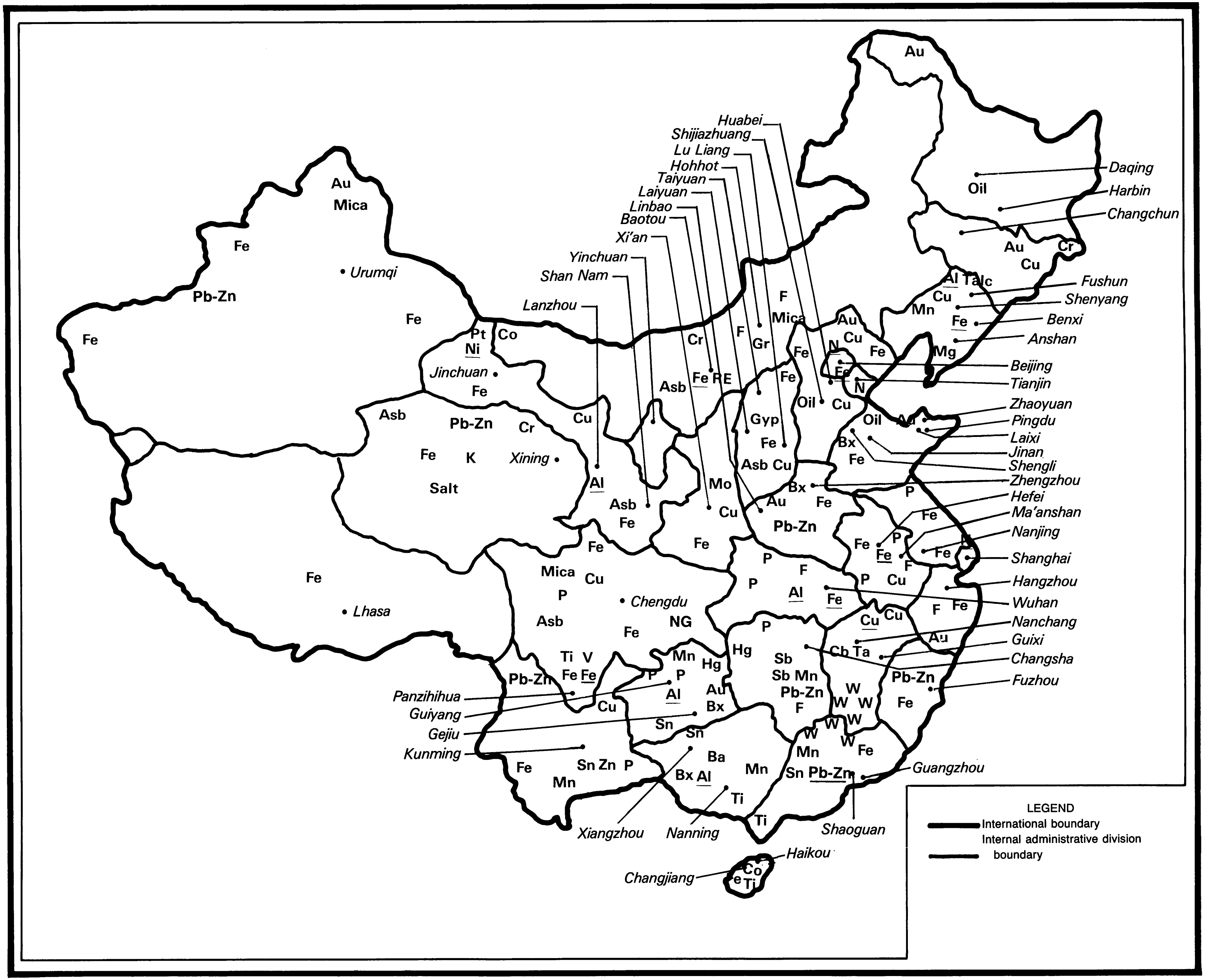
[1] Erlanger, S. The New York Times, Feb. 12, 1989, p. 25.

CHINA

AREA 9.6 million km² **POPULATION 1.1 billion**

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Shengli
Zhengzhou
Hefei
Ma'anshan
Nanjing
Shanghai
Hangzhou
Wuhan
Nanchang
Guixi
Changsha
Fuzhou
Guangzhou
Shaoguan
Haikou
Changjiang
Nanning
Xiangzhou
Kunming
Gejiu
Guiyang
Panzihihua
Chengdu
Lhasa
Xining
Jinchuan
Urumqi
Lanzhou
Shan Nam
Yinchuan
Xi'an
Baotou
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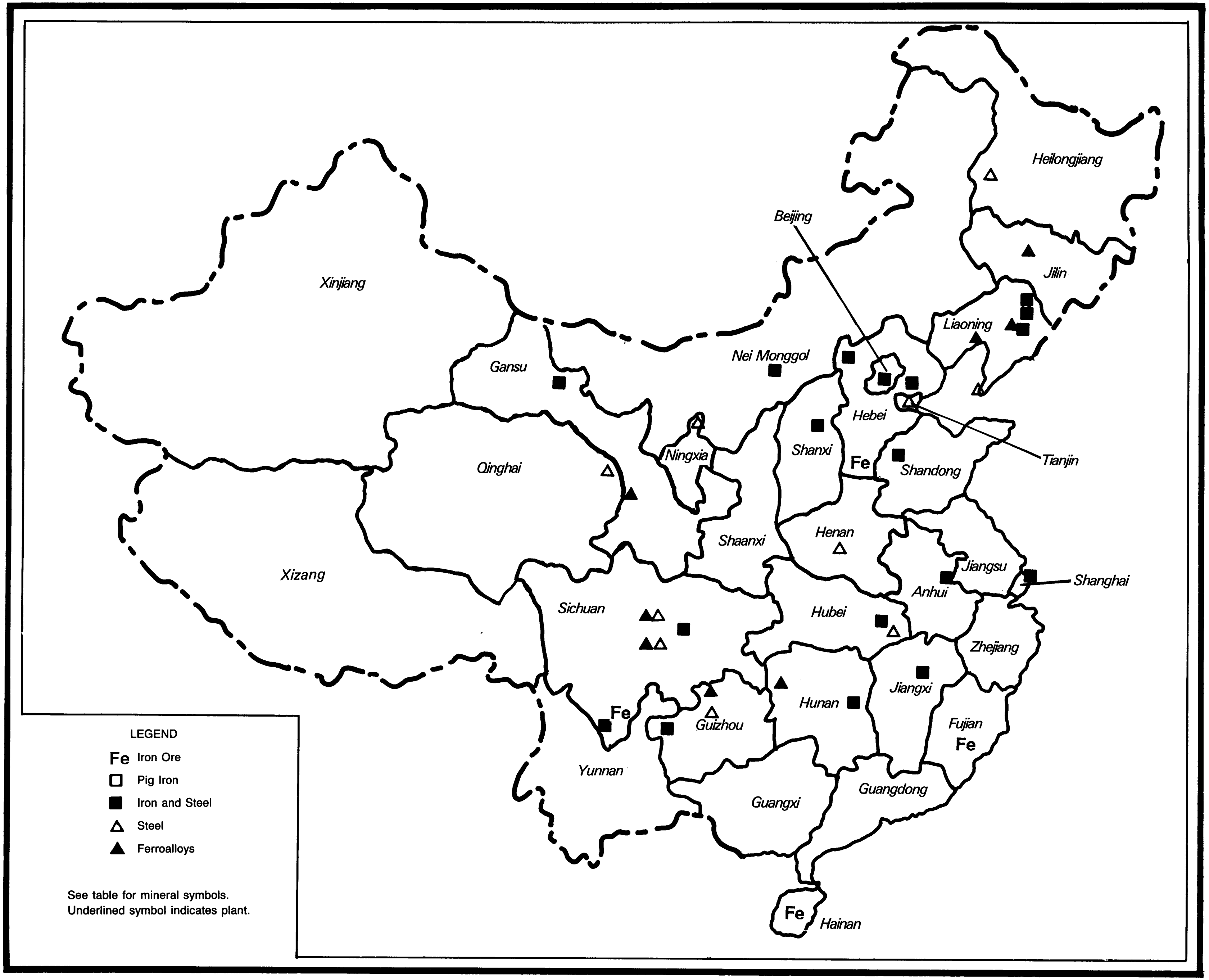
Laiyuan
Taiyuan
Hohhot
Lu Liang
Shijiazhuang
Huabei
LEGEND
International boundary
Internal administrative division boundary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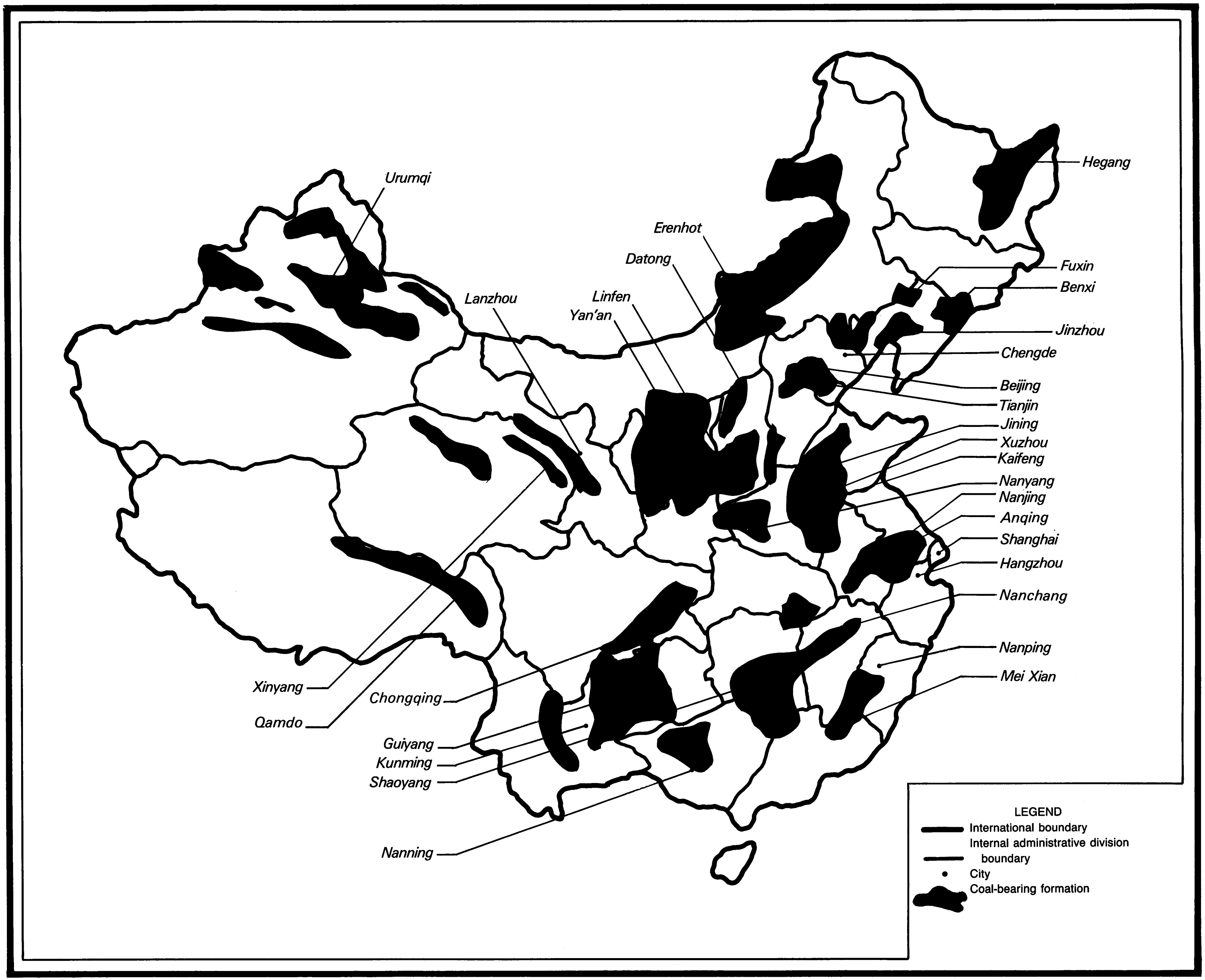
Anhui
Xizang
Sichuan
Hubei
Zhejiang
Hunan
Jiangxi
Guizhou
Fujian
Yunnan
Guangxi
Guangdong
Hainan
Fe
LEGEND
Fe Iron Ore
Pig Iron
Iron and Steel
Steel
Ferroalloys
See table for mineral symbols.
Underlined symbol indicates plant.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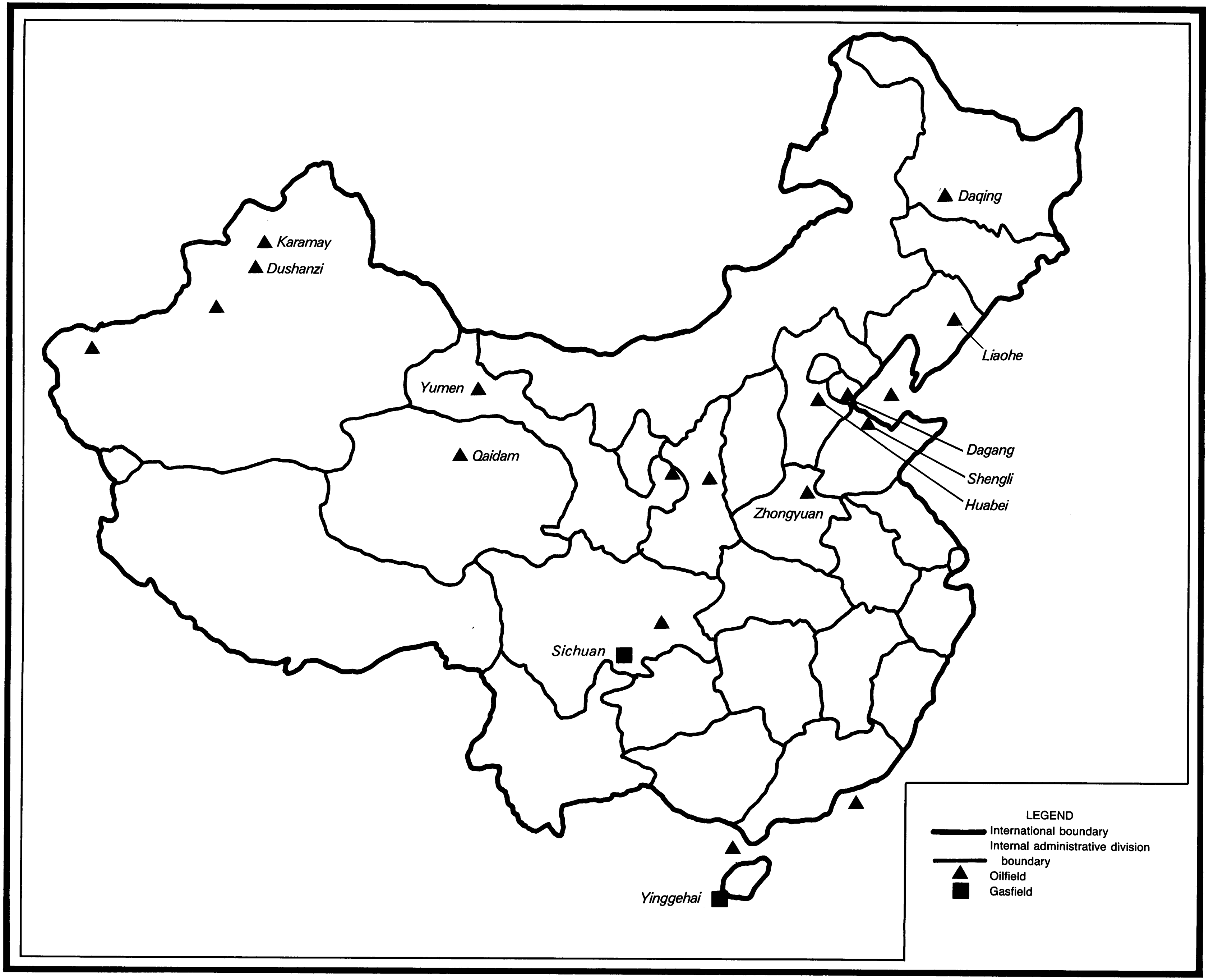
Jining
Xuzhou
Kaifeng
Nanyang
Nanjing
Anqing
Shanghai
Hangzhou
Nanchang
Nanping
Mei Xian
Xinyang
Qamdo
Chongqing
Guiyang
Kunming
Shaoyang
Nanning
LEGEND
International boundary
Internal administrative division boundary
City
Coal-bearing formation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Karamay
Dushanzi
Liaohe
Yumen
Qaidam
Dagang
Shengli
Huabei
Zhongyuan
Sichuan
Yinggehai
LEGEND
International boundary
Internal administrative division boundary
Oilfield
Gasfield

THE MINERAL INDUSTRY OF

CHINA

By Pui-Kwan Tse

Although 1989 began all but disastrously as the result of the Tiananmen prodemocracy demonstrations, the State Statistical Bureau reported that the national economy on the whole developed favorably. The gross national product increased by 39% and reached $424 billion in 1989, while the national income increased 3.7% to $351 billion. The output value of the agricultural sector increased 3.3% to $177 billion in 1989. The growth in agricultural products was 2.1%; forestry, 0.9%; animal husbandry, 5.5%; animal husbandry products, 5.8%; and fishery, 8%.

China is a major world producer and consumer of minerals, metals, and fuels. It is a prominent producer of antimony, barite, bauxite, cement, coal, fertilizers, fluorspar, iron and steel, magnesite, mercury, oil, rare earths, salt, and talc. However, because of large domestic demand, only a surfeit of a few commodities produced enter into world commerce, such as antimony, barite, refractory-grade bauxite, fluorspar, magnesite, talc, and tungsten. Although domestic output of coal and oil do not meet demand, China exports these fuels to gain much-needed foreign exchange. To supplement domestic production, China imports significant quantities of aluminum, chromium, cobalt, fertilizers, and iron and steel.

Tax payments to the Government on profits by state-owned enterprises were only $42 billion, a mere 0.2% increase over those of the previous year. There was an overall decrease in economic returns because of large inventories of some goods, reduced production, and generally poor management. The length of the turnover period for working funds increased from 97 days in 1988 to 108 days in 1989. Remittance to the state decreased from 21.99 yuan per 100 yuan of capital in 1988 to 19.41 yuan in 1989. Per capita labor productivity increased by only 1.6%. The cost of production rose generally, and quality control on some products was inconsistent.

The total investment in fixed assets reached $108 billion—$68 billion for state-owned enterprises; $14 billion for collectively owned enterprises; and $26 billion for private enterprises. In 1989, there were 123,000 state-owned capital construction projects, a decrease of 43,000 from these of 1988. Construction projects started in 1989 totaled 37,000 compared with 78,000 in 1988. Eighteen thousand projects that were under construction were suspended resulting in $18 billion savings in investment.

During 1989, appropriations for the state-owned energy industry totaled $17 billion; those for transportation, post, and telecommunications were $9 billion; cultural, education, and sanitation, $3 billion; construction, $41 billion; and appropriations for technical renovation and transformation, $21 billion.

While freight traffic increased, there was a downturn in passenger movement because of higher ticket prices. However, the efficiency and profits of the transport sector grew as reported by the State Statistical Bureau. The average daily cargo handling capacity of each locomotive increased 2.5% to 850,000 tons per kilometer, while the general haulage capacity of cargo locomotive increased 1.9%. Railway transportation profits increased 12.4%. Transport service by type of carrier in 1989 is shown in table 1, with growth rate in percent compared with 1988. The cargo volume handled at the major seaports increased 7.1% to 470 million tons in 1989.

The total value of retail sale of all commodities increased 8.9% to $218 billion—agricultural products, $27 billion, and consumer goods, $191 billion. The gains in retail sales by ownership were state-owned enterprises, 7.1%; cooperatives, 7.9%; joint ownership, 11.4%; and individual business operations, 12.1%.

The economy was affected by inflation, which resulted in an average annual increase of 17.8% in 1989. Retail prices rose by 27% in January and 27.9% in February, afterwards declining on a monthly basis to 6.4% in December. The highest average increase in prices in 1989 were for fuels, 27.4%; followed by grain, 21.3%; medicine and medical equipment, 21.2%; clothing, 18.1%; and foodstuffs, 16.2%. The cost of living in urban areas rose 16.3% in 1989 compared with the rate of increase of 20.7% in 1988.

Sales and shipments of domestically produced goods were generally depressed during the year because of higher prices. The average decrease for the year was 18.2%. Sales of rolled steel were 33.69

TABLE 1

CHINA: 1989 TRANSPORTATION FACTS

Carrier	1989	Growth rate (percentage)
Cargo (billion tons per kilometer):		
Railway	1,039.1	5.2
Highway	332.9	3.4
Waterway	115.1	10.7
Air	.7	-2.8
Pipeline (petroleum and gas)	65.4	.6
Passenger (billion persons per kilometer):		
Railway	303.7	-6.8
Highway	252.1	-.3
Waterway	19.0	-6.8
Air	18.0	-16.3

million tons, down 15.1%; coal, 250 million tons, down 7.6%; timber, 22.02 million cubic meters, down 25.8%; and cement, 30.86 million tons, down 11.4%.

In 1989, China's nontrade foreign exchange income was $3 billion more than its expenditure. Nontrade transactions in 1989 included construction projects and overseas labor and services valued at $1.38 billion. The value of new contracts concluded in 1989 for this category totaled $1.85 billion.

By census tabulation, China's pool of scientists and technicians was further expanded, albeit it was small relative to its resident population. By yearend, there were 22.18 million professionals, of which 10.46 million were in the field of natural science. There were 5,400 state-owned independent research and development institutions above the county level with 400,000 scientists and engineers. Persons engaged in scientific and technological activities in institutions of higher learning numbered 760,000, of which 650,000 were scientists and engineers. By yearend 1989, China's population was 1,111,910,000, an increase of 15,770,000 persons over that in 1989.

GOVERNMENT POLICIES AND PROGRAMS

The ownership of mineral rights is invested in the central Government. The operation of large mines and processing facilities is under the administration of various ministries and ministerial-level, Government-owned enterprises. Another tier is composed of provincial-level enterprises, which are operated independently but receive guidance and directives from the central Government. And yet another tier consists of locally run operations, which are usually small-scale mines in remote areas.

Under an open-door policy introduced early in the decade, China initially invited outside participation to introduce foreign technology and management for offshore oil exploration and development. Subsequently, this invitation was extended to include coal and onshore oil, as well as both the ferrous and nonferrous sectors, to spur rapid development of the minerals sector. Foreign participation in the form of joint ventures was to accelerate the development of the mining sector. This participation is largely directed to projects requiring considerable financing, as well as those for which China lacks modern, sophisticated technology. It was only in the very recent past that China considered the creation of quasi-Government private enterprises and Sino-foreign joint ventures. Therefore, there has been no uniform policy on external assistance because each venture is individually negotiated as to particulars and terms. Because of its need for minerals, China has itself turned to overseas ventures. Most notable of these is in joint participation with Australian firms for iron ore and aluminum production in Australia, with output to be exported to China.

During the decade of the 1980's, China promulgated legislation to attract foreign investment. These included laws on joint venture, taxation, and protection of intellectual property rights, i.e., copyrights and patents. The largest single joint venture was Occidental Petroleum Co.'s participation in the development of the Antaibao coal mine in Nei Monggol. Most of the remainder of foreign venture capital was for offshore oil drilling and development.

China continued its policy to invite foreign investment despite the Tiananmen incident in early 1989. New agreements on direct investment ratified with foreign businesses totaled $5.6 billion, an increase of 5.6%. During the year, actual receipts of foreign investment were up 4.1% valued at $3.3 billion.

In an attempt to restore market order to counter inflation, the state imposed new controls for speculation, profiteering, counterfeiting, and quality control. Sales of certain commodities such as chemical fertilizers, pesticides, and plastics for agricultural uses were placed under exclusive control by agencies and departments designated by the state.

The state continued the slow process of improving the domestic level of science and technology. In 1989, the Government established and/or revised 2,652 standards for various products and services. By the end of the year, there were 809 weather warning systems in place, 460 manned seismological stations, 21 telemetering seismological stations, and 814 marine monitoring stations. Government topographical agencies drew 23,731 charts and published 381 maps. The Government received 32,905 patent applications, of which 5,538 were foreign patent submissions. Patents approved during the year totaled 17,129. Technology contracts signed in 1989 totaled 262,000 involving an overall business transaction valued at $2.2 billion.

A 12-year program launched by eight Government bodies and approved by the State Planning Commission was named and undertaken as the "Operation Hunt for Treasures, 1989–2000." This project is a joint effort by the Ministry of Metallurgical Industry, China National Nonferrous Metals Industry Corp., Ministry of Geology and Mineral Resources, and five other agencies. According to Government planners, the present verified minerals reserves in China is insufficient to sustain the country's economic development at the turn of the century. Hopefully, extensive geologic reconnaissance would uncover new finds equivalent to the present-day reserves for oil; about 6 times that of natural gas; one-tenth to one-eight that of coal; from 13% to 15% for copper; and an equal amount of the present proven reserves for gold and silver.

The emphasis in the search for ores of aluminum, chromium, iron, lead and zinc, and manganese will be focused on locating rich and easily worked deposits. The exploration for industrial minerals needed by the chemicals and construction sectors will include phosphate, potash, and soda ash.

Energy demand in the year 2000 was expected to reach 1.5 billion tons of standard coal equivalent to be met by domestic production and utilization of petroleum, natural gas, coal, nuclear energy, oil shale, and geothermal steam, of which the first three sources account for 95% of the demand forecast. Although domestic coal and uranium were expected to be sufficient to meet individually its sectoral input to overall demand, the supply of oil and natural gas was expected to fall short of its share of projected energy demand.

China has large reserves of iron and manganese. However, most of the iron resources are low-grade deposits, while most of the manganese deposits are hard to work. Overall, about 80% of the demand for iron and manganese in the year 2000 would be met by domestic mining.

Most of China's chromite occurrences are in Xizang, where development is very difficult. Hence, China was expected to continue to rely on imported material. Aluminum, copper, lead, and zinc make up about 95% of China's nonferrous metals consumption. The verified reserves of the last three are sufficient to meet demand in the year 2000, but China's need for copper will exceed supply, notwithstanding a large resource base that is primarily low grade and sited in remote areas.

In the search for industrial minerals, emphasis was to be placed on potassium minerals and diamond. China was expected to continue as a net importer of both in 1989–2000.

The success of China's 12-year geology program is predicated on financing. In 1989, Government allocation for geological exploration was only 1.4% of total Government expenditure, down from a past high rate of 2.06%. China was expected to increase domestic funding for its geological projects as well as turn to overseas sources to secure foreign capital.

According to data of the State Statistical Bureau, the value of China's minerals production and processing in 1988 is shown in table 2.

The Ministry of Geology and Mineral Resources reported new finds of 137 mineral deposits: 53 for precious metals, 33 for nonferrous metals; 15 for ferrous and rare metals; and 36 for industrial minerals. The locations for some of the finds released by the Ministry were as shown in table 3, by province, antonomous region, or municipality.

PRODUCTION

China is one of the few countries that possesses a vast as well as diverse mineral resource base, and the Government has stressed the development of the mining industry to foster economic growth. Mineral fuels are the country's most important and largest minerals producing sector in terms of quantity and value. China ranks first in world coal output and sixth in oil production. Most of the output is domestically consumed. For metals, China is a major world producer of antimony, iron and steel, mercury, rare earths, tin, and tungsten. It is one of the world's leading producers of industrial minerals such as barite, fluorspar, magnesite, salt, and talc, as well as value added products such as cement and fertilizers.

The output value of the total industrial production increased 8.3% to $591 billion in 1989. By type of ownership, the growth rates were the state-owned sector,

TABLE 2

CHINA: VALUE OF MINERAL PRODUCTION AND PROCESSING, 1988

(Million dollars)

	Mining	Processing	Total
Fuels:			
Coal	5,406	665	6,071
Oil	4,623	6,299	10,922
Metals:			
Ferrous	428	13,215	13,643
Nonferrous	1,009	12,832	13,841
Industrial minerals	1,738	17,321	19,059
Total	13,204	50,332	63,536

TABLE 3

CHINA: NEWLY DISCOVERED METALS AND MINERALS IN CHINA

Commodity	Province, antonomous regions, or municipality
Precious metals:	
Gold	Anhui Rongdu, Wuhe
Do.	Beijing Yingchangling, Miyun
Do.	Hebei Shecengshan, Jiayu Bancanghe, Yichang
Do.	Liaoning Fuxin Xinmin
Do.	Nei Monggol Durenwuji, Sonid
Do.	Sichuan Xiangqu, Baiyen
Silver	Hebei Huoshigore-Liangjugou, Chicheng Pengjiangou, Chicheng
Do.	Henan Baishipo, Luoshan
Do.	Shandong Tongjianzhuang, Rongchang
Do.	Shanxi Xiaoqinggou, Lingqiu
Do.	Yunnan Weivei, Mengzi Xiachang, Wenshan
Do.	Zhejiang Qi 'ao, Shangyu
Nonferrous metals:	
Aluminum (Bauxite)	Shanxi Shuhe, Fenuang
Antimony	Guizhou Baogudi-Mabaiqing, Xingren Nei Monggol Amuwusu, Alxa
Do.	Xizang Meiduo, Amdo

3.7%; collective, 10.7%; private, 24.1%; and Sino-foreign, cooperative enterprises, and foreign wholly owned enterprises, 44.7%. The total value of light industry output was $289 billion and heavy industry $302 billion. The output of China's major products by administrative division, excluding Xizang, is given in table 5.

TRADE

China's trade continued to expand, reaching a total value of $111.6 billion in 1989, an increase of 8.6% over that of the previous year. China's trade during the current and past 5-Year Plan period was as shown in table 6, in million dollars.

By region, China's largest trade volume is in Asia, followed by Europe and North America. The configuration of China's trade pattern is distorted inasmuch as Xianggang (Hong Kong) and Aomen (Macau), collectively the country's largest trading partners, are in actuality transshipment points largely for goods departing and destined for China. The two-way trade pattern by area in 1989 is shown in table 7.

Individually, China's largest trading partners were Xianggang (Hong Kong), Japan, the United States, the Federal Republic of Germany, and the U.S.S.R., in that order, as shown in table 8.

The bulk of China's remaining trade in Asia was with member nations of the Association of Southeast Asian Nations.

The Government considers the trade deficit to be inflated inasmuch as it includes the value of goods not dealt with in foreign exchange. These items include imported equipment and materials donated gratis or needed by wholly owned foreign enterprise as part of their investment in China and domestic enterprises doing processing work with foreign-supplied materials.

To modernize its industrial base, China must import high-value, manufactured materials. It is a net importer of manufactured foods, machinery, and transport. The net import cost of these trade items were valued at $15.8 billion, which was largely offset by net export revenues from external shipments of food products, fuels, and light industry manufactures, which were collectively valued at $13.2 billion. China's trade by commodity classification is listed in table 9.

TABLE 3—Continued

CHINA: NEWLY DISCOVERED METALS AND MINERALS IN CHINA

Commodity	Province, antonomous regions, or municipality
Nonferrous metals—Continued	
Copper-nickel	Xinjiang Jinguquan, Hami
Lead-zinc	Hunan Lunqian, Ruchong
Do.	Sichuan Bobogou, Ganhou Dijing, Jinyang
Do.	Yunnan Huangchanchang, Shiping
Do.	Zhejiang Geping, Suichang
Tin	Guangdong Tiandong, Chao'an
Ferrous metals:	
Iron	Anhui Mabienshan, Lujiang Taipengcun, Yongzhen, Hexian
Manganese	Fujian Renchang, Qingliu
Do.	Henan Shendonggou, Lushi
Titanium (ilmenite)	Guangdong Linjiang, Fijin Guiwei, Yunan
Do.	Jiangsu Matoushan, Tongshan, Yanxibu, Pixian
Industrial minerals:	
Apatite	Sichuan Xiaogou, Leibo
Bentonite	Henan Angao, Nanuang
Do.	Shandong Changei, Weifang
Diatomite	Hebei Hailutu, Yangpo, Zhangbei
Fluorspar	Jiangxi Baifutang, Jingdezhen Jinjiadong, De'an
Ilite	Zhejiang Daqiao, Xiaoshan
Kaolin	Guangdong Zhuocun, Raoping
Do.	Henan Biyang
Do.	Sichuan Daheiyi, Huili
Pyrophyllite	Zhejiang Xiaoxiling, Taishun
Sylvite	Qinghai Mahai, Haixi
Talc	Henan Yashi, Luanchuan

TABLE 4

CHINA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989[p]
METALS						
Aluminum:						
Bauxite, gross weight		1,650,000	1,650,000	2,400,000	[r]3,500,000	4,000,000
Alumina, gross weight		825,000	825,000	1,200,000	[r]1,500,000	1,400,000
Metal, refined, primary		410,000	410,000	615,000	[r]710,000	850,000
Antimony, mine output, Sb content		15,000	15,000	15,000	[r]25,600	30,000
Bismuth, mine output, Bi content		260	260	260	275	275
Cadmium, smelter		540	650	680	[r]750	800
Copper:						
Mine output, Cu content		185,000	185,000	250,000	[r]375,000	375,000
Metal:						
Smelter, primary and secondary		225,000	225,000	300,000	[r]400,000	450,000
Refined, primary and secondary		400,000	400,000	400,000	[r]510,000	550,000
Gold, mine output, Au content		60	65	70	80	90
Iron and steel:						
Iron ore, gross weight	thousand tons	66,000	90,000	100,000	[r]99,000	100,000
Pig iron	do.	43,600	50,200	53,900	56,400	57,800
Ferroalloys	do.	900	[r]1,000	[r]1,500	[r]1,800	1,800
Steel, crude	do.	46,700	52,100	56,000	59,000	61,200
Steel, rolled	do.	36,900	40,500	43,900	47,000	48,700
Lead:						
Mine output, Pb content		200,000	227,000	267,000	250,000	330,000
Metal, refined, primary and secondary		210,000	240,000	246,000	[r]241,000	270,000
Magnesium metal, primary		7,000	7,000	7,000	[r]3,200	3,200
Manganese ore, gross weight	thousand tons	1,600	1,600	1,600	1,600	1,600
Mercury, mine output, Hg content		700	700	700	700	900
Molybdenum, mine output, Mo content		2,000	2,000	2,000	2,000	2,000
Nickel:						
Mine		25,000	25,000	25,000	25,000	25,000
Smelter		22,500	22,500	22,500	[r]24,700	25,600
Silver, mine output, Ag content		80	90	100	110	125
Tin:						
Mine output, Sn content		15,000	15,000	20,000	[r]29,500	29,500
Metal, smelter		15,000	15,000	20,000	[r]29,500	29,500
Tungsten, mine output, W content		15,000	15,000	18,000	20,000	25,000
Zinc:						
Mine output, Zn content		300,000	396,000	458,000	[r]420,000	460,000
Refined, primary and secondary		275,000	336,000	383,000	[r]420,000	460,000
INDUSTRIAL MINERALS						
Asbestos		160,000	150,000	150,000	150,000	150,000
Barite	thousand tons	1,000	1,000	1,250	1,500	1,750
Cement, hydraulic	do.	142,500	161,600	180,000	203,000	207,000
Fluorspar		850,000	900,000	1,000,000	1,100,000	1,750,000
Graphite		185,000	185,000	185,000	200,000	200,000
Gypsum	thousand tons	5,000	6,500	7,200	8,100	8,100

See footnotes at end of table.

TABLE 4—Continued

CHINA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989[p]
INDUSTRIAL MINERALS—Continued						
Kyanite and related materials		2,500	2,500	2,500	2,500	2,500
Lithium minerals, all types		15,000	15,000	15,000	15,000	15,000
Magnesite	thousand tons	2,000	2,000	2,000	2,000	2,000
Nitrogen: N content of ammonia	do.	15,000	15,500	16,000	16,200	17,000
Phosphate rock and apatite, P_2O_5 equivalent	do.	1,900	1,800	2,700	[r]4,100	4,100
Potash, marketable, K_2O equivalent	do.	40	40	40	40	40
Salt	do.	14,450	17,300	18,000	22,000	28,000
Sodium compounds: Soda ash, natural and synthetic	do.	2,000	2,100	2,400	2,600	3,000
Sulfur:						
Native	do.	200	300	300	300	300
Content of pyrite	do.	2,300	2,500	3,700	3,900	4,000
Byproduct, all sources	do.	350	300	500	550	600
Total	do.	2,850	3,100	4,500	4,750	4,900
Talc and related materials		[r]1,370,000	[r]1,500,000	[r]1,700,000	[r]1,900,000	2,100,000
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Anthracite	thousand tons	155,000	160,000	170,000	175,000	190,000
Bituminous and lignite	do.	695,400	710,000	750,000	770,000	850,000
Total	do.	850,400	870,000	920,000	945,000	1,040,000
Coke, all types	do.	39,000	41,400	45,000	47,000	50,000
Gas, natural:						
Gross	billion cubic meters	14	15	16	16	16
Marketed	do.	13	14	14	14	14
Petroleum:						
Crude (including crude from oil shale)	thousand 42-gallon barrels	873,500	953,500	978,200	999,200	1,000,000
Refinery products	do.	655,000	700,000	710,000	725,000	725,000

[p]Preliminary. [r]Revised.

[1]Table includes data available through Oct. 31, 1990.

[2]In addition to the commodities listed for which quantitative estimates of output have been made, China is known or believed to have produced other commodities for which no estimates have been prepared.

TABLE 5

CHINA: OUTPUT, BY ADMINISTRATIVE DIVISION, IN 1989

(Metric tons except as indicated)

	Industrial output[1]					Salt	Coal	Crude oil[2]	Electricity[3]	Pig iron	Crude steel	Rolled steel	Nonferrous metals[4]	Chemical fertilizer	Cement	Sulfuric acid	Soda ash	Caustic soda
	By type		By ownership															
	Light	Heavy	State	Collective	Other													
Muncipality:																		
Beijing	5,321	6,698	8,522	2,913	584	—	8,523,900	—	11,884	3,238,200	3,859,000	3,268,300	9,000	100,800	2,916,900	98,200	—	112,600
Shanghai	15,244	12,494	19,825	5,095	2,818	—	—	—	27,818	5,181,400	8,079,000	4,769,700	63,400	256,800	2,508,700	429,600	36,200	278,700
Tianjin	5,461	4,653	7,264	2,188	662	2,104,800	—	34,360	9,641	1,090,500	1,519,700 9,510,100	1,753,200	23,100	62,800	1,252,700	80,900	571,300	248,500
Province:																		
Anhui	5,223	4,308	6,320	3,175	37	2,700	31,014,100	—	17,186	2,725,400	2,199,000	1,717,800	64,600	1,056,300	8,314,200	548,500	52,000	82,300
Fujian	4,642	2,726	3,853	1,856	1,658	903,600	9,570,600	—	12,714	484,300	427,800	477,200	10,700	426,200	4,874,700	231,800	23,500	84,600

See footnotes at end of table.

TABLE 5—Continued

CHINA: OUTPUT BY ADMINISTRATIVE DIVISION IN 1989

(Metric tons except as indicated)

	Industrial output[1]					Salt	Coal	Crude oil[2]	Electricity[3]	Pig iron	Crude steel	Rolled steel	Nonferrous metals[4]	Chemical fertilizer	Cement	Sulfuric acid	Soda ash	Caustic soda
	By type		By ownership															
	Light	Heavy	State	Collective	Other													
Province—Continued																		
Gansu	1,224	3,076	3,644	642	14	28,000	14,175,800	10,724	16,431	650,100	647,700	363,400	236,300	250,700	3,491,600	333,600	46,000	27,300
Guangdong	18,715	8,725	12,399	9,494	5,547	414,600	9,232,100	20,068	29,468	765,800	993,100	1,213,800	103,900	733,600	18,905,200	956,600	—	110,800
Guizhou	1,357	1,874	2,733	464	34	—	32,383,600	—	9,589	578,300	374,000	224,700	96,600	448,300	2,917,000	63,600	—	14,600
Hainan	437	168	455	48	102	247,700	4,400	—	1,206	22,400	1,500	—	—	5,500	429,800	14,800	—	800
Hebei	6,529	7,173	9,067	4,513	122	3,081,900	57,349,800	42,155	36,382	4,181,100	3,507,900	2,763,000	21,100	1,430,900	13,300,000	621,800	35,200	106,000
Heilongjiang	4,598	8,331	10,348	2,464	43	—	75,423,300	405,556	27,524	506,000	937,900	784,100	6,300	347,000	5,538,900	118,700	800	77,400
Henan	6,035	6,844	6,559	3,047	39	—	81,172,300	69,580	29,903	1,591,800	1,575,500	1,241,000	103,800	1,334,300	10,052,300	369,700	117,900	113,600
Hubei	8,563	9,083	12,011	5,563	72	1,282,900	9,018,400	6,789	33,268	5,005,200	6,010,200	5,565,800	58,100	1,321,300	9,745,700	831,600	219,300	89,600
Hunan	4,905	5,906	7,463	3,215	133	410,500	36,984,400	—	18,123	1,477,600	1,355,800	1,164,600	243,700	1,237,100	9,920,700	670,300	53,100	138,100
Jiangsu	22,648	18,056	16,180	22,782	1,743	2,463,700	23,939,400	5,840	34,950	1,461,700	1,666,100	1,810,000	34,700	1,382,200	14,980,000	1,151,100	80,800	318,700
Jiangxi	365	3,380	4,767	1,618	56	194,100	21,269,800	—	11,915	785,700	1,052,400	949,400	86,500	328,700	4,931,300	434,100	13,000	53,900
Jilin	3,590	5,001	6,404	2,173	15	—	24,021,700	24,984	15,723	686,400	652,900	596,000	21,600	294,700	4,116,000	122,800	22,800	81,400
Liaoning	7,884	16,514	16,652	6,566	1,180	3,300,800	48,882,500	88,187	41,672	11,362,500	12,028,500	9,371,500	341,900	669,800	11,987,900	788,800	751,300	259,700
Qinghai	294	556	726	123	<1	1,153,700	2,820,600	5,293	5,773	—	308,100	278,300	31,800	55,100	538,100	21,900	—	730
Shaanxi	2,777	4,209	5,689	1,274	23	104,900	30,915,200	4,427	15,066	370,900	463,200	315,700	18,800	422,900	5,073,800	285,800	24,700	43,500
Shangdong	14,531	12,640	14,604	12,416	151	5,599,600	57,936,800	243,490	41,762	2,582,500	2,098,200	1,511,500	44,300	1,523,800	18,829,400	730,900	500,500	370,200
Shanxi	2,019	5,375	5,225	2,074	95	1,000	274,764,700	—	30,190	4,144,100	2,270,800	1,318,900	33,600	716,600	6,256,200	368,800	33,900	75,900
Sichuan	8,023	10,029	12,928	5,000	124	2,226,400	70,530,500	909	32,469	3,962,800	4,696,300	3,508,800	35,600	1,682,800	13,840,100	1,055,200	263,700	228,500
Yunnan	2,264	2,236	3,613	852	35	382,600	21,357,600	—	11,307	1,063,000	715,300	600,100	186,500	808,200	4,494,400	341,100	—	23,600
Zhejiang	13,139	7,474	7,040	13,124	449	217,200	1,412,600	—	19,679	508,900	801,800	801,800	30,200	679,900	12,757,200	263,600	86,500	142,100
Autonomous region:																		
Gaungxi	3,064	2,106	3,941	1,166	64	148,200	9,166,500	239	10,736	444,600	409,900	419,500	55,400	359,900	6,201,100	330,400	11,900	52,900
Nei Monggol	1,681	2,193	3,063	803	8	1,089,800	43,150,500	—	15,309	2,554,500	2,420,800	1,572,700	49,000	122,400	2,499,300	46,300	38,200	50,600
Ningxia	301	708	796	209	5	3,500	13,390,600	2,096	5,420	31,200	24,700	42,000	51,700	210,700	930,600	52,100	700	730
Xinjiang	1,478	1,609	2,533	525	29	2,662,100	17,154,300	46,751	6,201	362,000	302,400	248,500	17,700	277,800	2,637,400	36,300	—	11,000

[1]Million U.S. dollars.
[2]Thousand barrels.
[3]Million killowatt hours.
[4]Aggregate output of aluminum, antimony, copper, lead, magnesium, mercury, nickel, tin, titanium, and zinc.

In terms of mineral commodities, China's largest revenue was from the export of crude petroleum, followed by petroleum refinery products, coal, steel, refractory minerals, coke, and tungsten, collectively valued at $4.8 billion. However, the country's need for quality steel products and manufactures was costly and involved an import transaction valued at close to $6 billion alone. In addition, China imported ore, scrap metal, wire, pig iron, and billets and forgings to meet the country's demand for iron and steel. The domestic requirements, for chromite are almost wholly imported, while foreign purchases of alumina and aluminum metal provide about one-third of the aluminum demand. China continued to be a large net importer of fertilizer, mostly nitrogenous-based types. It must import almost all of its need for potassic fertilizer ingredients.

STRUCTURE OF THE MINERAL INDUSTRY

The country's large and strategic operations are state-run enterprises under the central Government. However, there is considerable overlapping of authority over various mineral and metal commodities. Barite, iron, iron ore, steel, and primary gold production, as well as some dolomite mines, fall under the Ministry of Metallurgical Industry. Nonferrous metals, including byproduct gold, are under the aegis of the China National Nonferrous Metals Industry Corp. The State Bureau of Supplies controls scrap metal recycling, while the Ministry of Commerce regulates scrap collection. The State Administration of Building Materials (SABM) has responsibility for sand and gravel and cement, dolomite, limestone, and stone aggregate use for construction. In turn, SABM has created a subordinate enterprise and incorporated it as the China Non-Metallic Mineral Industry Corp., which operated mines and processing facilities for a wide array of industrial minerals. Phosphate, potassium, salt, sulfur, and various inorganic compounds fall under the purview of the Ministry of Chemical Industry. Furthermore, there are separate governmental entities for the energy sector: the Ministry of Coal Industry, the Ministry of Petroleum Industry (onshore oil and natural gas), China National Offshore Oil Corp. (oil and natural gas), and the Ministry of Nuclear Industry (uranium).

COMMODITY REVIEW

Metals

China's metal-producing industry centers around a large iron and steel sector that also encompasses ferroalloy production and a much smaller nonferrous sector. Annual output capacity of crude steel is close to 65 million tons per year and that for ferroalloys about 1.9 million tons per year.

China's nonferrous metals output centers around 10 metals— aluminum, copper, lead, and zinc with much lesser output of antimony, magnesium, mercury, nickel, tin, and titanium. Production of aluminum, copper, lead, and zinc was almost 94% of the total national output of the 10 nonferrous metals in 1989. According to the China National Nonferrous Metals Industry Corp. (CNMIC), the collective target for output in 1990 was to be 2.25 million tons (see table 15).

China's nonferrous metals grew from 1,275,000 tons in 1984 to 2,016,300 tons in 1988, reaching 2,100,000 tons in 1989. Although the aluminum sector was given priority development, it is doubtful that the overall nonferrous metals production target will be met in 1990 principally because of energy shortage and the lack of the domestic capability and capacity to produce alumina for metal production.

Aluminum.—Because of the development priority granted to the aluminum sector by the State Planning Commission, metal production grew from 401,200 tons in 1982 to 713,000 tons in 1988, reflecting an average annual growth rate of 10.05%. However, during this period, the growth in alumina production averaged only 5.4% annually. In 1989, alumina production was about 1.44 million tons compared with the annual target of 1.60 million tons, resulting in a calculated shortfall of 80,000 tons of elemental content.

Because Guizhou Province has a verified bauxite reserve of 350 million tons, CNMIC was seeking international financing and technical assistance to expand the Guizhou aluminum complex at Guiyang with construction and development at possibly Anshun, Kaili, Yuping, and Zunyi. Presently, Guizhou

TABLE 6

CHINA: VALUE OF TRADE

(Million dollars)

	Total trade	Exports	Imports	Annual balance
Sixth 5-year plan:				
1981	44,022	22,007	22,015	−8
1982	41,606	22,321	19,285	+3,036
1983	43,616	22,226	21,390	+836
1984	53,549	26,139	27,410	−1,271
1985	69,602	27,350	42,252	−14,902
Seventh 5-year plan:				
1986	73,846	30,942	42,904	−11,962
1987	82,653	39,437	43,216	−3,779
1988	102,784	47,516	55,268	−7,752
1989	111,627	52,486	59,141	−6,655

TABLE 7

CHINA: DISTRIBUTION OF TRADE BY AREA IN 1989

(Million dollars)

	Exports	Imports	Balance
Asia	37,144	30,691	+6,453
Africa	739	427	+312
Europe	8,757	14,750	−5,993
Latin America	551	2,418	−1,867
North America	4,803	8,941	−4,138
Oceania	491	1,794	−1,303

TABLE 8

CHINA: DISTRIBUTION OF TRADE BY MAJOR TRADING PARTNERS IN 1989

(Million dollars)

	Exports	Imports
Xianggang (excludes Aomen)	21,916	12,542
Japan	8,362	10,535
Germany, Federal Republic of	1,609	3,379
U.S.S.R	1,849	2,147
United States	4,391	7,863

Aluminum is China's largest producer of aluminum metal, accounting for 17% of the national output. Annual production capacity for alumina at Guizhou is 400,000 tons and metal, 110,000 tons. The first phase of the development program, projected to be completed in 1991, will expand annual alumina capacity to 700,000 tons and add a 80,000-ton-per-year potline to raise metal capacity to 190,000 tons. Total cost of the first phase project was estimated at $270 million. The second phase development to be undertaken in 1991-95 will include an additional 80,000 tons per year of capacity and renovation of its predecessor smelter to increase capacity from 80,000 tons per year to 100,000 tons per year. In addition, another Bayer plant with a capacity of 600,000 tons per year of alumina will be installed. Meanwhile, CNMIC was completing renovations at Zhengzhou and Zibo to increase alumina production and modifications to the Southwest aluminum plant, completing new construction at Laibin for foil production, and continuing the expansion project at Baiyin for both alumina and aluminum production.

Other nonferrous metals development projects underway include the technical renovation and upgrading of the small magnesium plant at the Fushun aluminum smelter; titanium alloy production at Zigong; copper ore mining at Shongtianoshan, Sachang, Daye, and Dexing; copper smelting at Luoyang; lead-zinc mining at Dankoy; zinc mining at Huili; lead metal production at the North China smelter; and lead and zinc production at the Northwest smelter. According to CNMIC, the biggest problem in increasing China's aluminum production level and generally for nonferrous metals output is hampered by the shortage of raw materials, an insufficient supply of energy, and a lack of working capital.

Copper.—China's larger copper smelter and refinery operations are in Gansu, Jiangxi, Liaoning, and Shanghai. Total industry production capacity for metal is estimated at about 550,000 tons per year. Domestic production is insufficient to meet demand. To supplement domestic supply, China imported 178,166 tons of copper ore valued at $105.9 million in 1989; 70,082 tons of metal and alloy at $180.1 million; and 38,568 tons of copper metal manufactures at $142.0 million.

Iron and Steel.—China's output of

TABLE 9

CHINA: TRADE BY COMMODITY CLASSIFICATION

(Million dollars)

	Exports		Imports	
	1988	1989	1988	1989
Primary products:				
Food and live animals, chiefly for food	5,889	6,145	3,476	4,193
Beverages and tobacco	236	314	346	201
Crude materials, inedible	4,257	4,211	5,089	4,835
Mineral fuels, lubricants, and related materials.	3,949	4,269	788	1,650
Animal and vegetable oils, fats, and waxes	74	86	369	875
Manufactures:				
Chemicals and related products	2,897	3,201	9,139	7,556
Manufactured goods classified chiefly by material	10,489	10,897	10,409	12,335
Machinery and transport equipment	2,769	3,874	16,689	18,208
Miscellaneous manufactured articles	8,268	10,755	1,983	2,073
Commodities not elsewhere classified	8,687	8,734	6,979	7,215

TABLE 10

CHINA: 1989 EXPORTS OF SELECTED MINERAL COMMODITY

(Metric tons, unless otherwise indicated)

	Quantity	Value (thousand U.S. dollars)
Metals:		
Aluminum:		
Bauxite	574,748	34,940
Metal and alloys:		
Unwrought	13,411	27,380
Semimanufactures	6,299	1,714
Antimony metal, unwrought	32,993	63,630
Barium:		
Barium carbonate	83,831	18,680
Barium sulfate	1,031,302	29,300
Copper:		
Metal and alloys, unwrought	11,770	31,480
Semimanufactures	16,479	52,640
Iron and steel:		
Ferrosilicon	82,592	66,320
Pig iron and cast iron	530,000	70,160
Steel:		
Bars and rods	279,163	83,890
Shapes and sections	108,418	32,130
Sheets and plates	286,238	96,180
Tube and pipe	110,344	86,340
Other	95,837	48,910

See footnote at end of table.

crude steel increased 3% to 61.24 million tons in 1989. Projected output in 1990 was to approximate the 1989 level, resulting in a shortfall in supply of 7 million tons to meet domestic demand. In 1989, imports of steel manufactures were close to 10 million tons. Because of a shortage of foreign currency holdings and the pressure of servicing its foreign debt obligations falling due, China was expected to reduce steel imports by a large margin.

Finished steel output was 48.7 million tons. The industry continued to be incapable to supply the demand for thin and medium plate, silicon sheet, and seamless tube. Plate and tube accounts for 45% of the total steel domestically consumed. However, domestic output of these products account for about 36% of the total steel products domestically produced. Imports of certain steel products in 1990 were expected to exceed the restricted import targets because of the need for some steel product specifications.

Modernization of the iron and steel sector remains a formidable task. To meet the projected growth in demand and minimize imports, the industry was to open eight new iron ore mines and expand five existing mines. The existing mines to be expanded are those operated by the steel complexes at Anshan in Liaoning, Shoudu in Beijing, and Chongqing in Sichuan. The mines to be developed are near the large complexes around Anshan and Benxi in Liaoning, Wuhan in Hubei, and Maanshan in Anhui.

Eleven major iron and steel enterprises were slated for expansion and/or upgrading. These included Anshan, Wuhan, Meishan, and Baoshan in Shanghai; Maanshan and Laiwu in Shandong; Benxi and Panzhihua in Sichuan; and Shoudu and Baotou in Nei Monggol. However, because of a lack of funds, the highest priority was given to the installation of the No. 2 blast furnace at Baoshan, sintering and coking at Shoudu, sintering and ore dressing at Baotou, and the No. 4 blast furnace at Wuhan.

The Channar iron ore mine in Pilbara, Australia, went on-stream during the last quarter of 1989. The mine produced 300,000 tons during a 3-month trial, with all the ore scheduled to be shipped to China early in 1990. The project is by Channar Mining Pty. Ltd., 60%, and China National Metallurgical Import and Export Corp., 40%. The initial production rate will be 3 million tons of iron ore per

TABLE 10—Continued

CHINA: 1989 EXPORTS OF SELECTED MINERAL COMMODITY

(Metric tons, unless otherwise indicated)

	Quantity	Value (thousand U.S. dollars)
Metals—Continued		
Tin:		
Metal and alloys, unwrought	9,874	82,810
Tungsten:		
Metal, unwrought	791	3,110
Ore	30,901	105,370
Zinc:		
Metal and alloys, unwrought	20,109	21,710
Industrial minerals:		
Cement	436,486	17,240
Clay and other refactory minerals	2,309,827	231,330
Fluorspar	1,183,533	90,230
Talc	943,381	57,170
Fuels:		
Coal	15,340,000	554,040
Coke, semicoke	1,660,000	125,970
Petroleum:		
Crude oil	24,390,000	2,698,530
Refinery products	4,740,000	757,550

Source: China's Customs Statistics (1990.1).

TABLE 11

CHINA: 1989 IMPORTS OF SELECTED MINERAL COMMODITY

(Metric tons, unless otherwise indicated)

	Quantity	Value (thousand U.S. dollars)
Metals:		
Aluminum:		
Alumina	298,002	148,280
Metal and alloys, unwrought	175,510	372,310
Semimanufactures	70,812	258,300
Chromium: Chromite	1,230,000	58,240
Copper: Ore	178,166	105,920
Iron and steel:		
Iron ore	12,592,619	329,950
Pig iron and cast iron	690,000	102,120
Scrap (iron or steel)	120,000	19,560
Wire (iron or steel)	41,986	29,960
Steel:		
Bar and rods	940,000	354,230
Billets and forgings	190,000	47,890

See footnote at end of table.

year, increasing to achieve a capacity of 10 million tons of iron ore per year during a 9-year period.

Lead-Zinc.—China's larger lead-zinc smelter operations are in Gansu, Hunan, and Liaoning. The aggregate annual lead production capacity is about 265,000 tons and for zinc, 480,000 tons. Net foreign trade of these metals is negligible. For instance, in 1989, China exported 20,109 tons of unwrought zinc and imported 19,198 tons. The domestic demand for lead is estimated at 255,000 tons in 1989 and 455,000 tons for zinc.

Industrial Minerals

China possesses a diverse treasure trove of industrial minerals. Phosphate occurs in Guizhou, Hubei, Hunan, Sichuan, and Yunnan and pyrite in Guangdong. Fluorspar locates in Fujian, Nei Monggol, and Zhejiang. Barite occurs in Hunan; graphite in Heilongjiang and Shandong; talc in Guangxi, Liaoning, and Shandong; magnesite in Liaoning; and asbestos in Qinghai and Sichuan. There are large sepiolite deposits in Hunan and Jiangxi, and diamond occurrences have been found in Guizhou, Hunan, Liaoning, and Shandong. Dimension stone, kaolin, and quartz sands are abundant in Guangdong and Fujian.

According to China National Non-Metallic Minerals Industry Corp. (CNNMIC), China ranks first in world reserves of flake graphite, fluorspar, and gypsum; second for asbestos, bentonite, glauber salt, talc, and wollastonite; and third for perlite and zeolites. China also has large mineral resources for attapulgite, bauxite, celestite, diatomite, kaolin, kyanite, pyrophyllite, and sepiolite. There are also large resources of high-quality granite and marble.

CNNMIC's corporate strategy was to satisfy the domestic need for industrial minerals and penetrate the international market to expand sales and to obtain foreign exchange earnings. To this end, the company stressed industrial mineral projects that required small financial investment to develop, which could rapidly be brought into production, and which had a fast return on investment. During the seventh 5-year plan, CNNMIC began to integrate its operations by the establishment of industrial minerals production centers. The initial 10 resource bases are listed in table 16.

TABLE 11—Continued

CHINA: 1989 IMPORTS OF SELECTED MINERAL COMMODITY

(Metric tons, unless otherwise indicated)

	Quantity	Value (thousand U.S. dollars)
Metals—Continued		
Iron and steel—Continued		
Steel—Continued		
Seamless pipe	1,140,000	1,005,610
Shapes and sections	370,000	133,050
Sheets and plates	6,010,000	3,647,860
Wire rod	770,000	257,700
Others	250,000	199,860
Sodium:		
Sodium bichromate	8,032	9,440
Sodium carbonate	969,074	174,100
Sodium hydroxide	187,920	80,160
Sodium tetraborate	425	230
Titanium dioxide	19,214	52,180
Zinc: Metal and alloys, unwrought	19,198	27,770
Industrial minerals: Cement	1,230,000	58,240
Fertilizer, manufactured:		
Compound fertilizers	7,964,646	215,200
Potassium chloride	1,118,247	138,230
Superphosphate	141,816	24,020
Urea	7,940,709	1,169,790
Unspecified	3,767,595	816,410
Fuels:		
Coal	2,290,000	90,920
Electric current thousand kilowatt-hour	1,642,280	78,400
Petroleum:		
Crude oil	3,260,000	466,740
Refinery products	5,340,000	968,690

Source: China's Customs Statistics (1990.1)

CNNMIC proposed that autonomous producing enterprises such as small, local operations should also be consolidated into a single industrial base such as for barite production at Xianzhou, Guangxi with Jiaoxian, Shandong, and with barite operations in Hunan. The concept would also extend to barite operations in Fujiang, Hebei, Hubei, Hunan, and Zhejiang.

Mineral Fuels

China is a very large producer of fuels; in 1986, it produced more than 870 million tons of coal, more than 131 million tons of oil, and almost 14 billion cubic meters of natural gas. Total generation of electricity by thermal and hydropower plants in 1989 was 582 billion kilowatt-hours (kW·h). Moreover, there is energy production from unaccounted-for nonconventional sources such as animal chips, biogas, geothermal steam, wind power, and wood burning. Coal accounts for 73% of the commercial energy production; oil, 21%; natural gas, 2%; and hydropower, 4%. Given the magnitude of the energy supply, there is still insufficient energy to meet the national demand. Annual per capita consumption of coal alone is estimated at 0.2 tons. Moreover, power shortages have prevented

TABLE 12

CHINA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS					
Aluminum:					
Ore and concentrate[2]	thousand tons	785	1,251	355	Japan 173; Netherlands 165.
Metal including alloys:					
Unwrought		60,680	130,378	1,869	Hong Kong 55,284; Japan 50,139.
Semimanufactures		20,155	28,962	2,611	Hong Kong 11,309; Iran 3,474.
Copper:					
Ore and concentrate		73	7	—	All to Hong Kong.
Metal including alloys:					
Unwrought		5,565	49,144	159	Hong Kong 21,937; Singapore 14,165.
Semimanufactures		22,298	44,252	159	Hong Kong 29,379; Pakistan 3,888.
Iron and steel:					
Iron ore and concentrate:					
Excluding roasted pyrite		251	103	—	All to Hong Kong.
Pyrite, roasted	kilograms	201,000	500	—	Do.
Metal:					
Scrap		100,072	685,994	20	Hong Kong 289,041; Thailand 147,768; Japan 111,485.
Pig iron, cast iron, related materials	thousand tons	562	2,338	11	Japan 1,405; Hong Kong 419.
Ferroalloys		264,974	459,869	16,187	Japan 267,018; Hong Kong 111,822.
Steel, primary forms		2,095	19,364	90	Thailand 8,516; Japan 6,336.
Semimanufactures:					
Bars, rods, angles, shapes, sections		230,994	295,229	2,582	Hong Kong 175,163; Macau 47,763.
Universals, plates, sheets		52,487	354,029	48	Japan 157,650; Thailand 114,681.
Hoop and strip		3,049	10,809	([3])	Japan 4,107; Singapore 3,525; Hong Kong 1,012.
Rails and accessories		7,365	5,897	3	Botswana 3,113; Japan 2,296.
Wire		137,594	153,554	10,780	Hong Kong 36,589; United Arab Emirates 13,944.
Tubes, pipes, fittings		112,931	187,117	37,773	Hong Kong 66,357; Singapore 10,272.
Castings and forgings, rough		15,312	28,453	6,374	Japan 9,829; Saudi Arabia 4,033.
Lead:					
Ore and concentrate		79,756	58,829	—	Japan 24,759; North Korea 20,016; Australia 8,000.
Metal including alloys:					
Unwrought		23,460	11,856	19	Japan 5,635; Hong Kong 3,117.
Semimanufactures		50	26	—	Hong Kong 13; Japan 12.
Manganese: Ore and concentrate		41,182	40,250	—	North Korea 29,325; Japan 6,516; Hong Kong 1,009.
Nickel:					
Ore and concentrate		17	—		
Metal including alloys:					
Unwrought		50	387	—	Japan 220; Hong Kong 98; Netherlands 50.
Semimanufactures		11,688	2,270	293	Japan 1,650; Netherlands 200.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	kilograms	1,226,783	158,159	18,488	Japan 65,000; Hong Kong 37,980.
Silver:					
Ore and concentrate[4]	do.	58,629	21,453	—	Hong Kong 18,487; France 2,000.

See footnotes at end of table.

TABLE 12—Continued

CHINA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued				
Silver—Continued				
Metal including alloys, unwrought and partly wrought kilograms	21,490	3,420	—	Thailand 2,000; Hong Kong 1,417.
Tin:				
Ore and concentrate	16,710	23,855	630	Singapore 14,970; Hong Kong 3,567.
Metal including alloys:				
Unwrought	15,894	10,717	4,375	Japan 2,253; Netherlands 1,804.
Semimanufactures	6,276	6,244	452	Hong Kong 2,934; Japan 2,506.
Tungsten, molybdenum, tantalum, magnesium: Metals including alloys, all forms	2,004	1,635	159	Japan 526; Hong Kong 367; Netherlands 357.
Uranium and thorium:				
Ore and concentrate	564	—		
Metal including alloys, all forms kilograms	33	118,248	—	All to France.
Zinc:				
Ore and concentrate	37,220	108,175	2,500	Japan 86,245; North Korea 16,630.
Metal including alloys:				
Unwrought	95,338	13,838	103	Hong Kong 6,510; Japan 5,054.
Semimanufactures	5,623	420	—	Hong Kong 307; Japan 40.
Other:				
Ores and concentrates	68,169	62,835	9,751	U.S.S.R. 21,839; Japan 9,688.
Oxides and hydroxides (iron, lead, zinc, etc.)	35,153	45,354	2,491	Hong Kong 11,021; Netherlands 3,526.
Ashes and residues	5,410	9,111	—	Hong Kong 8,950; Japan 161.
Base metals:				
Scrap	4,878	10,633	10	Japan 5,363; Hong Kong 5,219.
Unwrought and semimanufactures	80,779	115,361	18,771	Japan 52,626; Netherlands 19,118.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural[5] value, thousands	$10,422	$17,947	$39	Japan $8,829; Hong Kong $8,086.
Grinding and polishing wheels and stones do.	$8,456	$8,981	$826	Hong Kong $3,849; Japan $570.
Asbestos, crude	473	570	—	Hong Kong 246; Cuba 200; Malaysia 111.
Cement	167,714	152,190	—	Hong Kong 119,265; Macau 21,249; Bangladesh 4,122.
Diamond: Natural:				
Gem, not set or strung value, thousands	$31,094	$49,984	$1,603	Hong Kong $37,569; Belgium-Luxembourg $4,655.
Industrial stones do.	$16	$316	—	All to Belgium-Luxembourg.
Fertilizer materials:				
Crude, n.e.s.	224	323	—	Japan 322; Hong Kong 1.
Manufactured:				
Nitrogenous	37,152	59,110	—	Malaysia 35,203; Thailand 13,398; Hong Kong 5,864.
Phosphatic	89,912	134,365	—	Japan 96,929; U.S.S.R. 25,000.
Potassic	52	—		
Unspecified and mixed	592	219	—	Malaysia 100; Guinea Bassau 50; Japan 34.
Lime	62,035	74,054	—	Hong Kong 63,092; Macau 10,546.
Nitrates, crude	118	—		

See footnotes at end of table.

TABLE 12—Continued

CHINA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Phosphates, crude		109,657	158,200	—	Malaysia 75,439; Hong Kong 40,971; Japan 20,446.
Potassium salts, crude		1,510	18	—	All to Hong Kong.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$12,260	$22,427	$355	Hong Kong $20,694; Singapore $517.
Synthetic	do.	$423	$1,563	$24	Hong Kong $711; Singapore $379.
Pyrite, unroasted		130,314	200,507	—	All to Japan.
Quartz, mica, feldspar, etc.		874,452	1,030,812	163,349	Japan 447,177; U.S.S.R. 110,696.
Salt and brine	thousand tons	1,069	382	(3)	North Korea 119; Hong Kong 115; U.S.S.R. 102.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value, thousands	$14,117	$15,546	$56	Japan $12,810; Hong Kong $1,934.
Worked	do.	$36,876	$55,877	$7,037	Japan $27,236; Hong Kong $9,748.
Calcareous stone[5]		162,577	136,237	2	North Korea 105,793; Macau 25,298.
Sand other than metal-bearing	thousand tons	4,114	4,603	—	Macau 2,835; Hong Kong 1,638.
Sand and gravel	do.	5,102	4,198	(3)	Hong Kong 3,783; Macau 379.
Sulfur: Elemental: Crude including native and byproduct		44,622	32,664	—	Thailand 15,441; Indonesia 10,015; Malaysia 3,406.
Other:					
Crude		1,514,785	1,943,853	792,748	Japan 676,379; Netherlands 94,803.
Refractory minerals[5]		1,306,709	6,167	4,886	Japan 369; Singapore 296.
Slag and dross, not metal-bearing		11,990	14,878	255	Japan 12,732; Hong Kong 1,026.
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Anthracite	thousand tons	1,905	2,028	—	Philippines 899; Japan 518; United Kingdom 234.
Bituminous	do.	11,610	13,598	—	Japan 4,143; Hong Kong 2,097; Philippines 1,936.
Briquets of anthracite and bituminous coal		—	60	—	All to Hong Kong.
Lignite including briquets		20,000	20,142	—	All to Philippines.
Coke and semicoke[6]	thousand tons	613	1,025	39	Romania 306; Japan 166; France 140.
Peat including briquets and litter		132	367	—	All to Japan.
Petroleum:					
Crude	thousand 42-gallon barrels	198,745	190,131	21,356	Japan 107,109; Singapore 32,487.
Refinery products:					
Liquefied petroleum gas	value, thousands	$2,603	$2,514	—	Hong Kong $1,922; Macau $584.
Gasoline	thousand 42-gallon barrels	19,837	17,437	2,294	Japan 8,004; Singapore 6,559.
Mineral jelly and wax	do.	1,067	1,120	89	Hong Kong 145; Singapore 123.
Kerosene and jet fuel	do.	3,438	3,610	—	Japan 2,023; Hong Kong 1,329; Singapore 193.
Distillate fuel oil	do.	10,446	10,759	—	Hong Kong 4,418; Japan 2,955; Singapore 2,570.
Lubricants	do.	1,677	1,708	194	Japan 426; Thailand 375.
Residual fuel oil	do.	3,491	3,925	—	Japan 2,322; Hong Kong 1,571.
Petroleum bitumen, coke, etc.	do.	614	550	—	Japan 510; Burma 30.

[1]Data presented in this table are from Summary Surveys of China's Customs Statistics. Table prepared by Audrey D. Wilkes.
[2]Includes alumina.
[3]Less than 1/2 unit.
[4]May include other precious ores and concentrates.
[5]Not further identified.
[6]Includes retort carbon.

TABLE 13

CHINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS				
Aluminum:				
Ore and concentrate[2]	322,149	159,535	1	Australia 110,532; India 39,500.
Metal including alloys:				
Unwrought	148,130	75,381	1,610	U.S.S.R. 36,254; Brazil 9,101; Netherlands 6,365.
Semimanufactures	56,498	56,320	4,030	Japan 12,179; Australia 10,207.
Copper:				
Ore and concentrate	199,572	172,999	30,311	Canada 36,982; Burma 29,453.
Metal including alloys:				
Unwrought	75,482	84,368	3,810	Chile 10,998; U.S.S.R. 9,812.
Semimanufactures	40,102	24,622	190	Japan 6,352; Hong Kong 6,251.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	10,829	10,541		Australia 6,620; Brazil 2,550; North Korea 1,075.
Pyrite, roasted	66,895	—		
Metal:				
Scrap	497,583	154,393	39,528	Brazil 51,770; Switzerland 25,531.
Pig iron, cast iron, related materials	1,475,392	871,205	73	U.S.S.R. 473,263; Brazil 305,980.
Ferroalloys	993	710	33	Japan 521; Mongolia 72.
Steel, primary forms	389,710	168,684	1	U.S.S.R. 101,702; Turkey 27,997.
Semimanufactures:				
Bars, rods, angles, shapes, sections thousand tons	5,470	2,697	18	Japan 793; U.S.S.R. 496.
Universals, plates, sheets do.	5,403	428	26	Japan 243; Turkey 45.
Hoop and strip do.	259	184	2	Japan 123; West Germany 19.
Rails and accessories do.	129	51		France 28; Japan 19; Australia 4.
Wire do.	52	19	([3])	Japan 6; Hong Kong 5.
Tubes, pipes, fittings do.	1,147	1,304	7	Japan 853; West Germany 189.
Castings and forgings, rough do.	1	8	([3])	Turkey 7.
Lead: Metal including alloys:				
Unwrought	4,575	4,577	511	Australia 1,100; Bulgaria 999.
Semimanufactures	429	229	1	Hong Kong 156; Japan 62.
Manganese: Ore and concentrate	235,999	276,691	—	Mozambique 72,837; Gabon 60,868; Botswana 53,834.
Nickel:				
Ore and concentrate	([3])	5	—	All from Norway.
Metal including alloys:				
Unwrought	209	2,471	190	U.S.S.R. 1,020; United Kingdom 425.
Semimanufactures	962	4,114	630	U.S.S.R. 946; United Kingdom 437.
Platinum-group metals: Metals including alloys, unwrought and partly wrought kilograms	2,620	4,863	822	United Kingdom 1,684; U.S.S.R. 1,580.
Silver:				
Ore and concentrate[4] do.	74,859	66,726	26,285	Hong Kong 40,416.
Metal including alloys, unwrought and partly wrought do.	17,852	27,136	237	North Korea 11,585; Hong Kong 5,535.

See footnotes at end of table.

TABLE 13—Continued

CHINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued					
Tin:					
Ore and concentrate		139	136	—	All from Burma.
Metal including alloys:					
Unwrought		55	34	(3)	Thailand 20; Malaysia 10.
Semimanufactures		247	313	2	Hong Kong 222; Japan 73.
Tungsten, molybdenum, tantalum, magnesium:					
Metals including alloys, all forms		4,195	5,810	1,804	Norway 3,465; Japan 295.
Uranium and thorium:					
Ore and concentrate	kilograms	500,380	237,750		All from West Germany.
Metal including alloys, all forms	do.	114	90		All from Japan.
Zinc: Metal including alloys:					
Unwrought		68,153	61,985	4,498	North Korea 17,225; West Germany 12,725.
Semimanufactures		1,604	559	(3)	Hong Kong 366; Japan 118.
Other:					
Ores and concentrates		243,325	471,002	10,608	India 173,617; Albania 88,237.
Oxides and hydroxides (iron, lead, zinc etc.)		10,775	3,972	384	West Germany 1,172; Japan 1,042.
Ashes and residues		2,865	4,223	14	U.S.S.R. 3,302; Netherlands 907.
Base metals:					
Scrap		7,353	7,587	1,548	Hong Kong 5,277; United Kingdom 358.
Unwrought and semimanufactures		10,457	1,661	31	West Germany 931; Zaire 392.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural[5]	value, thousands	$1,214	$628	$37	Hong Kong $294; Italy $140.
Grinding and polishing wheels and stones	do.	$6,048	$7,969	$701	Japan $4,049; Hong Kong $2,041.
Asbestos, crude		1,243	466	5	Mozambique 239; Zimbabwe 216.
Cement	thousand tons	2,106	1,518	(3)	North Korea 583; Hong Kong 373; U.S.S.R. 184.
Diamond: Natural:					
Gem, not set or strung	value, thousands	$37,897	$37,871	—	Hong Kong $12,853; Switzerland $12,360; Belgium-Luxembourg $6,342.
Industrial stones	do.	$7,986	$5,847	$803	Ireland $1,239; Belgium-Luxembourg $1,132.
Fertilizer materials:					
Crude, n.e.s.		11,299	11,112	—	Hong Kong 11,101.
Manufactured:					
Nitrogenous	thousand tons	5,620	8,629	516	U.S.S.R. 2,549; Romania 1,173; Kuwait 544.
Phosphatic	do.	292	156	37	Morocco 75; Tunisia 30.
Potassic	do.	1,787	2,244	29	Canada 1,351; Jordan 281.
Unspecified and mixed	do.	3,197	3,678	2,055	U.S.S.R. 188; Philippines 168.
Lime		92	160	—	Japan 80; Hong Kong 78.
Phosphates, crude		186,794	194,647		Morocco 120,916; Syria 73,587.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$33,749	$47,553	$116	Burma $30,771; Hong Kong $12,124.
Synthetic	do.	$365	$896	$320	Hong Kong $309; Brazil $132.

See footnotes at end of table.

TABLE 13—Continued

CHINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Quartz, mica, feldspar, etc.		37	369	73	Hong Kong 271; West Germany 10.
Salt and brine		217	405	1	Hong Kong 334; Japan 36.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value, thousands	$950	$97		Italy $63; Hong Kong $34.
Worked	do.	$17,257	$21,530	$614	Italy $13,609; Hong Kong $4,909.
Gravel and crushed rock		169	3,017	—	Hong Kong 2,915; Netherlands 52.
Calcareous stone[5]		423	527	121	France 220; Hong Kong 73.
Sand other than metal-bearing		85	118	—	Japan 104; Hong Kong 11.
Sulfur: Elemental: Crude including native and byproduct		31	20,598	([3])	Canada 20,561.
Other:					
Crude		1,628	30,495	738	Japan 11,336; Albania 9,494; Singapore 8,000.
Refractory minerals[5]		2,684	6,167	4,886	Japan 369; Singapore 296.
Slag and dross, not metal-bearing		53,524	96,411	106	North Korea 95,959; U.S.S.R. 133.
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Anthracite	thousand tons	1,717	1,597		All from North Korea.
Bituminous	do.	225	96		All from Australia.
Briquets of anthracite and bituminous coal	kilograms	907	—		
Coke and semicoke[6]		([3])	1,000	—	All from Japan.
Gas, natural: Gaseous	cubic meters	547	1,944		North Korea 1,558; Hong Kong 250.
Petroleum:					
Crude	thousand 42-gallon barrels	([3])	6,341	—	Oman 4,278; Indonesia 847; Malaysia 811.
Refinery products:					
Liquefied petroleum gas	value, thousands	$3,667	$6,565	$1,028	Singapore $2,338; Hong Kong $1,897.
Gasoline	thousand 42-gallon barrels	1,094	1,545	6	U.S.S.R. 929; Singapore 301.
Mineral jelly and wax	do.	11	6	([3])	Hong Kong 4.
Kerosene and jet fuel	do.	81	173	4	Singapore 123; Hong Kong 35.
Distillate fuel oil	do.	12,436	17,778	604	Singapore 12,639; U.S.S.R. 1,406.
Lubricants	do.	425	690	145	Hong Kong 203; Singapore 176.
Residual fuel oil	do.	766	2,530	38	Hong Kong 1,302; Singapore 1,180.
Petroleum bitumen, coke, etc.	do.	405	1,080	788	Albania 121; Singapore 85.

[1]Data presented in this table are from Summary Surveys of China's Customs Statistics. Table prepared by Audrey D. Wilkes.
[2]Includes alumina.
[3]Less than 1/2 unit.
[4]May include other precious ores and concentrates.
[5]Not further identified.
[6]Includes retort carbon.

TABLE 14

CHINA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year unless otherwise specified)
Aluminum:			
Bauxite	China National Nonferrous Metals Industry Corp.	Guangxi, Pingguo	300
Do.	do.	Guizhou, Guiyang	400
Do.	do.	Hunan, Zhengzhou	500
Metal	do.	Anhui, Hefei	25
Do.	do.	Gansu, Baiyin	50
Do.	do.	Gansu, Lanzhou	30
Do.	do.	Guangxi, Pingguo	40
Do.	do.	Guizhou, Guiyang	110
Do.	do.	Henan, Jiaozuo	30
Do.	do.	Henan, Sanmenxia	30
Do.	do.	Hebei, Wuhan	35
Do.	do.	Hunan, Changsa	15
Do.	do.	Jilin, Changchun	15
Do.	do.	Liaoning, Fushun	100
Do.	do.	Nei Monggol, Baotou	20
Do.	do.	Ningxia, Qingtongxia	100
Do.	do.	Ningxia, Yinchuan	30
Do.	do.	Qinghai, Xining	100
Do.	do.	Shaanxi, Tongchuan	10
Do.	do.	Shandong, Qingdao	15
Do.	do.	Shangdong, Zibo	100
Do.	do.	Shanxi, Taiyuan	25
Do.	do.	Yunnan, Kunming	15
Asbestos	China National Non-Metallic Minerals Industry Corp.	Gansu, ShanNam	130
Do.	do.	Nei Monggol, Baotou	
Do.	do.	Shanxi, Lai Yuan	
Do.	do.	Shanxi, Lu Liang	
Barite	do.	Guizhou, Xiangshou	NA
Coal, bituminous	Ministry of Coal Industry	Hebei	70,000
Do.	do.	Heilongjiang	70,000
Do.	do.	Henan	85,000
Do.	do.	Liaoning	50,000
Do.	do.	Shandong	60,000
Do.	do.	Shanxi	240,000
Do.	do.	Sichuan	60,000
Cobalt	China National Nonferrous Metals Industry Corp.	Hainan, Changjiang	5
Copper, refined		Anhui:	
Do.	do.	Tongling No. 1	30
Do.	do.	Tongling No. 2	30
Do.	do.	Gansu: Baiyin	110
Do.	do.	Hezheng Xian	35
Do.	do.	Wu Wei	35
Do.	do.	Henan, Zhuzhou	10
Do.	do.	Hubei, Daye	30

See footnotes at end of table.

TABLE 14—Continued

CHINA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year unless otherwise specified)
Copper, refined—Continued			
Do.	China National Nonferrous Metals Industry Corp.	Jiangxi, Guixi	90
Do.	do.	Liaoning, Shenyang	50
Do.	do.	Shanghai	65
Do.	do.	Shanxi, Taiyuan	35
Do.	do.	Tianjin	100
Do.	do.	Yunnan, Kunming	45
Gas, natural	do.	Sichuan	[1]2,000
Gold, refined	Ministry of Metallurgical Industry	Henan, Lingbao Shandong, Zhaoyuan	[2]90 [2]165
Graphite	China National Non-metallic Minerals Industry Corp.	Shandong, Laixi Shandong, Pingdu	190
Iron and steel:			
Iron ore	Maanshan Iron and Steel Co.	Anhui	7,500
Do.	Shoudu Iron and Steel Co.	Beijing	16,300
Do.	Meishan Iron Co.	Fujian	1,500
Do.	Jiuquan Iron and Steel Co.	Gansu	2,700
Do.	Hainan Mining Co.	Hainan	4,600
Do.	Hanxing Metallurgical Bureau	Hebei	2,900
Do.	Shirengau Mining Co.	do.	1,120
Do.	Wuhan Iron and Steel Co.	do.	5,100
Do.	Banshigau Mining Co.	Jiangxi	1,400
Do.	Anshan Iron and Steel Co.	Liaoning	26,800
Do.	Benxi Iron and Steel Co.	do.	13,700
Do.	Baotou Iron and Steel Co.	Nei Monggol	6,900
Do.	Taiyuan Iron and Steel Co.	Shanxi	2,850
Do.	Dabaoshan Mining Co.	Sichuan	1,670
Do.	Panzhihua Mining Co.	do.	8,260
Do.	Kuming Iron and Steel Co.	Yunnan	1,400
Ferroalloy	Maanshan Iron and Steel Co.	Anhui	30
Do.	Shoudu Iron and Steel Co.	Beijing	30
Do.	Northwest Ferroalloy Co.	Gansu	60
Do.	Zunyi Ferroalloy Co.	Guizhou	100
Do.	Hunan Ferroalloy Co.	Hunan	70
Do.	Jilin Ferroalloy Co.	Jilin	190
Do.	Jinzhou Ferroalloy Co.	Liaoning	50
Do.	Liaoyang Ferroalloy Co.	do.	50
Do.	Shanghai Steel Co.	Shanghai	180
Do.	Emei Ferroalloy Co.	Sichuan	40
Crude steel	Maanshan Iron and Steel Co.	Anhui	1,800
Do.	Wuhu Iron Co.	do.	2,000
Do.	Shoudu Iron and Steel Co.	Beijing	2,870
Do.	Tangshan Iron and Steel Co.	Hebei	1,370
Do.	Wuhan Iron and Steel Co.	Hubei	4,420

See footnotes at end of table.

TABLE 14—Continued

CHINA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year unless otherwise specified)
Iron and steel—Continued			
Crude steel—Continued	Anshan Iron and Steel Co.	Liaoning	8,100
Do.	Benxi Iron and Steel Co.	do.	1,650
Do.	Baotou Iron and Steel Co.	Nei Monggol	1,730
Do.	Baoshan Iron and Steel Co.	Shanghai	3,700
Do.	Shanghai Steel Co.	do.	5,700
Do.	Taiyuan Iron and Steel Co. No. 2.	Shanxi	1,580
Do.	Panzhihua Iron and Steel Co.	Sichuan	1,850
Do.	Tianjin Iron and Steel Co.	Tianjin	1,130
Lead	China National Nonferrous Metal Industry	Fujian, Lianchang	10
Do.	do.	Gansu, Baiyan	50
Do.	do.	Guangdong, Shaoquan	15
Do.	do.	Guangxi, Changpo	5
Do.	do.	Hunan, Songbai	10
Do.	do.	Hunan, Zhuzhou	50
Do.	do.	Liaoning, Shenyang	50
Do.	do.	Shanghai	5
Do.	do.	Yunnan, Lanping	20
Nickel, refined	China National Nonferrous Metals Industry Corp.	Gansu, Jinchuan	20
Petroleum, crude	China National Petroleum Corp.	Hebei, Shengli	33,350
Do.	do.	Heilongjiang, Daqing	55,000
Do.	do.	Liaoning, Liaohe	15,000
Do.	China National Offshore Oil Corp.	Beibu, Wan	
Do.	do.	Bohai, Wan	950
Do.	do.	Nanhai	
Potash	Ministry of Chemical Industry	Qinghai	40
Rare earth	Ministry of Metallurgical Industry	Nei Monggol, Baotou	25,000
Do.	do.	Gansu	5,000
Salt	Ministry of Chemical Industry	Anhui	200
Do.	do.	Qinghai	320
Talc	China National Non-Metallic Mineral Industry Co.	Guangxi, Longshen	130
Do.	do.	Liaoning, Haicheng	50
Do.	do.	Shandong, Qixia	5
Tin, smelter	China National Nonferrous Metal Industry Corp.	Guangxi, Dachang	5
Do.	do.	Yunnan, Geijiu	15
Tungsten concentrate	do.	Guangdong	
Do.	do.	Guangxi	
Do.	do.	Hunan	20
Do.	do.	Jiangxi	
Do.	do.	Zhejiang	
Zinc	do.	Fujian, Liancheng	15
Do.	do.	Gansu, Baiyan	100
Do.	do.	Guangdong, Shaoquan	30
Do.	do.	Guangxi, Changpo	20
Do.	do.	Hunan, Zhuzhou	135

See footnotes at end of table.

TABLE 14—Continued

CHINA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year unless otherwise specified)
Zinc—Continued	China National Nonferrous Metal Industry Corp.	Liaoning, Huludao	60
Do.	do.	Liaoning, Shenyang	20
Do.	do.	Yunnan, Lanping	40

NA Not available.
[1]Billion cubic feet.
[2]Thousand troy ounces.

TABLE 15

CHINA: TARGET PRODUCTION OF NONFERROUS METALS IN 1990

(Metric tons)

Metal	Quantity
Aluminum	850,000
Copper	550,000
Lead	260,000
Zinc	460,000
Total	2,120,000
Antimony	25,500
Magnesium	3,000
Mercury	900
Nickel	70,000
Tin	29,500
Titanium	1,100
Total	130,000
Grand total	2,250,000

industry from functioning at full capacity. Virtually all of the domestically produced fuels are internally consumed, with only small amounts of coal and oil made available for export to garner foreign exchange.

During the seventh plan, the planned annual growth rates for energy production are as follows: coal, 3%; oil 4%, natural gas, 3%, and electric power generation, 6%. By 1990, electric power generation is expected to reach 556 billion kW·h. About 75% of the new power generation is to be from thermal powerplants, mostly, if not all, coal-fired plants. During the plan period, the Gezhouba hydropower station is expected to be fully operational, with a total power generation of 14 billion kW·h. In addition, there are 11 hydropower stations proposed for construction, with a total generation of 61 billion kW·h. China has no electric power generation from nuclear reactors. However, construction has begun on a nuclear powerplant at Daya Wan, Guangdong, which calls for two 900-megawatt reactors. A second nuclear powerplant is also under construction, at Qinshan, Zheijiang.

During the seventh plan, the major areas expected to undergo more construction to expand coal production are in Hebei, Shanxi, Nei Monggol, Henan, Jiangsu, Anhui, Shandong, and Sichuan Provinces. The largest coal undertaking to date was the Sino-Occidental Oil Co.'s joint venture of the Pingshuo Mine at Antaibo, Shanxi, for a 15-million-ton-per-year mine. Most of the major coal mining regions under development are near the industrialized areas where increased production will ease energy shortages.

During the seventh plan, detailed surveys are to be made to explore oil-bearing formations in Liaohe, Shengli, Bohai, and Zhongyuan. In addition, China is to intensify development at Daqing and Shengli to maintain the present level of production and to increase output capacity at Dagang, Huabei, Liaohe, and Zhongyuan. Development is also to be focused on northwest China, especially the Junggar Basin in Xinjiang and the Qaidam Basin in Qinghai. China has opened the onshore area below the Chang Jiang to foreign oil companies for exploration. This area heretofore has not been extensively explored for oil. China is expected to continue joint-venture offshore exploration and development, especially in Bohai, Beibu, and Nan Hai.

Output of natural gas is expected to almost double by 1995, reaching 27 billion cubic meters. The increase in production is expected to come from the Tarim Basin in Xinjiang, the Yinggehai Basin in Beibu, gas wells in the Shaanxi-Gansu-Ningxia area in north-central China, and the Songhua-Liaohe river basin in northeast China.

As part of the national energy program, the State Council has promulgated energy conservation regulations, which went into effect April 1, 1986. The State Planning Commission and the State Economic Commission have been designated the primary energy conservation agencies, the latter for enforcing grassroots implementation in cooperation with regional authorities. The regulations apply to all sectors of the economy and are designed to tighten state control over energy use and waste and to foster the adoption of energy-efficient technology.

Coal.—China's premier fuel source is coal. Mine production in 1989 reached 1.054 billion tons, an increase of 60 million tons over output in the previous year. Shanxi Province continued to be the leading producer, accounting for 26% of the national output, followed by Henan with 8% and Heilongjiang with 7%.

The large energy-consuming area is east China, the industrial and agricultural output of which accounts for 75% of the total country's output value. However, coal production of east China constitutes only 34% of the total mined, of which Anhui, Hebei, Jiangsu, Shandong, eastern Nei Monggol, and the three northeastern Provinces—Heilongjiang, Liaoning, and Jilin—collectively account for 29% of the nation's coal output.

To ensure the continued growth in the economy, priority was being placed on coal development and production in east China, near the consuming areas, which would also ease the strain on rail transport.

TABLE 16

CHINA: INDUSTRIAL MINERAL RESOURCE BASES

	Administrative division: Principal location (other)	Principal commodity (other)
Talc Center	Liaoning: Haichnang (Gansu, Yingkoy, and Yiuyan)	Talc (magnesite and stone).
Do.	Shandong: Qixia (Haiyan, Pingduo, and Yiexian)	Talc (granite and marble).
Do.	Guangxi: Longshen	Talc.
Graphite Center	Shangdong: Nanshu (Beishu, Laixi, Pingduo)	Graphite (granite and marble).
Do.	Heilongjiang: Liumao (Jixi and Luobei)	Graphite.
Do.	Nei Monggol: Xinghe	Do.
East China Clay Base	Fujian: Longyan	Kaolin.
	Anhui: Jiashan	Attapulgite.
	Zhejiang: Linan	Bentonite.
Wollastonite Center	Jilin: Lishu and Panshi	Wollastonite.
	Jiutai	Bentonite.
	Chanbai	Diatomite.
	Penshi and Pingtong	Granite.
Silliimanite Center	Heilongjiang: Jixi	Sillimenite.
North China, East Mountain, and South-Central, Stone Material Base	Shangxi: Linqui	Granite.
	Hebei: Quyan	Marble.
	Shandong: Jinan, Rushan, Taishan	Granite.
	Henan: Yanshi	Do.
	Hubei: Huangang	Do.
	Guangdong: Liangian	Marble.

Between 1985 and 1987, 23 state-owned mines were placed in operation nationwide with a total output of 8.98 million tons at yearend 1987. According to the Ministry of Energy, output by these mines was to reach 10.13 million tons by 1990 and 17.32 million tons by 1995. In addition, there were 193 mines collectively producing 127 million tons per year. The state was to provide funding for exploration, mechanization, expansion, or technical upgrading to maintain their current aggregate level of output.

Another priority in the mining sector was for the reconstruction or expansion of the large state-owned mines as well as bringing on-stream new mining operations. Under the current 5-year plan (1986–90), 16 mines were to be put in operation with a total designed capacity of 16.09 million tons, and during 1991-95, production by 19 new mines was 14.46 million tons to the national output.

In comparison, 16 mines not under state ownership with a total annual capacity of 25.55 million tons were to be placed in operation by 1990, followed by 23 mines with a total capacity of 59.70 million tons by the last year of the eighth 5-year plan.

The Ministry also stressed expanding surface operations for mining brown coal. In Nei Monggol, the annual brown coal output capacity at Huolinhe was to reach 10 million tons by 1995 and 20 million tons by the year 2000. Similarly, capacity at Yiminhe was to attain the same targets as Huolinhe. At Yuanbaoshan, mine output was to reach 5 million tons by 1995.

Foreign funds were to be used for opening new mines. The first set of mines to be developed with overseas funding include the No. 2 and No. 3 mines at Jinan, a mine each at Futsun and Zieli, all in Shandong Province, at an estimated cost of $800 million. By 1990, the major coal-producing administrative divisions in east China would have a combined coal output of 287 million tons (202 million tons by the large, state-owned mines and 85.47 million tons by locally run mines), roughly equivalent to the total output by Shanxi Province alone. By 1995, output was to expand to 348.9 million tons (249 million tons for state-owned mines and 99.9 million tons by locally run mines).

In concert with other state agencies, a network of feeder railways in the mining districts were to be built to ensure coal movement. New power stations were to be built for the local power grid.

Petroleum.—According to the State Statistical Bureau, China's output of crude petroleum increased marginally to 137,000 tons in 1989. Onshore production totaled 136,650,000 tons compared with offshore output of 950,000 tons. Close to 75% of the national production is by the Daqing Oilfield, 55.55 million tons; Shengli, 33.35 million tons; and Liaohe, 15.35 million tons. Offshore production was from wells in Bhai and Beibu.

China National Petroleum Corp. (CNPC), formerly the Ministry of Petroleum Industry, is designated as the major prospector and sole developer and operator for onshore oil. Most of the onshore exploration is in the Junggar or Tarim Basin in Xinjiang. Between 1980 and 1989, the Ministry of Geology and Mineral Resources generated more than 50,000 line kilometers (km) of seismic profiles and sunk 160 exploratory wells. Two oil-bearing fields—Yiqikelike and Kehiya—were confirmed, 5 oil-bearing structures of commercial value were delineated, and 13 other structures have shown presence of hydrocarbons. Work has begun on developing the Huoshanshan

Oilfield to produce 1 million tons of oil (more than 7 million barrels) yearly. Preliminary estimates of oil reserves in the Hungu Basin is close to 10 billion tons (more than 70 million barrels) while that in the Tarin Basin is thought to be somewhat larger. Currently, the only commercial oil production in Xinjiang is by the Karamay Oilfield in northwest Jungar Basin.

The only other major development onshore was a newly found oil-bearing strata that was estimated to have several billion tons of reserves at the Liaohe Oilfield in northeast China. Five other oil-bearing strata have also been found north of Liaohe.

Because of dwindling onshore reserves, the Government continued to promote offshore exploration and development. Since its formation in 1982, China National Offshore Oil Corp. (CNOOC) had signed by yearend 1989 54 agreements and contracts with foreign firms, of which 20 have been relinquished. In 1989, 10 agreements and contracts were signed involving the completion of 22 to 25 wells.

Sixteen wildcat wells were drilled on 16 structures in 1989. Seven wells had oil or natural gas show. Thirteen appraisal wells were also drilled. CNOOC plans the development of 15 oilfields. Production of offshore crude oil in 1990 was projected at 1 to 1.2 million tons; 5 million tons in 1992; and as much as 8 million tons in 1995.

Reserves

China has numerous occurrences of a diverse array of metallic and industrial minerals and fossil fuels. The fuels industry is the country's most important and largest minerals sector in terms of resources and the quantity and value of output. Coal reserves are estimated to be in excess of 850 billion tons. Onshore oil reserves, estimated to be as much as 64.3 billion tons (470 billion barrels), are mainly from the commercial oil-bearing formations around Dagang, Daqing, Liaohe, Shengli in north China, and at the oil occurrences in Junggar, Karamay, and Tarim in Xinjiang. Estimates of China's offshore oil potential remains premature pending further delineation drilling and evaluation, especially in areas off the south China coast.

China has 55 billion tons of iron ore with an average grade of only 30% to 35% elemental content. Only 5% of the ore reserves contains 35% to 50% iron. The deposits vary widely in quality. Major deposits occur in Anhui, Hebei, Liaoning, and Nei Monggol.

Quantification for most of China's minerals resources are vaguely described. For instance, China's resources of rare earths is thought to be the largest in the world, the Jinquan deposit is described as the second largest nickel sulfide deposit in the world after that in Canada, and China's gold resources are estimated to be the sixth largest in the world.

With the exception of some commodities such as chromium, cobalt, and potash, China produces significant quantities of a wide array of minerals and metals, indicative of a large diverse resource base. China must possess world class reserves of antimony, barite, fluorspar, graphite, gypsum, magnesite, tungsten, and salt, for example, based on its production and/or export capability for these commodities.

INFRASTRUCTURE

Although China's communication-transport system is extensive, it is woefully inadequate to provide for the current needs of domestic commerce and foreign trade. There are more high-capacity highways and railroads in east and south China than in central and west China. However, the freight transport system in east China is overloaded. For example, Shanxi Province produces 25% of the national output of coal and has the capability to increase its production substantially. However, any increase in output has been restrained by the inadequacy of intraprovincial and interprovincial railways for coal haulage. China has 54,000 km of railway line, ranking fifth in the world. About 6,500 km is electrified. The longest rail line is the Fentai-Guangzhou with 2,295 km, followed by Lanzhou-Urumqi, 1,904 km; Lianyungang-Lanzhou, 1,754 km; and Tianjin-Shanghai, 1,323 km. During 1986–90, the Ministry of Railways is to update the heavily utilized railways in China. Overall, this is to include the addition of 3,600 km of new railway, double-tracking 3,300 km of existing lines, and adding 5,000 km of new electrified tracks. There is 980,000 km of highways, of which 162,000 km is paved, 617,200 km is gravel and/or improved earth roads, and the remainder is unimproved. There is 138,600 km of inland waterways, of which 109,800 km is navigable. Most of the navigable waterways are in Jiangsu, Guangdong, Zhejiang, Hunan, Sichuan, and Hubei, in that order, collectively accounting for 65% of the national total. China has 15 major ports and approximately 180 minor ones. The largest is Shanghai, which has an annual capacity of 115 million tons of cargo; next in size is Qinhuangdao with 45 million tons per year, followed by Dalien with a slightly smaller tonnage.

One of China's most ambitious projects is to harness the hydroelectric power potential of the Chang Jiang. The Gezhouba hydroelectric projects on the Chang Jiang, at Yichang, Hubei, has been designed to have 21 hydroelectric generators with a total capacity of 2.7 million kilowatts (kW). The planned output is 14.1 billion kilowatt hours per year. Ten 125,000-kW generators and two 170,000-kW generators were expected to be running by 1990, with a combined capacity of 1.6 million kW supplementing five 125,000-kW generators placed in operation during 1987–88. Under the seventh plan, priority has also been given to the construction of dams along the Hongshui River in Guangdong, the construction of the Ligiaxi Dam in Qinghai, and the Shuikou Dam in Fujian, and enlarging the Qingtongxi Dam in Ningxia.

There are 153 petroleum pipelines in China with a total length of 6,500 km for crude and 1,100 for refined products and 163 natural gas pipelines with a total length of 6,200 km.

OUTLOOK

Although China is already one of the world's leading producers of industrial minerals, metals, and fuels, it plans to increase production of various commodities in each sector. The annual production capacity in 1990 for crude steel is expected to reach 75 million tons; aluminum, 945,000 tons; copper, 550,000 tons; and gold, 112.5 million kilograms. More modest increases in capacity are planned for columbium and tantalum, lead, magnesium, nickel, titanium, and zinc. As for industrial mineral products, there are planned increases for the output capacity of cement, fertilizer, perlite, salt, soda ash, and titania. Although China is the world's leading producer of coal, annual output is planned to increase by at least 25 million tons by 1990. In addition to encouraging offshore oil exploration, China has opened the interior of the country for foreign exploration and development in an effort to increase the production of oil and natural gas. The planned increases in output during the seventh plan are expected to be consumed mostly domestically, inasmuch as China's per capita consumption of minerals, metals, and fuels has been very low and should increase. Any excess output will be made available for world trade. Because of its large resources, its production capability, and its need for foreign exchange, China is expected to continue to be a major force as a purveyor in the world market for such commodities as antimony, barite, fluorspar, magnesite, rare earths, talc, tungsten, vanadium, and yttrium. China is expected to remain a net importer of iron ore, steel, and fertilizers, particularly potash and, to a lesser extent, phosphate. As the result of industrial development being achieved under its ambitious modernization program, China's industry will be technologically better suited to the production of value added manufactures and advanced materials meeting international quality specifications. By the beginning of the 21st century, China will have laid the basis for the beginning of its economic transition in becoming a newly industrialized country.

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Ministry of Coal Industry
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Funei Dajie, Beijing

Ministry of Metallurgical Industry
46 Dongsi Xi Dajie, Beijing

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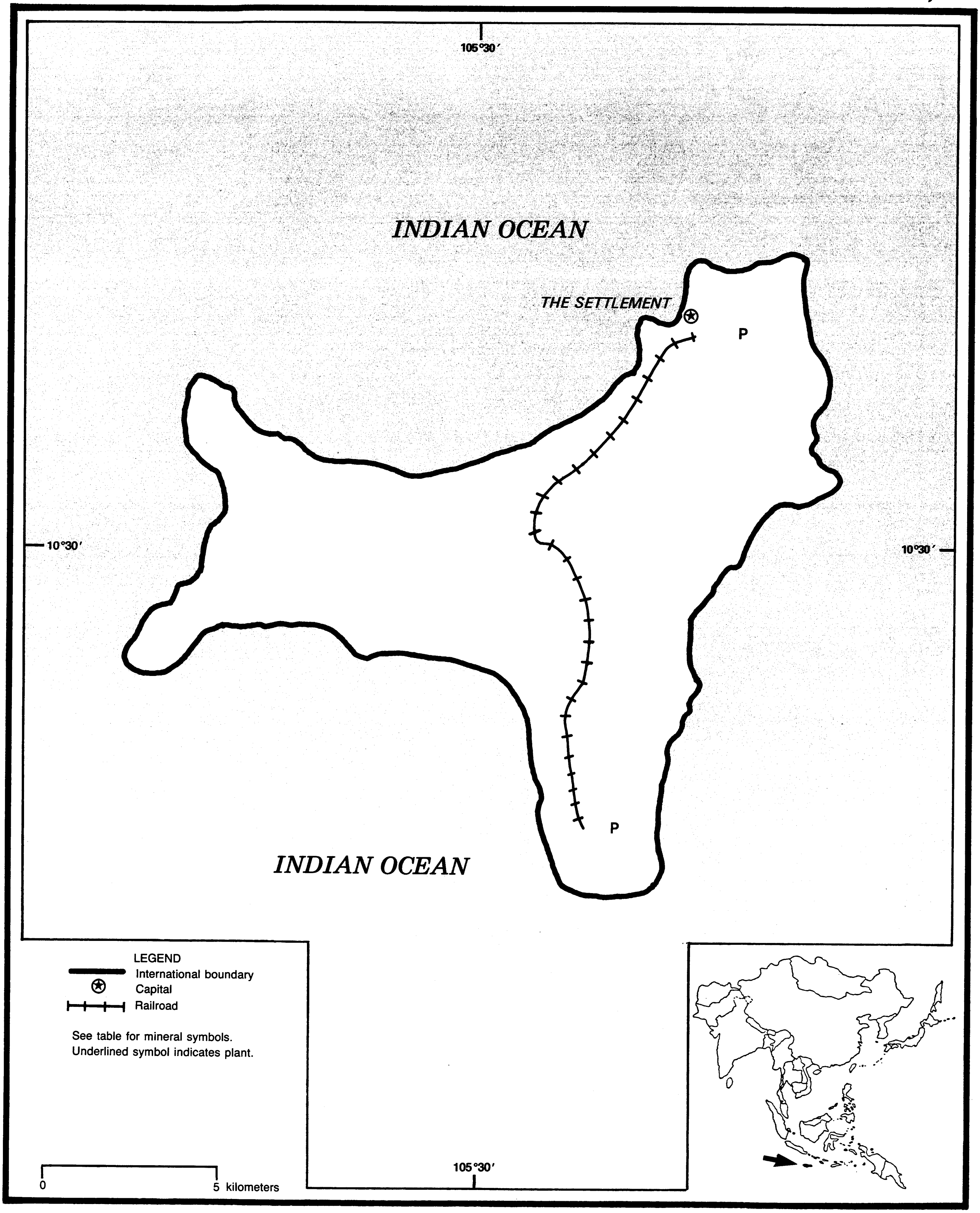
TERRITORY OF CHRISTMAS ISLAND

AREA 135 km² | **POPULATION 2,300**



THE MINERAL INDUSTRY OF

CHRISTMAS ISLAND

By Travis Q. Lyday

From 1897 until mining ceased in 1987, guano-base phosphate rock was the mainstay of the economy of the Territory of Christmas Island, an island territory of Australia in the Indian Ocean. The mining operation, owned by the Phosphate Mining Co. of Christmas Island, a wholly Australian Government-owned firm headquartered in Perth, was closed primarily because of the exhaustion of high-grade phosphate (A-grade rock) reserves. The area where what high-grade phosphate reserves remain has been classified as a national park to preserve the few remaining tall trees in the rain forest and, therefore, the natural habitat for the rare bird species on the island. Resources of B-grade rock are present in less sensitive parts of the island. The phosphate operation was also plagued by intense labor unrest, low productivity, and diminishing profits in its last year of operation, which also played a part in the closure.

There is one permanent-surface airport on the island and one shipping port, Flying Fish Cove. Electric generating capacity was reportedly 11,000 kilowatts.

TABLE 1

CHRISTMAS ISLAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Thousand metric tons)

Commodity[2]	1985	1986	1987	1988	1989
Phosphate rock, marketable:					
Gross weight	1,187	825	842	—	—
P_2O_5 content	418	288	294	—	—

[1] Table includes data available through Nov. 15, 1990.
[2] In addition to the commodity listed, crude construction materials such as sand and gravel and varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

TABLE 2

CHRISTMAS ISLAND: EXPORTS OF PHOSPHATE ROCK, BY DESTINATION

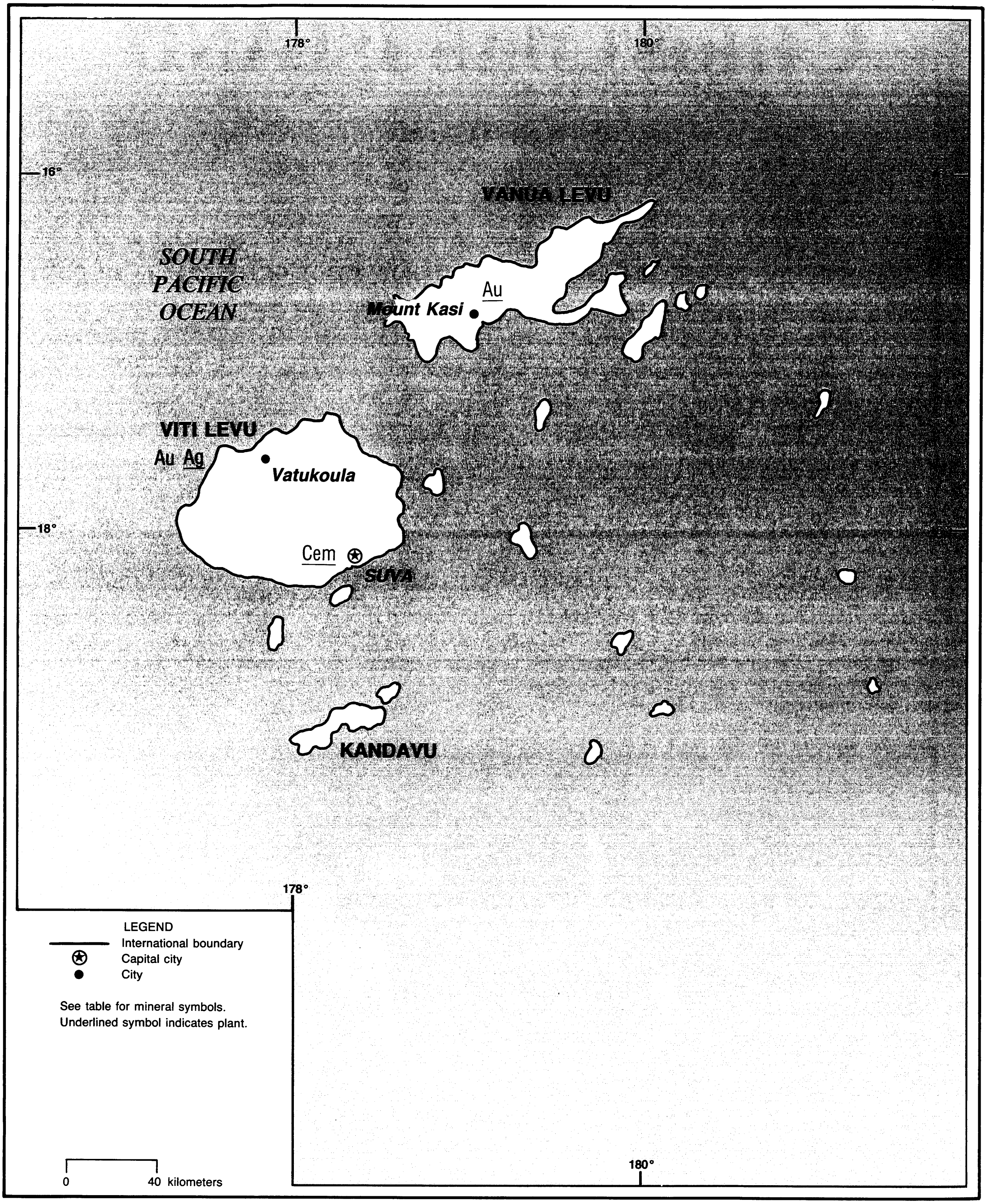
(Thousand metric tons)

Destination	1987	1988	1989
Australia	358.8	—	—
Indonesia	39.7	—	—
Japan	15.0	—	—
Korea, Republic of	9.3	—	—
Malaysia	253.8	—	—
New Zealand	164.9	—	—
Taiwan	5.4	—	—
Total	846.9	—	—

Source: Phosphate Rock Statistics 1989, International Fertilizer Industry Association Ltd.

FIJI

AREA 18,270 km² **POPULATION 757,000**



THE MINERAL INDUSTRY OF

FIJI

By Travis Q. Lyday

Fiji's mineral industry consists of two operating gold-silver mines, the Emperor and Tavua Basin, owned by the same companies and operating in close proximity to each other on the main island of Viti Levu; a cement plant near Suva; and several quarries for the production of stone and crushed gravel, limestone, and coral and river sands.

GOVERNMENT POLICIES AND PROGRAMS

In September, the Government signed a 15,000-barrel-per-day contract with Indonesia for the purchase of crude oil. The Government planned to sell the oil to a refinery for processing, then ship the refined products to Fiji for local consumption and distribution to neighboring countries.[1] Although the purpose was to achieve price stability rather than to lower fuel prices, refining costs were expected to be extremely high because of the very low grade of the crude.

PRODUCTION

The value of mine production continued to make a significant contribution to the Fiji economy, with gold production accounting for about 2% of the country's gross domestic product. Historically, gold mining has been carried out only at the Emperor Mine at Vatukoula in the northern part of Viti Levu. Since 1987, an ever-increasing amount has been produced from the Prince William deposit at Nasomo in the Tavua Basin, about 2.5 kilometers (km) south of the main Emperor workings.

TRADE

The value of unrefined gold and silver continued to be Fiji's second largest export, after sugar, and represented about 17% of export earnings.

STRUCTURE OF THE MINERAL INDUSTRY

The main mineral industry of Fiji is the underground/opencut gold operations at the Emperor Mine at Vatukoula, about 100 km northwest of the capital at Suva. The Emperor Mine produces silver as a byproduct, and until 1980, also recovered significant amounts of selenium and tellurium oxide from the telluride ore. Fiji has one cement plant at Lami just outside Suva. Other mineral industry operations in Fiji include quarries for stone and crushed gravel, limestone for the cement and lime industry, and coral and river sand dredging, all exclusively for domestic use.

COMMODITY REVIEW

Metals

Both the Emperor and Tavua Basin mine sites are managed and operated by

TABLE 1

FIJI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic		93,200	92,278	—	—	90,000
Gold, mine output, Au content	kilograms	1,888	2,952	2,962	4,273	[2]4,222
Lime[3]		3,261	2,305	—	—	2,000
Silver, mine output, Ag content	kilograms	442	531	843	995	[2]32
Stone, sand and gravel:[e]						
Coral sand for cement manufacture		126,500	160,900	85,585	[2]65,114	[2]82,487
River sand for cement manufacture		40,000	39,500	24,250	[2]14,157	[2]25,365
River sand and gravel, n.e.s.	cubic meters	1,200,000	577,500	[2]254,713	[2]1,219,800	1,000,000
Quarried stone	do.	105,030	160,000	[2]66,832	[2]49,711	[2]65,849

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Aug. 6, 1990.
[2] Reported figure.
[3] Produced from an unreported amount of domestically quarried limestone.

TABLE 2

STRUCTURE OF THE MINERAL INDUSTRY OF FIJI

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Capacity
Cement	Fiji Industries Ltd.	Suva, Vita Levu	105
Gold	Western Mining Corp. (Fiji)	Vatukoula, Vita Levu	[1]625
Do.	do.	Tavua Basin, Viti Levu	[2]1,710

[1]Throughput to the mill.
[2]Kilograms.

Western Mining Corp. (Fiji) Ltd. (WMCF), a wholly owned subsidiary of Australia's Western Mining Corp. Holdings Ltd., in joint venture with Emperor Gold Mining Co. Ltd. (EGM), a subsidiary of the United Kingdom-registered Emperor Mines Ltd. WMCF holds a 20% share in the Emperor Mine, the Vatukoula joint venture, and 50% in the operations at Nasomo, the Tavua Basin joint venture, with EGM owning the remainder of each.

The Vatukoula joint venture was planning to refurbish the Wallace-Smith shaft at the Emperor Mine to enable better access to the higher grade northern section of the mine. In addition, a new carbon-in-leach plant was scheduled to be built to increase throughput to the mill by 20%, to 750,000 tons per year.

Beta Ltd., a company owned by Gold Resources Ltd., 53%, and Associated Gold Fields NL, 47%, conducted geological mapping, geochemical sampling, and magnetic surveying during the first semester of the year on Kandavu Island as part of its gold exploration program.

Solomon Pacific Resources NL's wholly owned subsidiary, Solpac (Fiji) Ltd., continued exploration in the area of former underground workings at its Wainivesi gold prospect on Veti Levu, which included additional channel trenching and soil sampling. Moderate to strong sulfide mineralization was reported just to the west of the old workings.[2]

Newmont Pty. Ltd., having a 65% interest in the project, and Range Resources Ltd., with a 35% interest and acting as manager, applied for renewal of its special prospecting license to locate extensions to the known ore deposits at Mount Kasi on Vanua Levu. Mount Kasi previously was mined in the 1940's and currently is regarded as the second most significant gold prospect in Fiji, after that at Vatukoula (both the Emperor and Tavua Basin Mines).[3] Mineralization consists of eluvial and hard-rock zones.

Industrial Minerals

Paget Goldmining (Fiji) Ltd., a subsidiary of Australia's Paget Gold Mining Co. Ltd., was about 75% finished with its Environmental Impact Statement covering a 350-hectare marble prospecting lease near Toga village in the Sigatoka Valley on the southwestern coast of Viti Levu at yearend. The marble deposit has been described as being comparable with Italian marble, having a very fine grain and excellent polishing characteristics.[4]

Reserves

Metallic mineralization is widespread in Fiji, occurring as polymetallic base metal sulfide deposits, disseminated porphyry copper deposits, epithermal precious metal deposits, residual bauxite deposits, and manganese and heavy-mineral sand deposits. However, gold is the only mineralization being mined at present.

Proven recoverable reserves at the Emperor Mine are 1.2 million tons of ore grading 6.4 grams of gold per ton. The Nasomo deposit at Tavua Basin has proven recoverable reserves of 300,000 tons of ore grading 14 grams of gold per ton.

Australian-based Climax Mining Ltd. reported an indicated resource of 500,000 tons of ore grading 7 grams of gold per ton at its Faddys gold prospect in western Veti Levu, and Newmont and Range Resources reported a geological resource of 2.5 million tons of ore grading 2.5 grams of gold per ton at the Mount Kasi prospect in southwestern Vanua Levu.[5]

INFRASTRUCTURE

Essential elements of the island's infrastructure include 644 km of narrow-gauge railroad belonging to the Government-owned Fiji Sugar Corp.; 3,300 km of roads, including 390 km paved; 1,200 km bituminous-surface treated; 1,290 km gravel, crushed stone, or stabilized-soil surface; and 420 km unimproved earth. Inland waterways consist of 203 km, of which 122 km are navigable by motorized craft and 200-ton barges. There are 4 ports for international shipping and 26 airports in the country. Generating capacity in 1988 was reportedly 215,000 kilowatts.

Generally, infrastructure for mineral industry operations are regarded as adequate.

OUTLOOK

Although two military coups occurred in 1987, there has not been any adverse impact on exploration and mining in the country. The exploration by the minerals sector was expected to continue apace, especially for gold mineralization. About 45% of the country's land area was under active exploration and governed by more than 80 exploration licenses—a level of tenements as high as it has ever been. Expenditures on mineral exploration were estimated to be $5 million[6] in 1989, 5% more than in 1988. Production of gold has increased significantly in both years since the coups and is expected to increase in the near term as the Tavua Basin Mine continues to be developed.

[1]Far Eastern Economic Review (Hong Kong). Asia 1990 Yearbook. Dec. 1989, p. 120.

[2]Pacific Islands Monthly (Suva, Fiji). V. 59, No. 20, Sept. 1989, p. 38.

[3]Australian Journal of Mining (Richmond North, Australia). V. 4, No. 35, Aug. 1989, p. 27.

[4]Pacific Islands Monthly (Suva, Fiji). V. 60, No. 3, Mar. 1990, p. 31.

[5]Australian Journal of Mining (Richmond North, Australia). V. 4, No. 37, Oct. 1989, p. 64.

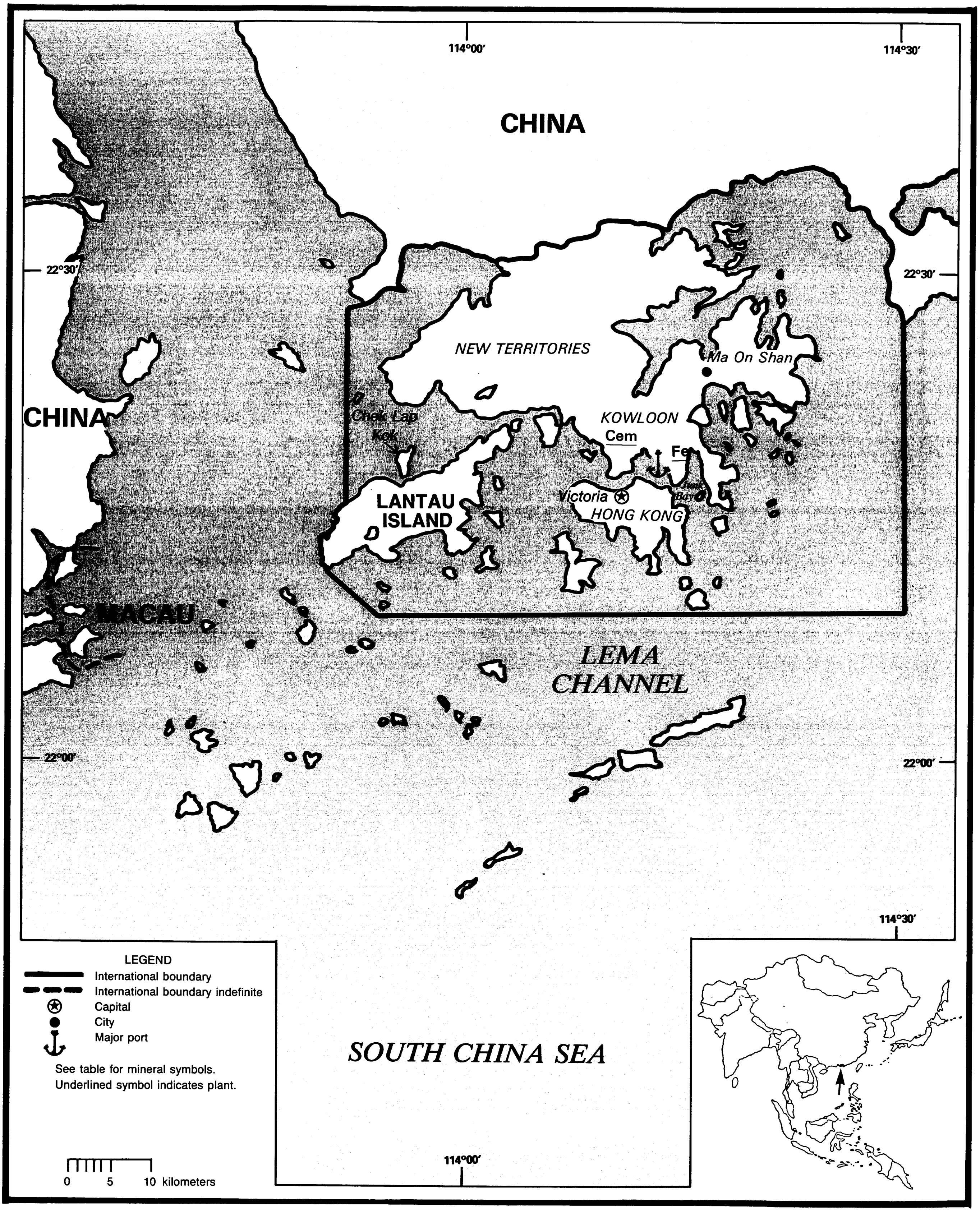
[6]Where necessary, values have been converted from the Fijian dollar (F$) to U.S. dollars at the rate of F$1.6=US$1.00.

OTHER SOURCES OF INFORMATION

Department of Mineral Resources
Suva, Fiji

HONG KONG AND MACAU

AREA 1,040 km² **POPULATION 5.8 million**



THE MINERAL INDUSTRY OF

HONG KONG AND MACAU

By Pui-Kwan Tse

The British Crown Colony of Hong Kong consists of Hong Kong Island, Lamma Island, Lantau Island, Stonecutter Island, Kowloon, the New Territories, and numerous outlying islands. Because of very limited resources, Hong Kong depended on imports for virtually all of its requirements—food, fuel, capital goods, raw materials, and water. Therefore, the economy was based on exports of value added goods and manufactures to generate sufficient foreign exchange earnings. Mining and quarrying were insignificant to the gross domestic product (GDP) as well as to total employment. Only small quantities of industrial minerals were produced, which were locally consumed. These included crushed rock aggregates, sand, and minor quantities of feldspar and kaolin.

Light industry was the bulwark of the economy. Clothing and textiles made up the largest industrial sector, followed by, in order of value, electronics, plastics, and watches and clocks. Ninety percent of the manufacturing output was exported, accounting for 95% of the value of total domestic exports.

The GDP in 1989 at current market prices was $57 billion, representing a per capita GDP of close to $10,000. Hong Kong's trade in 1989 totaled $145.3 billion, composed of the following: imports, $72.2 billion; domestic exports, $28.7 billion; and reexports, $44.4 billion.

Under three treaties concluded in 1843, 1860, and 1898, Hong Kong was to be administered as a British Crown Colony under a 99-year lease. On December 19, 1984, an agreement was reached between the Governments of China and the United Kingdom to return Hong Kong to Chinese sovereignty on July 1, 1997. The treaties of 1843 and 1860 whereby Hong Kong Island, the southern part of Kowloon Peninsula, and Stonecutters Island had been ceded in perpetuity to Britain will be voided. Under the 1984 agreement, in 1997, Hong Kong is to become a Special Administrative Region under Chinese sovereignty. For 50 years beyond the transfer data, Hong Kong's economic and social system is to remain unchanged.

On December 1, 1887, a treaty of amity and commerce was signed between China and Portugal placing Macau Peninsula and the islands of Coloane and Tarpa under Portugese administration. On June 30, 1986, representatives of the Governments of China and Portugal initiated discussion to return Macau to Chinese sovereignty. An agreement was reached on April 13, 1987, to return Macau to China on December 20, 1999. For 50 years beyond the transfer date, Macau's economic and social system is to remain unchanged. Consisting of a total land area of only 16 square-kilometers, Macau houses a population of 442,000, of which 95% are of Chinese descent.

Macau, with no mining industry, was dependent on imports for food, fuel, and construction and other raw materials. Foreign exchange was generated by manufacturing furniture, plastic products, textiles, and toys for export. The GDP in 1989 was $2.7 billion, equivalent to a per capita GDP of about $6,300. Trade in 1989 totaled $3.3 billion, composed of $1.7 billion for exports and $1.6 billion for imports.

GOVERNMENT POLICIES AND PROGRAMS

The Mines Div. of Hong Kong's Labour Department enforced legislative and safety regulations on mining and quarrying. In addition, it controlled the manufacture, storage, conveyance, and use of explosives in Hong Kong. At the end of 1989, there was only one mining lease for the extraction of feldspar and kaolin extant.

The Geotechnical Control Office (GCO) of the Civil Engineering Services Department supervised the production of rock aggregates by seven contract quarries and implemented landscape restoration of metropolitan quarries. GCO was also identifying sites and preparing an inventory of marine sand and gravel resources for use in reclamation and building construction. In mid-1989, a Fill Management Committee was created to project demand and to manage the use of fill resources for future development within Hong Kong's territories.

PRODUCTION

Because of severe land use limitations, the input of agriculture and fishery (culture as well as marine capture) and mining and quarrying, collectively, constituted a very small part of the colony's economy, each representing only 0.3% and 0.1%, respectively, of the GDP. Annual mine output included small quantities of feldspar and kaolin, and more than 10 million metric tons of crushed rock aggregate. The manufacture of cement from imported clinker was about 2,100,000 tons annually.

TRADE

As of January 1, 1988, Hong Kong adopted the use of the new trade classification known as the Harmonized Commodity Coding and Description System (Harmonized System). However, the trade statistics published are conversions of commodity data reported on import and export declarations to the Hong Kong modification

TABLE 1

HONG KONG: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
Cement, hydraulic	thousand tons	1,835	2,236	2,226	2,189	2,141
Clays:						
Kaolin		9,602	850	—	—	—
Other		82,446	68,737	92,504	61,888	44,562
Feldspar		26,777	35,208	22,853	11,050	5,152
Iron and steel: Metal: Steel, crude[e]		120,000	120,000	120,000	120,000	120,000
Quartz		116	33	—	—	—

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Oct. 25, 1990.
[2] In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimated of output levels.

of the Standard International Trade Classification Revision 2.

In 1989, total exports were valued at $73.1 billion, composed of domestic exports of $28.7 billion and reexports at $44.4 billion. Imports were valued at $72.2 billion. The leading markets for domestic exports were: the United States, $9.25 billion; China, $5.55 billion; Federal Republic of Germany, $2.01 billion; United Kingdom, $1.88 billion; Japan, $1.78 billion; Canada, $0.81 billion; Singapore, $0.74 billion; the Netherlands, $0.61 billion; Taiwan $0.57 billion; and Australia $0.54 billion. The sources of and markets for reexports by major trading countries in 1989 are shown in table 2.

The suppliers of imports by major trading countries were as follows:

TABLE 2

HONG KONG: SOURCES AND DESTINATIONS OF REEXPORTS IN 1989

(Billion tons)

	Source	Destination
China	24.14	13.27
Japan	4.99	2.85
Taiwan	3.46	2.11
United States	2.86	9.23
Korea, Republic of	1.45	1.70
Singapore	.65	1.41
Germany, Federal Republic of	.63	1.68
Switzerland	.52	—
France	.48	—
United Kingdom	.47	1.14
Australia	—	.74

China, $25.21 billion; Japan, $11.95 billion; Taiwan, $6.51 billion; United States, $5.93 billion; Republic of Korea, $3.26 billion; Singapore, $2.85 billion; Federal Republic of Germany, $1.74 billion; United Kingdom, $1.66 billion; Switzerland, $1.24 billion; and Italy, $1.30 billion.

Textile, fabric, apparel, and clothing accessories remained the largest component of domestic exports in 1989, valued at $11.08 billion. Shipments of watches and clocks were valued at $2.09 billion, and shipments for jewelry and gold and silversmiths' ware were valued at $0.84 billion. Exports in the electrical and electronics equipment category included electronic and computer components, $1.05 billion; household type equipment, $0.55 billion; telephone apparatus, $0.20 billion; and radio receivers, $0.19 billion. Other important exports included toys and dolls, $0.75 billion; resins and plastic materials, $0.70 billion; cuttery and household utensils, $0.68 billion; and articles and manufactures of plastic, $0.61 billion.

Receipts of raw materials and semimanufactures in 1989 were valued at $29.55 billion, constituting 41% of total imports. The other major import categories included consumer goods, $25.84 billion; capital goods, $11.46 billion; foodstuffs, $4.36 billion; and fuels, $1.60 billion.

STRUCTURE OF THE MINERAL INDUSTRY

The mineral industry of Hong Kong consisted of one private operation for the mining of feldspar and kaolin. The only other mineral output was rock aggregates produced by quarries under contract to the Government and aggregates produced by blasting for civil construction projects. The domestic iron and steel output was limited because of lack of natural resources. Three small steelworks, Shiu Wing, Shon Fung, and Fuji Marden all in Junk Bay, used electric arc furnaces to generate a total production of 12,000 tons of steel per year.

INFRASTRUCTURE

Hong Kong was one of the world's leading maritime centers with a world class port. It moved more container tonnage than any other single port in the world. Hong Kong's merchant marine fleet numbered more than 130 ships, and its shipowners controlled more than 50 million dead weight tons, making the industry a global force.

The colony had 35 kilometers (km) of 1.435-meter standard gauge of Government-owned railroads. There were 1,100 km of highways; 794 km of which were paved, and 306 km of gravel, crushed stone, or earth.

Kai Tak International Airport, with runways of 2,400 to 3,659 meters, handled more than 25 million passengers a year.

Hong Kong had modern telecommunications facilities providing domestic and international services via telephone, microwave transmission link-

TABLE 3

HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988 United States	Destinations, 1988 Other (principal)
METALS				
Alkali and alkaline-earth metals	109	176	10	Taiwan 79; Japan 30.
Aluminum:				
Ore and concentrate	25,971	15,010	—	Taiwan 9,630; Indonesia 3,509; Republic of Korea 1,580.
Oxides and hydroxides	1,193	20,137	—	Taiwan 20,000; Japan 77.
Metal including alloys:				
Scrap	27,656	31,928	117	Japan 26,748; China 2,699.
Unwrought	36,181	77,616	1,286	Republic of Korea 28,603; Japan 13,194.
Semimanufactures	35,479	48,511	2,948	China 30,635; Taiwan 6,250.
Arsenic: Oxides and acids	441	574	54	New Zealand 71; Egypt 70; Indonesia 68.
Beryllium: Metal including alloys, all forms value, thousands	$5	$1	—	All to China.
Chromium: Oxides and hydroxides	1,858	544	36	Taiwan 209; Netherlands 90; China 79.
Cobalt: Oxides and hydroxides	21	14	—	Singapore 4; Taiwan 3; North Korea 2.
Columbium and tantalum: Tantalum metal including alloys all forms	—	7	7	
Copper:				
Oxides and hydroxides	219	384	—	China 383.
Sulfate	70	445	40	China 297; Republic of Korea 42.
Metal including alloys:				
Scrap	36,954	62,368	183	Japan 22,788; China 17,559; Republic of Korea 10,602
Unwrought	3,792	32,888	1,442	Republic of Korea 8,608; Taiwan 5,825.
Semimanufactures	17,756	40,474	486	China 24,734; Taiwan 6,476.
Gold:				
Waste and sweepings value, thousands	$19,321	$10,652	$298	Australia $5,673; United Kingdom $2,546.
Metal including alloys, unwrought and partly wrought kilograms	15,815	23,333	(2)	Taiwan 16,280; China 3,454.
Iron and steel: Metal:				
Scrap	345,259	428,310	—	Taiwan 143,630; Indonesia 95,402; Japan 61,686.
Pig iron, cast iron, related materials	421	5,634	—	India 3,819; China 977; Taiwan 590.
Ferroalloys:				
Ferromanganese	1,540	4,297	—	Thailand 1,486; Taiwan 1,271; Indonesia 951.
Ferrosilicon	30,135	82,494	—	Japan 33,135; Republic of Korea 32,483; Taiwan 9,514.
Unspecified	6,524	9,753	305	China 3,755; Japan 2,211; Netherlands 1,294.
Steel, primary forms	13,174	34,934	—	Taiwan 11,426; Indonesia 6,272; Japan 6,150.
Semimanufactures:				
Bars, rods, angles, shapes, sections	181,751	201,360	—	China 140,365; Macau 36,339.
Universals, plates, sheets	203,006	320,449	1	China 265,015; Taiwan 11,012; Thailand 10,521.
Hoop and strip	28,496	85,997	6	China 79,866; Taiwan 2,308.
Rails and accessories	40	468	—	Taiwan 410; China 58.
Wire	20,154	28,335	1,356	China 23,858; Taiwan 896.
Tubes, pipes, fittings	37,616	39,388	384	China 29,541; Macau 2,878.
Castings and forgings, rough	3	3,245	1,267	China 1,339; Taiwan 284.

See footnotes at end of table.

TABLE 3—Continued

HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988 United States	Destinations, 1988 Other (principal)
METALS—Continued				
Lead:				
Ore and concentrate	194	143	—	All to Belgium-Luxembourg.
Oxides	266	295	36	Indonesia 119; Australia 72.
Metal including alloys:				
Scrap	3,523	3,266	—	China 1,965; Taiwan 1,191.
Unwrought	11,561	5,691	162	Republic of Korea 3,031; China 1,595.
Semimanufactures	106	98	—	China 65; Brunei 18.
Magnesium: Metal including alloys:				
Scrap	42	12	—	All to Japan.
Unwrought	50	292	—	China 250; Japan 30.
Semimanufactures value, thousands	$4	—		
Manganese:				
Ore and concentrate	725	629	—	Taiwan 429; Republic of Korea 200.
Oxides	1,965	3,199	—	Republic of Korea 945; Netherlands 542; China 391.
Mercury	243	81	—	Australia 36; China 11; India 11.
Molybdenum: Metal including alloys:				
Unwrought	6	26	19	United Kingdom 4; Taiwan 2.
Nickel:				
Oxides and hydroxides	76	39	—	China 22; Taiwan 5; Singapore 4.
Metal including alloys:				
Scrap	956	526	—	Japan 244; Taiwan 238.
Unwrought	6,227	4,979	47	China 1,696; Taiwan 1,071.
Semimanufactures	260	135	—	China 112; Taiwan 9.
Platinum-group metals:				
Waste and sweepings value, thousands	$9,054	$5,994	$4,872	United Kingdom $1,074.
Metals including alloys, unwrought and partly wrought kilograms	2,642	2,217	1,107	China 322; Japan 253.
Silver:				
Waste and sweepings value, thousands	$45,222	$30,364	$4	West Germany $16,896; United Kingdom $12,865.
Metal including alloys, unwrought and partly wrought kilograms	35,720	45,332	—	Thailand 14,785; Taiwan 10,643; China 8,540.
Tin:				
Ore and concentrate	6,912	16,248	138	Singapore 6,067; Malaysia 5,073.
Oxides kilograms	20	2,000	—	All to Taiwan.
Metal including alloys:				
Scrap	155	61	21	Taiwan 21; Japan 9.
Unwrought	2,176	3,149	647	Japan 1,448; Taiwan 594.
Semimanufactures	1,196	706	([2])	China 507; Taiwan 52.
Titanium: Oxides	4,784	13,210	957	China 3,678; U.S.S.R. 1,554; Republic of Korea 1,051.
Tungsten:				
Ore and concentrate	3,692	2,008	1,233	U.S.S.R. 346; Netherlands 170.
Metal including alloys:				
Scrap	7	29	22	Singapore 6.
Unwrought and semimanufactures	4	7	1	Taiwan 3; China 1.

See footnotes at end of table.

TABLE 3—Continued

HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988 United States	Destinations, 1988 Other (principal)
METALS—Continued				
Uranium and thorium: Oxides and other compounds	19	98	—	Japan 39; France 35; Indonesia 20.
Zinc:				
Oxides	763	3,747	335	Netherlands 888; China 469; United Kingdom 448.
Blue powder	154	102	—	All to China.
Metal including alloys:				
Scrap	109	1,105	—	China 1,068; Taiwan 37.
Unwrought	68,391	29,924	100	China 16,349; Republic of Korea 5,700.
Semimanufactures	123	130	—	China 102; Taiwan 11.
Other:				
Ores and concentrates	6,373	5,115	269	Republic of Korea 2,840; Taiwan 1,030.
Metalloids, unspecified[3]	18,033	36,276	4,043	Japan 19,967; Taiwan 3,491.
Ashes and residues	1,888	2,235	—	China 1,770; Taiwan 257.
Base metals including alloys, all forms	11,067	9,265	1,701	Netherlands 3,242; Japan 946.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	10,783	19,872	245	China 5,277; Taiwan 4,620; Macau 3,709.
Artificial:				
Corundum	26,258	40,010	572	Taiwan 14,403; Republic of Korea 12,927.
Silicon carbide	4,319	5,786	1,749	Taiwan 1,578; Republic of Korea 1,419.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$329	$776	$2	Republic of Korea $670; Taiwan $59.
Grinding and polishing wheels and stones	2,671	3,336	255	Indonesia 1,353; China 630.
Asbestos, crude	36	187	—	Indonesia 160; Republic of Korea 16.
Barite and witherite	2,396	5,941	—	Japan 1,895; Republic of Korea 1,255; Republic of South Africa 1,143.
Boron materials:				
Crude natural borates	9	—		
Oxides and acids	9,503	3,011	—	China 2,556; Vietnam 202; Taiwan 122.
Cement thousand tons	1,064	967	—	Macau 588; China 364.
Chalk	—	1	—	All to Philippines.
Clays, crude:				
Kaolin	176,647	263,611	—	Taiwan 206,005; Republic of Korea 41,019; Philippines 7,032.
Unspecified	8,084	20,457	—	Taiwan 17,026; Republic of Korea 2,290; Indonesia 687.
Diamond: Natural:				
Gem, not set or strung carats	746,988	1,247,673	371,433	Belgium-Luxembourg 276,661; Japan 184,202.
Industrial stones do.	136,678	122,784	1,256	China 81,063; Netherlands 28,785.
Diatomite and other infusorial earth	624	1,440	—	China 1,107; Taiwan 329.
Feldspar, fluorspar, related materials	77,515	79,524	—	Taiwan 68,686; Indonesia 6,680; Republic of Korea 3,786.
Fertilizer materials:				
Crude, n.e.s.	590	259	—	China 225; Taiwan 23.
Manufactured:				
Ammonia	108	919	—	China 914.
Nitrogenous	23,288	53,981	—	China 51,377; Philippines 2,402.

See footnotes at end of table.

TABLE 3—Continued

HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988 United States	Destinations, 1988 Other (principal)
INDUSTRIAL MINERALS—Continued					
Fertilizer materials—Continued					
Manufactured—Continued					
Phosphatic		2,622	181	—	Malaysia 117; Singapore 64.
Potassic		10	5,100	—	All to China.
Unspecified and mixed		2,862	100,954	3	Vietnam 51,992; China 48,797.
Graphite, natural		3,781	3,930	—	Republic of Korea 2,779; Taiwan 645; Poland 369.
Gypsum and plaster		4,960	2,928	17	China 1,243; Indonesia 967.
Iodine	kilograms	2,475	15,201	—	All to China.
Lime		226	5	—	Do.
Magnesium compounds:					
Magnesite, crude		24,343	33,371	—	Taiwan 26,486; Indonesia 4,497.
Oxides and hydroxides		1,295	8,734	—	Taiwan 5,253; Republic of Korea 2,684; Philippines 465.
Mica:					
Crude including splittings and waste		172	751	—	Taiwan 653; Japan 52.
Worked including agglomerated splittings		270	362	—	China 331; Republic of Korea 12.
Nitrates, crude		495	1,000	—	Indonesia 329; Republic of South Africa 270; Republic of Korea 160.
Phosphates, crude		550	—		
Pigments, mineral:					
Natural, crude		648	457	—	Indonesia 200; Dominican Republic 136; Taiwan 55.
Iron oxides and hydroxides, processed		4,151	6,364	—	Egypt 1,376; China 1,293; Indonesia 1,276.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$131,937	$172,617	$36,190	Japan $62,580; China $15,730.
Synthetic	do.	$920	$1,580	$189	Taiwan $384; China $255.
Salt and brine		614	1,757	—	China 1,072; Philippines 280.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		100,819	108,458	—	China 108,037; Macau 203.
Sulfate, manufactured		47,274	23,993	18	Indonesia 6,683; Republic of Korea 5,507.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		9,056	25,642	50	Taiwan 22,192; Japan 1,249.
Worked		16,454	15,477	852	China 9,572; Macau 1,320.
Dolomite, chiefly refractory-grade		66	69	—	Indonesia 51; China 18.
Gravel and crushed rock		1,704	6,058	—	Taiwan 2,995; China 2,716.
Limestone other than dimension		2,411	955	—	China 849; Republic of South Africa 46.
Quartz and quartzite		935	1,771	—	Taiwan 1,611; Nigeria 125.
Sand other than metal-bearing		537	582	—	China 486; Republic of Korea 24; Taiwan 23.
Sulfur:					
Elemental:					
Crude including native and byproduct		112	54	—	Vietnam 50; China 4.
Colloidal, precipitated, sublimed		88	169	—	Indonesia 90; Taiwan 22; China 20.
Sulfuric acid		155	301	—	China 287; Sudan 10.
Talc, steatite, soapstone, pyrophyllite		25,204	50,559	—	Taiwan 21,665; Indonesia 20,498; Malaysia 4,698.

See footnotes at end of table.

TABLE 3—Continued

HONG KONG: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Other:					
Crude		849	3,780	—	Taiwan 2,738; Republic of Korea 305; Nigeria 300.
Slag and dross, not metal-bearing		964	87	—	China 70; Taiwan 17.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		3	51	—	Macau 33; China 17.
Carbon black		1,649	7,028	—	Indonesia 4,756; Vietnam 530; Zimbabwe 452.
Coal: Anthracite		—	66	—	All to Macau.
Coke and semicoke		635	373	—	Indonesia 320; Taiwan 53.
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	154	192	—	China 109; Macau 83.
Gasoline	do.	165	265	—	China 146; Macau 119.
Mineral jelly and wax	do.	160	208	—	Republic of South Africa 100; Singapore 22; China 20.
Kerosene and jet fuel	do.	64	58	—	China 38; Macau 20.
Distillate fuel oil	do.	1,972	3,056	—	China 2,921; Macau 135.
Lubricants	do.	448	571	—	China 384; Taiwan 93.
Nonlubricating oils	do.	24	257	—	Philippines 149; Indonesia 54.
Residual fuel oil	do.	2,001	3,812	—	China 2,829; Macau 983.
Bitumen and other residues	do.	5	3	—	Macau 2; China 1.
Bituminous mixtures	do.	(2)	1	—	China(2); Macau(2).

[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Reported under SITC item 522.120 as "selenium, tellurium, phosphorus, arsenic, silicon and boron."

age, and a fiber optic transmission network.

Electricity in the colony was supplied by two commercial companies: Hong Kong Electric Co. Ltd. (HEC) and China Light and Power Co. Ltd. (CLP). HEC supplied Hong Kong Island and the neighboring islands of Ap Lei Chau and Lamma, while CLP supplied all of Kowloon and the New Territories, including Lantau and a number of other outlying islands. On January 18, 1985, Hong Kong Nuclear Investment Co., a wholly owned subsidiary of CLP, and Guangdong Nuclear Investment Co. of China ratified a joint-venture contract for the formation of Guangdong Nuclear Power Joint Venture Co. The joint-venture company will construct and operate a nuclear power station at Daya Bay in Guangdong Province. The power station will be composed of two 900-megawatt pressurized water reactors, scheduled for commissioning in 1992 and 1993. CLP will purchase about 70% of the power generated to meet anticipated, longer term demand.

Towngas and liquefied petroleum gas (LPG) was used throughout the colony for domestic, commercial, and industrial purposes. LPG accounted for 58% of the total gas sold. Towngas was distributed by Hong Kong and China Gas Co. Ltd. and LPG by major oil companies based in Hong Kong, e.g., Shell Oil Co., Mobil Oil Co., Esso Oil Co., etc.

Macau had 42 km of paved roads. Because of limited land area, there were no airfields. Because of silting, the harbor only accommodates freighters of limited tonnage for merchandise trade. Its chief feature was frequent schedules for passenger transport to and from Hong Kong by ferries, hydrofoils, hover ferries, and catamarans. Macau's casinos were the principal attraction for tourism.

OUTLOOK

The Asia and Pacific region has some of the fastest growing economies in the world. Sixty percent of Hong Kong's total trade is with Asia and Australasia. Moreover, discounting China, goods going through the colony had grown by 45% in 1989. Hong Kong is now the world's 11th largest trading economy.

To accommodate its vitality as a region center, the Government plans ambitious projects to expand the colony's infrastructure. A new Hong Kong International Airport is planned at Chek Lap Kok, to be opened in early

TABLE 4

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS				
Alkali and alkaline-earth metals	193	380	—	China 368; Japan 6.
Aluminum:				
Ore and concentrate	25,815	16,471	—	China 16,370; United Kingdom 100.
Oxides and hydroxides	943	84,029	2	China 84,006.
Metal including alloys:				
Scrap	3,072	5,512	348	China 4,050; Macau 620.
Unwrought	70,480	111,187	986	China 76,898; Canada 7,888.
Semimanufactures	70,952	82,629	12,510	Taiwan 13,319; Japan 11,996; China 11,397.
Arsenic: Oxides and acids	375	471	—	China 414; Netherlands 20.
Chromium: Oxides and hydroxides	2,987	1,090	94	China 367; Thailand 290.
Cobalt: Oxides and hydroxides	20	32	—	China 28; Singapore 3.
Columbium and tantalum: Tantalum metal including alloys all forms	—	17	—	All from China.
Copper:				
Ore and concentrate	5	—		
Oxides and hydroxides	331	375	—	Italy 108; Norway 100; China 92.
Sulfate	578	923	44	China 321; Taiwan 152.
Metal including alloys:				
Scrap	12,731	22,409	4,914	China 15,323; Japan 835.
Unwrought	9,578	30,542	1,356	China 27,067; Singapore 724.
Semimanufactures	97,771	120,028	3,777	Japan 33,814; China 30,486.
Gold:				
Waste and sweepings value, thousands	$2,338	$1,750	$6	China $988; Taiwan $146.
Metal including alloys, unwrought and partly wrought kilograms	157,268	464,257	45,296	Switzerland 150,446; United Kingdom 143,032.
Iron and steel: Metal:				
Scrap	43,600	86,071	536	China 81,091.
Pig iron, cast iron, related materials	7,523	9,027	158	China 8,084; Italy 303.
Ferroalloys:				
Ferromanganese	2,442	8,731	—	China 8,431; Republic of South Africa 300.
Ferrosilicon	34,911	96,300	—	China 94,454; Republic of South Africa 500; Norway 365.
Unspecified	7,770	13,433	—	China 9,365; Republic of South Africa 2,330; Netherlands 1,205.
Steel, primary forms	127,032	189,684	—	Republic of South Africa 65,347; Brazil 62,555.
Semimanufactures:				
Bars, rods, angles, shapes, sections	1,321,524	1,676,643	361	Brazil 423,667; Republic of South Africa 201,124.
Universals, plates, sheets	766,848	1,388,158	26,321	Japan 974,312; Taiwan 75,434.
Hoop and strip	72,083	96,097	2,987	Japan 66,550; Taiwan 4,040.
Rails and accessories[2]	5,419	2,892	—	Austria 1,362; United Kingdom 982; China 425.
Wire	69,180	79,655	392	China 37,622; Japan 11,378.
Tubes, pipes, fittings	205,322	223,076	918	China 69,898; Japan 49,964.
Castings and forgings, rough	566	20,947	103	China 18,854; Taiwan 1,205.

See footnotes at end of table.

TABLE 4—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued					
Lead:					
Ore and concentrate		512	50	—	All from China.
Oxides		334	406	(3)	China 325; West Germany 28.
Metal including alloys:					
Scrap		524	1,461	239	Japan 517; China 272.
Unwrought		12,006	7,781	—	China 4,825; Malaysia 653; Japan 602.
Semimanufactures		295	227	—	Republic of South Africa 80; China 62; Belgium-Luxembourg 35.
Magnesium: Metal including alloys:					
Unwrought		112	322	70	Norway 199; China 30.
Semimanufactures	value, thousands	$7	$1	$1	
Manganese:					
Ore and concentrate		665	629	—	All from China.
Oxides		2,297	4,816	—	China 3,946; Japan 491.
Mercury		254	158	—	China 129; Spain 11.
Molybdenum: Metal including alloys, all forms		[4]6	61	—	All from China.
Nickel:					
Oxides and hydroxides		40	150	111	China 28; Canada 5.
Metal including alloys:					
Scrap		456	222	222	
Unwrought		6,220	7,026	5	Norway 3,306; Netherlands 1,226.
Semimanufactures		230	181	4	France 58; United Kingdom 28.
Platinum-group metals:					
Waste and sweepings	value, thousands	$1,576	$3,388	—	Republic of Korea $3,112; United Kingdom $247.
Metals including alloys, unwrought and partly wrought	kilograms	1,684	3,318	9	United Kingdom 1,133; Netherlands 672.
Silver:					
Waste and sweepings	value, thousands	$551	$637	—	Philippines $290; United Kingdom $223.
Metal including alloys, unwrought and partly wrought	kilograms	61,346	87,375	8,487	West Germany 16,061; Australia 11,120.
Tin:					
Ore and concentrate		7,985	18,308	—	All from China.
Oxides	kilograms	—	1,200	200	United Kingdom 1,000.
Metal including alloys:					
Scrap		25	90	—	All from China.
Unwrought		4,655	6,152	(3)	China 5,454; Singapore 592.
Semimanufactures		835	1,030	8	China 552; Singapore 230.
Titanium: Oxides		11,308	20,906	894	China 12,098; Australia 2,396.
Tungsten:					
Ore and concentrate		1,278	1,419	—	China 1,404; Thailand 15.
Metal including alloys:					
Scrap		3	27	—	All from China.
Semimanufactures		9	12	1	China 8; Japan 2.
Uranium and thorium: Oxides and other compounds		43	154	—	China 132; France 19.

See footnotes at end of table.

TABLE 4—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Zinc:				
Ore and concentrate	—	19	—	United Kingdom 18; Belgium-Luxembourg 1.
Oxides	1,324	4,151	5	China 3,339; France 227.
Blue powder	187	160	1	Republic of Korea 144; Taiwan 11.
Metal including alloys:				
Scrap	599	1,176	249	Macau 517; China 375.
Unwrought	95,652	65,499	418	Australia 18,315; China 17,060.
Semimanufactures	714	590	—	West Germany 227; Belgium-Luxembourg 153.
Other:				
Ores and concentrates	4,925	6,669	—	China 6,500; Australia 121.
Metalloids, unspecified[5]	19,718	31,524	125	China 30,697; Japan 299.
Ashes and residues	7,153	8,748	—	China 8,545; Singapore 138.
Base metals including alloys, all forms	12,998	11,101	(3)	China 10,689.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	60,956	62,549	288	Indonesia 53,010; Italy 681.
Artificial:				
Corundum	27,084	42,455	476	China 40,363; Japan 744.
Silicon carbide	4,040	5,419	1	China 5,384.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$81	$413	$30	United Kingdom $271; Australia $89.
Grinding and polishing wheels and stones	3,991	5,164	153	China 3,259; Japan 768.
Asbestos, crude	78	221	—	All from China.
Barite and witherite	3,060	6,450	—	China 6,146; Thailand 126.
Boron materials:				
Crude natural borates	18	—		
Oxides and acids	12,494	3,280	3,072	Italy 108; China 82.
Bromine including fluorine	5	5	—	Mainly from Japan.
Cement thousand tons	4,453	4,738	(3)	Japan 2,197; Taiwan 1,163.
Clays, crude:				
Kaolin	197,422	265,948	1,300	China 254,453; Macau 8,800.
Unspecified	19,611	56,351	1,632	China 51,411; France 2,674.
Cryolite and chiolite	2	—		
Diamond: Natural:				
Gem, not set or strung thousand carats	2,573	3,008	180	India 1,303; Israel 766.
Industrial stones do.	356	654	11	Ireland 416; Netherlands 152.
Diatomite and other infusorial earth	1,227	2,330	2,232	China 90.
Feldspar, fluorspar, related materials	69,976	85,947	—	China 85,877; United Kingdom 36.
Fertilizer materials:				
Crude, n.e.s.	1,989	802	15	Netherlands 351; West Germany 224.
Manufactured:				
Ammonia	2,493	3,496	1	China 2,818; Malaysia 400.
Nitrogenous	29,375	84,077	36,300	U.S.S.R. 39,887; China 4,337.
Phosphatic	1,560	264	—	All from China.
Unspecified and mixed	10,476	80,268	169	Morocco 52,500; Mozambique 18,435.

See footnotes at end of table.

TABLE 4—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988 United States	Sources, 1988 Other (principal)
INDUSTRIAL MINERALS—Continued					
Graphite, natural		4,104	2,995	—	China 2,978; Taiwan 17.
Gypsum and plaster		152,552	113,482	688	Thailand 104,351; China 4,302.
Iodine	kilograms	2,426	15,800	—	West Germany 14,500; Japan 1,000.
Lime		43,893	46,059	—	China 45,949; Macau 80.
Magnesium compounds:					
Magnesite, crude		26,891	37,176	—	China 35,996; Taiwan 1,000.
Oxides and hydroxides		1,431	10,287	—	China 10,122; France 119.
Mica:					
Crude including splittings and waste		57	68	—	United Kingdom 36; China 28; Netherlands 4.
Worked including agglomerated splittings		1,408	1,722	20	Belgium-Luxembourg 880; Japan 360.
Nitrates, crude		1,420	1,328	18	China 1,190; Belgium-Luxembourg 120.
Phosphates, crude		350	35	—	China 34; West Germany 1.
Pigments, mineral:					
Natural, crude		523	791	—	Japan 400; China 391.
Iron oxides and hydroxides, processed		6,587	9,594	911	China 5,739; West Germany 1,318.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$122,615	$145,056	$21,568	Thailand $42,182; India $18,424.
Synthetic	do.	$2,276	$3,734	$372	China $901; Japan $518.
Salt and brine		129,938	131,362	1	China 118,824; Taiwan 5,100.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		189,064	163,896	117,865	West Germany 15,650; East Germany 9,397.
Sulfate, manufactured		78,682	68,407	4	China 66,071; Taiwan 1,812.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		15,721	41,539	—	China 40,229; Taiwan 854; Itay 353.
Worked		58,191	70,583	157	Italy 47,975; China 8,846.
Dolomite, chiefly refractory-grade		136	—		
Gravel and crushed rock	thousand tons	6,520	6,754	([3])	China 6,748; Philippines 4.
Limestone other than dimension		32,744	31,564	—	China 31,282; Taiwan 165.
Quartz and quartzite		2,698	2,011	3	China 1,657; West Germany 203.
Sand other than metal-bearing	thousand tons	1,261	1,584	([3])	China 1,579; Australia 1.
Sulfur:					
Elemental:					
Crude including native and byproduct		294	345	63	China 120; West Germany 198.
Colloidal, precipitated, sublimed		434	262	18	Republic of Korea 162; China 64.
Dioxide	kilograms	—	100	—	All from Netherlands.
Sulfuric acid		7,505	7,056	55	China 6,918; United Kingdom 50.
Talc, steatite, soapstone, pyrophyllite		30,312	49,804	438	China 48,891; Norway 153.
Other:					
Crude		3,185	6,741	989	China 5,117; Republic of South Africa 342.
Slag and dross, not metal-bearing		412	814	—	China 700; Thailand 92.

See footnotes at end of table.

TABLE 4—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		50	78	14	Japan 35; Singapore 24.
Carbon black		2,376	6,448	298	China 5,363; Philippines 475.
Coal: Anthracite and bituminous	thousand tons	8,010	9,267	(3)	Republic of South Africa 4,997; Australia 2,474.
Coke and semicoke		3,544	2,290	—	China 1,387; Japan 711.
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	2,056	2,043	(3)	Philippines 906; Singapore 882.
Gasoline:					
Aviation	do.	2	1	—	All from Australia.
Motor	do.	1,839	1,931	—	Singapore 1,383; China 359; Philippines 189.
Naphtha including white spirit	do.	2,199	2,446	(3)	Singapore 2,438.
Mineral jelly and wax	do.	239	279	4	China 261.
Kerosene and jet fuel	do.	10,017	11,150	—	Singapore 9,622; China 1,373.
Distillate fuel oil	do.	12,914	14,502	—	Singapore 8,639; China 4,287.
Lubricants	do.	782	792	79	Singapore 296; China 179.
Nonlubricating oils	do.	56	174	69	China 66; Japan 30.
Residual fuel oil	do.	14,431	14,944	—	Singapore 12,277; China 1,350.
Bitumen and other residues	do.	258	230	(3)	Singapore 119; Taiwan 77.
Bituminous mixtures	do.	2	2	(3)	United Kingdom 1.

[1] Table prepared by Audrey D. Wilkes.
[2] Excludes unreported quantites valued at $972,000 in 1987 and $178,000 in 1988.
[3] Less than 1/2 unit.
[4] Excludes unreported quantity valued at $18,000.
[5] Reported under SITC item 522,120 as "selenium, tellurium, phosphorus, arsenic, silicon and boron."

1997. Designed to operate 24 hours a day, it will handle more than three times the maximum capacity of Kai Tak. Port expansion will include increasing container throughput by five times, increasing container storage, creating onshore unloading facilities, providing accommodations for an increased number of trade vessels, and creating space for various auxiliary industrial activities.

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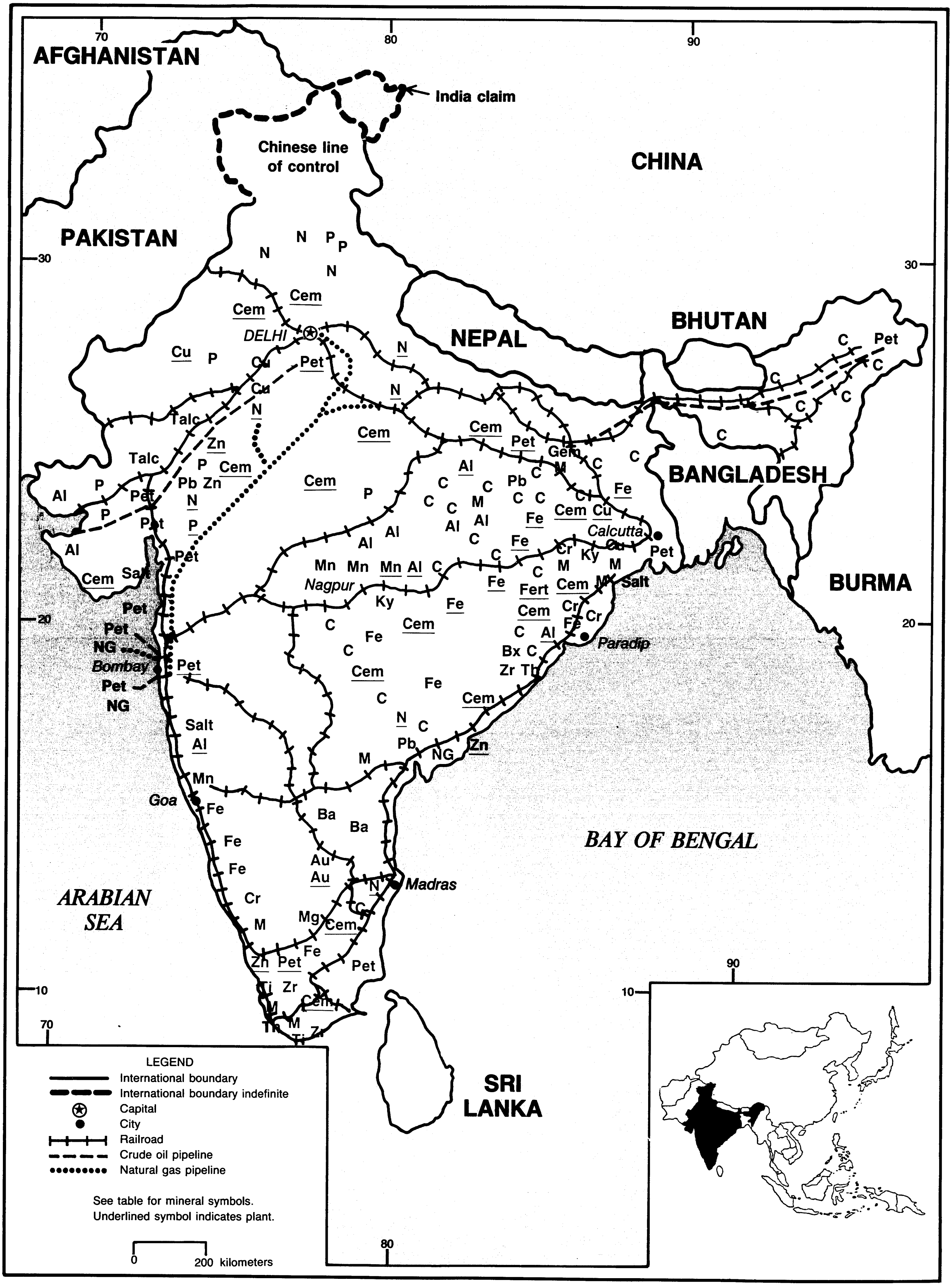
USSR
AFGHANISTAN
PAKISTAN
CHINA
NEPAL
BHUTAN
BURMA
BANGLADESH
SRI LANKA
JAMMU AND KASHMIR
HIMACHAL PRADESH
PUNJAB
HARYANA
Delhi
RAJASTHAN
Jhunjhunu
Jaipur
Ajmer
Bhilwara
Udaipur
Shahgarh
GUJARAT
Jamnagar
UTTAR PRADESH
1. Dehra Dun
2. Chunar
3. Renukoot
MADHYA PRADESH
1. Jhabua
2. Chhatarpur
3. Rewa
4. Shahdol
5. Mandla
6. Balaghat
7. Bilaspur
8. Korba
9. Durg
10. Bhatapura
11. Bastar
12. Jagdalpur
13. Bhilai
BIHAR
1. Rohtas
2. Bokaro
3. Ranchi
4. Singhbhum
5. Ghatsila
SIKKIM
ARUNACHAL PRADESH
NAGALAND
MEGHALAYA
ASSAM
Dibrugarh
MANIPUR
TRIPURA
Agartala
MIZORAM
WEST BENGAL
Karandighi
ORISSA
1. Sundargarh
2. Rourkela
3. Keonjhar
4. Dhenkanal
5. Cuttack
6. Panchpatmali
7. Loraput
8. Angul
MAHARASHTRA
Nagpur
Bombay
Bhandara
Chandrapur
Kalharpur
GOA
KARNATAKA
1. Shahabad
2. Belgaum
3. North Kanara
4. Bellary
5. Shimoga
6. Chikmagalur
7. Hassan
ANDHRA PRADESH
1. Adilabad
2. Visakhapatnam
3. Hyderabad
4. Guntur
5. Cuddapah
6. Anantapur
KERALA
Alwaye
Quilon
TAMIL NADU
Madras
Kalpakkam
Neyveli
Salem
Manavalakurichi
LEGEND
International boundary
International boundary indefinite
Province boundary
Major mineral facility
0
400 kilometers

INDIA

AREA 8.55 million km² **POPULATION 850 million**



THE MINERAL INDUSTRY OF

INDIA

By David B. Doan

In spite of political upheaval in 1989 and the downfall of the Gandhi regime, troubles in Kashmir, the threat of war with Pakistan, a continuing problem in Assam with hill tribes of the northeast, and a slowing economy burdened by increasing petroleum imports, the mineral industry of India turned in a performance that was generally good. Gains in production, modest for the majority of mineral commodities, in a few cases bordered on the spectacular. Some help was received from the continued loosening of strict controls on operations exerted by the avowedly socialist central Government. Otherwise, improvement came from technology transfer; joint ventures with foreign companies that shared capital and expertise; incremental upgrading of infrastructure; increasing installation of captive power supply in certain industries; and creeping computerization in data acquisition, retrieval, and control. Last but certainly not least, given the circumstances of India, was a favorable monsoon.

A degree of confusion marked the departure of the Gandhi hierarchy as V. P. Singh established his incoming administration, replacing ministers and other officials at various levels. The Singh Government was said to be a mix of an ostensibly free-market prime minister with sectarian Hindus and elements of the far left, the entire combination not free of ideological stress. Some observers thought that Gandhi's Congress Party, newly out of power, might reconsider its own leftist policies and bend toward market-driven economic goals, more or less as promised during the 1984 elections that gave Gandhi and his party an 80% landslide. Suffice it to say, the point was not moot. It involved the economic future of India at a time when other Asian countries, large and small, with freer markets, were experiencing double-digit growth and an increasing share of the world economy.

Meanwhile, the Indian economy turned out a gross national product (GNP) of about $136.1 billion,[1] representing growth of only about 4.5% for 1989 compared with 11% the year before. The labor force grew from 319 million in 1988 to 327 million in 1989, an increase of about 2.5%. During the same period, however, the unemployment rate also grew from 19.3% to 20%, statistically, but in real terms was probably higher. Foreign exchange reserves dropped from $6.4 billion in 1987 and $5.0 billion in 1988 to $4.4 billion in 1989. This precarious position motivated or influenced most decisions on import and export of mineral commodities. Foreign exchange viability had to be preserved at all costs, but burgeoning imports of petroleum and refinery products was a clear threat to this viability.

The other chronic problem affecting the economy overall, and not least the mineral sector, was the inability of India's power sector to meet the demand for electricity. India generated about 235 billion kilowatt hours (kW•h) from 65,000 megawatts (MW) of installed capacity, comparable in size to that of Britain or France. About 20% of power generated was lost in transmission and distribution.

About 80% of domestic power was generated through the authority of the state electricity boards (SEB's), but planning and operation by the managers has been almost traditionally influenced by state officials, who introduce political motives in such things as pricing policy. The SEB's powerplants commonly perform at low utilization of capacity, said to average approximately 54%, and engender large cumulative financial losses. India strove to augment its nuclear-power generating capability, but this was scheduled to amount to only 10,000 MW by the year 2000.

GOVERNMENT POLICIES AND PROGRAMS

India operates under a system of State and central Government mining laws, in some ways not unlike the United States. The principal Government laws are the Mines Act of 1952 and amendments; the Minimum Wages Act of 1948 and amendments; the Mineral Concession Rules of 1960; the Mines Labor Welfare Fund Act of 1976, covering several mineral commodities; and the Oil Mines Regulations of 1983. Together they form the fundamental operating rules and procedures for the mineral industry. The Government owns and operates most major mines, processing plants, and most (but not all) of the mineral-based industries.

With the abrupt replacement of the Rajiv Gandhi administration by that of V. P. Singh in November 1989, a degree of upheaval in policymaking was to have been expected. First indications were that the mineral industry would not be as affected as certain other sectors such as banking and finance. Basic employment practices of the Government were intended to change toward hiring a stipulated proportion of "backward castes," and agricultural loans of $588 million were to be forgiven by way of canceling any loans to farmers of up to approximately $606 each.

Most important in the mining sector was probably the new steel policy. Just after yearend, the V. P. Singh administration greatly liberalized the restrictions on manufacturing by private-sector steel companies. In an effort to attract private investment and to narrow the gap between demand and supply of domestic steel, private-sector secondary steel producers will be permitted to establish mills having a capacity of up to 1 million tons per year. More reforms were expected to be forthcoming, such as increasing the capacity limitation beyond the million-ton level and opening investment in steelmaking to foreign sources in certain cases. It was further believed that the public-sector Steel Authority of India Ltd. (SAIL) would gradually decontrol its steel prices.

Previous to this major change in policy, private-sector steelmaking was limited to plants not exceeding 250,000 tons per year, which are too small for achieving important economies of scale and use disproportionately large amounts of energy. Finally, all sponge iron-based steel miniplants were being encouraged to modernize their plants and operations for increased efficiency of production.

These changes of steel policy were seen as part of the Government's current overall policy of easing industrial controls and reinforcing the role of the private sector in basic industries such as power, steel, and cement.

Prior to the elections in November 1989, the Mica Trading Corp. of India (MITCO) ordered that private exporters must share export orders for all types of mica scrap with MITCO on a 50:50 basis and that MITCO would charge a commission of 2.5% on these orders. If MITCO did not have the required quality of scrap or was unable to meet the order for any other reason, it had discretionery power to hand the entire order to private exporters who would have to pay a negotiated rate of commission to MITCO.

Also, prior to the election of the new Government, the Department of Ocean Development put together a 20-year plan for mining polymetallic nodules on the deep-sea bed.

PRODUCTION

On balance, 1989 was not a great year but, in many respects, a good one for mineral production. The chief disappointment, perhaps, was the general lack of progress in the kind of petroleum exploration that is punctuated by important discoveries of reservoirs that will produce at agreeable rates for a significant length of time. If there were other clear disappointments, they were arguably offset by solid progress in some mineral commodity sectors that are important both to the domestic economy and to foreign trade.

Leading the list for the year, production of both bauxite and alumina registered gains of 20% compared with output in 1988. The bad news was that the huge new bauxite project in the Ghandhamardan Hills of Orissa was to be shut down for reasons hinging on the politics of environmentalism, tribal welfare, and religious interests. Next on the list was chromite, production of which climbed 19% above that of 1988, representing solid accomplishment in the effort to expand the output of this valuable ore. Equal to chromite on the list of proportionate increase was the production of all gem stones, up 19% over that of 1988. Lower on the scale of increase were secondary refined lead, up 14%, and primary refined lead, up 13%. The setback in this industry was the decrease of 18% in the lead content of ore and concentrates. Output of aluminum metal was also up 13%, but still in short supply versus the growing domestic demand. Production of mica increased by 10% over that of 1988, and the zinc content of ores and concentrates managed a respectable 8% expansion of output over that of the earlier year. Among the fertilizer minerals and materials, output of nitrogen was up 7% over that of 1988.

Production of iron ore and concentrates and copper content of ores and concentrates increased between 3% and 4% over that of the previous year, as did cement, in the industrial-mineral category. Of these, copper was probably the biggest problem in terms of domestic demand versus supply, and India's copper needs were growing steadily. Finally, steel, at slightly less than 12.9 million tons produced, represented a yearly increase of less than 1%, not a very good showing in terms of domestic requirements, plans, and projects. Of the latter, the long history of construction of the large Visakhapatnam (Vizag) Steel Plant (VSP) took a turn toward problems of water supply during the year, with no plain solution as yet in sight.

There could be satisfaction that almost all of the mineral industry showed at least some growth, and perhaps an equal measure of determination to improve production in some important categories was in order. In a centrally planned economy, it was probable that political upheaval, such as India experienced in 1989, did not make progress and improvement any easier in the production of mineral commodities.

TRADE

India continued its import and export policies for metals and minerals, promulgated for the 3-year period from April 1988 to March 1991. The object of this policy was to promote exports to the maximum extent, but in such a manner that the economy would not be affected by unregulated exports of items essentially needed within the country. The latter included nuclear minerals, beryl, copper ores and concentrates, lead ores and concentrates, precious gem stone rough, rock phosphate, sulfur, tungsten, and zinc ores and concentrates. India has been known traditionally for high tariffs on imports and more recently for a reluctance to follow the practice of virtually every other member of the General Agreement on Tariffs and Trade in holding consultations on conversion to the Harmonized Tariff System.

India has had an unpublished policy encouraging countertrade. Global tenders have included clauses to the effect that, all other factors being equal, preference would be given to companies willing to countertrade. The Indian Minerals and Metals Trading Corp. (MMTC) has been the principal countertrade body. MMTC estimated that countertrade obligations were worth $170 million in 1986–87, but more recent data were not yet available.

After several years of near-runaway growth in imports while exports stagnated, export growth jumped during 1988 and was thought to have risen even more in 1989. Resolution of yearly trade data is time consuming and, for India, not yet available for that year, but the general trend was known to be favorable. India's premier export, cut gem stones and jewelry, was worth at least $2.7 billion in 1988 and was expected to exceed this in 1989. The country's leading imports, petroleum and petroleum products, cost nearly the

TABLE 1

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1985	1986	1987	1988	1989[p]
METALS					
Aluminum:					
Bauxite, gross weight thousand tons	2,281	2,338	2,814	3,961	4,768
Alumina, Al_2O_3 equivalent do.	383	383	425	776	927
Metal, primary	260,010	257,096	265,000	375,000	423,400
Cadmium metal	194	160	214	237	275
Chromium: Chromite, gross weight	560,000	629,671	625,000	821,000	979,000
Copper:					
Mine output, Cu content	45,892	48,103	56,529	55,429	57,376
Metal, primary:					
Smelter	32,460	39,074	32,923	44,300	42,500
Refinery:					
Electrolytic (cathode)	28,020	37,853	[e]33,200	39,596	40,800
Fire refined[e]	1,000	1,000	780	1,000	1,000
Total[e]	29,020	38,853	33,980	40,596	41,800
Gold metal, smelter kilograms	1,828	1,874	1,874	1,942	2,006
Iron and steel:					
Iron ore and concentrate:					
Gross weight thousand tons	42,545	47,800	51,018	49,961	51,434
Iron content do.	26,633	29,923	31,937	31,226	32,198
Metal:					
Pig iron do.	9,835	10,509	10,893	11,735	12,080
Ferroalloys:					
Ferrochromium (including charge chrome)	66,497	84,000	126,227	140,262	133,522
Ferromanganese	163,438	179,132	172,819	138,331	149,139
Ferrosilicochromium	12,499	[e]10,000	12,321	2,769	11,384
Ferrosilicon	39,478	50,096	52,409	46,721	73,751
Silicomanganese	[e]20,000	24,782	37,504	52,895	75,469
Other	[e]500	[e]500	529	[e]500	386
Steel, crude:					
Steel ingots thousand tons	10,962	11,332	12,605	12,682	12,452
Steel castings do.	92	95	278	340	330
Total do.	11,054	11,427	12,883	13,022	12,782
Semimanufactures[3] do.	[4]7,841	7,753	8,600	9,501	9,241
Lead:					
Mine output, Pb content	27,085	37,578	[e]36,725	30,522	26,500
Metal, refined:					
Primary	15,567	19,933	20,669	18,833	21,260
Secondary	[e]10,000	11,300	12,126	9,889	13,469
Total	[4]25,567	31,233	32,795	28,722	34,729
Manganese:					
Ore and concentrate, gross weight thousand tons	1,240	1,213	1,302	1,333	1,334
Mn content	461,776	455,287	484,865	493,058	496,861
Rare-earth metals: Monazite concentrate, gross weight[e]	4,000	4,000	4,000	4,000	4,300
Selenium kilograms	[e]4,850	[e]4,800	4,026	5,103	4,261
Silver, mine and smelter output do.	25,380	35,271	37,946	40,958	35,499
Titanium concentrates, gross weight:					
Ilmenite	[4]143,000	[e]140,000	[e]140,000	[r e]140,000	[e]160,000
Rutile	[4]6,800	[e]7,000	[e]7,000	[e]5,000	[e]5,000

See footnotes at end of table.

TABLE 1—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989[p]
METALS—Continued						
Tungsten, mine output, W content		28	23	26	[e]30	[e]25
Zinc:						
Mine output, concentrate:						
Gross weight		87,082	94,597	104,809	118,056	127,600
Zn content		45,283	49,198	54,500	61,389	66,352
Metal:						
Primary		70,947	72,000	68,899	68,940	71,400
Secondary[e]		200	200	200	200	200
Total[e]		71,147	72,200	69,099	69,140	71,600
Zirconium concentrate: Zircon, gross weight		14,800	[e]16,000	[e]16,000	[e]16,000	[e]17,200
INDUSTRIAL MINERALS						
Abrasives, natural, n.e.s.:						
Corundum, natural		498	968	469	669	252
Garnet		5,917	5,366	[5]6,699	4,311	6,463
Jasper		5,078	2,426	4,407	3,915	5,535
Asbestos		30,183	25,236	29,110	31,123	36,502
Barite		579,742	344,000	247,000	445,604	548,103
Bromine, elemental[e]		350	350	350	350	350
Cement, hydraulic	thousand tons	33,050	[4]36,400	36,980	40,700	42,100
Chalk		114,964	106,708	101,641	109,782	120,078
Clays:						
Ball clay		236,625	277,460	279,912	330,126	251,806
Diaspore		9,605	11,580	11,018	10,901	15,189
Fire clay		592,047	583,000	634,000	596,835	612,378
Kaolin:						
Direct salable, crude	thousand tons	585	733	684	471	464
Processed[e]	do.	110	100	150	107	111
Total[e]	do.	695	833	834	578	575
Other[e]	do.	100	100	100	100	100
Diamond:						
Gem	thousand carats	[e]14	[e]13	[e]16	14	15
Industrial[e]	do.	2	2	3	3	3
Total[e]	do.	16	[r]15	19	17	18
Feldspar		46,101	46,288	49,663	57,656	56,690
Fluorspar:						
Concentrates:						
Acid-grade		11,107	[e]7,624	[e]8,261	8,823	10,300
Metallurgical-grade		[e]5,000	[e]4,109	[e]4,448	6,772	12,589
Total		[e]16,107	11,733	12,709	15,595	22,889
Other fluorspar materials, graded		[e]4,000	6,841	5,790	4,797	5,176
Gem stones excluding diamond:						
Agate including chalcedony pebble		750	[e]776	752	812	774
Garnet	kilograms	2,399	5,021	2,007	1,390	3,164
Graphite[6]		27,337	38,412	42,589	57,325	47,731
Gypsum		1,260,369	1,549,000	1,861,000	1,424,674	1,539,276

See footnotes at end of table.

TABLE 1—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989[p]
INDUSTRIAL MINERALS—Continued						
Kyanite and related materials:						
Andalusite		504	732	122	—	—
Kyanite		30,472	32,394	39,959	35,773	39,489
Sillimanite		17,095	14,905	12,756	15,377	16,117
Lime[e]		500,000	600,000	700,000	750,000	790,000
Magnesite		417,412	422,000	430,000	507,873	479,530
Mica:[7]						
Crude		4,820	4,746	4,240	3,839	4,186
Scrap and waste		2,515	2,773	6,307	3,694	3,121
Total		7,335	7,519	10,547	7,533	7,307
Nitrogen: N content of ammonia[4]	thousand tons	4,270	4,933	5,300	6,205	6,661
Phosphate rock including apatite		929,098	667,070	679,419	739,000	687,000
Pigments, mineral, natural: Ocher		108,549	98,668	145,245	151,781	173,366
Pyrites, gross weight		17,744	20,773	36,000	29,656	38,867
Salt:						
Rock salt	thousand tons	4	2	1	4	3
Other	do.	9,875	10,116	9,900	[e]9,200	[e]9,600
Total	do.	9,879	10,118	9,901	[e]9,202	[e]9,603
Sodium carbonate		813,600	873,600	969,600	[e]980,000	[e]1,000,000
Stone, sand and gravel:[8]						
Calcite		26,049	26,318	37,194	32,951	40,326
Dolomite	thousand tons	2,217	2,139	2,233	2,211	2,352
Limestone	do.	48,070	52,562	57,170	62,998	63,242
Quartz and quartzite	do.	259	274	299	101	93
Sand:						
Calcareous	do.	706	571	147	62	106
Silica	do.	[e]1,000	1,111	1,016	1,105	1,606
Other	do.	2,349	1,113	3,639	1,270	1,313
Slate		5,529	6,483	6,637	7,732	14,606
Sulfur:						
Content of pyrites		7,098	8,309	14,400	10,676	13,992
Byproduct:						
From metallurgical plants[e]		120,000	120,000	120,000	125,000	125,000
From oil refineries		305	[e]1,000	—	[e]1,000	[e]1,000
Total[e]		127,403	129,309	134,400	136,676	139,992
Talc and related materials:						
Pyrophyllite		53,741	53,005	60,457	64,923	94,264
Steatite (soapstone)		329,192	343,000	371,000	417,493	414,286
Vermiculite		1,805	6,681	2,905	4,052	2,764
Wollastonite		26,040	23,770	31,021	34,286	44,042
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous	thousand tons	149,259	[r]162,647	177,220	189,000	206,000
Lignite	do.	7,774	[r]7,991	8,311	12,600	13,400
Total	do.	157,033	170,700	185,531	201,600	219,400

See footnotes at end of table.

TABLE 1—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Coke:[e]						
Coke oven and beehive	thousand tons	13,000	13,000	13,000	13,000	13,000
Gashouse	do.	100	100	100	100	100
Other, soft	do.	100	200	200	200	200
Total	do.	13,200	13,300	13,300	13,300	13,300
Gas, natural:						
Gross	million cubic meters	8,138	[e]10,201	[e]9,918	8,813	8,918
Marketable[9]	do.	3,785	6,577	6,338	7,457	5,708
Petroleum:						
Crude	thousand 42-gallon barrels	219,132	228,416	220,929	230,680	240,900
Refinery products:						
Liquefied petroleum gases	do.	13,108	16,564	18,130	19,905	[e]20,500
Gasoline	do.	19,142	20,944	22,585	22,950	[e]23,200
Kerosene and jet fuel	do.	41,427	48,767	54,152	53,697	[e]54,000
Distillate fuel oil	do.	111,020	121,911	122,777	122,337	[e]123,000
Residual fuel oil	do.	53,919	52,800	57,416	56,803	[e]57,200
Lubricants	do.	[r]3,290	3,346	3,549	4,039	[e]4,100
Other	do.	51,303	59,103	66,201	67,286	[e]68,000
Total	do.	293,209	323,435	344,810	347,017	[e]350,000

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Table includes data available through Oct. 1990.

[2]In addition to the commodities listed, other clays (bentonite, common clays, and fuller's earth), other gem stones (aquamarine, emerald, ruby, and spinel), and uranium are also produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels. In 1975, production of 6,514 tons of uranium ore containing about 3 tons of U_3O_8 was reported from two mines, which was only a part of total national production. Reported production of sand and gravel and stone are clearly only partial figures and exclude a number of types of stone; the amounts reported are inadequate to provide sufficient aggregate for production of concrete from domestically produced and consumed cement, nor do they provide for other supplies of aggregate for road metal and other construction uses.

[3]Excludes production from steel miniplants.

[4]Data are for fiscal year beginning Apr. 1 of that stated.

[5]Official Indian Bureau of Mines figure is believed to be production from Government-owned operations. Private Indian production brings 1987 total to more than 20,000 tons.

[6]India marketable production is 10% to 20% of mine production.

[7]The disparity between amounts of mica produced versus amounts exported is based on (a) stockpiles, (b) illicit mines, and (c) some casual or occasional mining by others seeking additions to income nominally derived from other sources.

[8]Partial figures; for details, see footnote 2.

[9]Includes reinjected gas.

same amount, $2.65 billion, during the same year.

During 1989, India slightly reduced the domestic selling prices of some imported base metals such as copper, nickel, tin, and zinc, but not lead, reflecting the fall of their prices in international markets. At the end of the year, Indian officials announced that the country's trade deficit was reduced sharply in 1989, based on a 38% increase in export volume to an estimated $17.2 billion versus a marginal increase in imports. Although this was welcome news for the Indian economy, a surge in imports of petroleum loomed large in terms of financial problems for the coming year.

STRUCTURE OF THE MINERAL INDUSTRY

The mining industry of India comprises two main categories of ownership and management: the public-sector, or Government-owned companies, and the private-sector, or privately owned companies. Originally established as branches of the socialist, centrally planned economy that India chose for itself when it became independent, the various public-sector companies became well entrenched and, in some cases, very large. The coal and steel industries are good examples of the development of size, but other industries also grew, including aluminum, copper, and industrial minerals such as fertilizer. One or two privately owned and financed industries, perhaps chief among them Tata Iron and Steel Co. (TISCO), were permitted to develop into major size, partly because they could service India's economic requirements using investment capital only available to private venturing. It may be added parenthetically that, free from bureaucratic constraints, TISCO's productivity has been enormous, and it has developed subsidiary profit centers in many directions.

Distinctions have become blurred, particularly during the administration of Rajiv Gandhi, between the public and private sectors as some public companies have become partially privately owned, commonly by investment sources exerting little or no control over management. Another approach has been collaboration or joint venturing between Government public-sector companies and foreign private-sector companies, usually involving some form of technology transfer favoring India's industrial progress.

The Indian mining industry produces approximately 70 mineral commodities representing various ores, metals, and industrial minerals. It also produces mineral fuels, including coal, lignite, natural gas, and petroleum crude. The entire industry is expanding in size, capability, and variety of minerals extracted. Rate of growth is governed by the rapidity with which resources can be located, capital invested, and the requisite technologies acquired and applied to mining, processing, and production of concentrates and finished products.

Although it has been noted that there were 4,200 operating mines in India in 1986, more have been opened in the ensuing 3 years than have been closed as exploration advances and demand for mineral commodities increases. The majority of these mines have been small, manually operated surface pits of relatively low output. Of those 4,200 mines, however, approximately 70% extracted industrial minerals, 18% metallic minerals, and 12% mineral fuels such as coal and lignite. In addition, a steadily increasing number of wells have been drilled both onshore and offshore for petroleum crude and natural gas.

The coal sector, critical to generation of power and heat, has been in a state of flux during the past 15 years. Overall it has been changing from manual or, at best, partially mechanized underground mines to mechanized surface mines of high output. At the same time, underground mines have gradually undergone mechanization with the introduction of continuous mining and longwall mining equipment. These capital-intensive changes have benefited greatly from foreign technology and funding.

In the nonfuel group, 300 or more of the underground mines are in operation for production of such minerals as chromite, copper, gold, lead-zinc, and manganese in the metals sector and apatite, barite, fluorspar, graphite, mica, and steatite in the industrial-minerals sector. The mica industry has the largest number of underground mines, but they have been mostly manual operations producing only a few tens or hundreds of tons per year.

As in the fuels sector, the trend has been toward mechanization of the opencast mines, especially the new ones in which layoffs of labor were not a factor. Altogether, more than 240 mechanized open pits were in operation, the greater proportion of them producing chromite, dolomite and limestone, magnesite, manganese, and phosphate rock.

Total employment in mining and quarrying is at a level exceeding 1 million, 4.3% to 4.5% of the regularly employed labor force (India does not include subsistence and small-farm agricultural labor in its national employment figures). Public-sector employment accounts for more than 90% of the total and has been increasing at the expense of the proportion of private-sector jobs. Mining operations have been generally very labor intensive, with the coal and iron industries employing the largest numbers. Next in order are the steel, cement, and petroleum industries as major employers in the mineral industries. Principal areas of employment are the States of Bihar, Madhya Pradesh, Andhra Pradesh, Rajasthan, Orissa, and West Bengal. Relations between labor and management have been fairly good in the past few years and have not been a significant hindrance to the output of mineral commodities. Unrest between worker groups of differing ethnic and religious backgrounds has been rising in some areas for reasons not directly related to labor issues.

COMMODITY REVIEW

Metals

Aluminum and Bauxite.—Although the industry continued to be plagued by power outages, production continued to increase. Output of bauxite, at 4,768 thousand tons, was up 20% over that of the previous year. Alumina production, at 927,000 tons, increased almost 20% over that of 1989, while that for aluminum ingot, at a little more than 423,400 tons, increased almost 13% compared with the previous year. In general, the broad imbalance between supply and demand in India's domestic aluminum market is diminishing as increased production from National Aluminium Co.'s (NALCO) plant becomes available. NALCO installed its own 600-MW powerplant to ensure a continuous supply of electricity for its operations.

Domestic demand for aluminum, projected at 400,000 tons for 1989, has been enhanced by the Government's relaxation of previously tight controls on the metal's use. New initiatives include the use of aluminum to replace copper and brass in electric-power transmission lines, fittings, and switches; encouraging the use of aluminum foil in packaging; and the lifting of controls on price and distribution. On increasing output, India was also able to begin cutting imports of aluminum despite the rise in consumption.

After NALCO brings an operating maximum of 360 of its 480 pots into operation at its smelter at Angul, Orissa, projected to occur at the end of the fiscal year 1989–90, the total capacity of the Indian aluminum industry would be brought up to 580,000 tons per year. However, a fire in the coal-conveying system of the captive powerplant interrupted the flow of electricity to the potlines, shut down about 290 of the pots, and reduced operations drastically. Some of the disabled pots were frozen and needed digging out and relining. It was not clear how long repairs and recovery would require. Although it had been hoped that no aluminum would need to be imported in fiscal year 1990–91, the damage at NALCO casts doubt on such an eventuality.

The Government finally decided to close the Bharat Aluminium Co. (BALCO) bauxite project in the Ghandhamardan Hills of Orissa, about 200 kilometers (km) north of Panchpatmali, in the face of tribal, religious, and environmental opposition from agitators. First approved and scheduled for completion in 1985 as a 600,000-ton-per-year fully mechanized operation, the project was delayed in spite of efforts at reforestation and advantageous relocation of people. In that other BALCO bauxite mines are close to exhaustion, the company was said to

TABLE 2

INDIA: STRUCTURE OF THE MINERAL INDUSTRY

(Metric tons unless otherwise specified)

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year)
Aluminum:			
Bauxite	Bharat Aluminium Co. Ltd. (Government, 100%)	Mandia, Madhya Pradesh	200
Do.	do.	Bilaspur, Madhya Pradesh	600
Do.	Bombay Mineral Supply Co. (Pvt.) Ltd.	Jamnagar, Gujarat	150
Do.	Hindustan Aluminium Co. Ltd. (Government, 100%)	Ranchi, Bihar	[e]300
Do.	do.	Shandol, Madhya Pradesh	[e]300
Do.	Indian Aluminium Co. Ltd. (Government, 100%)	Kalharpur, Maharashtra	[e]250
Do.	do.	Ranchi, Bihar	[e]250
Do.	Madras Aluminium Co. Ltd.	Salem, Tamil Nadu	150
Do.	Minerals & Minerals Ltd. (Government, 100%)	Ranchi, Bihar	[e]200
Do.	National Aluminium Co. Ltd. (Government, 100%)	Panchpatmali, Orissa	2,400
Metal	Bharat Aluminium Co. Ltd. (Government, 100%)	Korba, Madhya Pradesh	100
Do.	Hindustan Aluminium Co. Ltd. (Government, 100%)	Renukoot, Uttar Pradesh	120
Do.	Indian Aluminium Co. Ltd. (Government, 100%)	Belgaum, Karnataka	73
Do.	National Aluminium Co. Ltd. (Government, 100%)	Angul, Dhenkanal District, Orissa	218
Barite	Andhra Pradesh Mining Corp. Ltd. (Government, 100%)	Mangampet, Cuddapah District, Andhra Pradesh	350
Do.	C. M. Ramanatha Reddy	Kodur, Anantapur District, Andhra Pradesh	75
Do.	K. Obul Reddy (Pvt.) Ltd.	Cuddapah District, Andhra Pradesh	25
Do.	Pragathi Minerals (Pvt.) Ltd.	Kodur, Anantapur District, Andhra Pradesh	50
Do.	Vijayalaxmi Minerals Trading Co.	do.	50
Cement	Bihar State Industrial Development Corp. (Government, 100%)	Rohtas-Palaman, Bihar	760
Do.	Cement Corp. of India Ltd. (Government, 100%)	Jagdalpur, Madhya Pradesh	1,000
Do.	do.	Tandur, Hyderabad District, Andhra Pradesh	1,000
Do.	do.	Yerraguntia, Cuddapah District, Andhra Pradesh	1,120
Do.	Hindustan Steel Ltd. (Government, 100%)	Rourkela, Orissa	2,140
Do.	Uttar Pradesh State Cement Corp. (Government, 100%)	Chunar, Uttar Pradesh	840
Do.	Associated Cement Co. Ltd.	Shahabad, Karnataka	1,076
Do.	Century Spring & Manufacturing Co.	Chandrapur, Maharashtra	1,000
Do.	Coromandel Fertilizers	Kalamalla, Cuddapah District, Andhra Pradesh	1,000
Do.	Jaypee Rewa Cement Ltd.	Rewa, Madhya Pradesh	1,000
Do.	Larsen & Toubro Ltd.	Chandrapur, Maharashtra	1,109
Do.	Modi Cement Ltd.	Bhatapura, Madhya Pradesh	1,000
Do.	Rajasthan Manufacturing & Weaving Mills Ltd.	Bhilwara, Rajasthan	1,042
Do.	Shree Cement Ltd.	Bewar, Ajmer District, Rajasthan	1,200
Chromite	Ferro Alloys Corp. Ltd.	Keonjhar District, Orissa	[e]75
	do.	Dhenkanal District, Orissa	[e]75
Do.	Mysore Minerals Ltd.	Hassan District, Karnataka	[e]125
Do.	Orissa Mining Corp. Ltd. (Government, 100%)	Cuttack District, Orissa	[e]200
Do.	do.	Dhenkanal District, Orissa	[e]200
Do.	do.	Keonjhar District, Orissa	[e]100
Do.	Tata Iron & Steel Co. Ltd.	Cuttack District, Orissa	[e]100

See footnotes at end of table.

TABLE 2—Continued

INDIA: STRUCTURE OF THE MINERAL INDUSTRY

(Metric tons unless otherwise specified)

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year)
Coal:			
Bituminous	Coal India Ltd: (Government, 100%)		
	Bharat Coking Coal Ltd. (Government, 100%)	105 mines in Bihar, Orissa, and Uttar Pradesh	[1] 160,000
	Eastern Coalfields Ltd. (Government, 100%)	187 mines in Bihar and West Bengal	
	Northern Coalfields Ltd. (Government, 100%)	61 mines in Madhya Pradesh and Uttar Pradesh	
	Southeastern Coalfields Ltd. (Government, 100%)	44 mines in Andhra Pradesh and Orissa	
	Western Coalfields Ltd. (Government, 100%)	55 mines in Madhya Pradesh, Maharashtra, and Orissa	
Lignite	Neyveli Lignite Corp. (Government, 100%)	Neyveli, Tamil Nadu	8,000
Copper:			
Ore	Hindustan Copper Ltd. (Government, 100%)	Khetri copper complex, Jhunjhunu District, Rajasthan:	
		Khetri Mine	825
		Kolihan Mine	825
		Chandmari Mine	330
Do.	do.	Indian copper complex, Singhbhum, District, Bihar:	
		Mosabani Mine	720
		Pathargora Mine	120
		Surda Mine	1,800
		Kendadih Mine	60
		Rakha Mine	e360
Do.	do.	Malanjkhand, Balaghar District, Madhya Pradesh	2,000
Metal	do.	Khetri smelter, Rajasthan	31
Do.	do.	Maubhandar smelter, Ghatsila District, Bihar	20
Iron:			
Ore and concentrate	Chowgule & Co. Pvt. Ltd.	Goa	e5,000
Do.	Dempo Mining Corp. Ltd. (Government, 100%)	do.	e7,000
Do.	V. M. Salgaocar & Bros. Pvt. Ltd.	do.	e4,500
Do.	Indian Iron & Steel Co. Ltd. (Government, 100%)	Singhbhum District, Bihar	e2,500
Do.	Kudremukh Iron Ore Co. Ltd. (Government, 100%)	Chikmagalur District, Karnataka	7,500
Do.	National Mineral Development Corp. Ltd. (Government, 100%)	Bellary District, Karnataka	3,000
Do.	Steel Authority of India Ltd. (Government, 100%)	Singhbhum Districts, Bihar	e3,500
Do.	do.	Bastar and Durg District, Madhya Pradesh	e7,000
Do.	do.	Keonjhar District, Orissa	e3,000
Do.	Tata Iron & Steel Co. Ltd.	Singhbhum District, Bihar	e3,500
Do.	do.	Keonjhar District, Orissa	e2,000
Steel, primary	Steel Authority of India, Ltd. (Government, 100%)	Bhilai, Durg District, Madhya Pradesh	2,680
Do.	do.	Bokaro, Bihar	2,230
Do.	Tata Iron & Steel Co. Ltd.	Jamshedpur, Singhbhum District, Bihar	1,740
Do.	159 private ministeel plants	Countrywide	4,700

See footnotes at end of table.

TABLE 2—Continued

INDIA: STRUCTURE OF THE MINERAL INDUSTRY

(Metric tons unless otherwise specified)

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year)
Kyanite	Hindustan Copper Ltd. (Government, 100%)	Lapso, Singhbhum District, Bihar	e22
Do.	Maharashtra Mineral Corp. Ltd. (Government, 100%)	Dahegaon, Bhandara District, Maharashtra	e24
Do.	Maharashtra State Mining Corp. Ltd. (Government, 100%)	Bhandara, Maharashtra	e28
Lead:			
Concentrate	Hindustan Zinc Ltd. (Government, 100%)	Gunter District, Andhra Pradesh	10
Do.	do.	Udaipur District, Rajasthan	20
Metal, primary	do.	Visakhapatnam, Andhra Pradesh	22
Do.	do.	Tundoo, near Ghatsila, Bihar	8
Magnesite	Burn Standard Co. Ltd.	Salem, Tamil Nadu	400
	Dalmia Magnesite Corp.	do.	
	Tamil Nadu Magnesite Ltd. (Government, 100%)	do.	
Manganese ore[2]	Aryan Mining & Trading Corp.	Sundargarh, Orissa	1,500
	Eastern Mining Co.	North Kanara, Karnataka	
	J. A. Trivedi Bros.	Balaghat, Madhya Pradesh	
	Manganese ore (India) Ltd. (Government, 100%)	Adilabad, Andhra Pradesh	
	do.	Balaghat, Madhya Pradesh	
	do.	Bhandara, Maharashtra	
	do.	Keonjhar, Orissa	
	Mangilah, Rungta (Pvt.) Ltd.	do.	
	Mysore Minerals Ltd.	North Kanara, Karnataka	
	do.	Shimoga, Karnataka	
	Orissa Manganese & MInerals (Pvt.) Ltd.	Sundargarh, Orissa	
	Orissa Mineral Development Co. Ltd. (Government, 100%)	Koraput, Orissa	
	Orissa Mining Corp. Ltd. (Government, 100%)	Keonjhar, Orissa	
	do.	Koraput, Orissa	
	R. B. S. Shreeram Durga Prasad & Falechand Marsingdas.	Vizianagaram, Visakhapatnam District, Andhra Pradesh	
	Rungta Mines (Pvt.) Lts.	Keonjhar, Orissa	
	Sandur Manganese & Iron Ores Ltd.	Bellary, Karnataka	
	Serajuddin & Co.	Keonjhar, Orissa	
	S. Lall & Co.	do.	
	Tata Iron & Steel Co. Ltd.	do.	
	do.	Sundargarh, Orissa	
Phosphate rock	Hindustan Zinc Ltd. (Government, 100%)	Udaipur District, Rajasthan	800
	Madhya Pradesh State Mining Corp. Ltd. (Government, 100%)	Jhabua, Madhya Pradesh	
	do.	Chhatarpur, Madhya Pradesh	
	Pyrites Phosphates & Chemicals Ltd.	Dehra Dun, Uttar Pradesh	
	Rajasthan State Mineral Development Corp. Ltd. (Government, 100%)	Udaipur District, Rajasthan	
	Rajasthan State Mines & Minerals Ltd. (Government, 100%)	do.	
Titanium, ilmenite concentrate	Kerala Minerals & Metals Ltd. (Government, 100%)	Chavara, Quilon District, Kerala	100
Do.	Indian Rare Earths Ltd. (Government, 100%)	do.	200
Do.	do.	Ganjam, Orissa, 100 kilometers south of Dhenkanal	220
Do.	do.	Manavalakurichi, Tamil Nadu	65

See footnotes at end of table.

TABLE 2—Continued

INDIA: STRUCTURE OF THE MINERAL INDUSTRY

(Metric tons unless otherwise specified)

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year)
Zinc:			
Concentrate	Hindustan Zinc Ltd. (Government, 100%)	Zawar, Udaipur District, Rajasthan	34
Do.	do.	Rajpura-Dariba, Udaipur District, Rajasthan	42
Metal	Cominco Binani Zinc Ltd.	Binanipuram, near Alwaye, Kerala	17
Do.	Hindustan Zinc Ltd. (Government, 100%)	Debari, Udaipur District, Rajasthan	49
Do.	do.	Visakhapatnam, Andhra Pradesh	30

[e] Estimated.
[1] The annual capacity of the 5 major Coal India subsidiaries was as follows: 14 mines, more than 1.0 million tons, for 17% of capacity; 32 mines, 0.5 to 1.0 million tons, for 17%; 80 mines, 0.3 to 0.5 million tons, for 24%; 254 mines, 0.1 to 0.3 million tons, for 39%; and the remaining mines, less than 0.1 million tons.
[2] Where not specified, capacity of clusters of surface manganese mines varies by orders of magnitude, depending on demand.

be planning bauxite purchases from NALCO to feed its 200,000-ton-per-year alumina refinery at Korba, in Madhya Pradesh.

Respecting the fact that about 16,300 kW•h of electricity is required to make a ton of aluminum, the future of India's aluminum industry seemed to rely heavily on the ongoing development of dependable power supplies.

Beryllium.—Indian officials announced that, using domestic beryl as raw material, they were the first country in the world after the United States to develop the technology for producing beryllium metal and its alloys. These metals are virtually indispensable to the space program, they asserted, as well as to their electrical and electronic industries. The Bhaba Atomic Research Centre (BARC) set up a pilot plant at Turbhe, New Bombay, to process about 2 kilograms (kg) of beryllium per batch for production of vacuum hot pressed (VHP) beryllium metal and copper-beryllium ingots. VHP technology was being utilized for production of both castings and hot-extruded rods 20 to 60 millimeters in diameter. Steps were being taken to produce 10-micron beryllium powder for making instrument-grade beryllium blocks for space applications. Both pure beryllium and copper-beryllium were provided to the Department of Space and the Department of Atomic Energy.

Chromium.—At 979,000 tons, production of chromite in 1989 climbed 19% over that of the previous year while both domestic and export demand was strong. Expanding ferrochrome and charge chrome industries in India required more chromium as steel production increased. International demand, especially from China and Japan, stimulated greater output of chromite mines in India and represented a valuable source of foreign exchange credits. The States of Orissa and Karnataka accounted for virtually all of the production, their shares having been approximately 94% and 5.8%, respectively. About 97% of India's chromite reserves have been located in Orissa, the greatest proportion of them in the Cuttack district where the mineral occurs in high-grade fines running 47% or more Cr_2O_3. Other chromite reserves in Orissa are in the Dhenkenal and Keonjar districts. Although the Government has restricted all new chromite mining to public-sector firms, some established private-sector companies, such as Tata Iron and Steel Co. (TISCO) and Mishrilal Dharmchand and Ferro Alloys Corp., account for nearly 50% of the ore mined.

The private-sector company Ispal Alloys Ltd. (IAL) was reported to have signed an agreement with Outokumpu of Finland for technical collaboration in setting up a $80 million chrome-ore pellet plant at Balasore, Orissa. Output of the plant was projected at 160,000 tons per year, all of it for export. The facility would also produce 22,000 tons of charge chrome and 15,000 tons of high-carbon ferrochrome per year. IAL was negotiating with buyers of ferrochrome from Europe, Japan, and the United States.

Japan especially turned to India for increased purchases of chromite ore after a 1988 United Nations resolution criticized Japan for its trade ties with the Republic of South Africa. This boded well to make Japan India's largest customer, a position it formerly held for a number of years before 1987, when China entered the Indian market. China and Japan took 75% of India's chromite exports in 1988, China's share having been 43% of the total. Other buyers included the Philippines, Taiwan, North Korea, and Sweden. The Government continues to permit export only of low-grade chromite ore to meet domestic demand for high-grade ore and, according to Indian statements, as an overall conservation measure.

During the year, taxes on export royalties were increased in an effort to conserve chromite ore. At the end of the year, there were indications that Orissa State would ban the export of ore from the State itself. If this were accomplished, its consequences could have serious effects on foreign-exchange earnings.

Copper.—India mined about 5.22 million tons of copper ore, projected to contain nearly 57,400 tons of metallic copper, an increase of 3.5% from output in 1988. As in previous years this fell considerably short of domestic demand for copper in all forms, necessitating expensive imports to make up the difference. Such imports probably were on the scale of 90,000 tons, minimum, to meet domestic requirements. The import figure may have been much more in view of the common quotation that India is only 40% self-sufficient in copper. All copper mining is carried on by Hindustan Copper Ltd. (HCL), a public-sector company operating primarily in the Singhbhum copper belt of Bihar, about 200 km west of Calcutta, and at Khetri-Kolihan in Rajasthan and Malanjkhand in Madhya Pradesh. Any prospects for significant increases in Indian copper output, let alone rising far enough to meet the steadily increasing demand, depend first of all on the success of exploration for new copper deposits. Existing grades of copper mineralization continued to decline as mining progressed; the average grade of Indian copper deposits in 1989 was estimated at 1.17%, down from more than twice that value originally. Exploration results have not been promising, but because of the size of the entire country much remains to be done. Meanwhile, HCL commissioned outside consulting support from Australia to study its operations in the Singhbhum copper belt. Recommendations included the consolidation of separate mine grids into one common grid throughout the region with the establishment of a computerized data base comprising geology, drill holes, and assay results integrated into the regional grid. Further proposals included the preparation of a long-term master plan for exploration and development through the entire belt and upgrading of mining methods, mine services, and infrastructure to afford higher productivity and financial return. The geology of the belt has been reinterpreted, and future expansion will likely be in the form of one major new mine rather than perpetuation of many small ones.

HCL commissioned a feasibility study by the Japanese firm, Bishimetal Exploration Corp., of the Malanjkhand copper deposits in Madhya Pradesh with the aim of upgrading exploration and operations with high technology, as well as increasing proven reserves in the area by a factor of five.

Gold.—India's 1989 output of gold, reported to have been 2,006 kg, amounted to an increase of about 3.3% from the previous year. With draconian constraints on gold imports other than for small amounts ostensibly for the jewelry trade, gold smuggling continued to flourish on nominal profit margins representing 25% to 50% on top of the world price and at times as much as 70% above the world quote. An entire industry involving many people has been built on smuggling, entirely because of import controls on gold, with some observers estimating that 60 to 70 tons now enter the country illegally each year. Near the end of the fiscal year, however, there were signs that the 27-year-old controls would be lifted in favor of a new and far less restrictive policy. It was believed this would go well with India's burgeoning gem stone industry and afford increased earnings of foreign exchange through value added by domestic goldsmiths and jewelers anxious to export finished pieces in the same way as has Thailand.

The Indian gold-mining industry otherwise pursued prospects and further exploration in various directions. The Geological Survey of India (GSI) located new resources in the vicinity of the Kolar fields, running 2 to 9 grams of gold per ton, that remained to be drilled and assessed. The Mineral Exploration Corp. (MEC) located a total of 2.97 million tons of gold ore during the year, including a deposit in Champion (west) of the Gadag gold belt about 160 km east of Goa. Other Gadag mineralization has graded 4.0 to 4.5 grams of gold per ton.

With the Kolar fields themselves rapidly dwindling in reserves, the Government decided to invite foreign companies to explore for gold in India. The terms for exploration would be similar to those for petroleum exploration by foreign companies with the individual companies bearing full risk in case of failure and production sharing with India in any joint mining ventures. The Government anticipated that foreign interest would bring in new exploration techniques and equipment as well as new processing methods, resulting in more competitive operations overall. Companies from Australia and Canada were said to have submitted applications that were under serious consideration by the Government.

Iron Ore and Pellets.—Production of iron ore and concentrates in 1989, at approximately 51.5 million tons, increased 3% over that of the previous year. Iron content was about 32.2 million tons. These values represented new highs for Indian iron ore output. Goa and Madhya Pradesh States continue to be the highest producers, representing not quite 50% of the total for the country.

Several features highlighted the year that boded well for the future of India's mining, processing, and exporting of iron ore. Kudremukh Iron Ore Co. Ltd. (KIOCL) showed its first yearly operating profit ever, net of depreciation and interest, of about $14.5 million on export revenues of about $105.5 million. Although exports were up almost 50% in rupee value, the fall in exchange rate for the rupee resulted in a profit of 10% to 15% in terms of the U.S. dollar. About 3.4 million tons of concentrates and 1.95 million tons of iron oxide pellets, for a total of 5.3 million tons, were exported for both blast furnace and direct-reduction consumption. KIOCL shipped its ores to at least 15 other countries, Japan having been the prime buyer of concentrates and Hungary the largest user of pellets. One element of the export market was a trial shipment to Iran, the first since the aborted development agreement with the Shah's Government that originally started KIOCL. With the abrogation of that agreement by the Khomeini Government, KIOCL was thrown on its own resources, requiring substitute capitalization and sales of ore to pay the price. For 1990, KIOCL projected the production of 6.5 million tons of concentrates and 2.5 million tons of pellets.

It was hoped and expected that India would export about 34 million tons of iron ore concentrates and pellets in fiscal year 1989 worth approximately $4.85 billion, which would be a tremendous boost to India's sagging foreign exchange reserves. The anticipated higher earnings would reflect not only higher world prices but, in particular, a 17% price hike conceded by Japan for its purchases of iron ore from India. Export data for the first half of the fiscal year, however, indicated a mild drop in iron ore shipments compared with those of the previous year. Observers attributed this not only to a slowdown in mining, which continued into the second half of the year, but also to labor unrest among Indian dockworkers.

Foreseeing higher Indian consumption from new steel mills and sponge-iron plants, Japanese steel companies were pursuing longer term contracts with Indian iron ore suppliers. This could only serve to strengthen the position of the industry and suggested a growing stability in contrast to the difficulties of the past. In the light of new competitiveness, MMTC decided to modernize both Paradip and Visakhapatnam harbors to facilitate ore handling, particularly for shipments to Japan, and as a measure to help stay abreast of stiff competition from Brazil.

The chronicle of India's iron ore sales to Romania took another turn during the year. MMTC was known to have offered Romania the use of its ships for transporting ore to the latter country's port of Constanza for purposes of increasing deliveries to the 1987-90 contract requirements. Less than 2.4 million tons of the 1988-89 requirement of 4 million tons was shipped, and 1989-90 shipments were falling further behind. It was believed that the Romanian National Salvation Front Government set a lower target for steel production than did the Ceausescu regime, and that output would fall by at least 6 million tons. Romania's ore carriers were thought to be hauling bulk foodstuffs, rather than iron ore, to Romania. Another opinion was that Romania was reluctant to export the products cited in the bilateral rupee agreement with India because they were badly needed domestically.

Iron and Steel.—Pig iron production increased to about 12.1 million tons, up about 3% compared with that of 1988. Based on first reports, the output of steel ingots and castings increased very slightly in 1989 at 12.87 million tons, up only about 32,000 tons. These data exclude production from steel miniplants, estimated to have been less than 3 million tons. Domestic demand for steel outstripped production, the difference having been met through imports that were projected at more than 2 million tons for 1989.

Long-term projections saw a domestic demand for steel at 19.5 million tons by 1995, increasing to 24 million tons by the year 2000. Thus it was believed that, short of an unforeseen expansion of steelmaking capacity, India would be forced to rely on an escalating volume of imports. By the year 2000, SAIL planned to more than double its production to 15 million tons per year at a cost of more than $12 billion. SAIL intended to utilize a greater proportion of present capacity, introduce technological upgrades, and foster higher labor productivity. Beyond that it planned further expansion of its plants at Bhilai, Bokaro, and Rourkela. TISCO, India's only major private-sector steel producer, also planned a $1.6 billion expansion of its capacity to 2.7 million tons per year by 1996. Although these and other programs were aimed at doubling the production of the integrated steel plants, actual accomplishment was seen to depend on timely completion of new projects, especially in the public sector. The Gandhi administration, which assembled these projects and priorities, was voted out late in the year. The new administration of V. P. Singh indicated early on that it intended to shift resources to agriculture at the expense of industry. The Singh Government, however, was believed in some quarters to contain the political seeds of its own demise. The rise and fall of such governments could only introduce a chaotic element into the type of long-range planning and mobilization of resources required for expanding steel production. The Singh Government, however long it were to remain in power, may go slowly in building the planned steel plants at Vijayanagar in Karnataka State and Daitari in Orissa, which together were projected to cost about $6.1 billion. Beyond these, no entirely new steel plants were planned in the near future because of soaring costs and budgetary constraints. The Government was said to be soliciting foreign assistance simply to expand and modernize existing plants.

The Government was also giving some needed encouragement to the ministeel sector, probably in view of the fact that ongoing operations in public-sector plants were at levels significantly below stipulated capacities. These plants were said to be troubled by inefficient management, power shortages, low productivity, Government controls on price and distribution, bad product mix, and high costs. The latter were not only high to begin with but, relative to operations at maximum efficiency, proportionately higher in light of the other difficulties. With all of the problems of overregulation, low productivity, and struggling technology, Indian steel in 1989 was not far from being the highest per unit cost in the world, whereas in the early 1960's it was among the lowest.

Meanwhile, the saga continued of the most expensive project ever to be undertaken in India, the VSP. Under construction with technical assistance from the U.S.S.R., the plant has been characterized in the Indian press as a monument to technological achievement, but the reality continued to belie the ideal. The blast furnace stoves were fired in October 1989, signifying a milestone in the development of the plant and marking the beginning of pig iron production, albeit with a silica content of more than 3%, unsuitable for manufacture of steel, which requires less than 1.2%. A more fundamental problem, however, concerned the requisite supply of water for turning out steel. The Andhra Pradesh Government was supplying VSP with about 18 million gallons per day. The schedule indicated a need for 32 million gallons per day when the blast furnace began operation, 45 million gallons per day by March 1990, 55 million gallons per day by June 1990, and 73 million gallons per day for full operation. Excavation problems in hilly terrain prevented, at least temporarily, the completion of the canal bringing the needed water to VSP. At the end of the year, it was estimated that the VSP operation registered a daily loss of $1.2 million because of the lack of water for the blast furnace. Evincing a degree of frustration, VSP, no longer relying on the Andhra Pradesh Government, itself undertook responsibility for the construction of the water supply.

In the light of more liberal policies in recent years, the sponge-iron industry has expanded rapidly. Although the Government perceived that the increasing demand for metal scrap for the steel miniplants could be entirely satisfied only through imports, sponge iron was an increasingly attractive substitute for scrap and helped conserve foreign exchange.

Lead and Zinc.—Production of lead concentrates was down for the second year in a row, the lead content having decreased to about 25,000 tons in 1989 or 18% below that of the previous year. Output of zinc concentrates, as well as the zinc content of the concentrates at 66,352 tons, both increased 8% over the comparable values for 1988. Productions of primary refined lead, at

21,300 tons, and secondary refined lead, at about 16,000 tons, were up 13% and 14%, respectively, compared with those of the previous year. Output of primary and secondary refined zinc combined, at about 71,600 tons, was up nearly 4% over that of 1988. Still deficient in production of most of the base metals, India's self-sufficiency in lead and zinc is less than 50%.

According to Indian press reports, the Hindustan Zinc Ltd. (HZL) $375 million "super smelter" for lead and zinc in Chittorgarh district of Rajasthan, about 200 km southwest of Jaipur, would be ready to go on-stream sometime in mid-1991. Being built with the aid of about $98 million from the United Kingdom, the plant will utilize ore, grading about 15.5% zinc and 1.9% lead, from the nearby Rampura-Agucha mine. Tonnage was projected at slightly more than 60 million, of which three-quarters was determined to be amenable to surface mining to a depth of 220 meters (m) below ground level. Stratabound in a Precambrian graphite-mica sillimanite host within a banded-gneiss complex, the ore body was still open downward at a depth of 320 m so that the deposit could be much larger than so far determined. Plans were to operate on a 3,000-ton-per-day throughput of ore from the mine. Officials hoped that the new integrated complex would satisfy 80% of domestic demand for zinc and 63% of that for lead. Cadmium and silver recovery was likewise expected from processing the ore. It was expected that the project would save $1.3 billion in foreign exchange through its anticipated 20-year life.

Magnesium.—IAL revealed plans to establish a gas-fueled $21 million plant, based on Japanese technology, for the production of 4,000 tons per year of magnesium metal near Agartala, the capital of Tripura State, about 100 km east of Dhaka, Bangladesh. The venture would not only be the first major private-sector undertaking in Tripura, which possesses ample natural gas resources, but would be the first magnesium production in India. The plant will utilize the silicothermic process using ferrosilicon and dolomite as raw materials. Technology and critical equipment for the plant was to be supplied by Ube Industries Ltd. of Japan. Production of 1 ton of magnesium would consume 1.2 tons of ferrosilicon, 12 tons of dolomite (calcium-magnesium carbonate), and 4 tons of oil or its equivalent in natural gas.

Manganese.—Production of manganese ore was slightly more than 1,334 thousand tons, an almost imperceptible increase over that of 1988. As a part of its liberalization policy, the Government announced the decentralization of manganese ore exports after October 23. Until that time, all contracts were processed through India's public-sector Minerals and Metals Trading Corp. (MMTC), but the Government nonetheless set limits on the total quantity of ore to be exported, along with certain other stipulations. However, apparently as one result of the replacement of the Gandhi administration by that of V. P. Singh, export of manganese ore was once again centralized in the hands of MMTC. Other sources reported that the reversal was instead the result of rising domestic demand combined with slow export activity. The 1989 export ceiling of 400,000 tons of manganese ore has been increased to 500,000 for 1990. Medium-grade ore has been redefined by the Government as that containing 38% to 46% Mn.

Nickel.—After experiencing difficulty in the development of technology for extracting nickel from laterite deposits in Orissa, research reports were released suggesting that "overburden material . . . being generated during the mining of chromite ore at Sukinda . . ." in Orissa State contained 0.4% to 0.9% nickel along with the 5% to 9% chromite being sought. The nickel occured in micron-sized particles affording great difficulty of extraction, but was wasted in that 10 tons of "overburden" was produced for each ton of chromite mined. Using hydrocyclones of varying vortex finder diameter and apex diameter, it was found that 60% to 70% of the nickel values could be recovered to produce a preconcentrate grading 1.2% nickel.

The connection, if any, is not clear, but it was announced that India's first nickel production plant, to have an annual capacity of 15,000 tons of contained nickel, was scheduled to be opened in 1992 in Orissa State at an unspecified location.

Platinum.—Deposits of platinum described as "huge" were discovered in laterites in the Bhuban-Barapada areas of the Dhenkanal district of Orissa, about 50 km northwest of Cuttack, by the Orissa Directorate of Mines and Geology (ODMG). Grades of 220 to 520 grams per ton, confirmed in 10 samples analyzed by the National Physical Laboratory in New Delhi, led to the deposit being characterized as possibly the highest value of platinum mineralization in nature ever recorded. Officials of ODMG, however, said that in view of the wide variation in analytical results, a further sampling program would be mounted and test results monitored in three or four laboratories. News of the discovery was received with surprise and scepticism in the Republic of South Africa, the implication having been noted that the latter country's dominance of western platinum markets could be threatened by such a large, high-grade find.

Layered ultrabasic rocks in the area are a prime source of chromite in south Asia and are recognized also to contain some cobalt and nickel. The platinum was found in testing local laterite deposits, surface weathering materials comprising essentially iron and aluminum oxides, for evidence of cobalt and nickel that would reflect underlying ultrabasic rocks. Thus, in searching for rocks containing more chromite and nickel, significant quantities of platinum were discovered in the overlying weathering products of the ultrabasics.

Tungsten.—Mining of tungsten had become virtually dormant in India primarily because of low ore grade, the one established source grading about 0.08%, but studies suggested that extraction might be feasible after all. Formerly under control of the Rajasthan State government, this deposit at Rewat was taken over by HZL on condition that HZL also receive other mining rights for fluorspar in the region. Exploration for tungsten continued in other places in Rajasthan and Maharashtra, with tentative indications of economic mineralization in both cases.

With technical help from Lucky Goldstar International of the Republic of Korea, Sterling Tungsten (ST), a new company in Madras, planned to start a $24 million plant for tungsten metal powder production. A subsidiary of

Sterling Computers, ST would be owned 25% by the parent company, 26% by Tamil Nadu Industrial Development Corp., and the balance by the public. Tungsten metal powder is not otherwise produced in India, and the parent company was reported to be interested in the electronic applications.

Uranium and Plutonium.—Although actual numerical data are not disclosed as a matter of policy, Uranium Corp. of India Ltd. (UCIL) reported that production of uranium concentrates had been up 19% the previous year. New equity capital was being received from the Government to finance new projects, said to cost in the $300 million range. Construction has started at Nawapahar and Turamdih in the Singhbhum district of Bihar, where underground mines will be opened and a common processing plant will be established at Turamdih. UCIL is eyeing the opening of more known deposits to meet the increasing demand for nuclear-grade uranium oxide in the expanding system of nuclear powerplants.

India's third plutonium reprocessing facility was being set up at Kalpakkam, near Madras in Tamil Nadu. The new plant will have the capacity to process three tons per year of spent natural uranium fuel from atomic reactors to produce two tons of plutonium metal annually, as well as an unspecified amount of U^{233}. The recovery technology would involve the solvent-extraction process, dissolving the spent fuel in nitric acid. India already operates two such plants, the Tarapur Atomic Power Plant in Maharashtra and a small plant at the Bhaba Atomic Research Centre (BARC) in Trombay, on the outskirts of Bombay.

Highly radioactive wastes from the reprocessing plants are scheduled to be stored for an interim period and then converted into solid glass and encased in metal cans, initially stored below ground level at the plant sites. After this they would be stored in deep underground repositories such as the mined-out portions of the Kolar Gold Fields, where BARC has been performing extensive tests.

Industrial Minerals

Cement.—Reaching a total of 41.2 million tons in 1989, production of cement increased about 3.5% over that of the previous year. Upon the removal of all controls on production and distribution in late 1989, the entire industry was poised for a further expansion through the next 10 years or so until the year 2000.

Cement production in India, especially in regions that have been experiencing shortages, would increase as the result of a $300 million loan from the World Bank. The project was to support the elimination of controls on price and aimed to make the entire industry more competitive by upgrading efficiency and stimulating growth. Energy costs, in particular, would be reduced. A pilot bulk-cement transport system was to be established at Kalamboli Railway Terminal, near Bombay. In addition to the modernization and restructuring of existing companies throughout India, the project was intended to expand cement production capacity in eastern and northern India, as well as to reduce cement costs in some of the poorest regions of the country. Finally, training was to be provided to cement plant workers at selected regional centers, as well as technical assistance to the office of the Commissioner of Development for the Cement Industry. This assistance would be for improvement of the cement miniplant sector, meaning companies that produce less than 200 tons per day. Environmental protection and pollution control measures were also a part of the project.

Jaiprakash Industries Ltd. planned to install the largest cement kiln in India at its plant at Rewa, about 500 km southwest of New Delhi. With a capacity of 4,500 tons per day, the kiln was to include a Folax cooler, coal-feed equipment, raw-meal silo, raw-meal feed equipment, and two electrostatic precipitators. An energy-efficient precalciner preheating process developed in Denmark was intended to save as much as $1.4 million per year in energy costs in comparison to the existing plant.

Fertilizer Materials.—India's 1989 fertilizer production fell seriously short of demand even though the industry was subsized to an extent exceeding $3 billion. Although production of nitrogen was up more than 7% at 6.2 million tons, production of phosphate rock was down by more than 7% at 687,000 tons. Investment in new plants was relatively small, many plants operated well below capacity, and India had to import at least 25% of its fertilizer materials. The Government's arbitrary selection of price levels for the fertilizer products turned out to be too low and, in combination with low depreciation rates, put many plants in financial difficulties. Observers believed India might be forced to increase fertilizer prices, always an option in centrally planned economies, to improve basic viability of the industry. Reduction of the depreciation period was anticipated.

In spite of the fact that India's fertilizer industry has undergone almost phenomenal growth since the 1950's, demand has continually outpaced development in a country whose reliance on agriculture has been critical. Dependence on imported fertilizer minerals, particularly phosphate, was unavoidable. Initially refusing to allot monies for purchase of imported phosphoric acid for the first half of the 1989 fiscal year because of escalating market prices, India was more or less forced to continue offshore buying. Nearly 1.6 million tons of phosphoric acid was thus purchased from Jordan, Morocco, and Senegal. Because prices and quantities on the international market became so uncertain, IFFCO, a major Indian fertilizer company, contemplated outright acquisition of a phosphoric acid plant in the United States or the construction of such a plant in the United Arab Emirates.

Uncertainty reigned over the allocation of natural gas produced in India for gas-based fertilizer plants owing to other needs such as power. Bangladesh offered an alternative by proposing India's equity participation in gas-based fertilizer plants in Bangladesh using the latter country's considerable gas resources. This plan afforded proximity, acessibility, and significant benefit to both countries, especially as compared to sources in the Persian Gulf or the United States.

The World Bank evinced interest in the establishment in India of ammonia miniplants based on technology developed by Imperial Chemical Industries (ICI) in the United Kingdom. Such plants would produce about 450 tons per day and require relatively small capital investment while diversifying both risk and supply. Interest on the part of Indian entrepeneurs was keen.

Gem Stones.—Although India's production of diamonds increased about 4.5% from 14,161 carats in 1988 to 14,825 carats in 1989, exports of cut and polished diamonds were valued at $3.013 billion, an increase of 17% above that of the previous year. This reflected, in part, India's growing emphasis on the importing of diamond rough from Belgium and the United Kingdom. Efforts were initiated to arrange a further supply from Botswana, Ghana, and Zimbabwe. Exports of other gem stones and jewelry increased the overall value of all gem stone and jewelry earnings, including diamonds, to $3.3 billion for 1989, up almost 19% compared with that of 1988.

While India's diamond industry continued to assert itself as a source of badly needed foreign exchange credits, increasing attention was given to exploration for diamond rough within the country in an effort to replace at least a proportion of the imported diamond rough needed to feed the country' growing capability in cutting and polishing. An agreement was signed between India's Mineral Exploration Corp. Ltd. and France's Bureau de Recherche et Minieres (BRGM) to explore for diamonds in south and central India, in which BRGM was to supply the exploration technology and $540,000 in credit. The exploration project was to concentrate on two diamondiferous areas in southern Andhra Pradesh and an additional one in Madhya Pradesh, possibly the two most promising States in the country for such investigations. The GSI, meanwhile, pressed its exploration activity in Andhra Pradesh and Karnataka as well as in the Panna diamond field of Madhya Pradesh, the only producing diamond mine in the country.

Granite.—India's granite-mining industry began to take hold in several States, including Bihar, Andhra Pradesh, Tamil Nadu, Orissa, and Karnataka, resulting in substantially higher export profits in 1988-89. Real profits were probably double those of the previous year, but differences in reporting periods combined with illicit extraction and selling tended to obscure the numerical values. All was not smooth, however, in the industry. Karnataka officials declared that although the private sector would be allowed to mine granite, all cutting and polishing would henceforth be done within the State rather than exporting the quarried granite rough to Tamil Nadu or Andhra Pradesh for cutting and polishing. With the main value addition occurring in Karnataka, higher foreign-exchange earnings and taxes would accrue to the State. Tamil Nadu, meanwhile, took steps to increase control over illicit granite quarrying and export by establishing a system of permits and unscheduled on-site inspections of operations.

New companies were set up near Madras in Tamil Nadu and at Balasore in Orissa for the manufacture of granite tiles. Local estimates at Balasore were that they could realize a 400% value addition in the production of finished granite tiles, which was a fair attraction in the $600 million yearly world granite trade. Having had only about 6% of this yearly market, Indian producers clearly aimed for a greater share.

Graphite.—The slow growth of India's steel industry, the key consumer of domestic graphite production, has not greatly stimulated development of the graphite industry, but expansion of the latter was underway nonetheless. Graphite India's (GI) application to expand its capacity to 30,000 tons per year was approved by the Directorate General of Technical Development (DGTD). GI would expand its Durgapur plant capacity of 6,000 tons per year to 15,000. Similarly, the capacity of its Bangalore plant would be increased from 10,900 tons per year to 15,000, thus achieving a total capacity of 30,000 tons per year for GI. Observers pointed out that 15,000 tons per year is the minimum economic size normal for graphite production operations. Two other companies, Carbon Corp. and Hindustan Electro-Graphite, having capacities of 8,000 and 13,000 tons per year, respectively, were each seeking to expand their capacities to 15,000 tons per year. In all, it was seen that these changes would result in a total capacity of 60,000 tons per year for the companies involved.

Officials of GI noted that both the steel industry and the planning commission have projected a near-doubling of ultimate demand for graphite products such as electrodes, anodes, and other forms. The bright future seen for direct-reduced iron-based steelmaking was thought to imply an equally promising future for domestic graphite production.

Inert Gases.—Although currently satisfying its helium requirements through imports from Canada and Poland, India has discovered a potentially large resource in West Bengal and neighboring States. The helium occurs in concentrations ranging from 0.4% to 1.8% among other gases emanating from hot springs in a belt nearly 2,500 km long and 500 km wide extending from Orissa through south Bihar, West Bengal, and Assam. A hot spring at Bakreswar in the Birbhum District of West Bengal tested 1.8% helium in the gaseous effluent. A small plant at the site was producing 65 liters per day of pure helium. In other springs where the proportion of helium is as low as 0.4%, the yield is high because of the overall rate of emanation. Many springs known to produce helium remain yet to be evaluated. The Government decided to invest $850,000 in the Eighth 5-Year plan for further exploration and extraction. Officials of the BARC noted that this helium could represent a world-class reserve and would be used for its planned superconducting cyclotron.

Mica.—Mica mining, for the most part a private-sector industry, is distributed essentially among three States, Bihar being the leader by producing about 45% of total output. Second is Andhra Pradesh with 34% and Rajasthan with the remainder or about 21% of India's production. Overall, the mica industry continued to decline in the midst of continuing troubles. Although official reports showed a corrected value of 3,839 tons produced in 1988 and 4,211 tons for 1989, suggesting an increase of about 10%, the actual picture was as usual somewhat clouded. Significant quantities of mica continued to emerge from stockpiles and from illicit mines. Domestic demand for mica has been at best limited and at most a small proportion of the quantities exported. If it is considered that the mica industry in India employed 500,000 workers at the end of World War II and only about 15,000 in 1989, the profile of decline would explain big stockpiles and relatively large exports compared to recent production.

At the end of the year, the Engineering Export Promotion Council (EEPC), which monitors and promotes the export of mica products, demanded withdrawal of the 3.5% tax on mica exports, originally imposed to finance labor welfare programs. EEPC said that with the Government collecting approximately $1 million in taxes on slightly more than $24 million in mica exports, it believed that mica's competitiveness in foreign markets was diminished.

Mineral Sands.—Deposits of rare-earth oxides (REO) described as "huge" in technical reports have been located at Nazareth, near Tuticorin, on the coast of Tamil Nadu about 100 km northeast of the southern tip of India. The public-sector Indian Rare Earths Ltd. (IRE) planned construction of a $25 million mineral separation plant under administrative control of India's Department of Atomic Energy. IRE otherwise has mined and processed mineral sands for ilmenite, monazite, rutile, sillimanite, and zircon in Kerala, Tamil Nadu, and Orissa States.

Mineral Fuels

Coal.—India produced about 206 million tons of bituminous and anthracite coal in 1989, an increase of 9% compared with output of the previous year but short of the target for the year of 210 million tons. Mechanized surface mining continued to play a growing role in total production and accounted for the entire increase. The surface mines employed only 15% of the labor but produced 66% of the total coal mined.

Implementation of about 50 new coal-mining projects, representing a projected combined annual output of about 80 million tons, has been delayed because of land-acquisition problems. Press reports at midyear said that Coal India Ltd. (CIL) would have to acquire approximately 100,000 hectares of nonforest land and 40,000 hectares of forest land for these new mining projects. Land aquisition has been an important contributory factor in the delay of several public-sector projects involving power, railways, and coal.

The Indian coal industry continued to benefit from foreign technological help. The Indo-French Coal Working Group agreed to broaden bilateral cooperation in which India seeks assistance in the engineering of thick-seam extraction, including sublevel caving, blasting gallery mining, and multisliced longwall operations. In another development, Australia offered assistance in the beneficiation of coking coal by reducing ash content to a uniform 19%, with an ensured thermal efficiency of 65%. Australia's BHP Engineering and Kinhill Engineering tested coal samples from several Indian mines and suggested changes, including coal washeries, that would upgrade the Indian coal. India has imported Australian low-ash coking coal in amounts increasing from less than 1 million tons in 1984 to 4 million tons in 1988. Thus, if domestic coal can be upgraded successfully, imports could be reduced or eventually stopped, with constructive effects on India's foreign-exchange position.

In November, a mine wall collapsed during blasting operations at the 400-foot level of the Mahavir mine at Raniganj in West Bengal. The area of the operating face was flooded from floor to roof, trapping 71 miners in a higher air-accessible space while 57 others escaped. Three days later 65 of the trapped miners were rescued by being lifted out through a rescue hole bored using a 24-inch bit, and another escaped on his own. Five miners died in the accident. The seam had been abandoned in 1965 and then reentered. The collapse and flood punctuated the new emphasis on mine safety during the increasing mechanization of Indian coal mines. Japan and the Federal Republic of Germany were reported to be helping CIL improve its safety program.

India's goal of raising coal production to 400 million tons per year by the year 2000, representing a doubling of the 1989 production, was seen to be ambitious. It was believed such a level of production would require new technologies such as hydraulic mining, shield mining to extract coal from thick and steep seams, blasting-gallery techniques to remove coal from standing pillars, shaft sinking, inclined drivage, introduction of high-capacity bucket-wheel excavators, and the development of very large open pit and underground mines. To achieve such a scale of production would also require CIL to generate a reliable internal cash flow through significantly higher profits, in that the company presently loses $100 million annually. India's already serious air-pollution problem would be exacerbated by burning twice the amount of coal presently consumed.

Lignite.—Output of lignite in 1989 reached a new high of 13.4 million tons, an increase of more than 6% compared with that of the previous year. Mechanization continued to improve production as large bucket-wheel excavators contended with the abrasive overburden and high ground water tables at Neyveli in Tamil Nadu, the largest known lignite deposit in India.

A massive expansion was planned to make the Neyveli Lignite Corp. (NLC) a "mega-power station" for all of south India, capable of meeting the energy requirements of Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, and Pondichery in years to come. The NLC, about 220 km southwest of Madras, was to be upgraded to produce 32 million tons per year of lignite to feed a power complex having an installed capacity of 4,200 MW by the turn of the century. Expected to cost at least $3.7 billion, the project would entail successive stages of new mine openings and associated individual powerplants. Even longer term plans were on the drawing board for taking lignite production to 52.5 million tons per year by the year 2000 and simultaneously boosting power-generating capacity to 7,330 MW.

The GSI announced during the year that it had discovered a previously unknown lignite field in the Jayakonda-Cholapuram area about 60 km from Neyveli. Borehole investigations suggested that the deposit includes seams of lignite almost 18.9 m thick, the thickest known in India. The 160 square kilometer deposit was estimated to contain 150 million tons of lignite.

Petroleum Crude.—Production of crude, at nearly 231 million barrels, increased a little more than 4% compared with that of the previous year. Exploration for new reservoirs maintained its previous tempo in spite of political changes, and some dry holes were drilled amidst the modest discoveries of the year.

Output of crude has fallen short of the Seventh 5-Year Plan target, and further plans to produce 365 million barrels in 1995 did not seem likely to succeed. Self-sufficiency in oil delined from 80% to about 60% during the Seventh Plan and seemed destined to decrease even further, which would in turn require an increase in imports. That the acute shortage of foreign-exchange credits would be able to sustain the rising volume and costs of imported oil was not obvious.

The Oil and Natural Gas Commission (ONGC), a public-sector company overseeing 90% of onshore and offshore exploration in India, is overextended and has an indifferent record of discoveries. With Oil India Ltd. (OIL), its counterpart public-sector company, it continued to exert its exploration effort in areas of proven reserves. New production was brought in from additional locations offshore on the well-known Bombay High structure and from other drilling in Assam, Gujarat, Tamil Nadu, Andhra Pradesh, and Rajasthan. Beyond this, the two companies began exploration in some new areas. OIL began drilling in the shallow waters off the coast of Gujarat and onshore in the Jailsalmer Basin of Rajasthan near Shahgharh. ONGC began work in Karandighi, West Bengal, and Mizoram (location not mapped). OIL, which accounted for about 8% of India's total production of crude, continued to rely on its old fields in Assam, but began looking with interest at concessions in Orissa, Rajasthan, and the Andaman Islands. OIL drilled one significant discovery near Dibrugarh in Assam that tested at 718 barrels per day from a depth of 3,600 m. OIL had earlier established significantly large quantities of natural gas in this area but was forced to cap the wells because of a lack of local customers and the absence of a pipeline for sending the gas to other markets. Crude oil reserves in the area have been projected at about 2.9 million barrels thus far.

Responding to permits issued by the Government following the third round of bids invited from foreign companies, the Chevron International-Texaco Joint Venture drilled a dry hole offshore Madras in Block KG-OS-1, moved the rig, and drilled a second dry hole in the adjacent block, P-OS-2. Following these attempts, it yielded its four leases and closed its operations in India. Later, Shell drilled two dry holes in the Konkan-Kerala Basin, offshore Kerala State in southwesternmost India. Australia's Broken Hill Proprietary also drilled two dry holes in the Konkan-Kerala Basin. Amoco was expected to commence drilling operations in the Krishna-Godavari Basin, offshore the area between Guntur and Visakhapatnam on the east coast, sometime in 1990. A fifth foreign entity, a team from the U.S.S.R., joined with ONGC in an integrated exploration program in the Cambay Basin onshore southern Gujarat and also in the onshore part of the Cauvery Basin in Tamil Nadu. Friction developed between ONGC and the Soviets when the former accused the latter of having imported excessive amounts of manpower and equipment and of bringing in technology that was less than state of the art.

A fourth round of bidding, which had seemed to have been developing rapidly during the year, seemed to have been greatly slowed after the elections. Allegations were set forth in the indigenous press and in a report by the World Bank that the previous Government's management of production of crude from the Bombay High left much to be desired. Although this was decried as playing politics against the old administration, there did remain an element of uncertainty. Opinions can differ on how to produce at the maximum efficient rate, but the criticisms involved excessive production of crude, with attendant flaring of gas and depletion of reservoir pressure, to meet production targets that may have been unrealistically high.

By yearend, no major new strikes of petroleum had been made, but India's consumption of crude and natural gas expanded steadily. Already a balance-of-payments problem in terms of increasing petroleum and product imports, the need became critical for more exploration, more discoveries, and more production.

Natural Gas.—Output of natural gas rose slightly in 1989, reaching almost 312 billion cubic feet or about 1% more than the output of the previous year. Plans were advanced for utilizing the relatively large proportion of gas, particularly associated gas, flared to the atmosphere, approximating 30% of total production. This was a conspicuous waste of energy that India could not afford, but had no good way of utilizing until emplacement of new pipelines and other infrastructure could stimulate latent demand to the point of accomodating supply. Prospects for discovery of new gasfields are considered promising in Jammu and Kashmir, Himachal Pradesh, Tripura, and Rajasthan. The Government hoped to expand the production of natural gas as a proportion of total hydrocarbons from 28% to as much as 36% by 1995.

Utilization of gas had originally been planned for fertilizer and petrochemical works, but delays in construction of adequate distribution systems and new gas-fed fertilizer plants have posed problems. Government policy changed several years ago to permit gas-fired powerplants and industrial uses such as for making sponge iron, but ONGC has not been able to market its current overproduction. Some steps have been taken to reduce production, but this would need to be done gradually and only to a point in order not to reduce production of greatly needed oil. The new Government has been working on a crude-oil and natural-gas policy for the Eighth 5-Year Plan, 1990–95, incorporating changes that reflected its election promises. This has introduced further delay into sectoral planning, but it was believed the overall result would be further modest growth in production. For the useful consumption of the amount of natural gas that India produces even now, it seemed that strenuous steps were needed. The first task was to identify potential points of most efficient use and establish a pipeline system to deliver the gas to those points. More consumers would then be connected to an expanding system as more new gas was discovered.

Reserves

Data on mineral reserves of India are principally determined by the various public-sector companies representing branches of the Government of India, along with the GSI and some private-sector companies. As reserves are extracted, exploration continually aims to locate new and better deposits, adding to the known totals. All mineral reserve values are estimates based on known information at a given time. By the same token, these estimates may be expected to vary from year to year. Some of the principal deficiencies of reserves compared to domestic demand for production are represented by copper and gold among the metals; fertilizer minerals in the industrial group; and coking coal, petroleum crude, and natural gas among the mineral fuels.

TABLE 3

INDIA: ESTIMATED RESERVES OF MAJOR MINERALS

(Thousand metric tons unless otherwise specified)

Major commodity		Reserves
Bauxite		1,000,000
Barite		35,000
Chromite		15,000
Coal:		
Bituminous		176,330,000
Lignite		4,290,000
Copper, in ore		4,000
Gold	kilograms	100,000
Graphite		736
Iron, in ore		7,100,000
Kyanite group		12,000
Lead, in ore		2,100
Limestone		60,000,000
Magnesite		100,000
Manganese ore		154,000
Natural gas	billion cubic feet	22,868
Petroleum crude	million barrels	5,307
Phosphate rock		102,000
Salt [1]		XX
Talc and related minerals		15,000
Titanium		62,000
Zinc		4,813
Zircon		1,420

XX Not applicable.
[1] Essentially all from seawater.

INFRASTRUCTURE

India's road network includes 515,000 km of hard-surface two-lane roads and approximately 1.12 million km of gravel, loose-surface, or prepared-earth routes having at least one lane and, in many stretches, two lanes. This secondary system is not well drained in all places, but generally can accomodate passing of vehicles headed in opposite directions. As in many Asian countries, access to some remote areas is by cart tracks, current or abandoned.

The railroad system comprises 33,600 km of broad-gauge 1.676-m track, 24,000 km of meter-gauge (1.000-m) track, and 4,250 km of narrow-gauge, 0.762-m and 0.610-m, track. The total track length of all gauges is approximately 61,850 km, 12,617 of it double track and 6,500 km having been electrified. The mixed-gauge trackage introduces complexities such as loss of time in transshipment and multiple stockage of spare parts. The rail system has much old equipment that is unreliable and expensive to maintain. At the end of the year, detailed plans were revealed for upgrading the railroads through the use of heavier rails of higher tensile strength, welded rails, and prestressed concrete sleepers to improve track structure. Modern electronic devices would improve reliability of signals and telecommunications. In addition, locomotives would be upgraded to higher horsepower and greater fuel efficiency, coaches would be built of lighter weight and greater speed potential, and freight cars would be constructed of better payload-to-weight ratio.

The country has about 16,200 km of inland waterways, with 3,630 km navigable by large vessels. Principal seaports are Bombay, Calcutta, Cochin, Kandla, Madras, New Mangalore, and Port Blair in the Andaman Islands, with a newer port at Visakhapatnam growing rapidly and showing signs of becoming India's most active port in the next 5 to 10 years. Cochin Port has endured labor problems and suffered losses of traffic to other ports. Madras Port has recently earned a reputation as the cleanest and most efficient port in India. India has a total of 345 airports, 292 presently usable. Of these, 202 have paved runways, 2 of them with runways 2,440 to 3,659 m long, and 91 of them with runways 1,220 to 2,439 m in length. Air service is civil and international and utilizes about 93 large transport aircraft.

The electric-power system has a present capacity of about 65,000 MW, some of it major industrial on-site capacity dedicated to specific plants, particularly in the copper and aluminum industries. By the year 2000, India plans to have an installed capacity of 10,000 MW of nuclear power. Total production of public-sector power in 1988 was 221 billion kW•h versus a demand of 238 billion kW•h.

Pipelines, relatively new to India, consist of 3,497 km for petroleum crude, 1,703 km for refined products, and 902 km for natural gas, in all totaling 6,102 km. Pipelines are undergoing further development and expansion as new routes and terminals are being proposed with increasing urgency.

OUTLOOK

India entered what showed signs of becoming a period of political instability as various ideological entities vied for election, mostly to earn only pluralities rather than commanding majorities. The old socialist mindset of the Nehru era contended with proponents of free enterprise wanting fewer restrictions on entrepreneurial venturing and development, all with a rich mixture of religious and caste distinctions that made for what the world has come to know as the Indian style of government. V. P. Singh replaced Rajiv Gandhi, but the Singh coalition is widely regarded by the Indian press to be weak and probably short-lived. Meanwhile, the country has steadily grown in population, expectations of social progress, and the desire for an improved quality of life. Against this background, India was short of power and increasingly short of petroleum products. Demand for virtually all mineral commodities increased steadily and, for some, greatly exceeded supply. The country has benefited from widespread mineral exploration within a very complex variety of geological terranes or provinces. The promise of additional mineral wealth awaits further and increasingly sophisticated search. Perceived shortfalls in mineral commodities, such as in ores of copper, gold, nickel; industrial fertilizer minerals such as phosphates and potash; and the mineral fuel petroleum can be paid for with the production of minerals with which India is endowed, such as bauxite, chromite, iron ore, and manganese among the metals; gem stones, granite, graphite, mica, and talc among the industrial minerals, and even coal, to name a few. But India's formidable and confusing plexus of trade regulations and restrictions, including virtually senseless tariff schedules, can and will defeat the kind of trade relations that the country would seem to need, increasingly, if it is to survive and progress.

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[1] Where necessary, values have been converted from Indian rupees (Rs) to U.S. dollars at the rate of Rs16.50 = US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

Geological Survey of India

Ministry of Steel and Mines
27 Jawaharlal Nehru
Calcutta 700 016, India
Indian Bureau of Mines
New Secretariat Building
Nagpur 440 00l, India
National Mineral Development Corp.
Hyderabad 500 004, India
Oil and Natural Gas Commission (ONGC)
Bombay Offshore Project
12 Floor, Express Towers, Nariman Point
Bombay 400 021, India
Oil India Limited (OIL)
Allabad Bank Building
17 Parliament Street
New Delhi 110 001, India

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INDONESIA

AREA 1,919,440 km² **POPULATION 187.7 million**

THE MINERAL INDUSTRY OF

INDONESIA

By John C. Wu

A mineral-resource-rich country, Indonesia was the world's second largest tin producer and the fourth largest nickel producer in 1989. Nickel and tin reserves are large and of world significance. Indonesia is a major producer of primary aluminum, bauxite, cement, copper, ferronickel, gold, iodine, and urea in the Far East. In the energy area, Indonesia was the world's largest producer and exporter of liquefied natural gas (LNG), the 7th largest producer of natural gas, and the 14th largest producer of crude petroleum in 1989. It is also a significant coal producer in Southeast Asia. Indonesia's coal and natural gas reserves are considered substantial by world standards.

The mineral industry remained an important sector of the Indonesian economy because of its significant contribution to Indonesia's gross domestic product (GDP), export earnings, Government revenues, and regional development. The total value of mineral output in 1989, which was estimated at $18 billion[1] in current dollars, accounted for 20% of real GDP, which was estimated at $89 billion. Of the total value of mineral output, 90% was crude petroleum and natural gas, and the remainder was mostly copper, gold, nickel, and tin.

Indonesia is important to the United States not only because it is a major supplier of crude petroleum and tin to the United States but also for the role that U.S. companies play in exploration and development of coal, copper, gold, and oil and gas in Indonesia. Since the early 1960s, major U.S. oil and mining companies had made considerable investments in the oil and gas, and the nonferrous minerals industries. As a result, several major U.S. companies having a Contract of Work (COW) with the Government have emerged as top producers of oil, natural gas, and copper in Indonesia. In the 1980's, major U.S. oil and mining companies continued to make substantial investments in Indonesia for exploration and development of oil and gas, coal, copper, and gold.

Indonesia was a net exporter of mineral products. In 1989, the total value of mineral exports, which was estimated at $10 billion, accounted for about 45% of total exports. Of the total mineral exports, about $8.7 billion was crude petroleum, refined petroleum products, and LNG. Nonfuel mineral exports totaled $1.4 billion, of which about 95% was exports of gold, copper, nickel, and tin. Indonesia's total value of mineral imports, which was estimated at $1.5 billion, accounted for about 9% of total imports. Of the total mineral imports, about $1 billion was heavy crude petroleum for consumption by the refinery industry and high-grade bituminous coal for consumption by the utility industry. Nonfuel mineral imports totaled $500 million, of which about 75% was imports of alumina, refined copper, lead, zinc, and raw materials, such as phosphate rock, gypsum, pyrite, for the manufacture of compound fertilizers.

In 1989, new investments in Indonesia continued to focus on increasing reserves and production capacities of oil and gas. However, because of improved world metal market conditions, more investments were made in copper and nickel. The Government of Indonesia approved a plan to double the capacity of its ferronickel plant and open a new nickel mine, while actively seeking financing of a planned alumina refinery.

New investment in Indonesia by foreign companies for exploration and development of oil and gas in 1989 was about $2.95 billion, of which $2 billion was mainly for development of the secondary production capacity in the Duri Oilfield by P.T. Caltex Pacific Indonesia (Caltex) and new oil and gas wells by Atlantic Richfield Indonesia Inc. and Roy M. Huffington Co., and about $600 million was for oil and gas exploration[2]. The Government also approved construction of a $1.9 billion oil refinery capable of processing 125,000 barrels per day (bbl/d) of crude petroleum in Balongan in the northeastern coast of West Java by 1994.

In the nonfuel minerals sector, a $511 million major expansion program to raise copper mining and milling capacity to 52,000 metric tons per day (mt/d) of ore at the Ertsberg Mine in Irian Jaya by 1992 and an $80 million expansion project to increase smelting capacity to 47,630 metric tons per year (mt/yr) of nickel in matte at the Soroako smelter in South Sulawesi by 1990 were started in 1989.

The Government announced in mid-1989 that a new nickel mine with a capacity of 4 million mt/yr of ore on Gag Island off Irian Jaya will be opened in 1991. The cost of developing the nickel mine was estimated at $200 million, which reportedly will be provided by Queensland Nickel of Australia. The Government approved the $150 million expansion project to double capacity of the state-owned Pomalaa ferronickel smelter to 9,600 mt/yr of nickel in South Sulawesi by 1993 and was actively seeking foreign capital from France and Japan for construction of a $600 million alumina refinery on Bintan Island, south of Singapore.

GOVERNMENT POLICIES AND PROGRAMS

Foreign companies had been encouraged by the Government to participate in exploration and development of its mineral resources in Indonesia under the COW. Since 1967, the terms of the COW had been changed and modified four times. However, the terms of the fifth generation COW, which has been implemented since 1986, had not attracted much foreign investment except in gold exploration because of the 1986 tax law. In an effort to attract more foreign investment in oil and gas as well as metallic and industrial minerals in the frontier areas, some modifications were made by the Government to the terms of the fifth generation COW to provide fiscal incentives to foreign investors. The so-called Frontier Incentives included investment in Irian Jaya and other isolated areas, especially in Eastern Indonesia; in low value minerals, which required a high initial capital investment; and in mining of complex minerals or deep seabed minerals.

Indonesia's Director General of Mines indicated that there will be some shifts and changes in the future mineral policies regarding such major issues as, requiring the foreign investor to participate more in regional development, in manpower development, in technology transfer, and in value added mineral processing.[3]

In September, the Government, through the Department of Mines and Energy, issued Decree No. 1158, to provide guidelines for environmental impact assessments in mining. The basic provisions regarding environmental managment can be found in Indonesian law No. 4 of 1982, which states the requirements for environmental impact analysis in every plan that is considered likely to have a significant impact on the environment. Decree No. 1158 classifies which activities in the mining and energy sectors may have an impact on the living environment, stipulates which activities requires various aspects of environmental impact assessment, and specifies which Government agencies are responsible for monitoring the activities.[4]

PRODUCTION

Growth in the mineral industry continued its 1988 upward trend and exceeded the expansion of the Indonesian economy three years in a row because of the continued recovery of the world's oil and metal markets. The output of crude petroleum reached the highest level in 5 years, while production of natural gas and coal both broke the previous record highs owing to increased exports.

In the nonfuel minerals sector, production of bauxite rose sharply because of the newly created export markets in the Federal Republic of Germany and the United States. Production of nickel reached a new high resulting from the continued strong demand in the Japanese market, while the production of copper and gold also broke the previous record level because of increased production from newly opened mines and the increased capacity to mine copper. Tin output reached its highest plateau in 8 years but was slightly under the Government goal as tin prices moved to a lower level in the second half of 1989. Production of most industrial minerals was lower than that of 1988; however, production of cement, iodine, and phosphate rock rose considerably in 1989. Increased cement production was mostly for export to the Asia market. The lower output of industrial minerals generally reflected a weaker demand in the domestic market.

TRADE

Indonesia is a minerals export oriented country. The value of crude petroleum exports, which contributed 75% to total export earnings in the 1970's, dropped considerably, as a share of total export earnings in the 1980's, especially after a slump in the world's oil price in the mid-1980's. However, because of increased exports of LNG and non-oil related minerals, such as coal, copper, gold, and nickel in the second-half of the 1980's, the overall mineral exports still commanded a lion's share of the total exports. Indonesia's mineral imports were limited to heavy crude petroleum, coal, and a few raw materials to meet the domestic manufacturing requirements.

In 1989, the estimated export value of major minerals and mineral products, in U.S. dollars, were: oil and gas, $8,670 million; nickel, $430 million; copper, $397 million; aluminum, $390 million; gold, $328 million; tin, $214 million; cement, $129 million; coal, $68 million; and bauxite, $11 million. Exports of crude petroleum went principally to Japan, Singapore, and the United States. Most of gold exports went to Singapore, while cement went mainly to Bangladesh and Singapore. Japan remained Indonesia's major export markets for aluminum, bauxite, copper, nickel, and tin. Exports of bauxite jumped 62% to 965,300 metric tons (mt) because of new exports to the Federal Republic of Germany. Exports of copper and gold both reached record highs.

The estimated import values of major minerals and mineral products, in U.S. dollars, were: crude petroleum, $1,000 million; base metals, $140 million; alumina, $70 million; phosphate, $55 million; sulfur, $50 million; coal, $40 million; pyrite, $35 million; and other mineral products, about $100 million. Saudi Arabia remained the major source of crude petroleum imports, while Australia was the major source of alumina, coal, and gypsum imports.

Mineral trade between Indonesia and the United States was limited to few major items. Crude petroleum and tin remained Indonesia's two major exports to the United States. Indonesia's major mineral imports from the United States were clay, coke, iron and steel scrap, phosphate, soda ash, and sulfur.

STRUCTURE OF THE MINERAL INDUSTRY

The oil and gas industry continued to dominate the Indonesian mineral industry because of its large share of the mineral industry's employment and output value. The tin industry was the second largest, followed by the nonferrous metals, the industrial minerals, and the coal industries.

The oil and gas industry consists of PERTAMINA, the state-owned oil and gas company, and 17 major foreign oil companies operating as a contractor under COW or under a production-sharing contract (PSC) with the Government. The tin industry consists of P.T. Tambang Timah (P.T. Timah), the state-owned tin mining and smelting company, and two foreign tin mining companies having COW's with the Government. The nonferrous industry consists of P.T. Aneka Tambang (P.T. Antam), the state-owned general mining company, two major foreign copper and nickel mining, and three small foreign gold mining companies having COW's with the Govern

TABLE 1

INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	830	650	635	513	862
Metal, primary		216,820	218,772	[r]202,002	184,859	196,869
Chromite sand, dry basis		—	—	—	7,636	7,635
Copper, mine output, Cu content		88,742	95,781	102,058	121,472	143,970
Gold, mine output, Au content[2]	kilograms	[r]2,619	[r]3,304	[r]3,643	4,738	6,155
Iron and steel:						
Iron sand, dry basis		130,930	153,271	193,986	202,748	142,654
Metal:						
Ferroalloys: Ferronickel		23,789	22,554	8,354	26,852	26,058
Steel, crude		1,200,000	1,500,000	1,453,000	2,050,000	[e]2,000,000
Manganese ore		33,496	6,612	1,855	10,957	9,364
Nickel:						
Mine output, Ni content[3]		40,336	53,679	[r]57,764	57,982	62,987
Metallurgical products:						
Matte: Ni content		24,946	27,975	26,508	28,864	29,030
Ferronickel: Ni content		4,802	[r]4,518	1,683	4,905	4,964
Silver, mine output, Ag content	kilograms	[r]38,327	[r]46,596	[r]50,485	58,336	73,884
Tin:						
Mine output, Sn content		[r]21,722	[r]24,497	[r]26,093	29,590	31,263
Metal		20,909	22,083	24,200	28,365	29,916
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	10,081	10,941	11,844	12,242	14,099
Clays:						
Bentonite		[r]6,658	5,730	[r]7,962	8,266	3,863
Fireclay		2,158,638	2,134,856	2,356,327	2,222,420	1,730,834
Kaolin powder		106,877	132,240	[r]122,046	147,109	157,122
Diamond:[e]						
Industrial stones	thousand carats	22	22	22	22	25
Gem	do.	5	6	7	7	7
Total	do.	27	28	29	29	32
Feldspar		24,496	17,995	15,019	11,388	13,025
Gypsum		622	532	1,367	894	449
Iodine	kilograms	13,416	5,790	8,227	9,753	14,275
Nitrogen: N content of ammonia		2,057,300	2,298,500	2,363,900	2,366,700	2,526,400
Phosphate rock		525	608	[r]3,098	411	10,549
Salt, all types[e]	thousand tons	600	600	600	600	600
Stone:						
Dolomite		1,500	—	38,492	70,043	68,731
Granite	thousand tons	1,421	1,422	1,181	1,122	1,195
Limestone	do.	[r]12,184	12,784	[r]15,966	13,430	10,199
Marble	square meters	9,699	3,530	[r]5,645	2,369	1,112
Quartz sand and silica stone		682,125	782,620	[r]877,579	421,126	301,706
Sulfur, elemental		4,023	4,525	3,941	4,321	3,890
Zeolite		—	—	—	626	640

See footnotes at end of table.

TABLE 1—Continued

INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989^p
MINERAL FUELS AND RELATED MATERIALS						
Asphalt rock, natural		450,633	242,055	84,889	—	—
Coal	thousand tons	1,942	2,601	^r2,979	4,095	8,812
Gas, natural:						
Gross	million cubic feet	1,580,012	1,628,860	1,731,083	1,846,861	1,975,421
Marketed	do.	1,148,628	1,113,286	1,188,358	1,312,090	^e1,400,000
Petroleum:						
Crude including field condensate	thousand 42-gallon barrels	483,768	507,228	479,057	491,509	514,184
Refinery products:						
Liquefied petroleum gas	do.	2,101	2,787	3,905	3,130	^e4,000
Gasoline	do.	23,619	28,119	30,007	32,026	^e32,000
Jet fuel	do.	3,845	1,631	3,763	5,795	^e6,000
Naphtha	do.	17,148	17,306	17,309	17,471	^e17,500
Paraffin wax	do.	79	116	152	192	^e200
Kerosene	do.	38,383	43,043	42,207	41,413	^e42,000
Distillate fuel oil	do.	50,060	73,490	77,355	79,628	^e80,000
Lubricants	do.	1,263	1,574	1,574	1,462	^e1,500
Residual fuel oil	do.	19,006	30,221	42,245	47,241	^e47,000
Unfinished oil requiring further processing	do.	25,710	22,621	1,663	1,565	^e1,600
Refinery fuel and losses	do.	8,527	10,004	12,790	13,677	^e14,000
Unspecified	do.	24,150	2,533	1,806	4,790	^e5,000
Total	do.	213,891	233,445	234,776	248,390	^e250,800

^e Estimated. ^p Preliminary. ^r Revised.

[1] Table includes data available through June 18, 1990.

[2] Includes Au content of copper ore and output by Government-controlled foreign contractors' operations. Gold output by operators of so-called Peoples' mines and illegal small-scale mines is not available but may be as much as 18 tons per year.

[3] Includes a small amount of cobalt that is not recovered separately.

ment. The industrial minerals sector consists of ten cement companies led by P.T. Indocement; a large number of private small companies mining granite, kaolin, and other industrial minerals; and three large state-owned fertilizer materials companies. The coal industry consists of two large state-owned coal mining companies and several local and foreign coal mining companies having PSC with the Government.

Out of 62.5 million Indonesians in the country's workforce, about 153,000 were employed by the mineral industry. According to Government and mining industry sources, employment of the oil and gas sector was about 60,000; the tin industry, about 32,000; nonferrous metals including bauxite, copper, gold, iron ore, and nickel, 12,000; the industrial minerals, 41,000; and coal, 8,000 workers. In line with the Government policy of Indonesianization, foreign companies operating in Indonesia are required to train Indonesian citizens to participate in all levels of operations. In past years, progress reportedly was made by major foreign contractors in training and employing more natives in mining and managment positions.

COMMODITY REVIEW

Metals

Aluminum and Bauxite.—Bauxite produced by P.T. Antam from open pit mines on Bintan island and three nearby small islands rebounded sharply owing to increased export markets. In 1989, because of new exports to Federal Republic of Germany and the United States, external shipments of bauxite rose 62% to 965,000 metric tons (mt) and its export earnings increased to $10.9 million from $6.5 million in 1988. According to P.T. Antam, export-grade bauxite reserves containing more than 52% Al_2O_3 on Bintan Island area are limited. However, to meet an anticipated increase in exports to Japan, the company reportedly planned to open a new mine in the Bukit Pari area.[5] Employment of the company's bauxite operations was about 800.

On Bintan Island, the remaining export-grade bauxite reserves are small. However, there are about 78 million metric tons (MMmt) of unexploited below export-grade reserves averaging 49.4% Al_2O_3 and 8.2% SiO_2, of which about 36 MMmt are at the Wacopek deposit. Additionally, in West Kalimantan, about 810 MMmt of low-grade reserves containing between 40% and 43% Al_2O_3, and between 2% and 4% SiO_2 had been identified, of which 360 million MMmt

TABLE 2

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS				
Aluminum:				
Ore and concentrate	525,811	583,900	67,860	Japan 484,000; Venezuela 32,040.
Oxides and hydroxides	1,669	—		
Metal including alloys:				
Scrap	45	1,544	—	Japan 1,540.
Unwrought	174,048	163,337	—	Japan 138,513; Singapore 11,833.
Semimanufactures	54,138	559,992	—	Singapore 532,407; Hong Kong 26,852.
Cobalt: Oxides and hydroxides	NA	22	—	All to Japan.
Copper:				
Ore and concentrate	298,584	250,770	—	Japan 221,267; Canada 19,895.
Metal including alloys, all forms	437	7,191	—	Thailand 3,036; Kuwait 1,428.
Gold: Metal including alloys, unwrought and partly wrought	NA	20	—	Mainly to Singapore.
Iron and steel: Metal:				
Scrap	6,625	2,877	—	Japan 2,530; Singapore 90.
Pig iron, cast iron, related materials	96,392	75,139	—	Japan 60,501; Thailand 4,500.
Ferroalloys:				
Ferrosilicon	NA	151	—	Japan 134; Taiwan 17.
Unspecified	168	—		
Steel, primary forms	136,101	347,341	35,295	Japan 267,154; Malaysia 28,942.
Semimanufactures:				
Bars, rods, angles, shapes, sections	88,901	167,490	106,945	Japan 34,841; China 9,507.
Universals, plates, sheets	16,699	123,340	58,209	Japan 45,978; Thailand 6,931.
Wire	1	503	—	Japan 461; Philippines 41.
Tubes, pipes, fittings	820	48,927	11,708	Singapore 34,948.
Castings and forgings, rough	2	12	1	Singapore 7; Netherlands 4.
Lead:				
Ore and concentrate	NA	353	—	Japan 250; Taiwan 103.
Metal including alloys, all forms	122	1,007	—	Singapore 463; Taiwan 308; Japan 236.
Manganese: Ore and concentrate:[2]				
Metallurgical-grade	4,959	5,000	—	All to Japan.
Nickel:				
Ore and concentrate	963,198	992,877	—	Japan 892,513; Australia 80,000.
Matte and speiss	54,315	49,496	—	Japan 40,799; Netherlands 5,720.
Silver: Ore and concentrate[3]	NA	199	—	All to Singapore.
Tin:				
Ore and concentrate	4,694	1,545	—	Malaysia 1,236; United Kingdom 309.
Metal including alloys:				
Scrap	—	86	—	All to Singapore.
Unwrought	23,804	24,241	—	Singapore 19,376; Netherlands 3,255.
Tungsten: Metal including alloys:				
Unwrought	—	7	—	All to West Germany.
Zinc:				
Ore and concentrate	NA	700	—	All to Japan.

See footnotes at end of table.

TABLE 2—Continued

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS—Continued					
Zinc—Continued					
Metal including alloys:					
Scrap		2,478	516	—	Taiwan 350; Singapore 166.
Unwrought		150	50	—	All to Singapore.
Semimanufactures		—	12	—	Do.
Other:					
Ores and concentrates		752	4,332	—	All to Singapore.
Ashes and residues		563	238	—	Singapore 200; Japan 38.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		15,650	73,978	103	Hong Kong 41,479; Taiwan 17,096.
Grinding and polishing wheels and stones		278	717	—	Hong Kong 383; Taiwan 211.
Barite and witherite		NA	1,716	—	Singapore 1,132; Papua New Guinea 545.
Cement	thousand tons	1,700	2,355	15	Bangladesh 1,092; Sri Lanka 311.
Clays, crude:					
Bentonite		NA	25,832	—	Malaysia 21,873; Singapore 3,938.
Kaolin		NA	76,405	—	Taiwan 41,623; Japan 21,055.
Unspecified		49,029	162	—	Singapore 141; Thailand 18.
Diatomite and other infusorial earth	kilograms	—	220	—	All to Singapore.
Fertilizer materials:					
Crude, n.e.s.		30	3,102	—	Japan 3,017; Taiwan 78.
Manufactured:					
Ammonia		273,370	243,154	—	Philippines 104,738; Taiwan 65,500; Republic of Korea 31,483.
Nitrogenous		1,536,826	907,757	NA	China 313,099; Thailand 151,177; Philippines 89,556.
Phosphatic		120	2,412	—	All to Taiwan.
Unspecified and mixed		4	55	—	Mainly to Malaysia.
Graphite, natural		NA	74	—	Japan 54; Australia 20.
Gypsum and plaster		83,935	80,421	—	Japan 40,221; Philippines 40,200.
Mica: Crude including splittings and waste		6	2	—	All to Singapore.
Phosphates, crude		NA	2,254	—	Japan 2,154; Singapore 100.
Precious and semiprecious stones other than diamond: Synthetic	kilograms	NA	32	—	All to Japan.
Salt and brine		36	—		
Sodium compounds, n.e.s.: Sulfate, manufactured		NA	10,258	—	Singapore 3,110; Japan 2,058; Republic of Korea 1,890.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	thousand tons	1,306	909	—	Mainly to Singapore.
Worked		255	871	233	Australia 337; Japan 168.
Gravel and crushed rock		—	21	—	All to Hong Kong.
Quartz and quartzite		36,875	16,920	—	Japan 16,800; Singapore 120.
Sand other than metal-bearing	thousand tons	61,693	47,268	—	Singapore 47,267.
Other:					
Crude		—	74	—	All to Singapore.
Slag and dross, not metal-bearing		—	6	—	All to West Germany.

See footnotes at end of table.

TABLE 2—Continued

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Destinations, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Carbon: Gas carbon		NA	200	—	Taiwan 96; Republic of Korea 94.
Coal: Anthracite and bituminous	thousand tons	999	893	—	Japan 305; Taiwan 234; Malaysia 107.
Coke and semicoke		19,804	—		
Gas, natural: Liquefied	thousand tons	[4]16,250	17,042	59	Japan 15,267; Republic of Korea 1,716.
Petroleum:					
Crude	thousand 42-gallon barrels	326,648	296,547	87,483	Japan 146,821.
Refinery products:					
Liquefied petroleum gas	do.	NA	6,817	9	Japan 3,817; Singapore 2,235.
Mineral jelly and wax	do.	([5])	12	—	Singapore 6; Taiwan 3.
Kerosene and jet fuel	do.	—	204	—	All to Singapore.
Distillate fuel oil	do.	1,334	744	—	Japan 664; Singapore 80.
Lubricants	do.	15	109	—	Mainly to Singapore.
Residual fuel oil	do.	34,312	44,096	7,217	Japan 35,479; Republic of Korea 1,200.
Bitumen and other residues	do.	243	627	40	Netherlands 377; Japan 169.
Petroleum coke	do.	53	99	—	All to Japan.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Includes manganiferous iron ore and concentrate.
[3] May include other precious metals.
[4] May include liquefied petroleum gas.
[5] Less than 1/2 unit.

are measured; 375 MMmt, indicated; and 75 MMmt, inferred.

Production of primary aluminum by P.T. Indonesia Asahan Aluminum (IN-ALUM) increased slightly but was still below its 225,000-mt/yr-capacity. Underutilization of smelter capacity caused by the shortage of electrical power and by the dispute on allocation of aluminum output between Indonesia and Japan seem unlikely to reoccur in the near future. However, according to the company, chemical pollution of Lake Toba, which could cause damage to the turbine of the powerplant became a new threat to the smelter.

Exports of aluminum ingot rose to 159,007 mt from 103,294 mt in 1988 as the Governments of Indonesia and Japan reached a provisional agreement in late 1989 for allocating the smelter's output among the two countries. Under the new agreement, the output will be distributed 51% to Japan and 49% to Indonesia according to a new formula based on equity shares of the two countries in the smelter after restructure of capital in 1987. In 1988, exports of aluminum went mainly to Japan and Singapore.

Because of the upsurge in the world's aluminum price during 1988-89, IN-ALUM reportedly had eliminated operating losses of $100 million by fiscal year 1988. According to an industry source in Japan, IN-ALUM posted an estimated profit of $120 million on sales of $420 million in fiscal year ending March 1989. However, the company still carried a $100 million in exchange losses, which had been brought on by the yen appreciation and an injected of yen-denominated capital equal to $69 million in 1987.

To meet IN-ALUM's requirements for raw materials in 1989, Indonesia continued to import about 360,000 mt of alumina from Australia, while actively seeking foreign capital to finance its planned alumina refinery on Bintan Island. According to the Department of Mines and Energy, the $600 million project attracted interest from France and the Federal Republic of Germany, but there was still no taker by yearend.

Copper.—Encouraged by the continued high level of copper prices on the world market, Freeport Indonesia, Inc. (Freeport) expanded its copper mining and milling capacity by opening new ore bodies and installing additional primary ball mills, and proceeded aggressively with its $511 million expansion program by initiating development of additional ore bodies in the Ertsberg mining area in 1989. To expand its exploration area, Freeport also signed a new agreement with the Government to explore for copper and associated minerals within an area of 6.1 million acres extending east and west of its existing 24,700-acre COW area in Irian Jaya in 1989.

According to the company's 1989 annual report, the total mine output of ore from the Ertsberg East underground mine averaged 23,600 mt/d and mill throughput, 24,700 mt/d, compared with 22,000 mt/d and 18,600 mt/d, respectively, in 1988. Production of copper, gold, and silver in concentrate reached new records at 143,970 mt, 4,323 kilograms (kg), and 61,305 kg, respectively;

TABLE 3

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS				
Alkali and alkaline-earth metals	2	—		
Aluminum:				
Ore and concentrate	8	61	1	Taiwan 39; Austria 20.
Oxides and hydroxides	303,496	263,007	54	Australia 239,205; Japan 12,379.
Metal including alloys:				
Scrap	8	13	—	All from Japan.
Unwrought	9,551	12,086	177	Australia 7,086; Canada 3,415.
Semimanufactures	23,772	38,469	1,179	Australia 22,015; Japan 4,578.
Arsenic: Oxides and acids	NA	84	(2)	Taiwan 47; China 35.
Beryllium: Metal including alloys, all forms	167	51	—	Japan 48; West Germany 2.
Chromium:				
Ore and concentrate	43	247	—	Philippines 211; Japan 36.
Oxides and hydroxides	515	331	47	United Kingdom 77; Italy 72.
Cobalt: Oxides and hydroxides	27	64	9	West Germany 16; Belgium-Luxembourg 15.
Columbium and tantalum: Tantalum metal including alloys, all forms kilograms	—	8	—	All from Taiwan.
Copper:				
Matte and speiss including cement copper	27	3	—	All from Singapore.
Sulfate	NA	241	(2)	Italy 126; Spain 40; Thailand 35.
Metal including alloys:				
Scrap	2,127	37	—	Singapore 36; Japan 1.
Unwrought	18,294	32,719	16	Zambia 14,206; Chile 12,588.
Semimanufactures	7,298	5,273	73	Japan 2,370; West Germany 1,225.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	754	91	—	Malaysia 47; Japan 24.
Pyrite, roasted thousand tons	1,669	961	—	Sweden 614; Brazil 347.
Metal:				
Scrap	475,558	461,160	64,466	Australia 146,237; Singapore 115,514.
Pig iron, cast iron, related materials	100,826	72,827	126	Malaysia 53,832; U.S.S.R. 16,759.
Ferroalloys:				
Ferromanganese	15,696	13,647	(2)	Australia 6,078; Mozambique 4,066.
Ferrosilicomanganese	NA	6,493	—	Australia 4,123; Mozambique 2,065.
Ferrosilicon	NA	3,933	—	China 2,066; Norway 982; Hong Kong 430.
Unspecified	9,468	6,266	—	Australia 6,040; Taiwan 49.
Steel, primary forms	93,400	210,642	1	Belgium-Luxembourg 109,777; Republic of Korea 34,517.
Semimanufactures:				
Bars, rods, angles, shapes, sections	95,035	98,678	878	Japan 54,574; Republic of Korea 12,256.
Universals, plates, sheets	790,544	651,386	5,010	Japan 531,134; Republic of Korea 43,357.
Hoop and strip	7,717	8,852	302	Japan 4,170; Republic of Korea 3,181.
Rails and accessories	5,399	25,511	(2)	Canada 10,685; Republic of Korea 8,890.
Wire	14,954	20,263	4	Taiwan 7,284; Republic of Korea 6,862.
Tubes, pipes, fittings	167,493	130,304	5,217	Japan 89,680; Republic of Korea 8,153.
Castings and forgings, rough	4,422	6,869	211	Japan 1,811; Belgium-Luxembourg 683.

See footnotes at end of table.

TABLE 3—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Lead:				
Oxides	1,243	1,012	—	Mexico 302; Republic of Korea 236; United Kingdom 182.
Metal including alloys:				
Scrap	161	—		
Unwrought	15,144	15,509	34	Australia 10,620; Taiwan 2,668.
Semimanufactures	519	123	1	West Germany 99; Netherlands 13.
Magnesium: Metal including alloys, all forms	145	171	19	Norway 114; Japan 18.
Manganese:				
Ore and concentrate:[3] Metallurgical grade	1,170	1,998	—	Singapore 1,908; Japan 30.
Oxides	17,672	17,926	257	Singapore 11,296; Japan 3,859.
Mercury	179	192	([2])	Australia 75; Singapore 62; China 40.
Molybdenum: Metal including alloys, all forms	1	5	([2])	Singapore 4.
Nickel:				
Ore and concentrate	1	—		
Matte and speiss	26	13	1	Japan 6; West Germany 3.
Metal including alloys:				
Scrap	—	4	—	All from Japan.
Unwrought	—	50	—	Japan 40; Taiwan 4.
Semimanufactures	59,770	42,967	62	Australia 42,002.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$13	$11	$11	
Rare-earth metals including alloys, all forms	NA	59	47	Singapore 5.
Silver:				
Ore and concentrate value, thousands	$4	—		
Metal including alloys, unwrought and partly wrought do.	$34	$7	—	All from Japan.
Tin:				
Oxides	—	4	—	Italy 2; Canada 1.
Ash and residue containing tin	NA	206	—	All from Republic of Korea.
Metal including alloys, all forms	24	19	([2])	Australia 6; Malaysia 3; Singapore 3.
Titanium: Oxides	12,749	6,380	397	Japan 3,203; West Germany 521.
Tungsten:				
Ore and concentrate	148	—		
Metal including alloys, all forms	12	32	([2])	Japan 10; Republic of Korea 9.
Uranium and thorium:				
Oxides and other compounds	NA	139	—	France 111; Singapore 10; United Kingdom 10.
Metal including alloys, all forms	NA	9	([2])	United Kingdom 6; Singapore 1.
Vanadium: Oxides and hydroxides	NA	7	2	Japan 3; Netherlands 1.
Zinc:				
Ore and concentrate	4	—		
Oxides	765	325	40	Japan 64; China 53; Peru 52.
Metal including alloys:				
Scrap	392	654	—	Singapore 301; Thailand 266.
Unwrought	48,558	49,176	419	Australia 37,176; Canada 3,164.
Semimanufactures	1,110	726	27	Australia 159; Singapore 147.

See footnotes at end of table.

TABLE 3—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Other:				
Ores and concentrates	1,845	1,133	—	Australia 1,040; Japan 49.
Ashes and residues	32	303	—	Australia 105; Singapore 89; Japan 61.
Base metals including alloys, all forms	103	1,167	6	United Kingdom 1,016; China 68.
Metalloids[4]	NA	270	7	Norway 65; Japan 64; China 52.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	706	568	18	China 224; Japan 126.
Artificial:				
Corundum	167	687	—	Australia 500; Japan 174.
Silicon carbide[5]	NA	232	(2)	Switzerland 77; West Germany 75; China 50.
Dust and powder of precious and semiprecious stones including diamond kilograms	NA	170	—	All from China.
Grinding and polishing wheels and stones	3,943	3,202	33	China 1,802; Japan 404; Italy 219.
Asbestos, crude	11,186	12,205	1,172	Canada 5,472; Mozambique 1,027.
Barite and witherite	57,959	15,364	453	Thailand 9,436; Batuampar 4,128.
Boron materials:				
Crude natural borates	17	5	—	Netherlands 4.
Oxides and acids	300	486	144	Italy 237; United Kingdom 41.
Bromine kilograms	NA	57	—	United Kingdom 40; Canada 8; Singapore 8.
Cement	6,308	3,684	496	Malaysia 2,047; Batuampar 840.
Chalk	1,383	1,219	—	Taiwan 1,200; West Germany 18.
Clays, crude	50,617	36,749	16,920	China 5,597; Japan 3,785.
Cryolite and chiolite	69	3	1	West Germany 2.
Diatomite and other infusorial earth	769	1,323	849	Republic of Korea 205; Japan 200.
Feldspar, fluorspar, related materials	12,504	14,193	—	China 9,765; India 1,500.
Fertilizer materials:				
Crude, n.e.s.	2,934	35	—	France 19; Australia 8.
Manufactured:				
Ammonia	76	7	1	Japan 3; Singapore 1.
Nitrogenous	3,349	1,721	44	Chile 620; Portugal 401.
Phosphatic	7,809	4,861	71	West Germany 2,579; Belgium-Luxembourg 1,400.
Potassic	92,123	211,993	33	Canada 170,613; Jordan 35,335.
Unspecified and mixed	30,300	29,099	581	Republic of Korea 13,252; West Germany 7,340.
Graphite, natural	968	704	(2)	Republic of Korea 480; China 157.
Gypsum and plaster	197,530	122,372	9	Thailand 115,373; Australia 1,708.
Iodine	NA	16	3	United Kingdom 6; Japan 3.
Kyanite and related materials	NA	177	—	Mozambique 176.
Lime	180	38	25	Singapore 6.
Magnesium compounds: Oxides and hydroxides	8,641	5,368	(2)	Hong Kong 2,237; China 1,592; Japan 1,158.

See footnotes at end of table.

TABLE 3—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Mica:				
Crude including splittings and waste	599	237	41	Japan 37; Norway 32.
Worked including agglomerated splittings	49	56	(2)	Sweden 21; China 18; Japan 12.
Nitrates, crude	836	—		
Phosphates, crude thousand tons	718	1,196	135	Jordan 498; Morocco 337.
Pigments, mineral:				
Natural, crude	NA	4,913	—	West Germany 4,404; China 500.
Iron oxides and hydroxides, processed	4,766	5,015	69	China 1,660; West Germany 1,604; Japan 517.
Potassium salts, crude	29	—		
Precious and semiprecious stones other than diamond: Synthetic value, thousands	$6	—		
Pyrite, unroasted	108	1	—	All to Singapore.
Salt and brine	60,887	85,463	24	Australia 84,868.
Sodium compounds, n.e.s.:				
Soda ash, natural and manufactured	151,326	174,311	73,149	Japan 36,416; France 21,440; Kenya 15,500.
Sulfate, manufactured	NA	18,026	3,160	China 12,148; Hong Kong 1,216.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	2,260	2,027	(2)	Italy 1,649; China 192.
Worked	5,493	3,008	174	Taiwan 2,073; Italy 379.
Dolomite, chiefly refractory-grade	7,075	5,158	—	United Kingdom 1,518; West Germany 1,349; Japan 1,112.
Gravel and crushed rock	1,378	1,224	143	France 831; Netherlands 60.
Limestone other than dimension	22	11	9	Norway 2.
Quartz and quartzite	191	604	—	China 438; Sweden 84; Republic of Korea 58.
Sand other than metal-bearing	1,496	2,151	1,605	Taiwan 230; Malaysia 174.
Sulfur:				
Elemental:				
Crude including native and byproduct	10,844	33,620	(2)	Singapore 11,604; Saudi Arabia 9,282; China 8,317.
Colloidal, precipitated, sublimed	221,404	345,495	75,910	France 254,428; Singapore 14,070.
Dioxide	NA	3	—	Netherlands 1; Singapore 1.
Sulfuric acid	103	66	5	Singapore 24; France 23.
Talc, steatite, soapstone, pyrophyllite	27,722	17,464	153	China 11,971; Republic of Korea 1,279.
Other:				
Crude	28,666	29,646	95	West Germany 27,627; Republic of Korea 782.
Slag and dross, not metal-bearing	28,907	21,019	207	Japan 20,218.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	936	988	275	Singapore 322; Japan 192.
Carbon:				
Carbon black	34,227	31,341	248	Australia 11,710; Taiwan 7,171.
Gas carbon	NA	5	—	Japan 4; China 1.

See footnotes at end of table.

TABLE 3—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	Sources, 1987	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Coal:					
Anthracite and bituminous		335,038	2,076,520	214	Australia 1,823,241; China 252,893.
Lignite including briquets		562	537	43	Singapore 279; Japan 181.
Coke and semicoke		[6]30,897	30,125	16	Japan 16,309; Taiwan 5,923; Australia 4,178.
Peat including briquets and litter		38	14	—	All from Netherlands.
Petroleum:					
Crude	thousand 42-gallon barrels	27,837	29,049	—	Saudi Arabia 28,558; Malaysia 491.
Partly refined	do.	NA	256	190	Singapore 21.
Refinery products:					
Liquefied petroleum gas	do.	(2)	(2)	(2)	France (2).
Gasoline	do.	330	315	(2)	Singapore 255; Australia 60.
Mineral jelly and wax	do.	96	52	(2)	China 22; West Germany 11.
Kerosene and jet fuel including white spirit	do.	3,379	7,379	(2)	Singapore 7,086; Philippines 265.
Distillate fuel oil	do.	4,993	4,792	(2)	Singapore 4,693; Philippines 87.
Lubricants	do.	389	902	367	Singapore 336.
Residual fuel oil	do.	3,559	4,423	(2)	Singapore 4,385.
Bitumen and other residues	do.	1,190	949	3	Singapore 811; Taiwan 105.
Bituminous mixtures	do.	14	15	(2)	United Kingdom 7; Singapore 4.
Petroleum coke	do.	303	492	491	Denmark (2).

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Includes manganiferous iron ore and concentrate.
[4] Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."
[5] Includes boron carbide.
[6] May include gas carbon.

compared with 121,472 mt, 3,515 kg, and 50,139 kg, respectively, in 1988. The Ertsberg open pit mine was depleted in March 1989. Most ore production was from the Ertsberg East underground mine with additional ore produced from the Deep Ore Zone (DOZ), which is vertically below the Ertsberg East ore body, using open-stope and cut-and-fill methods.

Mined ore was transported through ore passes to a tramway loading facility, then by aerial tramway to the mill, several kilometers (km) below the mine sites. The ore grade at the mill averaged 1.84% of copper, 0.6 gram of gold and 10.3 grams of silver per mt in 1989. After the ore is milled and beneficiated, the copper concentrate is then slurried through a 115-km pipeline to Freeport's port at Amamapare. The concentrate is then dewatered and exported principally to Japan under long-term contacts. The concentrate contains about 45% copper, 13.4 grams of gold, and more than 200 grams of silver per mt. In 1989, Indonesia exported 331,537 mt of copper concentrate principally to Japan and export earnings were valued at $396.5 million.

Under the ongoing multi-project expansion program, Freeport began its initial development of the newly discovered Grasberg ore body, about 3 km north of the Ertsberg East Mine; the Intermediate Ore Zone (IOZ), located beneath the Ertsberg East underground mine; and of the nearby Dom (the Dutch word for Cathedral) ore bodies. Mine production from the Grasberg open pit mine is expected to begin in early 1990 at an initial rate of 3,000 mt/d and gradually increase to 32,000 mt/d by 1992. Mine production from the Dom ore body is expected to begin by late 1990; and from the IOZ ore body, in 1992. In 1989, Freeport also commissioned two (the third and fourth) primary ball mills and related flotation facilities. The milling capacity at the Ertsberg area is expected to reach 32,000 mt/d by 1990. Additionally, a new concentrate slurry pipeline is also expected to become operational by mid-1990.

In August 1989, the board of directors of Freeport McMoRan Copper Co.(FMC), Freeport Indonesia's majority shareholder, approved a $511 million expansion program to raise the milling capacity to 52,000 mt/d by 1992. In October 1989, financing of the project was obtained from a consortium of international lenders, of which about $350 million reportedly was obtained from Japanese banks backed by future sales contract. Insurance against the risks of political instability, inconvertibility, expropriation, war, and breach of contract for the new investment reportedly was covered by the Overseas Private Investment Corp. of the United States and the Multilaterial Investment Guarantee Agency, an affiliate of the World Bank.[6]

In October 1989, FMC awarded a $300 million contract to Fluor Corp. of the United States to direct the expansion project to raise the mining and milling capacity. Fluor was to provide engineering and construction services at Freeport's copper operations in Irian Jaya. According to projections, the mining and milling capacity is expected to reach 32,000 mt/d in 1990, 40,000 mt/d in 1991, and 52,000 mt/d in 1992; and production of copper, gold, and silver in concentrate is expected to reach 166,000 mt, 5,800 kg, and 66,000 kg, respectively, in 1990; 176,000 mt, 6,200 kg, and 92,600 kg, respectively, in 1991; and 243,000 mt, 10,900 kg, and 123,700 kg, respectively, in 1992. Total investment in Ertsberg area mining operations has reached $500 million in 1989 and will exceed $1 billion in 1992. Freeport played an important role in Indonesia's regional development and is expected to contribute annually about $80 million to the Government (in the form of corporate and employee income taxes, royalties, land rent, and dividends), and will increase its employment from 4,200 in 1989 to 5,200, when the expansion is completed in 1992.

According to Freeport's 1989 annual report, by the end of 1989, the proved and probable reserves at the Dom, DOZ, Ertsberg East, Grasberg, and IOZ ore bodies totaled 256.4 MMmt of ore with an average of 1.6% copper, 1.24 grams of gold per mt, and 5.23 grams of silver per mt. Drilling is expected to continue on the surface and from inside the Grasberg adit and in the Grasberg vicinity areas. Additional exploration for copper and precious metals was being conducted at Guru Ridge, southeast of the Ertsberg East Mine.

In September, Freeport reached an agreement with the Government to spend at least $20 million in the next 3 years to explore for copper and associated minerals within an exploration area of 6.1 million acres along the Jayawi Jaya Mountain Ridge from west of its existing COW area extending east to the Papua New Guinea border. Free-

TABLE 4

INDONESIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand tons per year unless otherwise specified
Aluminum:			
Bauxite	P.T. Aneka Tambang (Government)	Kijang, Bintan Island	1,300
Metal	P.T. Indonesia Asahan Aluminum (Nippon Asahan Aluminum Co. of Japan, 59% and Government, 41%)	Kual Tanjun, North Sumatra	225
Cement	P.T. Indocement	Citeureup, West Java	7,700
Do.	P.T. Semen Cibinong	Narogong, East Java	1,500
Do.	P.T. Semen Gresik	Gresik, East Java	1,500
Do.	P.T. Semen Padang	Indarung, West Java	1,530
Coal	P.T. Allied Indo Coal (Allied Indonesia Coalfields Pty. Ltd. of Australia, 60% and P.T. Mitra Abadi Sakti of Indonesia, 20%)	Parambahan, West Sumatra	500
Do.	P.T. Tambang Batubara Bukit Asam (Government)	Bukit Asam, South Sumatra	4,000
Do.	Perum Tambang Batubara (Government)	Ombilin, West Sumatra	1,000
Copper, concentrate	Freeport Indonesia, Inc. (Freeport McMoRan Copper Copper Co. of the United States, 85.4%; Government, 8.9%; and others, 5.7%)	Ertsberg and Grasberg, Irian Jaya	350
Granite	P.T. Karium Granite (subsidiary of P.T. Pandawa Sempurna of Indonesia)	Karium Island	2,000
Petroleum, crude	Atlantic Richfield Indonesia, Inc. (subsidiary of ARCO of the United States)	Arjuna and Arimb offshore West Java	[1] 170
Do.	Maxus Southeast Asia Ltd. (subsidiary of Maxus Energy of the United States)	Cinta and Rama, offshore Southeast Sumatra	[1] 95
Do.	PERTAMINA (Government)	Jatibarang, West Java and Bunyu, offshore East Kalimantan	[1] 80
Do.	P.T. Caltex Pacific Indonesia (Texaco Inc., 50% and Chevron, 50%, both of the United States)	Minas, Duri, and Bangko, Central Sumatra	[1] 700
Do.	Total Indonesie (subsidiary of Compagnie Francaise des Petroles of France)	Handi and Bakapai onshore and off-East Kalimantan	[1] 180
Gas:			
Natural	Mobil Oil Indonesia, Inc. (subsidiary of Mobil Corp. of the United States)	Arun, Aceh in North Sumatra	[2] 1,700
Do.	Roy M. Huffington (subsidiary of HUFFCO of the United States)	Badak, East Kalimantan	[2] 1,000

See footnotes at end of table.

TABLE 4—Continued

INDONESIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand tons per year unless otherwise specified
Gas—Continued			
Liquefied	P.T. Arun LNG Co. Ltd. (Government, 55%; Mobil Oil, 30%; and the Japan Indonesia LNG Co., 15%)	Balang Lancang, Aceh in North Sumatra	10,100
Do.	P.T. Badak LNG Co. Ltd. (Government, 55%; HUFFCO Group, 30%; and the Japan Indonesia LNG Co. 15%)	Bontang, East Kalimantan	7,900
Nickel:			
in ore	P.T. Aneka Tambang (Government)	Pomalaa, South Sulawesi; and on Gebe Island, Moluccas	34
in matte	P.T. International Nickel Indonesia (Inco Ltd. of Canada, 78%; Sumitomo Metal Mining Co. Ltd. of Japan, 20%; other, 2%)	Soroako, South Sulawesi	48
Nitrogen	P.T. Asean-Aceh Fertilizer (Government, 60%; other members of Asean 40%)	Lhokseumawe, North Sumatra	506
Do.	P.T. Pupuk Iskandar Muda (Government)	Lhokseumawe, North Sumatra	506
Do.	P.T. Pupuk Kalimantan Timur (Government)	Bontang, East Kalimantan	1,012
Do.	P.T. Pupuk Sriwijawa (Government)	Palembang, South Sumatra	1,438
Steel, crude	P.T. Krakatau Steel (Government)	Cilegon, West Java	2,000
Tin:			
in ore	P.T. Koba Tin (Government, 25%; Renison Goldfields Consolidated Ltd. of Australia, 75%)	Koba, Bangka Island	6
Do.	P.T. Tambang Timah (Government)	Onshore and off-the islands of Bangka, Belitung, and Singkep	32
Metal, refined	Peleburan Timah Indonesia (Government)	Mentok, Bangka Island	32

[1]Thousand barrels per day.
[2]Million cubic feet per day.

port is expected to spend about $5 million on exploration in this area in 1990.

By yearend, the Government reportedly is expected to approve an agreement with Freeport to extend their original 30-year COW with the Government, which was signed under the first generation COW in April 1967, for another 30 years beyond the original expiration year in 2003. On the other hand, Freeport is expected to become a locally incorporated company under the foreign investment law and issue additional shares to local investors. Freeport also was asked by the Government to consider building a 50,000 mt/yr to 75,000 mt/yr copper smelter if economically viable. According to Government officials, the establishment of a local copper smelter would increase export earnings of value added products, reduce imports of refined copper, and create more jobs in the local area. Indonesia imports and consumes between 30,000 mt and 40,000 mt of refined copper annually.

Gold.—Gold production moved higher again in 1989 and surpassed its previous record output of 1988. According to official Government statistics, overall gold production rose from 4,738 kg in 1988 to 6,155 kg, of which 4,323 kg was recovered as a byproduct by Freeport from the Ertsberg East copper mine in Irian Jaya and the remainder was by P.T. Antam's Cikotok gold mine in West Java, P.T. Lusan Mining's Lebong Tandai gold mine in South Sumatra, and by other Government contractors operating in Kalimantan. Additionally, a large number of small-scale peoples' mines and illegal gold miners operating mainly in Kalimantan reportedly produce more than 18,000 kg of gold in 1989.

According to the Central Bureau of Statistics, exports of gold surged to 25,017 kg from 21,764 kg in 1988. The value of gold exports, however, rose only to $328 million from $317 million in 1988 because of lower gold prices in 1989. Indonesia continued to export most of its gold to Singapore. Gold contained in copper concentrate was exported mainly to Japan.

Because of the continued weakening of the gold price on the world market and less than expected gold findings in the concession areas during 1987–89, gold exploration activities in Indonesia have slowed down somewhat. In 1988–89, ownership of several joint-venture firms had been consolidated or changed hands, while 18 of 103 foreign contractors reportedly had relinquished their COW areas. However, several contractors continued to make progress toward commercial operation, either through construction of mine and processing plants, or completing the final stage of their feasibility study.

As a result of acquisitions by Billiton Metals Inc., a wholly owned subsidiary of the Royal Dutch Shell Group of the Netherlands, of the Australian CSR Group's mining interests in Indonesia in 1988, Billiton became the majority shareholder of P.T. Lusang Mining in 1989. The Lebong Tandai underground mine, which is located about 170 km from Bengkulu in Southwest Sumatra and operated by P.T. Lusang Mining, produced 857 kg of gold in 1988, and about 930 kg in 1989. Employment of P.T. Lusang was 600.

P.T. Primar Lirang Mining (P.T.

PLM), another Billiton acquisition of mining interests from the CSR Group in 1988, reportedly completed its feasibility study in July 1989. Billiton, 90% owner of P.T. PLM, started construction of an open pit mine and ore treatment plant at the Lerokis deposit in 1989. Upon completion of the mine and ore processing facilities in November 1990, the Lerokis gold mine on Wetar Island, which is located offshore north of East Timor, is expected to produce about 1,900 kg/yr of gold, 25,000 kg/yr of silver, and 100,000 mt/yr of API specification grade barite useable for oil drilling muds and has an estimated mine life of 6 years.

P.T. Ampalit Mas Perdana, which went into trial operation in October 1988 at its Ampalit alluvial mine in the concession area of Kasongas B Block, Central Kalimantan, began production with improved efficiency and produced 298 kg of gold and 2,500 mt of zircon concentrate containing 51.8% of ZrO_2 in 1989. Pelsart Resources NL of Australia, a 42.5% majority owner of the Ampalit Mine, reportedly was also involved in developing a nearby property at the Cempaga Buang deposit.

P.T. Monterado Mas Mining (P.T. MMM) began gold production in August 1989. Rio Tinto Zinc (RTZ) Group of the United Kingdom, which acquired mining interests in Indonesia previously held by BP Minerals International Ltd. of the United Kingdom in 1989, became a 65% majority shareholder of the gold project. Other partners in the project included International Finance Corp., an affiliate of the World Bank, (20%) and P.T. Prima Searco (15%). The Monterado Mine, located in the Samalantan District of Sambas Regency about 160 km north of Pontianak in West Kalimantan, has 36 million m^3 of ore reserves averaging 193 milligrams of gold per m^3 and a peak mining capacity of 4.6 million m^3/yr of ore. The Monterado operation has two 400-ton-per-hour floating gravity concentrators, and a gold processing plant. The gold production capacity is 529 kg/yr. Employment at the Monterado mining operation was about 300. According to the company, gold production at the Monterado in 1989 was below capacity because of technical problems in the operation of the two bucketwheel dredges.

P.T. Kelian Equatorial Mining (P.T. KEM) reportedly completed its feasibility study for developing an open pit gold mine, southwest of Kelian Luar near Longiram in East Kalimantan. In 1989, CRA, the majority owner of the Kelian gold project, reportedly had requested the Government for approval to proceed with the development of an open pit mine and construction of a conventional carbon in pulp treatment plant. The total capital cost was estimated at $185 million.

P.T. KEM, which is 67.95% owned by CRA Ltd. of Australia, 22.05% by Kalimantan Gold NL of Australia, and 10% by P.T. Buana Jaya Raya Jakarta Mining Co. of Indonesia, planned to begin gold production in mid-1991 with an annual throughput of 6 MMmt of ore to yield 8,210 kg/yr of gold. The company will become the largest primary gold producer in Indonesia. According to CRA, the mineable reserves including primary and oxide ores at the Kelian deposit were estimated at 53.5 MMmt averaging 1.97 grams of gold per mt of ore.

The ownership of P.T. Indo Muro Kencana (P.T. IMK) was consolidated in 1989 by the majority shareholder. Duval Corp. (Indonesia), which is a wholly owned subsidiary of Pennzoil Co. of the United States, took 90% of the equity and P.T. Gunung Moro Perkasa of Indonesia retained its 10%. Duval continued to conduct detailed regional exploration in its COW area in Central Kalimantan. A feasibility study for developing three mining sites at the Berujan, Kerikil, and Tengkanong deposits in the Mt. Muro area of Central Kalimantan was expected to be completed by the end of 1990.

P.T. Ara Tutat, which was jointly developing alluvial gold deposits with Indo Pacific Resources NL of Australia in Aceh, North Sumatra, reportedly completed construction of its Woyla alluvial gold dredge at the end of 1988. Gold mining operations reportedly began at the Marisa alluvial gold mine but were interrupted in August 1989 for technical reasons. About 90 kg of gold reportedly were recovered from 633,000 m^3 of ore in 1989.

The problems of illegal gold miners persisted in Indonesia, especially in the dense forest area of Central Kalimantan. According to the local government officials, about 15,000 to 20,000 illegal miners were still operating in the concession area held by P.T. Ampalit Mas Perdana in Central Kalimantan. In an effort to remove these illegal miners from the area, the local government security officials reportedly set up road blocks to prevent illegal miners from receiving their supplies and urging them to leave the area. Some illegal miners reportedly used not only picks and shovels but also sophisticated equipment, such as water pumps and diesel-powered stamp mills and created considerable damage to the environment.

Iron and Steel.—Iron sand concentrate produced by P.T. Antam along the eastern shores of Cilacap in Central Java declined because of reduced metal sales to the cement industry. Almost all of Indonesia's iron ore requirement for its iron and steel industry was met by imports. Indonesia continued to import about 2 MMmt of high-grade iron ore mainly from Brazil and Sweden in 1989. Demand for iron ore will increase to about 4 MMmt when P.T. Krakatau Steel (P.T. KS) completes its expansion program in 1992. P.T. KS reportedly was in the final stage of evaluating the project for the modification of its HYL I fixed-bed process plants to incorporate the continuous HYL III process. Following the selection of an engineering and construction contractor from bidders including Kawasaki Heavy Industries, Davy Drave, and MAN-GHH, actual construction is expected to begin in mid-1990.

In connection with P.T. KS's expansion program, capacity of the Cigading Port along the northwestern coast of West Java will be expanded to accommodate any future increase in iron ore and coal imports. Tarmac International and Babcock Contractors, both of the United Kingdom, were awarded the port expansion project by P.T. KS in late 1989. The project reportedly will be financed partially with a $22 million concessionary loan by the British Government. Upon completion in 1992, the Cigading port will be able to accommodate vessels up to 75,000 DWT.

Nickel.—The continued strong demand for nickel in the Japanese market led to a record production of nickel ore, nickel matte, and ferronickel in Indonesia in 1989. Export earnings of nickel also exceeded the 1988 record. An expansion program to boost the smelter's capacity of nickel matte at Soroako in Sulawesi was well advanced. A plan to double the capacity of the Pomalaa ferronickel plant from 4,800 mt/yr to 9,600 mt/yr of contained nickel had been approved by the Government. By yearend, P.T. Aneka Tambang reached an agreement with Queensland Nickel of Australia to supply nickel ore from a new nickel mine yet to be opened in 1991 on Gag Island off Irian Jaya.

Nickel ore produced by P.T. Aneka Tambang from nickel mines in the Pomalaa area of South Sulawesi and on Gebe Island increased to 2 MMmt. Exports of nickel ore in 1989 remained at 1.6 MMmt, of which about 75% of high-grade ore was shipped to Japan and 25% of lower grade ore to Australia. Export earnings of nickel ore rose to $63.8 million from $44.1 million in 1988. Higher nickel prices were the main factor for the increased export earnings in 1989.

Production of nickel in matte by P.T. International Nickel Indonesia (P.T. Inco) from its Soroako integrated nickel complex in South Sulawesi reached a new record of 29,148 mt in 1989, despite a loss of about 150 mt of nickel matte caused by a furnace spill and production interruptions caused by construction of new facilities. Exports of nickel in matte, all to Japan, remained at 28,700 mt but export earnings from nickel matte rose to $304.2 million from $299.2 million in 1988. The expansion program to increase the smelter's capacity to 47,630 mt/yr by the end of 1990 from 35,000 mt/yr was well underway in 1989. By the end of 1989, proven and probable nickel reserves at P.T. Inco's Soraoko concession area were estimated at 77.1 MMmt of ore containing 1.45 MMmt of nickel.

P.T. Inco, which is 78% owned by Inco Ltd. of Canada, 20% by Sumitomo Metal Mining Co. Ltd. of Japan, and 2% by a Japanese consortium led by Mitsui & Co. and Nissho Iwai Corp., planned to make a public share offering of up to 20% of equity interest in P.T. Inco through the Jakarta Stock Exchange in 1990. According to a company official, the public share offering is in accordance with the original 1967 COW, which called for an eventual 20% ownership by local investors. Since 1978, P.T. Inco had offered to sell 2% per annum to the Government, but the offer was not exercised. The 20% stake, according to the company, could be worth between $300 million and $400 million.[7]

Production of Ferronickel by P. T. Antam at its Pomalaa ferronickel plant in South Sulawesi set a new record at 26,058 mt containing 4,964 mt of nickel in 1989. Exports of ferronickel rose to 25,338 mt containing 4,732 mt of nickel from 21,968 mt containing 4,017 mt of nickel in 1988. Export earnings of ferronickel increased to $61.9 million from $54.9 million in 1988.

To boost export earnings of nickel, P.T. Antam, with Government approval, was planning to double its Pomalaa ferronickel plant from 4,800 mt/yr to 9,600 mt/yr of contained nickel with an estimated cost of $150 million. The expansion program reportedly will take about 4 years to complete. In May, P.T. Antam signed an agreement with Queensland Nickel Pty. Ltd. of Australia to jointly conduct a feasibility study to develop a new lateritic nickel mine on Gag Island, about 100 km off Sorong in the northwestern tip of Irian Jaya. In July, Queensland Nickel reportedly agreed to provide more than $100 million to finance the project to develop a nickel mine with 4 million mt/yr capacity on Gag Island.[8] In return, P.T. Antam is to export nickel ore from Gag Island to Queensland Nickel's Yabulu nickel refinery, in Townsville of Queensland, Australia.

Indonesia's nickel ore reserves are large, accounting for approximately 12% of the total world reserves. In addition to P.T. Inco's 77 MMmt reserves containing 1.88% of nickel, nickel reserves on Gag Island, which were previously estimated by P.T. Pacific Nickel Indonesia in the late 1970's, were 160 MMmt containing 1.64% nickel, 0.12% cobalt, and 35.7% iron, of which about 29 MMmt contained 2.3% nickel, 0.074% cobalt, and 24.0% iron. Nickel reserves on Gebe Island, according to an estimate by P.T. Indonesia Nickel Development Co., in 1969 consisted of 21.1 MMmt of nickel-silicate ore grading 2.22% nickel and 72.2 MMmt of oxide ore at 1.25% nickel. Nickel reserves in the Pomalaa area were estimated recently by P.T. Antam at 37 MMmt grading 1.28% nickel.

Tin.—Indonesia remained the world's second largest tin producer, accounting for 15% of the Western World production. However, Indonesia's tin production was only slightly higher than that of Malaysia in 1989. According to some industry observers in Malaysia, China probably was the second largest tin producer in the world in 1989, following Brazil. Indonesia, capable of producing 35,000 mt/yr of tin, was limited by the extension of the Supply Rationalization Scheme (SRS) of the Association of Tin Producing Countries (ATPC) to restrict its tin exports to no more than 31,500 mt between March 1, 1989 and February 28, 1990. Exports of refined tin rose to 25,396 mt and were valued at $211.8 million; compared with 23,805 mt, and $160.2 million in 1988.[9]

Table 5 shows Indonesia's production of tin in concentrate in metric tons, by company and area, in 1987–88.

In 1989, P.T. Timah produced 23,824 mt of tin in concentrate, accounting for 76.2% of total tin production. Of total tin produced by P.T. Timah, 14,400 mt was from Bangka Island, 6,300 mt from Belitung, and 3,100 mt from Singkep Island. In 1989, the company operated 19 sea-going dredges, 10 land dredges, one open pit mine, 66 gravel pumping units, 9 other types of mines, and 193 small-scale gravel pumping units operated by contractors. In 1989, the number of employees was reduced to 25,446 in 1989 from 26,500 in 1987. According to officials of the state-owned tin mining company, to cope with the depressed market price of tin in 1985–86, production costs had been cut to about $6.10/kg from $9.80/kg

TABLE 5

INDONESIA: TIN PRODUCTION BY COMPANY AND AREA

Company and area	1987	1988
P.T. Tambang Timah:		
Bangka Island	12,785	13,680
Belitung Island	5,544	5,960
Singkep Island	3,306	3,307
P.T. Koba Tin:		
Bangka Island	4,042	6,022
P.T. Preussage Kelapa Kampit:		
Belitung Island	540	621
Total	26,217	29,590

Source: Department of Mines and Energy (Jakarta). Indonesian Mining Yearbook, 1988.

by implementing a hiring freeze and curtailing capital investments. As a result of this policy, tin mining productivity has declined considerably because many aging dredges were left without adequate maintenance and major equipment went unrepaired. The company reportedly was facing the problems of making large capital expenditures under an unfavorable market condition in 1989. However, the company was to double its exploration expenditures in Sumatra and was to spend about 70% of its 1989 exploration budget to increase offshore tin reserves around the three islands areas. The company reportedly had computerized the processing and interpretation of its geological survey data.

According to P.T. Timah, its production costs rose slightly to \$6.40/kg in 1989 from \$6.30/kg in 1987. To improve the company's operational efficiency, a new president, who was installed in December, called for a restructuring of operations including the use of more labor-intensive contractors to mine marginal areas.

P.T. Koba Tin, a joint-venture firm of Renison Goldfields Consolidated of Australia (75%) and P.T. Timah (25%), produced 7,035 mt of tin in concentrate from the Koba and Payung areas in the southern part of Bangka Island in 1989. Production capacity was raised to 8,000 mt/yr with commissioning of a new dredge of 24 ft^3 with 5 million ft^3/yr capacity in 1988. The company's workforce was about 1,600 in 1989. Production costs of P.T. Koba Tin reportedly was about \$5.30/kg.

P.T. Preussag Kalapa Kampit, which operated a partially underground and partially open pit tin mine in the north-central part of Belitung Island with a workforce of about 300, produced 404 mt of tin in concentrate in 1989. P.T. Preussag exported directly 558 mt of tin in concentrate valued at \$3.9 million in 1988. In May, Preussag AG of the Federal Republic of Germany sold 100% of its equity interest in P.T. Preussag to P.T. Gunung Kikara Mining, 75% owned by Mr. Probosutedjo, a well-known Indonesian businessman, and 25% by RWS Mine Managment of the United Kingdom. Preussag reportedly had invested about \$1 million since it took over the mining operation from P.T. Broken Hill Pty. of Australia in 1986.

Pelebburan Timah (Peltim), the tin smelter owned by P.T. Timah at Mentok in northwestern part of Bangka Island, processed tin concentrate delivered from tin mines operated by P.T. Timah and P.T. Koba. The 32,500 mt/yr smelter produced 29,900 mt of refined tin, compared with 28,400 mt in 1988. Among the two brands of refined tin that Peltim produced, Bangka tin with 99.935% purity became more popular in the Japanese market because of its lower content of arsenic and lead. P.T. Timah was considering a plan to expand Peltim's smelter capacity by 11,500 mt/yr to 44,000 mt/yr to toll smelt Australian ore beginning in 1991.

Indonesia exported annually more than 80% of its tin production. However, domestic tin consumption had grown from 880 mt in 1987 to about 2,000 mt in 1989. According to P.T. Timah, in 1988, domestic tin consumption was 1,338 mt, of which 670 mt was for plating, 520 mt for solder, 87 mt for pewter, 52 mt for Babbitt metal, and 9 mt for other uses.

Industrial Minerals

Cement.—Cement production in Indonesia rose to a record high at 14 MMmt in 1989 as demand for cement in the domestic and overseas markets continued to grow. According to the Indonesia Cement Association, exports of cement including clinker reached 4 MMmt, compared with 3 MMmt in 1988. P.T. Indocement continued to dominate the industry by accounting for 49% of total production and about 60% of total exports. The company reportedly was operating at 90% of its 7.7 MMmt/yr-capacity in 1989.

To improve its financial condition, P.T. Indocement made a public share offering of 59.9 million shares at \$5.63 a share on the Jakarta Stock Exchange in November. The \$337.2 million offering represents 10% of the company's equity. The fund raised from this offering reportedly would be used to retire some of the company's debts. In 1985, the Government provided a \$330 million financial assistance to the company in exchange of a 30% equity in P.T. Indocement to rescue the company from overcapacity and heavy debt. Because of a 66% increase in sales, the company was expected to make a profit of about \$6 million in 1989, compared with a loss of \$46 million in 1988 and \$58 million in 1987.

Granite.—Granite was produced by P.T. Karimum Granite (P.T. KG) on Karimum Island, off the east coast of Sumatra. About 80% of the company's output was exported primarily to the nearby construction industry of Singapore. P.T. KG also manufactures polished granite tiles for the domestic and overseas markets. According to the Central Bureau of Statistics, exports of granite were 874,000 mt valued at \$6.3 million in 1988. Exports and export earnings of granite blocks were estimated at 980,000 mt and \$9 million in 1989 because of stronger demand by the construction industry of Singapore.

Diamond.—Acorn Security Ltd. of Australia, which was to develop Indonesia's first diamond mine in a swampy area, southeast of Banjar Baru in South Kalimantan in 1988, reached an agreement with BP Minerals International Ltd. of the United Kingdom for a 40% partnership with a \$6 million capital investment in the project to ensure continued development of the diamond mine. Under the agreement, the new funding would be used for drill sampling, recovery testing, and for a program designed to increase proven reserves. However, the ongoing project was interrupted by a decision made by the RTZ Group of the United Kingdom to withdraw from the project. BP Minerals sold all of its mining and minerals interests to the RTZ Group in 1989. In late 1989, Acorn Security reportedly had initiated legal action claiming damages against RTZ.[10]

Phosphate.—Although Indonesia is self efficient in nitrogeneous fertilizer materials, more than 98% of domestic requirements for phosphate materials were met by imports. In 1989, domestic production of phosphate rock by 6 small private mining companies operating in Java was only about 10,500 mt, compared with domestic consumption of about 1.1 MMmt. Indonesia spent annually about \$60 million of foreign exchange to import about 1 MMmt of phosphate rock principally from Jordan, Morocco, and the United States. Most imported phosphate went to the state-owned P.T. Petrokimia Gresik for manufacture of triple superphosphate and the remainder for detergent and other chemical manufacturing.

Mineral Fuels

Coal.—Indonesia's coal production reached a record at 8.8 MMmt in 1989, more than double that of 1988. About 3.4 MMmt was produced from the Bukit Asam Mine in South Sumatra by the state-owned P.T. Tambang Batubara Bukit Asam. Another state-owned Perum Tambang Batubara (PTB) produced 610,400 mt from the Ombilin Mine in West Sumatra. The remaining 4.1 MMmt was produced by Indonesian private enterprises and foreign contractors operating in Sumatra and Kalimantan. Exports of coal, according to the Central Bureau of Statistics, surged 95% to 2.7 MMmt and export earnings rose 66% to $68 million in 1989.

As the world's coal market condition improved, 5 of the 10 PTB contractors had started production, 2 started mine construction, and 3 were in feasibility stage or in the final stages of exploration. The five producing PTB contractors in 1989 were P.T. Allied Indo Coal (P.T. AIC), P.T. Arutim Indonesia (P.T. AI), P.T. Kaltim Prime Coal (P.T. KPC), P.T. Multi Harapan Utama (P.T. MHU), and P.T. Tanito Harum (P.T. TH).

P.T. AIC, which is 80% owned by Allied Indonesia Coalfields Pty. Ltd of Australia and 20% by P.T. Mitra Abadi Sakti of Indonesia, produced 513,200 mt from the Parambahan open pit mine, 6 miles north of Sawahlunto in West Sumatra. The annual capacity of the Parambahan Mine is 550,000 mt. In 1989, most output was exported to Japan, Republic of Korea, and Taiwan. About 75,000 mt was sold to domestic cement plants. The company reportedly had completed its infrastructure project. The total capital investment in 1989 was about $2.5 million.

P.T. AI, which began an open pit operation at the Senakin Mine in South Kalimantan, reportedly reached its designed capacity at an annual rate of 1 MMmt in August. Its output was 686,400 mt in 1989. Proven reserves of the coal deposit were 100 MMmt. In November, another 1 MMmt/yr open pit coal mining was started by the company at the Satui Mine, also in South Kalimantan. Proven reserves at the coal deposit were 50 MMmt. P.T. AI planned to expand the combined capacity of the two mines to 8 MMmt/yr by 1995. The total capital investment by the company so far had reached $45 million. About 60% of the coal production from the two mines was exported principally to the Philippines and Thailand, with the remainder to domestic cement plants. P.T. AI is 100% owned by Utah International Inc., which is a wholly owned subsidiary of Broken Hill Pty. Ltd. of Australia.

P.T. MHU, which made a share offering to local investors, is now 40% owned by New Hope Indonesia PL of Australia, 12% by Mr. Igrahim Rijsjad and 10% by P.T. Asminco Bara Utama of Indonesia, and 38% by six independent Indonesian shareholders. P.T. MHU, which started its Busang open pit coal mine in East Kalmantan in 1988, raised the monthly rate from 40,000 mt to 70,000 mt in September of 1989 and reached 100,000 mt by year end. The company planned to increase its capacity from 1.2 MMmt/yr to 1.5 MMmt/yr by June 1990. Coal production from the Busang Mine in 1989 was about 722,400 mt, of which about 50% went to the Suralaya powerplant in West Java and about 360,000 mt was exported to India, Japan, and Taiwan in 1989. Proven reserves at the Busang coal deposit were 13 MMmt of subbituminous coal.

P.T. TH, which is the only Indonesian coal contractor, raised its open pit coal production from the Sukodadi Pondok Labu and Central Busang areas, about 45 km northwest of Samarinda in East Kalimantan, to about 638,000 mt in 1989. Most coal produced by the company was exported to Japan and Taiwan. Proven reserves at the mining areas were estimated at 19.5 MMmt having a heating value of 6,500 kilocalories per kg. Additional reserves of 19.7 MMmt reportedly were proven in the nearby Sebulu, Sigihan, Belore, and Ketapang area as a result of exploration conducted by the company in 1988-89.

P.T. Kaltim Prima Coal (P.T. KPC), P.T. Kideco Java Agung (P.T. KJA), and P.T. Utah Indonesia (P.T. UI), started mine construction in 1989. Among these three coal contractors, P.T. KPC will become Indonesia's largest coal mining company when its large open pit mining operation at the Pinang mine reaches full capacity of 7 MMmt/yr in 1996. P.T. KPC, which is 50% owned by British Petroleum PLC of the United Kingdom and 50% by Conzinc Riotinto Australia Ltd. of Australia, started mine construction in January at the Pinang Mine, about 125 km north of Samarinda in East Kalimantan. In 1988, the company produced and made three trial shipments of 120,000 mt to Hong Kong, Japan, and the Netherlands. In 1989, an additional 280,000 mt of trial shipments was made to the Federal Republic of Germany, Japan, Taiwan, and Western European countries. With a high possibility of long-term contracts to supply coal to the Federal Republic of Germany, Hawaii, Hong Kong, Italy, Japan, the Netherlands, and Taiwan, P.T. KPC planned to invest a total $500 million for developing the mine and gradually increase its mine production to meet the overseas demand.

According to P.T. KPC, the main facilities at the Pinang mining complex, near the town of Sangatta, will have an open-pit mine, a coal preparation plant, an overland conveyor system, a coal stockyard, a coal terminal, an office building, a coal-fired powerplant, a workshop, a warehouse, and a mining town. A Dutch consortium led by Holland Coal Handling was awarded the contract for the design and construction of the overall project. Construction of the complex was scheduled for completion in September 1991. A deep water port at Tanjung Bara will also be built to accommodate vessels up to 180,000 DWT. According to the company's plan, coal output will be raised from 344,000 mt in 1989 to 600,000 mt in 1990, 1.7 MMmt in 1991, 4.7 MMmt in 1992, 5.5 MMmt in 1993, 6.0 MMmt in 1994, 6.5 MMmt in 1995, and 7 MMmt in 1996. The workforce at full capacity will reach 2,300 in 1996. Proven reserves at the Pinang Mine, were 100 MMmt of subbituminous coal and probable reserves were estimated at 262 MMmt.

P.T. KJA, which is equally owned by four companies from the Republic of Korea, reportedly was completing its mine development at the Samaranggau and Roto in the Pasir region of East Kalimantan. The company planned to produce 500,000 mt of coal in 1990 and to increase output to 1.6 MMmt in 1992. Proven reserves at the two open pit mining area were 98 MMmt with an estimated probable reserves of about 438 MMmt. P.T. Utah, another foreign contractor, 100% owned by Utah International, was also completing construction of a 1 MMmt/yr open pit mine at the Petangis deposit in East Kalimantan. Production was scheduled to start in late 1990. Proven reserves were 25 MMmt in the area.

P.T. Adaro Indonesia, which is 50% owned by Indonesia Coal Pty. Ltd of Australia, 20% by Empresa Nacional Adaro de Investigaciones Mineras S.A. Of Spain, and 15% each by P.T. Tirtamas Majutama and P.T. Asminco Bara Utama of Indonesia, reportedly was conducting feasibility study to develop two mines in the Paringin and Tutupan areas of South Kalimantan. According to the company's plan, the Paringin Mine was scheduled to open in 1991 with a capacity of 1 MMmt/yr, which was to increase to 2 MMmt/yr in 1992. The Tutupan Mine was scheduled to open in 1992 with an initial output of 1 MMmt/yr, then gradually increase to 3 MMmt/yr in 1994.

P.T. Berau Coal, which is 60% owned by Mobil Petroleum Corp. Inc. of the United States and 40% by Nissho Iwai Corp. of Japan reportedly is expected to complete a feasibility study by early 1991 to develop a 5 MMmt/yr mine in the Lati area of East Kalimantan. P.T. Chung Hwa Overseas Mining Development, which is jointly owned by Taiwan Power Co. and Energy and the Mining Research/Service Organization of Taiwan, was still in its exploration stage in its concession area near Martapura in South Kalimantan.

As part of overall coal development in East and South Kalimantan, a coal terminal will be built in the southwestern part of Laut Island, off the east coast of South Kalimantan by a joint-venture firm of Consolidated Bulk Handling Pty. Ltd. of Australia and P.T. Terminal Batubara Indah and P.T. Dermaga Batu Perkasa of Indonesia. Construction is expected to start actually in July 1990 and to be completed by mid-1992.

Petroleum and Natural Gas.—Production of crude petroleum increased from that of 1988, while the output of natural gas reached a new record in 1989. Increased output of crude petroleum was due largely to the opening of new oilfields by 3 of the 17 foreign contractors having a production sharing contract with the Government. The record level of natural gas output was caused by increased demand of LNG. In early 1989, the Government announced a new pricing formula for the exports of crude petroleum and improved terms for PSC holders. As a result, exports of crude petroleum rose by 7% and exploration of oil and gas stepped up considerably in 1989.

Production of crude petroleum, excluding condensate, averaged 1,231,000 bbl/d, a 4.3% increase over that of 1988, but was less than the quota allocated to Indonesia by the Organization of Petroleum Exporting Countries (OPEC) during 1989. The OPEC's quota allocated to Indonesia was 1,240,000 bbl/d for the first half of 1989, and 1,307,000 bbl/d for the second half of 1989. In the November OPEC Ministerial Conference, Indonesia's quota was raised to 1,374,000 bbl/d for the first half of 1990. Production of condensate not subject to quotas rose 7.4% to an average of 177,700 bbl/d. According to PERTAMINA, the state-owned oil and gas company, Indonesia's production capacity including condensate in 1989 was estimated at 1,451,000 bbl/d.[11]

According to Indonesia's Directorate General of Oil and Gas, production of crude petroleum was by the state-owned PERTAMINA, and 17 foreign oil companies having a COW or PSC with the Government in 1989. The top five producers were CALTEX (46.2%), Atlantic Richfield Indonesia Inc. (8.5%), Mobil Oil Indonesia Inc. (8.5%), Maxus Southeast Asia Ltd. (MAXUS) (5.9%), and PERTAMINA (5.2%). The remainder was produced by 13 foreign contractors.

In 1989, CALTEX raised its output by 22% to an average of 650,200 bbl/day by expanding the steamflood capacity from two to three patterns of its steamflood project in the Duri Oilfield in Riau Province of Sumatra. CALTEX planned to complete a total of ten patterns in the Duri Oilfield by 1995 at a cost of $1.8 billion. Maxus, formerly Iiapco Division of Natomas International Corp., raised its output by 14% to an average of 82,500 bbl/d by bringing onstream three new wells in the Intan Oilfield, off southeast Sumatra. Hubay Oil (Malacca Strait) also raised its output by 38% to an average 73,200 bbl/d by bringing onstream new oilfields in the Malacca Strait.

Production of natural gas rose by 7% to a record high level of 1,975 billion cubic feet in 1989. Mobil Oil and Roy M. Huffington Co. remained the two dominant producers accounting for more than 70% of total natural gas production in 1989. Of the total output, about 60% was for production of LNG and LPG; about 13% was consumed by the nitrogen fertilizer, utility, iron and steel, and city gas industries; and the remainder, was for producers' own use and flared.

P.T. Arun LNG Co. Ltd., which operated 6 LNG processing trains at Balang Lancang in the Aceh Province of North Sumatra, produced 10 MMmt of LNG for export all to Japan in 1989. P.T. Badak LNG Co. Ltd. (P.T. BLC) operated 4 trains at Badak in Bontang of East Kalimantan and produced about 8 MMmt of LNG for export to Japan and the Republic of Korea. By yearend, P.T. BLC reportedly completed its fifth LNG processing train with capacity of 1.5 MMmt/yr and planned to export LNG to Taiwan beginning in February 1990.

In an effort to encourage more exploration and development of oil and gas, the Indonesian Government took a positive action to soften the terms of PSC's in February. Under the new terms of the PSC, the split ratio will give a bigger share of oil output to the contractors depending upon the amount of daily output, the number of years a field has been in production, the type of reservoir rocks, depth of water, whether the contract area is in the frontier area or not, and whether the field is an enhanced oil recovery or not. For example, the split ratio (between the Government and the contractor) of a 10,000 bbl/d marginal oilfield in a conventional area for the first 2 years was raised to 80:20 from 85:15. However, the ratio would be reduced to 90:10 when production reaches over 150,000 bbl/d. The new ratio for a pre-Tertiary rock field producing 50,000 bbl/d in frontier area is 75:25 but would be reduced to 85:15 when production reaches more than 150,000 bbl/d.

To increase production and make Indonesia crude more competitive in the world market, the Government abandoned the Government selling prices and adopted a new pricing formula as recommended by the Indonesian Petroleum Association. The new pricing formula for Indonesian crudes effective from April was based on the monthly average spot prices of five internationally traded crudes. The basket of five crudes were Indonesia's Minas, Malaysia's Tapis, Australia's Gippsland, Omani crude, and United Arab Emirate's Dubai Fateh. Under the new formula, the Government is to adjust monthly the price for an Indonesian crude, say Minas, on the 15th of each month, according to the average price of the basket during the last 15 days of previous month plus or minus the difference between the rolling average price of Minas and that of five crudes during the previous 12 months.[12]

As a result of the new incentives provided to the oil and gas industry, the Government reportedly signed 19 contracts with foreign oil companies, compared with 10 in 1988. Of the 19 contracts, 12 were under new terms of PSC, 5 were extensions, and one each was for joint operation agreement and enhanced oil recovery contract. According to PERTAMINA, exports of crude petroleum rose to an average of 809,050 bbl/d from 762,535 bbl/d in 1988 and exports of LNG also rose to 18.5 MMmt from 17.5 MMmt. Export earnings of oil and gas were estimated at $8.7 billion accounting for 40% of total exports in 1989.

To increase exports of refined petroleum products, the Government had approved a $1.9 billion project to build a new 125,000 bbl/d refinery at Balongan on the northeastern coast of West Java. Foster Wheeler of the United Kingdom and JGC Corp. of Japan were awarded the contract to jointly build the refinery beginning in April 1990. The construction was scheduled for completion by the end of 1993 for start up in 1994. A six-member Japanese consortium led by Mitsui & Co. is to provide the project's financing on a non-recourse basis and British Petroleum will market the exportable surplus created at other Indonesian refineries for a 10-year period. Exports of processed petroleum products had been monopolized by the state-owned PERTAMINA in the past. Under a new rule, private local and foreign companies reportedly will be allowed to invest in refining and gas processing operations for export through a cooperative agreement with PERTAMINA.[13]

RESERVES

Indonesia is estimated to have large ore reserves of nickel and tin, and significant reserves of bauxite, coal, copper, natural gas and crude petroleum. Nickel reserves are located mainly in South Sulawesi, on Gebe Island, and on Gag Island. Tin reserves are concentrated onshore and offshore Bangka Island and around nearby islands of Belitung, Kundur, Karimum, and Singkep. Bauxite reserves are on Bintan Island and West Kalimantan; coal, in West and South Sumatra and East Kalimantan; and copper, in the Ertsberg and Grasberg areas of Irian Jaya. Crude petroleum and natural gas reserves are concentrated onshore and offshore Sumatra, offshore north of Java, and onshore and offshore East Kalimantan.

According to the Indonesian Department of Mines and Energy and industry sources, ore reserves of major minerals are as follows in thousand metric tons unless otherwise specified:

TABLE 6

INDONESIA: RESERVES OF MAJOR MINERALS

Commodity		Thousand tons
Bauxite		[1] 396,000
Coal		[2] 3,000,000
Copper		[3] 256,400
Gas, Natural	billion cubic feet	87,015
Nickel		[4] 367,000
Petroleum, Crude	million barrels	8,200
Tin		[5] 740

[1] Includes proven reserves on Bintan Island and West Kalimantan, grading no less than 40% Al_2O_3.
[2] Includes proven and probable reserves.
[3] Represents proven and probable reserves, grading 1.6% Cu, in the Ertsberg and Grasberg areas of Irian Jaya.
[4] Represents proven and probable reserves on Gag Island, Gebe Island, in the Pomalaa and Soroako areas of South Sulawesi, grading between 1.5% to 2% Ni.
[5] Offical proven reserves.

Sources: The Indonesian Department of Mines and Energy, the Indonesian Mining Association, Freeport Indonesia, Inc., P.T. Inco., and Oil and Gas Journal.

INFRASTRUCTURE

Indonesia's infrastructure, including terminals, port facilities, highways, railroads, and pipeline system are adequate to transport most mineral products to the domestic and overseas markets. However, because of the rapid development of coal in Sumatra and Kalimantan, upgrading of railways and development of new coal terminals are necessary for delivery of coal to the main coal consumers in West Java and for export to Far East markets. In South Sumatra, the rehabilitation of the 450-km railroad system has not yet been completed, but a modern coal terminal at Tarahan was completed in 1987.

In 1988–89, many country roads and small ports along the eastern coast of South Kalimantan were built by foreign contractors developing coal mines in Kalimantan. In order to handle heavy volume of coal exports, development of a major coal terminal on the southeastern part of Laut Island off South Kalimantan will be completed in 2 to 3 years. In 1989, a $15 million coal terminal was well advanced at Teluk Bayur, south of Padang on the western coast of Sumatra.

Additionally, Indonesia is to expand an iron ore receiving port at Cigading on the northwestern coast of West Java by 1992 to accommodate increased requirements for iron ore by P.T. KS. Indonesia is also planning to construct an integrated natural gas pipeline network for delivery of natural gas from gasfields in Natuna Sea to nearby Batam Island for future industrial activities in the area and to Arun gasfields in Aceh of North Sumatra for production of LNG. The 2,240 km pipeline network, which will be built by the private sector, will cost about $3 billion.

OUTLOOK

The mineral industry of Indonesia should continue to grow because of increased production of coal, copper, gold, and nickel, while production of crude petroleum and tin is expected to remain steady. Exports of coal, copper, natural gas (in the form of LNG), and nickel were also expected to increase substantially in the next 2 years. With the improved terms of PSC's, exploration and development of oil and gas should intensify in Indonesia. However, exploration for gold by investors especially in Kalimantan could slow down further as the gold price moves lower in the world market.

The outlook for coal, copper, natural gas, and nickel is brighter than for gold, crude petroleum, and tin. By 1992, Indonesia is expected to produce more than 13 MMmt of coal, 250,000 mt of copper in concentrate, over 2 trillion cubic feet of natural gas, and over 65,000 mt of nickel. Future increases in gold production would result more from the expansion of copper operations in the Ertsberg and Grasberg areas than output from primary gold mines in Kalimantan. A marginal increase in crude petroleum may come from a secondary recovery project in the Duri Oilfield. A small increase in tin could materialize if P.T. Timah sucessfully carried out restructuring and modernization programs to increase its productivity.

According to the Indonesian National Investment Coordinating Board, the Government is easing rules and regulations on foreign investments to attract the required capital to help develop the country. Deregulation measures and concise criteria for the Government's foreign investment approval process will facilitate opening the door to increased flows of foreign capital. As a result, foreign investment is expected to increase at a rate of about 3% a year from $4.7 billion in 1989. Japan, the Republic of Korea, and the United States will remain the three leading foreign investors.

The Indonesian economy is expected to improve further from that of 1989 as the country's manufacturing sector continues to grow, the energy sector continues to recover, and its economic reform continues to boost the domestic and foreign investment. The country's external debt, consisting of $36 billion official debt, $13 billion medium- and long-term debt, and $6 billion short-term non-guaranteed private debt, is expected to increase slightly because of ongoing construction of major petrochemical projects and increased regional development programs. The country's debt service ratio is expected to remain at about the 38% to 40% level. However, the ratio could be reduced if Indonesia's export earnings move higher in the coming years.

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[1] Where necessary, values have been converted from Indonesian rupiah (Rp) to U.S. dollars at the rate of Rp1,770=US$1.00 in 1989.

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Agencies

Department of Mines and Energy
Directorate General of Mining,
Directorate of Coal, and
Directorate General of Geology and Mineral Resources
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Jakarta 12790, Indonesia

Directorate of Mineral Resources and Geological
Research and Development Center
Jl. Diponegoro 57, Bandung 40122
Indonesia

Directorate General of Oil and Gas
Jl. M.H. Thamrin No. 1, Jakarta
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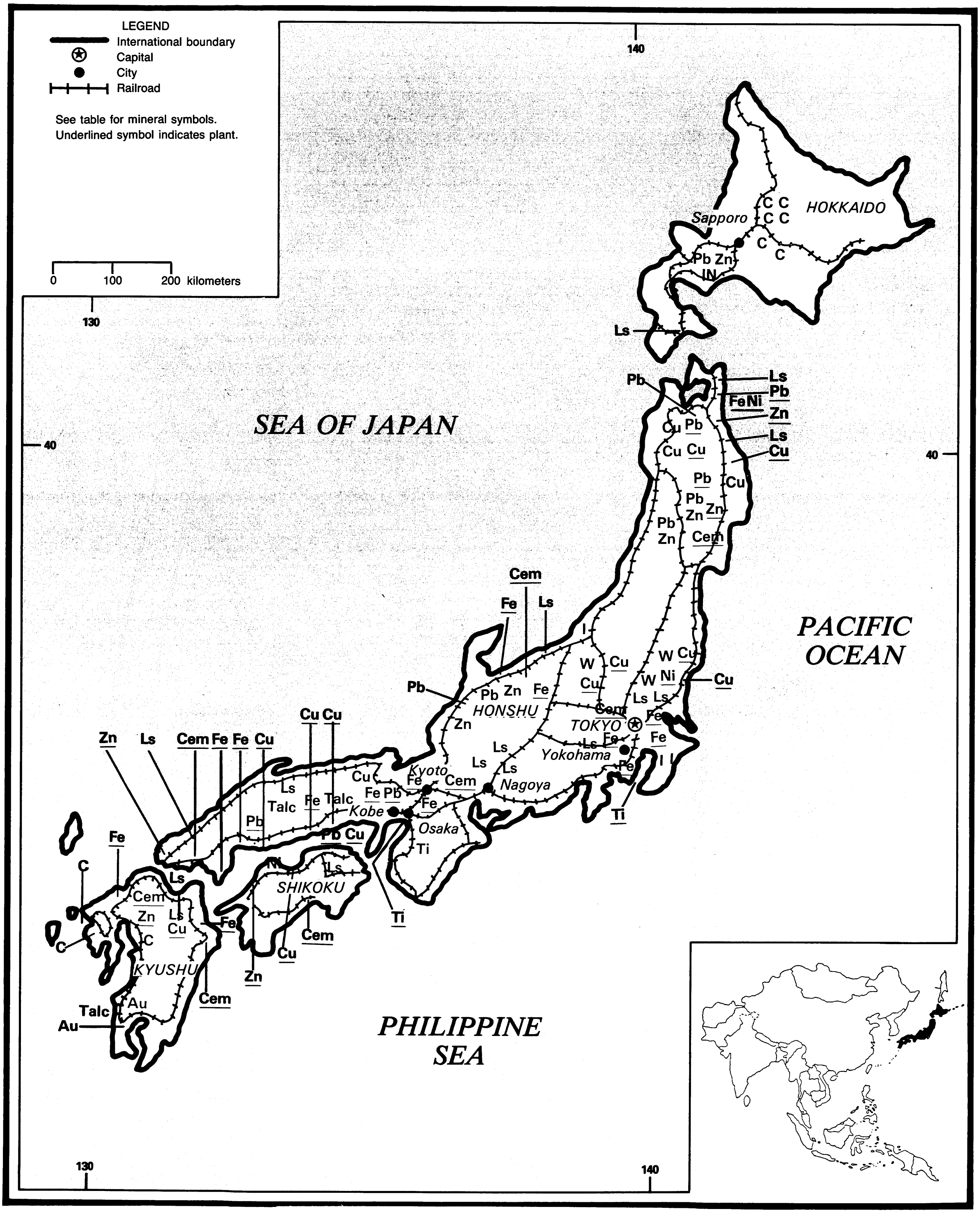
JAPAN

AREA 377,835 km² **POPULATION 123.6 million**



THE MINERAL INDUSTRY OF

JAPAN

By John C. Wu

Japan is poor in both energy and nonfuel minerals resources. However, it is a major world importer and consumer of both fuel and nonfuel mineral commodities, with a large mineral processing sector to support its world-class manufacturing sector. In 1989, Japan was the world's largest producer of indium metal, iodine, electrolytic manganese dioxide, pyrophyllite, selenium metal, and tellurium metal; and the second largest producer of cadmium metal, high-purity gallium metal, pig iron, and steel. Japan was ranked the third largest producer of cement, limestone, nickel metal, titanium sponge metal, and zinc metal; the fourth largest producer of copper metal and lime in the world; and one of the world's top six producers of bromine, high-purity germanium metal, primary magnesium, and silica sand. Ore reserves of all fuel and most nonfuel minerals in Japan are very small. However, its reserves of iodine, silica stone, and silica sand are large and of world significance.

Japan is one of the world's major markets for primary aluminum, cadmium metal, chromium ore, coal, cobalt metal, copper concentrate and copper metal, ferrochromium, iron ore, ilmenite, industrial salt, liquefied natural gas (LNG), manganese ore, nickel ore, crude petroleum, phosphate rock, potash, precious metals, rutile, and zircon sand. Japan is a major supplier of manufactured fertilizer materials, iodine, electrolytic manganese dioxide, high-purity rare metal products, iron and steel products, and titanium sponge metal and mill products.

The mining sector of Japan's mineral industry has been contracting since the early 1980's because of mine closures due to depleted ore reserves and high production costs and because of increased imports of minerals and metals due to the appreciation of the yen. According to Japan's Economic Planning Agency, the sector contribution of the mining industry to Japan's gross domestic product (GDP) dropped to below 0.35% in 1989 from 0.38% in 1985 and 0.57% in 1980. The value of the crude mineral output in 1989 was estimated at $9.6 billion,[1] and the GDP was estimated at $2.8 trillion in current dollars. Despite the small contribution of the mining sector to the GDP, the mineral processing sector is important to the Japanese economy because of its supporting role for providing the basic materials to the export-oriented manufacturing sector and growing domestic economy.

Japan is an important market for U.S. exports of primary aluminum, beryllium metal, coal, copper concentrate, ferrous and nonferrous metals scrap, lithium products, primary magnesium, molybdenum concentrate, phosphate rock, rare earths, soda ash, tantalum products, and refined petroleum products, especially diesel fuel and gasoline. On the other hand, Japan is an important U.S. supplier of aluminum and copper mill products, iodine, iron oxide, high-purity rare metals, high-quality steel products, and titanium sponge metal and mill products.

Because of its shrinking mining industry and growing demand for minerals and metals, Japan's mineral commodities imports, including crude and processed fuel and nonfuel minerals, according to the Ministry of Finance, rose 19% to $67.4 billion, and mineral commodities exports remained steady at $24.6 billion between 1988 and 1989. Japan suffered from $42.7 billion of mineral trade deficit largely owing to large imports of mineral fuels, which amounted to $43.1 billion in 1989. Of total imports of mineral fuels, $21.5 billion was for crude and partially refined petroleum; $8.3 billion for refined petroleum products; $5.9 billion for coal, including anthracite and bituminous coal; $5.5 billion for LNG; and $1.9 billion for other fuels. Imports of metallic ores and scrap totaled $9.3 billion, of which $3.1 billion was for iron ore, $4.7 billion for nonferrous ores, and $1.5 for ferrous and nonferrous scrap. Iron and steel products and nonferrous metals imports were $5.1 billion and $9.9 billion, respectively, in 1989. Japan's metals exports totaled $21.6 billion, of which $14.8 billion was iron and steel products and $6.8 billion was nonferrous and other metals. Exports of industrial minerals and their products totaled $3.1 billion in 1989.

GOVERNMENT POLICIES AND PROGRAMS

To maintain the Japanese economic security and steady economic growth, the stability of overseas raw materials supplies is the most important objective of the Government's mineral policy. According to the Ministry of International Trade and Industry (MITI), the objectives of the Government's mineral policy had been clearly defined in the early 1970's as (1) to secure stable sources of minerals, (2) to systematically develop domestic resources, (3) to actively promote development of overseas mineral resources through economic cooperation with mineral-rich developing countries, and (4) to stockpile rare metals.

Because of the changes in the minerals supply and demand situations in both the domestic and the world's markets between the 1970's and 1980's, a Mining Industry Council (MIC) was formed in September 1989 to conduct study on supply and demand for the nonferrous minerals and metals. The Council also was to conduct studies on the future role of the domestic mineral industry and to redefine the Government's mineral policy for the 1990's and beyond. The Council should complete its final report and make recommendations to the MITI by mid-March 1990.

According to the Metal Mining Agency of Japan (MMAJ), a quasi-Government organization under supervision of the MITI, the important subjects of discussion by the Council included: (1) world's supply-and-demand outlook for nonferrous metals, (2) Japan's mineral resources problems in the 1990's, (3) the role of Japan's mineral industry in the 1990's, and (4) a new mineral policy for the 1990's. The Council reportedly will urge the Government to (1) actively encourage private companies to expand their overseas minerals exploration activities through Government partnership and more Government loan programs, (2) clearly define the overseas targeted areas and types of minerals, and (3) sufficiently evaluate the feasibility study of the selected overseas projects.

Because of increased demand for rare metals by the high-technology sector, the MITI planned to launch a 5-year program to study a recycling system for a group of metals in Japan beginning in April 1990. The study is to focus on the recycling of barium, chromium, cobalt, columbium, europium, molybdenum, nickel, palladium, platinum, selenium, tantalum, titanium, and yttrium. The scope of the study will include (1) the development of a data base for imports and consumption of these metals in Japan, (2) the investigation of scrap collection and utilization for these metals in Japan, and (3) the investigation of the profitability of Japan's recycling activities of these metals.[2]

In November 1989, a nonprofit quasi-Government organization called the Japan Metal Economics Research Institute was established in Tokyo jointly by the MITI, MMAJ, and 47 private mining and smelting, metal fabricating, and wire and cable manufacturing companies. Its main activities include collecting and analyzing information on the supply and demand for selected metals in the domestic and world markets, conducting workshops and symposia, publishing reports, and participating in joint research with domestic and foreign organizations. The Institute reportedly will also conduct research on political trends in metal-producing countries and act as a consultant to private companies on overseas acquisition and minerals development projects. The $1.5 million annual budget was funded by the Government and membership fees from company members.

In fiscal year 1989, Japan continued to build its metals stockpile of chromium (in ferrochromium), cobalt (in metal), manganese (in ferromanganese), molybdenum (in concentrate), nickel (in metal, ferronickel, and nickel oxide), tungsten (in concentrate), and vanadium (in ferrovanadium) under a two-scheme plan. According to MMAJ, by fiscal year 1989 ending March 1990, stockpile of the seven metals by the Government program reached a 35.7-day supply using the 1986 consumption base, and the private program reached a 15.3-day supply. MMAJ, which is managing the Government program, stockpiles these seven metals in MMAJ's two warehouses at Takahagi in Ibaraki Prefecture. Japan Rare Metals Association, which is managing the private program, stockpiles the seven metals in member companies' warehouses.

PRODUCTION

In the nonfuel minerals sector, mine production of all nonferrous minerals, except chromium and tungsten, declined from that of 1988 mainly because of production cutback at two major nonferrous metal mines, the Uchinotai Mine and the Hanaoka Mine, both in Akita Prefecture. In late 1988, the Nodatamagawa Mine, a small-scale manganese mine, resumed its mine operation in Iwate Prefecture. Mine production of most construction-related industrial minerals increased from that of 1988 mainly because of stronger demand by the construction industry.

In the mineral fuels sector, the coal industry shut down permanently the Horonai Mine, the oldest and second largest coal mine in Hokkaido, and continued to implement production cutback at the remaining seven major coal mines in Hokkaido and Kyushu. Production of natural gas and crude petroleum continued to decline and remained small. In 1989, no significant oil and gas discoveries were made in Japan.

In the mineral processing sector, production of most metal and processed industrial minerals was higher than that of 1988 because of a stronger demand by the domestic manufacturing and construction industries resulting from higher growth in the Japanese economy. Declines in production of zinc and a few minor metals were generally caused by either lack of raw materials or unfavorable market conditions in 1989.

TRADE

Japan is a major world importer of energy, nonfuel minerals, and nonferrous metals. It is also a major world exporter of processed minerals. However, because of its poor indigenous mineral resources, Japan has consistently suffered from a mineral trade deficit. The mineral trade deficit was largely a result of large imports of mineral fuels and metallic mineral ores.

Because of the continued economic growth resulting from a further expansion in domestic demand in 1989, imports of mineral fuels rose from $38.4 billion in 1988 to $43.1 billion, accounting for 20.4% of total imports in 1989. Imports of metallic minerals, including ores, iron and steel products, nonferrous metals, and metal scrap, rose from $22.4 billion in 1988 to $24.3 billion, accounting for 11.5% of total imports in 1989. Exports of minerals and processed minerals remained at $24.6 billion, accounting for 9% of total exports in 1989. However, exports of iron and steel dropped from $15.3 billion in 1988 to $14.8 billion because of reduced exports, especially to China, while exports of nonferrous metals and industrial minerals rose from $9.4 billion in 1988 to $9.8 billion because of increased exports of industrial minerals in 1989.

The United States remained the most important trading partner of Japan because of its significant role in supplying Japan with a wide variety of raw materials, foodstuffs, and manufactured products. Japan, on the other hand, is an important supplier of a wide variety of metals and fabricated products as well as machinery and equipment to the United States.

In terms of overall merchandise trade, Japan's exports to the United State rose by 4% to $93.2 billion, accounting for 34% of Japan's total exports in 1989. Japan's imports from the United States

TABLE 1

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	1987	1988	1989[p]
METALS					
Aluminum:					
Alumina, gross weight — thousand tons	978	607	358	415	466
Metal:					
Primary:					
Regular grades — do.	227	140	41	35	35
High-purity — do.	5	8	12	14	16
Secondary[2] — do.	861	872	894	954	999
Antimony:					
Oxide	8,243	9,677	9,805	10,661	10,327
Metal	296	194	196	185	173
Arsenic, white (equivalent of arsenic acid)[e]	500	500	500	500	500
Bismuth	642	640	546	524	502
Cadmium, refined	2,535	2,489	2,450	2,614	2,694
Chromium:					
Chromite, gross weight	11,920	10,642	11,815	9,508	11,674
Metal	3,557	2,987	3,235	3,041	3,412
Cobalt metal	1,277	1,338	124	109	99
Columbium and tantalum: Tantalum metal	77	66	87	123	92
Copper:					
Mine output, Cu content	43,208	34,924	23,817	16,666	14,650
Metal:					
Blister and anode:					
Primary	802,300	827,700	871,000	854,600	882,300
Secondary	130,300	124,400	109,200	139,400	123,200
Total	932,600	962,100	980,200	994,000	1,005,500
Refined:					
Primary	802,341	827,657	870,994	854,608	882,263
Secondary	133,636	115,380	109,355	100,500	107,303
Total	935,977	943,037	980,349	955,108	989,566
Gallium metal:					
Primary	10	10	10	6	[e]6
Secondary	10	10	16	28	32
Germanium:					
Oxide	14	14	13	14	13
Metal	10	9	5	4	4
Gold:					
Mine output, Au content — kilograms	5,309	10,280	8,590	7,310	6,098
Metal:					
Primary — do.	43,030	48,979	56,058	92,029	110,330
Secondary[3] — do.	60,224	105,901	133,856	166,121	190,586
Total	103,254	154,880	189,914	258,150	300,916
Indium metal — do.	16,000	18,000	27,207	48,388	49,472
Iron and steel:					
Iron ore and iron sand concentrate:					
Gross weight — thousand tons	338	291	266	96	42
Fe content — do.	212	182	167	60	26
Roasted pyrite concentrate (50% or more Fe) — do.	218	205	210	214	211

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	1987	1988	1989[p]
METALS—Continued					
Iron and steel—Continued					
Metal:					
Pig iron and blast furnace ferroalloys thousand tons	80,569	74,651	73,418	79,295	80,196
Electric-furnace ferroalloys:					
Ferrochrome	[r]340,033	[r]280,548	[r]263,9882	95,406	324,371
Ferromanganese	441,703	359,044	332,286	378,351	394,055
Ferronickel	227,043	200,311	203,143	242,276	275,341
Ferrosilicon	150,167	107,236	73,706	73,767	74,936
Silicomanganese	216,916	148,429	91,896	106,970	122,192
Other:					
Calcium silicon	2,496	2,005	1,419	1,360	808
Ferrocolumbium	1,072	862	714	649	737
Ferromolybdenum	3,143	1,894	2,032	2,656	2,784
Ferrotungsten	114	122	96	91	77
Ferrovanadium	3,353	2,867	2,639	3,776	3,127
Unspecified	2,575	2,015	1,384	1,761	3,578
Total	[r]1,388,615	[r]1,105,333	[r]973,303	1,107,063	1,202,006
Steel, crude thousand tons	105,279	98,275	98,513	105,681	107,909
Semimanufactures, hot-rolled:					
Of ordinary steels do.	82,731	78,136	78,825	84,100	86,686
Of special steels do.	16,802	15,004	14,871	16,396	15,876
Lead:					
Mine output, Pb content	49,951	40,327	27,870	22,889	18,595
Metal, refined:					
Primary	233,706	232,732	218,770	217,711	207,735
Secondary do.	133,257	128,720	119,730	122,260	124,639
Total	366,963	361,452	338,500	339,971	332,374
Magnesium metal:					
Primary	[r]8,456	8,116	8,180	9,012	11,385
Secondary	20,894	13,400	10,300	10,020	12,075
Manganese:					
Ore and concentrate:					
Gross weight	21,140	5,905	—	80	—
Mn content	5,562	1,535	—	17	[e]20
Oxide	49,081	57,159	66,731	67,460	55,629
Metal	4,864	3,854	3,753	4,350	4,960
Molybdenum:					
Mo content of concentrate[e]	98	—	—	—	—
Metal	565	586	624	652	707
Nickel metal:					
Refined	23,257	[r]24,681	21,397	19,961	21,939
Ni content of nickel oxide sinter	15,200	18,953	22,301	24,185	22,244
Ni content of ferronickel	54,589	49,630	49,405	57,556	62,834
Total	93,046	[r]93,264	93,103	101,702	107,017
Platinum-group metals:					
Palladium metal kilograms	1,359	1,453	1,417	1,170	821
Platinum metal do.	691	663	753	647	1,031

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
METALS—Continued						
Rare-earth oxide[4]		NA	NA	3,053	3,760	4,052
Selenium, elemental		497	427	481	471	471
Silicon, high-purity		1,471	2,094	1,671	1,545	1,759
Silver:						
Mine output, Ag content	kilograms	339,485	351,270	281,020	251,971	155,792
Metal:						
Primary	do.	1,642,805	1,724,615	1,845,318	1,837,277	1,986,928
Secondary[3]	do.	89,231	113,482	142,186	161,991	166,564
Total	do.	1,732,036	1,838,097	1,987,504	1,999,268	2,153,492
Tellurium, elemental		56	56	[r]53	60	51
Tin:						
Mine output, Sn content		510	500	86	—	—
Metal, smelter		1,391	1,280	895	846	808
Titanium:						
Metal		21,897	14,481	10,083	16,408	21,341
Oxide		217,695	222,941	[r]239,401	259,875	283,184
Tungsten:						
Mine output, W content		568	579	259	266	296
Metal		2,638	2,557	2,713	3,481	3,758
Uranium metal[e]	kilograms	5,000	5,000	5,000	5,000	5,000
Vanadium metal[5]		762	843	[e]840	880	[e]840
Zinc:						
Mine output, Zn content		253,021	222,071	165,675	147,217	131,794
Oxide		72,832	68,277	73,434	83,312	84,034
Metal:						
Primary		629,504	626,489	591,516	601,082	590,460
Secondary		160,652	127,247	116,865	124,702	123,518
Total		790,156	753,736	708,381	725,784	713,978
Zirconium:						
Metal[e]		45	45	45	45	45
Oxide		[e]6,700	[e]6,700	7,430	7,345	7,100
INDUSTRIAL MINERALS						
Asbestos		2,971	3,593	3,143	[e]3,000	[e]3,000
Barite		76,665	52,848	31,625	—	—
Bromine, elemental[e]		12,000	15,000	15,000	15,000	15,000
Cement, hydraulic	thousand tons	[r]72,847	[r]71,264	71,551	77,554	79,717
Clays:						
Bentonite		461,530	[r]478,254	[r]468,705	455,137	526,131
Fire clay		1,148,196	1,004,150	907,342	961,354	942,199
Kaolin		221,996	[r]203,983	[r]172,781	157,771	165,696
Feldspar and related materials:						
Feldspar		30,895	32,063	33,754	29,465	43,137
Aplite		469,386	457,375	[r]466,429	526,286	606,096
Gypsum[e]	thousand tons	6,300	6,400	6,000	6,300	6,300
Iodine, elemental		7,251	7,389	7,014	7,451	7,592
Lime: Quicklime	thousand tons	7,454	6,717	6,745	7,726	8,486
Nitrogen: N content of ammonia	do.	1,628	1,508	1,556	1,524	1,539
Perlite[e]		75,000	75,000	75,000	75,000	77,000

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
INDUSTRIAL MINERALS—Continued						
Salt, all types	thousand tons	[r]1,719	1,370	1,397	1,363	1,367
Silica sand		4,386,906	3,925,411	3,892,322	4,200,410	4,377,941
Sodium compounds, n.e.s.:						
Soda ash		4,057,102	[r]1,020,849	1,098,465	1,083,121	1,105,308
Sulfate		276,814	253,450	255,313	246,541	256,393
Stone, crushed and broken:						
Dolomite	thousand tons	4,329	3,953	3,834	5,423	5,465
Limestone	do.	164,156	162,358	165,957	182,468	190,859
Sulfur:						
S content of pyrite	do.	253	158	79	70	[e]63
Byproduct:						
Of metallurgy	do.	1,201	1,228	[r e]1,225	[r e]1,300	[e]1,300
Of petroleum	do.	1,044	985	[e]1,012	[e]1,077	[e]1,100
Talc and related materials:						
Talc		78,616	63,851	[r]55,899	49,213	55,665
Pyrophyllite		1,355,625	1,270,112	1,241,069	1,244,491	1,233,600
Vermiculite[e]		17,000	[r]15,000	[r]15,000	[r]15,000	15,000
MINERAL FUELS AND RELATED MATERIALS						
Carbon black	thousand tons	632	616	629	720	779
Coal:						
Anthracite	do.	26	13	10	9	8
Bituminous[6]	do.	16,357	15,999	13,039	11,214	10,179
Total	do.	16,383	16,012	13,049	11,223	10,187
Coke including breeze:						
Metallurgical	do.	48,622	45,132	43,717	47,727	46,899
Gashouse including breeze	do.	3,120	3,006	2,716	2,907	2,896
Fuel briquets, all grades	do.	315	241	200	185	159
Gas, natural:						
Gross[7]	million cubic meters	2,225	2,105	2,168	2,097	2,009
Marketed	do.	2,368	2,208	2,350	2,294	2,155
Natural gas liquids:						
Natural gasoline	thousand 42-gallon barrels	57	56	57	56	55
Liquefied petroleum gas from natural gas (field plants only)[e]	do.	300	300	300	300	250
Peat[e]		60	60	60	60	60
Petroleum:						
Crude	thousand 42-gallon barrels	3,929	4,629	4,453	4,353	4,032
Refinery products:						
Liquefied petroleum gas	do.	50,243	44,010	45,029	46,784	46,809
Gasoline:						
Aviation	do.	75	82	57	57	[e]75
Other	do.	215,514	214,866	216,136	222,904	241,723
Jet fuel	do.	27,229	25,285	25,348	24,272	26,335
Naphtha	do.	65,093	60,822	55,250	55,061	56,287
Kerosene	do.	152,477	151,484	126,003	132,300	128,488
Paraffin	do.	994	[e]980	[e]900	[e]1,000	[e]1,000
Distillate fuel oil	do.	147,596	164,308	158,685	160,730	174,705

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum—Continued						
Refinery products—Continued						
Lubricants	thousand 42-gallon barrels	12,133	11,730	12,271	12,743	12,561
Residual fuel oil	do.	408,655	386,452	378,659	399,899	422,159
Asphalt and bitumen	do.	29,814	33,418	34,436	35,758	36,085
Petroleum coke	do.	1,088	956	824	937	792
Unfinished oils	do.	39,525	40,928	43,161	47,677	53,218
Refinery fuel and losses[8]	do.	153,968	136,458	140,464	133,961	[e]140,000
Total	do.	1,304,404	[e]1,271,779	[e]1,237,223	[e]1,274,083	[e]1,340,237

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through Oct. 22, 1990.
[2]Includes unalloyed ingot, alloyed ingot, billet, and mother alloys.
[3]Recovered from scrap, waste, and returned by end users.
[4]Includes oxide of cerium, europium, gadolinium, lanthanun, neodymium, praseodymium, samarium, terbium, yttrium, and neodymium fluoride.
[5]Represents metal content of vanadium pentoxide recovered from petroleum residues, ashes, and spent catalysts.
[6]Includes coking coal and steam coal.
[7]Includes output from gas wells and coal mines.
[8]May include some additional unfinished oils.

rose 15% to $48.2 billion, accounting for 23% of Japan's total imports in 1989. Despite higher Japanese imports from the United States, Japan continued to enjoy close to $45 billion of merchandise trade surplus with the United States because of increased exports of chemicals, electronic, electric, and general machinery to the United States in 1989.

STRUCTURE OF THE MINERAL INDUSTRY

In terms of Japan's industry work force, the mineral industry consisted of a small nonferrous metal mining sector, a medium-size coal mining sector, a large nonmetallic mining sector, and a world-class mineral processing sector. Mining and mineral processing businesses are owned and operated by private companies incorporated in Japan. However, the mineral industry received the Government's financial and technical assistance and followed the Government's policy guidelines during the industry's restructuring period (1986-89).

Because of the restructuring program resulting from the industry depression and changes in minerals supply and demand situations in both domestic and world markets in the 1980's, the industry's capacity and employment had been reduced considerably. Sectoral contraction in coal and nonferrous metal mining sectors was more drastic than other sectors because of high production costs and low import prices.

According to MITI, coal was produced mainly from 11 major mines in the Hokkaido and Kyushu areas with a total capacity of 18 million metric tons per year (MMmt/yr) and work force of 13,000 in 1986. The number of major coal mines was reduced to 7 with a total capacity of 11 MMmt/yr and work force of only 5,730 in 1989. The number of operating nonferrous metal mines and employment also declined to 27 and 2,693, respectively, in 1989 from 52 and 7,743, respectively, in 1986.

In line with the overall mining industry's restructuring program, reduction in employment and production capacity was also implemented by the nonmetallic mining and the mineral processing sectors. Between 1986 and 1989, the cement industry reduced its work force by 17% to 7,127 and capacity by 23% to 98 MMmt/yr, and the steel industry reduced its work force by 14% to 296,432 and capacity by 6% to 141.6 MMmt/yr. The number of nonferrous metal smelters and employment also shrank to 20 and 6,354, respectively, in 1989 from 22 and 8,016, respectively, in 1986. According to the Statistics Bureau of Japan's Management and Coordination Agency, the number of persons employed by the mining industry in 1989 had reduced to about 70,000 or about 0.1% of the Japanese labor force of 62 million, compared with 95,000 persons or about 0.2% of 58 million in 1985.

COMMODITY REVIEW

Metals

Aluminum.—Japan was the world's largest importer of primary aluminum and became one of the major forces in the world market. Japan's primary aluminum imports broke the 1988 record and reached 2.2 million metric tons (MMmt) (in metal content of primary aluminum and alloyed ingots) and accounted for 31% of the primary aluminum traded in market economy countries in 1989. Consumption of primary aluminum also broke the 1988 record, reaching 2.4 MMmt in 1989. Domestic primary aluminum production by Nippon Light Metal Co. Ltd. remained steady and small. Japan relied 98.5%

TABLE 2

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	752	422	—	India 189; Nigeria 73; Republic of Korea 57.
Aluminum:				
Ore and concentrate	637	954	—	Republic of Korea 884; Taiwan 60.
Oxides and hydroxides	197,845	198,269	5,858	Canada 55,286; Republic of Korea 38,954.
Metal including alloys:				
Scrap	r8,707	7,334	48	Taiwan 5,320; Republic of Korea 1,244.
Unwrought	r1,927	3,433	465	Thailand 1,655; Taiwan 356.
Semimanufactures	213,775	134,593	48,534	Taiwan 20,609; Republic of Korea 13,899.
Antimony:				
Oxides and hydroxides	NA	728	2	Taiwan 253; Republic of Korea 170.
Metal including alloys, all forms	5	19	5	Hong Kong 4; Singapore 2.
Beryllium: Metal including alloys, all forms kilograms	r353	424	—	Taiwan 210; Republic of Korea 127.
Bismuth: Metal including alloys, all forms	55	68	6	Belgium-Luxembourg 32; Netherlands 26.
Cadmium: Metal including alloys, all forms	201	158	—	Netherlands 101; East Germany 27.
Chromium:				
Ore and concentrate	309	298	—	Singapore 176; Republic of Korea 84; Indonesia 20.
Oxides and hydroxides	5,804	3,954	478	Taiwan 1,474; Republic of Korea 1,166.
Metal including alloys, all forms	NA	2,014	863	Netherlands 386; Belgium-Luxembourg 156.
Cobalt:				
Oxides and hydroxides	21	48	15	Taiwan 19; Republic of Korea 7.
Metal including alloys, all forms	NA	207	48	Republic of Korea 49; West Germany 35.
Columbium and tantalum: Tantalum metal including alloys, all forms	18	30	9	West Germany 13; Republic of Korea 4.
Copper:				
Oxides and hydroxides	—	982	4	Taiwan 354; Singapore 267; United Arab Emirates 108.
Sulfate	705	888	126	Taiwan 638; Singapore 49.
Metal including alloys:				
Scrap	r5,831	6,933	12	Republic of Korea 2,796; Taiwan 2,727.
Unwrought	r73,067	78,494	24,176	Republic of Korea 25,136; Taiwan 13,411.
Semimanufactures	r228,268	192,215	33,601	Taiwan 39,932; Hong Kong 33,251.
Germanium: Metal including alloys, all forms kilograms	NA	213	8	Singapore 172; Malaysia 20.
Gold:				
Ore and concentrate[2]	2,475	12	—	All to Philippines.
Waste and sweepings grams	495	639	—	All to Hong Kong.
Metal including alloys, unwrought and partly wrought kilograms	11,525	11,241	306	Singapore 5,580; North Korea 1,453.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	24	8	—	All to Taiwan.
Metal:				
Scrap	377,397	415,616	54	Republic of Korea 228,945; Taiwan 150,586.
Pig iron, cast iron, related materials	50,969	42,695	7,171	Taiwan 22,320; Republic of Korea 4,305.
Ferroalloys:				
Ferrochromium	4,883	4,450	2,957	Republic of Korea 467; Netherlands 348.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988	
				United States	Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Ferroalloys—Continued					
Ferromanganese		19,122	12,849	3,367	Taiwan 2,283; Qatar 1,900.
Ferronickel		1,885	15	—	Republic of Korea 14.
Ferrosilicon		1,345	4,868	1	Taiwan 2,684; Republic of Korea 1,789.
Silicon metal		—	115	32	Republic of Korea 53; Taiwan 22.
Unspecified		r4,785	6,614	1,122	Republic of Korea 1,966; Taiwan 1,466.
Steel, primary forms	thousand tons	2,764	NA		
Semimanufactures:					
Bars, rods, angles, shapes, sections	thousand tons	3,505	NA		
Universals, plates, sheets		12,352	NA		
Hoop and strip		466	NA		
Rails and accessories		235	171	80	Canada 40; China 17.
Wire		(3)	196	77	Libya 24; Hong Kong 10.
Tubes, pipes, fittings		4,010	4,637	686	U.S.S.R. 1,521; China 856.
Castings and forgings, rough		15	NA		
Lead:					
Oxides		80	117	(4)	China 85; Republic of Korea 18.
Metal including alloys:					
Scrap		18,201	23,998	—	Taiwan 16,814; Republic of Korea 5,086.
Unwrought		r17,113	1,286	—	Taiwan 496; North Korea 399; Hong Kong 152.
Semimanufactures		r223	317	13	Hong Kong 59; Indonesia 49.
Lithium: Oxides and hydroxides		—	7	—	Republic of Korea 2, Hong Kong 1; Pakistan 1.
Magnesium: Metal including alloys, all forms		r166	84	(4)	Singapore 40; Thailand 18.
Manganese:					
Ore and concentrate, metallurgical-grade		1,853	929	—	Republic of Korea 202; Bangladesh 200; Philippines 198.
Oxides		44,722	45,739	14,923	Indonesia 5,290; U.S.S.R. 4,000.
Metal including alloys, all forms		NA	136	—	Australia 80; China 20; United Kingdom 20.
Mercury		200	191	(4)	Netherlands 104; Indonesia 22.
Molybdenum:					
Oxides and hydroxides		—	12	—	Taiwan 6; West Germany 5.
Metal including alloys, all forms		81	62	5	Republic of Korea 27; West Germany 7.
Nickel:					
Ore and concentrate		(5)	—		
Matte and speiss		r264	288	—	Mainly to India.
Oxides and hydroxides		—	163	14	Republic of Korea 64; Singapore 29.
Metal including alloys:					
Scrap		67	150	94	Philippines 17; United Kingdom 17.
Unwrought		r228	544	12	China 408; Indonesia 55.
Semimanufactures		r1,090	2,201	155	Libya 277; India 246; Republic of Korea 192.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988 United States	Destinations, 1988 Other (principal)
METALS—Continued				
Platinum-group metals:				
Waste and sweepings	18	1	—	All to West Germany.
Metals including alloys, unwrought and partly wrought kilograms	2,656	8,826	837	Australia 4,249; Canada 1,873.
Rare-earth:				
Compounds	NA	804	165	Taiwan 360; Republic of Korea 71.
Metals	—	8	1	Republic of Korea 4; Netherlands 3.
Selenium, elemental	252	273	65	United Kingdom 61; Netherlands 55.
Silicon, high-purity	—	263	47	Malaysia 114; United Kingdom 22.
Silver:				
Waste and sweepings	2	22	—	West Germany 20; Hong Kong 2.
Metal including alloys, unwrought and partly wrought kilograms	71,148	91,303	981	Taiwan 26,848; Singapore 21,132.
Tin:				
Oxides	10	—		
Metal including alloys:				
Scrap	41	68	—	Netherlands 32; Philippines 18.
Unwrought	87	119	7	Republic of Korea 90; Philippines 10.
Semimanufactures	512	441	9	Hong Kong 135; Republic of Korea 125.
Titanium:				
Ore and concentrate	—	97	([4])	China 60; Taiwan 37.
Oxides	29,492	30,905	6,733	Taiwan 8,251; Singapore 4,776.
Metal including alloys, all forms	4,344	10,760	3,307	United Kingdom 3,070; France 1,418.
Tungsten: Metal including alloys, all forms	269	313	86	West Germany 86; Republic of Korea 40.
Uranium and thorium: Oxides and other compounds	[6]601	47	—	United Kingdom 46; Hong Kong 5.
Vanadium: Oxides and hydroxides	—	71	—	Belgium-Luxembourg 33; Australia 12; Indonesia 11.
Zinc:				
Oxides	1,134	1,292	166	Taiwan 394; Indonesia 185.
Metal including alloys:				
Scrap	3,233	5,017	—	Taiwan 4,233; Republic of Korea 767.
Unwrought	53,237	26,642	2	Taiwan 14,210; Republic of Korea 6,781.
Semimanufactures	1,420	1,562	35	Taiwan 883; Republic of Korea 99.
Zirconium:				
Ore and concentrate	—	172	—	Republic of Korea 76; Taiwan 40; India 25.
Metal including alloys, all forms	NA	38	3	France 17; Romania 7.
Other:				
Ores and concentrates	[r]220	1,013	—	Taiwan 1,001.
Oxides and hydroxides	—	369	103	Republic of Korea 205; Taiwan 39.
Ashes and residues	8,600	5,463	50	Taiwan 1,944; Republic of Korea 1,725.
Base metals including alloys, all forms	[r]2,638	5	1	Switzerland 2.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	16,814	11,063	746	Republic of Korea 8,831; Taiwan 1,307.
Artificial:				
Corundum	30,190	29,561	2,216	Republic of Korea 13,647; Australia 3,493.
Silicon carbide	5,725	6,395	264	Republic of Korea 4,256; Taiwan 1,630.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988 United States	Destinations, 1988 Other (principal)
INDUSTRIAL MINERALS—Continued				
Abrasives, n.e.s.—Continued				
Dust and powder of precious and semiprecious stones including diamond kilograms	51,537	6,034	1,050	Republic of Korea 1,997; Taiwan 1,520.
Grinding and polishing wheels and stones	6,856	7,644	1,544	Republic of Korea 963; Taiwan 773; Hong Kong 644.
Asbestos, crude	r121	72	—	Taiwan 26; Thailand 18; Tunisia 15.
Barite and witherite	—	7	—	Benin 4; Sudan 3.
Boron materials:				
Crude natural borates	1,593	1,719	—	Taiwan 1,575; Hong Kong 144.
Oxides and acids	316	150	1	Republic of Korea 83; Thailand 22; Brazil 20.
Cement thousand tons	4,336	3,399	1,725	Hong Kong 2,195; Singapore 495.
Chalk	124	748	—	All to Republic of Korea.
Clays, crude	r55,271	58,983	(4)	Taiwan 37,017; Republic of Korea 10,804.
Cryolite and chiolite	36	12	—	Republic of Korea 10; Taiwan 2.
Diamond: Natural:				
Gem, not set or strung carats	9,267	3,797	248	Belgium-Luxembourg 3,296; Hong Kong 236.
Industrial stones do.	89,000	38,820	—	Taiwan 23,200; India 10,000; North Korea 3,000.
Diatomite and other infusorial earth	1,400	1,986	(4)	China 706; Indonesia 424; Thailand 363.
Feldspar, fluorspar, related materials	31,526	30,403	—	Taiwan 25,905; Republic of Korea 1,539; Indonesia 1,528.
Fertilizer materials:				
Crude, n.e.s.	136	35	—	Taiwan 17; Mexico 12.
Manufactured:				
Ammonia	190	242	1	Republic of Korea 84; Thailand 49; Vietnam 38.
Nitrogenous	r797,432	870,354	872	Thailand 299,371; Philippines 204,199.
Phosphatic	53,326	1,814	—	Somalia 650; Republic of Korea 500; Mali 300.
Potassic	385	1,187	—	Somalia 645; Yemen, Sanaa 296; Philippines 197.
Unspecified and mixed	r176,885	129,816	3,329	Pakistan 38,167; Sri Lanka 25,647.
Graphite, natural	2,020	1,767	255	Republic of Korea 486; Taiwan 321.
Gypsum and plaster	5,032	5,896	7	Taiwan 1,717; Malaysia 1,441.
Iodine	76,091	6,120	2,251	United Kingdom 1,111; France 693.
Kyanite and related materials	10,362	5,207	340	Republic of Korea 3,492; Taiwan 484.
Lime	1,153	11,601	—	Papua New Guinea 10,452; Republic of South Africa 674.
Magnesium compounds:				
Magnesite, crude	—	307	—	Philippines 187; Taiwan 73.
Oxides and hydroxides	93,845	102,460	19,272	Republic of Korea 18,142; India 15,365.
Mica:				
Crude including splittings and waste	r318	529	8	Republic of Korea 254; Taiwan 159.
Worked including agglomerated splittings	1,001	106	12	Taiwan 55; Republic of Korea 17.
Phosphates, crude	(4)	4	—	Indonesia 3, Republic of Korea 1.
Phosphorus, elemental	176	242	11	China 53; United Kingdom 43; North Korea 30.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Pigments, mineral:					
Natural, crude		30	45	—	Taiwan 38; Republic of Korea 4.
Iron oxides and hydroxides, processed		29,648	33,927	2,050	Republic of Korea 14,633; Taiwan 11,749.
Precious and semiprecious stones other than diamond:					
Natural	kilograms	36,076	47,488	24	Hong Kong 18,293; Philippines 15,653.
Synthetic	do.	141,606	30,374	9,137	Republic of Korea 6,883; Taiwan 5,533.
Pyrite, unroasted		200	400	—	All to Australia.
Quartz crystal, piezoelectric		NA	112	11	Malaysia 35; Taiwan 19; Republic of Korea 16.
Salt and brine		727	656	121	North Korea 163; Republic of Korea 155.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		137,201	116,831	10	Indonesia 43,432; China 40,200.
Sulfate, manufactured		4,826	14,547	—	Indonesia 4,902; Republic of Korea 4,336; Thailand 3,890.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		327	1,417	4	Taiwan 1,002; Republic of Korea 337.
Worked		r1,204	1,906	63	Hong Kong 869; Republic of Korea 669.
Dolomite, chiefly refractory-grade		1,304	1,920	—	Indonesia 1,635; Taiwan 245.
Gravel and crushed rock		r75,268	77,533	33	Australia 76,000; Republic of Korea 1,052.
Limestone other than dimension		1,396,929	1,842,980	448	Australia 1,031,199; Taiwan 716,135.
Quartz and quartzite		r879	24,265	([4])	Taiwan 23,214; Malaysia 515.
Sand other than metal-bearing		4,930	4,477	50	Taiwan 2,670; Singapore 567.
Sulfur:					
Elemental:					
Crude including native and byproduct		138,133	170,366	899	Republic of Korea 137,663; Taiwan 30,477.
Colloidal, precipitated, sublimed		1,692	2,294	15	Republic of Korea 832; Taiwan 671.
Sulfuric acid		510,209	526,032	35,859	Taiwan 207,903; Philippines 111,059.
Talc, steatite, soapstone, pyrophyllite		2,654	2,658	135	Republic of Korea 670; Taiwan 582; Philippines 336.
Vermiculite[8]		NA	16,065	—	Republic of Korea 12,559; Taiwan 3,315.
Other:					
Crude		r30,193	11,013	362	Taiwan 3,500; Republic of Korea 3,197.
Slag and dross, not metal-bearing		406,263	850,642	33,000	Republic of Korea 354,378; Singapore 283,397.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		31	5	—	Mainly to China.
Carbon black		9,425	9,991	595	Republic of Korea 3,172; Taiwan 2,246.
Coal, all grades including briquets		r1,286	1,304	—	Thailand 741; Burma 145; Taiwan 114.
Coke and semicoke	thousand tons	3,170	2,898	1,150	Romania 327; Philippines 267.
Peat including briquets and litter		—	40	—	All to Taiwan.
Petroleum:					
Crude	42-gallon barrels	51	—		
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	93	10	([4])	China 5; Hong Kong 4.
Gasoline	do.	1,632	925	([4])	Republic of Korea 304; Singapore 302.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Mineral jelly and wax	thousand 42-gallon barrels	424	429	44	India 63; Republic of Korea 60; Republic of South Africa 51.
Kerosene and jet fuel	do.	1,900	428	—	Republic of Korea 312; Hong Kong 67.
Distillate fuel oil	do.	3,380	1,156	—	Republic of Korea 820; Hong Kong 333.
Lubricants	do.	[9]176	1,465	3	Republic of Korea 547; Singapore 317.
Nonlubricating oils	do.	NA	103	(4)	Taiwan 59; Republic of Korea 9.
Residual fuel oil	do.	3,299	953	(4)	Republic of Korea 835; Hong Kong 117.
Bitumen and other residues	do.	22	22	—	Hong Kong 8; Thailand 8.
Bituminous mixtures	do.	4	2	(4)	NA.
Petroleum coke	do.	540	514	252	U.S.S.R. 85; Netherlands 56.

[r] Revised. NA Not available.
[1] Excludes exports under Japanese-United States Mutual Defense Agreement or for account of U.S. military forces. Table prepared by Audrey D. Wilkes.
[2] May include other precious metals.
[3] Unreported quantity valued at $284,174,000.
[4] Less than 1/2 unit.
[5] Unreported quantity valued at $2,000.
[6] Includes rare-earth compounds.
[7] Includes bromine and fluorine.
[8] Includes perlite and chlorites.
[9] Excludes unreported quantity valued at $104,378,000.

on imports of primary aluminum to meet its domestic demand for primary aluminum in 1989.

According to the Ministry of Finance, imports of primary aluminum totaled 2,363,190 tons in 1989, of which 97,592 tons was high-grade ingots; 1,647,770 tons, regular-grade ingots; and 617,828 tons, alloyed ingots. Among the top seven suppliers of primary aluminum to Japan, Australia accounted for 24% of total primary aluminum imports; the United States, 21%; Venezuela, 9%: New Zealand, 8%; Brazil and Indonesia, 7%, each; and Canada, 6%. According to an estimate by Marubeni Corp., the percentage share of primary aluminum imports from the spot market in 1989 was about 39%; from overseas captive-import (equity participation), 32%; and from long-term contract, 29%.[3]

To make it easier for the Japanese aluminum industry to control the risk associated with wide price fluctuation in the world primary aluminum market, the London Metal Exchange (LME), in mid-1989, approved listing of 16 warehouse companies led by Mitsubishi Warehouse & Transportation Co. Ltd., Sumitomo Warehouse Co. Ltd., Mitsui Warehouse Co. Ltd., and Yasuda Warehouse Co. Ltd. to operate 62 warehouses in the 6 major Ports of Hakata, Kobe, Moji, Nagoya, Osaka, and Yokohama in Japan. The first 9 warehouse companies operating 32 warehouses went into operation on July 19, 1989, and the second 7 warehouse companies operating 30 warehouses started business on August 14, 1989. The LME operations in Japan are managed by the LME Japan Warehousing Liaison Council.[4]

Domestic demand for primary aluminum rose by 4.7% to a new record at 2,392,508 tons in 1989 owing to a stronger demand for aluminum rolled mill products by the automobile and construction industries. According to MITI, consumption of primary aluminum for aluminum rolling accounted for 73%; for aluminum casting, 4%; for wire and cable, 3%; for steel deoxidization and aluminum diecasting, 2% each; and other, 16%. Despite the continued growth in demand for aluminum cans by the beer industry, the overall demand for aluminum sheet by the manufacturers of beverage cans declined because of increased use of bottles and steel cans by the soft drinks industry in 1989.

To increase stable supply of primary aluminum from overseas captive-import, in August 1989, Kobe Steel Ltd. and Marubeni Corp. signed an agreement with Societe Generals de Financement du Quebec (SGF) of Canada to participate in a $900 million Alouette project to build a 215,000-metric-ton-per-year (mt/yr) aluminum smelter in Sept-Iles, about 900 kilometers (km) northeast of Montreal, Canada. Under the agreement, Kobe Steel and Marubeni are to provide $120 million for a 13.33% equity and $60 million for a 6.67% equity, respectively. The Alouette project is expected to come on-stream in April 1992.

According to Sumitomo Metal Industries Ltd., a $31 million contract, which was signed by the China International Trust and Investment Corp. (CITC) in August 1988 to purchase Sumitomo Metal's mothballed 99,000-mt/yr aluminum smelter at Sakata in Yamagata Prefecture, was canceled by CITC in October

TABLE 3

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS					
Alkali and alkaline-earth metals		r148	95	59	United Kingdom 28.
Aluminum:					
Ore and concentrate	thousand tons	1,872	2,149	—	Australia 1,226; Indonesia 597; Malaysia 182.
Oxides and hydroxides		41,775	72,048	28,434	Australia 36,727; West Germany 3,870.
Metal including alloys:					
Scrap		430,642	399,154	230,415	Australia 30,495; Hong Kong 26,187.
Unwrought	thousand tons	1,835	2,292	321	Australia 548; Brazil 250; New Zealand 220.
Semimanufactures		55,325	88,294	16,697	France 7,923; Bahrain 7,634; Taiwan 7,425.
Antimony:					
Ore and concentrate		5,886	6,376	—	Bolivia 4,034; China 2,012.
Oxides		4,368	6,201	114	China 4,066; United Kingdom 1,400.
Metal including alloys, all forms		4,743	5,817	—	China 5,729; Thailand 66.
Arsenic: Oxides and acids		325	104	—	All from France.
Beryllium:					
Oxides and hydroxides		103	73	60	China 13.
Metal including alloys, all forms	kilograms	1,098	861	861	
Bismuth: Metal including alloys, all forms		—	326	(2)	China 182; Republic of Korea 109.
Cadmium: Metal including alloys, all forms		NA	2,545	—	Republic of Korea 646; Belgium-Luxembourg 574; China 539.
Chromium:					
Ore and concentrate		674,743	976,168	—	Republic of South Africa 585,648; India 96,024; Madagascar 85,775.
Oxides and hydroxides		2,407	2,513	965	West Germany 831; U.S.S.R. 370.
Metal including alloys, all forms		NA	725	175	United Kingdom 457; China 67.
Cobalt:					
Oxides and hydroxides		432	445	49	Belgium-Luxembourg 295; Finland 59.
Metal including alloys, all forms		4,772	4,934	114	Zaire 3,070; Zambia 658.
Columbium and tantalum:					
Ore and concentrate		1,371	3 1,172	—	Canada 799; Brazil 158; Malaysia 101.
Tantalum metal including alloys, all forms		49	107	71	West Germany 18; Taiwan 14.
Copper:					
Ore and concentrate	thousand tons	2,981	3,436	517	Canada 916; Philippines 471.
Matte and speiss including cement copper		21	65	—	All from Taiwan.
Oxides and hydroxides		—	658	293	Norway 240; Australia 60.
Sulfate		4 468	229	(2)	U.S.S.R. 104; Thailand 85.
Metal including alloys:					
Scrap		r97,841	108,438	38,323	Hong Kong 22,692; Singapore 10,435.
Unwrought		380,425	448,851	34,886	Zambia 152,081; Chile 94,622.
Semimanufactures		r26,632	35,170	3,698	Taiwan 18,523; Republic of Korea 7,234.
Germanium:					
Oxides		25	775	41	United Kingdom 710.
Metal including alloys, all forms	kilograms	4,348	4,403	70	China 3,280; France 557.
Gold:					
Waste and sweepings	do.	1,821	2,246	—	Singapore 2,235; Mexico 10.
Metal including alloys, unwrought and partly wrought	do.	239,216	293,784	6,856	Switzerland 118,405; Australia 47,100.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Indium: Metal including alloys, all forms	31	30	9	France 7; Italy 6.
Iron and steel:				
Iron ore and concentrate, excluding roasted pyrite thousand tons	112,034	123,377	—	Australia 52,416; Brazil 27,932; India 21,762.
Metal:				
Scrap do.	2,358	1,789	755	U.S.S.R. 219; Australia 211.
Pig iron, cast iron, related materials do.	1,443	2,918	5	China 1,302; U.S.S.R. 552.
Ferroalloys:				
Ferrochromium	427,711	473,707	—	Republic of South Africa 264,472; India 67,880; Zimbabwe 49,584.
Ferromanganese	27,425	27,383	—	Republic of South Africa 10,378; France 6,520; Brazil 2,385.
Ferromolybdenum	1,018	1,486	77	Austria 469; China 401.
Ferronickel	29,935	48,664	—	New Caledonia 25,043; Dominica 10,319; Indonesia 8,479.
Ferrosilicochromium	7,166	17,511	—	Republic of South Africa 6,413; Zimbabwe 5,801; China 5,297.
Ferrosilicomanganese	150,740	158,410	—	China 60,411; Republic of South Africa 53,285; U.S.S.R. 30,683.
Ferrosilicon	387,454	539,846	7,427	Brazil 110,719; Norway 87,425.
Silicon metal	113,435	132,749	3,157	China 67,668; Brazil 26,128; Republic of South Africa 13,738.
Unspecified	r12,534	29,519	2,727	Brazil 7,201; China 6,998.
Steel, primary forms	2,537,197	NA		
Semimanufactures:				
Bars, rods, angles, shapes, sections	[5]541,817	1,068,541	1,015	Republic of Korea 402,889; Brazil 132,406.
Universals, plates, sheets	[6]1,606,737	NA		
Hoop and strip	[7]14,909	NA		
Rails and accessories	2,868	7,069	73	Republic of Korea 3,975; China 2,272.
Wire	[8]32,890	74,137	1,465	Republic of Korea 55,232; Brazil 8,115.
Tubes, pipes, fittings	r203,525	390,153	5,184	Republic of Korea 339,841; Thailand 7,959.
Castings and forgings, rough	r26,540	NA		
Lead:				
Ore and concentrate	r294,728	279,537	6,290	Canada 94,901; Australia 64,697; Peru 32,030.
Oxides	19,720	26,233	5	Mexico 10,619; Republic of Korea 9,407; France 4,095.
Metal including alloys:				
Scrap	65	17	—	All from Republic of Korea.
Unwrought	r49,404	75,774	([2])	Mexico 19,574; Australia 17,856; Taiwan 11,642.
Semimanufactures	51	236	22	Indonesia 200; West Germany 8.
Lithium: Oxides and hydroxides	969	935	831	China 70; West Germany 19.
Magnesium: Metal including alloys:				
Scrap	495	699	—	Taiwan 597; Malaysia 53.
Unwrought	13,521	15,305	9,584	Norway 2,721; U.S.S.R. 1,002.
Semimanufactures	489	658	394	Republic of Korea 117; Italy 70.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Manganese:				
Ore and concentrate, metallurgical-grade thousand tons	1,581	1,922	(2)	Republic of South Africa 1,069; Australia 538.
Oxides	2,632	3,309	59	West Germany 831; China 439; U.S.S.R. 370.
Metal including alloys, all forms	NA	9,893	1,248	Republic of South Africa 7,506; China 1,118.
Mercury	75	40	10	China 30.
Molybdenum:				
Ore and concentrate	17,115	22,987	7,071	Chile 7,130; Canada 6,495.
Oxides and hydroxides	468	351	289	China 43; Taiwan 19.
Metal including alloys, all forms	380	661	324	West Germany 216; Austria 56.
Nickel:				
Ore and concentrate thousand tons	2,927	3,266	—	New Caledonia 1,370; Indonesia 1,124.
Matte and speiss	54,610	62,658	—	Indonesia 37,046; Australia 23,098.
Oxides and hydroxides	—	290	3	Canada 264; China 15.
Metal including alloys:				
Scrap	3,089	3,578	1,845	Taiwan 1,143; United Kingdom 76.
Unwrought	r42,613	34,327	130	Canada 9,731; U.S.S.R. 5,851; Norway 5,261.
Semimanufactures	r4,901	6,966	956	United Kingdom 3,393; Canada 1,847.
Platinum-group metals:				
Waste and sweepings kilograms	6,688	4,537	15	Taiwan 4,372; Turkey 101.
Metals including alloys, unwrought and partly wrought do.	106,764	76,522	8,234	Republic of South Africa 19,041; United Kingdom 17,657; U.S.S.R. 15,212.
Rare-earth:				
Compounds	8,934	14,555	3,550	China 5,404; France 1,641.
Metals including alloys, all forms	278	468	39	China 371; Brazil 40.
Selenium, elemental	21	33	(2)	Philippines 30.
Silicon, high-purity	63	91	31	Denmark 20; France 16.
Silver:				
Ore and concentrate	r4,032	7,207	51	Australia 6,024; Peru 1,132.
Waste and sweepings	r1	21	1	Malaysia 10; Hong Kong 7.
Metal including alloys, unwrought and partly wrought	657	1,015	86	Mexico 472; Peru 204.
Tellurium, elemental	5	(9)		
Tin:				
Oxides	4	17	—	China 9; United Kingdom 6.
Metal including alloys:				
Scrap	15	2	—	All from Philippines.
Unwrought	r33,588	35,517	(2)	Malaysia 15,093; Indonesia 6,505; Thailand 6,481.
Semimanufactures	72	33	6	Singapore 22.
Titanium:				
Ore and concentrate	570,377	642,209	5,697	Malaysia 234,504; Australia 176,258.
Oxides	6,613	6,784	54	Republic of Korea 2,050; China 1,836; Belgium-Luxembourg 1,034.
Metal including alloys, all forms	NA	923	313	United Kingdom 222; U.S.S.R. 215.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Tungsten:				
Ore and concentrate	1,938	2,785	—	Portugal 1,080; Australia 585; China 553.
Metal including alloys, all forms	284	465	54	Republic of Korea 232; West Germany 84.
Uranium and thorium:				
Ore and concentrate	1	39	—	Malaysia 30; Canada 9.
Oxides and other compounds kilograms	2,458	2,730	250	France 1,480; India 1,000.
Metal including alloys, all forms value, thousands	$26	—		
Vanadium:				
Ore and concentrate	68	NA		
Oxides and hydroxides	2,763	5,339	69	Republic of South Africa 4,106; China 832.
Metal including alloys, all forms	NA	173	27	West Germany 136; Republic of South Africa 10.
Zinc:				
Ore and concentrate	974,026	1,068,407	29,282	Australia 518,615; Peru 190,273.
Oxides	9,093	10,959	34	Republic of Korea 4,994; Taiwan 2,889.
Metal including alloys:				
Scrap	4	764	224	Singapore 406; Taiwan 80.
Unwrought	116,885	130,302	240	North Korea 41,033; Republic of Korea 28,912; Peru 14,306.
Semimanufactures	1,652	1,338	71	France 721; Norway 166.
Zirconium:				
Ore and concentrate	177,474	197,592	4,941	Australia 153,683; Republic of South Africa 24,790.
Metal including alloys, all forms	415	510	340	France 149; Taiwan 14.
Other:				
Ores and concentrates	r20,138	23,002	15,003	Australia 8,049.
Oxides and hydroxides	705	—		
Ashes and residues	55,929	67,178	12,183	U.S.S.R. 5,653; Indonesia 5,118.
Base metals including alloys, all forms	r9,009	101	31	West Germany 27; Brazil 25.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	7,260	7,137	1,119	India 5,354; China 526.
Artificial:				
Corundum	38,028	71,620	446	China 50,975; Hungary 10,298; Brazil 4,900.
Silicon carbide	37,468	49,824	316	China 28,305; Brazil 7,662.
Dust and powder of precious and semiprecious stones excluding diamond kilograms	915,267	573,070	398,787	India 126,000; Taiwan 42,000.
Grinding and polishing wheels and stones	782	1,228	99	Taiwan 502; Austria 198; Italy 120.
Asbestos, crude	r277,238	320,393	12,203	Canada 102,127; Republic of South Africa 84,531.
Barite and witherite	r68,996	91,355	—	China 91,314; West Germany 36.
Boron materials:				
Crude natural borates	62,321	52,180	—	Turkey 51,870; U.S.S.R. 310.
Elemental	[10]42	11	([2])	China 9, West Germany 1.
Oxides and acids	26,195	30,735	21,923	Italy 5,250; Turkey 3,250.
Bromine	[11]3,560	[12]4,871	450	Israel 4,421.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Cement		r2,554,044	3,602,270	398	Republic of Korea 1,847,640; Taiwan 1,725,078.
Chalk		r60	(2)	(2)	Canada.[2]
Clays, crude	thousand tons	r1,047	1,321	834	China 189; Brazil 107.
Cryolite and chiolite		340	357	—	Denmark 272; Greenland 85.
Diamond:					
Natural:					
Gem, not set or strung	thousand carats	2,380	3,385	88	India 1,778; Israel 665; Belgium-Luxembourg 564.
Industrial stones	do.	520	631	231	Zaire 146; Belgium-Luxembourg 113.
Dust and powder	do.	1,542	1,810	94	Zaire 837; Ireland 583.
Synthetic:					
Gem, not set or strung	carats	27,750	—		
Dust and powder	thousand carats	40,823	49,242	20,907	Ireland 27,556; U.S.S.R. 351.
Diatomite and other infusorial earth		5,006	6,860	6,637	China 198.
Feldspar, fluorspar, related materials:					
Feldspar		13 17,977	11,709	—	Australia 5,520; China 3,228; North Korea 1,983.
Fluorspar		527,545	609,113	(2)	China 455,331; Republic of South Africa 59,550.
Unspecified		r—	11,191	—	Norway 9,700; Canada 1,491.
Fertilizer materials:					
Crude, n.e.s.		4,029	21,884	26	Indonesia 11,875; Republic of Korea 6,035.
Manufactured:					
Ammonia	kilograms	1,331	998	349	West Germany 649.
Nitrogenous		r268,786	285,777	44,730	Qatar 94,271; Indonesia 56,920.
Phosphatic		140,396	185,619	56,682	China 94,040; Republic of Korea 34,138.
Potassic		r1,439,810	1,278,208	127,332	Canada 678,168; West Germany 141,887.
Unspecified and mixed		r570,750	665,057	492,203	Republic of Korea 129; Norway 15,293.
Graphite, natural		94,268	98,611	477	China 45,605; Republic of Korea 38,343.
Gypsum and plaster		r1,470,822	2,914,046	662	Thailand 2,680,587; Mexico 135,872.
Iodine		NA	59	59	
Kyanite and related materials		26,609	36,060	6,028	Republic of South Africa 29,074; India 574.
Lime		8	(2)	—	Pakistan;[2] Qatar.[2]
Magnesium compounds:					
Magnesite, crude		36,202	12,199	1	China 11,626; Ireland 349.
Oxides and hydroxides		277,613	387,973	769	China 339,341; Israel 261,219.
Other		—	3,432	—	West Germany 3,132; East Germany 300.
Meerchaum, amber, jet		445	NA		
Mica:					
Crude including splittings and waste		r17,227	21,122	284	India 8,166; China 6,478.
Worked including agglomerated splittings		251	324	1	Belgium-Luxembourg 159; India 157.
Nitrates, crude		818	—		
Phosphates, crude	thousand tons	2,160	1,821	970	Jordan 290; Morocco 264.
Phosphorus, elemental		20,898	20,191	8,103	United Kingdom 2,122; China 1,928.
Pigments, mineral:					
Natural, crude		634	1,084	9	China 1,050.
Iron oxides and hydroxides, processed		10,815	13,164	3,747	West Germany 5,542; Sweden 1,417.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Precious and semiprecious stones other than diamond:					
Natural	kilograms	573,922	853,818	39,954	Brazil 435,438; Republic of South Africa 96,779.
Synthetic	do.	186,932	49,569	45,543	Switzerland 2,660.
Pyrite, unroasted		r205,020	259,652	(2)	China 188,425; Australia 70,733.
Quartz crystal, piezoelectric		NA	54	27	West Germany 13; Brazil 11.
Salt and brine	thousand tons	6,830	7,229	1	Australia 3,861; Mexico 3,269.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		r4,335	330	—	U.S.S.R. 210; China 85; France 35.
Sulfate, manufactured		[14]95,835	5,601	1,679	China 3,754; Indonesia 108.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		1,041,210	1,656,968	38,178	Taiwan 411,044; Republic of Korea 293,902.
Worked		r258,871	456,970	559	Republic of Korea 174,651; China 133,139.
Dolomite, chiefly refractory-grade		767,672	964,774	3,878	Philippines 229,470; Republic of Korea 227,905.
Gravel and crushed rock		272,394	455,671	387	Taiwan 407,581; Philippines 21,182.
Limestone other than dimension		r33,865	881	—	France 832; China 48.
Quartz and quartzite		r121,809	126,014	1,581	India 64,814; Thailand 24,439.
Sand other than metal-bearing		r1,647,606	2,250,441	1,491	Australia 1,224,588; Taiwan 528,834.
Sulfur:					
Elemental:					
Crude including native and byproduct		68	2,305	—	Canada 2,200; Republic of Korea 86.
Colloidal, precipitated, sublimed		99	110	(2)	China 66; France 36.
Sulfuric acid		58	47	4	Taiwan 26; Republic of Korea 17.
Talc, steatite, soapstone, pyrophyllite		579,171	660,570	29,568	China 494,912; Australia 124,863.
Vermiculite[15]		NA	30,403	82	Republic of South Africa 17,334; China 12,500.
Other:					
Crude		r367,754	373,998	71,611	Republic of Korea 187,128; China 37,702.
Slag and dross, not metal-bearing		432,765	378,899	870	Republic of South Africa 101,557; Taiwan 85,564.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		23,752	3,391	3,094	Trinidad and Tobago 297.
Carbon black		16,979	24,133	11,534	Republic of Korea 6,299; West Germany 2,232.
Coal:					
Anthracite and bituminous	thousand tons	92,554	104,181	13,405	Australia 49,588; Canada 20,464.
Lignite including briquets		42,541	32,455	818	U.S.S.R. 26,353; Australia 4,283.
Coke and semicoke		125,795	220,134	26,250	China 122,220; Australia 66,265.
Gas, natural: Liquefied	thousand tons	29,114	31,032	163	Indonesia 16,228; Malaysia 6,119.
Peat including briquets and litter		38,818	51,407	481	Canada 48,474; West Germany 1,067.
Petroleum:					
Crude	thousand 42-gallon barrels	1,131,957	1,180,759	—	United Arab Emirates 244,538; Saudi Arabia 214,751; Indonesia 155,576.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	r 146,883	147,978	(2)	Saudi Arabia 65,550; United Arab Emirates 33,116.
Gasoline	do.	153,714	172,235	3,291	Saudi Arabia 58,841; Kuwait 21,593.
Mineral jelly and wax	do.	96	113	46	Republic of South Africa 33; China 22.
Kerosene and jet fuel	do.	57,886	71,089	5,289	Singapore 20,292; Saudi Arabia 16,002.
Distillate fuel oil	do.	28,404	23,645	4,723	Saudi Arabia 15,996; Algeria 9,487.
Lubricants	do.	1,012	974	188	Singapore 602; Taiwan 53.
Nonlubricants	do.	1,913	352	207	France 67; Australia 22.
Residual fuel oil	do.	109,943	103,792	3,294	Indonesia 37,273; Singapore 14,610; Republic of Korea 10,992.
Bitumen and other residues	do.	384	956	656	China 164; Taiwan 102.
Bituminous mixtures	do.	12	43	5	Venezuela 30; Republic of Korea 4.
Petroleum coke	do.	21,371	22,997	21,497	China 319; Taiwan 294.

r Revised. NA Not available.
[1] Excludes imports under Japanese-United States Mutual Defense Agreement or for account of U.S. military forces. Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Includes vanadium ore and concentrate.
[4] Includes zinc sulfate.
[5] Excludes unreported quantity valued at $12,002,000.
[6] Excludes unreported quantity valued at $4,880,000.
[7] Excludes unreported quantity valued at $2,675,000.
[8] Excludes unreported quantity valued at $16,992,000.
[9] Included in elemental boron.
[10] Includes arsenic.
[11] Includes iodine.
[12] Includes fluorine.
[13] Includes leucite, nepheline, and nepheline syenite.
[14] Includes sodium hydrogen sulfate and sodium pyrosulfate.
[15] Includes perlite and chlorites.

1989. Despite the approval of the sale by the Japanese Government, CITC reportedly was unable to obtain an approval from the Chinese Government.

Beryllium.—Japan is a major world consumer of beryllium; however, Japan relied 100% on imports to meet its requirements for beryllium oxide and metal. Imports of beryllium oxide declined from 100 tons in 1986 to the 73-ton level in 1989 because of a sluggish market in the semiconductor industry. Major import sources of beryllium oxide were the United States with 60 tons and China with 13 tons in 1989. Japan also imported 1,979 kilograms (kg) of beryllium metal, including ingot, powder, and scrap, and 144 kg of beryllium metal products from the United States in 1989.

Imports of beryllium oxide and metal were mainly for production of beryllium-copper master alloy and beryllium-aluminum alloy. Nippon Gaishi Co. Ltd. operated a plant in Handa, Aichi Prefecture, to produce beryllium-copper master alloy (containing 3% beryllium) and beryllium-aluminum alloy (containing 4% beryllium) with an annual capacity of 1,000 tons and 50 tons, respectively. Other producers of beryllium alloys included Dowa Mining Co. Ltd., which operated a 100-mt/yr plant in Honjo, Saitama Prefecture, and Santoku Metal Industries Co. Ltd., which operated a 24-mt/yr plant in Kobe, Hyogo Prefecture.

Production of beryllium-copper master alloy in 1989 was estimated at 1,370 tons. To meet the domestic demand for beryllium-copper master alloy, Japan imported about 50 tons, principally from the United States. Consumption of beryllium-copper master alloy, which was estimated at 1,420 tons in 1989, was mainly for manufacturing of connectors, switches, and printed circuit boards. According to Japanese industry sources, application of beryllium-copper master alloy for manufacturing of electronic parts used by the automobile industry is expected to increase.

Chromium.—Chromium ore produced by Nippon Chrome Industries Ltd. from the Wakamatsu Mine in Tottori Prefecture increased slightly from that of 1988, but remained small when compared with Japan's total consumption. Japan continued to rely on imports for 99% of its chromium ore and 59% of its ferrochromium requirements in 1989.

TABLE 4

JAPAN: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons unless otherwise specified)
Coal	Hokutan Sorachi Coal Mining Co. Ltd.	Sorachi, Hokkaido Prefecture	700
Do.	Mitsui Coal Mining Co. Ltd.	Ashibetsu, Hokkaido Prefecture and Miike, Kyushu	3,000
Do.	Matsushima Coal Mining Co. Ltd.	Ikeshima, Kyushu	1,200
Do.	Sumitomo Akabira Coal Co. Ltd.	Akabira, Hokkaido Prefecture	600
Do.	Taiheiyo Coal Mining Co. Ltd.	Tiaheiyo, Hokkaido Prefecture	2,000
Copper:			
In concentrate	Hanaoka Mining Co. Ltd. (subsidiary of Dowa Mining Co. Ltd.).	Hanaoka, Akita Prefecture	9
Do.	Shin Kamaishi Mining Co. Ltd. (subsidiary of Nittetsu Mining Co. Ltd.).	Kamaishi, Iwate Prefecture	4
Do.	Uchinotai Mining Co. Ltd. (subsidiary of Dowa Mining Co. Ltd.).	Uchinotai, Akita Prefecture	2
Refined	Hibi Kyodo Smelting Co. Ltd. (63.5% owned by Mitsui Mining and Smelting Co. Ltd., 20.3% by Nittetsu Mining Co. Ltd., 16.2% by Furukawa Co. Ltd.).	Tamano, Okayama Prefecture	168
Do.	Mitsubishi Metal Corp. Ltd.	Naoshima, Kagawa Prefecture	204
Do.	Nippon Mining Co. Ltd.	Hitachi, Ibaraki Prefecture and Saganoseki, Oita Prefecture	300
Do.	Onahama Smelting and Refining Co. Ltd. (49.3% owned by Mitsui Metal Corp., 29.8% by Dowa Mining Co. Ltd., 7.7% by Furukawa Co. Ltd., 13.2% by other).	Onahama, Fukushima Prefecture	234
Do.	Sumitomo Metal Mining Co. Ltd.	Besshi, Ehime Prefecture	192
Gold:			
In concentrate	Mitsui Kushikino Mining Co. Ltd.	Kushikino, Kagoshima Prefecture	[1] 200
Do.	Sumitomo Metal Mining Co. Ltd.	Hishikari, Kagoshima Prefecture	[1] 6,000
Refined	Mitsibishi Metal Corp.	Naoshima, Kagawa Prefecture	160,000
Do.	Nippon Mining Co. Ltd.	Hitachi, Ibaraki Prefecture	[1] 15,000
Do.	Sumitomo Metal Mining Co. Ltd.	Niihama, Ehime Prefecture	[1] 30,000
Limestone	Mitsubishi Mining & Cement Co. Ltd.	Higashitani, Fukuoka Prefecture	8,000
Do.	Nittetsu Mining Co. Ltd.	Torigatayama, Kochi Prefecture and Nittetsu-Tsukumi, Oita Prefecture	15,000
Do.	Onoda Cement Co. Ltd.	Onoda-Tsukumi, Oita Prefecture and Onoda-Nagaiwa, Iwate Prefecture	11,000
Do.	Sumitomo Cement Co. Ltd.	Shuho, Yamaguchi Prefecture	8,000
Do.	Todaka Mining Co. Ltd.	Todaka-Tsukumi Oita Prefecture	10,000
Do.	Ube Industries Ltd.	Isa, Yamaguchi Prefecture	11,000
Iodine, crude	Ise Chemical Industries Co. Ltd.	Oami-Shirasato, Ichinomya, Misaki, and Hikari, Chiba Prefecture; Kurosaki, Niigata Prefecture; and Sadowara, Miyazaki Prefecture	4.3
Do.	Nippon Natural Gas Industry Co. Ltd.	Minamihinato-Shirako, Koji-Shirako, Yokoshiba, and Narashino, Chiba Prefecture	1.3
Do.	United Resources Industry Co. Ltd.	Chosei and Otaki, Chiba Prefecture	1.8
Lead:			
In concentrate	Hanaoka Mining Co. Ltd.	Hanaoka, Akita Prefecture	8
Do.	Kamioka Mining and Smelting Co. Ltd. (subsidiary of Mitsui Mining and Smelting Co. Ltd.).	Kamioka, Gifu Prefecture	4
Do.	Toyoha Mining Co. Ltd. (subsidiary of Nippon Mining Co. Ltd.).	Toyoha, Hokkaido Prefecture	10
Do.	Uchinotai Mining Co. Ltd.	Uchinotai, Akita Prefecture	4

See footnotes at end of table.

TABLE 4—Continued

JAPAN: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons unless otherwise specified)
Lead—Continued			
Refined	Kamioka Mining and Smelting Co. Ltd.	Kamioka, Gifu Prefecture	31.2
Do.	Mitsubishi Cominco Smelting Co. Ltd. (owned 55% by Mitsubishi Metal Corp., 45% by Cominco Ltd. of Canada).	Naoshima, Kagawa Prefecture	42
Do.	Mitsui Mining and Smelting Co. Ltd.	Takehara, Hiroshima Prefecture	43.8
Do.	Nippon Mining Co. Ltd.	Saganoseki, Oita Prefecture	36
Do.	Toho Zinc Co. Ltd.	Chigirishima, Hiroshima Prefecture	84
Manganese:			
In electrolytic dioxide	Mitsui Mining and Smelting Co. Ltd.	Takehara, Toyama Prefecture	25
Do.	Tosoh Corp.	Hyuga, Miyazaki Prefecture	24
Do.	Japan Metals and Chemical Co. Ltd.	Takaoka, Yoyama Prefecture	18
Nickel:			
In ferronickel	Hyuga Smelting Co. Ltd. (subsidiary of Sumitomo Metal Mining Co. Ltd.).	Hyuga, Miyazaki Prefecture	26.4
Do.	Nippon Yakin Kogyo Co. Ltd.	Oheyama, Kyoto Prefecture	15
Do.	Pacific Metals Co. Ltd.	Hachinohe, Aomori Prefecture	36
In oxide	Tokyo Nickel Co. Ltd. (45% owned by Inco Ltd., 30% by Shimura Kako Co. Ltd., 10% by Mitsui & Co. Ltd., 15% by other).	Matsuzaka, Mie Prefecture	36
Refined	Sumitomo Metal Mining Co. Ltd.	Niihama, Ehime Prefecture	[2]25
Steel, crude	Kawasaki Steel Corp.	Mizushima, Okayama Prefecture; and Chiba, Chiba Prefecture	16,880
Do.	Kobe Steel Ltd.	Kakogawa and Kobe, Hyogo Prefecture	8,300
Do.	NKK Corp.	Fukuyama, Hiroshima Prefecture; and Keihin, Tokyo Prefecture	22,130
Do.	Nippon Steel Corp.	Oita, Oita Prefecture; Yawata, Fukuok Prefecture; Kimitsu, Chiba Prefecture; and Nagoya, Aichi Prefecture	48,800
Do.	Sumitomo Metal Industries Ltd.	Kashima, Ibaraki Prefecture; and Kokura, Fukuoka Prefecture	22,140
Pyrophyllite	Goto Kozan Co. Ltd.	Goto, Nagasaki Prefecture	204
Do	Ohira Kozan Co. Ltd.	Ohira, Okayama Prefecture	132
Do.	Sankin Kogyo Co. Ltd.	Otsue, Hiroshima Prefecture	72
Do	Shinagawa Shirenga Co. Ltd.	Mitsuishi, Okayama Prefecture	180
Do.	Shokozan Kogyosho Co. Ltd.	Yano-Shokozan, Hiroshima Prefecture	180
Do.	Showa Kogyo Co. Ltd.	Showa-Shokozan, Hiroshima Prefecture	60
Titanium, Sponge metal	Osaka Titanium Co. Ltd.	Amagasaki, Hyogo Prefecture	13.2
Do.	Showa Titanium Co. Ltd.	Toyama, Toyama Prefecture	3
Do.	Toho Titanium Co. Ltd.	Chigasaki, Kanagawa Prefecture	12
Zinc:			
In concentrate	Hanaoka Mining Co. Ltd.	Hanaoka, Akita Prefecture	35
Do.	Kamioka Mining and Smelting Co. Ltd.	Kamioka, Gifu Prefecture	60
Do.	Toyoha Mining Co. Ltd.	Toyoha, Hokkaido Prefecture	50
Do.	Uchinotai Mining Co. Ltd.	Uchinotai, Akita Prefecture	10
Refined	Akita Smelting Co. Ltd.	Iijima, Akita Prefecture	156
Do.	Mitsubishi Metal Corp.	Akita, Akita Prefecture	96
Do.	Nikko Zinc Co. Ltd.	Mikkaichi, Toyama Prefecture	120
Do.	Toho Zinc Co. Ltd.	Annaka, Gunma Prefecture	139
Do.	Hachinohe Smelting Co. Ltd.	Hachonohe, Aomori Prefecture	101

[1] Kilogram.
[2] Capacity will be expanded to 29,000 million metric tons per year in 1990.

Despite a sharp increase in the average import price of chromium metal in 1989, imports of metallurgical- and refractory-grade chromium ore rose almost 7% to 1,043,468 tons in 1989 because of increased consumption by the iron and steel and ferroalloy industries. The Republic of South Africa remained the dominant supplier of chromium ore, accounting for 57% of total imports. Other important suppliers of chromium ore were India (11%), Madagascar and Albania (7% each), and Turkey (6%).

To import less ferrochromium, NKK Corp. and Pacific Metals Co. Ltd. reportedly had reactivated one of their idle electric furnaces in late 1988. As a result, consumption of metallurgical-grade chromium ore by the ferroalloy industry rose by 9% to 654,242 tons, and production of ferrochromium rose by 10% in 1989.

Imports of ferrochromium remained high at 477,080 tons in 1989 compared with 473,707 tons in 1988 because of a stronger demand for ferrochromium by the specialty steel industry. The Republic of South Africa remained the dominant supplier of ferrochromium, providing 59%. Other important suppliers in 1989 were the Philippines (11%), India (10%), Zimbabwe (9%), and China and Brazil (3% each).

Cobalt.—Japan continued to rely on imports to meet its requirement for cobalt. In 1989, a small quantity of cobalt was recovered by Sumitomo Metal Mining Co. Ltd. using imported materials at its Niihama cobalt-nickel refining facilities in Ehime Prefecture on Shikoku Island. The Nikko cobalt-nickel refinery owned by Nippon Mining Co. Ltd. remained shut down owing to lack of raw material. Sumitomo Metal Mining reportedly is expanding its Niihama nickel production capacity by converting a certain part of its cobalt refining facilities into nickel refining facilities.

Imports of cobalt metal, including powder and scrap, declined by 32% to 3,342 tons in 1989 because of excessive imports in 1988 and a slight decline in demand for cobalt by the manufacturers of magnetic materials. The major suppliers of cobalt in 1989 were Zaire, accounting for 48%; Belgium, 24%; Zambia, 12%; and Norway, 7%.

According to MITI, consumption of cobalt metal rose 11% to 2,585 tons in 1989 because of increased demand in all but the magnetic materials sector. Consumption of cobalt by sector in 1987-89 is shown in table 5.

Copper, Lead, and Zinc.—Mine production of copper, lead, and zinc all declined because of the continued streamlining of mining operations through employment reductions at the remaining six major nonferrous metal mines in the Prefectures of Akita, Aomori, Gifu, Iwate, and Hokkaido. To meet a stronger domestic demand, Japan's imports of copper, lead, and zinc increased substantially in 1989.

Japan remained the world's largest importer of copper in 1989. Imports of copper ore and concentrate remained at about 3.4 MMmt; however, imports of refined copper broke the 1984 previous record high of 470,202 tons, reaching 487,191 tons in 1989. Japan's imports of unalloyed copper in 1989 by form and origin are shown in table 6.

In 1989, imports of lead ore and concentrate rose 7% to 298,964 tons, of which 37% came from Canada, 24% from Australia, 16% from Peru, 7%

TABLE 5

JAPAN: CONSUMPTION OF COBALT, BY END USE

(Kilograms)

Sector	1987	1988	1989
Catalysts	281,580	276,984	373,006
Cemented carbides	246,363	256,026	302,121
Magnetic materials	426,266	595,628	555,457
Specialty steels	493,825	675,005	786,665
Tubes, sheets, rods, and wires	272,520	284,148	332,552
Other	181,907	243,466	235,160
Total	1,902,461	2,331,257	2,584,961

Source: The Ministry of International Trade and Industry of Japan (Tokyo). Yearbook of Minerals and Nonferrous Metals Statistics, 1989, p. 175.

TABLE 6

JAPAN: IMPORTS OF UNALLOYED COPPER IN 1989, BY FORM AND ORIGIN

(Metric tons)

Country of origin	Coppper concentrate	Copper scrap	Unwrought		Semimanufactures
	Gross weight		Unrefined	Refined	
Australia	173,897	19	—	26,605	119
Canada	884,137	495	—	7,913	3
Chile	223,348	—	—	145,185	—
Indonesia	288,047	—	—	185	7
Malaysia	106,572	2,135	—	—	41
Mexico	78,462	—	—	314	—
Papua New Guinea	394,293	—	—	—	—
Peru	59,651	—	21,915	25,009	—
Philippines	449,789	1,854	—	50,372	—
Portugal	87,940	—	—	—	—
United States	552,992	22,870	—	49,223	2,583
Zambia	—	—	—	145,550	—
Other	73,832	23,369	24	36,835	27,928
Total	3,372,960	50,742	21,939	487,191	30,681

Source: Ministry of Finance of Japan (Tokyo). Japan Imports and Exports, Commodity by Country, Dec. 1989.

from Thailand, 6% from the Republic of South Africa, 5% from China, and 5% from other countries. Imports of zinc ore and concentrate dropped 4% to 1,028,985 tons, of which 51% came from Australia, 15% each from Canada and Peru, 8% from China, and 11% from other countries. However, imports of refined lead and zinc metal increased by 16% and 18% to 59,689 tons and 132,746 tons, respectively, in 1989 because of lower domestic metal production and a stronger demand for lead and zinc. Australia, Mexico, and the U.S.S.R. were the major suppliers of refined lead; Australia, Canada, North Korea, and the Republic of Korea were the major suppliers of zinc metal in 1989.

According to MITI, utilization of refining capacity was at 84% of 1,182,000 mt/yr for refined copper, 83% of 316,200 mt/yr for refined lead, and 74% of 896,040 mt/yr for zinc metal. Metal production of copper, lead, and zinc by source of raw materials is shown in table 7.

Mitsubishi Metal Corp., a major nonferrous metals producer, began rebuilding its copper smelter at Naoshima in Kagawa Prefecture in northeastern Shikoku in late 1989. The company reportedly is dismantling an old reverberatory furnace and replacing it with a new single-line continuous smelting furnace. The construction work on the new 204,000-mt/yr smelter is scheduled for completion by May 1991 with an estimated cost of $131 million. According to the company, by using the sophisticated continuous smelting technology, the smelter will be able to cut its production cost by 20% to 40% through higher efficiency and lower energy and labor costs.[5] The company's refinery capacity at Naoshima remained unchanged at 163,200 mt/yr.

To improve the stability of its copper concentrate supply, Mitsubishi Metal reportedly raised its minority equity holding in class B share of Atlas Consolidated Mining and Development Corp., a major Philippine copper and gold producer, to 10.49% in September 1989. The action was taken following raw materials shortage problems caused by a riot at the Bougainville Mine in Papua New Guinea and a strike at the Highland Valley copper mine in Canada.

In early 1989, Mitsubishi Metal announced that its will spend about $260 million to build a new copper smelter at Texas City, about 64 km south of Houston, Texas. Construction was planned to begin in early 1990 after the company received necessary permits from U.S. Federal and State Governments. The accessibility to a deepwater port, low electricity rate, a large pool of skilled labor, and the availability of oxygen supply were the major factors for selecting Texas City as the ideal site for the new smelter. Construction of the new smelter was scheduled for completion by 1992 at an initial rate of 150,000 mt/yr of anodes.

During 1989, Mitsubishi Metal reportedly was actively seeking partners in the United States and Japan to participate in the Texas City copper smelter project. By late 1989, Nippon Mining Co. Ltd., Dowa Mining Co. Ltd., and Furukawa Co. Ltd. reportedly had signed up to participate in the project, and Fluor Daniels Corp. of the United States was awarded a contract to provide the detail engineering for the smelting facilities. Mitsubishi Metal had established a subsidiary in the United States, called Texas Copper Co., to operate the new smelter project.

Domestic demand for copper continued the 1988 upward trend and reached a new high at 1,560,955 tons, of which 69% was for wire and cable, 30% for brass mill products, and 1% for other uses. Exports of refined copper rose 16% to 32,842 tons in 1989 because of increased exports to the Republic of Korea and Taiwan. Overall stocks of refined copper declined by 2.4% to 108,498 tons at the end of 1989.

Domestic demand for refined lead increased slightly to 297,500 tons in 1989, of which 62% was for storage batteries, 23% for inorganic chemicals, 5% for solders, 4% for lead pipe and sheet, and 6% for other uses. Exports of refined lead dropped to only 22 tons from 406 tons in 1988. Overall stocks of refined lead dropped by 8% to 28,671 tons at the end of 1989.

Domestic demand for zinc metal rose by 2% to 776,056 tons, of which 48% was for sheet galvanizing; 15% for

TABLE 7

JAPAN: SOURCE MATERIALS FOR PRODUCTION OF COPPER, LEAD, AND ZINC

(Metric tons)

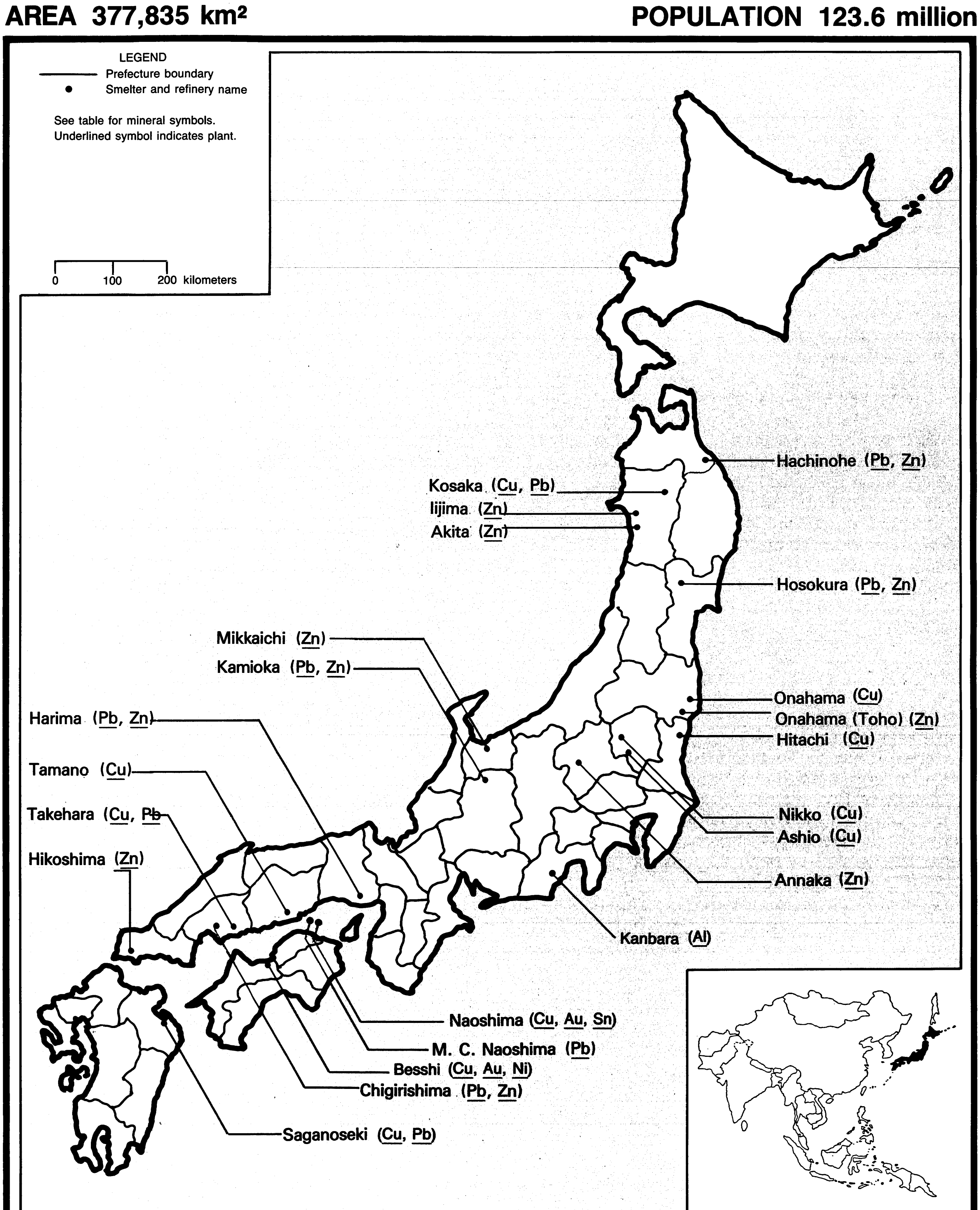
Commodity and source	1987	1988	1989
Copper, refined			
Domestic ore and concentrate	9,653	8,501	6,547
Imported ore and concentrate[1]	861,341	846,107	875,716
Scrap	64,764	57,629	58,496
Other materials	44,591	42,871	48,807
Total	980,349	955,108	989,566
Lead, refined			
Domestic ore and concentrate	42,963	41,380	38,052
Imported ore and concentrate	175,807	176,331	169,683
Scrap	7,400	8,605	9,495
Other materials	42,282	41,079	42,748
Other secondary	70,048	72,576	72,396
Total	338,500	339,971	332,374
Zinc, slab			
Domestic ore and concentrate	167,859	152,744	134,725
Imported ore and concentrate	423,657	448,338	455,735
Scrap	23,388	21,585	24,407
Other materials	50,714	55,508	48,940
Other secondary	43,765	47,609	50,171
Total	708,381	725,784	713,978

[1] Including blister.

Source: Ministry of International Trade and Industry of Japan (Tokyo). Yearbook of Minerals and Nonferrous Metals Statistics, 1987-89, annual.

FIGURE 1

JAPAN: LOCATION OF MAJOR NONFERROUS SMELTING AND REFINING PLANTS



Metal Mining Agency of Japan (Tokyo) publication adapted from *Mining Activities of Japan, 1989.*

tube, wire, and general galvanizing; 13% for brass mill products; 12% for zinc alloy diecastings; and 12% for other uses. Exports of zinc metal dropped 15% to 17,862 tons in 1989. Overall stocks of zinc metal, however, rose 13% to 95,696 tons at the end of 1989.

Gallium.—Japan remained one of the world's major consumers and one of the world's leading producers of high-purity gallium metal in 1989. Dowa Mining temporarily shut down its rare metals refinery plant and stopped production of primary gallium using domestically produced zinc residue at Kosaka in Akita Prefecture. Because of the availability of low-cost chloride recycling technology, secondary production of gallium increased considerably in 1988-89. According to Japan's Rare Metal News, secondary production of gallium metal by Dowa Mining, Nichia Chemical Co. Ltd., Rasa Industries Co. Ltd., Sumitomo Chemical Co. Ltd., and Sumitomo Metal Mining was about 28,000 kg in 1988 and 32,000 kg 1989. Most of these secondary producers extracted gallium metal from scrap of gallium arsenide, gallium phosphate, and compound semiconductors purchased from the domestic and overseas markets. Consumption of high-purity gallium metal was estimated at 47,300 kg in 1988 and about 54,200 kg in 1989.

Because of increased consumption, imports of gallium metal rose by 40% to 18,562 kg in 1989, of which 15,721 kg was high-purity gallium metal and 2,841 kg was crude gallium metal (intermediate-grade). In 1989, the suppliers of high-purity gallium metal were International Gallium GmbH of the Federal Republic of Germany, 6,100 kg; Rhone-Poulenc S.A. of France, 8,423 kg; and Alcan Electronic Materials of Switzerland, 1,198 kg. The suppliers of crude gallium metal were Metal Impemex of Czechoslovakia, 300 kg; China Nonferrous Metals Imports and Exports Corp., 471 kg; and Aluminium Kervaell of Hungary, 2,070 kg.[6]

Gold and Silver.—Mine production of gold and silver continued to decline in 1989 because of diminished recovery of byproducts from copper-lead-zinc mines and reduced output from gold and silver mines. According to MITI's survey, as of April 1989, only five mines in which gold and silver were the principal products were operating, all in Kagoshima Prefecture in southern Kyushu. Gold and silver production by Sumitomo Metal Mining from the Hishikari Mines decreased to 5,490 kg and 3,009 kg in 1988 from 6,319 kg and 3,298 kg, respectively, in 1987. Gold and silver production by Mitsui Kushikino Mining Co. Ltd. from the Kushikino Mine also decreased to 133 kg and 886 kg in 1988 from 258 kg and 1,644 kg, respectively, in 1987. Three other small-scale primary gold and silver mines operating in 1989 were the Kasuga Mine, the Akeshi Mine, and Iwato Kinsan Mine.

Following discovery of the Yamada gold deposit in 1988 near its Hishikari Mine, Sumitomo Metal Mining planned to spend about $29 million to develop the Yamada deposit and begin mining gold in late 1992. According to Sumitomo Metal Mining, ore reserves at the Yamada deposit were estimated at 2 MMmt of ore, grading between 20 and 25 grams per ton.

In 1989, two gold veins were discovered by the MMAJ near the abandoned Iwami silver mine, about 20 km south of Oda in Shimane Prefecture. According to MMAJ, one vein, about five centimeters thick at 373 meters below sea level, contains 34.38 grams of gold per ton and 1,449.5 grams of silver per ton, 4.87% copper, 14.44% lead, and 7.16% zinc. Another vein, about 29 centimeters thick at 658 meters below sea level, contains 109.4 grams of gold per ton, 103.3 grams of silver per ton, 8.17% copper, 0.01% lead, and 0.04% zinc. MMAJ planned to drill three more holes west of the existing exploratory drilling site in 1990.

Japan's metal production of gold and silver both reached record highs because of increased supply of raw materials from foreign ore, scrap, and others, such as slimes from lead and zinc refineries. In 1989, metal production of gold and silver by source of raw material was as follows: from foreign sources, 80.3% for gold and 61.0% for silver; from domestic sources, 10.0% for gold and 10.1% for silver; from scrap, 3.3% for gold and 10.9% for silver; and from other, 6.4% for gold and 18.0% for silver.

Sumitomo Metal Mining continued to refine gold and silver at its Toyo smelting and refining facilities in Ehime Prefecture, while Mitsubishi Metal shifted its gold and silver refining to the newly inaugurated Naoshima precious-metals refinery in Kagawa Prefecture in late November 1989. The old precious-metals refinery in Osaka, owned and operated by Mitsubishi Metal, was closed in late 1989.

Japan continued to rely on imports to meet 50% of its gold metal demand and 27% of its silver metal demand in 1989. Imports of gold metal dropped by 3% to 284,235 kg because of increased recovery from imported ore and concentrates. Of this total import, 46% was from Switzerland, 18% from Australia, 10% from Canda, 9% from United Kingdom, 6% from the U.S.S.R., and 3% each from the United States and the Republic of South Africa.

Imports of silver metal decreased by 8% to 853 tons. Mexico and Peru remained the two dominant suppliers of silver metal, providing 39% and 31%, respectively, in 1989. Other important suppliers of silver in 1989 were the United States, 12%; Australia, 9%; and Chile and the Republic of Korea, 4% each. According to Government and industry sources, supply and demand for gold and silver in 1988-89 are shown in table 8.

Iron and Steel.—Mine production of iron sand and roasted pyrite by nine small-scale mining companies operating in the Prefectures of Iwate, Shimane, Okayama, Oita, and Kumamoto dropped to a lower level in 1989 than has been reported since the first decade of the 20th century. Japan continued to rely on imports to meet virtually all of its iron ore requirements. Imports of iron ore, including iron sand, pellet, and sinter, rose by 3.5% to 127.7 MMmt in 1989 because of increased demand. Australia, Brazil, and India remained the three dominant sources, supplying 44%, 23%, and 17%, respectively, in 1989.

Consumption of iron ore, including iron sand, pellet, and sinter, by blast furnaces increased 2% to 131.6 MMmt in 1989. Production of pig iron reached the highest level since 1985. According to MITI, by the end of 1989 only 36 of 47 blast furnaces were operating compared with 37 of 48 in 1988. According to the Japan Iron and Steel Federation (JISF), the average pig iron output rate

TABLE 8

JAPAN: SUPPLY AND DEMAND FOR GOLD AND SILVER

(Gold in kilograms, silver in metric tons)

	1988	1989
Gold:		
Supply		
Primary metal production:		
From domestic ore	13,179	10,954
From imported ore and concentrate	69,224	88,587
From other materials	9,626	10,789
Metals imports	293,757	284,235
Secondary recovery	166,121	190,586
Total supply	551,907	585,151
Demand		
Demand for industrial use		
Dental and medical	13,028	14,582
Electrical, electronic, and communications apparatus	35,602	43,121
Gold plating	18,895	16,741
Gilding	695	2,257
Jewelry	95,525	109,261
Decorations and badges	695	928
Pottery and porcelain	4,345	4,124
Fountain pens	550	716
Watches	728	3,955
Subtotal	170,063	195,685
Demand for industrial arts and crafts	3,151	3,588
Demand for investment and other		
Private investment	201,995	215,097
Other	165,468	152,654
Total domestic demand	540,677	567,024
Exports	11,230	18,127
Total demand	551,907	585,151
Silver:		
Supply		
Beginning stock	779	843
Primary metal production	1,837	1,987
Metal imports	924	853
Secondary recovery	162	167
Total supply	3,702	3,850
Demand		
Silver nitrate for photography	1,765	1,704
Silver nitrate for other uses	298	278
Electrical contacts	260	295
Brazing alloy	135	141
Electroplating	174	117
Rolled products	174	215
Jewelry and silverware	94	110
Other	331	322
Domestic consumption	3,231	3,182
Exports	13	1
Total	3,244	3,183
Ending stock	843	1,159

Source: Ministry of International Trade and Industry, Ministry of Finance, and Japan Mining Industry Association. From Rare Metal News (Tokyo). Industrial Rare Metals, No. 101, Annual Review 1990, pp. 178-179.

or blast furnace productivity, as measured by tons of pig iron output per cubic meter of blast furnace volume per day, rose to 1.93 from 1.89 in 1988. Of the total number of blast furnaces in operation, 18 reportedly averaged more than 2.0 tons of pig iron output per cubic meter of blast furnace volume per day in 1989.

Japan remained the world's second largest crude steel producer, accounting for 13.8% of the world production in 1989. The ranking of Japan's top 7 steelmakers among the top 50 steel companies in the market economy countries is shown in table 9.

Because of the continued growth in domestic demand for steel by the automobile and construction industries, crude steel output reached the highest level since 1980. Of the crude steel produced in 1989, 69.4% was processed by the basic oxygen furnaces and 30.6% by the electric furnaces. By yearend, the industry scrapped 3 of 78 basic oxygen furnaces and 8 of 490 electric furnaces. As a result, the industry's crude steel capacity was reduced to 141.6 MMmt/yr from 143.2 MMmt/yr in 1988, and the industry's labor force was also cut by 9,334 to 295,551 workers by the end of 1989.

Japan continued to raise efficiency of its steelmaking with a continuous casting ratio of 94.6% compared with 93.3% in 1988. The continuous casting ratio of ordinary steel was 97.9% and of specialty steel 78.9% in 1989.

Domestic steel consumption reached the highest level in history. According to calculations by the JISF, Japan's apparent steel consumption, in crude steel equivalent, reached 93.3 MMmt in 1989 compared with the previous record of 89.3 MMmt set in 1973. However, exports of steel, in crude steel equivalent, dropped to 22.3 MMmt in 1989, the lowest level since 1970.

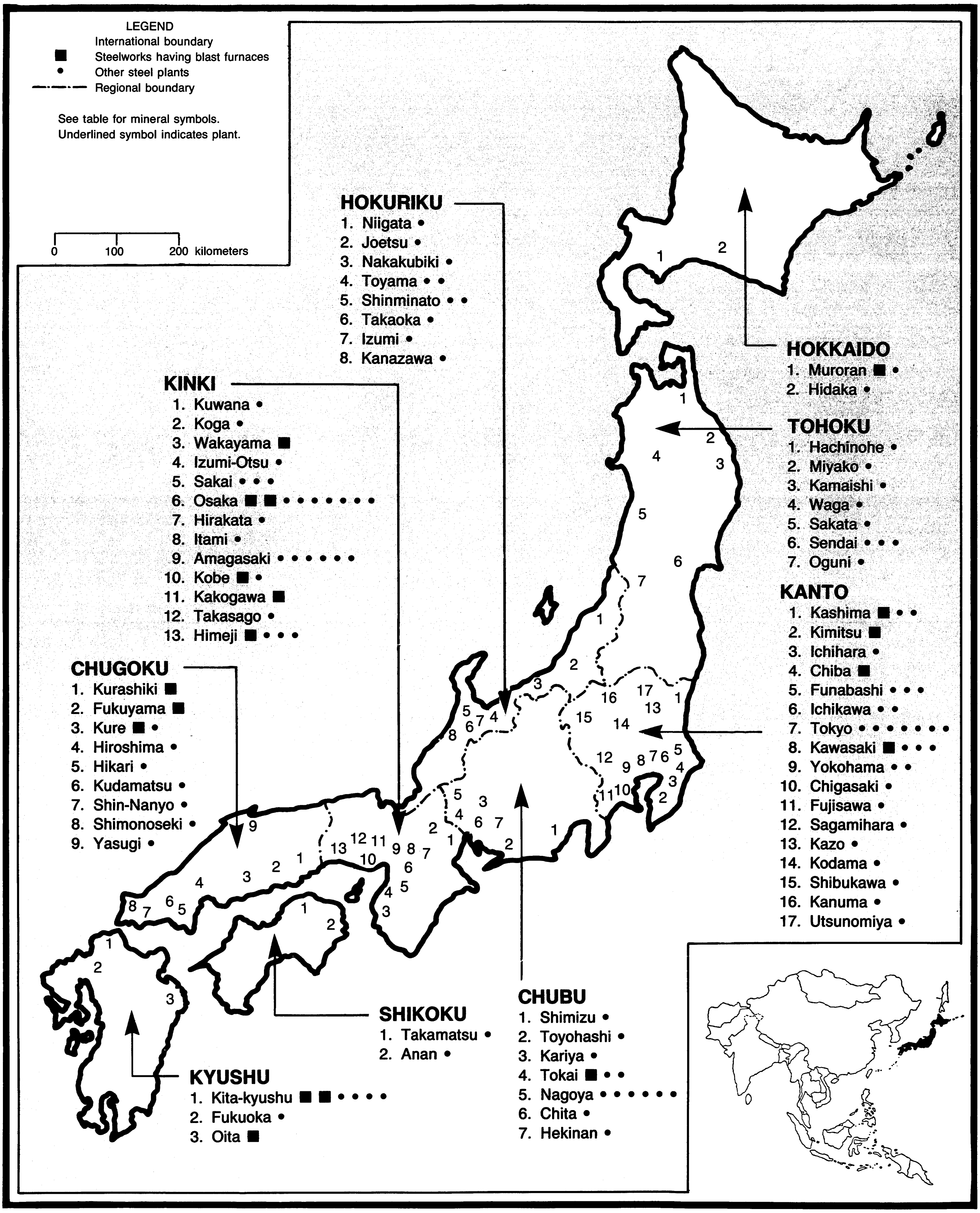
Stronger domestic demand for steel was sustained by increased orders for steel bars, steel shapes, hot- and cold-rolled sheets, surface-treated and surface-coated sheets, and heavy and medium plate by the construction, electrical machinery, home and office appliances, and automobiles industries. Domestic orders for ordinary and specialty steel products by end use are shown in table 10.

Exports of iron and steel declined for the fourth year in a row by 14.6% to 20.2 MMmt owing mainly to a 20%

FIGURE 2

JAPAN: LOCATION OF MAJOR STEELWORKS

AREA 377,835 km² **POPULATION 123.6 million**



The Japan Iron and Steel Federation (Tokyo) publication adapted from *The Steel Industry of Japan, 1989.*

TABLE 9

JAPAN: CRUDE STEEL PRODUCTION AND RANKING OF TOP SEVEN COMPANIES

	Output (Million metric tons)		Ranking among market economy country companies	
	1988	1989	1988	1989
Nippon Steel Corp.	28.34	28.38	1	1
NKK Corp.	12.04	12.28	8	7
Kawasaki Steel Corp.	10.93	11.01	12	11
Sumitomo Metal Industries Ltd.	11.80	11.00	10	12
Kobe Steel Ltd.	6.46	6.45	17	18
Nisshin Steel Co. Ltd.	3.25	3.45	36	35
Tokyo Steel Manufacturing Co. Ltd.	3.43	3.42	34	36
Total	76.25	75.99	XX	XX

XX Not applicable.

Source: Metal Bulletin (London). No. 7460, Feb. 22, 1990, p. 21.

TABLE 10

JAPAN: DOMESTIC ORDERS FOR ORDINARY STEEL AND SPECIALTY STEEL PRODUCTS, BY END USE

(Thousand metric tons)

	Ordinary		Specialty	
	1988	1989	1988	1989
Automobiles	10,833	11,642	2,454	2,707
Construction	15,529	17,006	547	607
Conversion and processing	3,495	3,600	3,805	3,911
Electric machinery	2,820	3,030	96	116
Home and office equipment	796	920	247	265
Industrial machinery	1,858	2,159	1,188	1,307
Rolling stock	47	44	28	32
Shipbuilding	1,935	2,305	60	127
Steel dealers	19,884	22,335	1,364	1,372
Tanks and containers	2,119	2,292	37	34
Other	325	345	70	83
Total	59,641	65,678	9,896	10,561

Source: Japan Iron and Steel Federation (Tokyo). The Steel Industry of Japan, 1990, p. 11.

reduction in exports to China because of China's economic readjustment, a 50% decrease in exports of welded and seamless pipes to the U.S.S.R., and a 20% drop in exports to the United States because of the Voluntary Restraint Agreement. Of total exports, 16.3 MMmt was ordinary steel products; 3.1 MMmt was specialty steel products; and 0.8 MMmt was other products, including pig iron, ferroalloys, cast iron pipe, clad steel sheet, wire and wire products, ingots and semifinished products. Export earnings from iron and steel products also decreased by 2.9% to $15.6 billion. However, the average export unit price increased by 13.7% to $773 per ton, reflecting increased exports of high value added steel products in 1989.

Imports of iron and steel products declined by 2.5% to 10.8 MMmt; however, the value of iron and steel product imports increased 9.3% to $5.1 billion in 1989 because of higher import unit price. Of the total imports, 6.4 MMmt was ordinary steel products, 2.3 MMmt was pig iron, 1.3 MMmt was ferroalloy, and 0.9 MMmt was steel slab, semimanufactured, wire, and specialty steel products. The Republic of Korea, Brazil, and Taiwan remained the three dominant suppliers, accounting for 26%, 6%, and 5%, respectively, of total imports in 1989. Imports of iron and steel from the United States rose 297% to 530,000 tons in 1989.

Despite increased raw material and labor costs, according to the interim reports of 40 JISF member companies, the iron and steel industry reported a 20.7% increase in pretax profits to $3.1 billion for the first half of fiscal year ending September 1989. The increased pretax profit reportedly was owing to a stronger domestic demand, a higher export price, and a successful industry rationalization program. During the same period, Japan's five largest steel companies, Nippon Steel Corp., NKK Corp., Kawasaki Steel Corp., Sumitomo Metal Industries Ltd., and Kobe Steel Ltd., reported a combined pretax profit of $1.85 billion, a 24% increase from the same period in 1988.

Capital investments in plant and equipment by the steel industry for fiscal year 1989 (April 1989 to March 1990), according to MITI, is expected to reach $5 billion, a 32% rise from the previous fiscal year. First priority was given to investment in continuous casting equipment, followed by investment in renovation of plants and development of new business. Capital investment by the steel industry accounted for 3.9% of Japan's total investment by all industries in 1989.

The Japanese investment in the U.S. steel industry reached a record high in 1989. In May, Kawasaki Steel Corp. paid $525 million to acquire 50% equity in Armco Steel Co.'s Eastern Steel Div. and will spend an additional $175 million to assume Eastern Steel's debt and other obligations. In December, Nippon Steel Corp. completed the purchase of 50% equity in Inland Steel Industries for $310 million. An agreement was also reached between Kobe Steel and USX Corp. for Kobe to invest $300 million in a 50-50 joint-venture steel mill project in Lorian, OH. According to U.S. industry sources, Japan's major investments in the U.S. steel industry since 1983 are shown in table 11.

Manganese.—Japan resumed mine production of manganese ore in 1988. Kita Hoshi Mining Co. Ltd., which

TABLE 11

JAPAN: MAJOR INVESTMENT IN THE U.S. STEEL INDUSTRY

U.S. company and asset	Japanese investor and year of investment	Investment (million dollars)	Japanese ownership (percentage)
Wheeling-Pittsburgh Steel Corp. Coating line	Nisshin Steel 1983	65	67
California Steel Corp. Fontana plant	Kawasaki Steel 1984	138	50
National Intergroup National Steel Corp.	NKK Corp. 1984	323	50
LTV Steel Co. Electrogalv. line	Sumitomo Metal 1987	100	50
Inland Steel Industries Cold Rolling Mill	Nippon Steel 1989	310	40
Armco Steel Co. Eastern Steel	Kawasaki Steel 1989	700	50
USX Corp. USS Div.	Kobe Steel 1989	300	50
Total		1,936	XX

XX Not applicable.

Source: AUS Consultants; The Washington Post, No. 319, Oct. 20, 1989 pp. C1-C2; The New York Times, Dec. 21, 1989, p. D2; Journal of Commerce, V. 384, No. 27,216 Apr. 27, 1990, p. 1; San Francisco Chronicle, Dec. 20, 1989, p. C7; and American Metal Market, v. 97, No. 61, Mar. 29, 1989, pp. 1 and 20.

operated a small-scale manganese mine at Nodata Magawa in Iwate Prefecture, produced about 80 tons in 1988 and reported no production in 1989. Japan continued to rely on imports for all of its manganese ore requirements in 1989.

Despite a stronger demand for manganese ore by the iron and steel industry, imports of manganese ore remained at the same level of 1988 because of tight supply in the world market and a sharp increase in import price. According to the Ministry of Finance, Japan's import c.i.f. price per ton of manganese ore rose to $95.62 in December 1989 from $68.75 in December 1988. According to industry sources, the f.o.b. price per ton of manganese ore from Australia and the Republic of South Africa rose 57% to $108 and 63% to $106.56, respectively, in 1989.

Imports of manganese ore totaled 1,615,325 tons in 1989, of which 25,124 tons was high-grade manganese dioxide ore; 1,211,761 tons, metallurgical-grade manganese ore containing more than 39% manganese; and 378,440 tons, other manganese ore containing less than 39% manganese. Australia and the Republic of South Africa remained the two dominant suppliers of manganese ore providing 34.6% and 48.4%, respectively, in 1989.

For production of ferromanganese and silicomanganese, the ferroalloy industry consumed 753,109 tons of metallurgical-grade manganese ore compared with 707,594 tons in 1988. In 1989, Japan also imported 323,677 tons of ferruginous manganese ore for production of pig iron in 1989 from India (24%) and the Republic of South Africa (76%). Production of manganese metal reportedly reached a record high mainly because of increased demand by the specialty steel industry. No export of manganese metal was reported in 1989. However, production of electrolytic manganese dioxide fell sharply mainly because of reduced exports to the United States resulting from imposition of antidumping duties by the U.S. Government against the Japanese manganese dioxide producers in 1989.

Following a successful operation of a pilot plant, Chuo Denki Kogyo Co. announced in July 1989 that it will build a $18.3 million plant at Taguchi in Niigata Prefecture to produce 6,000 mt/yr of high-grade chemical manganese dioxide and 10,000 mt/yr of other manganese chemicals. The plant should become operational for production of some unspecified manganese chemical in April 1990 and of chemical manganese in October 1990.[7]

In April 1989, the U.S. International Trade Commission (ITC) determined that a U.S. industry was materially injured by reason of imports of electrolytic manganese dioxide from Greece and Japan that were being sold at less than fair value. As a result of this ITC ruling, antidumping duty margins were imposed as follows: 77.43% for imports from Mitsui Mining and Smelting Co. Ltd. and 71.91% from Tosoh Corp. of Japan.

Nickel.—Japan remained the world's third largest producer of nickel metal in 1989, but all of its raw material requirements for nickel were met by imports. Because of a stronger demand for nickel by the stainless steel industry, imports of nickel ore, ferronickel, and refined nickel continued to increase in 1989. However, imports of nickel matte decreased slightly because of reduced shipments from Australia and Indonesia.

Imports of nickel ore rose by 17.2% to 3.8 MMmt, a new high since 1980. The principal suppliers in 1989 were New Caledonia, 47%; Indonesia, 31%; and the Philippines, 22%. Consumption of nickel ore by the ferroalloy industry rose by 11.5% to 2.7 MMmt in 1989. Despite a record production of ferronickel since 1980, imports of ferronickel reached 52,073 tons, a record high in 1989. The major suppliers of ferronickel in 1989 were New Caledonia, 25,685 tons; Indonesia, 12,555 tons; the Dominican Republic, 9,639 tons; and Colombia, 3,737 tons. Imports of nickel matte for production of refined nickel and nickel oxide sinter decreased from 58,756 tons in 1988 to 55,768 tons. Of this amount, 64% was from Indonesia, 34% from Australia, and 2% from Taiwan. Production of refined nickel by Sumitomo Metal Mining at its Niihama plant in Ehime Prefecture was near capacity. Because of raw material shortage and permanent shutdown of the Tsuruga plant by Nippon Nickel Co. Ltd., production of nickel oxide decreased in 1989. Nickel oxide sinter produced by Tokyo Nickel Co. Ltd. at its Matsusake plant in Mie Prefecture was equivalent to about 60% of its capacity in 1989.

Because of continued strong demand by the specialty steel, nonferrous alloy, and battery industries, imports of refined nickel rose by 11% to 37,973 tons in 1989. The major suppliers were the U.S.S.R., 34%; Norway, 18%; Zimbabwe, 15%; Canada, 14%; the United Kingdom, 6%; Australia, 5%; and Finland, 3%. In addition, Japan also imported 4,906 tons of nickel powder, foil, and flakes, mainly from the United Kingdom and Canada. Supply and demand for refined nickel, according to MITI, are shown in table 12.

Because of the growing domestic demand for refined nickel by the stainless

TABLE 12

JAPAN: SUPPLY AND DEMAND FOR REFINED NICKEL

(Metric tons)

	1987	1988	1989
Supply:			
Beginning stock	13,653	15,250	11,934
Production	21,397	19,961	21,939
Imports[1]	46,085	39,350	42,934
Total supply	81,135	74,561	76,807
Consumption:			
Specialty steel	39,064	42,526	42,270
Magnetic material	3,266	2,860	2,819
Nonferrous alloy	3,670	3,439	4,000
Rolled sheet	843	773	801
Galvanized sheet	6,046	6,256	5,907
Catalyst	429	437	520
Batteries	2,383	2,896	2,924
Coinage	433	1,222	733
Other	1,784	2,253	2,503
Exports	351	525	112
Total	58,269	63,187	62,589
Ending stock	15,250	11,934	12,315

[1] Includes refined nickel ingots, powder, foil, and flakes.

Source: Ministry of International Trade and Industry of Japan (Tokyo). Yearbook of Mineral and Nonferrous Metals Statistics, 1989, p. 173.

steel industry, Sumitomo Metal Mining announced in September 1989 that it would spend about $6.3 million to expand the capacity of its Niihama plant by 18% to 26,200 mt/yr. The expansion program is expected to be completed by early 1990. A new refining technology developed by Sumitomo Metal Mining reportedly would be adapted at the Niihama plant. According to the company, the newly developed technology processes nickel matte into nickel chloride through chlorine leaching.

To secure a long-term supply of nickel ore for its Hyuga ferronickel plant in Miyazaki Prefecture, an agreement is expected to be concluded by the spring of 1990 for Sumitomo Metal Mining to acquire a 21% stake in Est Ballande of France, which operates a 500,000-mt/yr nickel mine in New Caledonia. Sumitomo Metal Mining reportedly would pay about $22 million to acquire the stake from Banque Indosuez, a subsidiary of Compagnie Financiere de Suez of France.

Rare Earths.—Japan was one of the world's major consumer of rare earths. All of Japan's rare-earth requirements were met by imports. Imports of rare earths grew considerably in 1989 because of increased consumption of cerium oxide for cathode-ray tube, yttrium oxide and europium oxide for fluorescent materials, and neodymium oxide for neodymium-iron-boron magnets. For domestic production of rare-earth products, Japan imported rare-earth ore and concentrate and crude rare earths. Japan also imported rare-earth products to meet its domestic demand.

According to the Ministry of Finance, the import c.i.f. price of cerium oxide jumped from $3.13 per kg in 1988 to $6.57 per kg in 1989 because of increased demand for cerium as a polishing agent for cathode-ray tubes. Imports of rare-earth materials are shown in table 13.

In 1989, imports of bastnaesite were estimated at 1,400 tons, all from the United States. Imports of crude rare earths were mainly from Malaysia, 625 tons; Brazil, 577 tons; the United States, 545 tons; and China, 271 tons. The major suppliers of rare-earth products were the United States (374 tons), France (139 tons), the U.S.S.R. (115 tons), and China (65 tons) for cerium oxide; France (216 tons), the U.S.S.R. (21 tons) and China (19 tons) for lanthanum oxide; China (242 tons) and Brazil (69 tons) for rare-earth metals; China (3,282 tons), Malaysia (485 tons), France (474 tons), the U.S.S.R. (232 tons), the United States (183 tons), and Canada (102 tons) for rare-earth compounds; and China (718 tons) and France (47 tons) for yttrium oxide.

Domestic production of rare-earth products reached a record high in 1989. Rare-earth products were produced by Santoku Metal Industry Co. Ltd. in Hyogo, Nippon Yttrium Co. Lt. in Tokyo, Nissan Rare Earth Chemicals Co. Ltd. in Saitama, Seimi Chemical Co. Ltd. in Kanagawa, Shin-Etsu Chemical Industry Ltd. in Fukui,

TABLE 13

JAPAN: IMPORTS OF RARE-EARTH RAW MATERIALS AND PRODUCTS

(Metric tons)

	1987	1988	1989
Bastnaesite ore and concentrate	1,800	1,650	[e]1,400
Crude rare earths	3,751	5,254	2,294
Rare-earth products:			
Cerium oxide	258	481	704
Lanthanum oxide	102	196	258
Yttrium oxide	391	688	776
Other rare-earth compounds	4,430	5,328	4,863
Rare-earth metals	278	468	337

[e] Estimated.

Source: Ministry of Finance of Japan (Tokyo). The Rare Metal News (Tokyo), Industrial Rare Metals, No. 101, Annual Review, 1990, p. 77.

Tokoku Metals & Chemicals Co. Ltd. in Fukushima, Mitsui Metal & Mining Co. Ltd. in Fukuoka, Nippon Rare Earths Co. Ltd. in Ehime, and Mitsubishi Chemical Industries Ltd. in Malaysia and Norway.

According to the Japan Society of Newer Metals, consumption of rare-earth products is shown in table 14.

In Japan, cerium oxide was used mainly as a polishing agent for television tube glass, plate glass, and optical glass; decoloring of television tube glass; and as a catalyst for automobile exhaust gas control. Lanthanum oxide was used as an additive to optical lens and ceramic condensors and also as a catalyst for automobile exhaust gas control. Samarium oxide was used for the manufacture of magnetic materials for computer printers and monitors. Europium oxide and yttrium oxide were used as red phosphor in the manufacture of color television and tricolor fluorescent lamps. Misch metal was used for the manufacture of automobile parts and lighter.

Titanium.—Japan remained the world's third largest producer of titanium sponge metal and one of the major producers of titanium dioxide pigment. However, the country's titanium and titania producers were wholly dependent on imported raw materials. The sponge was produced from imported rutile and from synthetic rutile that was in turn produced from a portion of other imported titaniferous materials. Japan has annually imported about 21,000 tons of rutile grading about 96% TiO_2 from Australia. Other 1989 titanium raw material imports included 616,090 tons of ilmenite principally from Malaysia (239,491 tons) and Australia (173,278 tons), and 107,245 tons of titanium slag principally from South Africa (96,525 tons). The ilmenite was consumed principally in the manufacture of titanium dioxide for pigments and in the production of synthetic rutile; a small amount reportedly was used as a blast furnace additive in the steel industry.

To secure long-term supply for the growing demand for rutile and ilmenite, Nissho Iwai Corp., a major Japanese trading company, purchased two rutile and zirconium mining operations from Pioneer International Ltd. of Australia for about $185 million in December 1989. The RZ Mines Group near Newcastle in New South Wales and the Cable Sands Group near Bunbury in Western Australia have a combined production of 28,000 mt/yr of rutile, 260,000 mt/yr of ilmenite, and 50,000 mt/yr of zirconium. In a separate agreement, Nissho Iwai planned to finance a $3 million feasibility study to build a 100,000-mt/yr titanium slag plant near an ilmenite deposit at Westport on New Zealand's South Island. The feasibility study is expected to be completed by May 1990.[8]

Production of titanium sponge metal by Osaka Titanium Co. Ltd., Toho Titanium Co. Ltd., and Showa Titanium Co. Ltd. increased considerably because of a stronger demand in the domestic and oversea markets in 1989. The Japan Titanium Society expected titanium sponge metal production to increase by 19% to 25,300 tons in 1990 if the rutile requirements from overseas sources could be secured. This increased level of titanium sponge production included 12,600 tons for Osaka Titanium, 10,200 tons for Toho Titanium, and 2,500 tons for Showa Titanium.[9]

According to the society, total shipments of titanium sponge metal rose 19% to 22,088 tons, of which 16,166 tons was for the domestic market and 5,922 tons for exports. Both Osaka Titanium and Toho Titanium reported record sales and profits in 1989 stemming from increases in demand by the aircraft, chemical, and power generating machinery industries.

Exports of titanium metal totaled 5,922 tons in 1989, of which 2,796 tons went to the United Kingdom, 1,354 tons to France, 901 tons to the United States, 513 tons to the Federal Republic of Germany, 306 tons to the Netherlands, and the remainder to other countries. Japan also exported 2,633 tons of titanium scrap and powder principally to the United States (1,872 tons) and the Federal Republic of Germany (132 tons).

In December, Toho Titanium announced that it had reached an agreement with Titanium Metals Corp. of America (Timet) to jointly build a 10,000-mt/yr titanium sponge plant in Henderson, Nevada. According to the agreement, Toho Titanium is to provide the vacuum-distillation technology and, jointly with Nippon Mining, Mitsui & Co., and Mitsui U.S.A., provide about $73 million to finance the plant. After the plant is completed in 1991, Toho will have the option to acquire 25% of Timet's stock and has a right to take up to 2,700 mt/yr of the sponge metal production. The joint-venture project reportedly will improve Timet's production technology and allow Toho Titanium to meet the anticipated future requirements for its customers.[10]

TABLE 14

JAPAN: CONSUMPTION OF RARE EARTHS AND YTTRIUM

(Metric tons)

	1987	1988	1989
Cerium oxide	3,150	3,100	3,300
Europium oxide	10	11	11
Lanthanum oxide	380	400	420
Misch metal	250	230	230
Neodymium oxide	(1)	(1)	550
Rare-earth fluorides	60	50	(2)
Samarium oxide:[3]	350	370	365
Yttrium oxide	240	270	280
Other rare earths	[4]450	[4]610	[5]120
Total	4,890	5,041	5,276

[1] Included in "Other rare earths."
[2] Included in "Other rare earths."
[3] Includes recycled scrap.
[4] Includes gadolinium oxide, neodymium oxide, praseodymium, and terbium.
[5] Includes gadolinium oxide, praseodymium, terbium, and rare-earth fluorides.

Source: Japan Society of Newer Metals (Tokyo). The Rare Metal News (Tokyo). Industrial Rare Metals, No. 101, Annual Review, 1990, p. 75.

For production of titanium dioxide pigment and synthetic rutile, Japan consumed about 616,000 tons of ilmenite and about 107,000 tons of titanium slag in 1989. Production of titanium dioxide pigment reached a record high in 1989 because of the continued growth in demand by the manufacturers of paint, printing ink, synthetic resin, and paper. According to the 1990 Annual Review of Rare Metal News of Japan, the capacity of the titanium dioxide industry expanded by 7.3% to 313,400 mt/yr in 1989. The capacity by company at the end of 1989 is as follows: Ishihara Sangy Co. Ltd., 146,400 mt/yr; Teika Co. Ltd. (formerly Tekoku Kako Co. Ltd.), 50,400 mt/yr; Sakai Chemical Industry Co. Ltd., 43,200 mt/yr; Furukawa Mining Co. Ltd., 21,600 mt/yr; Tohkem Products (formerly Tohoku Chemical Industry Co. Ltd.), 18,800 mt/yr; Titan Kogyo Co. Ltd., 16,800 mt/yr; and Fuji Titanium Industry Co. Ltd., 16,200 mt/yr.[11]

Supply and demand for titanium dioxide, as reported by the Japan Titanium Dioxide Industry Association, is shown in table 15.

Tungsten.—Mine production of tungsten ore and concentrate increased slightly because of improved market conditions in 1989. Two scheelite mines, the Kiwada Mine and the Kuga Mine in Yamaguchi Prefecture, reportedly produced 409 tons and 56 tons of tungsten concentrate, respectively, in 1989. Japan's import reliance of tungsten was about 83% in 1989.

To meet domestic requirements for tungsten, Japan imported 2,316 tons of tungsten concentrate, mainly from Portugal at 939 tons; China, 626 tons; Australia, 328 tons; Peru, 202 tons; and Bolivia, 102 tons. Consumption of tungsten concentrate dropped by 22% to 2,564 tons because of reduced demand by the manufacturer of tungsten metal and ferrotungsten. However, to meet overall demand for ferrotungsten and intermediate tungsten metal products by the specialty steel and ultrahard alloys producers, Japan imported 735 tons of ferrotungsten mainly from China and Austria and 4,482 tons of intermediate tungsten metal products mainly from China and the Republic of Korea.

Vanadium.—Vanadium pentoxide recovered by Taiyo Mining and Industry Co. Ltd. and Shinko Chemical Co. Ltd. from petroleum residues, ashes, and spent catalysts was about 1,000 tons in 1989. Because of reduced demand by the producers of ferrovanadium and specialty steel, imports of vanadium pentoxide declined by 19% to 4,312 tons, and imports of ferrovanadium also declined sharply from 595 tons in 1988 to 235 tons in 1989. The principal suppliers were the Republic of South Africa (3,992 tons) and China (224 tons) for vanadium pentoxide, and the Federal Republic of Germany (100 tons) and Belgium (51 tons) for ferrovanadium in 1989. Consumption of ferrovanadium declined to 3,343 tons from 4,053 tons in 1988 because of reduced consumption by the producers of high-strength steel and structural alloy steel in 1989.

TABLE 15

JAPAN: SUPPLY AND DEMAND FOR TITANIUM DIOXIDE

(Metric tons)

Item	1987	1988	1989
Production	239,401	259,875	283,184
Imports	45,677	45,953	67,906
Domestic consumption:			
Ceramic condensers	2,528	2,810	2,658
Chemical fibers	4,717	4,704	4,697
Paint	89,604	99,622	108,409
Paper	13,147	15,915	18,310
Printing ink	30,070	34,858	38,477
Rubber	3,833	3,848	3,694
Synthetic resin	15,138	16,868	19,173
Other	14,400	19,488	17,954
Exports	66,727	62,265	62,857
Producer stocks	9,836	9,333	16,288

Source: Japan Titanium Dioxide Industry Association (Tokyo). The Rare Metal News, No. 1562, Sept. 16, 1990, p. 5.

Industrial Minerals

Cement.—Japan remained the world's third largest cement producer in 1989. Because of the continued growth in demand by the construction industry and increased exports, the output of cement reached its highest level since 1983. As a result, both sales and profits of the industry improved considerably in 1989. Despite the improved financial conditions with less pressure from imports in 1989, the industry continued its third restructuring program to increase productivity and to diversify into ceramics production, real estate development, and food processing.

According to MITI, Japan's annual cement clinker capacity was reduced from 97.6 MMmt in 1987 to 94 MMmt in 1988 and 91.3 MMmt in 1989. The industry's capacity utilization rose from 77.7% in 1987 to 88.4% in 1989. Consumption of raw materials for cement production in 1989 included 84 MMmt of limestone, 18 MMmt of clay, 4 MMmt of silica stone, 4 MMmt of ore slag, and 3 MMmt of gypsum. The industry's employment was reduced to 7,127 from 7,624 in 1988. According to the Cement Association of Japan, energy consumption per ton of cement had dropped to below 900 thousand kilocalories in 1989 from 1 million kilocalories in 1985.

Domestic consumption of cement rose to 75 MMmt from 74 MMmt in 1988, and exports of cement, including clinker, increased to 6.6 MMmt from 5.0 MMmt in 1988. Of total domestic demand for cement, 70% was for the ready-mixed concrete, 15% for cement products, 3% for civil engineering works, 2% for public and private buildings, 1% for construction of roads and ports, and 9% for other uses.

Exports of clinker rose from 1.6 MMmt in 1988 to 2.2 MMmt in 1989, of which 1.4 MMmt went to Hong Kong. Exports of portland cement rose from 3.4 MMmt in 1988 to 4.4 MMmt in 1989. The major buyers of portland cement in 1989 were the United States, 2.1 MMmt; Hong Kong, 1.4 MMmt; and Singapore, 513,000 tons. Imports of portland cement grew slightly from 3.6 MMmt in 1988 to 3.7 MMmt, of which 2 MMmt was from the Republic of Korea and 1.6 MMmt from Taiwan. Average import c.i.f. price from the Republic of Korea and Taiwan was $46.59 per ton and $46.55 per ton, respectively, in 1989.

To expand its overseas cement production and take advantage of lower labor cost, in December 1989, Onoda Cement Co. Ltd., Japan's second largest cement producer, began construction of a 1.2-MMmt/yr cement clinker plant in Darien, northeast China. According to the Japan-China joint-venture agreement signed in April 1989, the $146 million plant was to be completed by 1992. The joint-venture firm is owned by Onoda Cement (41%) and Mitsui & Co. (10%) of Japan and the China Huaneng Raw Materials Corp.(40%) and Darien City Cement Factory (9%) of China.

In late December, Toyo Menka Kaisha Ltd., a major Japanese trading company, reportedly was negotiating with a Polish cement company to established a Japan-Poland joint-venture firm to manufacture cement in Poland. According to a Japanese local press report, construction of the 2-MMmt/yr cement plant in Szczecin near the East German border is expected to begin in 1991. Financing of the joint-venture cement project will be by the International Finance Corp., a subsidiary of the World Bank; Toyo Menka and Onoda Cement of Japan; a Polish cement manufacturer; and the Industrial Development Foundation of Poland.

Diamond.—Sumitomo Electric Industries Ltd., which had successfully mass produced synthetic diamond of 1.2 carats in weight measuring 6 millimeters in diameter in 1985, reportedly began mass production and marketing of synthetic single-crystal diamond weighing 5 to 9 carats and measuring up to 1 centimeter in diameter in 1989. These large-size synthetic single-crystal stones were marketed for industrial use as a bonding tool used for mounting semiconductors and as heat sinks for semiconductor devices, among other uses.

Asahi Diamond Industrial Co. Ltd., Japan's largest manufacturer of diamond-tipped tools, reportedly agreed to develop jointly with General Electric Co. of the United States a new technology for producing synthetic diamond in the United States. The joint-venture firm, Genasystems Inc., was 60% owned by General Electric and 40% by Asahi Diamond. It will use chemical vapor deposition method to manufacture the synthetic diamond for tools and parts.[12]

Limestone.—Japan is self-sufficient in limestone. Its annual output ranks the third largest in the world following China and the U.S.S.R. Because of the continued growth in demand by the cement and construction industries, production of limestone broke the previous record level of 185 MMmt in 1980 and reached a new record of 191 MMmt in 1989. According to MITI, the number of operating limestone quarries increased from 301 in 1987 to 320 in 1989. However, the number of industry employees decreased from 9,796 in 1987 to 9,545 in 1989. The leading producers in 1989 were Mitsubishi Mining & Cement Co. Ltd., Nihon Cement Co. Ltd., Nittetsu Mining Co. Ltd., Onoda Cement Co. Ltd., Sumitomo Cement Co. Ltd., Todaka Mining Co. Ltd., and Ube Industries Ltd.

Consumption of limestone rose by 6% to 195 MMmt in 1989 following a robust 12% growth in 1988. Of total demand for limestone in 1989, 45% was for cement production, 29% for construction materials and aggregate, 11% for iron and steel making, 6% for production of lime, and 9% for other uses.

Limestone proven ore reserves, according to the Agency of Natural Resources and Energy of MITI, were 11.9 billion tons, averaging 53.8% calcium oxide (CaO). In addition, there was 9.4 billion tons of probable reserves averaging 54.0% CaO and 40.4 billion tons of possible reserves averaging 53.4% CaO.

Salt.—Japan remained the world's largest importer of salt. Domestic salt production of about 1.4 MMmt was sufficient to meet the nonindustrial use in the domestic market. However, Japan is 100% dependent on imports to meet its industrial salt requirements for the caustic soda and chlorine industries.

Because of the continued strong demand for industrial salt by the caustic soda and chlorine industries, imports of salt rose by 7% to 7.7 MMmt, a record high, in 1989. Australia and Mexico remained the principal suppliers, providing 4.1 MMmt and 3.5 MMmt, respectively, in 1989. The average import c.i.f. price was $27.12 per ton from Australia and $27.25 per ton from Mexico in 1989. Exportadora de Sal of Mexico and Dampier Salt Pty. Ltd. of Australia were the two major supplying companies. Imports of salt from China had dropped to about 30,000 tons in 1989 from 700,000 tons in 1986 because of increased demand for salt by the Chinese caustic soda industry and damp weather conditions in China.

Silica Stone and Sand.—Japan is self-sufficient in silica stone, but relied on imports to meet about 28% of its requirement for silica sand in 1989. Silica stone was produced mainly from the Prefectures of Hyogo and Kyoto, and silica sand from the Prefectures of Aichi and Gifu. There were many smaller silica stone and silica sand mining operations in the Prefectures of Fukuoka, Fukushima, Shimane, and Yamaguchi in 1989. The major producers were Fujii Mining Co. Ltd., Tokai Industries Ltd., Toyu Industries Ltd., and Tokuyama Industries Ltd. for silica stone and Tokai Ceramics Raw Material Co. Ltd., Hotaku Mining Co. Ltd., Tokai Industries Ltd., and Yamakawa Sangyo Co. Ltd. for silica sand.

Because of increased demand by the cement, construction, iron and steel, and glass industries, production of both silica stone and silica sand reached a 9-year high in 1989. To meet domestic demand, Japan imported 1.7 MMmt of silica sand, principally from Australia (82%) and Malaysia (17%), in 1989. About 58% of silica stone in Japan was used as aggregate for road and other civil engineering works in 1989. Other uses were as raw material by the cement industry (25%) and the iron and steel industry (5%). Most silica sand was used as raw material by the glass and soda industries (56%) and as molding sand by the foundry industry (23%).

Mineral Fuels

Coal.—Japan's coal production dropped by 1 MMmt to 10.2 MMmt in 1989 because of reduced coal production from the Horonai Mine in Hokkaido and the Miike Mine in Kyushu. In line with the Eighth National Coal Policy, the Horonai Mine was finally shut down permanently by the Hokutan Horonai Coal Mining Co. Ltd. after 120 years of operations. All 1,090 miners at the Horonai Mine were dismissed at the end of September 1989. The mine produced 1.1 MMmt of coal in 1988 and about 0.9 MMmt in 1989. To continue streamlining its coal operation, Mitsui Coal Mining Co. Ltd. discharged 700 miners from its work force and cut output of its Miike Mine by 19% to 2.5 MMmt in 1989. The total number of operating coal mines have been reduced from 24 in 1988 to 22; of those, 7 were large-scale collieries.

In 1989, the output of anthracite coal was reduced by 14% to 7,935 tons, that of coking quality bituminous coal by 17% to 857,249 tons, and that of bituminous (steam) coal by 8% to 9,322,125 tons. Of the total coal produced in 1989, 63% was from the Hokkaido area and 37% from the Kyushu and Honshu areas. The average heating value of all coal mined in Japan declined to 5,920 kilocalories per kilogram from 5,970 kilocalories per kilogram in 1988. The industry's employment declined by 1,982 to 5,730 at the end of 1989. However, the industry's labor productivity, as measured by tons per month per miner, rose to 124 from 113 in 1988.

Despite a slight decline in domestic demand for coal, Japan continued to import coal at a high level in 1989 because of reduced domestic coal production. Coal imports in 1989 totaled 101.5 MMmt, including 68.7 MMmt of coking coal, 31.1 MMmt of other bituminous (steam) coal, and 1.7 MMmt of anthracite. The total of coal imports was equivalent to about 18% of Japan's primary energy supply in 1989. Japan's coal imports by source are shown in table 16.

Overall consumption of coal dropped slightly from that of 1988 mainly because of reduced demand by the iron and steel industry. According to MITI, coal consumption by sector is shown in table 17.

TABLE 16

JAPAN: COAL IMPORTS IN 1989, BY SOURCE

(Thousand metric tons)

Source	Anthracite	Bituminous: Coking	Bituminous: Steam
Australia	179	30,003	21,939
Canada	—	17,721	1,318
China	409	1,163	2,414
Colombia	—	198	—
Indonesia	—	91	324
Korea, North	456	—	—
New Zealand	—	347	—
South Africa, Republic of	187	3,532	1,234
U.S.S.R.	353	5,499	2,165
United States	—	10,137	1,727
Vietnam	108	—	—
Other	—	—	5
Total	1,692	68,691	31,126

Source: Ministry of International Trade and Industry of Japan (Tokyo). Yearbook of Production Supply and Demand of Petroleum, Coal, and Coke, 1989, pp. 154-157.

Petroleum and Natural Gas.—Japan was the largest importer of natural gas and crude petroleum in the world. Its domestic production of natural gas and crude petroleum was negligible when compared with its huge consumption of crude petroleum, refined petroleum products, and LNG. Production of crude petroleum and natural gas in 1989 was equivalent to just 0.3% and 4.0%, respectively, of Japan's requirements.

Because of the continued boom in the Japanese economy and a relatively low and stable price of crude petroleum, demand for crude petroleum and natural gas rose 6% to 1,158.6 million barrels and 7% to 49.3 billion cubic meters, respectively, in 1989. To meet a higher demand, imports of crude petroleum rose by 8.2% to 1,318.9 million barrels; imports of natural gas, in the form of LNG, rose by 7.9% to 47.1 billion cubic meters; and imports of refined petroleum products, which included diesel, gasoline, heavy fuel oil, jet fuel, kerosene, and naphtha, rose by 5.2%, reaching a record high of 320.4 million barrels. Imports of crude petroleum and refined petroleum products and LNG represented about 57% and 10%, respectively, of Japan's primary energy supply in 1989.

Crude petroleum imports came mainly from the Middle East region (71%) and Asia (24%). In 1989, the main supplying countries of crude petroleum were the United Arab Emirates, 20%; Indonesia and Saudi Arabia, 13% each; Iran, 8%; China and Oman, 7% each; and Iraq and Qatar, 6%, each. LNG imports came mainly from Indonesia, 52%; Malaysia, 20%; Brunei, 16%; the United Arab Emirates, 7%; and the United States, 3%.

The main supplying countries of refined petroleum products were Saudi Arabia, 23%; Kuwait and Singapore, 14% each; the United Arab Emirates, 9%; and China, the Republic of Korea, and the United States, 4% each.

To reduce the tax burden on the oil industry that resulted from imposition of a 3% consumption tax beginning in April 1989, the Ministry of Finance reduced the import tariff on crude petroleum by 34% from 530 yen per kiloliter or $0.62 per barrel to 350 yen per kiloliter or $0.41 per barrel, effective April 1, 1989. The import tariffs on refined petroleum products were also reduced, ranging from a 9% cut on imports of kerosene to 26% cut on C-grade heavy fuel oil. According to the Petroleum Association of Japan, the revenues generated from import tariffs on crude petroleum and refined petroleum products totaled about $74 million, and from petroleum tax, $3.2 billion in fiscal year 1989. Of the total revenues from these two sources, about 23% was used for subsidies to the coal industry's restructuring programs, 53% for subsidies to Government and private oil stockpiles, and the remainder for subsidies to oil exploration and development as well as for revitalization of the oil industry.

In line with the Government indus-

TABLE 17

JAPAN: COAL CONSUMPTION, BY SECTOR

(Thousand metric tons)

Sector	1988	1989
Manufacturing:		
Cement, ceramics, and other	16,319	17,599
of which:		
Domestic	764	491
Imported	15,555	17,108
Coke	5,293	5,106
of which:		
Domestic	271	187
Imported	5,022	4,919
Iron and steel	66,448	64,306
of which:		
Domestic	781	658
Imported	65,667	63,648
Utilities:		
Electric power	23,917	24,527
of which:		
Domestic	9,537	9,326
Imported	14,380	15,201
Gas	869	841
of which:		
Domestic	290	214
Imported	579	627
Other:	1,198	908
of which:		
Domestic	1,164	884
Imported	34	24
Total consumption	114,044	113,287
of which:		
Domestic	12,807	11,760
Imported	101,237	101,527

Source: Ministry of International Trade and Industry of Japan (Tokyo). Energy Production and Demand Monthly Statistics, Apr. 1990, pp. 12-13.

trial policy to promote energy security and improve the industry's international competitiveness, Japan's oil industry is to scrap facilities with refining (atmospheric and vacuum distillation) capacity of 550,000 barrels per day by 1993, reducing total capacity to about 4 million barrels per day. According to MITI, the capacity utilization of the oil refining industry rose to 69.2% from 64.7% in 1988. At the end of 1989, Japan's crude oil distillation capacity stood at 4,551,610 barrels per day.

Since the 1986 import liberalization of refined petroleum products, the Japanese oil refiners have been helping the Republic of Korea, Taiwan, and some members of the Association of Southeast Asian Nations (ASEAN) to process increasing volume of their crude petroleum using Japan's excess refining capacities. According to Japan's local press reports, the processed volume had grown to 14.5 million barrels in 1989 from 8.2 million barrels in 1986. About two-thirds of the volume reportedly was processed by Idemitsu Kosan Co. Ltd. and General Sekiyu K.K. at their refining facilities in Okinawa Prefecture. Because of insufficient secondary processing facilities and growing demand for refined petroleum products in China, the Republic of Korea, Taiwan, and ASEAN countries, the Japanese refiners were asked by these countries to process their crude petroleum to produce gasoline, kerosene, diesel fuel, and heavy fuel oil.

Reserves

Japan's reserves for limestone and some other industrial minerals, notably iodine, pyrophyllite, and silica stone, are large and of world significance, but its ore reserves for other major minerals, especially for oil and gas, and metallic minerals except for gold and zinc are negligible. According to MITI, ore reserves of major minerals are as shown in table 18.

INFRASTRUCTURE

Japan has one of the world's most modern and complete infrastructures for its mining and mineral processing industry. Despite its small land area, Japan has a highway system of 1.1 million km, of which 65% is paved, and a railroad network of 27,327 km, of which 93% is 1.067-meter narrow gauge. Both highway and railroad networks link not only all major seaports and coastal cities on four major islands but also connect Honshu (main island) to the islands of Shikoku and Kyushu in the south and Hokkaido in the north

TABLE 18

JAPAN: RESERVES OF MAJOR MINERALS

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Coal		7,000,000
Copper ore, elemental content		316
Dolomite[1]		989,012
Gold ore, elemental content	kilograms	558,000
Iodine		[e]1,800
Lead ore, elemental content		660
Limestone[2]		61,675,776
Pyrophyllite		143,611
Silica stone[3]		1,065,661
Silica sand[4]		361,337
Zinc ore, elemental content		3,457

[e] Estimated.
[1] Average ore grade is 17.8% MgO.
[2] Average ore grade is 53.5% CaO.
[3] Average ore grade is 90.0% SiO_2.
[4] Average ore grade is 72.4% SiO_2.

Sources: Ministry of International Trade and Industry: Agency of Resources and Energy.

via bridges or tunnels. Japan's domestic and international telecommunication services are among the best in the world with four satellite earth stations as well as submarine cables to China, the Philippines, the U.S.S.R., and the United States. For electric power transmission and distribution, Japan has a route length of 84,400 km and a circuit length of 144,000 km concentrating in the major industrial areas of Fukuoka, Hiroshima, Nagoya, Osaka, Takamatsu, Toyama, and Tokyo. Japan also has an extensive pipeline system that includes 1,800 km for natural gas, 84 km for crude petroleum, and 322 km for refined petroleum products.

Japan has 18 major ports and more than 2,000 minor ports for receiving raw materials from overseas and exporting manufactured products. The major port facilities, including terminal and warehouse, are among the most indispensable infrastructure for the mineral industry because of their role in receiving imported raw materials, such as coal, iron ore, nonferrous ore, crude petroleum, and LNG, for mineral processing plants and powerplants as well as for their role in exporting value added mineral and metal products. The major seaports of major mineral processing centers are Chiba, Hachinohe, Hiroshima, Kawasaki, Kobe, Osaka, Nagoya, Niigata, Shimizu, Shimonoseki, Tokyo, Toyama, and Yokohama in Honshu; Fukuoka, Kita Kyushu, and Oita in Kyushu; and Muroran and Tomakomai in Hokkaido.

OUTLOOK

The mining sector is expected to continue its 1989 downward trend because of the continuing decline in output of nonferrous minerals and mineral fuels, despite the anticipated increase in output of industrial minerals. According to Japan's Mining Industry Association, mine production of copper, lead, and zinc is expected to decrease because of the continuing streamlining of operations at the remaining six major nonferrous mines in the Prefectures of Akita, Aomori, Gifu, Hokkaido, and Iwate. Coal output is expected to drop to less than 10 MMmt in 1990 because of an announced shutdown of the Minami Oyubari Mine in Hokkaido by Mitsubishi Coal Mining Co. Ltd. According to the Limestone Association of Japan, mine production of limestone and silica stone, along with most other industrial minerals, is expected to increase slightly because of the expected strong demand by the construction industry.

Outlook for the mineral processing sector, however, is brighter than that of the mining sector. Because of the continuing expansion of the Japanese economy, most ferrous and nonferrous mineral processing plants are expected to operate at the slightly higher rate than that of 1989. According to the Japan Iron and Steel Federation, production of crude steel is expected to reach between 108 MMmt and 109 MMmt in 1990 because of the continued strong demand by the domestic automobile and construction industries. Production of most nonferrous metals, such as cadmium, copper, gold, magnesium, nickel, rare-earth oxide, titanium sponge, and zinc, is expected to increase in 1990 because of the growing domestic and overseas demand for these metals. Production of cement is expected to remain at the high level of 79 MMmt to 80 MMmt in the next 2 years because of the booming construction industry and increasing exports to the United States and Hong Kong.

Because of decreasing domestic mine production of nonfuel minerals and mineral fuels and because of the continuing growth in the Japanese economy, imports of minerals and metals are expected to increase in the next 2 years. In line with its mineral policy to secure and diversify its long-term supply of raw materials for a steady economic growth, Japan is expected to continue to actively participate in joint exploration and development of minerals in both developed and developing countries. These countries included Australia, Brazil, Canada, Chile, China, Peru, Mexico, Mongolia, and the United States for base metals and rare metals. The so called rare metals included antimony, columbium, lithium, molybdenum, nickel, rare earths, strontium, tantalum, titanium, tungsten, and vanadium.

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[1] Where appropriate, values have been converted from Japanese yen (Y) to U.S. dollars at the rate of Y137.96=US$1.00 in 1989.

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[3] Metal Bulletin (London). No. 7451, Jan. 22, 1990, p. 7.

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[6] The Rare Metal News (Tokyo). No. 1540, Apr. 1, 1990, p. 2.

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Chiyoda-ku
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1-24-14 Toranomon
Minato-ku
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1-1-3 Higashi
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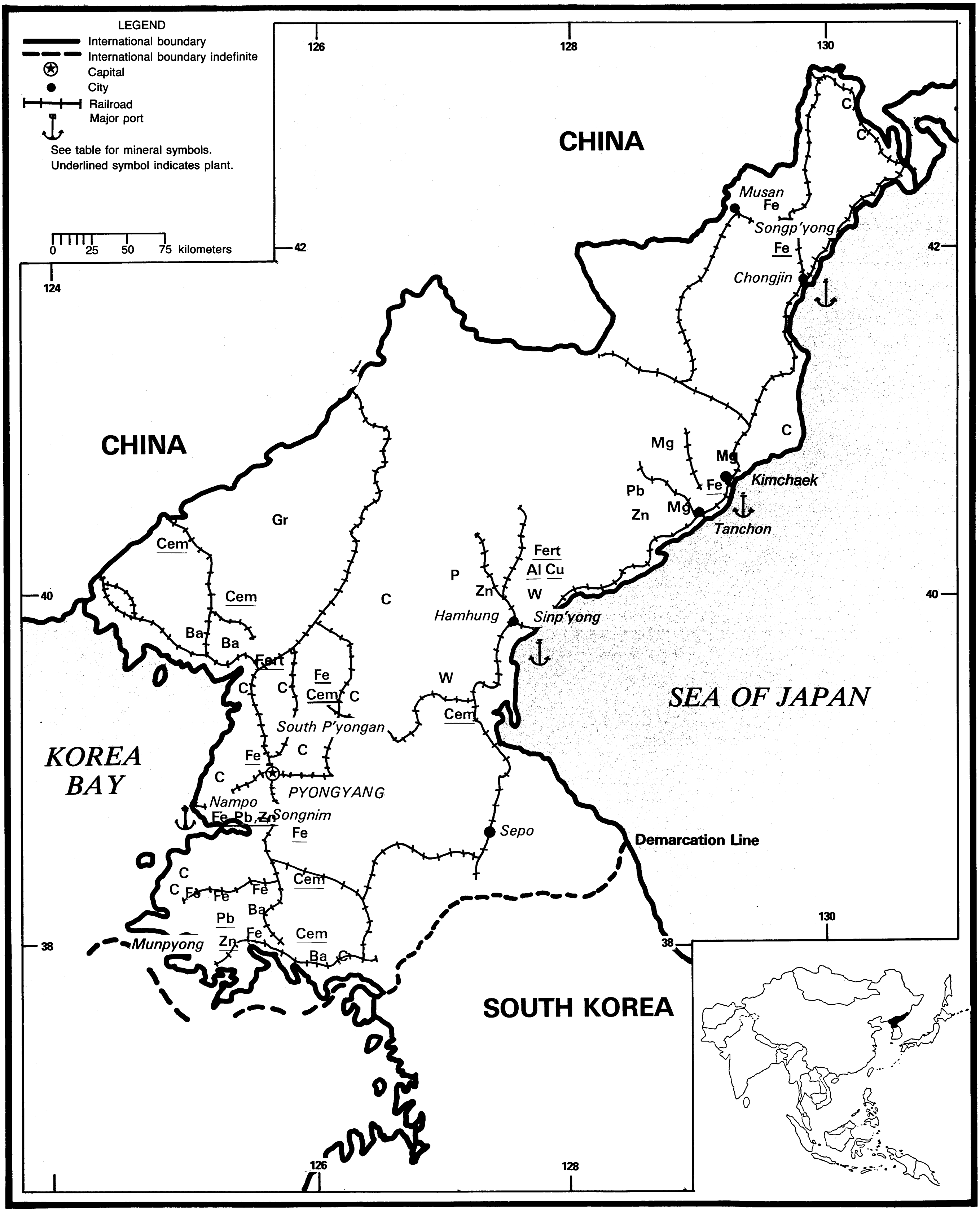
NORTH KOREA

AREA 120,540 km² **POPULATION 21.3 million**



THE MINERAL INDUSTRY OF

NORTH KOREA

By Chin S. Kuo

North Korea's economy in general has been stagnant; the 1989 economic growth was estimated at 2% compared with 5.1% for that of 1988. All significant economic activities were subject to stringent Government controls. The development of the country's mineral resources and basic industries was given high priority. The mineral industry was performing better than any other sector in the economy during the year. Driven by the ideology of self-reliance, the Government strived to increase mineral production for domestic consumption as well as for export, the latter to earn foreign exchange in such commodities as anthracite coal, graphite, magnesite, talc, and tungsten. On the other hand, the country had to import equipment, technology, and other mineral commodities such as aluminum, chromium, and petroleum. In 1989, North Korea's trade position worsened, and the country's external debts reached an estimated $4 to $6 billion.[1] The country has more than $250 million worth of loans outstanding to Japan.

Agreements with China covering the construction of hydroelectric powerplants on the Yalu and a joint-venture hotel in Pyongyang were signed in late 1988. Under mutual aid programs, North Korea delivered finished and semifinished goods to the U.S.S.R.

PRODUCTION

The major minerals and metals produced in North Korea were anthracite coal, graphite, iron ore, lead, magnesite, steel, tungsten, and zinc. The level of output for each commodity remained about the same as last year, with only cement, coal, copper, graphite, and steel showing moderate increases in production.

TRADE

North Korea's trade with the U.S.S.R., its principal trading partner, included exports of steel, light industrial products, foodstuffs, and machinery and imports of sophisticated machinery and chemicals, as well as whole-plant manufacturing facilities.

Japan was North Korea's third largest trading partner after the U.S.S.R. and China, with bilateral trade totaling $287 million. North Korea imported machinery worth $114 million from Japan and exported food, minerals, and textiles worth $173 million to Japan.

Under a mutual trade agreement, Albania was to export chrome ore, copper wire, and rolled copper in return for North Korean magnesite and tinplate. The country also has an agreement to provide equipment, spare parts, and technical assistance to help rehabilitate Uganda's Kilembe copper mine and in return receive an unspecified amount of copper from the mine. Iran increased its annual oil exports to North Korea to 2 million tons (about 14.6 million barrels) and assisted the country's efforts in prospecting for oil offshore in exchange for raw materials and metals.

STRUCTURE OF THE MINERAL INDUSTRY

North Korea is a centrally planned economy country. Virtually all industrial enterprises are either state-owned and state-run or operated as cooperatives. They accounted for 95% of the country's industrial output. Ministries and ministerial-level committees have jurisdiction over the mining, metallurgical, and energy establishments.

The country had an estimated work force of 6 to 8 million, of which 48% was engaged in agricultural production and the remainder in mining and manufacturing operations, services, and other industrial production. The labor force was largely unskilled and undereducated.

COMMODITY REVIEW

Metals

Copper.—The nonferrous metal complex at Hungnam smelted local concentrates from the lead and zinc mine at Komdok in addition to producing blister copper from concentrates imported from Mexico. The country's refined copper production capacity was about 35,000 tons per year, and output was estimated at this level. Of this, only one-half was needed for domestic consumption, and the rest was exported to earn foreign exchange.

Iron and Steel.—Most ironworks and steelworks were under the jurisdiction of the Ministry of Metal Industry. Iron ore production increased substantially at the Tokhyon Mine and the Chaeryong Mine. The construction of the No. 3 dressing plant at the Musan mining complex was underway to double the processing capacity of the complex. The capacity of the complex was recently expanded from 5.5 million tons to 6.5 million tons per year. Further expansion at the complex was to increase iron ore production capacity to 10 million tons in 1990 and 15 million tons in the future for Musan.

Both the Chollima steel complex and the Kimchaek iron and steel complex increased rolled steel output during the year. At the Chollima steel complex, it was planned to raise the production capacity of crude steel to 2 million tons per year. As a part of the project, a thermal powerplant was to be built.

TABLE 1

NORTH KOREA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989
METALS						
Aluminum metal ingot, primary		10,000	10,000	10,000	10,000	10,000
Cadmium metal, smelter		100	100	100	100	100
Copper:						
Mine output, Cu content		[r]10,000	[r]10,000	[r]12,000	[r]12,000	12,000
Metal:						
Smelter:						
Primary		23,000	15,000	25,000	24,000	25,000
Secondary		5,000	5,000	5,000	5,000	5,000
Total		[r]28,000	[r]20,000	[r]30,000	[r]29,000	30,000
Refined:						
Primary		23,000	24,000	25,000	24,000	25,000
Secondary		10,000	10,000	10,000	10,000	10,000
Total		[r]33,000	[r]34,000	[r]35,000	[r]34,000	35,000
Gold, mine output, Au content	kilograms	5,000	5,000	5,000	5,000	5,000
Iron and steel:						
Iron ore and concentrate, marketable:						
Gross weight	thousand tons	8,000	8,500	8,500	9,000	9,500
Fe content	do.	[r]3,600	4,000	4,000	4,200	4,400
Metal:						
Pig iron	do.	[r]5,750	[r]6,500	[r]6,500	6,500	6,500
Ferroalloys, furnace type unspecified	do.	120	120	120	120	120
Steel, crude	do.	6,500	[r]6,600	[r]6,700	6,800	7,300
Lead:						
Mine output, Pb content		[r]80,000	[r]85,000	[r]90,000	[r]90,000	80,000
Metal:						
Smelter, primary only		[r]60,000	[r]60,000	[r]64,000	[r]64,000	65,000
Refined:						
Primary		60,000	60,000	64,000	64,000	70,000
Secondary		5,000	5,000	6,000	6,000	5,000
Total		[r]65,000	[r]65,000	[r]70,000	[r]70,000	75,000
Silver, mine output, Ag content	kilograms	50	50	50	50	50
Tungsten, mine output, W content		1,000	1,000	500	500	500
Zinc:						
Mine output, Zn content		180,000	225,000	220,000	225,000	230,000
Metal, primary		180,000	180,000	210,000	210,000	210,000
INDUSTRIAL MINERALS						
Barite		100,000	100,000	100,000	100,000	100,000
Cement, hydraulic	thousand tons	8,000	8,000	9,000	12,000	16,000
Fluorspar		40,000	40,000	40,000	40,000	40,000
Graphite		25,000	25,000	25,000	25,000	35,000
Magnesite, crude	thousand tons	[r]1,500	[r]1,500	1,500	1,500	1,500
Nitrogen, N content of ammoni	do.	450	450	450	500	500
Phosphate rock		500,000	500,000	500,000	500,000	500,000
Salt, all types		570,000	570,000	570,000	570,000	570,000
Sulfur	thousand tons	230	230	230	230	230
Talc, soapstone, pyrophyllite		100,000	100,000	100,000	100,000	100,000

See footnotes at end of table.

TABLE 1—Continued

NORTH KOREA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Anthracite	thousand tons	44,000	48,000	55,000	62,000	65,000
Lignite	do.	13,000	14,000	15,000	18,000	20,000
Total	do.	57,000	62,000	70,000	80,000	85,000
Coke	do.	3,000	3,000	3,000	3,000	3,000
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	7,200	7,700	7,700	8,000	8,300
Jet fuel and kerosine	do.	1,500	1,600	1,600	1,700	1,800
Distillate fuel oil	do.	6,700	7,100	7,100	7,400	7,700
Residual fuel oil	do.	3,700	4,000	4,000	4,100	4,200
Refinery fuel and other products	do.	1,900	2,000	2,000	2,100	2,200
Total	do.	21,000	22,400	22,400	23,300	24,200

[r] Revised.
[1] Table includes data available through July 20, 1990.
[2] In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

The Kimchaek iron and steel complex in North Hamgyong Province, the country's largest integrated steel plant, produced an estimated 5.4 million tons of crude steel in 1988. The complex also underwent second-stage expansion with projects completed, including the installation of a holding furnace, a converter, three continuous ingot-moulders, two oxygen plants, an oxygen centrifugal compressor, a limestone calciner, and a casting shop. A production capacity of 10 million tons of crude steel was designed in the long-range plan. The construction of a thermal power station was begun at Kimchaek. When completed, it would also supply electricity to the Songjin steel complex for iron and steel production.

The annual production capacity of the steel plant at Nampo was to be expanded in stages from 1 million tons to 3 million tons. The Kangson steelworks with a capacity of 700,000 tons per year was expanded to double its production capacity to 1.4 million tons. In addition, new production facilities were being constructed at the Chongjin steelworks and the Puryong metallurgical plant.

Lead and Zinc.—New mining faces were opened up at the lead-zinc mines in the Komdok mining complex, and the output was increased 60% over that of the previous year with large investments in equipment. A number of new deposits were being studied for development in Takgol and other southern districts. The country produced about 80,000 tons of lead in ore per year. However, part of lead ore concentrate was sent abroad for smelting.

Industrial Minerals

Cement.—Production of cement reached 16 million tons. The major cement production facilities were at the industrial centers at Sunchon, Chonnaeri, Haeju, Komusan, and Sangwon. The Sangwon cement plant was recently commissioned. A large amount of cement was currently being used in the construction of the Sunchon vinalon complex and the Sariwon potassic fertilizer complex.

Graphite.—A large-scale graphite mine was being developed in the Hunsgang area, South Hwanghae Province. Two ore processing plants near the site were completed with a combined capacity of 100,000 tons. North Korea exported its graphite mainly to garner foreign exchange.

Magnesite.—North Korea has the largest and some of the best quality magnesite deposits in the world; the level of output was estimated at 1.5 million tons per year. Its magnesia clinker was exported to more than 10 countries.

The magnesite deposits near Tanchon, South Hamgyong Province, where the Yongyang magnesite mine is, were estimated at 6 billion tons. An expansion project was in progress at the Yongyang Mine to increase annual dressing capacity of magnesite to 1.3 million tons. The project included an ore chute, a belt conveyer, a crushing and screening site, and 10 vertical kilns. There was already a magnesia plant at Tanchon with sufficient capacity to process the increased tonnage of magnesite mined at Yongyang before the new kilns were completed.

Other deposits were at Paekam, Yanggang Province, and Kimchaek, North Hamgyong Province. In addition, a magnesite mine was newly developed at Taehung. Kanyo Province also had large deposits of high-grade magnesite.

Nitrogen Fertilizer.—The first-stage projects were completed at the Sunchon vinalon, increasing the vinalon production capacity to 50,000 tons per year. Completion of planned second-stage construction will enable the complex to produce 100,000 tons of vinalon and 900,000 tons of nitrogen fertilizer annually at some future time. Tetoron, acrylics, polyethylene resin, vinyl chlo-

TABLE 2

NORTH KOREA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Principal destinations, 1988
METALS			
Aluminum: Metal including alloys, all forms	7,418	5,816	Japan 5,565; Hong Kong 236; Indonesia 15.
Cadmium: Metal including alloys, all forms	—	37	All to Japan.
Copper: Metal including alloys, all forms	1,249	652	Japan 296; China 241; Hong Kong 105.
Gold: Metal including alloys, unwrought and partly wrought value, thousands	—	$71,731	Japan $68,368; Hong Kong $3,363.
Iron and steel:			
Iron ore and concentrate including roasted pyrite	941,919	1,088,323	All to China.
Metal:			
Scrap	20,535	24,772	Japan 23,545; China 1,227.
Pig iron, cast iron, related materials	96,828	64,258	Japan 29,538; U.S.S.R. 28,650; China 6,070.
Ferroalloys	5,369	6,925	U.S.S.R. 3,433; Japan 3,386; Hong Kong 106.
Steel, primary forms	152,086	25,198	China 11,932; Philippines 9,563; Japan 3,693.
Semimanufactures:			
Bars, rods, angles, shapes, sections	20,148	21,404	China 21,057; Indonesia 347.
Universals, plates, sheets	197,166	102,408	China 82,283; Hong Kong 11,256; Philippines, 6,790.
Hoop and strip	20	4	All to Hong Kong.
Wire	19	82	China 79; Hong Kong 3.
Tubes, pipes, fittings	2,179	4,699	China 4,478; Indonesia 212.
Castings and forgings, rough	375	415	China 354; Indonesia 61.
Unspecified	215,000	187,000	All to U.S.S.R.
Lead:			
Ore and concentrate	—	1,860	All to Belgium-Luxembourg.
Metal including alloys, all forms	11,475	10,778	Japan 10,382; Hong Kong 396.
Magnesium: Metal including alloys, all forms	107	114	Japan 107; Indonesia 7.
Nickel: Metal including alloys, all forms	—	236	Indonesia 170; China 35; Japan 31.
Silver: Metal including alloys, unwrought and partly wrought value, thousands	$2,656	$9,526	Japan $5,179; China $2,420; Hong Kong $1,927.
Titanium: Oxides	—	17	All to Indonesia.
Zinc:			
Ore and concentrate	NA	1,950	All to Japan.
Metal including alloys, all forms	60,200	58,853	Japan 41,033; China 17,225; Hong Kong 595.
Other:			
Ores and concentrates	21	—	
Ashes and residues	4,117	3,564	All to Japan.
Base metals including alloys, all forms	21	—	
INDUSTRIAL MINERALS			
Abrasives, n.e.s.: Grinding and polishing wheels and stones	19	—	
Cement	1,089,674	911,131	China 583,131; U.S.S.R. 328,000.
Clays, crude	2,491	8,566	All to Japan.
Feldspar, fluorspar, related materials	607	1,983	Do.
Fertilizer materials: Manufactured:			
Nitrogenous	43,003	72,060	China 71,087; Japan 973.
Unspecified and mixed	75	9	All to China.

See footnotes at end of table.

TABLE 2—Continued

NORTH KOREA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Principal destinations, 1988
INDUSTRIAL MINERALS—Continued			
Graphite, natural	6,511	8,996	Austria 1,316; Japan 7,670; Thailand 10.
Magnesium compounds:			
Magnesite, crude	—	9,064	Egypt 7,141; Sweden 1,923.
Oxides and hydroxides	—	44,364	Japan 36,061; Spain 8,279.
Unspecified	[2]4,762	—	
Precious and semiprecious stones other than diamond: Synthetic value, thousands	—	$12	All to Japan.
Stone, sand and gravel:			
Dimension stone, all forms	8,258	15,352	Do.
Gravel and crushed rock	827	318	Do.
Quartz and quartzite	928	1,756	Do.
Sulfur: Elemental including native and byproduct	—	36	All to Indonesia.
Talc, steatite, soapstone, pyrophyllite	9,864	2,556	Japan 2,456; Indonesia 100.
Other:			
Crude	2	7	All to China.
Slag and dross, not metal-bearing	52,206	115,619	China 95,959; Japan 19,660.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	294	540	Thailand 388; Indonesia 152.
Coal, all grades including briquets	2,006,010	497,794	All to Japan.
Petroleum:			
Partly refined 42-gallon barrels	—	189	All to Indonesia.
Refinery products:			
Liquefied petroleum gas value, thousands	$126	—	
Residual fuel oil 42-gallon barrels	602,397	223,000	All to Hong Kong.
Bituminous mixtures do.	—	85	All to Indonesia.

[p] Preliminary. NA Not available.

[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by North Korea, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any imports of mineral commodities from North Korea during 1988.

[2] Excludes unreported quantity valued at $4,478,000 imported by Japan.

ride, and other chemicals would also be produced.

The Hukbosan fertilizer plant at the Anju coal mining complex produced 100,000 tons of fertilizer per year from local raw materials. The Hungnam fertilizer complex also produced nitrogen fertilizer.

Mineral Fuels

Anthracite coal was the most abundant indigenous mineral resource in the country and was produced in large quantity for both domestic consumption and export. The Kukdong and Yangdong coal mines produced more than 1 million tons of anthracite for metallurgical purposes. However, the country continued to rely on foreign sources for bituminous coal. China was the country's foremost source in 1988, providing nearly 1.8 million tons of coal and almost 14,000 tons of coke. In the same year, the U.S.S.R. exported 800,000 tons of coal and 237,000 tons of coke, and Japan shipped nearly 33,000 tons of coke but no coal. Australia may also have provided coal in 1988, but the level of shipments was unreported. For 1989, data on deliveries from Australia and China were not available, Japan provided neither coal nor coke, and shipments to North Korea from the U.S.S.R. fell to 749,000 tons of coal and 190,000 tons of coke.

High-caloric anthracite deposits were discovered in the Paekam District of Yanggang Province, and the reserves were estimated to be at least 1 million tons. Coal deposits amounting to 10 million tons were also found in Chunbi, Togol, and Kangdong areas of the Kangdong coal mining district. The expansion of a coal mine in the Anju area, 60 kilometers (km) north of Pyongyang, was completed with Soviet assistance.

Reserves

North Korea has a variety of mineral resources such as anthracite, copper, fluorspar, gold, graphite, iron ore, lead, magnesite, pyrite, salt, tungsten, and zinc. The country has the most abundant magnesite deposits in the world. The estimated reserves of major commodities are presented in table 5.

TABLE 3

NORTH KOREA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Principal sources, 1988
METALS			
Alkali and alkaline-earth metals value, thousands	$14	—	
Aluminum:			
Ore and concentrate	3,000	—	
Oxides and hydroxides	7,554	12,395	Japan 12,369; China 26.
Metal including alloys:			
Scrap	16	—	
Unwrought	128	24	Japan 19; Hong Kong 5.
Semimanufactures	1,543	1,986	China 1,801; Japan 165.
Chromium:			
Ore and concentrate	24,000	21,000	All from U.S.S.R.
Oxides and hydroxides	83	6	All from Japan.
Cobalt: Oxides and hydroxides	1	—	
Columbium and tantalum: Tantalum metal including alloys, all forms	([2])	1	All from Austria.
Copper: Metal including alloys:			
Scrap	78	—	
Unwrought	409	300	Hong Kong 299; Japan 1.
Semimanufactures	320	329	Japan 26; China 68.
Germanium: Metal including alloys, all forms value, thousands	—	$4	All from Japan.
Gold: Metal including alloys, unwrought and partly wrought kilograms	—	1,453	Do.
Iron and steel: Metal:			
Scrap	674	340	Do.
Ferroalloys:			
Ferromanganese	6,653	1,000	Do.
Unspecified	15,153	12,357	U.S.S.R. 7,185; China 5,142.
Semimanufactures:			
Bars, rods, angles, shapes, sections	1,680	339	Japan 203; Sweden 113.
Universals, plates, sheets	3,955	2,513	All from Hong Kong.
Hoop and strip	398	193	Do.
Rails and accessories	1,396	256	All from Japan.
Wire	[3]1,294	172	China 125; Japan 47.
Tubes, pipes, fittings	8,472	8,200	U.S.S.R. 4,128; China 2,029; Japan 1,920.
Castings and forgings, rough	([4])	—	
Unspecified	7,414	43,994	All from U.S.S.R.
Lead:			
Ore and concentrate	5,368	20,016	All from China.
Oxides	—	11	All from Japan.
Metal including alloys, all forms	7,504	399	Do.
Magnesium: Metal including alloys, all forms	56	NA	
Manganese:			
Ore and concentrate	60,932	60,325	U.S.S.R. 31,000; China 29,325.
Oxides	148	109	All from Japan.

See footnotes at end of table.

TABLE 3—Continued

NORTH KOREA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988 p	Principal sources, 1988
METALS—Continued			
Mercury	—	1	All from Japan.
Molybdenum: Metal including alloys, all forms	7	1	All from Austria.
Nickel:			
Ore and concentrate	—	20,364	All from Indonesia.
Metal:			
Unwrought	1,894	4	All from Japan.
Semimanufactures kilograms	—	140	Do.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$107	NA	
Silver: Metal including alloys, unwrought and partly wrought do.	$25	NA	
Tin: Metal:			
Unwrought	140	15	Hong Kong 13; Japan 2.
Semimanufactures	17	—	
Titanium:			
Oxides	106	40	Hong Kong 20; Japan 20.
Metal including alloys, all forms	—	7	All from Japan.
Tungsten:			
Ore and concentrate	919	NA	
Metal including alloys, all forms kilograms	(5)	828	Austria 500; Japan 328.
Zinc:			
Ore and concentrate	10,300	16,630	All from China.
Metal including alloys, all forms	2	6	All from Japan.
Other:			
Ores and concentrates	317	—	
Oxides and hydroxides	50	—	
Base metals including alloys, all forms	203	190	China 172; Hong Kong 18.
INDUSTRIAL MINERALS			
Abrasives, n.e.s.:			
Artificial: Corundum	—	75	Hong Kong 74; Japan 1.
Dust and powder of precious and semiprecious stones excluding diamond value, thousands	$62	$49	All from Japan.
Grinding and polishing wheels and stones	92	97	Do.
Asbestos, crude	36	—	
Boron materials: Oxides and acids	226	2	All from Japan.
Cement	55	60	Do.
Clays, crude	136	—	
Diamond: Natural:			
Gem, not set or strung value, thousands	—	$61	All from Belgium-Luxembourg.
Industrial stones do.	$36	$6	All from Japan.
Fertilizer materials: Manufactured:			
Nitrogenous	118	—	
Potassic	11,000	32,000	All from U.S.S.R.
Unspecified and mixed	23	—	

See footnotes at end of table.

TABLE 3—Continued

NORTH KOREA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988[p]	Principal sources, 1988
INDUSTRIAL MINERALS—Continued				
Gypsum and plaster		25	—	
Iodine including bromine and fluorine	kilograms	475	640	All from Japan.
Mica:				
Crude including splittings and waste		3	4	Do.
Worked including agglomerated splittings		[6]2	—	
Phosphorous, elemental		—	30	All from Japan.
Pigments, mineral: Iron oxides and hydroxides, processed	value, thousands	$4	—	
Precious and semiprecious stones other than diamond:				
Natural	do.	$12	$1	All from Thailand.
Synthetic	do.	$46	NA	
Salt and brine		195,200	119,261	China 119,098; Japan 163.
Sodium compounds, n.e.s.: Soda ash, natural and manufactured		1,770	1,020	Yugoslavia 1,000; Japan 20.
Stone, sand and gravel:				
Dimension stone, all forms		304	51	Japan 31; Hong Kong 20.
Quartz and quartzite		—	12	All from Japan.
Calcareous stone, n.e.s.		137,501	105,793	All from China.
Sand other than metal-bearing		—	1	All from Japan.
Sulfur:				
Elemental, all forms		3	3,011	China 3,000; Japan 11.
Sulfuric acid		10	6	All from Japan.
Other:				
Crude		180	—	
Metalloids, unspecified[7]		148	30	All from Japan.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black		1,189	2	Do.
Coal, all grades including briquets		2,605,397	2,597,174	China 1,797,174; U.S.S.R. 800,000.
Coke and semicoke		245,280	283,823	U.S.S.R. 237,000; Japan 32,927; China 13,896.
Petroleum:				
Crude	thousand 42-gallon barrels	14,908	13,479	China 8,775; U.S.S.R. 4,704.
Refinery products:				
Liquefied petroleum gas	42-gallon barrels	—	12	All from Japan.
Gasoline	do.	41,642	28,152	All from China.
Mineral jelly and wax	do.	2,211	1,094	China 858; Yugoslavia 236.
Kerosene and jet fuel	do.	186	—	
Lubricants	do.	37,476	34,804	China 32,872; Yugoslavia 1,932.
Residual fuel oil	do.	2,944	NA	
Bitumen and other residues	do.	[8]42,626	NA	
Unspecified	do.	1,022,000	896,000	All from U.S.S.R.

[p] Preliminary. NA Not available.

[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by North Korea, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any exports of mineral commodities to North Korea during 1988.

[2] Excludes unreported quantity valued at $247,000 exported by Japan.

[3] Excludes unreported quantity valued at $340,000 exported by Japan.

[4] Less than 1/2 unit.

[5] Unreported quantity valued at $21,000.

[6] Excludes unreported quantity valued at $20,000 exported by Japan.

[7] Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

[8] May include petroleum coke.

TABLE 4

NORTH KOREA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies [1]	Location of main facilities	Capacity (thousand metric tons per year)
Anthracite coal	Ministry of Electric and Coal Industries	West Coast District, South P'yongan	25,000
Iron:			
Ore	Musan Mine	Musan, Chongjin	6,500
Steel	Kimch'aek Iron and Steel Complex	Songp'yong, Chongjin	6,800
Lead, refined	Hungnam Refinery	Hamhung, South Hamgyong	55
Magnesite	Yongyang Mine	Tanch'on, South Hamgyong	1,000
Tungsten, in ore	Mannyon Mine	Sinpyong, North Hwanghae	2
Zinc, refined	Korea Metals and Chemicals Corp.	Munpyong, Kangwon Nampo, Nampo Tanch'on, South Hamgyong	140

[e] Estimated.
[1] All Government owned and operated.

TABLE 5

NORTH KOREA: RESERVES OF MAJOR MINERALS

Commodity	Reserves (thousand metric tons)
Anthracite	1,800,000
Iron ore	400,000
Lead in ore	3,200
Magnesite	490,000
Tungsten in ore	60
Zinc in ore	6,000

INFRASTRUCTURE

North Korea is a country with mountains and hills occupying 80% of its total area. The length of inland waterways totals 2,250 km, most navigable only by small craft. There were 20,280 km of highway, mostly unpaved, and 4,600 km of railroad, the principal mode of transportation. There were six major ports: Nampo on the west coast, Chongjin, Kimchaek, Najin, Unggi, and Wonsan on the east. A 37-km pipeline was available for importing crude oil from the Daqing Field in Heilongjiang, China. Total electricity generation capacity (58% hydropower and 42% thermal) was 6,440 megawatts. There were 1,500 hydroelectric powerplants, mostly small, scattered throughout the country.

OUTLOOK

North Korea's isolation from the outside world has severely impaired its economic development. The country is deliquent in its external debt payments, both for principal and for interest. Furthermore, the country is hampered by the lack of exportable goods for world commerce, which severely limits foreign currency earnings. Hence, North Korea's two-way trade volume remains small. Its ballooning trade deficit is the result of purchases of high-value goods exacerbated by exports of low-value primary products. The country has to import refined metal and petroleum products while exporting anthracite, graphite, and magnesite. The development of its mineral resources requires foreign capital and technology that have not been forthcoming. Although the campaign for self-reliance has been in effect for more than three decades, the industrial output in the future will only increase slightly.

[1] Where necessary, values have been converted from Korean won (W) to U.S. dollars at the rate of W2.30=US$1.00 for 1989.

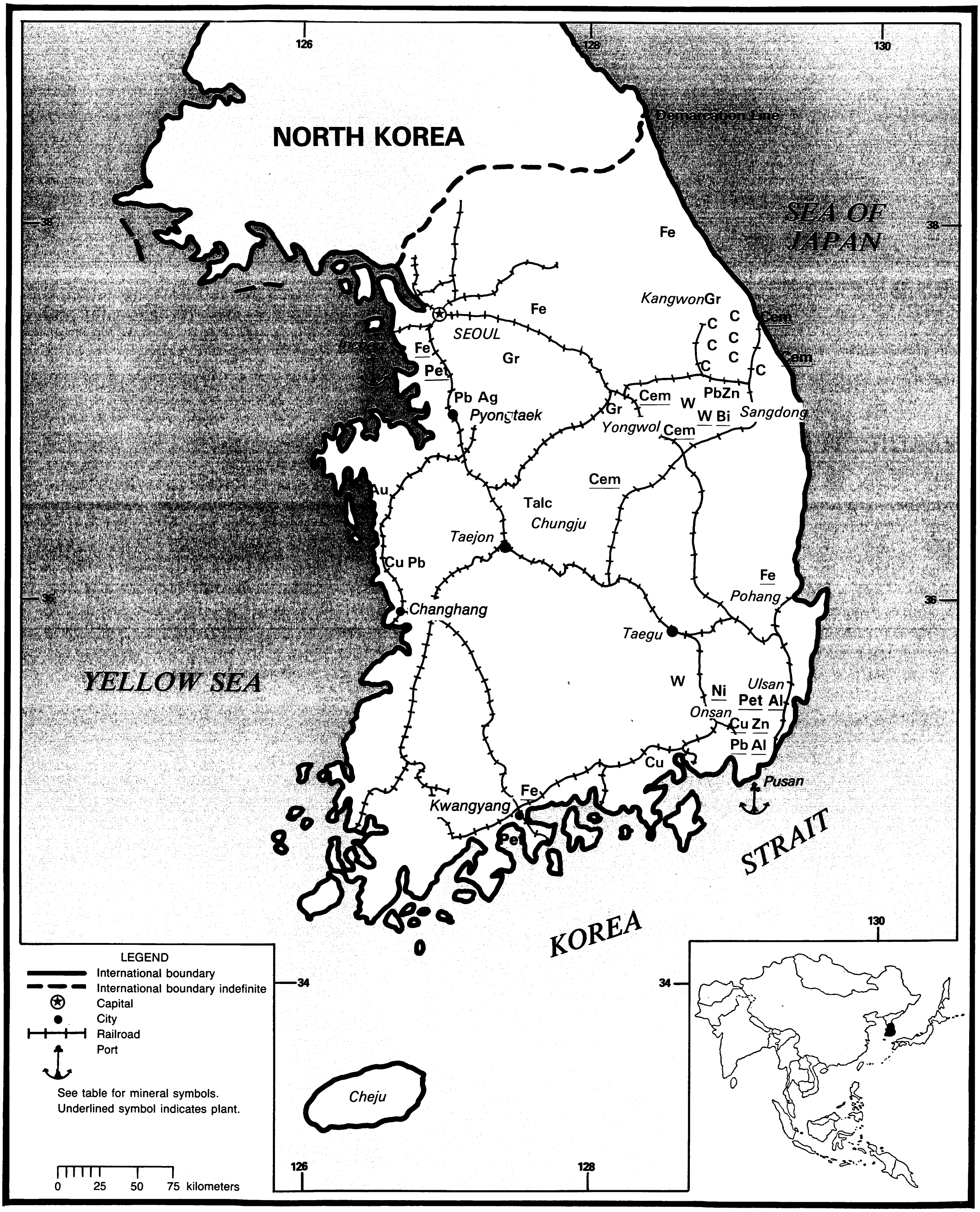
OTHER SOURCES OF INFORMATION

Agency

Central Institute of Mining Industry
Pyongyang, North Korea

REPUBLIC OF KOREA

AREA 98,480 km² **POPULATION 43.0 million**



THE MINERAL INDUSTRY OF THE

REPUBLIC OF KOREA

By Chin S. Kuo

The country's economy slowed down considerably after 3 consecutive years of above 12% gross national product (GNP) growth and, in 1989, the economic expansion was down to 6.6%.[1] The consumer-price index was estimated to be 6% in 1989 compared with 7.1% in 1988; the outlook for 1990 was forecasted to be for a 5% increase.

The increase in wages had more than doubled since the beginning of 1987. Labor unrest had been a major factor in determining the performance of the country's economy during the past 2 years. However, the slow economic growth was likely to force labor to adopt a less confrontational stance in 1990's wage negotiations. Fewer strikes were expected, but they would be longer and involve more intense negotiations. Because of the aggressive labor environment and higher wage requirement, foreign companies started to reconsider their investment and operations in the country.

The mining sector's output contributed only a small percentage to the country's GNP and was insufficient to meet the material requirements of the manufacturing sector except for a few isolated industrial minerals. Imports of raw materials and fuels continued and will remain so as the country lacks major indigenous energy resources.

To secure sources of raw materials, Lucky-Goldstar International Co. Ltd. planned to mine copper from the Los Pelambres mine in Chile jointly with Midland Bank of the United Kingdom on a debt for equity basis. It is planning to acquire a 40% stake by investing $31 million[2] in the joint venture. The 25,000-ton-per-year underground mine is expected to start up in 1991.

Daewoo Corp. decided to proceed with a copper mine development project at Monywa in northwest Burma. The mine has been operating for more than two decades and produces about 60,000 tons per year of copper concentrate grading at about 22%. Daewoo plans to install new dressing equipment and provide processing expertise valued at $20 million. In exchange, Monywa's concentrate will be exported to the Republic of Korea under a countertrade deal.

The country is also expanding its presence in the world market through the acquisition of foreign steel producers. In August, Sammi Steel Co. Ltd. acquired the three North American specialty steel divisions of Rio Algom Ltd. of Toronto. One of them was AlTech Specialty Steel Corp. in Dunkirk, NY.

Seoul-based Hai Tai International and an unnamed Turkish partner planned to establish a 51-49 joint-venture company and invest $1 million jointly for a feasibility study and test drilling to develop an antimony mine in Turkey. Sunkyong Ltd. and Turkish Aegean Metals reportedly reached an agreement in principle to form a joint venture to develop a chromite mine in northwestern Turkey that would produce 200,000 tons per year of refined chromium for partial export to the Republic of Korea.

GOVERNMENT POLICIES AND PROGRAMS

Under the Government's privatization program of state-owned companies, 21% of Korea Electric Power Co. (Kepco) was sold to raise new capital, and a one-third stake in Pohang Iron and Steel Co. Ltd. (Posco) was floated since 1988.

The Government is to spend $30 million for research and the building of an exploration ship for deep-sea mining by 1992 to establish mining rights for manganese nodules southeast of Hawaii. The claim area is a 75,000-square-kilometer region with estimated reserves of 100 million tons, giving a combined potential annual production of 3 million tons of primarily manganese and associated values of cobalt, copper, and nickel.

The Government's Office of Supply, which administers the country's stockpile of strategic materials, has introduced a lease-back program for its aluminum stocks. The lease of 500 tons of aluminum ingot for 6 months was signed with Seoul Light Metals Ltd. This office also planned to spend $170 million on importing metal commodities for its stockpile, including 30,000 tons of aluminum, 1,000 tons of nickel, 6,000 tons of zinc, 5,000 tons of copper, 3,500 tons of ferrosilicon, 1,000 tons of ferrochrome, 50 tons of ferrovanadium, 30 tons of cobalt powder, and 200,000 tons of small steel bars.

PRODUCTION

Mining accounted for only 2.8% of the country's total industrial production in 1989. Among the mining sectors, anthracite coal output contributed 58.8% of the tonnage produced, followed by industrial minerals, 37.1%, notably dolomite, graphite, and limestone, and metal ore, 4.1%, primarily iron, lead and zinc, and tungsten ores.

TRADE

The Republic of Korea's exports in terms of current dollar increased less than 10% in 1989 compared with double-digit expansion in the previous 3 years. Total exports were $60 billion in 1988. A smaller trade surplus of $6 billion was realized in 1989 compared with $11.4 billion in 1988. As a result,

TABLE 1

REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
METALS						
Aluminum, primary		17,695	18,643	21,654	17,500	17,500
Bismuth metal		135	[r]136	145	132	96
Cadmium, smelter		—	—	—	490	[e]500
Copper:						
Mine output, Cu content		309	220	178	36	4
Metal:						
Smelter		106,900	165,024	157,923	169,000	179,890
Refined, primary		140,144	157,846	154,591	168,334	178,665
Gold metal	kilograms	2,403	4,648	7,600	11,121	14,270
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	542	582	470	390	334
Fe content	do.	304	326	263	218	187
Metal:						
Pig iron	do.	8,833	9,017	11,057	12,577	14,846
Ferroalloys:						
Ferromanganese		61,396	53,721	58,044	75,924	85,329
Ferrosilicon		34,840	30,939	12,646	8,909	4,582
Other		54,879	66,499	90,382	89,966	101,818
Total		151,115	151,159	161,072	174,799	191,729
Steel, crude	thousand tons	13,539	14,554	16,782	19,117	21,873
Lead:						
Mine output, Pb content		9,699	11,864	13,998	14,457	16,535
Metal, smelter		22,394	22,890	62,593	60,799	[e]60,000
Manganese ore and concentrate:						
Gross weight		[r]111	177	91	—	—
Mn content		[r]44	71	36	—	—
Molybdenum, mine output, Mo content		333	315	325	144	132
Silver metal	kilograms	124,096	156,586	209,058	226,687	239,214
Tin, mine output, Sn content		[r]31	1	3	—	—
Tungsten, mine output, W content		2,579	2,455	2,375	2,029	1,701
Zinc:						
Mine output, Zn content		45,746	37,282	23,530	21,820	23,202
Metal, primary		111,653	127,439	186,078	223,000	240,184
INDUSTRIAL MINERALS						
Asbestos		4,703	2,983	2,518	2,428	2,361
Barite		2,785	[r]3,778	2,942	2,573	3,735
Cement, hydraulic	thousand tons	20,424	23,403	25,662	28,995	30,474
Clays: Kaolin		658,282	[r]849,742	630,945	832,110	1,219,174
Diatomaceous earth		53,613	54,841	64,783	71,952	75,019
Feldspar		145,414	130,895	180,269	241,511	232,607
Fluorspar, metallurgical-grade		705	243	63	261	856
Graphite:						
Crystalline		1,602	641	838	678	1,186
Amorphous		69,877	96,577	106,507	107,767	100,282
Total		71,479	97,218	107,345	108,445	101,468

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
INDUSTRIAL MINERALS—Continued						
Kyanite and related materials: Andalusite		42	33	85	112	[e]100
Mica: All grades		20,044	41,997	31,938	18,848	[e]30,000
Nitrogen: N content of ammonia		441,983	426,778	474,891	506,471	480,310
Salt		643,000	729,000	664,000	1,020,000	830,000
Soda ash, manufactured		250,890	264,213	[e]288,500	[e]280,000	[e]280,000
Stone, sand and gravel:						
Limestone	thousand tons	[r]35,135	[r]38,060	41,675	46,377	48,011
Quartzite	do.	872	885	1,235	1,379	1,554
Sand including glass sand	do.	1,096	1,233	1,350	1,488	1,358
Talc and related materials:						
Pyrophyllite		738,304	587,049	690,819	673,776	770,298
Talc		194,174	210,631	161,052	146,478	162,098
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		91,019	120,534	146,758	183,346	193,358
Coal: Anthracite	thousand tons	24,543	24,253	24,273	24,295	20,785
Coke[e]	do.	5,200	5,100	5,100	5,200	5,500
Fuel briquets: Anthracite briquets		19,453	20,595	23,587	22,926	18,700
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	9,729	9,821	10,936	13,618	18,309
Jet fuel	do.	[e]10,000	9,662	[e]9,500	[e]9,500	[e]9,600
Kerosene	do.	10,452	9,559	7,966	10,619	13,161
Distillate fuel oil	do.	54,783	58,859	60,296	73,504	88,577
Residual fuel oil	do.	75,566	75,937	[e]73,400	[e]75,000	100,320
Lubricants	do.	3,807	7,317	[e]7,100	[e]7,300	[e]7,400
Other	do.	19,031	13,576	[e]15,000	[e]15,000	[e]16,000
Refinery fuel and losses[e]	do.	[2]4,036	4,000	4,000	4,000	4,000
Total[e]	do.	187,404	188,731	188,198	208,541	257,367

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Apr. 9, 1990.

the current account surplus was cut nearly in half from that of 1988, which topped $14 billion.

At the beginning of 1989, there was a flurry of small-scale trade with North Korea, most of it on a barter basis. Lucky-Goldstar International imported 600 tons of electrolytic copper from Iran in 1989.

The country's trade with China turned into a deficit from the 1988 surplus; imports from China were mostly coal, feed grain and meal, oil, and textile goods, whereas exports to China were mostly metal, steel, and textile products. Construction of a major industrial and port complex was begun on the west coast to boost trade with China.

STRUCTURE OF THE MINERAL INDUSTRY

Most of the country's large, mineral-related companies are state-owned and under the control of either the Ministry of Trade and Industry or the Ministry of Energy and Resources. In recent years, some state-owned enterprises have gradually gone public, and part of the Government interest has been transferred to private investors' hands. The structure of the mineral industry is presented in table 4.

The country's number of persons employed in the mining sector decreased significantly to 93,000 compared with a high of 187,000 in 1986. The mineral industry labor is skilled and highly productive, in particular metal ore miners. Miners are dominated by male workers at 90%. About 98% of the work force is under 50 years of age.

COMMODITY REVIEW

Metals

Aluminum.—Aluminum of Korea Ltd. planned to construct a large-scale aluminum rolling mill with 100,000 tons in annual capacity in Ulsan by

TABLE 2

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS				
Aluminum:				
Ore and concentrate	—	2	—	All to Taiwan.
Oxides and hydroxides	191	168	—	Bangladesh 73; Taiwan 23; Thailand 23.
Metal including alloys:				
Scrap	71	352	35	Japan 312.
Unwrought	2,875	7,643	114	Singapore 5,195; Japan 1,433.
Semimanufactures	24,925	164,433	494	Japan 99,676; Canada 44,207.
Antimony:				
Oxides	142	39	—	All to Japan.
Metal including alloys, all forms	244	2	—	All to Lebanon.
Arsenic: Oxides and acids	268	133	NA	Taiwan 71; Japan 52.
Bismuth: Metal including alloys, all forms	152	180	20	Japan 107; Netherlands 51.
Cadmium:				
Oxides and hydroxides	292	—		
Metal including alloys, all forms	163	731	—	Japan 621; Netherlands 110.
Chromium:				
Oxides and hydroxides	3	66	—	Hong Kong 34; Taiwan 32.
Metal including alloys, all forms kilograms	—	72	—	All to Hong Kong.
Cobalt:				
Oxides and hydroxides	42	16	—	All to Japan.
Metal including alloys, all forms	(2)	32	—	Do.
Columbium and tantalum: Tantalum metal including alloys, all forms value, thousands	$31	—		
Copper:				
Matte and speiss including cement copper do.	$2	—		
Oxides and hydroxides	30	12	—	All to Indonesia.
Sulfate	41	18	—	All to New Zealand.
Ash and residue containing copper	118	—		
Metal including alloys:				
Scrap	r443	1,274	9	Japan 964; Philippines 141.
Unwrought	183,920	20,979	(2)	Japan 12,004; Singapore 8,000.
Semimanufactures	42,844	93,911	1,792	Hong Kong 51,095; Taiwan 17,459.
Gold:				
Waste and sweepings value, thousands	$628	$68	$65	France $3.
Metal including alloys, unwrought and partly wrought kilograms	3,395	6,551	2,069	Japan 2,118; Hong Kong 2,027.
Indium: Metal including alloys, all forms do.	2	—		
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	8	—		
Metal:				
Scrap	42,164	40,440	46	Japan 35,096; Hong Kong 3,650.
Pig iron, cast iron, related materials	r3,479	78,528	—	Japan 78,136.
Ferroalloys:				
Ferromanganese	5	—		
Ferrosilicon	76	302	—	Taiwan 200; Japan 102.
Unspecified	r38	—		

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Steel, primary forms	thousand tons	1,686	353	57	Japan 136; Indonesia 78.
Semimanufactures:					
Bars, rods, angles, shapes, sections		1,611,308	1,284,769	159,228	Japan 356,962; Saudi Arabia 121,314.
Universals, plates, sheets		1,732,537	NA		
Hoop and strip		55,732	NA		
Rails and accessories		62,345	47,750	2,985	India 13,712; Singapore 9,860; Taiwan 6,889.
Wire		161,254	148,710	8,209	Japan 59,023; Indonesia 8,317.
Tubes, pipes, fittings		912,871	1,779,966	932,352	Japan 462,315; Hong Kong 130,492.
Castings and forgings, rough		29,295	NA		
Lead:					
Ore and concentrate		4,606	—		
Oxides		3,598	9,756	—	Japan 9,186; Indonesia 455.
Metal including alloys:					
Scrap		716	1,068	—	All to Japan.
Unwrought		8,715	3,504	81	Japan 1,542; Taiwan 1,220; India 306.
Semimanufactures		188	138	1	Saudi Arabia 84; Pakistan 23; Japan 18.
Magnesium: Metal including alloys:					
Scrap		11	—		
Unwrought		18	123	—	Singapore 36; Bahrain 34; Japan 33.
Semimanufactures		93	133	—	Japan 133.
Manganese:					
Oxides		107	44	—	Japan 35; Sri Lanka 9.
Metal including alloys, all forms		—	1	—	All to Sri Lanka.
Mercury	kilograms	2	138	—	All to Pakistan.
Molybdenum:					
Ore and concentrate		r126	—		
Metal including alloys:					
Scrap		—	3	—	All to Japan.
Unwrought		1	—		
Semimanufactures		—	18	—	Mainly to Indonesia.
Nickel: Metal including alloys:					
Scrap		639	881	—	Japan 877.
Unwrought		42	—		
Semimanufactures		53	63	(2)	Japan 56.
Platinum-group metals:					
Waste and sweepings	value, thousands	r$1,755	$3,635	—	Hong Kong $2,517; United Kingdom $573; West Germany $513.
Metals including alloys, unwrought and partly wrought:					
Palladium	kilograms	—	32	—	All to Japan.
Platinum	do.	53	67	30	Japan 37.
Unspecified	do.	46	—		

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued				
Selenium, elemental	38	24	—	Japan 15; Netherlands 7; West Germany 2.
Silicon, high-purity	(2)	9	6	Sri Lanka 1.
Silver:				
Waste and sweepings[3] value, thousands	$2,220	$177	$55	Japan $119.
Metal including alloys, unwrought and partly wrought kilograms	142,752	81,472	(2)	Japan 60,072; Taiwan 20,342.
Tin: Metal including alloys:				
Scrap	53	—		
Unwrought	206	553	—	Japan 533.
Semimanufactures	29	32	2	Pakistan 9; Saudi Arabia 8; Hong Kong 6.
Titanium:				
Ore and concentrate	43,593	147,350	—	All to Japan.
Oxides	3,215	3,584	288	Japan 2,069; Taiwan 323.
Metal including alloys, all forms	23	25	19	India 3; Japan 3.
Tungsten:				
Ore and concentrate	467	203	—	Japan 184; West Germany 19.
Oxides and hydroxides	21	50	—	West Germany 45; Japan 5.
Metal including alloys:				
Scrap	19	37	—	Japan 23; United Kingdom 14.
Unwrought	1	291	2	Japan 223; United Kingdom 55.
Semimanufactures	268	1	(2)	Mainly to Japan.
Uranium and thorium: Oxides and other compounds kilograms	—	1	NA	NA.
Vanadium: Metal including alloys, all forms	—	181	—	All to Japan.
Zinc:				
Oxides	5,638	6,155	—	Japan 4,948.
Blue powder	NA	513	—	Hong Kong 267; Singapore 91; Australia 60.
Ash and residue containing zinc	20,588	42	—	Japan 34; Hong Kong 8.
Metal including alloys:				
Scrap	100	—		
Unwrought	38,035	70,657	18,553	Japan 29,038.
Semimanufactures	870	412	49	Japan 163; Singapore 109.
Other:				
Oxides and hydroxides	—	126	—	Taiwan 102; Japan 14.
Ashes and residues	3,755	8,463	—	Australia 8,102.
Base metals including alloys, all forms kilograms	55	5	5	
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	(2)	5	(2)	Australia 1; Hong Kong 1; Japan 1.
Artificial: Corundum value, thousands	$3	—		
Dust and powder of precious and semiprecious stones including diamond kilograms	389	1,223	—	Hong Kong 1,197.
Grinding and polishing wheels and stones	2,147	2,456	429	Canada 283.
Asbestos, crude	41	—		
Cement thousand tons	4,910	3,681	457	Japan 1,847; Hong Kong 719.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Clays, crude:					
Bentonite		3,132	4,608	—	Japan 2,158; Taiwan 1,380; Thailand 1,056.
Chamotte earth		8,103	12,897	—	All to Japan.
Fire clay		—	2	—	All to Thailand.
Kaolin		49,314	48,180	—	Japan 42,352; Taiwan 5,828.
Unspecified		(2)	11	—	All to Japan.
Diamond: Natural:					
Gem, not set or strung	value, thousands	$581	$926	$43	Japan $566; Hong Kong $167.
Industrial stones	carats	255,000	—		
Diatomite and other infusorial earth		423	100	—	All to Indonesia.
Feldspar		19,258	24,100	—	All to Taiwan.
Fertilizer materials:					
Crude, n.e.s.		861	1,039	—	All to Japan.
Manufactured:					
Ammonia		27	1	NA	NA.
Nitrogenous		117,524	186,330	35	Fiji 26,200; Malaysia 15,134; unspecified 83,400.
Phosphatic		26,580	92,959	—	Japan 87,232; Fiji 5,500.
Potassic		41,172	55,300	NA	Japan 18,450; Malaysia 6,100; unspecified 25,400.
Unspecified and mixed	thousand tons	902	1,127	NA	Thailand 441; Japan 180.
Graphite, natural		r56,827	51,537	NA	Japan 37,266; Taiwan 11,889.
Gypsum and plaster		r82	11,289	—	Japan 11,205.
Kyanite and related materials:					
Andalusite		108	—		
Mullite		—	12	—	All to Indonesia.
Lime		r2,003	—		
Magnesium compounds: Oxides and hydroxides		33	768	—	West Germany 450; Taiwan 192; Philippines 108.
Mica: Worked including agglomerated splittings		3	37	—	Mainly to Japan.
Phosphates, crude		(2)	1,652	—	All to Japan.
Pigments, mineral: Iron oxides and hydroxides, processed		46	287	—	Japan 202; Taiwan 78.
Potassium salts, crude		10,176	—		
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$11,522	$11,005	$5,049	Japan $4,913.
Synthetic	kilograms	51,454	9,456	5,995	Japan 1,273.
Quartz crystal, piezoelectric	grams	NA	5,700	200	Japan 5,500.
Salt and brine		r49,967	14,467	1,053	Japan 13,068.
Sodium compounds, n.e.s.: Soda ash, manufactured		9	356	NA	NA.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		r329,930	331,926	(2)	Japan 308,592; Taiwan 22,791.
Worked		118,222	364,289	3,214	Japan 359,779.
Dolomite, chiefly refractory-grade		163,195	224,230	—	All to Japan.
Gravel and crushed rock		347	874	—	Taiwan 604; Japan 270.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Quartz and quartzite		r4,905	7,870	—	Japan 7,250; Taiwan 602.
Sand other than metal-bearing		r1,817	45	NA	NA.
Sulfur:					
Elemental:					
Crude including native and byproduct		4,961	5,191	—	Indonesia 2,393; Malaysia 702; Burma 650.
Colloidal, precipitated, sublimed		—	37	—	Indonesia 16; Japan 16.
Sulfuric acid		r173	14,925	NA	Australia 7,021; Philippines 4,996; Taiwan 2,873.
Talc, steatite, soapstone, pyrophyllite		36,580	36,072	1,778	Thailand 9,859; Japan 6,237; Philippines 5,027.
Vermiculite[4]		134	400	—	All to Hong Kong.
Other:					
Crude		r342,167	305,225	—	Japan 190,582; Taiwan 109,606.
Slag and dross, not metal-bearing		r77,524	79,219	—	All to Japan.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		—	17	—	All to Singapore.
Carbon:					
Carbon black		12,572	28,363	NA	Indonesia 10,791; Japan 6,388; India 2,810.
Gas carbon		([2])	—		
Coal:					
Anthracite		1,007	20	—	All to Bangladesh.
Bituminous		112	210	—	Taiwan 160; Thailand 50.
Coke and semicoke		7,817	3,163	—	Japan 2,987.
Petroleum:					
Crude	thousand 42-gallon barrels	7,926	([2])	—	All to Japan.
Refinery products:					
Liquefied petroleum gas	do.	112	16	9	Japan 7.
Gasoline	do.	r2,765	4,551	665	Japan 3,829.
Naphtha	do.	7,176	9,115	254	Japan 8,458; Taiwan 266.
Mineral jelly and wax	do.	4	10	—	Bangladesh 6; Japan 2; Taiwan 1.
Kerosene and jet fuel	do.	r2,435	1,100	—	Japan 468; unspecified 631.
Distillate fuel oil	do.	r5,511	7,447	30	Japan 5,070; Taiwan 283.
Lubricants	do.	r523	453	1	Libya 28; Taiwan 19; unspecified 303.
Residual fuel oil	do.	r89,733	12,330	—	Japan 8,972; Singapore 541.
Bitumen and other residues	do.	36	42	NA	Hong Kong 21; Japan 9; Singapore 6.
Bituminous mixtures	do.	16	18	NA	Thailand 9; Pakistan 5; Japan 4.

r Revised. NA Not available.

[1] Table prepared by P. J. Roetzel and Audrey D. Wilkes.

[2] Less than 1/2 unit.

[3] May include other precious metals.

[4] May include some perlite and chlorite.

TABLE 3

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS					
Alkali and alkaline-earth metals:					
Alkali metals		141	91	(2)	Japan 68; France 22.
Alkaline-earth metals	kilograms	35,996	28,219	27,818	Japan 401.
Aluminum:					
Ore and concentrate		30,363	24,733	NA	Hong Kong 6,880; Guyana 6,408; unspecified 10,271.
Oxides and hydroxides		107,010	118,474	300	Australia 82,915; Japan 31,925.
Ash and residue containing aluminum		—	623	88	Japan 380; Australia 155.
Metal including alloys:					
Scrap		43,244	27,840	15,009	Saudi Arabia 3,941.
Unwrought		513,496	266,575	30,955	Australia 114,774; Canada 39,094.
Semimanufactures		44,461	54,588	14,459	Japan 15,400.
Antimony:					
Ore and concentrate		5,266	3,780	NA	Hong Kong 245; Thailand 103; unspecified 3,357.
Oxides		616	416	(2)	Japan 162; unspecified 183.
Metal including alloys, all forms		725	416	(2)	Hong Kong 20; Panama 20; unspecified 376.
Arsenic:					
Oxides and acids		2	1	—	Mainly from Japan.
Metal including alloys, all forms		NA	15	(2)	NA.
Beryllium: Metal including alloys, all forms	kilograms	480	300	265	Japan 35.
Bismuth: Metal including alloys, all forms	do.	141	100	—	All from Japan.
Cadmium:					
Oxides and hydroxides	do.	60	—		
Metal including alloys, all forms		(2)	38	(2)	Mainly from Japan.
Cesium and rubidium: Metal including alloys, all forms	value, thousands	—	$10	$10	
Chromium:					
Ore and concentrate		41,150	7,408	78	Philippines 7,009.
Oxides and hydroxides		2,668	2,814	826	Japan 1,249; West Germany 312.
Metal including alloys, all forms		—	118	8	Japan 95.
Cobalt:					
Oxides and hydroxides		56	65	2	Belgium-Luxembourg 21; Finland 19; United Kingdom 6.
Metal including alloys, all forms		276	404	12	Zaire 220; Netherlands 68; Belgium-Luxembourg 49.
Columbium and tantalum:					
Ore and concentrate	kilograms	100	50	—	All from Australia.
Metal including alloys, all forms:					
Columbium	do.	—	41	—	All from Japan.
Tantalum		1	3	(2)	Mainly from Japan.
Copper:					
Ore and concentrate		553,628	346,370	68,822	Papua New Guinea 82,809; Chile 62,893.
Matte and speiss including cement copper		9,941	25,114	17,099	United Kingdom 2,423; Chile 2,384.
Oxides and hydroxides		1,292	1,213	1,022	Peru 72.
Sulfate		168	351	24	Japan 48; France 38; unspecified 239.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Copper—Continued				
Ash and residue containing copper	—	22,230	—	All from Japan.
Metal including alloys:				
Scrap	215,937	129,098	70,322	Hong Kong 11,751.
Unwrought	120,012	147,960	19,708	Chile 36,707; Philippines 29,587; Japan 28,423.
Semimanufactures	26,324	43,030	2,750	Japan 16,451; Taiwan 14,705.
Gallium: Metal including alloys, all forms kilograms	—	110	6	France 60; West Germany 25; Japan 19.
Germanium:				
Oxides do.	—	291	—	Japan 211; West Germany 80.
Metal including alloys, all forms do.	—	36	33	West Germany 3.
Gold:				
Ore and concentrate	4,007	417	—	Colombia 356; Mexico 61.
Waste and sweepings value, thousands	—	$136	$136	
Metal including alloys, unwrought and partly wrought kilograms	24,466	7,397	1,195	Australia 3,139; West Germany 1,076.
Hafnium: Metal including alloys, all forms do.	—	5	5	
Indium: Metal including alloys, all forms do.	27	263	7	Peru 62; Japan 33; unspecified 138.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	18,011	20,228	21	Australia 7,863; Brazil 5,386; Peru 2,980.
Pyrite, roasted	9,832	—		
Metal:				
Scrap thousand tons	3,519	3,892	2,433	Australia 382.
Pig iron, cast iron, related materials do.	680	2,790	11	Hong Kong 1,002; unspecified 1,422.
Ferroalloys:				
Ferrocolumbium	171	278	—	Brazil 211; Japan 63.
Ferrochromium	13,572	16,290	160	Philippines 5,449; Zimbabwe 5,382.
Ferromanganese	4,409	3,743	NA	Spain 988; Norway 500; unspecified 2,100.
Ferromolybdenum	541	946	55	Taiwan 254; Netherlands 97; unspecifed 324.
Ferronickel	364	946	—	Colombia 509; Dominica 423.
Ferrosilicochromium	18	18	—	All from Zimbabwe.
Ferrosilicon	43,395	68,440	50	Norway 12,848; Brazil 8,045; unspecified 36,049.
Ferrovanadium	319	492	85	Austria 133; Canada 94; Belgium-Luxembourg 92.
Silicon metal	4,465	4,082	8	Australia 735; unspecified 2,706.
Unspecified	r4,689	6,550	212	Japan 3,321; France 1,045.
Steel, primary forms thousand tons	1,908	632	3	Brazil 179; United Kingdom 169; Taiwan 102.
Semimanufactures:				
Bars, rods, angles, shapes, sections	998,918	765,099	14,510	Japan 398,716; Brazil 112,870.
Universals, plates, sheets thousand tons	1,314	NA		
Hoop and strip	45,751	NA		
Rails and accessories	3,060	2,420	62	Japan 1,432; West Germany 747.
Wire	85,827	17,042	1,239	Japan 13,217; Brazil 998.
Tubes, pipes, fittings	245,599	223,093	11,632	Japan 169,555; West Germany 22,024.
Castings and forgings, rough	2,845	NA		

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988 United States	Sources, 1988 Other (principal)
METALS—Continued					
Lead:					
Ore and concentrate		4,861	1,994	—	All from Canada.
Oxides		11	9	1	West Germany 4; Japan 2.
Ash and residue containing lead		—	155	—	Japan 128; Singapore 27.
Metal including alloys:					
Scrap		45,894	53,902	11,971	Saudi Arabia 12,125; Australia 10,657.
Unwrought		76,529	87,181	1,970	Australia 37,221; Mexico 17,282; Taiwan 8,550.
Semimanufactures		78	313	172	West Germany 104; Japan 32.
Lithium:					
Oxides and hydroxides		588	153	149	France 1.
Metal including alloys, all forms	kilograms	188	366	146	Japan 185.
Magnesium: Metal including alloys:					
Scrap		8	17	17	
Unwrought		1,157	1,673	958	Norway 309; Canada 175.
Semimanufactures		279	370	117	Canada 210.
Manganese:					
Ore and concentrate:					
Battery-grade		5,508	5,172	NA	Singapore 4,394.
Metallurgical-grade		368,372	386,639	68	Australia 170,501; India 95,686; Gabon 36,292.
Oxides		4,117	3,969	22	Japan 1,912; West Germany 511; Belgium-Luxembourg 498.
Metal including alloys, all forms		NA	697	21	Taiwan 208; unspecified 429.
Mercury	kilograms	28,509	33,791	1,771	Japan 18,745.
Molybdenum:					
Ore and concentrate		522	13,520	66	Canada 13,425.
Oxides and hydroxides		—	(2)	—	All from Japan.
Metal including alloys:					
Unwrought		—	3	(2)	Japan 2; United Kingdom 1.
Semimanufactures		32	54	9	Japan 37.
Nickel:					
Matte and speiss	value, thousands	$5	$10	$10	
Oxides and hydroxides		86	99	2	Japan 66; Canada 25.
Metal including alloys:					
Scrap		555	2,077	261	Japan 1,101; Belgium-Luxembourg 196.
Unwrought		4,962	5,260	87	Canada 1,804; Norway 559.
Semimanufactures		2,130	1,099	90	Japan 539; Canada 144; France 119.
Platinum-group metals:					
Waste and sweepings	value, thousands	—	$115	$63	Japan $52.
Metals including alloys, unwrought and partly wrought:					
Palladium	kilograms	NA	333	49	Japan 145; West Germany 112.
Platinum	do.	319	405	147	United Kingdom 176; West Germany 45.
Rhodium	do.	NA	48	(2)	United Kingdom 27; West Germany 17.
Iridium, osmium, ruthenium	do.	NA	17	13	West Germany 2.
Unspecified	do.	146	—		

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Rare-earth metals including alloys, all forms	19	35	17	NA.
Selenium, elemental	12	10	—	Japan 9; Belgium-Luxembourg 1.
Silicon, high-purity	—	472	48	NA.
Silver:				
Waste and sweepings[3] value, thousands	$1,703	$28	—	All from Japan.
Metal including alloys, unwrought and partly wrought kilograms	11,276	66,760	2,933	Mexico 51,965; Canada 2,849.
Tellurium, elemental do.	80	274	24	Japan 150; United Kingdom 100.
Tin:				
Ore and concentrate	3,698	4,123	79	Thailand 400; Hong Kong 187; unspecified 3,002.
Oxides	1	4	(2)	Japan 3; United Kingdom 1.
Metal including alloys:				
Scrap	3	40	—	All from Japan.
Unwrought	4,295	4,924	1	Malaysia 3,509; Indonesia 1,063.
Semimanufactures	415	326	109	Japan 149; Malaysia 37.
Titanium:				
Ore and concentrate	63,918	62,117	NA	Malaysia 53,822; Australia 7,493.
Oxides	3,558	4,710	86	Japan 2,599; West Germany 1,157.
Metal including alloys:				
Scrap	—	7	NA	United Kingdom 5.
Unwrought	80	93	1	Japan 90.
Semimanufactures	261	386	54	Netherlands 81; Japan 52.
Tungsten:				
Oxides and hydroxides	(2)	489	(2)	Mainly from Taiwan.
Metal including alloys:				
Unwrought	—	1	(2)	Japan 1.
Semimanufactures	r120	66	8	Japan 51; Austria 3.
Uranium and thorium:				
Ores and concentrates	18	—		
Oxides and other compounds	—	80	76	West Germany 4.
Uranium metal including alloys, all forms value, thousands	$5	$9	$5	West Germany $4.
Vanadium:				
Oxides and hydroxides	5	7	(2)	Mainly from Japan.
Metal including alloys, all forms kilograms	—	106	5	Japan 101.
Zinc:				
Ore and concentrate	408,138	456,345	NA	Australia 205,348; Canada 176,141.
Oxides	309	660	74	Japan 216; Taiwan 170; France 80.
Blue powder	NA	17	—	All from Portugal.
Matte	—	2,358	1,487	Japan 662.
Ash and residue containing zinc	856	1,289	113	Saudi Arabia 632; Japan 342; Canada 162.
Metal including alloys:				
Scrap	10,010	12,881	1,616	Japan 6,819.
Unwrought	36,388	20,453	137	Mexico 4,147; Belgium-Luxembourg 2,749; unspecified 5,724.
Semimanufactures	1,308	1,175	21	Japan 829; Peru 238.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued					
Zirconium:					
Ore and concentrate		19,002	24,430	146	Australia 14,808.
Oxides		—	41	2	United Kingdom 21; Japan 10; France 8.
Metal including alloys:					
Scrap		—	66	16	Japan 50.
Unwrought		—	7	NA	NA.
Semimanufactures		—	45	18	France 15; Canada 9.
Other:					
Ores and concentrates		([4])	34	—	All from Philippines.
Oxides and hydroxides		71	28	([2])	Japan 18; United Kingdom 10.
Ashes and residues		r630	11,225	62	Japan 10,959.
Base metals including alloys, all forms		r553	6	1	Japan 3.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		16,309	608,889	2,820	Japan 324,828; Indonesia 199,582.
Artificial:					
Corundum		29,139	34,845	411	Japan 13,614; Brazil 3,064.
Silicon carbide		8,699	12,168	18	Italy 1,485; West Germany 1,411; unspecified 1,923.
Dust and powder of precious and semiprecious stones excluding diamond	kilograms	772	5,797	57	Japan 5,440.
Grinding and polishing wheels and stones		1,309	1,418	72	Japan 1,065.
Asbestos, crude		77,596	87,470	1,535	Canada 43,151; Zimbabwe 8,976.
Barite and witherite		3,241	3,533	NA	Thailand 1,877; United Kingdom 1,038; Ireland 388.
Boron materials:					
Crude natural borates		2,523	2,185	2,185	
Elemental	kilograms	—	433	96	West Germany 277; Japan 60.
Oxides and acids		2,932	3,467	2,437	Italy 828.
Bromine		163	286	88	Italy 65.
Cement		7,691	164,714	84	Indonesia 125,169; India 32,912.
Chalk		4,950	15,896	—	France 15,707.
Clays, crude:					
Bentonite		3,749	10,728	4,765	Greece 5,000.
Chamotte earth		11,589	7,109	788	Hong Kong 1,800; unspecified 4,264.
Fire clay		—	199	68	Japan 71.
Kaolin		112,041	148,077	82,918	Japan 19,676; Hong Kong 16,793.
Unspecified		104,089	13,376	7,794	Hong Kong 3,471; Japan 1,832.
Cryolite and chiolite		40	21	—	Japan 10; Denmark 6; West Germany 5.
Diamond:					
Natural:					
Gem, not set or strung	carats	[5]45,000	14,980	900	Taiwan 4,000; Hong Kong 3,610.
Industrial stones	do.	30,000	235,115	56,425	Ireland 133,500; Japan 22,455.
Dust and powder	kilograms	19	249	154	Belgium-Luxembourg 92; United Kingdom 3.
Synthetic:					
Gem, not set or strung	carats	1,000,000	175,050	78,330	Japan 53,550; West Germany 21,950.
Dust and powder	kilograms	2,749	4,038	1,067	Ireland 2,533; Japan 397.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988 United States	Sources, 1988 Other (principal)
INDUSTRIAL MINERALS—Continued					
Diatomite and other infusorial earth		96	345	109	Japan 194; Spain 40.
Feldspar, fluorspar, related materials:					
Feldspar		1,905	2,849	54	Japan 1,752; Hong Kong 450.
Fluorspar		61,752	50,453	19	Thailand 25,716; Taiwan 7,851.
Unspecified		—	21	—	All from Norway.
Fertilizer materials: Manufactured:					
Ammonia		422,975	397,495	269,285	Indonesia 67,201; Saudi Arabia 36,204.
Nitrogenous		22,931	29,879	1,400	West Germany 2,265; unspecified 25,526.
Phosphatic		3	500	—	All from Japan.
Potassic		697,864	662,938	444	Canada 492,315; Jordan 77,100.
Unspecified and mixed		883	1,011	10	Belgium-Luxembourg 162; unspecified 774.
Graphite, natural		3,784	5,942	1	Japan 345; Hong Kong 329; unspecified 5,099.
Gypsum and plaster		198,685	395,177	560	Thailand 360,525.
Iodine		13	11	NA	Chile 6; Japan 2.
Kyanite and related materials:					
Andalusite		4,791	3,269	NA	Hong Kong 400; unspecified 2,869.
Kyanite		791	1,561	1,480	Sweden 81.
Mullite		7,172	4,710	1,421	Japan 3,289.
Lime		41	103	NA	Japan 98.
Magnesium compounds:					
Magnesite, crude		4,700	3,870	40	Japan 265; unspecified 3,529.
Oxides and hydroxides		54,509	85,370	201	Japan 17,049; unspecified 61,175.
Other		—	388	—	West Germany 200; Japan 90; Taiwan 44.
Mica:					
Crude including splittings and waste		1,084	1,925	341	Malaysia 1,008; India 405.
Worked including agglomerated splittings		403	401	17	Japan 191; Belgium-Luxembourg 138.
Nitrates, crude		7,798	8,202	NA	China 7,421.
Phosphates, crude	thousand tons	1,702	1,653	1,366	Jordan 153.
Phosphorous, elemental		2,319	3,539	2,554	NA.
Pigments, mineral:					
Natural, crude		119	158	2	Austria 96; Japan 32; United Kingdom 24.
Iron oxides and hydroxides, processed		15,228	22,401	2,603	Japan 12,875; Australia 2,160.
Precious and semiprecious stones other than diamond:					
Natural	kilograms	272,305	303,675	38,511	Brazil 156,918; Japan 28,143.
Synthetic	do.	206,880	224,111	163,595	Taiwan 24,129.
Quartz crystal, piezoelectric	do.	NA	10,365	808	Belgium-Luxembourg 7,190; Japan 2,067.
Salt and brine	thousand tons	1,103	1,053	([2])	Australia 827; Mexico 101.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		44,310	110,654	110,649	Japan 5.
Sulfate, manufactured		59,731	80,677	105	Taiwan 5,483; Japan 3,240; unspecified 69,239.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		4,936	75,875	2,514	India 66,352.
Worked		4,253	17,701	154	Italy 15,059.
Dolomite, chiefly refractory-grade		425	876	—	United Kingdom 661; Norway 195.
Gravel and crushed rock		2,642	2,481	101	France 1,517; Japan 649.
Limestone other than dimension		5,779	89,594	([2])	Mainly from Japan.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued				
Quartz and quartzite	1,146	1,862	63	Sweden 752; Japan 327; Singapore 326.
Sand other than metal-bearing	260,925	389,436	449	Australia 326,787; Malaysia 56,600.
Sulfur:				
Elemental:				
Crude including native and byproduct	521,005	585,328	20,639	Canada 431,615; Japan 133,074.
Colloidal, precipitated, sublimed	1,903	2,531	1,525	Japan 925.
Dioxide	1	—		
Sulfuric acid	108,749	44,414	1,013	Japan 43,399.
Talc, steatite, soapstone, pyrophyllite	63,938	96,313	5,175	Hong Kong 1,773; unspecified 88,540.
Vermiculite[6]	—	22,072	95	Japan 11,690; Philippines 3,487.
Other:				
Crude	[r]94,094	55,106	2,249	Japan 32,735; Australia 3,767.
Slag and dross, not metal-bearing	9,530	308,942	—	Japan 306,319.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	80	201	201	
Carbon black	6,992	9,297	1,946	Japan 3,315.
Coal:				
Anthracite thousand tons	3,433	2,803	329	Australia 204; unspecified 2,153.
Bituminous do.	18,386	21,913	3,197	Australia 8,350; Canada 4,772.
Briquets of anthracite and bituminous coal	103	1	—	All from Japan.
Lignite including briquets	39,280	20,989	—	Mainly from Australia.
Coke and semicoke	134,929	189,044	16,805	Japan 123,572; Australia 29,973.
Gas, natural: Liquefied thousand tons	1,687	1,898	(2)	Mainly from Indonesia.
Peat including briquets and litter	83	181	—	Canada 168.
Petroleum:				
Crude thousand 42-gallon barrels	[r]206,216	237,414	NA	Oman 42,635; United Arab Emirates 39,825; unspecified 46,675.
Refinery products:				
Liquefied petroleum gas do.	[r]9,813	14,427	(2)	Saudi Arabia 8,131; Kuwait 3,766; United Arab Emirates 1,850.
Gasoline do.	[r]120	24,468	1	Australia 24,466.
Naphtha do.	9,919	7,635	121	Saudi Arabia 2,199; Singapore 1,453; Philippines 716.
Mineral jelly and wax do.	109	124	10	Japan 70.
Kerosene and jet fuel do.	[r]3,129	457	(2)	Singapore 335; Japan 114.
Distillate fuel oil do.	[r]10,372	9,306	1,107	Saudi Arabia 3,538; Japan 1,723.
Lubricants do.	349	2,671	35	Japan 2,620.
Residual fuel oil do.	16,118	12,165	4,347	Singapore 2,235; Saudi Arabia 1,746.
Bitumen and other residues do.	(2)	—		
Bituminous mixtures do.	4	118	19	United Kingdom 97.
Petroleum coke do.	1,058	1,125	709	Australia 333.

[r] Revised. NA Not available.
[1] Table prepared by P. J. Roetzel and Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] May include other precious metals.
[4] Revised to zero.
[5] Excludes unreported quantity valued at $799,000.
[6] May include some perlite and chlorite.

1991. Technical assistance will come from Japan's Nippon Light Metal Co. Ltd. The mill, which represents an investment of $343 million, will feature automated hot-rolling and cold-rolling facilities. The company presently operates a 17,500-ton-per-year smelter in Ulsan. Annual demand for aluminum products was estimated at 100,000 tons.

Bismuth.—Bismuth production fell as a result of the lower bismuth content in tungsten ores and was about 80 tons. Korea Tungsten Mining Co. Ltd. produces bismuth as a byproduct of its tungsten mining, and the bulk of its output is exported to Japan.

Copper.—Poongsan Metal Corp., founded in 1968, is the country's largest producer of copper products and brass with export turnover of more than $600 million per year. Poongsan Metal's new flat-rolled copper operation at Cedar Rapids, IA was expected to come on-stream by late 1991. The plant will be equipped with four rolling mills, several advanced casting machines, and four flat-rolled coil slitters to produce copper and copper alloys from copper scrap. Output of the plant would be 6,500 tons per month. Poongsan invested $127 million on the facility, purchased production equipment from ArrowHead Metals Ltd. of Toronto, and established PMX Industries as its U.S. subsidiary. It was also considering building a stainless steel flat-roll mill, possibly at the same site.

Poongsan also agreed with three Japanese mining companies to set up a joint-venture firm, Japan Copper Casting Co. Ltd., in Tokyo to make oxygen-free copper products used in electronic parts. Poongsan's proposed joint venture with Padaeng Industry Co. of Thailand for manufacturing copper products was in the advanced stage of negotiations.

Iron and Steel.—The Republic of Korea registered a double-digit percentage increase (14.2%) over that of 1988 in raw steel production, reaching 21.8 million tons. Progressive commissioning of Posco's Kwangyang works was the contributing factor. Total steel consumption was 16.9 million tons, up 16.7% over that of 1988. During 1989, the country exported 7 million tons of steel, representing a rise of 5.2% over that of the previous year.

There are 13 steelmaking companies and 71 rolling enterprises in the country. The largest steel producer is Posco, while the other major steelmakers are Dongkuk Steel Mill Co. Ltd., Inchon Iron and Steel Co. Ltd., and Sammi Steel Co. Ltd. The major rolled steel producers are Union Steel Manufacturing Co. Ltd. and Dongbu Steel Co. Ltd. Cheap labor was a major factor in keeping the costs down for the country's producers. The Republic of Korea remained the lowest cost steelmaker among the market economy countries at $418 per ton.

The third phase of expansion at Kwangyang was on schedule during 1989, and completion of the third blast furnace was expected in January 1991, thus increasing raw steel capacity by another 2.7 million tons per year. The contract for the fourth blast furnace was signed with Davy McKee Co. Ltd. of the United Kingdom in December. The hearth furnace will be the same as the three previous ones with a 13.2-meter diameter and 8,200-ton-per-day-capacity. Construction of phase four will be completed by the end of 1992 and add the same capacity of 2.7 million tons per year. Phases three and four will share infrastructure facilities. In view of the expansion scheme, Posco's capacity will reach 18 million tons by early 1991 and 21 million tons by the end of 1992. Posco will then be the world's second largest steelmaker after Nippon Steel Corp. of Japan. The country's total steel production capacity, including some minor makers, is expected to reach 26.3 million tons, meeting about 80% of domestic needs.

A new cold-roll mill was started up also at Kwangyang in January with a capacity of 1.22 million tons per year. Another major cold-rolled coil producer, Union Steel Co. Ltd., having a capacity of 880,000 tons per year, was shut down during the early part of the year because of a labor dispute.

In March, Posco's new stainless steel mill at Pohang, with a capacity of 250,000 tons per year, was commissioned and produced 110,000 tons of hot-rolled stainless steel during the year. The 50,000-ton-per-year capacity cold mill will be commissioned in July 1990.

USX-Posco Industries, a joint venture between U.S. Steel Corp. and Posco in Pittsburg, CA, produces cold-rolled steel plates. A $437 million facility-expansion project was completed in April to in-

TABLE 4

REPUBLIC OF KOREA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year)
Aluminum, primary	Aluminum of Korea Ltd.	Ulsan	17.5
Bismuth, metal	Korea Tungsten Mining Co. Ltd.	Sangdong	0.135
Cement	Ssangyong Cement industrial Co. Ltd.	Yongwol	11,500
Copper, metal	Lucky Metals Co. Ltd.	Changhang	50
Do.	do.	Onsan	150
Graphite	Kaerion Graphite Ltd.	Kangwon	25
Do.	Wolmyong Mining Co.	do.	26
Lead, metal	Lucky Metals Co. Ltd.	Changhang	15
Do.	Korea Zinc Co. Ltd.	Onsan	80
Nickel, metal	Korea Nickel Corp.	do.	12
Steel	Pohang Iron and Steel Co. Ltd.[1]	Kwangyang	5,400
Do.	do.	Pohang	9,100
Talc	Dongyang Talc Mining Co.	Chungju	NA
Tungsten, in ore	Korea Tungsten Mining Co. Ltd.	Sangdong	3
Zinc, metal	Korea Zinc Co. Ltd.	Onsan	165
Do.	Young Poong Corp.	Sukpo	75

NA Not available.
[1] Mostly government owned.

crease production capacity to 1.36 million tons per year of flat-rolled carbon steel. The new facility used up to 1.5 million tons per year of outside hot bands, including 40,000 tons from Pohang.

Posco, which currently exports steel products to China via Hong Kong or Singapore, was negotiating an agreement to ship more than 1 million tons of steel goods per year directly to China while importing Chinese iron ore. It was trying also to tap a new export market in the U.S.S.R., directly shipping more than 10,000 tons of cold-rolled coil in 1989. Posco also shipped about 400 tons of galvanized sheet to Vietnam during the latter part of the year. Import of iron ore from India was to be 3.5 million tons per year for the next 4 years. Posco imported about 26% of its iron ore requirement from Brazil. In 1990, it intends to increase the tonnage bought from both Brazil and other countries, including Australia, Chile, and Peru.

Dae Yang Metal Co. Ltd. operated at 50% of capacity a 40,000-ton-per-year plant at Panwon, near Seoul, and produced cold-roll metal from imported hot-rolled coils. Meanwhile, Inchon Iron and Steel Co. Ltd. commissioned its 50,000-ton-per-year cold-rolled stainless mill in November.

Lead and Zinc.—The domestic demand for lead was expected to reach 186,000 tons in 1989; however, production level was about 106,000 tons. A considerable amount of lead was imported from Australia, Canada, and Mexico. The country's total production capacity is estimated to be 130,000 tons per year.

Lucky Metals Co. Ltd. (formerly Korea Mining and Smelting Co. Ltd.) announced in November that it was closing its aging lead smelter in Changhang, 180 kilometers (km) south of Seoul on the west coast, in March 1990. The smelter produced 15,000 tons of lead ingot per year. Two major suppliers of lead concentrate to the smelter were Young Poong Corp. at 1,000 tons per month and Dong Bang Mining Co. Ltd. at 600 tons per month. Meanwhile, Korea Zinc Co. Ltd. was planning to commission a 60,000-ton-per-year lead smelter at Onsan, south of Pohang, in June 1991. At that time, total production capacity would be increased to 190,000 tons per year.

Zinc consumption and production were 192,000 tons and 242,000 tons, respectively. The production surplus was exported to Japan and the United States. Japanese imports of Korean zinc were near 40,000 tons. In the first half of 1989, 25,127 tons of Korean metal reached the Japanese market, while imports of about 15,000 tons were expected in the second half. The country's total zinc production capacity is 247,000 tons per year. Zinc concentrates were imported from Australia, Canada, and Peru.

Nickel.—The country's first 12,000-ton-per-year nickel smelter at Onsan, run by Korea Nickel Corp. (owned by Korea Zinc, 55%; Inco, 25%; and Keo-Yang, 20%), produced 430 tons of utility nickel (nickel content 90%) in June and 700 tons per month during July and August. The main buyer, Posco, was expected to take about 500 tons per month in 1989 and 1990. When Posco expands its hot stainless coil production capacity in 1991, the intake will be increased to 600 tons per month. The feed of nickel oxide sinter to the smelter came either from PT Inco or from Canadian sources.

Tin.—Lucky Metals, using electrolytic process to treat low-grade concentrate, increased capacity to 70 tons of tin metal per month. Meanwhile, Keymetals Korea Co. Ltd. was operating below its capacity.

Tungsten.—Korea Tungsten Mining Co. Ltd. began commercial operation of a new tungsten wiremaking plant with rated production capacity of 2 tons per month at its Daegu works. The new plant was built under a technical cooperation agreement with Lamp Metal of the United Kingdom. The country's annual consumption of tungsten wire was 50 tons, and one-half of the demand would still be imported from Japan and the United States.

Hyundai Corp., together with Korea Tungsten Mining, was studying the feasibility of establishing a tungsten processing venture in China. Low-quality Chinese tungsten ore would be refined into high-grade material, aimed mostly at export markets.

Industrial Minerals

Mica.—The Republic of Korea, an emerging major producer, accounted for as much as 12% of world production of crude mica. Most of the output was consumed by the domestic fabricating industry.

Titanium Dioxide.—The Government approved in December a plan to construct a titanium dioxide plant in the country by E. I. du Pont de Nemours & Co. of the United States. The approval was contingent upon further in-country testing of the byproduct aggregates and Du Pont's compliance to the country's environmental laws and regulations.

Mineral Fuels

The country's only indigenous energy resource is anthracite coal. However, declining production is not sufficient for the reduced demand. Imports of additional anthracite, as well as bituminous coal, oil, and liquefied natural gas (LNG) are necessary to fulfill the nation's energy requirements. Thermal and nuclear powerplants contribute equally to the bulk of domestic electric power generation, whereas small hydropower plants provide the remainder.

Coal.—Imports and consumption of anthracite were declining. However, imports of bituminous coal were expanding for big users such as Kepco, Posco, and Ssangyang Cement Industrial Co. Ltd. for power generation and for the steel and cement industries.

Domestic production of anthracite totaled 20 million tons, down from 24.3 million tons in 1988. The forecast in production is 18.3 million tons in 1990, 16.5 million tons in 1992, and 16 million tons in 1994. Demand for anthracite was 24 million tons, down from 25.6 million tons in 1988. The forecast in demand is 21.6 million tons in 1990, 18 million tons in 1992, and 16.8 million tons in 1994. Imports of anthracite accounted for 90% of total anthracite demand and were 1 million tons, down from 1.7 million tons in 1988. The estimated level of imports was 1 million tons in 1990 and was to hold at that level through 1994.

Hyosung Corp., a trading company, imported 20,000 tons of anthracite coal from North Korea. Hyosung received pulverized coal instead of the lump coal it ordered. Ssangyong Corp., another trading company, canceled an order of 20,000 tons of North Korean anthracite because of problems with coal quality. Samsung Co. was also reported to be not satisfied with the delivery and quality of North Korean coal.

Imports of bituminous coal were 23.3 million tons, up from 22 million tons in 1988. Of this, 33.2% came from Australia, 22.1% from Canada, and 16% from the United States.

The Government was considering legalizing the use of foreign workers from such countries as Bangladesh, Guatemala, India, and the Philippines to make up for a shortage of miners at local coal mines. About 43,900 Korean miners are now employed at the country's 240 mines, a shortfall of 2,800 workers from optimum operation levels.

Liquefied Natural Gas.—The consumption of LNG totaled more than 1.9 million tons and was expected to reach more than 2 million tons in 1990. LNG imports increased 35% over that of last year. In an effort to satisfy the growing demand, the Government was to find another LNG import source in addition to Indonesia in 1990 and increase the annual LNG receiving capacity to 7 million tons by 1996. The country intends to double its imports of LNG to 4 million tons per year in the near future and to 6 million tons by the year 2000. Indonesia currently provides 2 million tons per year under a 20-year contract. U.S. and Canadian suppliers would be approached as sources.

Petroleum.—The country's oil consumption was 287.3 million barrels, up 10.1% from a year earlier. Oil consumption as a percentage of total energy use was 49.6% compared with 47% in 1988. Coal supplied 33% of the energy needs, while LNG represented only 4% of the mix. Oil demand will rise an average of 11.7% annually over the 1990-94 period. The cost of oil imports was about $4.9 billion, up 28% from that of 1988. Oil imports were more than 20 million barrels above the level of imports of the previous year.

The expansion in domestic oil refining capacity caused severe competition among five refiners. The industry's total capacity now stands at 840,000 barrels per day, operated at 96% of rated capacity, and is expected to reach 1.24 milliom barrels per day in 1992. Three smaller companies—Kyung In Energy Co., Ssangyong Oil Refining Co., and Kukdong Oil Co.—will each increase its refining capacity from 60,000 to 160,000 barrels per day.

The country is short of energy for its industrial sector, and residential demand has been steadily increasing as well. To search for oil, the Ministry of Energy and Resources approved a proposal submitted by British Petroleum PLC, Korea Petroleum Development Corp., and Japan National Oil Corp. to explore two oil beds off the southern coast of Cheju Island. The three partners will drill more than three wells from 1989 through 1997.

Korea Petroleum Development Corp. in November spudded an $8 million wildcat on a gas prospect in the Korea Strait, 128 km east of Ulsan. Identified resource potential is estimated at 42.5 billion cubic meters.

Yukong Ltd. and European firms discovered oil in eastern Ecuador after 2 years of exploration. The partners were British Gas, 37.5%; Total of France, 25%; and Maersk of Denmark, 12.5%. Yukong has invested more than $8 million on the overseas venture. The Republic of Korea's two producing ventures abroad are West Madura in Indonesia and Marib in North Yemen.

Yukong also signed an agreement with Burma Oil and Gas Enterprise to explore the Chindwin basin in northern Burma by spending $47 million during the next 5 years on a 39,000-square-kilometer tract.

Reserves

Anthracite coal is the most important mineral resource in the country. Indigenous metallic minerals include ores of lead and zinc and tungsten, the latter being significant in terms of world output, but not in reserve base. Industrial minerals with a large share of world production are diatomaceous earth, feldspar, graphite, mica, pyrophyllite, and talc. Major mineral reserves of the country are tabulated as shown in table 5.

INFRASTRUCTURE

The country's transport system is well developed. Railroads with a total length of 3,110 km are state run. National highways total 13,400 km and provincial and local roads, 49,500 km. The use of inland waterways is considerably limited because of rugged terrain. Port facilities are adequate, with Pusan being the largest among 11 major ports. Kwangyang Port is being built to handle iron ore and Pyongtaek Port as an LNG import terminal. Marine cargo accounts for 45% of the total cargo transported in the nation.

TABLE 5

REPUBLIC OF KOREA: RESERVES OF MAJOR MINERALS

Major commodity	Reserves (thousand tons)
Bismuth	4
Coal, anthracite	1,450,600
Graphite	39,500
Pyrophyllite and talc	15,000
Tungsten, in ore	60
Zinc, in ore	10,800

OUTLOOK

The iron and steel industry was under the influence of sluggish performance of automobiles and electronics industries in 1989. Forecasts call for slow growths of 7.8%[3] in domestic demands for steel products and of 4.4% in exports during 1990. Decreasing demands from the related industries and the reduction of exports to China will continue for a short period of time beyond 1990. Meanwhile, expansion of production facilities in the industry will prepare for the surging demands in volume and the need of special steel and high-quality cold coil in the future when the country's economy upturns.

Good performance of housing and public construction sectors will boost the cement industry's production to meet the expected demand increase of 6% and same level of exports in 1990. The industry may face oversupply problems when new and expanded capacities are added after 1991. It will also have to cope with the problems of rationalization of distribution system and environmental pollution.

The oil refining industry can expect a 16.6% growth over 1989 because of low oil prices, consumers' preference to high-quality heating fuels, and increasing demands from petrochemical industry and transportation sectors. However, the decrease in demand resulting from the continuous decline of overall economic growth may hinder the expected expansion of refining facilities.

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[1] Korea Economic Update, Washington, DC, Feb. 13, 1990, p. 1.

[2] Where necessary, values have been converted from Korean won (W) to U.S. dollars at the rate of W680 = US$1.00 for 1989.

[3] Korean Business Review, Seoul, Korea, Feb. 1990, p. 18.

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Agencies

Korea Institute of Energy and Resources
219-5, Garibong-dong
Kuro-gu Seoul, Republic of Korea

Ministry of Energy and Resources
1, Chungang-dong, Kwach on
Kyonggi Seoul, Republic of Korea

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1, Chungang-dong, Kwach on,
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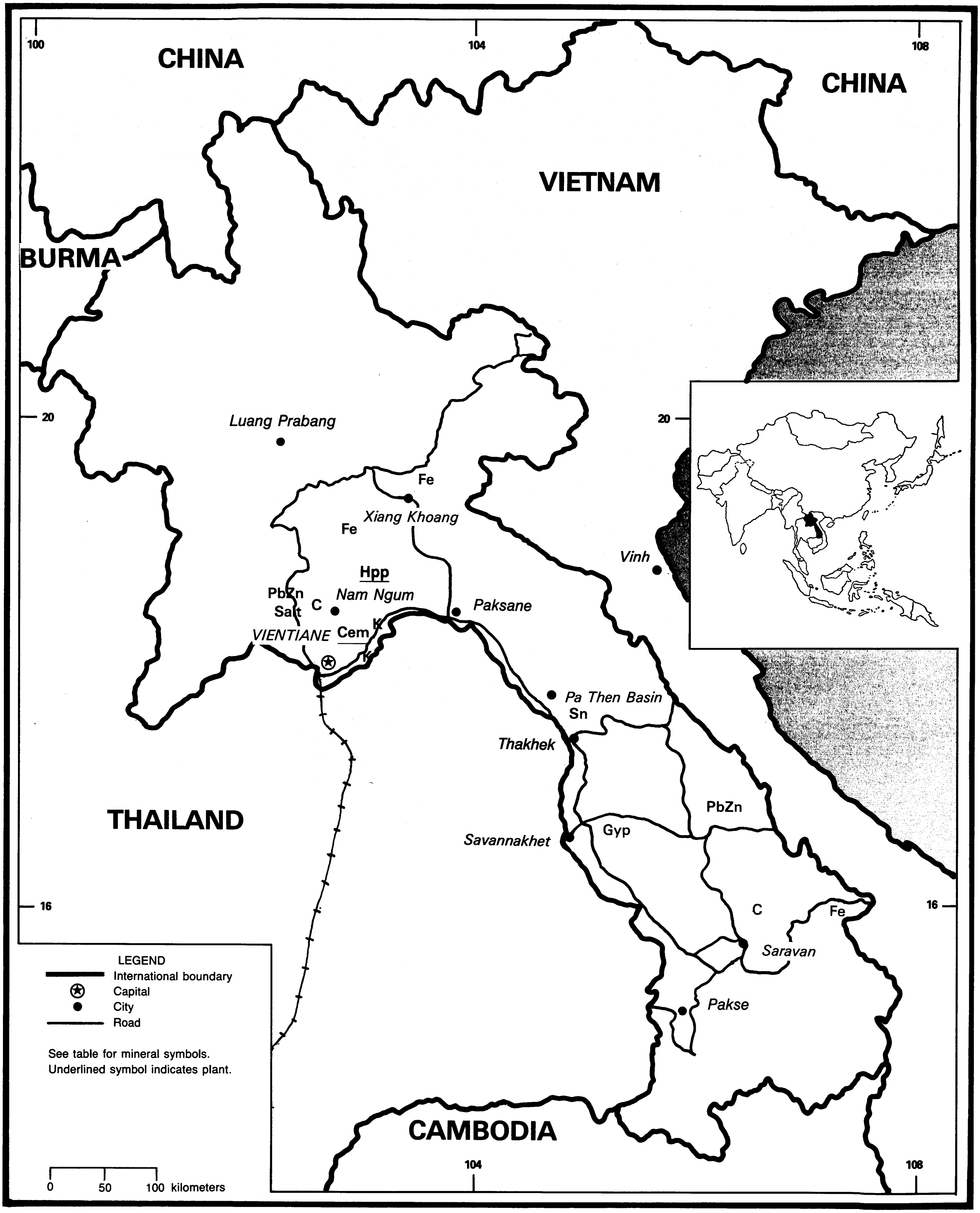
LAOS

AREA 236,800 km² **POPULATION 4.0 million**



THE MINERAL INDUSTRY OF

LAOS

By David B. Doan

Laos is a small and poor country with a miniscule mineral industry, but during 1989 it made some progress in production of mineral commodities and in organizing for mineral development. Its agrarian economy, much of it slash-and-burn cropping, supported the great majority of Lao people; consequently, there was little understanding of mineral production. The Government's recognition of the need for mineral exploration and development throughout the country led to the adoption of legal measures designed to encourage both domestic and foreign participation. With an estimated per capita gross domestic product of about $140[1] coupled with an inflation rate of 19% in 1988 and increasing to almost twice that much in 1989, the country obviously could benefit from the tapping of its mineral resources. The development of a mining sector would lead to new sources of revenue and the creation of jobs that would be independent of the agricultural sector.

GOVERNMENT POLICIES AND PROGRAMS

The Government established a new law designed to attract foreign investment capital, authorizing both joint ventures and wholly owned foreign investment projects. The new code guarantees remittance of profits as well as protection against nationalization.

Late in the year an agreement was negotiated for a project financed by the United Nations Development Program (UNDP) to strengthen the capacity of the Department of Geology and Mines, of the Ministry of Industry and Handicrafts, for mineral exploration and development. The agreement would provide for rehabilitation of mineral and chemical laboratories and support a geochemical survey and mineral-inventory data base. The UNDP's award was nearly $1.2 million, although the Government's contribution was about $34,000 at 1989 exchange rates.

Laos' Second 5-Year Plan, ending in 1990, aimed for doubling exports and nearly doubling industrial production together with significant improvement of the transportation infrastructure. It was, however, far from clear that these goals would be achieved. The future role of the U.S.S.R., heretofore the largest provider of aid to Laos, seemed likely to diminish.

PRODUCTION

Mining of tin continued its decline, while local people in the mining district lost interest because of problems in bartering for desired goods as payment for their work. However, the same individual prospectors for tin may have switched to a search for gem stones, whose production was thought to be double that of the previous year. Output of cement was up significantly, probably stimulated by the realization that much of it will be needed as Laos builds the roads and bridges so sorely needed in the expansion of its infrastructure. Rock salt production was down, possibly reflecting increased production in northeastern Thailand, on the other side of the Mekong River. Output of gypsum climbed but, at 104,000 tons in 1989, was not yet back to the 130,000-ton level of 1986.

TRADE

Laos was not a major trading nation and barely a subordinate one so far as world mineral commodities were concerned. All of its relatively minor tin production was thought to be exported to nearby Thailand. Gypsum was believed to be largely sold to neighboring Vietnam. Probably the most significant export of Laos was electricity. Most of the production by the 150-megawatt Nam Ngum hydroelectric plant, 65 kilometers (km) north of Vientiane, was purchased by Thailand. This has been the largest source of foreign-exchange credits to Laos. The country's modest mineral needs, primarily petroleum products, cement clinker, and fertilizer, were imported from Vietnam, Thailand, and other countries via Thailand.

TABLE 1

LAOS: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989
Cement (from imported clinker)		[3]2,500	4,000	4,500	4,500	[3]6,875
Gem stones (sapphires)	carats	—	3,000	8,000	15,000	[3]32,825
Gypsum		110,000	130,000	70,000	[3]80,000	[3]104,000
Salt, rock		10,000	30,000	13,000	30,000	[3]7,950
Tin, mine output, Sn content		[3]540	550	450	[3]300	[3]281

[1]Table includes data available through Aug. 10, 1990.
[2]In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

STRUCTURE OF THE MINERAL INDUSTRY

The mineral industry of Laos was essentially unstructured, but the situation was undergoing change. Although private-sector activity in the mineral industry was excluded until 1987, reforms in the old laws have led to foreign interest in mineral development. Private-sector interest was initially attracted to exploration for petroleum and gold, and then to other commodities such as coal and gem stones, which were beginning to receive attention from potential capital sources in other countries.

COMMODITY REVIEW

Metals

Gold.—As one of the first mineral agreements signed with a foreign entity, the Government granted a 20-year concession for exploration and mining of gold and other minerals to a Thai-Australian joint venture. The 130 square kilometers (km^2) concession was about 60 km west of Vientiane, reportedly near "Sannakham" (Ban Na Khan) opposite Thailand's mineral-rich Loei Province on the other side of the Mekong River. The concession would be worked by the joint-venture partners consisting of Kumpu Siam Co. Ltd. of Thailand and Australian Pacific Resources Pty. Ltd. of Australia. Investment for stage 1, including exploration and possibly exploitation, thought to require 2 to 5 years, was to be approximately $500,000. Both lode ("hard-rock") and alluvial gold deposits are known in Loei. Net benefits from any gold produced during the first stage would be split equally between the joint-venture company and the Laotian Government, and the latter will have right of first refusal to purchase gold produced by the company.[2]

Tin.—The main production center for tin in Laos, Phon Tiou, is situated on a Mekong River tributary about 35 km

TABLE 2

LAOS: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988[p]	Destinations, 1988: United States	Destinations, 1988: Other (principal)
Abrasives, n.e.s.	value, thousands	$90	—		
Aluminum: Metal including alloys, scrap		926	4,365	—	All to Thailand.
Coal, all grades		—	10	—	Do.
Copper: Metal including alloys, all forms		398	1,795	—	Thailand 1,782; China 13.
Diamond, natural gem, not set or strung	value, thousands	$1	—		
Fertilizer materials: Manufactured:					
Ammonia		—	502	502	
Nitrogenous		—	2,218	2,218	
Potassic		—	210	210	
Gypsum and plaster		682	NA		
Iron and steel:					
Iron ore and concentrate including roasted pyrite		—	67,250	67,250	
Metal:					
Scrap		408	35,941	—	All to Thailand.
Pig iron, cast iron, related materials		—	26	—	All to Austria.
Semimanufactures		2	75	—	All to China.
Lead: Metal: Scrap		—	25	—	All to Thailand.
Precious and semiprecious stones: Natural	kilograms	—	1	—	Do.
Salt and brine		7,838	—		
Stone, sand and gravel:					
Dimension stone: Crude		32	—		
Limestone		13,805	—		
Tin: Ore and concentrate		—	4	—	All to Malaysia.
Other:					
Crude, nonmetals		24	54	—	All to China.
Base metals including alloys, all forms		[2]9	35	—	Do.

[p]Preliminary. NA Not available.

[1]Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Laos, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from United Nations information and data published by the partner trade countries.

[2]Excludes unreported quantity imported by United States valued at $33,000.

TABLE 3

LAOS: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988[p]	Principal sources, 1988
METALS				
Alkali and alkaline-earth metals		—	46	All from Thailand.
Aluminum: Metal including alloys, all forms		[2]58	4	Do.
Cobalt: Ore and concentrate	kilograms	—	35	Do.
Copper: Metal including alloys, all forms		1	8	Do.
Iron and steel: Metal:				
Pig iron, cast iron, related materials		—	2	All from China.
Ferroalloys		50	—	
Semimanufactures:				
Bars, rods, angles, shapes, sections		924	597	All from Japan.
Universals, plates, sheets		120	—	
Wire		50	—	
Tubes, pipes, fittings		227	12	Japan 7; China 5.
Unspecified		3,541	3,587	All from U.S.S.R.
Lead: Metal including alloys, all forms	kilograms	2,000	246	All from Thailand.
Nickel: Metal including alloys, all forms	value, thousands	$1	—	
Silver: Metal including alloys, unwrought and partly wrought	do.	$1	—	
Titanium: Oxides	kilograms	—	14	All from Thailand.
Zinc:				
Ore and concentrate		630	—	
Oxides		1	—	
Metal including alloys, all forms		957	1,583	All from Thailand.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones	kilograms	8,000	1,804	Thailand 1,329; Japan 475.
Cement		18,068	239	All from China.
Chalk	kilograms	—	332	All from Thailand.
Clays, crude	do.	—	500	Do.
Diamond, natural gem, not set or strung	value, thousands	—	$236	All from Belgium-Luxembourg.
Fertilizer materials: Manufactured:				
Ammonia		1	7	All from Thailand.
Nitrogenous		447	108	Do.
Unspecified and mixed		[3]550	140	Mainly from Belgium-Luxembourg.
Gypsum and plaster		—	26	All from Hong Kong.
Potassium salts, crude		34,507	NA	
Salt and brine		159	169	Thailand 114; China 55.
Sodium compounds, n.e.s.: Sulfate, manufactured		—	2	All from Thailand.
Stone, sand and gravel:				
Dimension stone, all forms		[4]51	9	Do.
Gravel and crushed rock		—	7,754	Do.
Limestone other than dimension		24	89	Do.
Sand other than metal-bearing		3	—	
Sulfur:				
Elemental: Colloidal, precipitated, sublimed		3	([5])	All from Thailand.
Sulfuric acid		8	114	Do.
Other: Crude		—	220	Do.

See footnotes at end of table.

TABLE 3—Continued

LAOS: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988[p]	Principal sources, 1988
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		—	10	All from Thailand.
Carbon black		—	8	Do.
Coal, all grades		—	2	Do.
Coke and semicoke		3	3	Do.
Petroleum refinery products:				
Liquefied petroleum gas	42-gallon barrels	—	44	Do.
Lubricants	do.	[6]14	—	
Bitumen and other residues	do.	—	1,395	Do.
Unspecified	do.	432,586	682,080	All from U.S.S.R.

[p] Preliminary. NA Not available.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Laos, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any exports of mineral commodities to Laos during 1988.
[2] Excludes unreported quantity valued at $4,000 exported by Japan.
[3] Excludes unreported quantity valued at $18,000 exported by Thailand.
[4] Excludes unreported quantity valued at $2,000 exported by United States.
[5] Less than 1/2 unit.
[6] Excludes unreported quantity valued at $17,000 exported by Japan.

north of Thakhek. The tin concentrates were produced largely through a cottage industry involving the people of about 21 villages, who individually search the mountains and streambeds for tin ore that can then be collected at Phon Tiou and exchanged for in bartered goods. The Phon Tiou factory, however, has been short of exchange materials such as food and daily-necessity items. Consequently, lack of barter goods depressed ore collection so that tin production decreased through the past 2 or 3 years to 281 tons in 1989. Proven tin reserves were thought to total about 65,000 tons, with the potential for much more contingent on more systematic exploration and delineation.

Industrial Minerals

In 1989, the Government reported for the first time the production of gem stones (probably sapphires and possibly rubies) in its yearly analysis. No mine sites were specified, but the southwestern corner of Laos, on either side of the Mekong River, has been regarded as a good prospect for gem stones in continuation of the east-west belt of occurrences through the southern part of northeast Thailand 25 to 50 km north of the Cambodian border. Although clearly in its infancy, the establishment of a gem stone industry in Laos could become significant to the country's earning of sorely needed foreign-exchange credits.

Mineral Fuels

Coal.—The country mined about 1,000 tons of high-quality coal in 1989, which by Laos standards represents an incipient industry. The Australian Government awarded $75,000 to the Laos Ministry of Industry and Handicraft to help raise productivity to 5,000 tons per year. Exploration carried out in Vientiane Province indicated approximately 4 million tons of coal reserves in a surveyed area of 1 km^2. Coal deposits were known to occur in other provinces.

Petroleum, Crude.—The Government signed a production-sharing contract with Hunt Oil Co. of Dallas, Texas, covering development activity on approximately 26,000 km^2 centering on Pakse, near the southwest corner of Laos, and four adjoining provinces. Although the country has no legislation as yet regulating crude oil or natural gas exploration and development, the agreement was negotiated on the basis of Laos' newly established foreign-investment laws. The agreement specified an initial 2-year pe-

TABLE 4

LAOS: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year)
Cement	Ministry of Construction (Government, 100%)	Sai Phou Louang plant at Thong Pong, 15 km north of Vientiane	10
Gypsum	Lao Minerals Exploration Co. (Government, 100%)	Dong Hen, open pit, 40 km east of Savannakhet	100
Tin, in concentrate	do.	Bo Neng, Nong Seun, and Phontiou Mines, Pa Then Basin	1.5

riod of exploratory work, plus four more 2-year periods if desired. This was the first contract between Laos and a U.S. company since the end of the Vietnam War in 1975.

Offsetting the Lao Hunt Oil Co. block to the north, the Government earlier signed an agreement with the British-French partnership comprising Enterprise Oil PLC, London, and Cie. Francaise des Petroles, Paris, covering about 20,000 km^2 in the Savannakhet area of the central Laos panhandle.

Reserves

Any information on mineral reserves would be pure estimates and premature in view of the present efforts to organize mineral exploration and development in the country. Metals, industrial minerals, and mineral fuels, including copper, gold, iron ore, lead and zinc, tin, gem stones, gypsum, potash, coal, and probably petroleum, appear to have production potential in Laos.

INFRASTRUCTURE

Laos had a total of roughly 27,530 km of roads, of which there was 1,856 km having a bituminous surface. Another 7,450 km consisted of gravel, crushed stone, or other improved surface. The remaining 18,224 km was unimproved, loose surface, and potentially impassable during the rainy season from May to September or October.

The country included 4,590 km of inland waterways, essentially the Mekong River and its tributaries. Another 2,890 km of waterway was seasonally navigable by craft drawing 0.5 meters (m) or less, a common form of local transportation for the Lao people during the period of annual flooding.

Laos had a total of 64 airports, 50 of them in operating condition, but only 9 with paved runways. Two airports had runways 2,440 to 3,659 m long, and 12 had runways 1,220 to 2,439 m long.

The country had one pipeline 136 km long, which was believed to be in the process of being extended from Vientiane, Laos, to Vinh, Vietnam. When completed, it was expected to be about 420 km long and have the capacity to move a minimum of 200,000 tons per year of refined petroleum products.

Power was generated by the 150-megawatt Nam Ngum hydroelectric plant 65 km north of Vientiane, but other than for what was consumed locally in the Vientiane area, most of the output was exported to Thailand.

Assistance in construction of new roads was being extended by the World Bank and the United States. Japan made a gift to Laos of 50 buses for Vientiane municipal commuters. The United States was planning further assistance that included upgrading of schools, hospitals, irrigation networks, telecommunications, and the construction of a small hydroelectric powerplant.

OUTLOOK

Laos is just verging on social, political, and industrial consolidation and development. The country seems to have excellent possibilities for major mineral development with consequent benefit to its economy—increasing the national income and enhancing the wellbeing of the people. The major problem is a lack of capital to develop infrastrucure and industry. Having legislated with foresight on foreign venturing in the country, obstacles and problems to modernization in Laos may be resolved.

[1] Where necessary, values have been converted from the Lao kip (K) to U.S. dollars at the rate of K725 = US$1.00.

[2] Australian Journal of Mining. V. 4, No. 39, Dec. 1989, p. 20

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Vientiane, Laos

Department of Geology and Mines
Ministry of Industry and Handicrafts
Vientiane, Laos

MALAYSIA

AREA 329,750 km² **POPULATION 17.4 million**

THE MINERAL INDUSTRY OF

MALAYSIA

By John C. Wu

Malaysia remained the world's third largest tin producer and an important producer of bauxite, copper, crude petroleum, ilmenite, kaolin, monazite, natural gas, and zircon in Southeast Asia. Malaysia's tin reserves are the largest in the world, and ilmenite reserves contained in the tin ore are of world significance.

The mining industry remained an important sector of the Malaysian economy. Because of increased production of crude petroleum, natural gas, and tin, the overall output of the industry grew 7% in 1989. The total value of mineral production, which was estimated at \$2.7 billion[1] in 1978 constant dollars, accounted for 11% of the Malaysian real gross domestic product (GDP), which was estimated at \$25 billion in 1989. Although most of its mineral products were exported to Japan, Malaysia remained an important supplier of tin, columbium and tantalum ore and concentrates, and crude rare earths to the United States.

In mineral trade, Malaysia was a net exporter of mineral products. Exports of crude petroleum, natural gas, and refined tin accounted for more than 97% of mineral exports. Other mineral exports, including bauxite, copper concentrate, ilmenite, kaolin, monazite, and zircon, accounted for about 3%. Overall mineral exports accounted for about 17% of the Malaysian export earnings in 1989.

In 1989, major investment in Malaysia's mineral industry remained in the mineral fuels sector. To increase oil production capacity, development of Malaysia's largest oilfield project, Seligi Oilfield, offshore Terengganu, continued with additional production platforms being installed. To increase consumption of natural gas, construction of the 730-kilometer (km) pipeline distribution system in Peninsular Malaysia has begun, and agreements to build the world's first middle distillate synthesis (MDS) gas processing plant in Sarawak and a petrochemical complex in Kuantan have been reached. A major expansion program to raise production capacity of liquefied natural gas (LNG) at the Bintulu plant in Sabah and a plan to build a 60-megawatt (MW) to 90-MW gas-fired powerplant along with a 77-km pipeline in Sabah were announced.

In the nonfuel minerals sector, a plan to build Malaysia's first titanium dioxide plant in Telok Kalong, Terengganu, had materialized. Development of the country's second copper deposit at Mengapur in Pahang was expected to begin in 1990.

GOVERNMENT POLICIES AND PROGRAMS

In line with the Fifth Malaysia Plan (1986-90), the Ministry of Primary Industries (MPI) was working with the United Nations Development Program on a mineral development policy and planning project to expand the mineral industry. The Geological Survey of Malaysia (GSM) and the Department of Mines were commissioned by MPI in 1988 to draft a national mineral policy with fiscal and financial incentives to encourage local and foreign investment in new developments of the mineral industry. MPI was also drafting the mining code, Federal Mineral Act, model of mineral agreement, mineral title management, and a mineral sector development plan. The final draft is expected to be completed by the end of 1990.

In response to a request by the Malaysian Iron and Steel Industry Federation (MISIF), the Government imposed a 10% export duty on scrap metal in January despite strong opposition from scrap metal exporters. The MISIF claimed that the industry faced a serious problem of raw material shortage because the local scrap metal industry exported most of the Malaysian scrap metal to Japan, the Republic of Korea, and Taiwan for a higher price.

In June, the State Government of Perak, the largest tin-producing State in Malaysia, with permission of the Federal Government, began collecting a 1% tin royalty on tin sales at a price of \$7.41 per kilogram (kg), with a maximum of 2% on tin sales at a price of \$9.78 per kg.

PRODUCTION

The mineral industry continued to grow in 1989, resulting mainly from increased output of crude petroleum and natural gas. The output of both crude petroleum and natural gas reached a record high in 1989 because of increased exports. Malaysia had developed a new open pit coal mine at Kapit in central Sarawak in 1988 and was developing a new underground coal mine at Silantek in west Sarawak. The output of coal from the Kapit mine was at a higher level than that of 1988 because of increased operating capacity in 1989.

In the nonfuel minerals sector, production of tin and byproducts of tin mining, such as ilmenite, monazite, xenotime, and zircon, increased as more gravel pump mines resumed operation in 1989. Production of copper concentrate also increased from that of 1988. Copper production in 1988-89 was about 20% lower than the normal capacity because of depleting ore reserves in the mining area. Production of bauxite remained at the same level as that of 1988 because of stagnant demand in the Japanese market. Production of

TABLE 1

MALAYSIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
METALS						
Aluminum: Bauxite, gross weight	thousand tons	492	566	482	361	350
Antimony, mine output, Sb content (Sarawak)		12	—	129	—	—
Columbium and tantalum concentrate, gross weight		80	215	228	—	—
Cb content of columbium[e]		12	32	34	—	—
Ta content of tantalum[e]		6	15	16	—	—
Copper, mine output, Cu content (Sabah)		30,507	28,301	29,861	22,014	23,500
Gold, mine output, Au content:						
Malaya	kilograms	221	275	[r]484	717	680
Sabah	do.	2,452	[r]2,217	2,713	1,773	1,920
Sarawak	do.	136	[r]226	315	439	260
Total	do.	2,809	[r]2,718	[r]3,512	2,929	2,860
Iron and steel:						
Iron ore and concentrate	thousand tons	182	208	161	132	102
Steel, crude	do.	550	750	750	[e]550	550
Rare-earth metals: Monazite, gross weight		5,808	5,959	2,908	2,920	3,100
Silver, mine output, Ag content						
Sabah	kilograms	16,213	14,065	15,480	10,490	10,800
Sarawak[3]	do.	—	—	[e]10	14	8
Tin:						
Mine output, Sn content		36,884	29,135	30,388	28,866	31,000
Metal, smelter		45,500	43,788	44,363	49,945	50,000
Titanium: Ilmenite concentrate, gross weight		315,736	414,941	509,202	486,305	497,000
Tungsten, mine output, W content		13	4	—	([4])	—
Zirconium: Zircon concentrate, gross weight		11,652	12,633	17,828	25,671	19,700
INDUSTRIAL MINERALS						
Barite		23,394	17,677	38,935	38,766	36,500
Cement, hydraulic	thousand tons	3,128	[r]3,569	[r]3,316	3,775	4,640
Clays: Kaolin		82,576	85,052	96,882	116,869	107,000
Nitrogen: N content of ammonia		53,400	250,600	321,300	300,600	330,000
MINERAL FUELS AND RELATED MATERIALS						
Coal	thousand tons	—	—	—	28	116
Gas, natural (Sarawak):						
Gross	million cubic meter	13,683	14,894	16,433	16,730	17,571
Petroleum:[5]						
Crude	thousand 42-gallon barrels	156,950	183,814	181,724	198,343	205,495
Refinery products:						
Gasoline	do.	8,745	8,808	9,130	9,804	9,850
Jet fuel[e]	do.	2,650	2,700	2,900	3,000	3,000
Kerosene	do.	3,461	3,876	3,943	4,041	4,100
Distillate fuel oil	do.	11,719	10,293	10,183	10,753	10,800
Residual fuel oil	do.	7,543	8,298	8,350	9,107	9,200
Other[e 6]	do.	11,492	11,500	12,000	12,500	12,500
Total[e]	do.	45,610	45,475	46,506	49,205	49,450

[e]Estimated. [p]Preliminary. [r]Revised.

[1]All production is from Peninsular Malaysia (Malaya) unless otherwise specified. Table includes data available through Apr. 16, 1990.

[2]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone), fertilizers, and salt is produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

[3]Byproduct from gold mines in Sarawak.

[4]Revised to zero.

[5]Includes production from Malaya, Sabah, and Sarawak.

[6]Includes LPG, naphthas, and lubricants.

gold decreased slightly owing mainly to lower output from primary gold mines in Sarawak. Production of barite and kaolin both decreased in 1989. In 1988, a small mica mine began operation in Perak. The output of mica averaged 180 tons per month in 1989.

TRADE

Malaysia continued to enjoy a mineral trade surplus in 1989. Export earnings of crude petroleum, natural gas in the form of LNG, and nonfuel minerals, including copper and tin, increased considerably because of higher market prices and stronger demand in the Japanese market. Export earnings of bauxite, ilmenite, and monazite were lower because of reduced exports to Japan. Despite higher tin price, exports of the Malaysian tin metal have been restricted by extension of the Supply Rationalization Scheme (SRS) of the Association of Tin Producing Countries (ATPC) in 1989. In 1989, Malaysia exported about 432,800 barrels per day (bbl/d) of crude petroleum or 74% of its output and 6.5 million metric tons (MMmt) of LNG or 80% of its natural gas output. Export earnings of crude petroleum and natural gas were estimated at $3.5 billion, accounting for more than 95% of the Malaysian mineral exports. Exports of tin metal totaled 49,000 tons and were valued at $450 million, and copper concentrate, 106,000 tons and valued at $71 million. Estimated export earnings of other minerals, including bauxite, ilmenite, monazite, kaolin, and zircon, amounted to $22 million.

Malaysia's minerals imports were limited to iron ore for production of hot-briquetted iron (HBI), tin ore for tin toll smelting, and industrial minerals, including phosphate rock and potash for manufacture of fertilizer materials and gypsum for construction materials. However, to meet domestic refinery requirements and consumption, Malaysia imported about $800 million worth of crude petroleum and refined petroleum products in 1989.

STRUCTURE OF THE MINERAL INDUSTRY

The Malaysian mineral industry is dominated by the oil and gas and tin industries in terms of contribution to the Malaysian GDP, employment, and export earnings. Oil and gas were produced by three foreign oil companies having joint-venture agreements or production-sharing contracts with the Government and the State-owned PETRONAS Carigali Sdn. Bhd. Tin was produced by the State-owned Malaysia Mining Corp. Bhd. (MMC) and many small- and medium-size privately owned Malaysian incorporated companies. In 1989, the oil and gas industry employed about 5,000, and the tin industry employed about 13,000. According to the latest estimate by the Government, employment in the mining industry totaled only 38,000 compared with the Malaysian total labor force of 6.8 million in 1989.

COMMODITY REVIEW

Metals

Copper.—Copper concentrate produced by Mamut Copper Mining Sdn. Bhd. from the Mamut Mine in Sabah increased from 91,504 tons in 1988 to about 101,000 tons. The average ore grade at mill head was between 0.45% and 0.48% copper, and the average monthly output of concentrate was about 8,400 tons compared with 7,625 tons in 1988. The lower output in 1988 was due to heavy rainfall in the mining area. The ore reserves at the Mamut Mine were expected to be depleted by 1991 or 1992.

All copper concentrate was trucked from the mill to the port, 115 km west of Kota Belud, at Kuala Abai on Usukan Bay, for export to Japan. According to Japanese trade statistics, Japan imports of copper concentrate from Malaysia were 106,572 tons and were valued at $71 million in 1989.

Following an intensive drilling program for copper in the Mengapur area of Pahang in central Peninsular Malaysia, MMC reportedly was conducting a feasibility study for a new open pit copper mine. The Mengapur copper deposit was believed to contain significant amounts of molybdenum and tungsten.

Gold.—Gold production in 1989 was estimated at 2,870 kg. Of that amount, about 1,920 kg was recovered as a byproduct of the Mamut copper mining, and the remainder was produced from about 30 small-scale gold mines in the States of Kelantan, Pahang, and Sarawak as well as a byproduct of tin mining in the States of Perak and Selangor. Gold mining in Peninsular Malaysia was in alluvial gold deposits and in Sarawak in quartz-calcite veins and quartzose deposits.

In May, MMC completed a feasibility study in the Pergau-Tadoh area in Kelantan and planned to start drilling and bulk sampling in January 1990. The gold prospecting project is a joint venture of MMC (24.99%); MMC's 52%-owned subsidiary, Tronoh Mines Malaysia (24.01%); and the State government of Kelantan (51%).[2]

According to GSM's 1987 annual report, lode and placer deposits along the central belt of Peninsular Malaysia in Raub, Selensing, Chegar, Perah, Merapoh, Tui, Trias, Punjom, and Luit in the State of Pahang and Sungai-Galas, Sungai-Neggiri, Sungai-Pergau, Ulu-Sokor, Pulai, and Gua-Musang in the State of Kelantan are some of the promising areas that warrant systematic and detailed prospecting. In its recent report entitled "Gold Potential of the Gunung Ledang Area, Johore, Peninsular Malaysia," GSM reported finding gold in a 95-square-kilometer area northwest of Gunung Ledang.

Iron and Steel.—Domestic production of iron ore continued to decline because of depleting ore reserves and the reduced number of operating mines. In 1989, iron ore was produced from five open pit mines in the States of Kedak and Perak. Most iron ore was consumed by Malayawata Steel Bhd. at Prai in Penang. To meet domestic demand, Malaysia imported annually about 800,000 tons of high-grade iron ore principally from Brazil and Sweden to feed the direct-reduced HBI plant on Labuan Island off Sabah. Production of direct-reduced HBI by Sabah Gas Industries Malaysia Sdn. Bhd. (SGIM) on Labuan Island remained at 600,000 tons in 1989.

The country's second direct-reduced HBI plant operated by Perwaja Terengganu Sdn. Bhd. (PTSB) at Telok Kalong in Terengganu, however, remained shut down. PTSB, the country's third largest steelmaker, stopped production of HBI in 1987 because of technical problems

TABLE 2

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987 United States	Destinations, 1987 Other (principal)
METALS				
Aluminum:				
Ore and concentrate	412,600	199,000	54,000	Japan 61,000; Canada 38,000.
Oxides and hydroxides	—	3	—	Thailand 2; Singapore 1.
Metal including alloys:				
Scrap	8,993	6,548	—	Japan 5,371; Singapore 667; Taiwan 250.
Unwrought	237	2,499	—	Sri Lanka 2,300; Singapore 158.
Semimanufactures	8,805	14,405	74	Singapore 8,156; Hong Kong 1,619.
Antimony: Ore and concentrate	NA	980	—	Singapore 735; Hong Kong 245.
Arsenic: Oxides and acids	NA	46	—	All to Philippines.
Beryllium: Metal including alloys, all forms kilograms	—	10	10	
Chromium: Oxides and hydroxides	—	1	—	Mainly to Singapore.
Columbium and tantalum: Ores and concentrates	NA	136	—	Netherlands 126; Japan 10.
Copper:				
Ore and concentrate	118,758	122,103	—	All to Japan.
Matte and speiss including cement copper	18	—		
Sulfate	NA	20	—	Mainly to Singapore.
Metal including alloys:				
Scrap	14,637	14,551	61	Republic of Korea 4,009; Japan 3,766.
Unwrought	—	8	—	All to Singapore.
Semimanufactures	4,021	8,984	3	Singapore 7,093; Hong Kong 432.
Gold:				
Waste and sweepings kilograms	NA	315	142	Singapore 147; Hong Kong 19.
Metal including alloys, unwrought and partly wrought do.	NA	998	160	Hong Kong 708; Singapore 92.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	34,856	1,849	—	Singapore 1,699; Thailand 150.
Metal:				
Scrap	45,990	44,419	18	Singapore 34,056; Indonesia 8,580.
Pig iron, cast iron, related materials	354,884	605,821	38,478	India 161,190; Japan 155,161.
Ferroalloys	44	76	—	Singapore 64.
Steel, primary forms	8,967	18,015	—	Singapore 16,977; Taiwan 1,000.
Semimanufactures:				
Bars, rods, angles, shapes, sections	146,960	261,835	51,925	Singapore 134,891; Japan 36,834.
Universals, plates, sheets	7,945	7,330	21	Singapore 5,881; United Arab Emirates 449.
Hoop and strip	481	950	—	Singapore 930.
Rails and accessories	1,914	1,415	—	Singapore 1,201; Indonesia 134.
Wire	1,178	2,940	36	Singapore 1,222; Hong Kong 586.
Tubes, pipes, fittings	53,861	58,974	12,859	Singapore 25,835; Hong Kong 7,272.
Castings and forgings, rough	550	500	1	Singapore 397; Canada 51.
Lead: Metal including alloys:				
Scrap	90	954	—	All to Singapore.
Unwrought	1,101	2,725	20	Indonesia 690; Singapore 456.
Semimanufactures	24	698	21	Hong Kong 318; Singapore 258.
Magnesium: Metal including alloys, all forms	34	66	—	Mainly to Japan.
Manganese: Oxides	NA	20	—	All to Singapore.

See footnotes at end of table.

TABLE 2—Continued

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
METALS—Continued				
Mercury	NA	1	—	Mainly to Thailand.
Nickel:				
Ore and concentrate	—	1	—	All to Singapore.
Metal including alloys:				
Scrap	69	46	—	Singapore 38; Taiwan 8.
Unwrought	10	17	3	Philippines 8; Republic of Korea 4.
Semimanufactures	146	118	7	Singapore 77; Japan 32.
Platinum-group metals: Metals including alloys, unwrought and partly wrought kilograms	(2)	49	49	
Rare-earth metals: Monazite concentrate	NA	1,024	—	France 903; Japan 104.
Silver:				
Waste and sweepings[3] value, thousands	$3,175	$5,569	$5,140	Hong Kong $169; Singapore $113.
Metal including alloys, unwrought and partly wrought do.	$86	$127	$1	Japan $93; Singapore $30.
Tin: Metal including alloys:				
Scrap	204	217	—	Singapore 169; Hong Kong 41.
Unwrought	40,658	50,319	3,468	Japan 14,720; Netherlands 8,646.
Semimanufactures	584	451	23	United Kingdom 103; Republic of Korea 86.
Titanium:				
Ore and concentrate	NA	302,687	—	Japan 197,658; Republic of Korea 31,586; Spain 20,619.
Oxides	NA	97	—	Singapore 80; Taiwan 17.
Tungsten:				
Ore and concentrate	10	—		
Metal including alloys, all forms	3	1	—	All to Japan.
Zinc:				
Oxides	57	58	—	Singapore 56.
Metal including alloys:				
Scrap	1,076	1,175	—	India 587; Singapore 490.
Unwrought	1	1	—	Mainly to Indonesia.
Semimanufactures	277	136	—	Singapore 73; Indonesia 32.
Zirconium: Ore and concentrate	NA	11,930	—	U.S.S.R. 2,500; Taiwan 2,199; Netherlands 1,954.
Other:				
Ores and concentrates	401,758	—		
Ashes and residues	9,743	15,495	—	Singapore 12,605; West Germany 2,009.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc. value, thousands	—	$2	—	All to Singapore.
Artificial: Corundum	—	(4)	—	Do.
Dust and powder of precious and semiprecious stones including diamond value, thousands	—	(4)	—	All to Thailand.
Grinding and polishing wheels and stones do.	NA	$52	$8	Singapore $22; Japan $9.
Asbestos, crude	—	1	—	Mainly to Singapore.
Barite and witherite	9,664	7,171	—	Singapore 7,167.

See footnotes at end of table.

TABLE 2—Continued

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Boron materials:				
Crude natural borates kilograms	—	50	—	All to Thailand.
Oxides and acids	NA	29	—	Thailand 15; Singapore 14.
Cement	551,089	1,062,987	—	Singapore 653,553; Sri Lanka 187,166; Bangladesh 174,919.
Chalk	415	6,668	—	Singapore 6,614; Thailand 54.
Clays, crude	54,371	48,673	—	Japan 18,669; Taiwan 15,278; Singapore 10,340.
Diamond: Natural:				
Gem, not set or strung value, thousands	$12,006	$26,366	—	Belgium-Luxembourg $25,816; Singapore $429.
Industrial stones do.	$191	—		
Diatomite and other infusorial earth	16	6	—	All to Singapore.
Fertilizer materials:				
Crude, n.e.s.	116	38	—	Singapore 24; Brunei 9.
Manufactured:				
Ammonia	NA	22,990	—	Philippines 10,532; Thailand 7,096; Taiwan 4,788.
Nitrogenous	264,655	386,910	50,500	Thailand 129,799; Philippines 53,654.
Phosphatic	76	147	—	All to Singapore.
Potassic	860	5,011	—	Thailand 4,682; Singapore 329.
Unspecified and mixed	3,430	5,093	—	Indonesia 3,456; Singapore 1,603.
Graphite, natural	216	([4])	—	NA.
Gypsum and plaster	61	([4])	—	All to Singapore.
Lime	10,754	6,635	—	Mainly to Singapore.
Magnesium compounds: Oxides and hydroxides	—	8	—	All to Singapore.
Mica:				
Crude including splittings and waste	1,765	1,797	—	Republic of Korea 838; Taiwan 472; Japan 353.
Worked including agglomerated splittings	—	4	—	All to Singapore.
Nitrates, crude	—	9	—	Singapore 7; Philippines 2.
Phosphates, crude	2,104	4,777	—	Singapore 2,486; Hong Kong 2,248.
Pigments, mineral: Iron oxides and hydroxides, processed	NA	28	—	All to Singapore.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$394	$506	—	Singapore $243; United Kingdom $230.
Synthetic do.	$1,397	$2,531	—	Japan $2,530.
Pyrite, unroasted	16	—		
Salt and brine	6,482	509,892	118	Thailand 305,258; Singapore 203,266.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	29	82	—	Bangladesh 37; Singapore 23; Sri Lanka 20.
Sulfate, manufactured[5]	NA	15	—	Thailand 11; Singapore 4.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	[6]4,167	843,859	—	Singapore 840,608; Brunei 3,068.
Worked	751	1,625	([4])	Singapore 1,156; Hong Kong 150.
Dolomite, chiefly refractory-grade	281	161	—	Indonesia 160.

See footnotes at end of table.

TABLE 2—Continued

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Destinations, 1987: United States	Destinations, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued				
Gravel and crushed rock	109,487	134,446	—	Brunei 123,365; Singapore 11,081.
Limestone other than dimension	33,175	51,080	—	Singapore 48,854; Brunei 1,839.
Quartz and quartzite	6,358	(4)	—	All to Singapore.
Sand other than metal-bearing	2,644,451	8,025,521	40	Singapore 7,705,163.
Sulfur:				
Elemental:				
Crude including native and byproduct	17	—		
Colloidal, precipitated, sublimed	19	19	—	Nigeria 18.
Sulfuric acid	134	142	—	Mainly to Singapore.
Talc, steatite, soapstone, pyrophyllite	142	76	—	Singapore 75.
Other:				
Crude	337	7	1	Singapore 6.
Slag and dross, not metal-bearing	6,311	128	—	Taiwan 60; India 44; Japan 21.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	—	40	—	Singapore 32; Australia 2; Hong Kong 2.
Carbon black	4,445	5,989	—	Indonesia 4,306; India 687; Singapore 669.
Coal, all grades including briquets	70,367	5	—	Mainly to Singapore.
Coke and semicoke	22	120	—	Singapore 82; Sri Lanka 36.
Gas, natural: Liquefied value, thousands	$749,020	$691,092	—	All to Japan.
Peat, including briquets and litter	—	10	—	All to Singapore.
Petroleum:				
Crude thousand 42-gallon barrels	145,836	139,619	4,099	Singapore 39,851; Japan 32,157.
Refinery products:				
Liquefied petroleum gas value, thousands	NA	$34,361	—	Japan $33,434; Singapore $412.
Gasoline thousand 42-gallon barrels	3,303	3,302	—	Japan 2,893; Singapore 409.
Kerosene and jet fuel do.	3,958	3,882	—	Singapore 1,339; Japan 2,542.
Distillate fuel oil do.	1,979	1,935	—	Thailand 1,498; Singapore 436.
Lubricants do.	3	6	(4)	Singapore 3; Taiwan 2.
Residual fuel oil do.	6,615	6,596	119	Singapore 4,437; Japan 2,039.
Bitumen and other residues do.	—	(4)	—	All to Singapore.
Bituminous mixtures do.	—	6	—	Singapore 3; Hong Kong 1.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Unreported quantity valued at $125,000.
[3] May include other precious metals.
[4] Less than 1/2 unit.
[5] Includes sodium pyrosulfate.
[6] Excludes unreported quantity valued at $2,730,000.

TABLE 3

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987 United States	Sources, 1987 Other (principal)
METALS				
Alkali and alkaline-earth metals	19	5	1	United Kingdom 3.
Aluminum:				
Ore and concentrate	1,319	2,762	—	China 2,746; Singapore 16.
Oxides and hydroxides	12,300	12,030	37	Japan 7,519; Australia 4,089.
Metal including alloys:				
Scrap	1,339	849	—	Singapore 492; Japan 321.
Unwrought	26,449	31,536	35	Australia 16,907; Canada 7,295.
Semimanufactures	9,282	8,768	317	Japan 3,857; Australia 736.
Antimony: Metal including alloys, all forms	NA	97	—	Thailand 89; China 8.
Arsenic: Oxides and acids	NA	1,466	9	Philippines 821; France 188.
Bismuth: Metal including alloys, all forms value, thousands	NA	$4	—	All from United Kingdom.
Cadmium: Metal including alloys, all forms	NA	2	—	Australia 1.
Chromium:				
Ore and concentrate	8	39	—	Mainly from Zimbabwe.
Oxides and hydroxides	161	144	2	United Kingdom 113; Japan 14.
Cobalt:				
Oxides and hydroxides	12	8	([2])	Singapore 6.
Metal including alloys, all forms	NA	155	—	Canada 149; France 5.
Columbium and tantalum: Ores and concentrates	NA	3,860	—	All from Singapore.
Copper:				
Ore and concentrate	3	4	([2])	Singapore 2.
Matte and speiss including cement copper	81	6	—	United Kingdom 5.
Sulfate	NA	867	6	U.S.S.R. 341; Australia 210.
Metal including alloys:				
Scrap	987	288	([2])	Singapore 198; Japan 54.
Unwrought	8,827	19,027	15	Zambia 9,664; Chile 7,060.
Semimanufactures	17,428	22,301	840	Chile 11,416; Japan 8,247.
Gold:				
Waste and sweepings value, thousands	NA	$1	—	All from Thailand.
Metal including alloys, unwrought and partly wrought kilograms	NA	6,323	983	Singapore 2,715; Saudi Arabia 1,032.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	1,026,495	819,111	—	Brazil 668,663; Sweden, 149,005.
Pyrite, roasted	—	3	3	
Metal:				
Scrap	4,219	221,708	30,063	Singapore 64,028; Australia 57,262.
Pig iron, cast iron, related materials	1,657	3,436	5	China 2,349; Japan 782.
Ferroalloys:				
Ferromanganese	5,927	5,193	6	France 2,074; Australia 2,060.
Ferrosilicon	NA	2,345	—	Norway 1,797; Japan 153; China 150.
Unspecified	8,370	5,416	49	China 1,881; Brazil 1,500.
Steel, primary forms	46,929	130,172	28	Brazil 64,048; Netherlands 32,549.

See footnotes at end of table.

TABLE 3—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures:				
Bars, rods, angles, shapes, sections	169,450	145,969	481	Japan 57,612; United Kingdom 49,446.
Universals, plates, sheets	708,825	[3]444,888	NA	NA.
Hoop and strip	12,593	9,581	119	Japan 5,209; United Kingdom 1,313.
Rails and accessories	19,409	1,411	6	Japan 448; Republic of Korea 389.
Wire	20,316	15,870	147	China 9,001; Japan 1,683.
Tubes, pipes, fittings	110,772	NA		
Castings and forgings, rough	1,557	2,122	36	China 738; Singapore 375.
Lead:				
Ore and concentrate	28	4	(2)	Austria 3.
Oxides	304	271	1	Singapore 110; Australia 57.
Metal including alloys:				
Scrap	1,053	1,755	—	United Kingdom 1,200; Japan 326.
Unwrought	11,658	13,552	6	Australia 4,881; Burma 3,183.
Semimanufactures	1,717	1,921	16	Singapore 782; Australia 488.
Magnesium: Metal including alloys, all forms	41	15	(2)	Norway 10; West Germany 3.
Manganese:				
Ore and concentrate	985	1,170	—	Brazil 778; Mexico 212; Singapore 127.
Oxides	1,106	1,277	(2)	Japan 565; Singapore 454.
Metal including alloys, all forms	NA	9	9	
Mercury	6	9	1	Algeria 2; China 2; West Germany 2.
Molybdenum: Metal including alloys, all forms	12	1	—	Mainly from Japan.
Nickel:				
Ore and concentrate	15	11	1	Finland 6; Netherlands 1.
Matte and speiss	41	41	(2)	Norway 27; Finland 11.
Metal including alloys:				
Scrap	22	5	—	Singapore 3; Netherlands 1.
Unwrought	133	111	45	Japan 23; Canada 14.
Semimanufactures	819	585	10	Japan 186; Italy 171.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$329	$672	$8	Singapore $449; Hong Kong $78.
Rare-earth metals:				
Monazite concentrate	NA	872	—	Indonesia 803; Nigeria 69.
Xenotime concentrate	NA	6	—	Mainly from Singapore.
Silver:				
Ore and concentrate[4] value, thousands	$41	$9	—	All from United Kingdom.
Waste and sweepings[4] do.	$139	$270	$215	Hong Kong $24; Japan $24.
Metal including alloys, unwrought and partly wrought do.	$752	$1,194	$185	Japan $526; Hong Kong $271.
Tin:				
Ore and concentrate	23,806	31,408	214	Australia 13,911; China 9,414.
Metal including alloys:				
Scrap	—	16	—	Thailand 10; Hong Kong 6.
Unwrought	600	806	262	Singapore 239; Burma 165.
Semimanufactures	161	172	52	Singapore 71; Hong Kong 23.

See footnotes at end of table.

TABLE 3—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
METALS—Continued				
Titanium:				
Ore and concentrate	NA	3,759	(2)	Thailand 3,446; Australia 300.
Oxides	7,616	8,755	704	West Germany 2,355; Australia 2,155.
Metal including alloys, all forms	NA	4	3	Netherlands (2).
Tungsten:				
Ore and concentrate	56	3	2	Hong Kong 1.
Metal including alloys, all forms	146	27	(2)	West Germany 17; United Kingdom 6.
Uranium and thorium: Thorium ore and concentrate value, thousands	$157	$43	—	Australia $21; United Kingdom $15.
Zinc:				
Ore and concentrate	30	15	—	Australia 10; United Kingdom 5.
Oxides	205	235	(2)	West Germany 94; China 60; United Kingdom 51.
Metal including alloys:				
Scrap	138	205	—	Australia 108; Singapore 40; Thailand 36.
Unwrought	14,894	18,510	41	Australia 12,758; Canada 1,796.
Semimanufactures	1,152	665	31	Australia 265; Norway 102.
Zirconium: Ore and concentrate	NA	879	—	Singapore 459; Japan 389.
Other:				
Ores and concentrates	2,597	2	—	Mainly from Netherlands.
Ashes and residues value, thousands	$963	$612	$3	Japan $306; Singapore $128.
Base metals including alloys, all forms do.	$844	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	228	866	22	Indonesia 568; Hong Kong 105.
Artificial: Corundum	28	959	—	Australia 951.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$41	$4	(2)	Mainly from Japan.
Grinding and polishing wheels and stones do.	$2,849	$4,195	$186	Japan $1,316; China $741.
Asbestos, crude	16,947	20,153	1,819	Canada 13,701; Greece 1,380.
Barite and witherite	10,437	15,992	7,758	United Kingdom 285; Singapore 100.
Boron materials:				
Crude natural borates	73	44	19	Italy 18.
Oxides and acids	402	672	328	China 188; Italy 75.
Cement	64,545	55,175	3,019	Singapore 31,373; Taiwan 5,954.
Chalk	869	641	(2)	United Kingdom 406; Australia 142.
Clays, crude	90,916	67,512	33,157	Indonesia 22,638; United Kingdom 3,488.
Diamond: Natural:				
Gem, not set or strung value, thousands	$24,042	$33,238	—	Belgium-Luxembourg $17,837; United Kingdom $7,205.
Industrial stones do.	$24	$73	$60	Japan $9; Belgium-Luxembourg $3.
Diatomite and other infusorial earth	788	688	522	Philippines 108.
Feldspar, fluorspar, related materials	20,866	25,845	58	India 12,848; Thailand 8,664.
Fertilizer materials:				
Crude, n.e.s.	40,109	33,589	56	Singapore 32,767; Australia 521.

See footnotes at end of table.

TABLE 3—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials—Continued				
Manufactured:				
Ammonia	339	269	40	Australia 56; Belgium-Luxembourg 42.
Nitrogenous	388,272	410,416	79	Japan 118,209; Indonesia 74,614.
Phosphatic	15,216	18,539	1,470	China 10,924; Republic of Korea 2,905.
Potassic	466,456	611,744	3,320	China 334,827; U.S.S.R. 132,068.
Unspecified and mixed	136,509	179,675	1,685	West Germany 76,717; Belgium-Luxembourg 49,676.
Graphite, natural	510	734	3	West Germany 509; Republic of Korea 70.
Gypsum and plaster	152,528	137,416	199	Thailand 132,236; Japan 1,378.
Lime	5,942	5,031	—	Thailand 4,661; Singapore 305.
Magnesium compounds: Magnesite, crude including calcined	5,595	9,730	3	China 6,957; Japan 991.
Mica:				
Crude including splittings and waste	87	352	10	China 188; India 109.
Worked including agglomerated splittings	13	19	([2])	France 12; Japan 2.
Nitrates, crude	27	41	11	Japan 20; Belgium-Luxembourg 10.
Phosphates, crude	283,857	384,588	413	Christmas Island 203,834; Jordan 79,308.
Pigments, mineral: Iron oxides and hydroxides, processed	1,361	1,534	103	West Germany 501; United Kingdom 218.
Potassium salts, crude	10	184	—	Mainly from Taiwan.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$2,436	$1,169	$1	Singapore $494; West Germany $245.
Synthetic do.	$410	$528	—	Japan $378; Thailand $125.
Pyrite, unroasted	—	13	13	
Salt and brine	152,962	175,316	1,765	Australia 57,520; Thailand 47,291.
Sodium compounds, n.e.s.:				
Soda ash, natural and manufactured	50,680	57,980	18,592	Kenya 30,500; Romania 2,798.
Sulfate, manufactured	NA	25,275	9,694	China 13,260; Indonesia 1,358.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	1,572	991	—	Italy 417; China 139; Taiwan 134.
Worked	8,383	4,996	1	Italy 3,489; China 788.
Dolomite, chiefly refractory-grade	2,605	3,083	—	Philippines 3,017; Norway 56.
Gravel and crushed rock	1,607	2,088	37	Japan 1,067; France 424.
Limestone other than dimension	7,443	1,272	—	Philippines 1,200; Singapore 38.
Quartz and quartzite	51	168	1	China 120; Japan 22.
Sand other than metal-bearing	1,480	2,138	14	Japan 892; New Zealand 589.
Sulfur:				
Elemental:				
Crude including native and byproduct	886	1,631	70	Republic of Korea 426; Singapore 309.
Colloidal, precipitated, sublimed	22,796	20,349	2	Singapore 15,624; China 4,042.
Dioxide	NA	17	—	Singapore 13; Japan 2.
Sulfuric acid	1,591	1,322	40	Singapore 932; West Germany 321.
Talc, steatite, soapstone, pyrophyllite	7,010	6,796	41	China 3,753; Republic of Korea 1,364.

See footnotes at end of table.

TABLE 3—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	Sources, 1987: United States	Sources, 1987: Other (principal)
INDUSTRIAL MINERALS—Continued				
Other:				
Crude value, thousands	$337	$147	$4	Japan $83; Austria $28.
Slag and dross, not metal-bearing	10,233	26,681	1	Japan 21,032; Singapore 5,607.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	36,887	8,242	5	Singapore 4,601; West Germany 2,154.
Carbon:				
Carbon black	1,423	2,623	204	Taiwan 1,585; Singapore 348.
Gas carbon	—	2	—	All from United Kingdom.
Coal:				
Anthracite and bituminous including briquets	380,417	519,843	—	Australia 237,264; China 161,549; Indonesia 120,945.
Lignite including briquets	16	(2)	—	Mainly from United Kingdom.
Coke and semicoke	20,883	21,470	6	Japan 10,332; Australia 8,797.
Peat including briquets and litter	4	9	9	
Petroleum:				
Crude thousand 42-gallon barrels	14,131	11,393	—	Kuwait 7,286; Saudi Arabia 3,785.
Refinery products:				
Liquefied petroleum gas value, thousands	$19,017	$25,364	$83	Singapore $24,981.
Gasoline thousand 42-gallon barrels	7,496	8,446	6	Singapore 7,923; Philippines 243.
Mineral jelly and wax do.	53	62	10	China 14; Japan 14.
Kerosene and jet fuel do.	1,759	1,848	(2)	Singapore 1,831.
Distillate fuel oil do.	7,176	6,475	—	Mainly from Singapore.
Lubricants do.	644	879	13	Singapore 673; Australia 52.
Residual fuel oil do.	(5)	12,667	(2)	Singapore 12,170; Kuwait 497.
Bitumen and other residues do.	533	517	(2)	Singapore 510.
Bituminous mixtures do.	20	10	(2)	Singapore 6.
Petroleum coke do.	45	56	17	Indonesia 36.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Partial total; complete data not available.
[4] May include other precious metals.
[5] Unreported quantity valued at $162.000.

related to quality specification of the HBI produced by the plant. Nippon Steel Corp., the Japanese partner, designer, and builder of the plant, paid $203.7 million in 1987 to compensate PTSB for failure to resolve the technical problems. In 1989, PTSB became the Government wholly owned steel company when the Japanese consortium led by Nippon Steel sold its $27 million share, or 30% equity, in the plant to the Government for just a token US$0.37 (M$1.00). In 1989, the Government took over 51% equity in PTSB from Heavy Industries Corp., another State-owned enterprise.

After the restructuring, PTSB reportedly was seeking about $260 million in loans to revive the faulty direct-reduced HBI plant. Because of PTSB's requirements for HBI in steelmaking, the company planned to build from scratch a new direct-reduced HBI plant and then revive the old plant. According to the company's managing director, Midrex Corp. of the United States, Voest-Alpine AG of Austria, and HYL SA of Mexico had expressed interest in building the new HBI plant. PTSB was using mostly scrap iron to produce steel billet. Under a new management, production of steel billet had increased to 600,000 tons from 480,000 tons in 1988. By mid-1989, PTSB's accumulated losses reached $259 million, and its total debt was estimated at $496 million.[3]

Tin.—Malaysia's tin industry improved considerably in 1989 when the prices of tin on the Kuala Lumpur Tin Market (KLTM) moved higher, while the world's surplus stocks were reduced by increased world consumption of tin and extension of ATPC's SRS (export control). According to the Malaysian

Department of Mines, for the first 11 months, tin production rose to 29,331 tons from 26,370 tons in the same period of 1988, resulting mainly from increased output by the gravel pumping sector.

Because the prices of tin on the KLTM rose from $7.07 per kg in 1988 to a 3-year high of $10.26 per kg in April 1989, the average number of operating mines increased from 219 in December 1988 to 242 in April 1989 and reached 265 in November 1989. Most of the increase in number of the operating mines was in the gravel pumping sector, which registered 185 in November compared with 141 in the same month of 1988. Additionally, there were 33 dredges, 33 open pit mines, and 14 underground mines operating in November. Employment in the tin industry also increased from 11,445 in 1988 to about 12,800 in 1989.

According to a local press report, however, because of excessive tin supply in the world market following the surge of tin price in the first half of 1989, the prices of tin on the KLTM dropped from $9.96 per kg in June to $8.15 per kg in September then to $6.78 per kg in November. About 38 gravel pumping mines, which reopened early in 1989 and had an estimated production cost of $7.40 per kg, reportedly were in great financial difficulties and might not survive for long unless the Government provided a diesel fuel subsidy.[4]

Of the tin produced in the first 11 months, 41% was by gravel pumping, 38% by dredging, 9% by open pits, and 12% by others. Most tin concentrates produced in Malaysia were sold and delivered to two domestic tin smelters for production of tin metal. Datuk Keramat Smelter Bhd. treated both domestic ore and foreign ore imported mainly from Australia, Bolivia, China, and Zaire. Malaysian Smelting Corp. Bhd. treated mostly high-grade domestic ore and also received about 30% of its ore requirements from Australia, Bolivia, and China.

In 1988, exports of tin metal, including toll-smelting and reexport, totaled 48,922 tons and were valued at $345 million. Domestic tin consumption was 2,420 tons; of that amount, 1,122 tons was for solder, 751 tons was for tinplate manufacturing, 371 tons for pewter, and 176 tons for others. In 1989, exports of tin metal were estimated at

TABLE 4

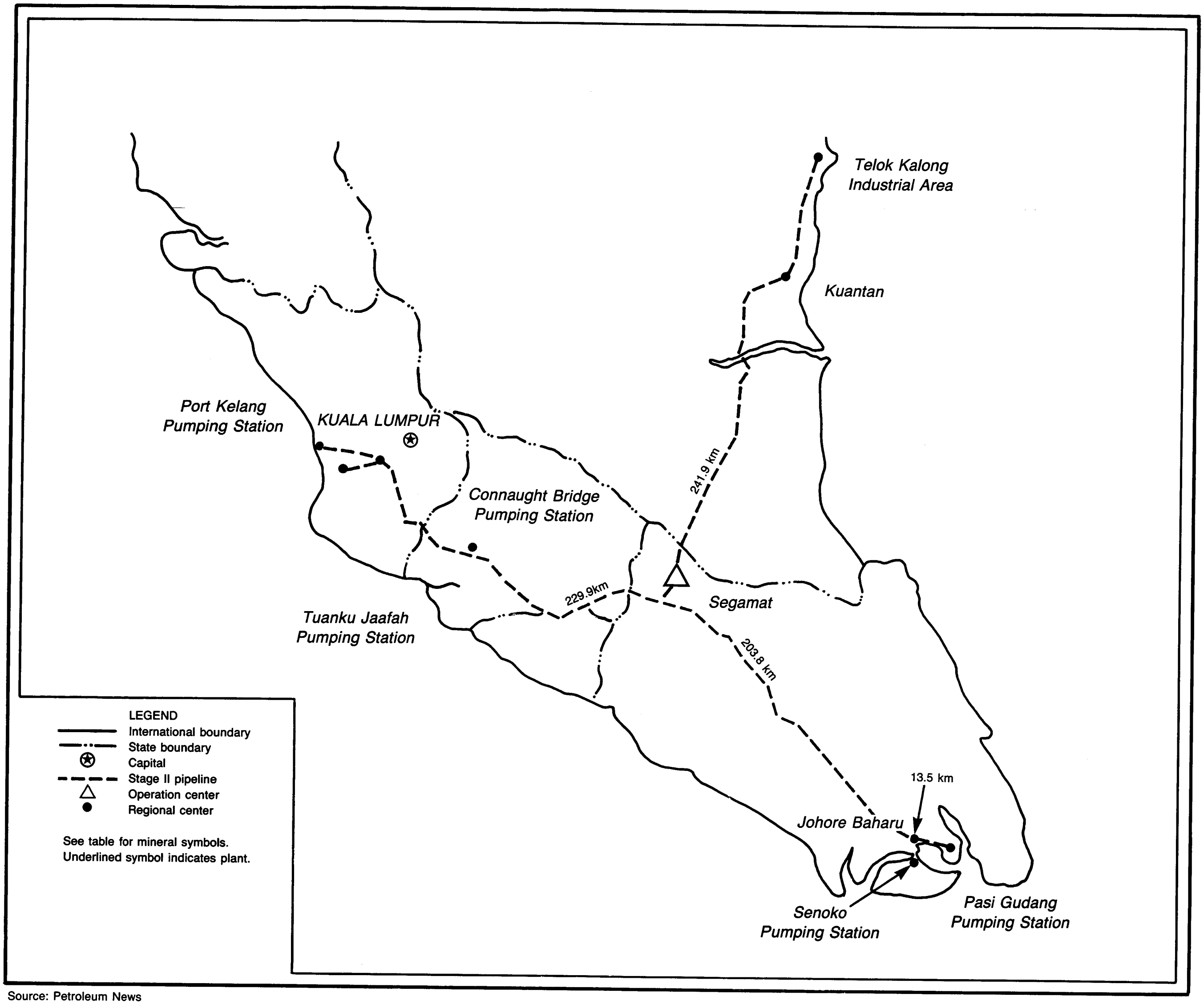
MALAYSIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year unless otherwise specified
Bauxite	Johore Mining and Stevedoring Co. Sdn. Bhd. (61% owned by Alcan Aluminum Ltd. of Canada, 39% by local investors and others)	Telok Ramunia, Pengerang, Johore	400
Cement	Associated Pan Malaysia Cement Sdn. Bhd.	Rawang, Selangor, and Kanthan, Perak	2,500
Do.	Cement Industries Malaysia Sdn. Bhd.	Kangar, Perils	1,000
Do.	Kedah Cement Sdn. Bhd. (Government-owned).	Langkwai, Kedak	1,200
Do.	Perak-Hanjong Cement Sdn. Bhd. (60% owned by Hyundai Cement Co. Ltd. of South Korea, 40% by Perak State government)	Padang Rengas, Perak	1,200
Do.	Tasek Cement Bhd.	Ipoh, Perak	1,100
Copper, concentrate	Mamut Copper Mining Sdn. Bhd. (80% owned by Monanza Mining Co. Ltd., 20% by Sabah Mining Development Co. Ltd. of Japan)	Mamut, Sabah	110
Gas:			
Natural	Esso Production Malaysia Inc.	Offshore Terengganu	[1]5.66
Do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	[1]2.83
Do.	Sarawak Shell Bhd.	Offshore Sarawak	[1]33.98
Liquefied, natural	Malaysia LNG Sdn. Bhd. (60% owned by PETRONAS, 17.5% each, by Shell Gas N.V. and Mitsubishi Corp., and 5% by Sarawak State government)	Tanjung Kidurong, Bintulu, Sarawak	6,200
Petroleum, crude	Esso Production Malaysia Inc.	Offshore Terengganu	[2]320
Do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	[2]100
Do.	Sarawak Shell Bhd.	Offshore Sarawak	[2]180
Tin:			
Concentrate	Malaysia Mining Corp. Bhd. (56.6% owned by Government, 14.5% by Charter Consolidated, 3.8% by Datuk Keramat Holdings Bhd., and 25.1% by the public)	Concentrated in the States of Perak and Selangor	12
Refined	Datuk Keramat Smelting Bhd. (50.5% owned by Amalgamated Metal Corp., 29% by Consolidated Tin Smelter, and 20.5% by Malaysia Mining Corp. Bhd.)	Georgetown, Penang	40
Do.	Malaysia Smelting Corp. Bhd. (58% owned by Straits Trading Co. and 42% by Malaysia Mining Corp.)	Butterworth, Penang	60

[1] Million cubic meter per day.
[2] Million 42-gallon barrels per day.

FIGURE 1

PENINSULAR GAS UTILIZATION PROJECT–STAGE II



Source: Petroleum News

49,000 tons, and export values rose to $450 million because of higher tin price. The major importers were the Netherlands, 29%; Japan, 26%; the United States, 11%; and the Republic of Korea, 8%. Domestic tin consumption was expected to grow by 8% to 2,610 tons because of increased consumption for tinplate manufacturing in 1989.

In its continuing effort to reduce the world tin surplus from about 38,400 tons in early 1989 to a normal level of about 20,000 tons, ATPC extended its SRS for the second time in its 22d session meeting held in Kuala Lumpur in January, and revised export quotas for the third year's SRS to 106,400 tons from 101,900 tons. For the third year of SRS effective March 1, 1989, to February 28, 1990, the quota allocated to Malaysia was 31,700 tons compared with 31,650 tons for the period of March 1988 to February 1989.

MMC, the country's largest tin mining company, along with its subsidiaries, produced 11,294 tons of tin in concentrates or 39% of Malaysia's tin output in 1988. MMC group companies operated one open pit mine and have 38 dredges, of which 21 were operational and 17 were idled under maintenance or were permanently shutdown. Because of improved market conditions, MMC's sales rose 21% to $239 million with pretax profit of $27.3 million in 1988. In mid-1989, MMC reported that its first 6 months pretax profit reached $26.4 million from sales of $147 million. The higher pretax profit for the first half of 1989, however, was attributed partially to sales of its 25.7% stake in the Sungei Besi Mine to Bahagia Mewah Sdn. Bhd. for about $554,000 in April.

According to MMC's Chairman, Malaysia's known tin reserves were estimated at 1.1 MMmt. However, its economic reserves are being depleted rapidly at the current mining rate. In an effort to maintain tin mining as its core activity, MMC continued to explore for tin in Malaysia and overseas. In May, MMC reportedly signed an agreement with the China National Nonferrous Metals Industry Corp. for joint exploration and development of placer tin deposits in the coastal areas of Guangdong Province in China. MMC was believed to have also signed a letter of intent with the Bureau of Geology and Mineral Resources of Yunnan Province in October 1988 to jointly develop ilmenite deposits in Yunnan.[5] In late 1989, MMC reportedly had also proposed to the Government of Burma to set up a joint venture for exploration and development of tin resources in southern Burma.

PERSTIMA, the sole producer of tinplate, began construction of its second tinplate line in Pasir Gudang, Johore. The second electrolytic tinning line, which would be partially owned by Kawasaki Steel Corp. of Japan and would have a 90,000-metric-ton-per-year (mt/yr) capacity, was expected to come on-stream in December 1990. In 1989, tinplate production by PERSTIMA was about 96,000 tons, and Malaysia's demand for tinplate was about 126,000 tons and was expected to rise to 130,000 tons by 1990.

Titanium.—Following completion of feasibility studies, Tioxide (Malaysia) Sdn. Bhd., a unit of Britain's Tioxide Group PLC, decided in August to build a $148 million titanium dioxide plant in Telok Kalong, Terengganu. Construction of the plant reportedly will begin in January 1990. Annual capacity of the plant is expected to be 50,000 tons of titanium dioxide pigment, of which about 80% will be exported mainly to the Far East market.

Other Metals.—Malaysia's production of other metallic minerals included bauxite; silver as a byproduct of copper mining; and ilmenite, monazite, rutile, struverite, xenotime, and zircon as byproducts of tin mining. Most of these mineral commodities were exported to European Community countries and Japan. Production of bauxite by Promet Berhad Group from the Pengerang area in Johore remained at the same level as that of 1988 owing to the stagnant market in Japan. Production of both ilmenite by Syarikat Pendorong Sdn. Bhd. at Kampar in Perak and monazite by Beh Minerals Sdn. Bhd. at Lahat in Perak increased slightly because of growing demand in the Japanese market.

Malaysia stopped antimony production in 1985. The Paku Kong Mine, an underground antimony mine in the Bau area, was closed in 1985 due to flooding of the underground workings and the low price of antimony in the world market. According to GSM, large-scale mining of antimony appears unlikely because most of the eluvial ore lying near the surface had been mined out. However, a local company was expected to participate with Negara Mining Co. to begin small-scale open pit operations in the Gunong-Buan and Gunong-Pangga areas. Antimony reserves in the areas were estimated at 20,000 tons.[6]

Industrial Minerals

Barite.—Barite production decreased in 1989 because of the temporary shutdown of two small-scale mining operations in the State of Pahang. Barite mining operations were mainly in the Sok area of Kelantan, the Tasik-Chini area of Pahang, and the Kuala-Trengan area of Terengganu. Most barite was processed and sold to the domestic oil and gas industry for drilling mud.

Kaolin.—Kaolin production was from 17 open pit operations concentrated in the Tapa-Bidor area of Perak and the Jemaluang area of Johore. High-grade kaolin was produced from two mines in the Bidor area. The high level of the kaolin production in the past 2 years was due to improvements in processing and increased exports to the Far East market. According to the Department of Mines, exports of kaolin accounted for about 44% of total production.

Mineral Fuels

Coal.—An open pit coal mining operation was started at the Kapit Mines in Sarawak by Global Minerals Sarawak Sdn. Bhd. in July 1988. According to the Department of Mines, the mine employed 98 miners and produced 27,982 tons of subbituminous coal in 1988. Most of the coal production was exported to Japan and Taiwan at a price of about $35 per ton. Coal produced from the Kapit Mine in the Merit-Pila area was estimated at 96,000 tons in 1989.

A new underground coal mining operation was started at the Silantek Mine in Sarawak by a joint venture of Luck Hill Mining Sdn. Bhd. and a South Korean-Taiwanese consortium in April. The initial output was about 36,000 mt/yr in 1989 and will be gradually increased to 120,000 mt/yr by 1995. The Silantek Mine has proven reserves of 7.3 MMmt having heating values of between 6,600 and 8,000 kilocalories per kilogram. Exports of coal produced from Silantek began in 1989 to Taiwan.

In December, the Director-General of GSM announced that at least 200 MMmt of coal has been discovered in the Maliau Basins in southern Sabah. The coal discovered in the area was described by GSM as high-quality bituminous coal. Broken Hill Pty. Ltd. of Australia, which has a concession area of 1,700 square kilometers in the Maliau Basin, also discovered a coal seam of more than 5 meters thick at Susui and 10 seams of varying thickness on the scarp side of Gunung Lotung in 1987.[7]

Natural Gas.—Natural gas production averaged 47.3 million cubic meters per day (MMm^3/d) compared with 45.9 MMm^3/d in 1988. The Central Luconia Gasfield offshore Sarawak continued to produce more than 36.8 MMm^3/d of natural gas (80%) for production of LNG and nitrogen fertilizer materials (ammonia and urea) in Bintulu, Sarawak. The remaining natural gas production was from the Duyong Gasfield and Bekok Oilfield offshore Terengganu (13%) and the Samarang Oilfield offshore Sabah (7%).

Because of increased demand for LNG in Japan, Republic of Korea, and Taiwan, Malaysia LNG Sdn. Bhd. planned to expand the annual capacity of its LNG plant in Bintulu by 4 MMmt to 10 MMmt by 1992. The $3 billion expansion program will include building a second LNG plant with two trains and four 125,000-cubic-meter LNG tankers. In 1989, LNG production at the Bintulu plant reached 6.5 MMmt. All LNG was exported to Japan and valued at $1 billion. Tokyo Electric Power Co. Inc. and Tokyo Gas Co. Ltd. were the two Japanese buyers.

Production of urea and ammonia at the Association of South East Asian Nations (ASEAN) fertilizer plant in Bintulu, Sarawak, increased following a temporary shutdown for maintenance in 1988. Production of urea and ammonia was 500,000 tons and 326,000 tons, respectively, in 1988. At full capacity, the fertilizer plant requires 1.4 MMm^3/d of natural gas as feedstock to produce 1,500 metric tons per day (mt/d) of urea and 1,000 mt/d of ammonia.

In early 1989, PETRONAS Gas Sdn. Bhd. awarded a contract to a Malaysian-Japanese consortium to upgrade and extend the 30-year old Miri-Lutong gas distribution system in Sarawak.

To utilize the abundant natural gas resources offshore Sarawak, Shell Malaysia Ltd. signed an agreement in September with PETRONAS, the State-owned oil and gas company, to build the world's first MDS gas conversion plant next to the Bintulu LNG plant in Sarawak by late 1992. The $660 million MDS plant would require 100 MMm^3/d of natural gas as feedstock to produce 500,000 mt/d or 12,000 bbl/d of synthesized liquid hydrocarbons, such as diesel and kerosene. Shell MDS, a joint venture of Shell (60%), Mitsubishi Corp. of Japan (20%), PETRONAS, and the Sarawak State Government (10%, each), had been established to operate the plant.[8]

In early 1989, Sabah Gas Industries, which operated a 660,000-mt/yr methanol plant, a 720,000-mt/yr direct-reduced HBI plant, and a 47-megawatt powerplant, announced that it planned to sell the entire stake in the methanol plant because of the heavy burden of the yen-dominated loan. The methanol plant, which produced 562,000 tons of methanol in 1988, was expected to make a profit of $9.4 million from sales of $103.4 million in 1989. Sumitomo Corp. of Japan and Samsung Electronics Co. Ltd. of the Republic of Korea reportedly had expressed interest.[9]

To increase utilization of natural gas resources offshore Sabah, a plan to construct a 60-megawatt (MW) to 90-MW combined-cycle powerplant at Kota Kinabalu in Sabah and a 77-km gas pipeline between ERB West Gasfield offshore Sabah and Sepanger Bay was proposed jointly by the Sabah Electricity Board and Sabah Energy Corp. The consulting services for a feasibility study involved type, size, and alternative site for the proposed gas-fired power-generation system, estimated capital cost, and general arrangement of plant and ancillary facilities. The feasibility study reportedly would be financed by the International Bank for Reconstruction and Development.

For construction of the 730-km gas pipeline in the second phase of the Peninsular Gas Utilization project, PETRONAS Gas awarded a $120 million contract to two consortia for the supply of the pipeline. The Malaysian-Japanese consortium was to supply 88,933 tons of pipes to link the Telok Kalong gas processing plant in Terengganu and Segamat in Johore to Pasi Gudang. The Malaysian-Brazilian consortium was to supply 58,709 tons of pipes to link Port Kelang on the west coast of Peninsular Malaysia to Segamat (see figure 1). The first delivery of the line pipes was scheduled in April.

The Malaysian-Japanese consortium composed of Sinar Berlian Sdn. Bhd., Antah Oil Tools Services Sdn. Bhd., and Pelia Enterprise Sdn. Bhd. of Malaysia and Mitsubishi Corp., C Itoh & Co. Ltd., and Sumitomo Corp. of Japan. The Malaysian-Brazilian consortium was composed of Sabandra-Hamison Sdn. Bhd. of Malaysia and Petrobras Comercio International SA, Interbras SA, and Confab Industrial SA of Brazil.

Petroleum.—Esso Production Malaysia Inc. (EPMI), Sarawak Shell Bhd. (SSB), and Sabah Shell Petroleum Co. Ltd. (SSP) remained the three crude petroluem producers. In 1989, all crude petroleum was produced from 81 platforms in 31 oilfields offshore Terengganu, Sarawak, and Sabah. Total output, including condensate, averaged 563,000 bbl/d compared with 543,000 bbl/d in 1988.

The increased output in 1989 was mostly from a new platform called Seligi A in the Seligi Oilfield offshore Terengganu, which was brought onstream by EPMI in late 1988. The Seligi Oilfield will become Malaysia's largest with a peak capacity of 100,000 bbl/d when six additional production platforms are installed in 1994.

In 1989, Malaysia exported about 77% or 432,000 bbl/d of its low-sulfur and light-crude petroleum, in decreasing order, to Japan, Singapore, the Republic of Korea, the Philippines, Thailand, and the United States. However, Malaysia imported about 40,000 bbl/d of heavy crude petroleum, in decreasing order, from Saudi Arabia, Kuwait, and Iran to meet the requirements for the domestic refineries. Export earnings and import bills of crude petroleum were estimated at $2.5 billion and $200 million, respectively, in 1989.

Since the new terms of production-sharing contracts (PSC) became effective in 1986, PETRONAS had awarded 23 new PSC to foreign oil companies for exploration for oil and gas in Malaysia, of which 7 PSC were signed in 1987, 10 in 1988, and 6 in 1989. Exploration for oil and gas onshore and offshore Sabah, Sarawak, and East Coast Peninsular Malaysia intensified in 1989 as the foreign contractors had committed to spend $277 million and drill more than 45 exploratory wells in 1989. In 1988, only $92 million was spent for drilling eight exploratory wells.

As a result of oil and gas exploration in 1988-89, foreign companies having new PSC terms with the Government made four important oil discoveries. Sabah Shell discovered oil in its SB-1 Block offshore Sabah in November 1988. Taiyo Malaysia Oil Development Co. Ltd. of Japan discovered oil and gas in its PM-10 Block East Coast offshore Terengganu in January 1989. Malaysia Baram Oil Development Co. Ltd. (MBOD) of Japan discovered oil in its SK-14 Block onshore along the northern coast of Sarawak near the Sabah border in August 1989. Overseas Petroleum and Investment Corp. of Taiwan discovered oil in its SK-7 Block offshore Sarawak in October. The oil discovery on the northern coast of Sarawak by MBOD was Malaysia's first onshore strike in 50 years.

According to an estimate by PETRONAS, more than 130 exploratory wells (80 wildcats and 50 appraisal wells) and 350 development wells will be drilled in the next 4 years. The surge in exploration is expected to lead to a substantial increase in Malaysia's proven oil and gas reserves as well as a rise in production in the mid-1990's. To encourage deep-water oil exploration, PETRONAS reportedly was drafting new PSC terms for oil and gas exploration in water of more than 200 meters deep.

Reserves

Malaysia is estimated to have the largest tin reserves in the world. The estimated ore reserves of ilmenite associated with ore reserves of cassiterite (tin) are also large. Reserves of bauxite, copper, natural gas, petroleum, and several industrial minerals are small but are considered significant in the Far East and South Asia. According to the Malaysian Government and industry sources, reserves of major minerals are as shown in table 5 in thousand metric tons unless otherwise specified.

TABLE 5

MALAYSIA: RESERVES OF MAJOR MINERALS

(Thousand metric tons unless otherwise specified)

Bauxite		14,000
Clays[1]		25,600
Copper, in concentrate		[e]120
Gas, natural	billion cubic meter	1,487
Petroleum, crude	million 42-gallon barrels	2,900
Marble		68,000
Tin, in concentrate		1,100
Titanium, oxide in ilmenite concentrate		[e]900

[e] Estimated.
[1] Includes kaolin and ball clay.

Sources: Geological Survey of Malaysia, Malaysia Mining Corp. Bhd. and PETRONAS.

INFRASTRUCTURE

Malaysia's highways, railroad system, and port facilities were adequate to transport most of the nonfuel mineral products to the domestic and overseas markets. However, because of increased consumption and exports of oil and natural gas, Malaysia's infrastructure has been improved substantially in the past 10 years. Further improvement was expected when a new gas pipeline system is completed and railroad and port capacity are upgraded and extended in Peninsular Malaysia by the end of the Fifth Malaysian Plan in 1992.

In 1989, construction of the $476 million pipeline distribution system to deliver offshore natural gas to Singapore in the south and to the industrial and population centers on the west coast of Peninsular Malaysia had begun. On the east coast of Peninsular Malaysia, construction of a $310 million petrochemical complex to produce methyl tertiary butyl ether (MTBE) and polypropylene in Kuantan was also started. A new gas-fired powerplant at Kota Kinabalu in Sabah and a 77-km gas pipeline between an offshore gasfield and Sepanger Bay in Sabah were in the feasibility stage.

In order to remove bottlenecks in the transport system on the west coast of Peninsular Malaysia, the railroad along the industrial areas of the Klang Valley and Rawamg Seremban will be double-tracked, and the port capacity at Pulau Lumut and Port Klang is expected to be expanded by 1995.

OUTLOOK

The mineral industry of Malaysia should continue to enjoy a steady growth because of increasing activity in the mineral fuels sector. The output of crude petroleum is expected to be raised to more than 560,000 bbl/d as EMPI gradually increases production capacity of its Seligi Oilfield offshore Terengganu. The output of natural gas is expected to be raised to more than 48.1 MMm^3/d as the trend toward domestic natural gas consumption continues to increase. Coal production is also expected to move higher when two mines in Sarawak reach full capacity in the next 2 years.

In the nonfuel minerals sector, the tin industry should continue to play the major role. However, due to the low prices of tin resulting from oversupply in the world market during the fourth quarter of 1989, tin production is expected to remain at the 30,000 tons level. Production of bauxite should remain relatively unchanged because of the continuing weak Japanese demand for bauxite. Despite the fast-depleting copper reserves at the Mamut Mine in Sabah, Malaysia copper production is expected to move higher as the development of a new copper deposit at Mengapur in Pahang is completed by MMC in the next 2 years.

A national mineral policy along with various fiscal and financial incentive programs to encourage local and foreign investment in new development of the mineral industry is expected to be completed in 1990. As a result of these Government efforts, exploration and development of nonfuel minerals, especially in clays, copper, gold, and silver, should intensify in the first half of the 1990's.

According to a forecast by the Malaysian Ministry of Finance, the Malaysian economy is expected to grow 6.5% in 1990. Because of increased Government spending for infrastructure, the public foreign debt will continue to rise. However, because of a substantial reduction in private foreign debt resulting from a lower cost of borrowing in the domestic capital market in 1989, the overall national external debt (medium- and long-term) is expected to decline to $15 billion in 1990 from $16.4 billion in 1989. As a result, Malaysia's debt service ratio is expected to drop to 10.5% in 1990 from 11.8% in 1989.

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[1] Where necessary, values have been converted from Malaysia ringgits (M$) to U.S. dollars at the rate of M$2.71 = US$1.00 in 1989.

[2] South-East Asia Mining Letter (London). Focus-Malaysia. Aug. 1, 1989, p. 3.

[3] U.S. Embassy, Kuala Lumpur, Malaysia. State Dep. Telegram 04460, May 31, 1989, p. 2 and Telegram 10698, Dec. 29, 1989, p. 1.

[4] The Straits Times (Singapore). Re-opened Malaysian Mines Badly Hit by Plunge in Tin Price. Nov. 22, 1989, p. 42.

[5] Metal Bulletin (London). MMC Plans Joint Venture in China. No. 7395, June 26, 1989, p. 11.

[6] U.S. Embassy, Kuala Lumpur, Malaysia. State Dep. Telegram 05091, June 21, 1989, p. 1.

[7] ———. State Dep. Telegram 10698, Dec. 29, 1989, p. 3.

[8] Petroleum Economist (London). Malaysia-Major Gas Development. V. 56, No. 10, Oct. 1989, p. 323.

[9] Petroleum News (Hong Kong). Business Briefs-Malaysia. V. 19, No. 12, Feb. 1989, p. 59.

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Agencies

Department of Mines Malaysia
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Publications

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MONGOLIA

AREA 1,565,000 km² **POPULATION 2.1 million**

THE MINERAL INDUSTRY OF

MONGOLIA

By John C. Wu

Mongolia has a wide variety of mineral resources. Mineral resources, which had been identified by Mongolia's Ministry of Energy, Mining, and Geology (MEMG),[1] included asbestos, chromium, clay, coal, copper, fluorspar, gold, gypsum, iron, lead, limestone, molybdenum, petroleum, phosphate, rare earths, salt, silver, tin, tungsten, and zinc. However, only coal, copper, fluorspar, gold, gypsum, limestone, molybdenum, silver, tin, and tungsten were being mined. The other minerals were either in the exploration delineation stage or in the process of being considered for development.

Coal, copper, fluorite, molybdenum, tin, and tungsten were the important minerals produced by the mineral industry. In 1989, Mongolia was the world's third largest producer of fluorspar and an important producer of copper, molybdenum, tin, and tungsten in the centrally planned economy countries. Ore reserves of fluorspar were large and those of copper, molybdenum, and tungsten were considered substantial. The mineral industry remained an important sector of Mongolian economy. The industry's output accounted for about 19% of Mongolia's gross domestic product (GDP), which was estimated at $1.9 billion[2] in 1989, and its exports contributed about 40% to Mongolia's export earnings.

There was no mineral trade between Mongolia and the United States. Mongolia's mineral trade was mostly with the U.S.S.R. and Eastern European countries. However, a small quantity of copper concentrate was being exported to Finland under a 10-year barter trade agreement signed in 1987. Mongolia also exported a small quantity of copper concentrate to Japan during 1988–89 under a separate trade agreement signed in 1988. Because of its small mineral processing sector for metals and refined petroleum products, Mongolia imported most of these value added products from the U.S.S.R. and other member-countries of the Council for Mutual Economic Assistance (CMEA) to meet its domestic demand. As a result, Mongolia has suffered a mineral trade deficit annually, especially with the U.S.S.R.

Mongolia continued to focus its investments on expanding and upgrading the mining and milling capacities of the Erdenet Mine in 1989. The fifth-phase expansion project to raise the mining capacity of the Erdenet Mine was completed in December 1989. The second-stage modernization to upgrade and raise the milling capacity reportedly was still being considered in August 1989. A plan to develop the Burenhaan phosphate deposit near Hovsgol Lake, however, was dropped by the Government because of unfavorable market conditions and environmental concerns.

GOVERNMENT POLICIES AND PROGRAMS

The Mongolian People's Republic (MPR) Laws on State Enterprises and Mineral Wealth were passed by the People's Great Hural in January 1989. The Law on State Enterprises is a basic document of economic management reform to emphasize the financial autonomy of individual enterprise. The Law on Mineral Wealth is a basic document of land use and protection of mineral wealth and environment.

In line with the Soviet's perestroyka (restructuring) programs, changes and reforms were underway in Mongolia to encourage group and individual initiative and independence. Administrative control through orders reportedly was eliminated. According to the Ministry of Foreign Economic Relations, new legislation was also passed by the People's Great Hural in 1989 in an effort to attract foreign capital investment from the market economy countries. The new legislation provides such fiscal incentives as 2 to 3 years of tax holiday, a maximum tax rate of 30%, and 10 to 15 years of free repatriation of dividends.[3]

According to MEMG, to develop and utilize Mongolia's mineral resources more efficiently, the Government was undertaking extensive work on further development of the mining and mineral processing sector. To achieve this goal, Mongolia was seeking assistance and cooperation not only from Eastern bloc countries but also from the international mining community.

PRODUCTION

The output of the mineral industry continued to grow while coal, copper, molybdenum, and tungsten production moved to a higher level in 1989. Increased production of copper and tungsten was a result of increased capacity and new export markets. Production of major industrial minerals, such as cement and fluorspar, was estimated to remain at the 1988 level. Mongolia was believed to have had some production of gold, silver, and zinc, but the actual amount of production was not available. Stronger demand for coal by the domestic electric power generating industry continued to be a major factor for further expansion of the coal mining industry.

TRADE

Despite increased exports of copper, fluorspar, molybdenum, tin, and tungsten, all in the form of ores and con-

TABLE 1

MONGOLIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989
Cement, hydraulic[3]	thousand tons	151	425	541	502	500
Coal:[3]						
Anthracite and bituminous	do.	480	497	655	692	800
Lignite and brown	do.	r6,043	6,567	7,110	7,914	8,000
Total	do.	r6,523	7,064	7,765	8,606	8,800
Copper, mine output, Cu content		128,000	136,000	140,000	160,000	165,000
Fluorspar, all grades	thousand tons	787	790	800	800	800
Gypsum	do.	32	32	32	32	32
Lime, hydrated and quicklime	do.	95	95	95	r100	100
Molybdenum, mine output, Mo content		1,000	1,100	1,100	1,100	1,200
Petroleum refinery products:						
Kerosene	thousand 42-gallon barrels	23	23	23	23	23
Residual fuel oil	do.	20	20	20	20	20
Salt		16,000	16,000	16,000	16,000	16,000
Tin, mine output, Sn content		1,000	1,000	1,000	1,200	1,200
Tungsten, mine output, W content		1,500	1,500	1,500	2,000	2,200

r Revised.
[1] Table includes data available through Aug. 20, 1990.
[2] In addition to the commodities listed, gold, silver, crude construction materials such as sand and gravel, varieties of stone such as limestone, and zinc presumably are produced, but available information is inadequate to make reliable estimates of output levels.
[3]

centrates, Mongolia's imports of value added mineral products such as refined petroleum products, iron and steel products, and fertilizer materials rose even more. Mongolia suffered from a mineral trade deficit because of high imports of energy and processed minerals from the U.S.S.R. Exports of copper and molybdenum concentrate were mostly to the U.S.S.R and Eastern bloc countries and accounted for about one-third of total export earnings. Beginning in 1988, about 8% of the copper output was being exported to Finland and Japan annually. Mongolia exported most of its fluorspar, tin, and tungsten production to the U.S.S.R. and Eastern bloc countries.

According to trade statistics of the member-countries of CMEA, Mongolia imported 868,000 tons or about 6.3 million barrels of refined petroleum products, 30,500 tons of lubricating oil, and 72,500 tons of bituminous coal in 1988. Major imports of processed nonfuel mineral products included 84,000 tons of steel products, 21,800 tons of phosphatic fertilizer, and 14,400 tons of nitrogenous fertilizer, with the U.S.S.R. being the major supplier of these products.

TABLE 2

MONGOLIA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988p	Principal destinations, 1988.
Cement		216,718	[2]155,000	All to U.S.S.R.
Copper: Ore and concentrate		10,314	5,301	All to Japan.
Fertilizer materials: Manufactured:				
Nitrogenous		—	1,026	All to China.
Potassic		—	230	Do.
Gold: Au content of waste and sweepings	kilograms	—	4	All to United States.
Iron and steel: Metal:				
Scrap		43,974	46,531	U.S.S.R. 43,000; China 3,531.
Pig iron, cast iron, related materials		—	199	All to China.
Semimanufactures		25	701	Do.
Mercury		13	—	
Precious and semiprecious stones: Natural	value, thousands	—	$4	All to Japan.
Other: Base metals including alloys, all forms		—	25	All to China.

p Preliminary.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Mongolia, this table should not be taken as a complete presentation of this country's mineral exports. Unless otherwise specified, these data have been compiled from United Nations information and data published by the partner trade countries.
[2] Statistical Yearbook of Members of the Council for Mutual Economic Assistance, Moscow, U.S.S.R.

TABLE 3

MONGOLIA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Principal sources, 1988
Abrasives, n.e.s.: Grinding and polishing wheels and stones kilograms	[2]7,000	414	All from Japan.
Aluminum: Metal including alloys, all forms	2	—	
Cement[3]	46,000	45,000	All from U.S.S.R.
Coal: Anthracite and bituminous[3]	68,000	800,000	Do.
Coke and semicoke[3]	5,000	5,000	Do.
Copper: Metal including alloys, semimaufactures	([4])	—	
Fertilizer materials: Manufactured:			
Nitrogenous[3]	34,146	33,323	Do.
Phosphatic (P_2O_5 content)[3]	32,811	43,800	Do.
Gypsum and plaster	2	—	
Iron and steel: Metal:			
Pig iron, cast iron, related materials[3]	2,231	2,381	Do.
Semimanufactures	75,911	93,100	U.S.S.R. 93,099.
Petroleum refinery products[3] thousand 42-gallon barrels	5,810	5,978	All from U.S.S.R.
Sodium compounds, n.e.s.: Soda ash, natural and manufactured[3]	2,400	NA	
Sulfur: Sulfuric acid[3]	1,275	1,475	Do.

[p] Preliminary. NA Not available.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Mongolia, this table should not be taken as a complete presentation of this country's mineral imports. Unless otherwise specified, these data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any exports of mineral commodities to Monoglia during 1988.
[2] Excludes unreported quantity valued at $1,000 exported by Japan.
[3] Statistical Yearbook of Members of the Council for Mutual Economic Assistance, Moscow, U.S.S.R.
[4] Less than 1/2 unit exported by Austria.

STRUCTURE OF THE MINERAL INDUSTRY

Mongolia's mining industry was dominated by large-scale mining of coal, copper-molybdenum ore, and fluorspar, which were developed with financial and technical assistance from the U.S.S.R. The coal mining industry consisted of 15 mining operations. The largest coal mine at Baga-Nuur in central Mongolia produced about 45% of the country's coal output. Mongolia's only large copper and molybdenum mine was at Erdenet in north-central Mongolia. Fluorspar mining was by one large and five medium- and small-scale operations mainly in eastern and southeastern Mongolia. The largest fluorspar mine at Bor-Ondor in southeastern Mongolia produced about 60% of total fluorspar output. Mining of gold, silver, tin, and tungsten was by medium- or small-scale operations in central and eastern Mongolia undertaken by joint-venture firms of Mongolian and Eastern bloc countries.

TABLE 4

MONGOLIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year unless otherwise specified)
Coal	Government coal mining enterprise	Baga-Nuur in Central Mongolia	4,000
Copper, concentrate	Mongolia-Soviet Mining and Concentrating Works (a Mongolian-Soviet joint venture)	Erdenet in Bulgan	[1]420
Fluorspar	Mongolsovtsvetmet (a Mongolian-Soviet joint venture)	Bor-Ondor and Dzun-Tsagandel in Hentiy	600
Do.	Mongolczechoslovakmetal (a Mongolian-Czechoslovakian joint venture)	Chuluut-Tsagandel in Tov	45
Molybdenum, concentrate	Mongolia-Soviet Mining and Concentrating Works	Erdenet in Bulgan	[2]4
Tungsten, concentrate	Wolframvest A Hungarian company	Tsagaan-Davaa near Ulan Bator	[3]3

[1] Average copper content is 33%.
[2] Average molybdenum content is 50%.
[3] Average tungsten content is 60%.

COMMODITY REVIEW

Metals

Copper and Molybdenum.—Copper and molybdenum mining by the Mongolian-Soviet Mining and Concentrating Works at the Erdenet Mine in Bulgan Aymag or administrative district reportedly reached 17 million metric tons (MMmt) of ore. Production of copper and molybdenum concentrates was about 350,000 tons and 3,500 tons, respectively, in 1989.[4] The fifth-phase expansion to raise mining and milling capacity by 4 million metric tons per year to 20 million metric tons per year was completed in December 1989. Newly installed milling facilities included MMS-90x60, 160-cubic-meter (m^3) autogenous grinding mills, pulp pumps having a capacity of 6,000 m^3, and 40 m^3-capacity flotation cells. As of 1989, employment of the Mongolian-Soviet Mining and Concentrating Works at the Erdenet copper and molybdenum complex was about 5,700 employees, of which 70% were Mongols. Among the

Mongols, about 750 were engineers and technical workers.

In addition to the U.S.S.R. and Eastern European countries, Finland and Japan have been added as destinations of Erdenet copper concentrate exports. Exports to Finland and Japan were estimated at about 30,000 tons in 1989. To meet the growing export demand, Mongolia planned to launch the second-stage modernization project. The project goal reportedly was to increase the milling capacity to 25 metric tons per year and to build a copper smelter at the combine with financial and technical assistance from Japan.

Gold.—According to Mongolia's MEMG, gold deposits had been discovered in the gold-bearing zones of North Khentii, North Kherlen, and Bayankhongor. Exploration for gold was being conducted at Zaamar, Bayankhongor, and Tolgoit. The largest known gold mining operation reportedly was by the Mongolsovtsvetmet, a Mongolian-Soviet joint venture, at the Tolgoit alluvial deposit in north-central Mongolia. The mining and processing capacity at Tolgoit was 2 million cubic meters per year of gold-bearing sands. In 1981, Mongol-Bulgarmetal, a Mongolian-Bugarian joint venture, was established to explore and develop alluvial gold deposits in the Mukhar-Ereg area of Bayanhongor Aymag. A joint-venture firm reportedly was mining and processing about 200,000 cubic meters per year of gold-bearing sand in the area.

Tin and Tungsten.—Mongol-Czechoslovakmetal, a joint-venture firm of Mongolia and Czechoslovakia, produced tin and tungsten concentrates from the Modoto alluvial deposit in Khentii (Hentiy) Aymag. According to MEMG, the mine produced about 190 mt/yr of tin concentrate grading 50% tin and 20 mt/yr of tungsten concentrate grading 20% WO_3 as a byproduct. Other tin deposits, including the Deed-Kumyr and Janchivlan properties in eastern Mongolia are being considered for development. Tungsten mining operations were at Burentsogt, Ikh-Khairkhan, Tumentsogt, and Yugoayr. Other known mining operations according to Soviet and Western sources were at Kobdogol, Kyzyltay, Tsagaan-Davaa, and Ulaan-Uul. As a result of increased export demand, tungsten production capacity had been expanded considerably.

Industrial Minerals

Fluorspar.—Most fluorspar deposits are in eastern and southeastern Mongolia. According to MEMG, there were more than 200 identified fluorspar deposits in Mongolia. Major mining operations were at Berh, Bor-Ondor, Chuluut-Tsagaan-Del, Delgerkhaan, Khajuu-Ulaan, Khar-Airage, Orgon, and Zuun-Tsagaan-Del. The Bor-Ondor Mine, the largest underground fluorspar mine in Mongolia, was operated by Mongolsovtsvetmet. The Bor-Ondor operation, 290 kilometers (km) southeast of Ulan Bator, was capable of producing 400,000 mt/yr of ore. Mongolsovtsvetmet also operated mines at Berkh, Khar-Airag, Khajuu-Ulaan, and an ore-dressing plant capable of producing 115,000 mt/yr of fluorspar concentrate containing 92% CaF_2. Chuluut-Tsagaan-Del Mine, operated by Mogol-Czechosolvakmetal, produced 45,000 mt/yr of medium-grade fluorspar.

Phosphate.—Despite the Government's efforts to develop Mongolia's phosphate resources around the Hovsgol Lake area, unfavorable market conditions and opposition by nearby residents had prevented the development project of the Burenhaan deposit in 1989. Mongolia continued to rely on the U.S.S.R for all of its phosphate requirements. According to Soviet trade statistics, exports of superphosphate from the U.S.S.R. to Mongolia were about 33,000 tons in 1987 and 44,000 tons in 1988.

Pigment.—Following the discovery of about 70 deposits of clay and sandy soils, that contain pigment materials, Mongolia obtained financial and technical assistances from the United Nations Industrial Development Organization and the United Nations Development Program in the early 1980's. Mongolia had established basic laboratory facilities and a pilot plant for processing mineral pigments reportedly was under construction in Ulan Bator. The pilot plant planned to begin production of mineral pigments from clay and sandy soils in 1990. The mineral pigments will be used as coloring agents. If operation of the pilot plant is proven successful, a commercial plant with a capacity of 1,500 mt/yr of dry pigments will be built following a feasibility study.[5]

Mineral Fuels

Coal.—According to MEMG, there were 15 mining operations, of which 2 were underground mines and 13 open pit mines. Of the total coal output, about 91% was brown coal and lignite and the remainder was anthracite and bituminous coal. Three major coal mines in central Mongolia produced about 80% of total coal output in 1989.

The Baga-Nuur open pit mine, 120 km southeast of Ulan Bator, was the country's largest, producing about 4 MMmt. The Government planned to expand capacity of the Baga-Nuur Mine to 6 million metric tons per year. Coal reserves at the Baga-Nuur deposit according to MEMG were 627 MMmt. The average heating value was 6,600 kilocalories per kilogram, having up to 15% ash content and up to 33% moisture content.

The other two major coal mines were the Nalayha Kapitalnay Mine near Ulan Bator, and the Shariyn Gol Mine near Darhan both in central Mongolia. These two mines together produced a total of about 3 million metric tons per year. According to MEMG, a new open pit mine had been developed at Tavan-tolgoyt in South Govi Aymag. The mine, 90 km east of Dalandzadgad, was capable of producing more than 100,000 mt/yr of hard coal. Coal reserves in the area were estimated at 6,300 million metric tons, of which 2,150 million metric tons was coking-grade coal. Several deposits of industrial minerals, such as fire clay, gypsum, limestone, and sand and stone reportedly had been identified in the areas adjacent to the Tavan-tolgoyt coal deposit.

Most of the coal production was consumed by the powerplants in the industrial centers of Ulan Bator and Darhan in central Mongolia and Choybalsan in eastern Mongolia. To meet other coal requirements, Mongolia imported annually more than 70,000 tons of anthracite and bituminous coal for power generation and industrial uses, principally from the U.S.S.R.

Petroleum.—Crude petroleum had been produced at the Dzuunbayan oilfield near Saynshand in southeastern Mongolia. According to MEMG, crude petroleum output from the oilfield ceased following a reduction in flow rates. To evaluate Mongolia's hydrocarbon potential, MEMG and Exploration Associates International of Texas Inc. of the United States reached an agreement to compile jointly all existing unpublished geological and geophysical data. The joint-venture program was scheduled for completion by November 1990.[6]

Reserves

Mongolia was believed to have large reserves of fluorspar and significant reserves of coal, copper, and molybdenum. Fluorspar reserves were mainly in eastern and southeastern Mongolia. Coal reserves were in central Mongolia and at Tavan-tolgoyt. Copper and molybdenum reserves were mainly at the Erdenet in north Mongolia and the Tsagaan-Suvarga in the eastern Govi Desert. Phosphate reserves in the Hovsgol Lake area were large but were considered not economically viable because of low ore grade. According to MEMG and the 1987 Soviet Mining Encyclopedia, ore reserves of major minerals are shown in table 5 in thousand metric tons unless otherwise specified.

TABLE 5

MONGOLIA: RESERVES OF MAJOR MINERALS

Commodity	Thousand, metric tons
Coal	[1]7,000,000
Copper	[2]540,000
Fluorspar	[3]22,000
Molybdenum	[2]540,000

[1]Includes 6.3 billion tons at the Tavan-tolgoyt deposit and 627 million metric tons at the Baga Nuur deposit.

[2]Includes 300 million metric tons of ore grading 0.85% Cu and 0.012% Mo at the Erdenet Mine and 240 million metric tons of ore grading 0.53% Cu and 0.018% Mo at the Tsagaan-Suvarga Mine.

[3]Ore grade between 35% and 45% CaF_2.

Sources: The Mongolian Ministry of Energy, the Mining Industry, and Geology; Mining Encyclopedia (Moscow). No. 3, K-O, Mongolia (in Russian), 1987; and American Metal Market, V. 90, No. 4 Jan. 7, 1982, p. 1.

INFRASTRUCTURE

Mongolia's highways, railroad system, and water supply were adequate for smooth operation of the existing mining industry. However, Mongolia needs to import some electricity and most of its refined petroleum products from the U.S.S.R. owing to the lack of hydroelectrical power generation and petroleum refining facilities, respectively. For example, the electric power requirements for the Erdenet copper and molybdenum combine were imported from the hydroelectric powerplant in the Gusinoouzersk area of the U.S.S.R. The country's richest coal resources at Tavan-tolgoyt in south Govi was far from major industrial centers in the north-central region.

To transport mineral products, Mongolia relied mostly on unpaved highways and its Trans-Mongolian Railway. To increase use of the railroad for transporting the mineral products, four railroad branch lines were completed and placed into service in past years. The first branch line was mainly for shipping copper and molybdenum concentrate from the Erdenet Mine to transshipment terminals for the export markets. The other two branch lines were to ship coal from the Baga-Nuur Mine and the Shariyn Gol Mine to powerplants in the industrial areas of Ulan Bator and Darhan. A new branch line to connect the Bor-Ondor fluorspar mine to the Trans-Mongolian railway reportedly had been constructed and went into service in the late 1980's.

Mongolia had a 1,800-km railway system, of which 1,750-km was 1.524-meter broad gauge; a 46,700-km highway network, of which 1,000 km was hard surfaced roads running round the Ulan Bator and Darhan areas; and a 397-km inland waterway system based mainly on the Selenge River and on Hovsgol Lake. There were six thermal electric power stations having 657,000 kilowatt of installed capacity that produced 2,950 million kilowatt hours of electricity in 1988.

OUTLOOK

The mineral industry of Mongolia should continue to grow because of increased production of coal, copper, and molybdenum to meet external demand, while the production level of fluorspar would vary depending on the demand by the Soviet iron and steel industry. Any future increase in coal would come mainly from the Baga-Nuur Mine and the Tavan-tolgoyt Mine when their capacities are expanded to meet the domestic demand for electricity grow. Production of copper concentrate is expected to increase to more than 500,000 mt/yr when the mining and milling capacity at the Erdenet Mine reach 25 million metric tons per year in 1990 to meet the growing demand by the U.S.S.R. and other countries.

As a result of its perestroyka program, Mongolia should open its market and seek assistance from the Western World to develop its economy and mining industry. For example, in late 1989, Mongolia began talks with Japan on economic cooperation and trade. Japan reportedly is expected to provide financial and technical aid to Mongolia for joint-venture exploration for minerals, such as rare earths, and for conducting feasibility studies for construction of an iron reduction plant and a copper smelter in Mongolia.

The estimated external trade deficit was $360 million in 1989 because of the high import value of refined petroleum products and machinery and equipment. About 94.7% of the external trade was with the centrally planned economy countries. Mongolia reportedly suffered from external debt owing to heavy investments for industrial development during the past two 5-year-plans (1981-90). However, the country's economic situation could improve when Mongolia begins to open its trade with the market economy countries.

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[1]Batkhuyag, S. Mongolia's Mineral Wealth. Int. Min. (London), v. 7, No. 2, pp. 10-14.

[2]Where necessary, values have been converted from Mongolian tughriks (Tug) to U.S. dollars at the rate of Tug.3.03 = US$1.00.

[3]Mining Journal (London). Annual Review, Mining 1990, Mongolia. June 1990, p. 92.

[4]Work cited in footnote 1.

[5]Mining Magazine (London). Mongolia Mineral Project. V. 160, No. 7, July 1989, p. 17.

[6]Oil and Gas Journal. Newsletter. V. 88, No. 5, Jan. 29, 1990, p. 2.

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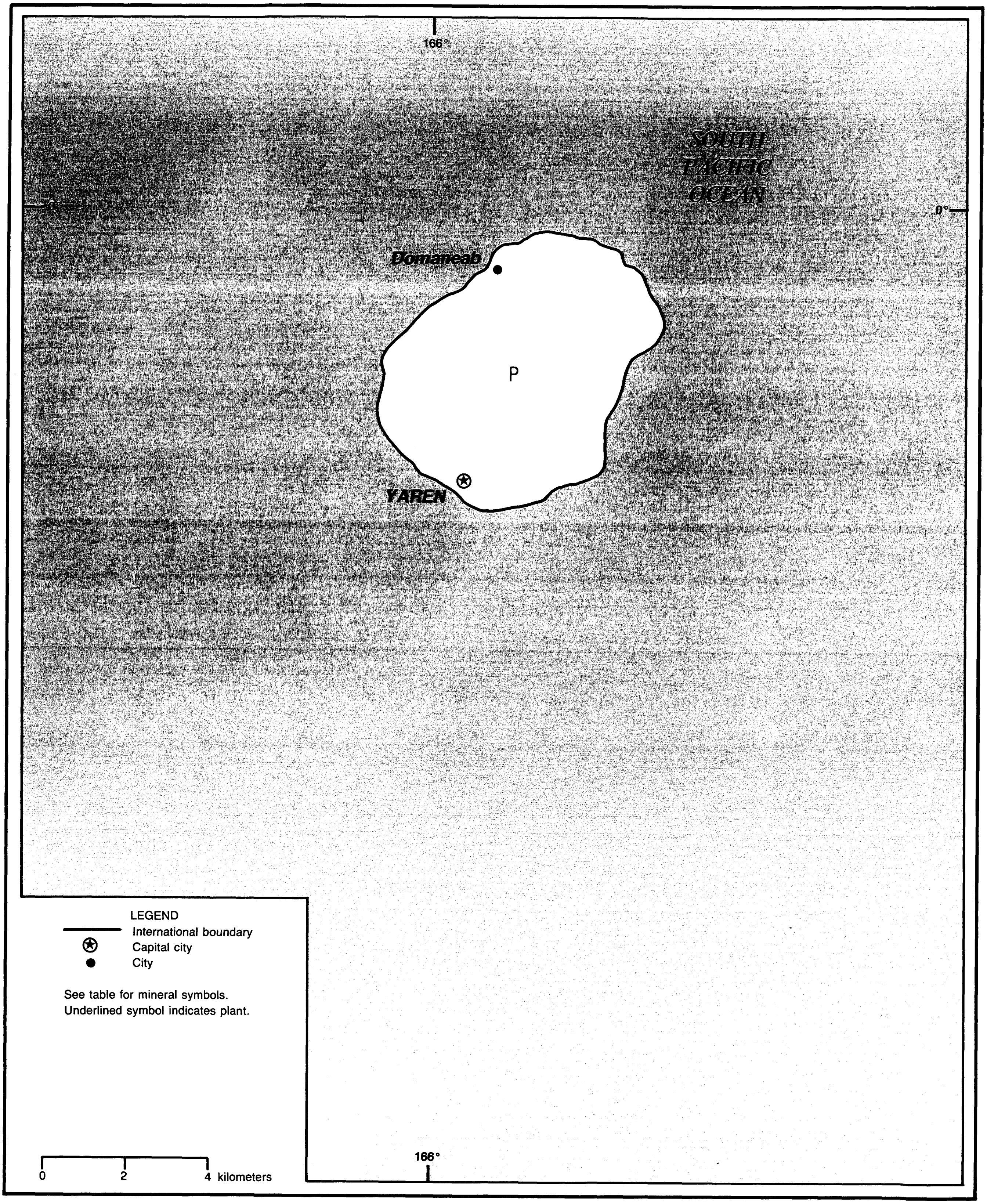
NAURU

AREA 21 km² **POPULATION 9,000**



THE MINERAL INDUSTRY OF

NAURU

By Travis Q. Lyday

GOVERNMENT POLICIES AND PROGRAMS

The Government appealed to the International Court of Justice at The Hague seeking compensation from Australia for damage to the island's environment that occurred during the mining of phosphate rock from 1919 until 1968 by the British Phosphate Commission (BPC), comprised of Australia, New Zealand, and the United Kingdom. Australia administered Nauru's phosphate mining on behalf of the other partners. The three countries held joint United Nations trusteeship of the island subsequent to its becoming a League of Nations mandate in 1919 as a former German territory. The German-owned Pacific Phosphate Co. began mining of phosphate in Nauru in 1906. The Government's independent Commission of Inquiry previously had determined that compensation for past mining was $180 million and called upon the three nations of the BPC to pay one-third, or $60 million. Australia previously had rejected the compensation claim, but has, however, agreed to accept the jurisdiction and ruling of the International Court. Australia has until January 21, 1991, to file its reply. The Government of Nauru also was expected to take similar action against New Zealand and the United Kingdom.

PRODUCTION

The Nauruan economy continued to be based on the mining of extensive high-grade phosphate rock deposits mined on the central plateau of the island by the Government-owned Nauru Phosphate Corp. (NPC). The deposits are among the richest in the world, having a consistent content of 84% BPL (bone phosphate of lime or tricalcium phosphate), equivalent to 38.5% phosphorous pentoxide (P_2O_5).

TRADE

All phosphate rock mined on Nauru was exported by NPC. Phosphate remained Nauru's sole export. Exports of phosphate rock, by destination, for 1987-89 are given in table 2.

STRUCTURE OF THE MINERAL INDUSTRY

The 21-square-kilometer island of Nauru is one of three historic phosphate-producing islands of the Pacific. The other two are Banaba (or Ocean Island) in the Gilbert Islands Group of Kiribati and Makatea, part of French Polynesia; however, Nauru is the only remaining producer. Phosphate is its only major mineral product.

Nauru's phosphate rock is mined and exported by the Government-owned NPC.

COMMODITY REVIEW

Industrial Minerals

Phosphate rock remains the sole mineral commodity produced on Nauru, except for minor amounts of crude construction materials used for domestic purposes. Nauruan phosphate remained

TABLE 1

NAURU: PRODUCTION OF MINERAL COMMODITIES[1 2]

Commodity		1985	1986	1987	1988	1989[p]
Phosphate rock	thousand metric tons	1,508	1,494	1,376	1,541	1,181

[p] Preliminary.
[1] Table includes data available through July 30, 1990.
[2] In addition to the commodities listed, crude construction materials (common clays, sand and gravel, and stone) are produced, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.

TABLE 2

NAURU: EXPORTS OF PHOSPHATE ROCK, BY DESTINATION

(Thousand metric tons)

Destination	1987	1988	1989
Australia	1,061.9	1,253.3	822.8
Japan	4.3	—	—
Korea, Republic of	38.2	40.5	52.8
New Zealand	202.9	188.8	305.8
Philippines	68.2	57.9	—
Total	1,375.5	[1]1,540.4	[1]1,181.3

[1] Data do not add to total shown because of independent rounding.
Source: Phosphate Rock Statistics 1989, International Fertilizer Association Ltd.

TABLE 3

NAURU: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies	Location of main facilities	Capacity (thousand metric tons per year)
Phosphate rock	Nauru Phosphate Corp.	Aiwo District	1.5

the highest grade of phosphate rock available in world commerce.

Production of phosphate rock in 1989 decreased 23%. Mining is done by clamshell buckets from deposits interdigitated with evenly spaced dolomitized coral limestone pinnacles. The associated coral was cobbed for domestic use as road aggregate.

Reserves

Phosphate rock reserves on Nauru are expected to be sufficient for only a few more years of mining at current production levels, with estimated depletion by 1995.

INFRASTRUCTURE

There are 3.9 kilometers (km) of the Government-owned railroad, which is used to transport phosphates from the central plateau of the island to processing facilities in the Yaren District on the southwestern coast, and about 27 km of roads, including 21 km paved and 6 km improved earth. There is one permanent-surface airport in the country and one shipping port. Electricity generating capacity in 1988 was reportedly 13,250 kilowatts. Generally, infrastructure for the mining of phosphate rock is regarded as adequate.

OUTLOOK

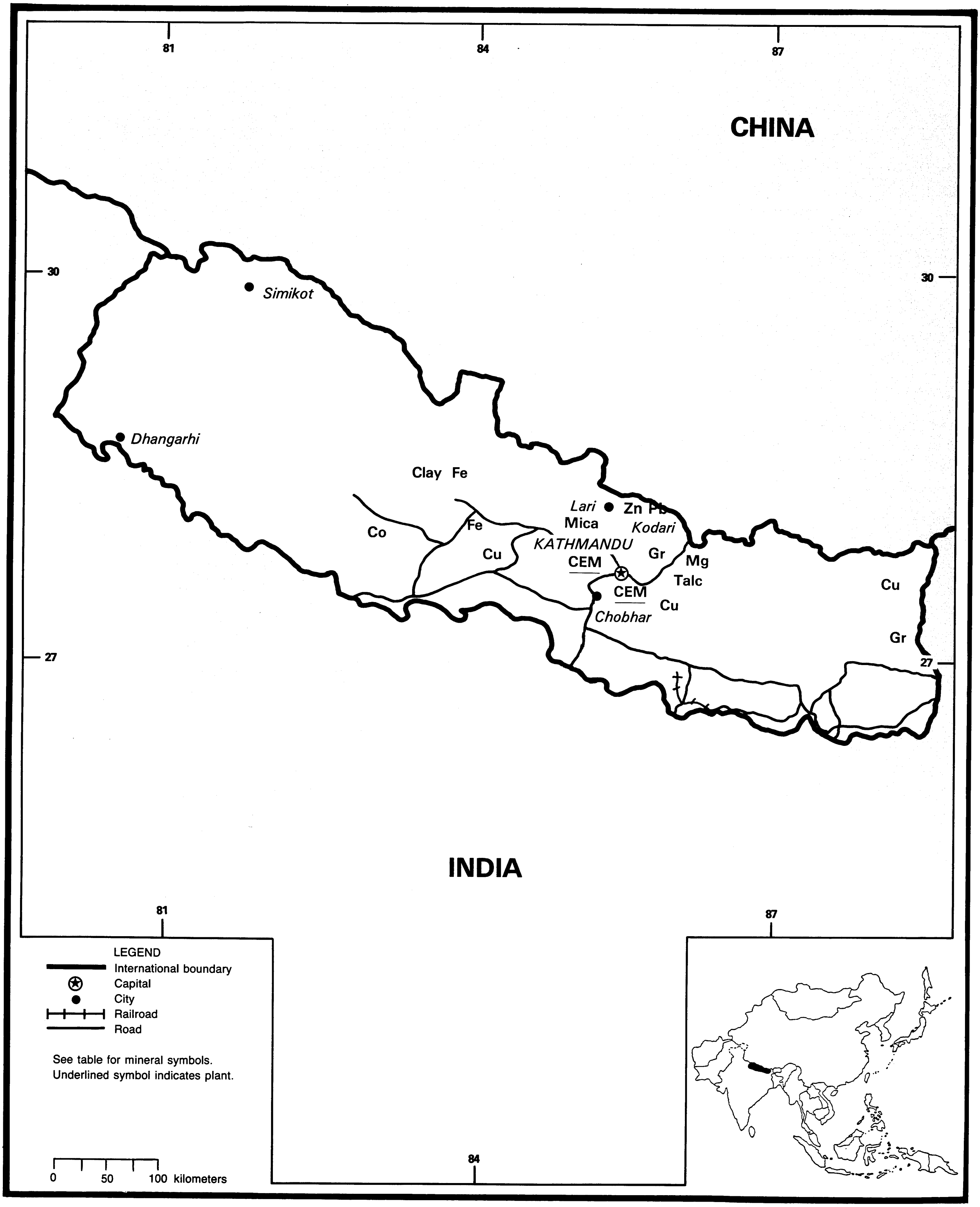
In general, production of phosphate rock has been declining during the past decade, and the annual output is expected to continue decreasing as reserves are depleted. The Australian-based Nauru Trust, which was set up in anticipation of depletion of Nauru's only resource, continues to invest earnings from its phosphate export earnings to lessen the impact on the island's economy when mining is no longer viable.

OTHER SOURCES OF INFORMATION

Nauru Phosphate Corp.
Aiwo District
Republic of Nauru

NEPAL

AREA 141,800 km² **POPULATION 19.1 million**



THE MINERAL INDUSTRY OF

NEPAL

By David B. Doan

As one of the poorest and least developed nations in the world, landlocked Nepal produced little in the way of mineral commodities beyond its own relatively simple needs, primarily for construction. Situated between two enormous countries, China and India, access to much of Nepal has been very difficult from either side. Modern development of the country started only after World War II and had progressed unevenly since then. In isolated villages where the lifestyle has not changed in the past 100 years, yearly per-capita income may have been as low as $20,[1] although in Kathmandu and other urban areas, particularly along the border with India, such yearly income may have ranged up to about $600. Meanwhile, economic difficulties have increased. Foreign-aid monies constituted one-half of the entire budget and three-quarters of the development budget, but in many cases results did not seem to correspond to amounts of money committed. The country was an absolute monarchy, governing through a panchayat or council system and a single political party. Accountability had been essentially only to the royal family, and political unrest had steadily increased throughout the country.

In March 1989, India closed 19 of its 21 border-crossing points into Nepal, imposed unreal tariffs on Nepalese imports, and banned outright the export of various commodities into Nepal, including petroleum products. Although India maintained that trade and transit treaties had expired and that Nepal was slow to negotiate new ones, it seemed clear that India was annoyed that Nepal had purchased arms from China and encouraged improvement of road access from China inward to Kathmandu. At yearend, the two countries were at a total impasse, and Nepal's economy was headed downhill. One result of all this was an increase in political unrest and a concerted call for a multiparty political system for the country.

GOVERNMENT POLICIES AND PROGRAMS

With the realization that the key to industrial progress and prosperity lies in development of the nation's infrastructure, road building and power generation were being given priority in the use of international loan funds received by the Government. Two master plans were in preparation, one for rural electrification and the other for nationwide power transmission and distribution. With technical assistance from the World Bank, 10-year master plans were being worked out by the Nepal Electricity Authority. Great emphasis was attached to the need for replacement of wood-burning by electricity as the basic energy supply for the country. This in turn would allow reforestation and contribute to environmental improvement by stabilizing watersheds and reducing flood potential.

The Department of Industries announced that The Foundry Workshop Ltd., a public-sector metalworking concern in Patan, would be transferred to the private sector. The workshop had been established in 1979 by the Department of Mines and Geology with the support of the United Nations Development Program and the United Nations Industrial Development Organization.

Late in the year the Government let it be known that it would soon formulate a new industrial and commercial policy with the object of increasing Nepal's competitiveness in trade, especially as to exports to India. Although mineral commodities were not mentioned, it was at least foreseeable that the export of gem stones, limestone, magnesite, marble, and talc could earn valuable foreign-exchange credits.

PRODUCTION

Nepal's output of cement reached a new high at slightly less than 218,000 tons, but even so was only up about 1% from the previous year. Lignite production, at 8,311 tons, increased nearly 16% from the preceding year, but the total output was miniscule compared to the country's energy needs. Production of agricultural lime, at more than 40,000 tons, was almost double that of the year before and suggested progress toward satisfying the requirements of Nepal's developing agricultural sector. Output of dimension stone in the form of cut marble, which increased by 50% to 23,450 tons, and craggy marble, which increased by a factor of 10 at about 69,000 tons, suggested a developing market for ornamental stone. Production of beryl, not reported prior to 1988, more than doubled from 400 kilograms (kg) in 1988 to 900 kg in 1989, but it is not clear whether this is in the form of aquamarine, morganite, or possibly emerald rough.

On the downside, production of magnesite decreased almost 40% from the preceding year to about 28,000 tons in 1989. Although India's growing iron and steel industry would seem to require magnesite for both new and replacement refractory brick in high-temperature furnaces, its export by Nepal may have slowed as the consequence of barriers imposed by India in connection with the Indo-Nepalese trade dispute.

TRADE

Nepal had generally not been a significant producer of mineral commod-

TABLE 1

NEPAL: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity[3]		1985	1986	1987	1988	1989[p]
Cement, hydraulic		31,479	92,853	151,631	215,010	217,666
Clays for cement manufacture		4,242	6,798	[e]10,000	8,033	7,206
Coal: Lignite		6,808	4,536	5,081	8,311	9,639
Copper ore:						
Gross weight		6	[e]6	[e]6	9	20
Cu content		2	[e]2	2	3	7
Gem stones:						
Beryl	kilograms	([4])	([4])	([4])	400	900
Garnet[e]	do.	[5]27,300	25,000	25,000	25,000	25,000
Tourmaline	do.	60	[e]50	[e]50	22	[e]20
Lime, agricultural		7,000	584	[e]500	21,200	40,500
Magnesite, crude		19,851	63,190	38,388	45,000	27,978
Salt		7,500	[e]7,000	[e]7	6	7,200
Stone:						
Limestone		55,953	174,798	334,270	323,584	289,743
Marble:						
Chips		700	[e]700	11,644	1,164	57
Cut	square meters	7,641	10,442	15,847	15,855	23,448
Craggy	do.	691	3,590	6,168	6,171	68,954
Talc		6,015	[r e]8,780	3,539	4,430	6,728

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Sept. 12, 1990.
[2]Data are for the fiscal year ending mid-July of that stated.
[3]In addition to the commodities listed, construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.
[4]Beryl may have been produced before 1988 but quantities were not reported.
[5]Reported figure.

ities except as required locally for construction in connection with both rural and, increasingly, urban development. Two exceptions were magnesite and talc, the latter a byproduct of magnesite processing, both having been produced primarily for export to India, but together amounting to less than 1% of the total value of Nepal's exports.

Imports had consisted mainly of fertilizer minerals and construction materials as well as coal and petroleum refinery products used for fuel. Export earnings historically had not paid the cost of imports.

STRUCTURE OF THE MINERAL INDUSTRY

The mineral industry of Nepal was very small, sparsely distributed and, for the most part, in early stages of development. The country's lack of roads and power-supply distribution had slowed the growth of present mines and plants, such as they were, and hindered the establishment of new operations. In general the mines were privately owned and operated, but the Government shared ownership of the magnesite mine equally with a private Indian company.

About 3% of Nepal's labor force of roughly 4 million was employed in all industries, and somewhat less than 5% of this industrial force is devoted to the mineral sector.

TABLE 2

NEPAL: STRUCTURE OF THE MINERAL INDUSTRY

Major Commodity	Major operating companies	Location of main facilities	Capacity (thousand tons per year)
Cement	Hetauda Cement Industries Ltd.	Kathmandu.	260
Do.	Himal Cement Co. Ltd.	Chobhar, south of Kathmandu.	50
Magnesite, dead burnt	Nepal Orind Magnesite Ltd.	Dolakha District, 50 km east of Kathmandu.	50
Zinc and lead	Nepal Metal Co.	Lari, 60 km northwest of Kathmandu.	.4

COMMODITY REVIEW

Metals

The Nepal Metal Company, Ltd. continued to prepare its Lari zinc property in the region of Ganesh Himal, about 60 kilometers (km) north of Kathmandu, for production. Located in very rugged terrain 4,421 meters (m) (14,500 feet) above sea level, the property had involved many problems in connection with its development. Because the ore body pitches steeply downward in the same direction that topography rises, no sure method of surface exploration was available at reasonable cost. Total ore resources (proved plus probable plus possible) were estimated to be slightly more than 2 million tons grading 12.51% zinc with variable proportions of combined lead and between 15 and 30 grams per ton of silver. Subsurface exploration during mining development had been contemplated, but first an entry in the form of shaft or incline must be excavated and prepared. Access was torturous by a road that needed improvement. Electric power must be brought in through some of the world's most forbidding terrain.

On the plus side, the deposit was open down-dip and probably on two sides. The geology of this highly deformed area is not unfavorable to a very large metalliferous deposit.

Industrial Minerals

The cement industry of Nepal, which relied on Indian coal, became increasingly short of fuel as a result of the restriction of trade in the impasse with India. One of the two leading cement manufacturers, Hetauda Cement Industries Ltd., about 45 km southwest of Kathmandu, with a capacity of 260,000 tons per year, was in desperate straits for fuel. Finally it was able to import 6,000 tons of coal from Indonesia, sufficient to operate the plant for 2 months. Although strictures on the supply of Indian coal were later eased, this plant operated significantly below capacity in that production for the year was only a little less than 218,000 tons for the entire country.

Mineral Fuels

Although Nepal produced no petroleum crude or natural gas, organized exploration began to get underway. The southern part of the country, amounting to between one-quarter and one-third of the total area, consists of the Siwalik foothills and the Terai plains, bordered on the north by the Himalayan structural front. This southern margin had been divided into 10 exploration blocks that have been under intense scrutiny. Seismic surveys suggested the presence of a thick sequence of relatively undeformed sedimentary rocks that corresponded in age and hydrocarbon potential to the producing areas in India and Pakistan to the west and India, Bangladesh, and Burma to the east.[2]

The Shell Nepal B.V.-Triton Energy joint venture leased Block 10 comprising 4,969 km^2, drilled a dry hole, and relinquished the exploration contract in May 1990. Such a relinquishment, in the context of exploration strategy in the petroleum industry, did not condemn the area south of the Himalayan structural front. It simply saved money while further analysis could be carried on, and results from other blocks scrutinized and traded between exploration companies.

Reserves

With the exception of the Government's conditional assumption of about 2 million tons of zinc and lead reserves at the Lari site, no data on any other mineral reserves were available. Estimates are listed for magnesite and talc, but it was doubtful that systematic studies had been done on these minerals. Plenty of limestone was thought to be available for manufacture of cement, but reserve projections were likewise lacking.

TABLE 3

NEPAL: ESTIMATED MAJOR MINERAL RESERVES

(Thousand metric tons)

Magnesite	3,000
Talc	2,000
Zinc (with lead)	2,000

INFRASTRUCTURE

Nepal had a poorly developed 6,000-km road system consisting of about 2,650 km of paved surfaces, 850 km of loose-stone surface, 2,260 km of improved and unimproved earth surface, and 240 km of seasonally trafficable cart tracks that were essentially undrained. Virtually all of the road network has been built after World War II. Most of the mountainous northern region of the country was not accessible by wheeled vehicles. The country's railroads amounted to 52 km of 0.762-m narrow gauge, all of it next to the border with India; 10 km of the rail system was owned by the Government.

Airports in Nepal totaled 38, with 5 of them having paved runways. One airport had runways 2,440 to 3,659 m in length, and an additional nine airports had runways 1,220 to 2,439 m long.

Although Nepal had very high potential for hydroelectric power generation, development had not progressed very far. No regional power grid had yet been established, and electricity was available regularly only in Kathmandu and a few of the other larger towns. Generating capacity was approximately 230 megawatts (MW) of which 42% is provided by the Marsyangdi Hydroelectric Plant commissioned in early 1990. Typical yearly output has been about 530 million kilowatt hours (kWh) or about 30 kWh per capita. By late 1990, generating capacity was expected to be increased to at least 237 MW.

OUTLOOK

If Nepal can develop its infrastructure, especially roads and electric power, rapidly enough to satisfy the needs of its growing population, it may be able to accomplish mineral exploration and production on a scale sufficient to make a difference to its economy. Geologically, Nepal is positioned very favorably for the occurrence of both metallic mineralization in the Himalayas and petroleum entrapment in the subsurface of the southern margins of the country. Resources, however, cannot be determined without access for prospecting and drilling. Modification of the absolute monarchy to a constitutional monarchy, with much greater dispersion of authority and responsibility, would be a first step toward more effective use of development loans from international sources. Technical aid in mapping and mineral exploration, agricultural improvement, and the engineering of civil construction projects, now at a modest level, could then be devoted to broader applications and significantly increased development of the country.

[1]U. S. Embassy, Kathmandu. Dep. of State Airgram A-08, Oct. 18, 1989, p. 1.

[2]Oil and Gas Journal. V. 87, No. 11, Mar. 13, 1989, p. 69.

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Department of Mines and Geology
Lainchour
Kathmandu, Nepal

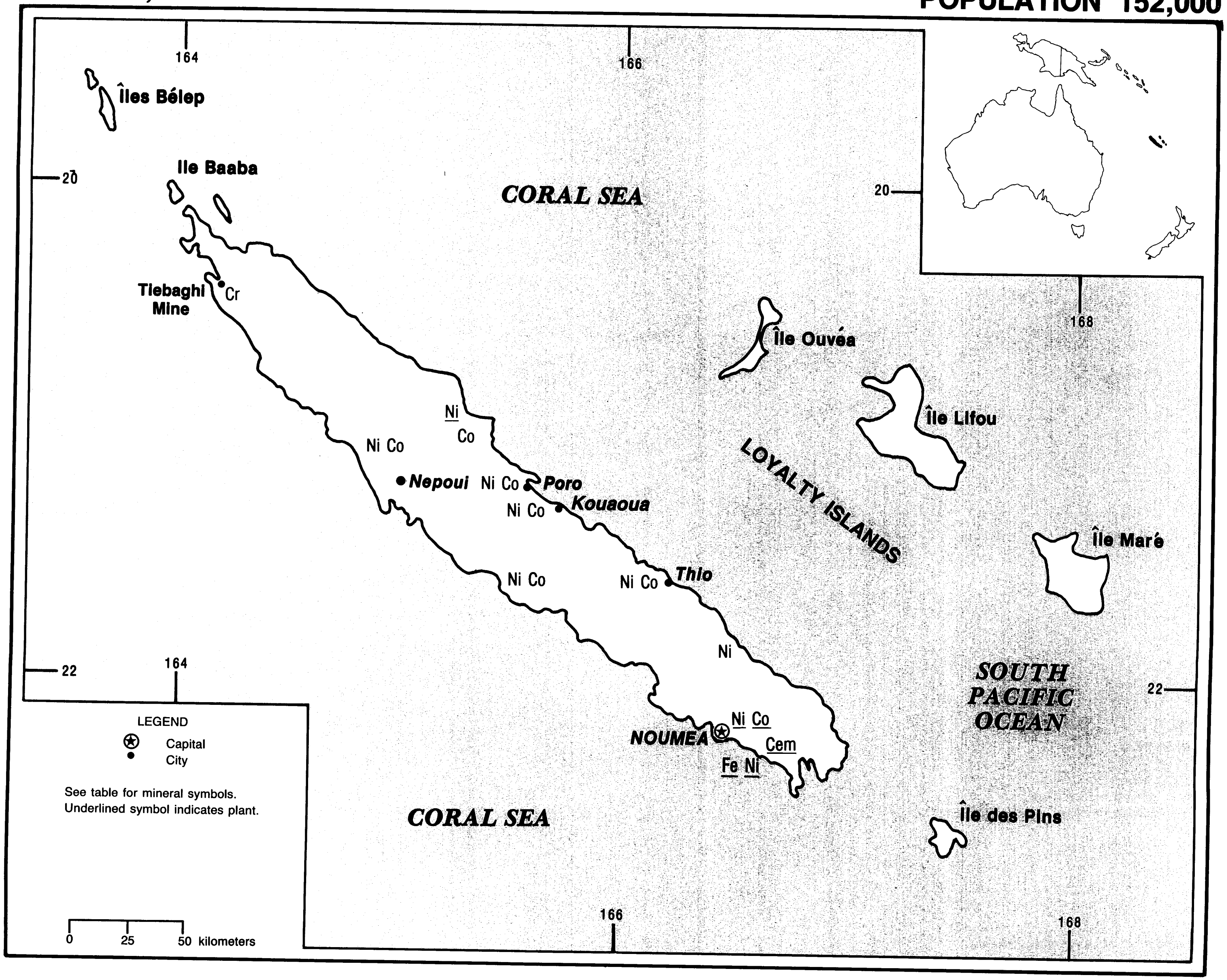
Publication

Nepal Industrial Digest, Nepal Industrial Development Corporation, Kathmandu, Nepal

NEW CALEDONIA
(France)

AREA 19,060 km²

POPULATION 152,000



THE MINERAL INDUSTRY OF

NEW CALEDONIA

By Travis Q. Lyday

INTRODUCTION

The mineral industry in the French Territory of New Caledonia and Dependencies continued to be dominated by the mining of nickeliferous laterite ore, which is used for the subsequent production of ferronickel of various grades and of nickel matte, and high-quality chromite ore produced from ultramafic rock. Minor amounts of cobalt are recovered as a component of nickel matte exports from refining operations at Sandouville, Le Havre, northern France. Pit and quarry construction materials also are produced.

PRODUCTION

Chromical S.A. mined refractory-grade (low-silica, high-grade fines) chromite ore in addition to producing high-grade lumpy ore and high-grade fines from its 450-ton-per-day capacity underground Tiebaghi Mine in the northern part of the island of New Caledonia. Ore production averaged 60% lumpy metallurgical-grade, 30% fines for the ferrochrome industry, and 10% refractory-grade from run-of-mine ore containing 20% to 52% chromic oxide (Cr_2O_3).[1]

Le Nickel-SLN (SLN) produced nickel ore from 12 operations on the island of New Caledonia. SLN also produced ferronickel and nickel matte at its Doniambo smelter at Noumea. New Caledonia is the third largest producer of mined nickel in the world after Can-

TABLE 1

NEW CALEDONIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
Cement[e]		60,000	40,000	50,000	60,000	[2]67,232
Chromite, gross weight		[r]78,820	[r]72,207	[r]61,832	70,341	[2]60,281
Cobalt, mine output:						
Co content[e 3]		5,186	5,000	5,800	6,000	6,000
Recovered[e]		675	700	750	800	800
Nickel:						
Ore:						
Gross weight	thousand tons	3,600	3,125	2,842	3,385	[2]4,855
Ni content		72,360	61,800	56,850	67,700	100,000
Metallurgical products:						
Ferronickel:						
Gross weight[e]		140,800	[2]130,500	115,600	146,300	140,500
Metal content (nickel plus cobalt)		36,103	33,001	29,531	37,352	36,000
Nickel matte:						
Gross weight[e]		12,100	12,260	11,300	14,300	13,500
Metal content (nickel plus cobalt)		8,905	9,160	8,283	10,470	10,000
Stone, sand and gravel:[e]						
Stone:						
Crude (unspecified)	cubic meters	20,000	20,000	20,000	20,000	20,000
Crushed	do.	90,000	100,000	100,000	100,000	100,000
Sand	do.	60,000	75,000	75,000	75,000	75,000
Silica (for metallurgical use)	do.	15,000	15,000	15,000	15,000	15,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Aug. 6, 1990.
[2]Reported figure.
[3]Series reflects cobalt recovery from ores and intermediate metallurgical products of nickel exported from New Caledonia to France and Japan.

ada and the U.S.S.R. and was a leading supplier of ferronickel, with about 40% of the world market.[2]

TRADE

Contracts were signed for the supply of 1 million tons of nickel ore per year with New Caledonian miners, and ore shipments began to Australia's Yabulu nickel refinery near Townsville, Queensland, by the end of 1989.

TABLE 2

NEW CALEDONIA: EXPORTS OF NICKEL, BY TYPE AND DESTINATION

(Metric tons)

Type	1987	1988	Destinations, 1988
Ore	1,019,729	1,266,830	All to Japan.
Matte	r7,353	10,330	All to France.
Ferronickel, gross weight	r30,349	36,819	Australia 28,322; France 8,497.

r Revised.

Source: Annales Des Mines (Paris), Feb. 1990.

STRUCTURE OF THE MINERAL INDUSTRY

Chromical, New Caledonia's only chromite producer, is owned by Canada's Inco Metals Ltd. through its French subsidiary International Nickel France, which has a 55% controlling interest. The remaining 45% is split evenly between Sococal, a subsidiary of the Banque de Paris et des Pays-Bas, and Comines, a subsidiary of Coframines, which is a part of the French Bureau de Recherches Geologiques et Minieres (BRGM).

The mines operated by SLN, a wholly owned subsidiary of Metropolitan France's Societe Metallurgique le Nickel, supply about 65% of the mined nickel in the country, with the other 35% coming from much smaller scale, independently owned and operated mines.

TABLE 3

NEW CALEDONIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies	Location of main facilities	Rated capacity (thousand metric tons per year)
Cement	S.A. Ciments de Numbo	Noumea	180
Chromite, concentrate (52% Cr_2O_3)	Chromical S.A.	Tiebaghi Mine, 80 kilometers northwest of Nepoui	85
Nickel, ore	Societe Metallurgique le Nickel	Meaba Mine, Kouaoua	1,000
Do.	do.	Camp des Sapin and Le Mines, Thio	700
Do.	Independent producers	Several mines on north end of island	830
Ferronickel, matte	Societe Metallurigique le Nickel	Doniambo Smelter, Noumea	45

COMMODITY REVIEW

Metals

Chromium.—The Tiebaghi Mine was closed in October for a period of up to 15 months so that new ore reserves could be identified.[3] Originally, the mine was to be closed for only 10 months—through the end of the second quarter of 1990—but production problems, including flood damage, delayed the date for reopening to yearend 1990.

Nickel.—SLN announced in May an investment program to modernize and expand its mining and metallurgical operations in New Caledonia. The program will increase annual production incrementally at the Doniambo smelter at Noumea by more than 15% to 53,000 to 55,000 tons during the next 6 years.[4] Most of the investment will involve the opening of a new open pit mining center on the west coast of the island rather than requiring the addition of a new smelting furnace.[5] The improvements will include relining of the three existing Demag electric furnaces.[6]

Reserves

When the Tiebaghi Mine started production in 1982, ore reserves were put at 500,000 tons—about 5 years of production. However, the production life of the mine was extended to about 7.5 years subsequent to further exploration work after operations began. Several small-scale ore deposits have been identified during the present closure interval, both to the east and to the west of the present mine site. Exploratory work is continuing in order to prove reserves that will withstand mining for a longer period of time.

New Caledonia's nickel reserves, estimated to be 30% of world reserves, are second only to those of Cuba.

In addition to the abundant reserves of chromium and nickel ores, the island territory is well endowed with other mineral resources. Significant prospects have been reported for antimony, copper, gold, iron ore, lead-zinc, manganese, and phosphate rock. However, none of these has been mined commercially.

INFRASTRUCTURE

The transportation infrastructure includes 5,448 kilometers (km) of roads, of which 558 km are paved, 2,251 km are improved, and 2,639 km are improved earth. There are 29 airports serving the country, 4 with permanent-surface runways. International shipping ports include the port at the capital city of the territory, Noumea, and the ports at Nepoui, Poro, and Thio. Electricity generating capacity in 1988 was 400,000 kilowatts. Generally, infrastructure for the mining of chromite and nickel ores is regarded as adequate.

OUTLOOK

Although Chromical's Tiebaghi Mine is scheduled to be closed for all of 1990, the company is optimistic that sufficient chromite reserves will be identified for the company to continue viable operations at the site.

SLN projected an annual investment program at the rate of about $30 million[7] during the next 6 years to increase production in New Caledonia by 15%. Hence, its long-term contracts, generally for a period of 3 years, with European and Japanese clients should be protected from the effects of any price declines in the nickel market as well as ensure a reasonable rate of return from its operations.

The improved economy of New Caledonia, the diminished violence by separatist Melanesian Kanaks, and the lowering of corporate tax on profits from 50% to 35% also should boost both chromite and nickel production in New Caledonia in the future.

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[1] Metal Bulletin (London). No. 7414, Sept. 7, 1989, p. 15.

[2] American Metal Market (New York). V. 97, No. 117, June 16, 1989, p. 4.

[3] Metal Bulletin (London). No. 7400, July 13, 1989, p. 15.

[4] Work cited in footnote 2.

[5] American Metal Market (New York). V. 97, No. 103, May 26, 1989, p. 2.

[6] Metal Bulletin (London). No. 7377, Apr. 20, 1989, p. 11.

[7] Where necessary, values have been converted from French francs (F) to U.S. dollars at the rate of F6.60 = US$1.00. The Comptoirs Francais du Pacifique franc (CFPF) is linked to the French franc at the rate of CFPF18.18 = F1.0.

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Noumea, New Caledonia

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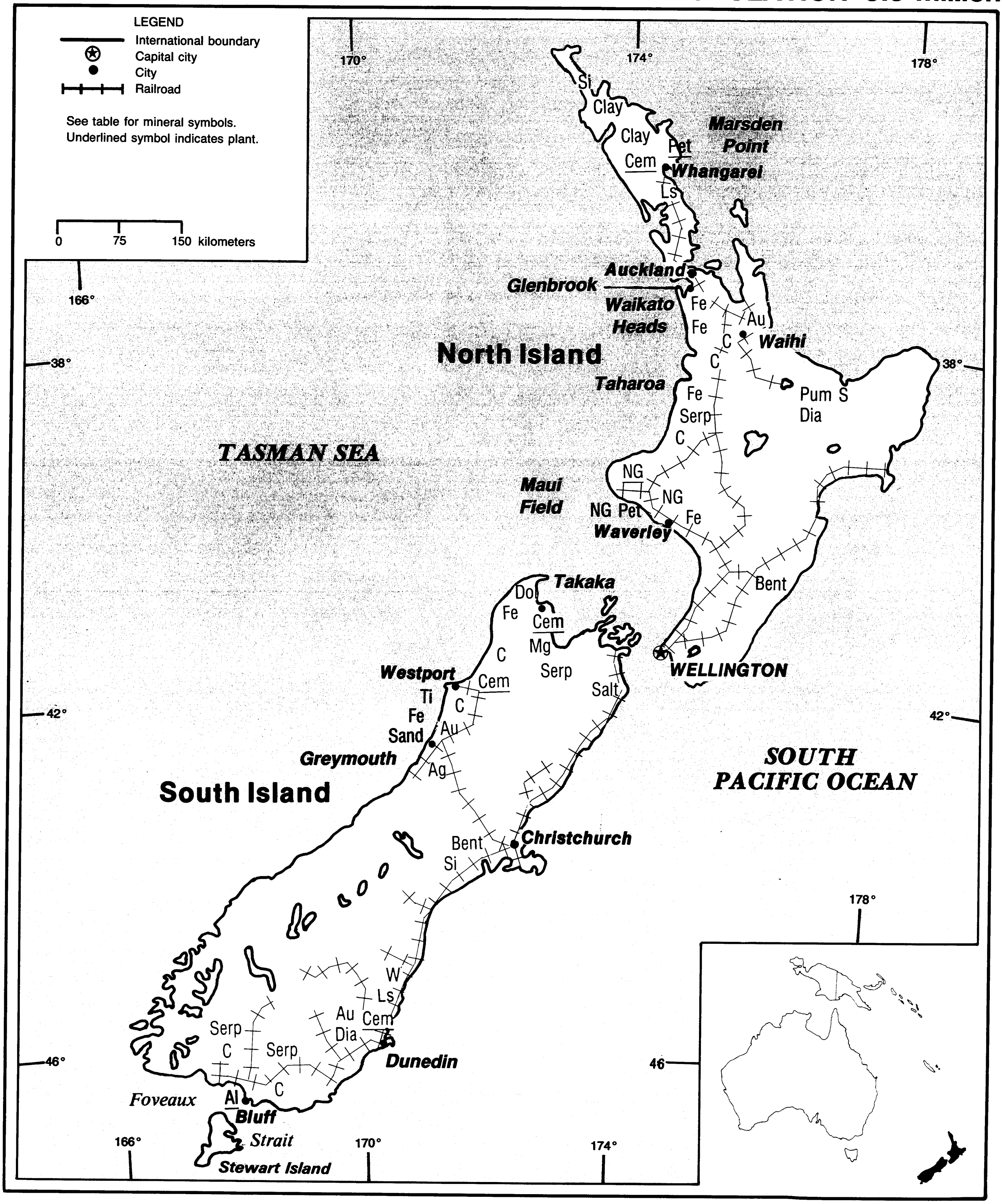
NEW ZEALAND

AREA 268,680 km² **POPULATION 3.3 million**



THE MINERAL INDUSTRY OF

NEW ZEALAND

By Travis Q. Lyday

The New Zealand mining industry is primarily centered on coal and gold, mineral commodities with long traditions in the country. The mineral industry in New Zealand began with the discovery of gold in the 1850's. Coal mining began about 1850, and by early in this century, its production value exceeded that of gold for the first time. During the 1960's, building aggregates replaced coal as the most valuable mineral product, but, in the early 1980's aggregates were, in turn, replaced by natural gas as the country's most valuable mineral product.

The existence of extensive iron sand deposits on the west coast of North Island was known for more than a century, but not until the late 1960's was a steelmaking industry in New Zealand able to use successfully the iron sands and coal from an area near Waikato North Head. Construction of the Glenbrook steelworks was completed in 1970, and its most recent expansion, completed in 1988, was to a 750,000-ton-per-year capacity.

Serious exploration for oil and gas began in the late 1950's and resulted in the discovery of two natural gas fields. The Kapuni Field was discovered in 1959, and its production, which started in 1970, has supplied gas to nine North Island Government distribution centers and a number of industrial customers. The much larger Maui offshore gas field was discovered in 1969, and production has been used primarily for electricity generation and as a premium fuel.

GOVERNMENT POLICIES AND PROGRAMS

The proposed Mining Act to replace that of 1971 was under review during the year as part of the Resource Management Law Reform (RMLR). The aim of the RMLR was the formulation of comprehensive, integrated, consistent, and equitable environmental management that would not promote mining as an activity above all others. The Ministry of Energy in its Energy and Mineral Resource Policy proposed greatly increased prospecting license application and inspection fees—those who benefit bear the cost—and a 5% royalty on the value of gold removed or a resource rental tax on the mining industry. This proposal was to apply to production revenue regardless of profit or loss and was to be an interim measure until the Government finalizes a new mining act.

PRODUCTION

Because reliable statistical information on production was unavailable for most commodities, production levels were estimated.

The mineral industry in New Zealand consisted mainly of mining coal; construction materials (clays, sand and gravel, and stone); limestone and marble for agricultural uses; and titaniferous magnetite sand (iron sand). Gold mining was renewed in the historic goldfield at Martha Hill, Waihi, on the Coromandel Peninsula in 1988, and New Zealand's second hard rock gold mine was started at Macraes Flat, South Island, during 1989. Crude mineral production also included fossil fuels—natural gas, natural gas liquids, and petroleum condensate. Crude petroleum, natural gas, and natural gas liquids production continued to increase.

The mineral processing sector consisted chiefly of the production of primary aluminum, manufactured fertilizers, petroleum refinery products, and crude steel produced mostly from imported raw materials.

TRADE

Among mineral commodity imports, crude petroleum, partly refined petroleum, and petroleum refinery products dominated. Other mineral commodity imports were alumina, fertilizer materials, and steel semimanufactures. Aluminum ingots continued to be the dominant mineral commodity export, followed closely by gold, steel semimanufactures and other products, and iron ore (iron sand).

STRUCTURE OF THE MINERAL INDUSTRY

A significant part of the minerals industry was controlled by the Government until 1984, including a considerable share of coal production capacity; oil and gas production facilities; the Glenbrook Steelworks; and the nation's sole oil refinery at Marsden Point. Since 1984, the Government has been reducing its attachment and control of these enterprises through deregulation and sale of its equity to the private sector. Major facilities in private hands during 1989 included the aluminum smelter at Bluff; the gold operations at Macraes Flat; the steel plant; four cement plants; and most of the mines and quarries for industrial minerals.

COMMODITY REVIEW

Metals

Aluminum.—New Zealand Aluminium Smelters Ltd.'s aluminum smelter at Bluff, Tiwai Point, South Island, stopped normal replacement of pots in the potlines early in the year to avoid

TABLE 1

NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
METALS						
Aluminum metal, smelter:						
Primary		240,835	236,332	252,000	264,398	[2]259,700
Secondary		1,500	4,000	4,000	3,100	[2]3,100
Total		242,335	240,332	256,000	267,498	[2]262,800
Gold, mine output, Au content	kilograms	886	1,265	1,148	2,404	2,700
Iron and steel:						
Iron ore, gross weight[e 3]		2,000	2,000	2,000	1,500	1,500
Iron sand (titaniferous magnetite):						
Gross weight	thousand tons	2,520	2,580	2,290	2,351	2,000
Fe content[e]	do.	1,425	1,425	1,300	[r]1,300	1,150
Pig iron (sponge iron)[e]	do.	170	200	200	200	200
Steel, crude	do.	228	291	[e]300	[e]250	250
Lead, refinery output, secondary[e]		6,000	4,000	[2]4,000	3,600	[2]5,000
Tungsten, mine output (scheelite):						
Gross weight		15	([4])	[e]10	[e]10	10
W content		7	([4])	[e]5	[e]5	5
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	863	906	880	812	[2]950
Clays:						
Bentonite		7,400	3,140	—	1,255	2,000
Kaolin (pottery)		24,471	28,464	25,548	29,649	30,000
For brick and tile[e]		145,000	145,000	145,000	[2]87,892	100,000
Lime[e]		160,000	160,000	160,000	150,000	100,000
Nitrogen: N content of ammonia		60,000	[e]60,000	73,000	[e]75,000	75,000
Pumice[e]		20,000	20,000	15,000	[2]25,003	25,000
Salt[e]		[2]51,500	—	60,000	60,000	60,000
Sand and gravel:[e]						
Silica sand (glass sand)		50,000	50,000	50,000	[2]55,201	55,000
Other industrial sand		350,000	350,000	350,000	[2]330,042	335,000
For roads and ballast	thousand tons	15,000	15,000	15,000	[2]12,455	13,000
For building aggregate	do.	5,000	5,000	5,000	[2]5,806	6,000
Stone:[e]						
Dolomite		18,000	18,000	18,000	[2]24,061	25,000
Greenstone	kilograms	3,000	3,000	3,000	3,000	3,000
Limestone and marl:						
For agriculture	thousand tons	1,500	1,500	1,500	[2]708	800
For cement	do.	1,500	1,500	1,500	[2]1,256	1,200
For other industrial uses	do.	215	215	215	[2]310	300
For roads	do.	350	350	350	[2]397	500
Serpentine		75,000	75,000	75,000	[2]16,042	15,000
Unspecified:						
Dimension		35,000	35,000	35,000	35,000	35,000
Rock for harbor work	thousand tons	2,500	2,500	2,500	[2]1,359	1,500
Sulfur		[r]1,294	[r e]1,000	[e]1,000	4,323	4,000

See footnotes at end of table.

TABLE 1—Continued

NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
MINERAL FUELS AND RELATED MATERIALS						
Carbon dioxide, liquefied[e]		10,000	10,000	10,000	10,000	10,000
Coal:						
Anthracite[e]	thousand tons	(4)	(4)	(4)	(4)	(4)
Bituminous	do.	651	679	[e]600	[e]650	650
Subbituminous	do.	1,669	1,767	[e]1,500	[e]1,600	1,500
Lignite	do.	228	195	[e]200	[e]200	250
Total	do.	2,548	2,641	[e]2,300	[e]2,450	[2]2,400
Coke:[e]						
Coke oven		2,000	2,000	2,000	2,000	2,000
Gashouse		6,000	6,000	6,000	6,000	6,000
Total		8,000	8,000	8,000	8,000	8,000
Fuel briquets[e]		5,000	5,000	5,000	5,000	5,000
Gas:						
Manufactured (from gasworks)[e]	million cubic feet	517	356	350	350	400
Natural:						
Gross production	do.	170,900	191,700	189,700	[e]190,000	[2]209,150
Marketed production	do.	137,162	164,283	[e]165,000	[e]165,000	[2]174,480
Natural gas liquids:[e]						
Liquefied petroleum gas	thousand 42-gallon barrels	910	976	1,201	1,000	1,250
Natural gasoline	do.	160	172	157	200	[2]250
Total	do.	1,070	[2]1,148	1,358	1,200	1,500
Petroleum:						
Crude	do.	6,844	10,585	10,220	10,629	[2]10,220
Refinery products:						
Gasoline	do.	6,001	13,150	11,492	[e]14,000	[2]6,429
Distillate fuel oil	do.	2,462	4,588	7,467	[e]5,000	[2]8,892
Residual fuel oil	do.	1,998	1,512	2,131	[e]2,000	[2]1,863
Other	do.	637	679	938	[e]1,000	[2]1,058
Refinery fuel and losses	do.	525	784	1,799	[e]1,000	1,000
Total	do.	11,623	20,713	23,827	[e]23,000	19,242

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Table includes data available through July 5,1990.
[2]Reported figure.
[3]Not used for manufacture of iron; reportedly consumed for gas purification, preparation of stock licks, and manufacture of brick. Because of these uses, iron content is not reported.
[4]Less than 1/2 unit.

serious damage to the plant. Moreover, it closed for a short time because of threatened industrial action by union power workers. At yearend, however, the company was planning expansion of capacity by 100,000 to 120,000 tons. The possible expansion concentrated on a successful conclusion to a proposal for a joint-venture buyout of the state-owned Lake Manapouri hydroelectric plant. This plant has provided most of the power for the smelter, and the buyout would ensure continued long-term power supply, presumably at competitive rates. New Zealand Aluminium was owned by Comalco NZ Ltd., which held a 79.36% majority share, and Japan's Sumitomo Chemical Co., which held the remaining 24.64%. In the proposed powerplant buyout, Comalco and Sumitomo would together take 25%, the state-owned Electricity Corp. of New Zealand would retain 25%, and 50% would be floated to the public.

Ferronickel.—New Zealand Nickel Smelters Ltd. began a final feasibility study to build a $120 million nickel smelter on South Island early in the year. A preliminary feasibility study already had been completed. Production, which would use imported concentrates from New Caledonia, would be 40,000 tons per year of ferronickel containing about 75% iron and 25% nickel. All production, at least initially, would be for the export market. Proposed sites for the facility have been narrowed to either Bluff or Timaru,

TABLE 2

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	65	—		
Metal including alloys:				
Scrap	7,976	9,371	—	Japan 6,989; Australia 1,357.
Unwrought	227,713	231,727	60	Japan 213,257; Netherlands 2,984.
Semimanufactures	7,732	10,930	273	Australia 6,819; Singapore 717.
Chromium: Oxides and hydroxides	1	1	—	All to Fiji.
Copper: Metal including alloys:				
Scrap	1,889	2,906	—	Australia 1,317; Spain 637; India 510.
Unwrought	([2])	105	33	Australia 48; United Kingdom 18.
Semimanufactures	([3])	6,679	1,244	Australia 4,002; Canada 355.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite thousand tons	1,794	1,464	—	Japan 1,463.
Metal:				
Scrap	2,839	2,132	—	Japan 1,040; United Kingdom 125.
Pig iron, cast iron, related materials	5	—		
Ferroalloys:				
Ferrosilicon	NA	106	—	NA.
Unspecified	NA	41	—	All to Australia.
Steel, primary forms	100,251	NA		
Semimanufactures:				
Bars, rods, angles, shapes, sections	15,879	NA		
Universals, plates, sheets	36,096	NA		
Hoop and strip	53	NA		
Wire	4,028	3,559	3	Australia 2,090; Hong Kong 768.
Tubes, pipes, fittings	4,185	6,263	2,583	Papua New Guinea 1,425; Australia 578.
Castings and forgings, rough	90	NA		
Lead:				
Oxides	1	3	—	All to Fiji.
Metal including alloys:				
Scrap	295	1,563	—	Republic of Korea 746; Australia 311.
Unwrought and semimanufactures	263	82	([4])	Australia 38; United Kingdom 18; Malaysia 13.
Magnesium: Metal including alloys, scrap	6	—		
Mercury value, thousands	$3	$3	—	Australia $2; Fiji $1.
Nickel: Metal including alloys:				
Scrap	182	509	—	Netherlands 370; India 42; United Kingdom 28.
Unwrought	—	14	—	All to Australia.
Semimanufactures	47	280	—	Australia 236.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$7	$353	—	Australia $251; United Kingdom $101.
Silicon, high-purity	NA	3	—	Mainly to Fiji.

See footnotes at end of table.

TABLE 2—Continued

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988 United States	Destinations, 1988 Other (principal)
METALS—Continued					
Silver:					
Ore and concentrate	value, thousands	—	$113	—	All to Australia.
Waste and sweepings	do.	$130	$118	—	United Kingdom $107; Australia $11.
Metal including alloys, unwrought and partly wrought	do.	$9	$1,469	$104	Australia $714; Hong Kong $408.
Tin: Metal including alloys:					
Scrap		169	20	—	NA.
Unwrought	value, thousands	$2	—		
Semimanufactures		42	536	—	Australia 515; Singapore 20.
Titanium: Oxides		11	19	—	All to Australia.
Tungsten: Metal including alloys, all forms	value, thousands	$44	—		
Zinc:					
Oxides		17	—		
Metal including alloys:					
Scrap		871	1,294	—	Australia 809; U.S.S.R. 36.
Unwrought and semimanufactures		9	13	—	Fiji 11; Australia 2.
Other:					
Ores and concentrates		192	—		
Ashes and residues		1,675	1,592	—	Japan 710; India 531.
Base metals including alloys, all forms	value, thousands	$2	—		
Metalloids[5]		NA	52	—	Australia 35; Singapore 15.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		776	[6]190	—	Australia 137; Fiji 50.
Grinding and polishing wheels and stones	value, thousands	$165	$230	$7	Australia $162; Canada $12.
Dust and powder of precious and semiprecious stones including diamond	do.	—	$12	—	United Kingdom $4.
Asbestos, crude	do.	$1	—		
Barite and witherite		12	—		
Boron materials: Oxides and acids		2	—		
Cement		48,184	17,426	—	Vanuatu 4,571; Solomon Islands 3,599; American Samoa 2,361.
Chalk		5	—		
Clays, crude		18,588	20,165	—	Japan 9,954; Republic of Korea 3,070; Malaysia 578.
Diamond:					
Gem, not set or strung	value, thousands	$1,052	$1,032	$26	Australia $634; United Kingdom $212.
Industrial stones	do.	$34	$8	$8	
Diatomite and other infusorial earth		5	9	—	New Caledonia 8.
Fertilizer materials:					
Crude, n.e.s.		203	6,008	—	Japan 2,033; Indonesia 2,013; Papua New Guinea 505.
Manufactured:					
Ammonia		5	1	—	Mainly to Tonga.
Nitrogenous		([7])	76,142	36,882	Australia 38,630; Japan 386.
Phosphatic		103	34	—	French Polynesia 22; Samoa 4.

See footnotes at end of table.

TABLE 2—Continued

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Fertilizer materials—Continued					
Manufactured—Continued					
Potassic		([8])	49	—	Cook Islands 40; Norfolk Islands 5.
Unspecified and mixed		([9])	535	40	Cook Islands 253; French Polynesia 50.
Gypsum and plaster		59	8	—	Papua New Guinea 6.
Lime		1,937	720	—	Papua New Guinea 475; Fiji 178.
Mica: Worked including agglomerated splittings	value, thousands	—	$9	—	New Caledonia $5; Australia $4.
Phosphates, crude		99	—		
Pigments, mineral: Iron oxides and hydroxides, processed		2	1	—	NA.
Potassium salts, crude	value, thousands	$1	—		
Precious and semiprecious stones other than diamond:					
Natural	do.	$626	$446	$29	Australia $354; United Kingdom $42.
Synthetic	do.	$49	$11	—	Australia $6; United Kingdom $5.
Salt and brine		3,907	2,036	—	Australia 1,140; American Samoa 343.
Sodium compounds, n.e.s.:					
Soda ash		3	—		
Sulfate		NA	18	—	All to Fiji.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value, thousands	$5	$1	—	All to Australia.
Worked	do.	$70	$339	$90	Samoa $86; Australia $63.
Dolomite, chiefly refractory-grade	do.	([10])	$22	—	French Polynesia $20.
Gravel and crushed rock		789	494	6	Malaysia 484.
Limestone other than dimension		421	1,269	—	Fiji 784; French Polynesia 341; Papua New Guinea 114.
Quartz and quartzite	value, thousands	$1	—		
Sand other than metal-bearing		415	233	—	Australia 197; Fiji 23.
MINERAL FUELS AND RELATED MATERIALS					
Sulfur:					
Elemental: Colloidal, precipitated, sublimed		8	9	—	Mainly to Fiji.
Sulfuric acid		145	106	—	Papua New Guinea 29; Fiji 28; Solomon Islands 16.
Talc, steatite, soapstone, pyrophyllite		15	—		
Other:					
Crude		499	219	—	Fiji 159; Solomon Islands 26.
Slag and dross, not metal-bearing		NA	40	—	All to Australia.
Asphalt and bitumen, natural		473	19	—	Australia 18.
Carbon black		2	—		
Coal: Bituminous		299,675	364,766	—	Japan 307,667; Australia 39,044.
Peat including briquets and litter		4,246	2,269	—	Australia 2,104; French Polynesia 66.
Petroleum:					
Crude	thousand 42-gallon barrels	370	2,600	—	All to Australia.
Refinery products:					
Liquefied petroleum gas	42-gallon barrels	([11])	6,194	—	Australia 6,078.

See footnotes at end of table.

TABLE 2—Continued

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Gasoline, motor	42-gallon barrels	1,435,166	1,431,834	46,784	Australia 773,288; Fiji 250,240.
Mineral jelly and wax	do.	71	158	—	Australia 79; Fiji 55.
Kerosene and jet fuel	do.	180,474	435,201	—	Japan 177,956; French Polynesia 120,730; Fiji 87,684.
Distillate fuel oil	do.	261,346	885,084	19,224	Japan 478,423; Papua New Guinea 191,767.
Libricants	value, thousands	$1,174	$408	$2	Fiji $238; Malaysia $54.
Residual fuel oil	42-gallon barrrels	27	208,558	—	Fiji 123,357; New Caledonia 48,072.
Bitumen and other residues	do.	224	48	—	All to Cook Islands.
Bituminous mixtures	do.	6,593	3,969	—	Papua New Guinea 1,715; Samoa 1,285.

NA Not available.
[1]Table prepared by Audrey D. Wilkes.
[2]Unreported quantity valued at $5,000.
[3]Unreported quantity valued at $14,922,000.
[4]Less than 1/2 unit.
[5]Reported under SITC item number as "selenium, phosphorus, etc."
[6]Excludes unreported quantity valued at $99,000.
[7]Unreported quantity valued at $9,689,000.
[8]Unreported quantity valued at $11,000.
[9]Unreported quantity valued at $352,000.
[10]Unreported quantity valued at $9,000.
[11]Unreported quantity valued at $152,000.

deep-water ports on South Island. South Island was selected because there is an excess of power capacity and vast reserves of coal.

Gold.—The Australian company BHP Gold Mines Ltd. announced during the first quarter it would sell its New Zealand operating companies to its joint-venture partners. Under the sale, BHP Gold's 70% interest in the Macraes Flat property in the Otago region of South Island would go to Union Gold (NZ) NL and its interests in six approved prospecting licenses and six licenses under application in the Coromandel Peninsula near Auckland would go to ACM Gold Ltd. Environmental pressure, the continuing weakness in gold prices, rising capital costs, and increased royalties and prospecting license levies were cited as the main reasons for the sale.

During the third quarter, it was announced that shares in the Macraes Flat project would be floated, creating the largest gold mining company in New Zealand. The new company, Macraes Mining Co. Ltd., will be 51% owned by Union Gold, and 32% will be offered to Union Gold shareholders. The remaining 17% equity will be offered to the New Zealand public.

The Australian gold mining company, Forsayth NL, through its wholly owned subsidiary Forsayth New Zealand Ltd., entered into a joint venture with Heritage Mining NL, the most active explorer and largest holder of prospecting licenses in the Coromandel Peninsula, to search for gold. Under the agreement, Forsayth will pay exploration costs, with Heritage as operator, until a mining application is submitted; thereafter, the costs will be shared equally. Forsayth will become the operator in the areas covered by a mining license.

Iron and Steel.—Equiticorp International Plc, a diversified manufacturing and financial group, was owner of 80% of New Zealand Steel, which was placed on sale at yearend 1988. Equiticorp, already overextended, collapsed in early January. Equiticorp purchased New Zealand Steel from the Government on the day of the October 1987 stockmarket crash and was in financial trouble before it actually took possession. After its failure, the Government placed the company in receivership to sell by tender all companies under the control of Equiticorp, which included the Glenbrook Steelworks.

Fletcher Challenge Ltd., a diversified domestic resources company, was widely expected to be the next owner of New Zealand Steel. However, Helenus Corp. Ltd., a consortium led and controlled by Australia's BHP Steel Ltd., was the eventual purchaser, in July, for $194 million, of both the 80% Equiticorp share and the 20% Fisher and Paykel Industries Ltd. (the domestic manufacturing group) share. Other shareholders in Helenus included New Zealand's Fisher & Paykel Industries Ltd., 25%; Steel & Tube Holdings New Zealand, 25%; and ANZ Banking Group NZ, 19%. In April, the China National Metals and Minerals Import and Export Corp. (Minmetals) was the successful bidder, with the purchase to take effect June 30. However, the deal was mutually terminated, apparently

TABLE 3

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS				
Alkali and rare-earth metals value, thousands	$13	$8	$2	United Kingdom $3.
Aluminum:				
Ore and concentrate	1,114	4,350	—	Guyana 4,182; China 167.
Oxides and hydroxides	507,712	460,141	12,774	Australia 443,199.
Metal including alloys:				
Scrap	752	346	4	Australia 280; Singapore 32.
Unwrought	2,726	5,562	275	Australia 3,880; Bahrain 1,227.
Semimanufactures	10,817	9,364	139	Australia 6,833; Japan 534.
Cadmium: Metal including alloys, all forms value, thousands	—	$6	—	Australia $5.
Chromium:				
Ore and concentrate	116	291	—	Republic of South Africa 271; Australia 20.
Oxides and hydroxides	112	209	47	West Germany 89; United Kingdom 62.
Cobalt:				
Oxides and hydroxides	13	15	1	United Kingdom 10; Australia 2.
Metal including alloys, all forms value, thousands	—	$20	$2	United Kingdom $17.
Columbium and tantalum: Tantalum metal including alloys, all forms value, thousands	$1	—		
Copper:				
Metal including alloys:				
Scrap	—	7	—	Australia 4.
Unwrought	2,451	4,391	8	Australia 1,376; West Germany 451.
Semimanufactures	[2]16,261	13,478	195	Australia 9,909.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	36	21	—	All from Australia.
Metal:				
Scrap value, thousands	$413	$269	—	New Caledonia $196; French Polynesia $53.
Pig iron, cast iron, related materials	935	685	1	Australia 391; United Kingdom 209.
Ferroalloys:				
Ferromanganese	570	1,456	—	Australia 1,442.
Unspecified	3,504	4,753	136	Australia 2,990; Japan 693.
Steel, primary forms	123	NA		
Semimanufactures:				
Bars, rods, angles, shapes, sections	91,102	NA		
Universals, plates, sheets	369,267	NA		
Hoop and strip	15,099	NA		
Rails and accessories	1,504	NA		
Wire	16,242	NA		
Tubes, pipes, fittings	36,499	NA		
Castings and forgings, rough	15	NA		
Lead:				
Oxides	81	99	1	United Kingdom 54; Australia 39.
Metal including alloys:				
Scrap	82	—		
Unwrought	4,091	3,395	—	Mainly from Australia.
Semimanufactures	113	39	—	Australia 33.

See footnotes at end of table.

TABLE 3—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Magnesium: Metal including alloys, all forms value, thousands	r$984	$608	$86	Norway $495; Canada $21.
Manganese:				
Ore and concentrate: Metallurgical-grade	102	76	—	Singapore 35; Japan 34.
Oxides	574	563	31	Japan 329; Australia 167.
Mercury value, thousands	$11	$17	—	Australia $6; Japan $3; United Kingdom $3.
Molybdenum: Metal including alloys, all forms do.	$83	$8	$2	Belgium-Luxembourg $4.
Nickel:				
Metal including alloys:				
Scrap	2	3	—	All from Australia.
Unwrought	52	61	—	Canada 54; Australia 7.
Semimanufactures	245	92	49	West Germany 18; Australia 17.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$389	$125	$2	United Kingdom $56; Australia $43.
Silicon, high-purity	NA	585	60	Norway 398; Republic of South Africa 63.
Silver:				
Waste and sweepings[3] value, thousands	$63	$41	$3	Australia $38.
Metal including alloys, unwrought and partly wrought do.	$1,960	$1,317	$31	Australia $1,205.
Tin: Metal including alloys, all forms	1,086	764	NA	Australia 677; Malaysia 78.
Titanium: Oxides	1,015	1,327	114	Australia 498; Finland 380.
Tungsten: Metal including alloys, all forms value, thousands	$687	$21	$2	Canada $19.
Zinc:				
Ore and concentrate	—	24	—	India 20; Australia 2.
Oxides	522	166	6	Australia 114; Thailand 34.
Metal including alloys:				
Scrap	—	979	—	All from Canada.
Unwrought	18,293	18,703	—	Australia 10,882; Canada 7,820.
Semimanufactures	[4]395	483	2	Australia 225; Canada 162.
Zirconium: Ore and concentrate	—	97	—	Australia 96.
Other:				
Ores and concentrates	455	154	—	Australia 148.
Ashes and residues	—	32	—	Japan 21; West Germany 11.
Base metals including alloys, all forms value, thousands	$457	$416	$7	Australia $289; West Germany $49.
Metalloids[5]	NA	73	—	Hong Kong 51; China 19.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	123	304	23	Turkey 102; Australia 85.
Artificial: Corundum	130	157	83	Italy 64; West Germany 10.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$196	$164	$71	Iran $34; Ireland $28.
Grinding and polishing wheels and stones do.	$2,633	$2,928	$283	Australia $553; Republic of Korea $332.
Asbestos, crude	22	—		
Barite and witherite	2,877	2,444	21	Thailand 741; Singapore 682.

See footnotes at end of table.

TABLE 3—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988 United States	Sources, 1988 Other (principal)
INDUSTRIAL MINERALS—Continued					
Boron materials:					
Crude natural borates	value, thousands	$276	$325	$14	Netherlands $282.
Oxides and acids		994	1,414	915	Italy 420; Canada 75.
Bromine including fluorine and iodine		—	12	2	Belgium-Luxembourg 7.
Cement		14,506	7,102	216	Malaysia 4,887; Singapore 842.
Chalk		648	1,146	1	United Kingdom 1,076.
Clays, crude		17,307	17,822	6,277	Australia 9,839.
Cryolite and chiolite		693	990	—	Denmark 989.
Diamond:					
Gem, not set or strung	value, thousands	$7,374	$6,354	$324	India $2,910; United Kingdom $873.
Industrial stones	do.	$222	$159	$70	Australia $70; United Kingdom $11.
Diatomite and other infusorial earth		2,115	2,631	1,922	Australia 416; Philippines 172.
Feldspar, fluorspar, related materials		933	825	—	Australia 253; Canada 196; Norway 181.
Fertilizer materials:					
Crude, n.e.s.		6,630	37	3	United Kingdom 29.
Manufactured:					
Ammonia		2	3	—	Australia 2; United Kingdom 1.
Nitrogenous		([6])	39,957	18,293	West Germany 7,659; Japan 5,658.
Phosphatic		223,679	41,002	9,492	Israel 26,491; Netherlands 3,500.
Potassic		123,686	81,010	10,318	U.S.S.R. 58,384; Canada 6,470.
Unspecified and mixed		([7])	42,145	15,173	Israel 16,386; West Germany 4,169.
Graphite, natural		55	75	2	Hong Kong 34; Republic of Korea 19.
Gypsum and plaster		130,523	122,888	15	Australia 116,176; Thailand 6,600.
Lime		7	6	—	All from Australia.
Magnesium compounds:					
Magnesite, crude		[8]4,591	7,482	137	China 7,055; Switzerland 244.
Oxides and hydroxides		NA	6,275	61	China 2,573; Australia 2,552.
Mica:					
Crude including splittings and waste	value, thousands	$214	$184	$10	China $61; India $35.
Worked including agglomerated splittings	do.	$142	$80	$4	Australia $36; Netherlands $12.
Nitrates, crude		NA	68	13	Poland 25; Belgium-Luxembourg 20.
Phosphates, crude		489,916	468,590	125,453	Nauru 176,577; Morocco 83,968.
Pigments, mineral: Iron oxides and hydroxides, processed		1,788	1,671	19	West Germany 1,524.
Potassium salts, crude		7,019	—		
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$3,853	$3,252	$50	Thailand $1,108; Australia $1,032.
Synthetic	do.	$152	$109	$12	West Germany $42; Japan $26.
Pyrite, unroasted		9	2	—	All from West Germany.
Salt and brine		62,719	90,874	3,671	Australia 73,009; Mexico 13,200.
Sodium compounds, n.e.s.:					
Soda ash		30,609	104	17	Australia 84.
Sulfate		NA	16,204	15,648	China 193.

See footnotes at end of table.

TABLE 3—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		3,697	2,446	—	Republic of South Africa 726; China 386; Australia 377.
Worked	value, thousands	$4,792	$5,215	$41	Italy $2,821; Australia $748.
Dolomite, chiefly refractory-grade		14	9	—	Mainly from West Germany.
Gravel and crushed rock		80	49	—	United Kingdom 24; Australia 21.
Limestone other than dimension		NA	24	—	Australia 20; Netherlands 4.
Quartz and quartzite		262	25	—	Sweden 21.
Sand other than metal-bearing		432	761	146	Australia 471; Japan 117.
Sulfur:					
Elemental:					
Crude including native and byproduct		84,121	126,843	1,432	Canada 124,668; Saudi Arabia 649.
Colloidal, precipitated, sublimed		278	65	—	Canada 38; Poland 18.
Sulfuric acid		56	34	—	Hong Kong 13; United Kingdom 11.
Dioxide		—	73	—	All from Australia.
Talc, steatite, soapstone, pyrophyllite		2,308	1,666	3	China 918; Australia 657.
Other:					
Crude	value, thousands	$480	$439	$21	Austria $201; West Germany $34.
Slag and dross, not metal-bearing		820	1,457	200	Australia 638; West Germany 567.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		22	154	54	Trinidad and Tobago 36; Belgium-Luxembourg 30.
Carbon black		6,357	5,708	707	Australia 4,618; Japan 219.
Coal:					
Anthracite and bituminous		875	699	33	United Kingdom 619; Australia 36.
Briquets of anthracite and bituminous coal		259	20	—	Australia 19.
Lignite including briquets		36	258	—	Australia 256.
Coke and semicoke	value, thousands	$434	$491	$21	Australia $470.
Peat including briquets and litter	do.	$1	—		
Petroleum:					
Crude	thousand 42-gallon barrels	15,565	18,272	—	Saudi Arabia 9,171; Australia 5,036; United Arab Emirates 1,443.
Refinery products:					
Liquefied petroleum gas	value, thousands	$51	$29	$4	Netherlands $9; United Kingdom $8.
Gasoline motor	do.	$105,271	$49,419	$6,667	Saudi Arabia $28,386; Australia $6,009.
Mineral jelly and wax	do.	$3,374	$3,546	$787	China $945; Australia $745.
Kerosene and jet fuel	do.	$17,621	$5,005	$387	Australia $3,806; Singapore $647.
Distillate fuel oil	do.	$19,742	$1,766	—	Malaysia $776; Singapore $502; Australia $377.
Lubricants	do.	$27,071	$20,607	$2,409	Australia $11,059; Singapore $5,165.
Residual fuel oil	do.	$2,685	$7	—	American Samoa $6; Australia $1.
Bitumen and other residues	42-gallon barrels	279	158	—	Mainly from Australia.

See footnotes at end of table.

TABLE 3—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Bituminous mixtures	42-gallon barrels	1,182	1,976	145	Singapore 1,115; Australia 661.
Petroleum coke	do.	475,788	651,690	643,396	Australia 8,074.

[r] Revised. NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Excludes unreported quantity valued at $2,367,000.
[3] May include other precious metals.
[4] Excludes unreported quantity valued at $534,000.
[5] Reported under SITC item number as "selenium, phosphorus, etc."
[6] Unreported quantity valued at $7,902,000.
[7] Unreported quantity valued at $8,124,000.
[8] May include oxides and hydroxides.

by Minmetals' inability to obtain bridge loans from international banking institutions following China's pro-democracy political suppressions in Tiananmen Square, Beijing, in May and June. Fisher and Paykel also had agreed to sell its share to Minmetals. New Zealand's Commerce and Overseas Investment Commissions had approved the sale of New Zealand Steel in late May.

The Glenbrook Steelworks, 60 kilometers (km) south of Auckland at Glenbrook, produces high quality special grades of steel in small volume. The mill processes local titaniferous iron sand, which is mined from the company's deposit at nearby Waikato North Head and pumped to the mill in a slurry form through an 18-km underground pipeline. Substantial reserves of coal suitable for the company's steel production were also available in deposits in the nearby Waikato region.

Titanium.—Japan's Nissho Iwai Corp. and L&M Mining Ltd.'s wholly owned subsidiary Buller Minerals Ltd. were conducting a $4 million feasibility study for a joint venture for the production of titaniferous slag for export to Japan. The raw material source for the slag would be a large ilmenite deposit at Westport on the west coast of South Island. The study was scheduled to be completed by May 1990. If the project proves viable, 250,000 tons of ilmenite will be upgraded in an electric arc furnace to produce about 100,000 tons of titaniferous slag per year, containing up to 85% titanium dioxide, as well as 60,000 tons of byproduct pig iron per year. At yearend, a pilot concentrator was processing heavy mineral sands at a rate of 50 tons per hour at Carters Beach, Westport.

Mineral Fuels

At the request of the Tainui Maori Trust Board early in the year, injunc-

TABLE 4

NEW ZEALAND: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies	Location of main facilities	Capacity (thousand metric tons per year unless otherwise specified)
Aluminum	New Zealand Aluminium Smelters Ltd.	Bluff, Tiwai Point, South Island	259
Cement	New Zealand Cement Holdings Ltd.	Westport, South Island	132
Do.	Golden Bay Cement Co.	Portland, South Island	450
Do.	Milburn New Zealand Ltd.	Whangarei, North Island	550
Coal	Coal Corp of New Zealand Ltd. (State-owned)	Waikato region, North Island	920
Gold	Waihi Gold Mining Co. Ltd.	Martha Hill, Waihi, North Island	[1] 1,775
Do.	Macraes Flat Joint Venture	Macraes Flat, near Dunedin, South Island	[1] 1,000
Silver	Waihi Gold Mining Co. Ltd.	Martha Hill, Waihi, North Island	[1] 11,350
Steel, crude	New Zealand Steel Ltd.	Glenbrook, North Island	750
Petroleum natural gas/ condensate	Fletcher Challenge Ltd.	Maui, northwest of Waverley, North Island	[2] 36
Petroleum products	New Zealand Refining Co. Ltd.	Marsden Point, near Whangarei, North Island	[3] 950

[1] Kilograms per year.
[2] Thousand cubic feet per day.
[3] Thousand 42-gallon barrels per day.

tion papers were filed against the sale of the Coal Corp. of New Zealand Ltd.'s (Coalcorp) state-owned coal mines in the Waikato region south of Auckland, North Island. Coalcorp, one of several state-owned enterprises up for sale, produced 75% of the nation's coal. Coalcorp's mines were clustered in three areas, one of which, around Huntly in the Waikato region, produced 920,000 tons of Coalcorp's annual output of 1.5 million tons from five mines for power stations, the Glenbrook Steelworks, and for industrial users in the north. The injunction was filed based on the claim that the land the Tainui Tribe is claiming under the Waitangi Tribunal included the mines at Huntly and untapped coal reserves. The Tainui Tribe was claiming both retroactive and future royalties for the coal.

Reserves

Coal in New Zealand has been mined only in certain well-defined areas, and no significant quantities of coal are known outside these areas. New Zealand mined bituminous, subbituminous, and lignite coals. The estimated measured, indicated, and inferred recoverable coal reserves, i.e., coal in the ground thought to be recoverable by mining techniques presently employed in New Zealand, are 4.5 billion tons. Most of the lignite reserves, if mined, would require large-scale mining techniques not currently used in the country.

New Zealand's resources of iron ore are contained in black sands of the western beaches from Westport southward in South Island and from Wanganui to Muriwai in North Island. These sands are estimated to contain a total of 850 million tons of combined titaniferous magnetite and ilmenite.

Although New Zealand is rich in epithermal gold deposits, exploration, prospecting, and development would face a high level of public opposition because of potential environmental degradation.

The reserves at the Waihapa oil field are estimated at 33 million barrels of oil in place, with 14 million barrels recoverable.[1]

INFRASTRUCTURE

New Zealand's downstream mineral industry had two steel mills; an aluminum smelter; aluminum, copper, and brass extrusion plants; and an oil refinery. Most of these operations were established and prospered under a mantle of Government protection, subsidies, or incentives until privatization was introduced in 1984.

Essential elements of the communications/transportation infrastructure included 4,700 km of Government-owned railroad; 93,000 km of roads, including 50,000 km paved and 43,000 km loose-surface improved; and pipelines consisting of 1,000 km for natural gas, 160 km for refined oil products, and 150 km for condensate. Inland waterways, of which there are about 1,600 km, are of little importance to the transportation industry. There are 2 principal airports out of an aggregate of 156 airports in the country. Electric generating capacity in 1988 was reportedly 7.7 million kilowatts, of which about 23% was from oil and/or coal-fired thermal plants, 73% from hydroelectric plants, and 4% from geothermal plants.

Generally, infrastructure for mineral industry operations are regarded as adequate.

OUTLOOK

Coal production in New Zealand is expected to decrease as the Government scaled back the operations of its wholly owned coal mining corporation, Coal Corp. of New Zealand Ltd. The commercial commitment for gold mining may be more encouraging as mining companies complete exploration in one of the last countries in the Pacific Rim with a potential for a modern-day gold rush. However, regulatory constraints and environmental concerns have thus far effectively limited any major expansion of the gold mining industry.

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[1] Mining Annual Review. Australasia. Min. J. (London), in press.

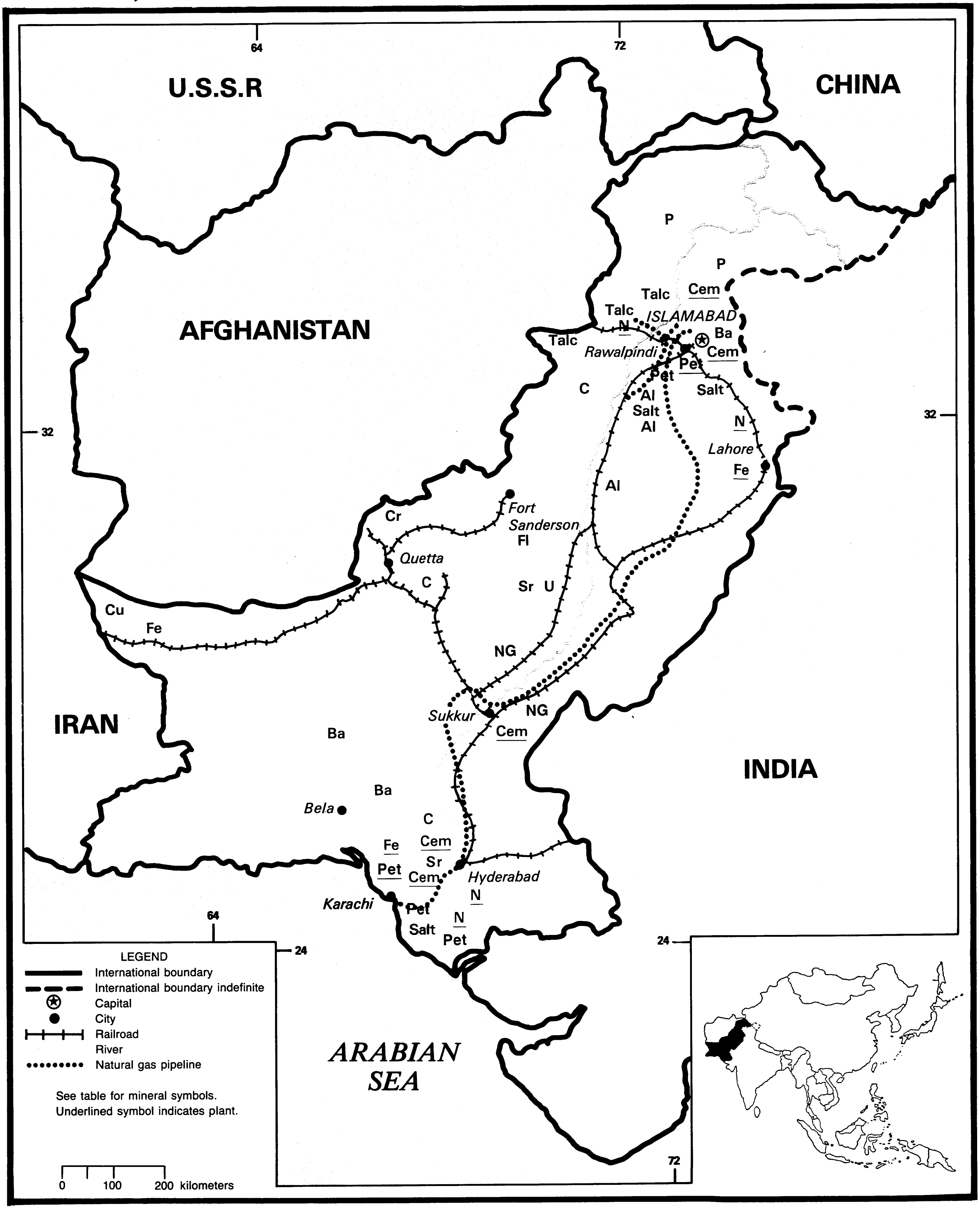
OTHER SOURCES OF INFORMATION

Mines Division
Ministry of Energy
Private Bag
Wellington
New Zealand

New Zealand Geological Survey
P.O. Box 30368
Lower Hutt
New Zealand

PAKISTAN

AREA 803,940 km² **POPULATION 115 million**



THE MINERAL INDUSTRY OF

PAKISTAN

By Pui-Kwan Tse

Despite the relatively high value of its crude mineral production, Pakistan generally has not been regarded as a major mineral-producing or mineral-consuming country. The Government has strongly supported programs to expand and diversify the domestic mineral industry, both to develop the natural economy and to reduce the mineral commodity imports. However, development of deposits of explorable mineral commodities has been restricted primarily by the lack of economic resources of such materials. There is no short supply of the ubiquitous industrial nonmetallics, but deposits of most metallic ores, internationally traded industrial minerals, and crude oil seemingly do not exist in sufficient quantities even to meet internal demand.

The country has to import a significant quantity of liquid fuels and a modest, though still substantial and vital, quantity of solid fuels. Additionally, Pakistan has to import iron ore to meet the requirements of its single integrated iron and steel plant and additional steel to augment the plant's output. Pakistan also imports virtually all nonferrous metals requirements, as well as substantial amounts of mineral fertilizers, both raw and processed, to enable the agricultural industries to continue to meet domestic demand.

GOVERNMENT POLICIES AND PROGRAMS

The Government of Pakistan is actively involved in the country's mineral industry. The Government controls the natural gas industry, the operation of the integrated steel plant, the production of cement and fertilizers, and the delineation and development of domestic mineral resources. However, much of the steel-rolling industry and fertilizer plants, about one-third of the cement output, and various mining ventures are in private hands. The Government has directed considerable effort to improve national self-sufficiency, particularly for energy, thereby hoping to reduce heavy foreign exchange outlays. However, the nature of existing mineral industry operations and limited undeveloped resources of any commercially exportable materials have made this a difficult goal to attain.

The Government continues to give priority to the development of the country's energy sector, followed by the transport and communications, water, urban and housing, education, health, and fertilizer sectors. During the Sixth Development Plan (1983-88), public-sector outlay for energy was $8.4 billion compared with $3.4 billion for water, $1.4 billion for fertilizer, and only $0.2 billion for minerals. Total public-sector outlay during the Sixth Plan was $28.1 billion. Public-sector outlays for minerals-related activities during the six development plan periods are given in table 1.

PRODUCTION

Pakistan's largest mining sector, in terms of value, was fossil fuels. However, by world standards, the output of crude oil and natural gas was small, while the annual mine output of coal averaged about 2.5 million metric tons (MMmt) during 1985-89. Mine output of metalliferous ores was also small in quantity and limited to bauxite and chromite. Mine production of antimony and manganese were sporadic as well as negligible in quantity. The largest quarrying operation was stone, followed by sand and gravel. Production of various clays—bentonite, fire clay, fuller's earth, and kaolin—dominates the remaining mine output of industrial minerals. Annual production of salt was about 1 million tons, and that for gypsum approached 0.5 MMmt. In addition, celestite, chalk, emery, feldspar, fluorspar, magnesite, ocher, phosphate rock, soapstone, and sulfur were mined, albeit each in inconsequential quantities. The manufacture of cement and chemical fertilizers was the dominant downstream component in the industrial mineral sector. Metals production is limited to iron and steel and refining of secondary lead.

TRADE

The value of Pakistan's total trade increased from $9.0 billion in 1987 to $10.6 billion in 1988, the most recent year for which complete trade data are available. In 1987, total exports were valued at $4.4 billion, and imports were valued at $6.2 billion, reflecting a trade deficit of $1.8 billion. Pakistan has an agrarian economy. By extension, its major industries,

TABLE 1

PAKISTAN: FUNDING FOR MINERAL-RELATED ACTIVITIES DURING THE SIX DEVELOPMENT PLAN PERIODS

(Million dollars)

Sector	1955–60	1960–65	1965–70	1970–78	1978–83	1983–88
Energy:	86.7	1,874.7	251.4	1,977.3	5,547.1	8,424.0
Power	82.1	166.4	224.4	1,554.3	4,017.0	16,673.1
Fuel	4.6	18.3	27.0	423.0	1.530	1,750.9
Water	138.4	656.7	644.7	1,830.0	2,252.9	3,377.3
Fertilizer	—	29.6	79.3	335.9	1,257.1	1,448.9
Minerals	17.7	13.4	38.7	70.3	57.1	556.9

TABLE 2

PAKISTAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
METALS						
Aluminum: Bauxite, gross weight		1,759	2,881	3,447	2,452	1,967
Antimony ore:						
Gross weight		24	—	45	—	51
Sb content[e]		4	—	7	—	8
Chromium: Chromite:						
Gross weight		5,188	8,299	10,181	3,327	27,105
Cr content[e]		1,712	2,739	3,330	1,090	8,900
Iron and steel:						
Pig iron	thousand tons	803	892	897	933	[e]1,000
Steel, crude[e]	do.	700	800	1,100	[r]1,000	1,000
Lead, refined, secondary[e]		1,000	1,000	2,000	2,000	2,000
Manganese ore:						
Gross weight		135	635	30	—	—
Mn content[e]		41	190	9	—	—
INDUSTRIAL MINERALS						
Abrasives, natural: Emery		4,630	4,972	[e]3,500	2,005	1,360
Barite		29,932	39,047	10,031	22,198	29,718
Cement, hydraulic	thousand tons	5,229	[e]6,130	6,832	7,041	[e]7,000
Chalk		2,082	2,192	4,292	5,035	4,165
Clays:						
Bentonite		1,611	1,282	2,537	4,880	5,466
Fire clay		68,537	87,522	122,513	124,581	130,627
Fuller's earth		10,647	15,228	17,945	12,395	15,436
Kaolin (china clay)		6,644	37,056	32,208	41,968	39,907
Other		285,000	520,000	680,661	924,237	880,382
Feldspar		5,633	11,575	6,675	9,026	7,703
Fluorspar		3,175	4,353	3,528	284	4,741
Gypsum, crude		409,000	373,000	449,013	374,258	466,969
Magnesite, crude		2,113	1,757	3,824	3,081	8,750
Nitrogen: N content of ammonia		1,106,800	1,154,400	1,179,000	1,173,000	[e]1,175,000
Phosphate rock:[e]						
Gross weight		—	50,000	32,000	35,000	40,000
P_2O_5		—	16,000	10,000	11,000	12,300
Pigments, mineral, natural: Ocher		553	608	1,792	1,040	2,394
Salt:						
Rock	thousand tons	583	576	268	406	721
Marine	do.	269	242	[r]251	266	250
Total	do.	852	818	[r]519	672	971
Sand and gravel:						
Gravel		16,000	—	10,750	—	—
Sand:						
Bajri and common		352,496	136,964	208,339	[e]210,000	[e]210,000
Glass		202,000	115,000	148,783	133,991	181,187
Sodium compounds, n.e.s.:						
Caustic soda		[e]52,300	[e]54,000	56,571	61,344	[e]60,000
Soda ash, manufactured		118,087	130,894	133,133	134,106	135,000

See footnotes at end of table.

TABLE 2—Continued

PAKISTAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
INDUSTRIAL MINERALS—Continued						
Stone:						
Aragonite and marble		62,000	168,000	228,619	211,896	260,178
Dolomite		121,578	136,271	141,846	69,131	59,228
Limestone	thousand tons	6,685	6,339	7,278	6,428	7,897
Other (reported as "ordinary stone")	do.	366	677	551	[e]580	[e]600
Strontium minerals: Celestite		718	997	1,114	488	956
Sulfur:						
Native		877	890	[e]1,120	690	—
Byproduct, all sources[e]		26,000	26,000	26,000	[r]25,000	25,000
Total[e]		26,877	26,890	27,120	[r]25,690	25,000
Talc and related materials: Soapstone		20,183	23,021	23,278	37,429	38,290
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades	thousand tons	2,199	2,025	2,419	3,199	2,642
Coke	do.	556	630	526	[e]600	[r]600
Gas, natural:						
Gross production	million cubic feet	366,282	392,485	410,849	437,300	[r]450,000
Marketed production (sales)[e]	do.	345,000	370,000	388,000	[r]413,000	425,000
Natural gas liquids[e]	thousand 42-gallon barrels	55	65	70	75	75
Petroleum:						
Crude	do.	12,522	15,065	15,230	16,310	[e]16,500
Refinery products:						
Gasoline	do.	5,738	5,865	7,012	[e]7,000	[e]7,000
Jet fuel	do.	3,712	3,944	[e]3,712	[e]3,700	[e]4,000
Kerosene	do.	2,379	3,209	[e]3,015	[e]3,000	[e]3,000
Distillate fuel oil	do.	11,473	13,152	13,040	[e]13,000	[e]13,000
Residual fuel oil	do.	10,250	11,382	11,635	[e]12,000	[e]12,000
Lubricants	do.	875	980	[e]1,005	[e]1,000	[e]1,000
Other	do.	3,217	3,526	[e]3,615	[e]4,000	[e]4,000
Total	do.	37,644	42,058	43,034	[e]43,700	[e]44,000

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Table includes data available through Dec. 4, 1990.

aside from cement and steel, are agriculturally oriented. Its major export commodities are agricultural-derivative products, which collectively account for more than 80% of the total value of exports. Because Pakistan lacks a broad industrial base, it must import high-value manufactured goods. Its major import classes, in descending order of value, are plant and machinery, transport equipment and vehicles, petroleum and refinery products, and iron and steel manufacture, which collectively account for more than 50% of the total value of imports.

In 1988, the major export commodities were cotton yarn and thread, $533 million; raw cotton, $598 million; cotton fabric, leather, and carpet, $1,001 million; and animal and vegetable commodities, $553 million. The major import commodities in 1988 were machinery and transport equipment, $1,826 million; chemicals, $577 million; minerals, fuels, lubricants, and related materials, $959 million; and animal and vegetable commodities, $740 million.

Imports of mineral commodities included chemical fertilizers, $176 million; iron and steel manufactures, $281 million; and nonferrous metals, $95 million.

STRUCTURE OF THE MINERAL INDUSTRY

The Government of Pakistan controls the major and key components of the country's mineral industry, such as the single integrated steel plant and the gas industry. However, there is still a substantial private mineral industry sector

TABLE 3

PAKISTAN: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies	Location of main facilities	Capacity[1]
Barite	Baluchistan Development Authority	Vicinity of Khuzdar, west of Sukkar	50
Do.	Bolan Mining Enterprises	do.	24
Do.	Razvi Mining Ltd.	Kalan and Retri, Abbottabad District; Kohistan District; and Gandori, Swat District	4
Bauxite	Black Mountain Minerals	Near Manshera, southwest of Rawalpindi	12
Do.	Punjab Mineral Development Corp.	Khushab, southwest of Rawalpindi	2
Cement	Associated Cement	Wah, Rawalpindi District	450
Do.	do.	Rohri, Sukkur District	270
Do.	Attock Cement (Pak) Ltd.	Hub Chowki, near Karachi	800
Do.	Gharibwhal Cement Ltd.	Jhelom, southeast of Rawalpindi	540
Do.	Javedan Cement Ltd.	16 km north of Karachi	600
Do.	Mustehkam Cement Ltd.	Hattar, Abbottabad	965
Do.	Zeal-Pak Cement Factory Ltd.	Hyderabad	1,206
Chromite	Numerous small companies	Most active mining in the Hindubagh area north of Quetta, but deposits extend 600 km along mountains on the Afghanistan border	28
Coal, bituminous	Central Government of Pakistan	Coalfields west and south of Rawalpindi along Salt Range and east and southeast of Quetta	[2]1,400
Do.	Pakistani Water and Power Development Authority	Lakhra Coalfield, northwest of Hyderbad	
Fluorspar	Baluchistan Development Authority	Dilband Ridge area, Kolat District, southeast of Fort Sandeman	5
Gas, natural	Sui Gas Transmission Co.	Suifield, northeast of Sukkur	[3]225
Do.	do.	Marifield, east of Sukkur	[3]95
Petroleum:			
Crude	Occidental Petroleum Co. Ltd.	Dhurnal Field, west of Islamabad	[4]5.5
Do.	Oil and Gas Development Commission (Government of Pakistan)	Tando Alam Field, east of Karachi	[4]1.5
Do.	Union Texas	Laghari Field, southwest of Karachi	[4]3.2
Do.	do.	Kheskeli Field, southeast of karachi	[4]1.3
Refined	Attock Refinery Ltd.	Rawalpindi	[4]13.1
Do.	National Refinery Ltd.	Karangi area of Karachi	[4]17.4
Do.	Pakistan Refinery Ltd.	Karachi	[4]16.9
Phosphate rock	Sarhad Development Authority	Kakul mine, Hazara area north of Islamabad	50
Salt:			
Marine	Numerous small firms	Salt pans along the Arabian Sea coast near Karachi	350
Rock	Government of Pakistan	Khewra, Warcha, and Kalabagh Mines, along southern escarpment of Salt Range, Rawalpindi Division	480
Steel, crude	Karachi Rolling Mills Ltd.	Karachi	35
Do.	Newshera Engineering Co. Ltd.	Lahore	30
Do.	Pakistan Steel Mills Corp. Ltd.	Karachi	1,100
Do.	Special Steels of Pakistan	do.	35
Strontium celestite	Industrial Mineral Enterprises	Dera Ghazi Khan, southeast of Fort Sandeman	0.6
Do.	Various small producers	Thano Bula Khan and Kalu Khuhar Mines, northeast of Karachi	
Talc	Black Mountain Minerals and others	In a belt extending from Parachinar near the Afghanistan border east across Peshawar Division to Sherwan	30

[1]Thousand metric tons per year unless otherwise specified.
[2]Not yet in operation; initial planned operating capacity subject to change. Various reports suggest figures as low as 200,000 million metric tons per year up to a figure of 4.3 million metric tons per year by yearend 1992.
[3]Million cubic feet.
[4]Million barrels per year.

consisting of smaller enterprises, including a number of steel mills, a shipbreaking industry, cement plants, fertilizer works, and numerous mines and quarries for various minerals. The Government also controls outright some oilfields and is a partner in others. Government involvement will continue because of substantial funding needed in initiating new major mining ventures. Most operations in Pakistan that can be foreseen at present would not seem very likely to attract private capital.

COMMODITY REVIEW

Metals

Pakistan has a weak metalliferous minerals resource base. There were a number of small operations for mining metal-bearing ores for aluminum, antimony, and manganese. The annual output of each was very minor as well as sporadic. The only established metal-producing sector was iron and steel and shipbreaking. Pakistan must import iron ore, ferroalloying ingredients, and scrap metal to meet the requirements of its single iron and steel complex as well as import virtually all of its requirements for nonferrous metals.

Aluminum.—About 2,000 tons of bauxite was produced at Manshera and Khusab, both southwest of Rawalpindi. The Manshera operation accounts for more than 75% of the annual output.

Chromium.—There were numerous small operations for the mining of chromite around Hindubagh, north of Quetta. In recent years, annual mine output has varied from 3,000 tons to 27,000 tons.

Copper.—In October 1988, Resource Development Corp. (RDC) and China Metallurgical Construction Corp. (CMCC) ratified a cooperation agreement for the construction of a smelter utilizing ore to be mined from the copper deposit at Saindak. Because of conflicting interpretations of the project proposal, no formal contract was agreed upon in 1989. Further negotiations were to be pursued in 1990.

Iron and Steel.—The Bin Qasim steelworks of Pakistan Steel Mills Corp. Ltd. (PSM) was the country's only integrated iron and steel complex, which has a rated output of 1.1 million tons per year. PSM reached an agreement in 1989 to utilize a Soviet credit of $95 million to expand the annual capacity at Bin Qasim to 3 MMmt. The terms for bidding for two 250,000-ton-per-year minimills utilizing iron ore to be mined at Nokkundi on Baluchistan and Kalabagh in Punjah were issued to interested firms in Australia, Austria, Germany, and Japan. The Geological Survey of Pakistan (GSP) was conducting further evaluation on an iron ore occurrence at Kirana Hills, near Chemiot, Punjab. Initial drilling revealed a hematite band from 91 meters (m) to the drilled depth of 240 m. PSM proposed a $6 million study to delineate and expand iron ore reserves at Nokkundi, Baluchistan.

Other Metals.—GSP and the United Nations Development Program (UNDP) have detailed an exploration program for lead-zinc at Duddar, Las Bela. Mineral zones up to 18 m in thickness with 15% to 16% zinc and 3% to 5% lead have been interested. UNDP will provide up to $3 million for technical and financial assistance. The Baluchistan Development Authority (BDA) was preparing a feasibility study for mining and beneficiating a lead-zinc occurrence at Gunga. Frontier and Tribal Areas Development Corp. completed geological mapping of 20,000 square kilometers and completed the drilling of 1,750 m for evaluating a copper deposit in Shinkai, Waziristan.

Industrial Minerals

There is mine production of a number of minerals in Pakistan. However, the large activities are quarrying operations for low-unit-value material—sand and gravel and stone. More than 1 MMmt of various grades and types of clays was produced. The only other minerals produced in locally significant quantities were salt, both rock and marine, and gypsum. The remainder of the industrial minerals domestically produced were negligible in terms of world output. The largest manufacturing sectors were cement and fertilizers.

Cement.—There were eight private-sector cement producers, each with a single plant. They collectively constituted an annual kiln output capacity of 2.32 MMmt. In addition, the State Cement Corp. of Pakistan (Pvt.) Ltd. had 13 companies operating 15 plants with a total annual kiln capacity of 5.24 MMmt. Altogether, Pakistan's aggregate kiln capacity was 7.56 MMmt. In 1989, the total output of cement was 7.3 MMmt, produced by 19 plants by a mix of private-sector and Government-run plants.

Fertilizer Materials.—Because Pakistan has an agrarian-based economy, the chemical fertilizer sector is one of the country's largest manufacturing industries. National Fertilizer Corp. Ltd., the largest producer, produced urea, ammonium sulfate, single superphosphate, ammonium nitrate, and nitrophosphate. Dawood Hercules Chemicals Ltd., Exxon Chemicals (Pvt.) Ltd., and Fanji Fertilizer Co. each produced urea. Pakistan Steel Mills Corp. Ltd. produced ammonium sulfate as a byproduct of its steel operations. Pakistan's fertilizer production by type of material is shown in table 4.

Other Industrial Minerals.—BDA was to evaluate newly discovered low-grade phosphate deposits at Bolan Pass and Bela. Under a UNDP proposal, drilling of a sulfur deposit at Koh-e-Sultan, Chagai, has been completed, and bulk samples have been submitted to the Pakistan Council of Scientific and Industrial Research for flotation tests.

Mineral Fuels

Domestic production of coal, petroleum, and natural gas accounted for about two-thirds of Pakistan's primary commercial energy demand requirements. The remainder was supplied by imports of coal and petroleum.

Natural gas is the overwhelmingly dominant domestic energy source, accounting for about 70% of Pakistan's total primary energy production compared with 15% from petroleum, 10% from nuclear power and hydropower, and 5% from solid fuels.

TABLE 4

PAKISTAN: PRODUCTION OF CHEMICAL FERTILIZER IN 1989

(Metric tons)

	Quantity
Ammonium nitrate	291,000
Ammonium sulfate	97,000
Nitrophosphate	306,000
Superphosphate	157,000
Urea	2,354,000

Coal.—Pakistan's coal resources were estimated at 1 billion tons, of which one-tenth is considered by Pakistan Mineral Development Corp. to be measured reserves. Annual mine production has remained small because most of the mining has been from outcropping of coal seams. Mine output decreased from 3.2 MMmt in 1988 to 2.6 MMmt in 1989. About 52% of the production was from Baluchistan, followed by 24% from Punjab, 22% from Sind, and the remainder from Northwest Frontier Province and other areas.

PMDC, in a joint venture with the Water and Development Authority, the Government of Sindh, and private investors, was to develop a coalfield at Lakhra to supply coal to three 50-megawatt powerplants under construction in Sindh. The Lakhra mine was designed to produce 1.2 MMmt of coal per year.

Natural Gas and Petroleum.—Aside from hydropower electric generation, natural gas production and use dominated the country's energy sector. Proven reserves of natural gas were estimated to be in excess of 625 billion cubic meters. Natural gas production in 1989 was 13.6 billion cubic meters. Close to 65% of the gas output was from wells in Baluchistan, 30% in Sind Province, with the remainder from Punjab. The bulk of the natural gas production is from gasfields, and less than 5% is natural gas associated with crude oil production. Crude oil production in 1989 was 18.6 million barrels. Two provinces accounted for the total production—Punjab, 55%, and Sind, 45%. Because of a lack of domestic funds for venture capital, there were foreign firms undertaking exploration in Pakistan. Moreover, more than 70% of the crude oil produced was from fields operated by foreign companies. During 1989, 18 companies completed drilling for 20 exploration and 36 development wells for a total depth of 125,390 m. Seven were abandoned as dry wells. In addition, there were 15 wells being drilled at yearend.

Reserves

Although Pakistan has a broad minerals base, the deposits of metallic ores, internationally traded industrial minerals, and crude oil do not exist in sufficient quantities to be more than local importance, much less of world significance. Pakistan's coal reserves were estimated at 1 billion tons; natural gas, 625 billion cubic meters; and petroleum, 96 billion barrels.

INFRASTRUCTURE

Pakistan's industrial and civil infrastructure is generally strained to meet the demands of a rapidly growing population, support for the military, and the needs of a large refugee establishment. It included a Government-owned rail system of about 8,800 kilometers (km), of which 80% was broad (1.676-m) gauge, 5% was meter gauge, and 6% narrow (0.762-m) gauge. The network includes 1,037 km of broad-gauge double-trade and 286 km of electrified track. The nation's road system of 101,315 km included 40,155 km paved, 23,000 km gravel, 29,000 km improved earth, and 9,100 km unimproved earth and sand track. There is a natural gas pipeline system of 2,269 km with 250 km of crude oil pipelines and 885 km of refined product lines. Additionally, there were 3 major seaports (Gwadar, Karachi, and Port Mudammad Bin Qasim) and 102 usable airfields, of which 70 had permanent surface runways, 1 exceeding 3,659 m, and 72 with runways 1,220 to 2,659 m. Electric power generating capacity totaled 7,575,000 kilowatts in 1989.

OUTLOOK

Although there is a wide array of known mineral resources aside from natural gas, Pakistan has a small mineral commodity processing sector. Moreover, it appears highly unlikely that Pakistan's role in the world mineral industry will alter appreciably in the near future. The country's financial base is weak, and the known mineral deposits are not of sufficient size to attract outside development capital. Governmental efforts to reduce import dependency for mineral fuels, fertilizers, and iron and steel products are being met with some success. However, any expansion of the economy will require anticipated uses in demand and necessitate imported materials and manufactures. The shipbreaking industry developed from an inconsequential activity in the late 1960's to a significant source of scrap and rerollable iron and steel, as well as of secondary nonferrous metals by the 1980's. However, the industry was facing a number of problems, including depreciation of the national currency, higher prices for vessels for scrapping, reduced billet prices by Pakistan Steel (a competitor in the local steel-rolling-mill market), and a higher duty on imported ships for scrapping than on other iron and steel scrap imports. The Saindak copper property, which has received considerable local press coverage, offers the potential for sufficient production to meet national needs for copper and to provide an exportable surplus, as well as for income from byproduct gold and silver. A Sino-Pakistani accord was signed in November 1989 for the development of the Saindak deposit and for the production of copper metal. Implementation of the project, slated to produce about 18,000 tons of copper, 50,000 troy ounces of gold, and 72,000 troy ounces of silver per year reportedly could be accomplished in 2 years after funding is in place, but whether or not this will be forthcoming under present market conditions is uncertain.

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Ministry of Works
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Lahore, Pakistan

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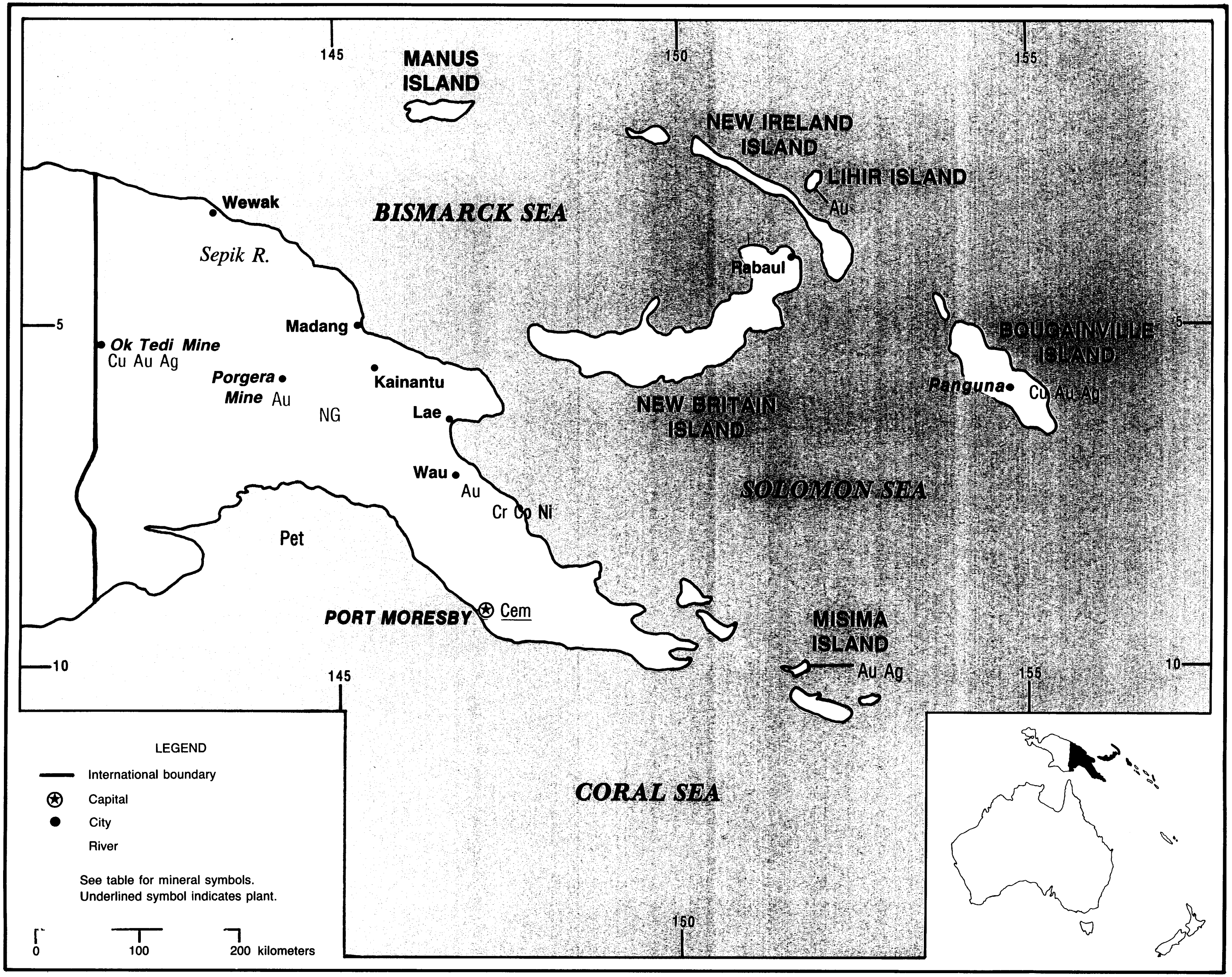
PAPUA NEW GUINEA

AREA 461,690 km² **POPULATION 3.5 million**



THE MINERAL INDUSTRY OF

PAPUA NEW GUINEA

By Travis Q. Lyday

GOVERNMENT POLICIES AND PROGRAMS

In 1989, the Government, partly as a consequence of civil disturbances on Bougainville Island, but also in recognition of the desires of the Provincial governments and traditional landowners to become formally involved in resource development, initiated a development forum process through which all parties involved—landowners, developers, and national and Provincial Governments—would meet at a certain stage in negotiating mine development and discuss jointly any problems. The prototype of this initiative involved the negotiations for the Porgera Mine in the western highlands region of the main island. As a result, an agreement was signed in May permitting mine development at Porgera. This agreement was also the first that directly offered the landowners, as well as the Provincial government, both a share in royalties and a share in the national Government's equity in a resource development project.

PRODUCTION

Five principal mines operated during 1989; three of these were in production at the beginning of 1990. Mining of gold and silver commenced in April at the Misima Mine on Misima Island in Milne Bay Province with about 4,200 and 35,000 kilograms (kg) of gold and silver, respectively, produced during the period to yearend 1989. The small-scale Mount Victor Mine near Kainantu in Eastern Highlands Province produced about 400 kg of gold in 1989 before the mining operation ceased at yearend. Ok Tedi Mining Ltd. (OTML) produced almost 442,000 tons of copper concentrate containing about 135,000 tons of copper, 16 tons of gold, and 30 tons of silver from its Ok Tedi Mine on Mount Fubilan in the Star Mountains of Western Province. With no operations since May 15, when the mine was closed by dissident landowners, production of copper and gold in 1989 at the Panguna Mine on Bougainville Island in North Solomons Province decreased 60% and 50% from that of 1988 to about 69,000 tons and 7,000 kg, respectively. The Wau open pit in Morobe Province produced almost 850 kg of gold and about 1,000 kg of silver during 1989. The pit is scheduled for closure in mid-1990.

TRADE

Papua New Guinea's economy remained agrarian, relying mainly on coffee, cocoa, and copra and palm oils for export earnings. Agriculture accounted for about one-third of both the gross domestic product (GDP), estimated at $3.56 billion,[1] and foreign exchange earnings of the country. The country's mineral industry was the second most important sector of the economy in 1989, accounting for about one-fifth of the GDP and 50% of total export receipts. Before its closing, the Panguna Mine on Bougainville Island was the nation's largest single income earner, accounting for 40% of all export revenues and 10% of Government income in 1988.[2]

STRUCTURE OF THE MINERAL INDUSTRY

Papua New Guinea is a mineral-rich country with a modern mining industry. There are also several small-scale mining sites. The country has a long history of gold mining and is a world-class producer of both copper and gold, ranking 11th in copper and 8th in gold.

At yearend, there were 167 active prospecting authorities in the country covering about 20% of the land area and spending about $60 million on exploration programs; and 38 petroleum pros-

TABLE 1

PAPUA NEW GUINEA: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
Copper, mine output, Cu content		175,048	178,211	217,699	218,634	201,025
Gold, mine output, Au content	kilograms	36,908	35,075	33,250	38,129	31,136
Silver, mine output, Ag content	do.	46,112	55,582	61,066	70,408	93,672

[p] Preliminary.
[1] Table includes data available through Aug. 6, 1990.
[2] In addition to the commodities listed, crude construction materials (common clays, sand and gravel, and stone) are produced, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.

TABLE 2

PAPUA NEW GUINEA: EXPORTS OF COPPER IN CONCENTRATES, BY DESTINATION

(Metric tons of copper content)

Destination	1988	1989
China	7,436	—
Germany, Federal Republic of	45,657	35,964
Japan	108,938	89,791
Korea, Republic of	22,754	23,470
Spain	7,413	7,647
Unspecified	29,693	7,970
Total	221,891	[1] 164,842

[1] Jan. to Sept.

Source: World Metal Statistics, July 1990.

pecting licenses covering about 230,000 square kilometers and spending about $230 million. There were about 60 companies each exploring for minerals and petroleum.

COMMODITY REVIEW

Metals

Copper.—Violence and sabotage by local landowners, whose original demand was a $11.3 million compensation claim against Australia's Bougainville Copper Ltd. (BCL), a 53.6%-owned subsidiary of Australia's CRA Ltd., for the adverse environmental impact and social damage of the Panguna Mine, broke out again in February. The mine was subsequently shut down on May 15 and, except for a few hours in September when an attempt was made to restore operations, remained on care and maintenance for the remainder of the year. The militant landowners became the Bougainville Revolutionary Army. Subsequently, their demands were reformulated, with compensation claims apparently dropped or forgotten. The new demands included permanent closure of the Panguna Mine; withdrawal of all Papua New Guinean Defense Forces, the national security force trying to protect the mine, plant, and local population; the departure from the island of all non-Bougainvilleans; and secession of Bougainville Island, which is much closer geographically, culturally, and ethnically to the Solomon Islands.

Although the original BCL agreement negotiated with the landowners in 1974 provided for review every 7 years, the national Government failed to take the opportunity to seek amendments in both 1981 and 1988, despite encouragement from BCL.[3]

BCL estimated the cost to reopen the mine, including reestablishment and training of the work force, recommissioning of plant and equipment, and repair of damage caused by vandalism and sabotage, at more than $100 million, providing that it could be done by January 1991.[4]

BCL filed suit near yearend for compensation for losses incurred at Panguna in the Victoria, Australia, Supreme Court against its insurers Metals and Minerals Insurance Pty. Ltd., Singapore; GRE Pacific Insurance Pty. Ltd., Papua New Guinea; Taisho Marine and Fire Insurance Co., Japan; and the American Home Insurance Co.[5]

Besides CRA's 53.6% share, BCL is owned 19.1% by the Government and 27.3% by foreign investors.

At the Ok Tedi Mine, there were several short but violent work stoppages in disputes over housing shortages and eligibility standards during the year. One of the ore feed conveyors collapsed in January, which left it out of action for more than 3 months. Also, a major landslide in August at the overburden dump forced the relocation of the main workshops. Despite these adversities, Ok Tedi had higher than predicted copper, gold, and silver production in 1989. OTML, the operator of the mine, is owned by BHP Minerals Holdings Pty. Ltd. and Amoco Minerals (PNG) Co., each with a 30% share; the Papua New Guinean Government, 20%; Metallgesellschaft AG and Degussa AG, 7.5% each; and Deutsche Finanzierungsgesellschaft Fuer Beteiligungen in Entwicklungslaendern GmbH, 5.0%. The mine produces about 145,000 tons of copper, 15,000 kg of gold, and 29,000 kg of silver per year.

OTML filed suit in November against its insurers, New Guinea Insurance Corp. and its underwriters, for $100 million following the collapse of the permanent tailings dam at Ok Ma in 1984. OTML has been dumping its mine waste into the Fly River since production started in

TABLE 3

PAPUA NEW GUINEA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies	Location of main facilities	Capacity (thousand kilograms per year)
Copper, gold, silver	Ok Tedi Mining Co. Ltd.	Ok Tedi Mine, Mount Fubilan, Western Province	[1] 145 Cu
Do.	do.	do.	15 Au
Do.	do.	do.	30 Ag
Do.	Bougainville Copper Ltd.	Panguna Mine, North Solomons Province	[1] 180 Cu
Do.	do.	do.	10 Au
Gold	Kennecott Explorations. (Australia) Ltd.	Ladolam deposit, Lihir Island, New Ireland Province	[2] 15 Au
Do.	New Guinea Goldfields Ltd.	Wau Mine, Morobe Province	([3])
Gold, silver	Misima Mines Pty. Ltd.	Misima Mine, Misima Island, Milne Bay Province	12 Au
Do.	do.	do.	81 Ag
Do.	Placer (PNG) Pty. Ltd. Renison Goldfields Consolidated Ltd., and Mount Isa Mines Ltd.	Porgera Mine, 130 kilometers west of Mount Hagen, Enga Province	[4] [5] 3,000
Do.	do.	do.	[5] 25 Au

[1] Metric tons per year.
[2] Mining expected to start in late 1992 at the rate of 8,000 kilograms per year; full capacity expected to be reached in 1993.
[3] Less than 500 kilograms.
[4] Thousand metric tons of ore.
[5] Mining expected to start in Sept. 1990 at the rate of 17,000 kilograms of ore per year; full capacity expected to be reached in 1993.

May 1984. OTML was granted in October an exemption from having to construct another tailings dam on the basis that the ground was too unstable and that construction costs would be prohibitive.[6]

Gold.—Progress continued toward formalizing the application to the Government to mine the Ladolam deposit in New Ireland Province. An engineering feasibility study was completed in midyear and was submitted to the Government near yearend in negotiations for a special mining lease. The Ladolam gold prospect, more commonly known as Lihir, is on Lihir Island, which is northeast of the island of New Ireland in the Bismarck Archipelago. Gold mineralization occurs within an elliptical volcanic crater (caldera) in four separate areas, namely, Coastal, Kapit, Lienetz, and Minifie. The prospect is being developed by a joint venture composed of Kennecott Explorations (Australia) Ltd., 88%, acting as manager, and Niugini Mining Ltd. of Australia, 12%.

Subject to successful governmental and financing approvals, mining was expected to start in late 1992. Mine planning calls for 3.6 million tons of oxide ore per year to be processed during the first year of mining operations. In the second year, mining of sulfide ore is scheduled to commence at 4.1 million tons per year, increasing to 4.8 million tons in the fourth year. Gold production is scheduled to be 7,800 kg in the first year of production, increasing to 25,000 kg per year thereafter. Mine life is expected to be 37 years.

Misima Mines Pty. Ltd.'s mine (Placer [PNG] Pty. Ltd., 80%, and the Government of Papua New Guinea, 20%), was commissioned in late March and poured its first bars of doré bullion shortly thereafter. The mine is in the eastern half of Misima Island in the Louisiade Archipelago in the Solomon Sea off the southeastern coast of the mainland, about 600 kilometers (km) from Port Moresby.

The necessary agreements permitting the start of mine construction at the Porgera gold-silver project were signed in May. The mine is in Enga Province in the western highlands region of the main island of New Guinea. It is operated by the Porgera Joint Venture: Placer (PNG) Pty. Ltd., wholly owned by Canada's Placer Pacific Ltd. and the manager of the joint venture; RGC (Papua New Guinea) Pty. Ltd., a wholly owned subsidiary of Renison Goldfields Consolidated Ltd.; and Highlands Gold Properties Pty. Ltd., a wholly owned subsidiary of Highlands Gold Ltd. and a member of Australia's MIM of the MIM Holding Ltd. group of companies. Each holds a 30% share, with Placer managing the project. The state of Papua New Guinea government holds the remaining 10% interest, of which 2.45% each is held on behalf of the local landowners and the Enga Provincial government.[7]

The first stage underground mine was under construction during the latter part of the year and is expected to be opened in September 1990. Production initially is planned to be 550,000 tons of ore per year to feed the concentrator and carbon-in-pulp extraction circuit. Because the ore is refractory (gold in close association with sulfide minerals), only about 40% of the contained gold-silver is readily recoverable by simple cyanide leaching. For this reason, gold-silver recovery will be obtained by pressurized oxidation of a bulk sulfide concentrate before conventional leaching. After initial processing begins in September 1990, residue from the carbon-in-pulp circuit will be stored on-site until the pressurized oxidation facilities are completed, which is expected to be early in 1993. An open pit is planned for the mining of 3 million tons of ore to produce 25,000 kg of gold per year beginning in 1993. On the basis of known reserves, Placer estimates that the underground mine will be phased out in 1997.[8]

The mine's power will be supplied by a 70-km electrical transmission line from a plant to be built at the Hides gasfield near Tari in Southern Highlands Province.

Open pit mining has been conducted at the old alluvial district of Wau in Morobe Province since 1926, excluding the years during World War II. Mining in 1989 was conducted by New Guinea Goldfields Ltd., a subsidiary of Renison Goldfields Consolidated Ltd. of Australia. Small amounts of alluvial gold was also recovered by sluicing by private individuals. The open pit was expected to be closed by June 30, 1990, but the private sluicing was expected to continue.

Up to 5,000 people from local tribes prospected a 1.5-square-kilometer area for gold using hand tools atop Mount Kare, 3,000 meters above sea level and 7 km southwest of the Porgera deposit in Southern Highlands Province. The Mount Kare Prospect was discovered in late 1987 by CRA. In 1988, as word of the rich alluvial deposit spread, local subsistence farmers and shop workers from surrounding villages began a modern-day gold rush to the remote area in the tradition of the 19th century. It was expected that the rush would be over by mid-1990 and that CRA could then continue exploration work for lode-type gold mineralization. It is estimated that 7 to 8 tons of gold has been won using only simple panning techniques by the indigenous people.

Mineral Fuels

A feasibility study and a land survey for a 335-km pipeline from the Iagifu and Hedinia Oilfields in the Lake Kutubu area of the Southern Highlands to a floating storage and loading facility 35 km offshore from Kerema, the capital of Gulf Province, in the Gulf of Papua were completed. The $810 million Kutubu joint-venture project was owned by Chevron Nuigini Pty. Ltd., 25%, acting as manager; BP Petroleum Development, 25%; Ampolax Group, 21.23%; BHP Petroleum (PNG) Inc., 12.5%; Oil Search Ltd., 10.02%; and Merlin Petroleum/Bond Energy Co., 6.25%. An application to the Government for a petroleum development license, the first for commercial production of oil in the country, was expected to be submitted by Chevron Nuigini in the first half of 1990. Production is planned for 1992.[9]

Reserves

Papua New Guinea, the largest of the islands of Oceania, also has the greatest share of Oceania's mineral resources. Ore reserves at the Panguna Mine are estimated to be about 510 million tons of copper ore grading about 0.5% contained copper, sufficient for a mine life of 13 to 15 years from the present pit.

Minable reserves at Lihir were reported to be 595 tons of gold, consisting of 4.7 million tons of oxide ore grading 1.96 grams per ton and 168 million tons of sulfide ore grading 3.48 grams per ton, in the Lienetz, Minifie, and Coastal areas.[10]

Proven and probable reserves at Misima are 56 million tons of ore grading 1.38 grams of gold per ton and 21 g of silver per ton, giving a mine life of at least 10 years.[11]

At the Porgera Project, total minable reserves are reported to be more than 60 million tons of ore averaging 6.5 grams of gold and 10 grams of silver per ton.[12] The high-grade Zone VII ore is estimated to have a minable reserve of 5.9 million tons of ore grading 27 g of gold per ton.[13]

Natural gas and petroleum potential is thought to be large, but sufficient proven reserves necessary for commercial production have not been fully established.

INFRASTRUCTURE

Essential elements of the transportation infrastructure include 19,200 km of roads, including 640 km paved; 10,960 km gravel, crushed stone, or stabilized-soil surface; and 7,600 km unimproved earth. Inland waterways, of which there are about 10,940 km, are of little importance to the transportation industry. There are 19 principal airports with permanent-surface runways out of an aggregate of 555 runways in the country. International shipping ports include Anewa Bay, Lae, Madang, Port Moresby, and Rabaul. There are no railroads. Electric generating capacity in 1988 was 364,000 kilowatts.

The vast majority of the in-place infrastructure in the country is concentrated in the provincial capitals.

OUTLOOK

Since closure of the Panguna Mine in May 1989, the Papua New Guinean economy has declined significantly—the mine provided 45% of the country's export earnings and 17% of the national budget during the period 1972-88.[14] In the shorter term, only the reopening of the mine could bring the economy back on course. However, in the longer term, production from huge gold mines such as Porgera and Lihir, as well as the new strikes confirming the enormous oil potential of the country, provide promise of a much needed economic boost. However, owing to the inadequate infrastructure throughout most of the country, as well as extremely rugged terrain and high precipitation, only those mineral deposits of world-class size that are found in the future will be economically viable.

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[1] Where necessary, the values have been converted from the Papua New Guinean kina (K) to U.S. dollars at the rate of K0.85 = US$1.00.

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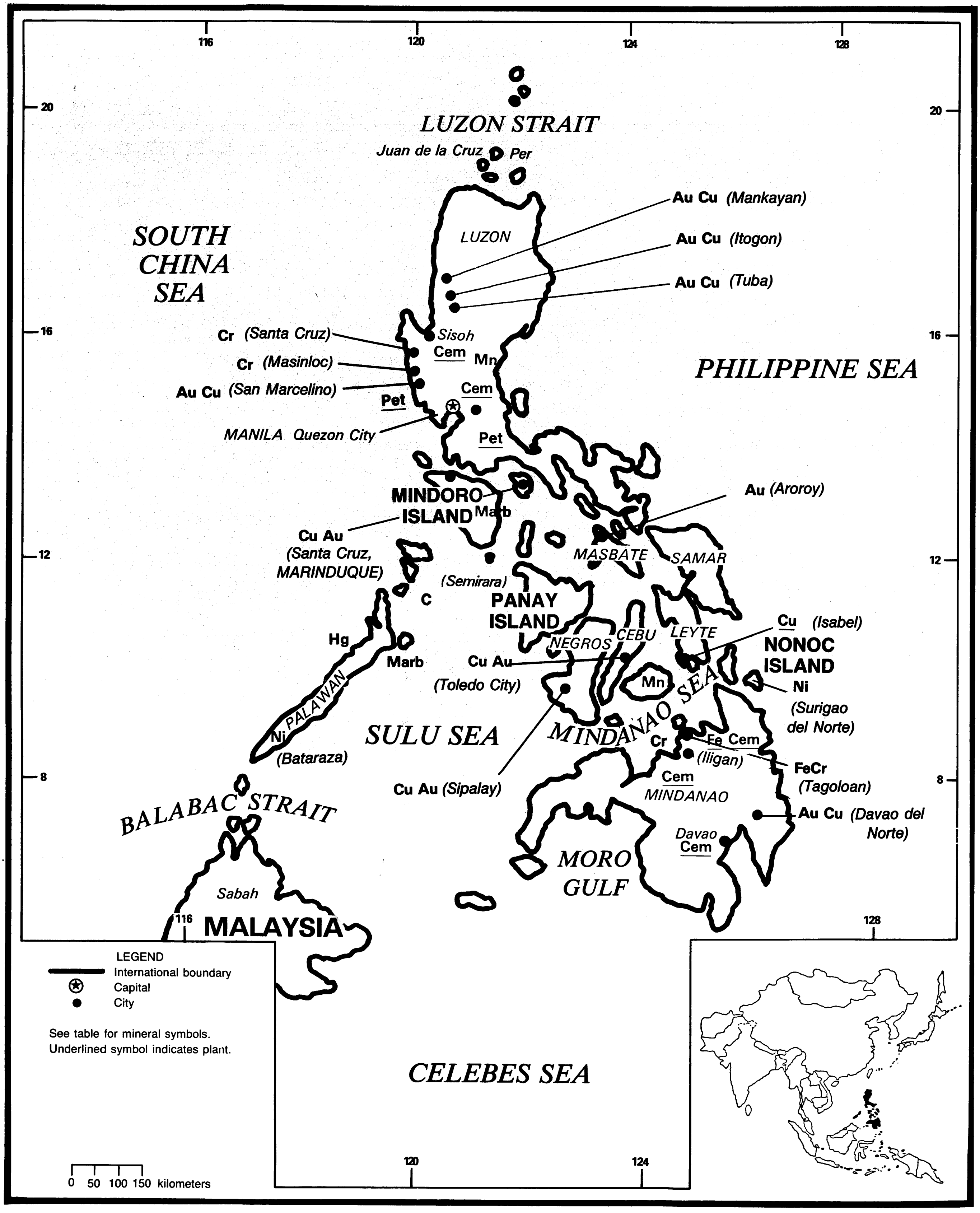
Agency

Office of Minerals and Energy
P.O. Box 2375
Konedobu, Papua New Guinea

PHILIPPINES

AREA 300,000 km² **POPULATION 66.1 million**



THE MINERAL INDUSTRY OF THE

PHILIPPINES

By Travis Q. Lyday

The Philippines' gross domestic product (GDP) increased by 5.8% on a constant dollar basis over that of 1988 to $44.4 billion[1] in 1989, the third successive year of real growth. The mining and quarrying sector of the minerals industry contributed just under 2% of the GDP; cement production, petroleum refining, and other mineral commodity processing added modestly to this total.

The Philippines was among the top 10 world producers of chromite, gold, and copper in 1989, ranking 6th, 9th, and 10th, respectively. It was an important regional producer of other commodities, including ferrochromium (FeCr), ferrosilicon (FeSi), mined nickel, and refined copper. By value, copper and gold remained the country's most important mineral products.

GOVERNMENT POLICIES AND PROGRAMS

The proposed mining code drafted in 1988 was pending passage before the Filipino Congress at yearend. An interim mining law[2] continued to govern mining activities within the Philippines during 1989. The interim law extended the Mineral Resources Decree of 1974 until the Congress passed the necessary law to implement the new system of granting mining rights in the Philippines.

PRODUCTION

The value of production of the Philippines mining industry was estimated to be $1.33 billion during 1989, an increase of about 20% over that of the previous year. The increase was mainly because of strong international metal prices and an increase in capacity utilization as a result of the expansion and refurbishing of mining projects. Gold contributed the largest share with about $500 million, followed by copper with about $365 million.

TRADE

Increased world chromium and copper prices during the year boosted export earnings in the mineral products sector by an estimated 13% over that of 1988 to about $860 million. Chromium prices increased 23% over those of 1988, enabling an estimated 35% increase in chromium export earnings in 1989. Receipts from exports of copper concentrates also increased an estimated 35% over those of the previous year. Although the total quantity of copper concentrate exports declined slightly, the increase in value was because of higher prices, which rose 41% from $433 per ton in 1988 to $609 per ton in 1989. Copper metal export receipts increased only about 5% despite a 30% improvement in prices because of a 20% reduction in export tonnage. Although gold prices declined during the year, export earnings remained steady.

Approximately 20% of Filipino export earnings were spent on mineral imports. The major mineral imports continued to be iron ore and concentrate, crude fertilizer, and high-thermal coal.

Japan and the United States continued to be the major trading partners of the Philippines.

STRUCTURE OF THE MINERAL INDUSTRY

The mining industry of the Philippines was dominated by a few large-scale private local companies mining chromite, copper, and gold. Coal was mined by numerous private companies and three subsidiaries of state-owned Philippine National Oil Corp. (PNOC). However, one large private company produced more than one-half of the country's coal. Copper, ferroalloys, and phosphate fertilizer were produced by three joint-venture firms. Cement was produced by 13 private companies.

COMMODITY REVIEW

Metals

Chromium.—The Philippines ranked ninth in world production of chromite in 1989, but a steadily declining output over the past decade resulted in the production of less than 2% of the world total for the year.[3] Decreased production was partly because of lessening demand for refractory-grade chromite, which is the predominant grade produced in the Philippines.

Benguet Corp., the largest operator, produced refractory-grade ore at Masinloc, northern Luzon Island, Zambales Province, for export and metallurgical-grade ore to feed the 60,000-ton-per-year FeCr plant at Tagaloan, Mindanao Island, operated by Ferrochrome Philippines Inc., a subsidiary of Voest-Alpine Stahl Linz GmbH of Austria.

The Department of the Environment and Natural Resources, on behalf of the Government, signed an agreement with the Revolving Fund for Natural Resources Exploration, an agency of the United Nations (U.N.) that conducts exploration programs in developing countries. Hopefully, renewed exploration efforts would lead to accelerated development of a major metallurgical-grade chromite deposit on Dinagat Island off the northern tip of Mindanao Island through a reexam-

TABLE 1

PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodities[2]	1985	1986	1987	1988[p]	1989[e]
METALS					
Arsenic: White (equivalent of arsenic acid)[e]	5,000	5,000	5,000	(3)	—
Chromium: Chromite, gross weight:					
Metallurgical-grade	122,359	85,271	69,429	[e]70,000	78,000
Chemical-grade	15,038	16,109	19,899	[e]20,000	18,700
Refractory-grade	134,634	72,850	98,572	[e]100,000	93,300
Total	272,031	174,230	187,900	[e]190,000	190,000
Cobalt, mine output, Co content	911	92	—	—	—
Copper:					
Mine output, Cu content	222,189	222,644	216,145	218,089	[4]189,500
Metal:					
Smelter	133,800	124,300	124,700	[e]125,000	[4]156,300
Refined	130,227	134,547	132,118	132,183	[4]132,200
Gold, mine output, Au content kilograms	33,063	40,322	32,599	35,500	[4]35,300
Iron and steel:					
Ferroalloys, electric-furnace:					
Ferrochromium	50,815	[e]55,000	—	—	70,000
Ferrosilicon[e]	20,000	20,000	—	—	9,000
Steel, crude thousand tons	250	[e]250	[e]250	331	300
Lead: Metal, secondary refined[e]	7,000	7,000	7,000	7,000	7,200
Manganese ore and concentrate, gross weight	387	232	421	2,251	650
Nickel:					
Mine output, Ni content	28,158	12,790	7,818	[e]10,800	[4]12,900
Metal, smelter	16,993	2,076	—	—	—
Silver, mine output, Ag content kilograms	54,411	54,499	52,374	51,709	[4]47,998
Zinc, mine output, Zn content	1,880	1,573	1,129	1,435	[4]1,200
INDUSTRIAL MINERALS					
Barite	—	—	—	349	500
Cement, hydraulic thousand tons	3,080	[r]3,280	4,276	5,353	6,000
Clays:					
Bentonite	24,971	1,800	759	2,030	2,000
Red	—	350	[e]300	[e]300	350
White	6,093	16,784	[e]7,000	4,730	5,000
Other	344,921	366,753	406,033	860,012	500,000
Feldspar	5,412	6,661	[e]6,000	9,200	6,000
Gypsum and anhydrite:					
Natural	300	13,080	13,233	2,250	5,000
Synthetic[e]	112,000	112,000	112,000	115,000	115,000
Lime	47,427	38,110	[r e]20,000	3,924	4,000
Magnesite	676	[e]650	[e]650	[e]650	700
Nitrogen: N content of ammonia[e]	17,000	17,000	—	—	—
Perlite	3,883	[e]3,500	[e]4,000	[e]4,000	4,000
Phosphate:					
Guano	1,229	3,466	[e]1,000	1,401	1,500
Phosphate rock	6,392	1,656	[e]8,000	7,104	7,000
Pyrite and pyrrhotite (including cuprous), gross weight	232,478	244,028	341,417	379,328	400,000
Salt, marine	421,058	785,354	446,532	492,080	500,000

See footnotes at end of table.

TABLE 1—Continued

PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodities[2]		1985	1986	1987	1988[p]	1989[e]
INDUSTRIAL MINERALS—Continued						
Sand and gravel:						
Silica sand	thousand tons	317	259	213	196	[4]310
Other[5]	thousand cubic meters	11,235	11,525	13,943	13,940	[4]14,990
Stone:						
Dolomite		362,101	281,346	[e]360,000	585,744	500,000
Limestone[6]	thousand tons	3,521	4,328	4,022	4,775	5,000
Marble (dimension), unfinished	cubic meters	4,010	7,586	5,000	[e]5,000	5,000
Volcanic cinder	do.	6,630	[e]1,000	1,000	[e]1,500	2,000
Tuff		19,505	([3])	—	47,515	40,000
Quartz		93,735	46,972	80,000	58,603	60,000
Crushed, broken, other[7]	thousand cubic meters	701	599	1,000	[e]1,000	1,000
Sulfur: S content of pyrite		108,102	113,473	158,179	[e]160,000	195,000
Talc		345	[e]1,000	—	27	—
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades		1,257,881	1,128,449	1,152,342	1,335,687	[4]1,343,000
Petroleum:						
Crude	thousand 42-gallon barrels	3,285	2,190	1,800	2,170	[4]1,876
Refinery products:						
Liquefied petroleum gas	do.	1,543	1,868	2,297	[e]2,500	2,500
Gasoline	do.	8,772	9,384	11,824	[r e]12,800	[4]12,600
White spirits	do.	187	213	248	[e]300	200
Jet fuel	do.	2,608	2,428	4,144	[r e]4,500	[4]4,420
Naphtha	do.	[e]1,462	1,670	2,448	[e]2,600	[4]4,367
Kerosene[e]	do.	2,500	2,700	2,500	2,500	[4]3,415
Distillate fuel oil	do.	14,629	15,681	18,404	[r e]19,900	[4]20,806
Lubricants	do.	714	735	763	[e]800	[4]415
Residual fuel oil	do.	15,311	17,516	20,186	[r e]21,800	[4]22,160
Asphalt	do.	242	255	279	[e]300	300
Refinery fuel and losses[e]	do.	[r]2,200	[r]2,400	[r]2,900	[r]3,100	[4]3,052
Total	do.	[r]50,168	[r]54,850	[r]65,993	[r e]71,100	[4]74,235

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through June 7, 1990.
[2]In addition to the commodities listed, the Philippines produces platinum-group metals as byproducts of other metals, but output is not reported quantitatively, and no basis is available to make reliable estimates of output levels.
[3]Revised to zero.
[4]Reported figure.
[5]Includes "pebbles" and "soil" not further described.
[6]Excludes limestone for road construction.
[7]Includes materials described as rock, crushed or broken; stones, cobbles, and boulders; rock aggregates; and broken adobe.

ination of existing data, detailed geological mapping, soil mapping, magnetic surveys, trenching, and auger- and diamond-drilling.

Although the size, grade, and continuity of the deposit, discovered by U.N. geologists in 1988, had not been fully defined, the U.N.-sponsored study estimated that the deposit contains 1 million to 2 million tons of massive metallurgical-grade ore[4] containing more than 50% chromic oxide (Cr_2O_3), including 500,000 tons categorized as proven reserves.[5]

Integrated Chrome Corp. (Inchrome), a joint venture of the Japanese FeCr producer Nippon Denko Co. Ltd. and the Philippine chromium ore producer Kaschrome, began production of charge chrome at the rate of 20,000 tons per year in March, with output shipped to Japan.[6] Inchrome obtained its ore from five of its own mines, supplemented by material from other domestic producers.

Ferro Chemicals Inc. at Iligan, Mindanao Island, which achieved a production capacity of 30,000 tons per year of FeCr in 1988 with the commencement of a second furnace, converted one of the furnaces to silicomanganese produc-

TABLE 2

PHILIPPINES: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS				
Aluminum: Metal including alloys:				
Scrap	59	697	—	Japan 394; Republic of Korea 199.
Unwrought	—	4	—	All to Japan.
Semimanufactures	47	49	—	Malaysia 24; Hong Kong 21.
Arsenic: Oxides and acids	4,543	6,373	2,752	New Zealand 1,005; Malaysia 900.
Chromium: Ore and concentrate	105,676	163,499	21,039	Sweden 26,201; Japan 24,771.
Copper:				
Ore and concentrate	361,952	450,330	—	Japan 410,303; Republic of Korea 18,368; Taiwan 17,918.
Metal including alloys:				
Scrap	8,150	2,702	—	Japan 1,983; Taiwan 497.
Unwrought	106,530	126,731	—	Japan 50,061; Taiwan 37,865; Republic of Korea 31,158.
Semimanufactures	3,607	1,233	4	Japan 466; Singapore 392.
Gold:				
Contained in copper concentrates kilograms	6,595	8,529	—	Japan 6,860; France 1,176; Finland 162.
Waste and sweepings do.	(2)	—		
Metal including alloys do.	—	151	2	Singapore 96; Hong Kong 53.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite, agglomerated thousand tons	4,017	4,874	303	Japan 4,570.
Pyrite, roasted	10,408	10,298	—	Taiwan 5,111; Republic of Korea 4,937.
Metal:				
Scrap	1,313	1,974	—	Japan 1,656; Taiwan 299.
Ferroalloys:				
Ferrosilicon	10,225	8,415	108	Japan 2,999; Republic of Korea 2,700.
Unspecified	50,820	61,514	5,992	Japan 49,080; Australia 3,702.
Semimanufactures:				
Bars, rods, angles, shapes, sections	109	150	149	Pacific Islands Trust Territory 1.
Universals, plates, sheets	82	26,066	2,305	China 18,732; Thailand 4,097.
Wire	3	4	—	All to Pacific Islands Trust Territory.
Tubes, pipes, fittings	1,608	4,343	4,117	Hong Kong 124.
Castings and forgings, rough	528	440	130	Australia 260.
Lead: Metal including alloys: Scrap	3	5	5	
Magnesium: Metal including alloys: Scrap	6	16	—	All to Japan.
Manganese:				
Ore and concentrate: Metallurgical-grade	20	—		
Oxides kilograms	—	480	—	All to Greece.
Nickel:				
Ore and concentrate	483,417	489,055	—	All to Japan.
Metal including alloys: Scrap	36	60	—	United Kingdom 32; Netherlands 24.
Silver:				
Waste and sweepings[3] kilograms	5,397	670	—	All to Hong Kong.
Metal including alloys, unwrought and partly wrought do.	4,903	32,565	258	Japan 20,910; Hong Kong 3,734.

See footnotes at end of table.

TABLE 2—Continued

PHILIPPINES: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988	
				United States	Other (principal)
METALS—Continued					
Tin:					
Ore and concentrate		1	—		
Metal including alloys:					
Scrap		34	14	—	Singapore 11; Japan 3.
Semimanufactures		16	208	—	Taiwan 192; Pacific Islands Trust Territory 16.
Titanium: Oxides	kilograms	553	200	—	All to Republic of Korea.
Zinc:					
Ore and concentrate		2,128	2,885	—	All to Japan.
Metal including alloys:					
Scrap		495	622	—	Japan 464; Taiwan 158.
Semimanufactures		1	—		
Other:					
Oxides and hydroxides		134	113	5	Netherlands 46; Japan 20.
Ashes and residues		22,881	36,956	—	Singapore 32,643; Japan 3,011.
Base metals including alloys, all forms		1,364	1,498	89	Australia 471; Japan 347.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		1,563	455	—	Hong Kong 207; Taiwan 188.
Grinding and polishing wheels and stones	kilograms	15	1,730	—	Thailand 1,662; China 68.
Cement		38,552	57	—	Australia 36; Pacific Islands Trust Territory 17.
Clays, crude		—	58	—	All to Taiwan.
Diamond: Industrial stones	carats	4,270	—		
Feldspar, fluorspar, related materials		16,419	38,489	—	All to Taiwan.
Fertilizer materials:					
Crude, n.e.s.		3,124	17,802	—	China 15,500; Japan 1,726.
Manufactured:					
Nitrogenous		36,279	23,671	—	Australia 18,901; Thailand 2,260; Malaysia 1,332.
Phosphatic		321,068	107,173	—	Thailand 34,905; China 33,000; Iran 15,750.
Potassic		—	54	—	Mainly to Australia.
Unspecified and mixed		181,850	253,264	—	Thailand 87,017; China 83,329; Vietnam 32,340.
Gypsum and plaster		61,227	60,790	—	All to Japan.
Magnesium compounds: Magnesite, crude including calcined		80	—		
Phosphates, crude		700	1,391	—	Taiwan 1,376.
Pigments, mineral: Natural, crude		1	1	—	All to Guam.
Pyrite, unroasted		54	—		
Salt and brine	kilograms	5,344	1,362	53	Pacific Islands Trust Territory 750; Hong Kong 400.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		7,323	14,042	19	Taiwan 10,356; Japan 3,496.
Worked		5,345	5,392	1,577	Japan 2,200; Australia 777.
Dolomite, chiefly refractory-grade		215,721	242,411	—	All to Japan.

See footnotes at end of table.

TABLE 2—Continued

PHILIPPINES: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Gravel and crushed rock		24,399	27,713	93	Japan 21,204; Hong Kong 3,332.
Limestone other than dimension		175,882	20,565	—	Taiwan 19,361; Malaysia 1,200.
Quartz and quartzite		2	—		
Sand other than metal-bearing		3,455	4,891	1,374	Japan 1,978; United Kingdom 417.
Sulfur: Sulfuric acid	kilograms	90	—		
Other: Crude		6,222	6,139	—	Republic of Korea 3,637; Taiwan 2,130.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		14	14	—	All to Hong Kong.
Carbon black		r587	1,628	—	Indonesia 597; Taiwan 304; Thailand 300.
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	1,362	1,554	139	Hong Kong 955; India 223.
Gasoline:					
Aviation	do.	10	62	—	All to Guam.
Motor	do.	332	32	32	
Naphtha	do.	2,229	2,943	—	Japan 2,047; Republic of Korea 364; Singapore 326.
Mineral jelly and wax	do.	(2)	(2)	—	Taiwan(2); Thailand(2).
Kerosene and jet fuel	do.	291	764	—	Japan 479; Pacific Islands Trust Territory 184.
Distillate fuel oil	do.	606	1,584	—	Guam 742; Japan 661.
Lubricants	do.	17	7	—	Thailand 3; Singapore 1.
Residual fuel oil	do.	34	789	—	Japan 647; Pacific Islands Trust Territory 142.
Bitumen and other residues	do.	(2)	—		

r Revised.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] May include other precious metals.

tion early in 1989. This was done because of a lack of low-cost domestic chromium ore, declining FeCr prices, and announcements from various producers worldwide of capacity and production increases.[7]

Copper.—Development of Marcopper Mining Corp.'s San Antonio ore body, 3 kilometers (km) from its Tapian Mine in the island province of Marinduque, virtually stopped again early in the year because of financial difficulties. The San Antonio ore body contains 198 million tons of ore averaging 0.44% copper, sufficient for a mine life of 20 years. The development was previously discontinued in 1983, when copper prices plunged to unprofitable levels, but was recommenced in late 1988. Unless Marcopper can develop the San Antonio ore body, which was projected to take at least an additional 2 years to become operational, it was feared that Marcopper would have to close down permanently and sell its assets because reserves at the Tapian open pit mine were expected to be depleted during the first part of 1990.[8] Marcopper, the Philippines' third largest copper producer, announced during the third quarter at least a temporary shutdown beginning in early 1990.[9]

The decision to proceed with development work at the San Antonio ore body was dependent on the company obtaining about $60 million in new financing to develop the mine site and purchase new mills and other equipment, obtaining Government tax concessions, restructuring defaulted loans with its creditors, and obtaining a Government permit to use the Tapian mill's ocean tailings disposal system.

Atlas Consolidated Mining and Development Corp. filed suit in the first quarter against a hostile takeover bid by Convoy Consolidated Holdings Ltd. in both U.S. and Philippine courts, charging that the bidder was in violation of securities laws in both jurisdictions. The lawsuit in the United States was filed because 30% of Atlas' shares is owned by the U.S. public.[10] A. Soriano Corp. (Anscor) was also fighting for control of Atlas, but both Anscor and Convoy came to terms in July to end their hostile bidding. Under the agreement, Convoy would limit its holdings in Atlas to 17.1% (previously

TABLE 3

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS				
Alkali and alkaline-earth metals	79	4	(2)	West Germany 3.
Aluminum:				
Ore and concentrate	933	4,637	52	Malaysia 2,476; China 1,445.
Oxides and hydroxides	8,257	5,775	66	China 2,532; Japan 1,405.
Metal including alloys:				
Scrap	793	344	36	Hong Kong 261; Singapore 36.
Unwrought	10,808	10,222	11	Australia 5,319; France 2,012.
Semimanufactures	11,038	11,361	591	Republic of Korea 3,282; Japan 2,448.
Arsenic: Oxides and acids	52	65	—	Malaysia 60; United Kingdom 5.
Chromium:				
Ore and concentrate	12,000	52,111	—	India 38,014; Madagascar 14,088.
Oxides and hydroxides	93	125	—	West Germany 85; Italy 20.
Cobalt: Oxides and hydroxides kilograms	2,104	7,164	—	Japan 3,519; United Kingdom 2,050; Hong Kong 1,000.
Copper:				
Ore and concentrate	22,005	107,030	10,000	Papua New Guinea 64,948; Indonesia 16,782.
Sulfate	135	209	—	Bulgaria 182; Taiwan 20.
Metal including alloys:				
Scrap	2	331	1	Taiwan 247; Japan 21.
Unwrought	543	2,483	2	Singapore 979; Taiwan 800.
Semimanufactures	4,540	5,946	483	Japan 2,133; Republic of Korea 566.
Gold: Metal including alloys, unwrought and partly wrought kilograms	103	117	21	West Germany 52; Singapore 35.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite, not agglomerated thousand tons	r3,791	3,055	5	Brazil 1,552; Australia 1,171.
Metal:				
Scrap	108,994	93,730	45,940	Netherlands 22,719; China 13,435.
Pig iron, cast iron, related materials	70,612	74,133	5,022	Malaysia 35,896; China 27,505.
Ferroalloys:				
Ferromanganese	2,297	3,963	—	Mozambique 1,273; China 1,104; West Germany 335.
Ferrosilicomanganese	—	1,219	—	Thailand 608; Brazil 350; Hong Kong 140.
Ferrosilicon	554	159	88	China 50; United Kingdom 18.
Unspecified	563	325	—	Netherlands 65; Australia 51; Belgium-Luxembourg 41.
Steel, primary forms	639,280	709,986	—	Brazil 271,856; Republic of Korea 151,891; Australia 71,223.
Semimanufactures:				
Bars, rods, angles, shapes, sections	79,718	130,139	99	Japan 19,529; West Germany 16,884; Mozambique 16,619.
Universals, plates, sheets	358,779	427,244	1,173	Japan 181,788; Brazil 65,986; Republic of Korea 51,760.
Hoop and strip	4,483	6,968	189	Japan 4,024; China 720.
Rails and accessories	557	2,230	4	Republic of Korea 1,459; Japan 424.
Wire	10,785	15,847	121	Republic of Korea 5,371; China 3,391.
Tubes, pipes, fittings	20,614	34,165	434	Japan 18,144; West Germany 8,103.
Castings and forgings, rough	(2)	147	—	Republic of Korea 70; Singapore 54; Taiwan 17.

See footnotes at end of table.

TABLE 3—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Lead:				
Oxides	27	33	22	Australia 10.
Metal including alloys:				
Scrap	9,069	12,394	442	Australia 8,198; Singapore 3,203.
Unwrought	8,739	4,724	58	Taiwan 2,349; Australia 1,828.
Semimanufactures	447	766	171	Australia 285; Hong Kong 131.
Magnesium: Metal including alloys, all forms	3	9	1	Norway 4; West Germany 2.
Manganese:				
Ore and concentrate: Metallurgical-grade	3,594	3,209	—	Singapore 2,853; Japan 245.
Oxides	1,142	2,040	2	Japan 1,082; Brazil 567.
Mercury	66	132	—	China 99; Hong Kong 28.
Molybdenum: Metal including alloys, all forms	4	8	5	Belgium-Luxembourg 2.
Nickel: Metal including alloys:				
Unwrought	91	143	7	Singapore 88; Mozambique 19.
Semimanufactures	91	72	23	Japan 14; Australia 13.
Platinum-group metals: Metals including alloys, unwrought and partly wrought kilograms	—	16	8	West Germany 6; United Kingdom 1.
Silver: Metal including alloys, unwrought and partly wrought do.	7	226	51	Republic of Korea 130; Japan 45.
Tin: Metal including alloys:				
Scrap	5	12	—	All from Taiwan.
Unwrought	797	733	3	Indonesia 527; Singapore 81.
Semimanufactures	3	37	2	Taiwan 34.
Titanium:				
Ore and concentrate	1,305	1,550	—	Australia 1,370; Japan 92.
Oxides	1,679	1,701	190	Japan 522; Australia 226.
Tungsten: Metal including alloys, all forms	82	5	([2])	Belgium-Luxembourg 3.
Uranium and thorium: Oxides and other compounds kilograms	60	190	—	All from United Kingdom.
Zinc:				
Oxides	700	765	44	Republic of Korea 427; Taiwan 82.
Metal including alloys:				
Scrap	60	121	—	Australia 61; New Zealand 40.
Unwrought	21,376	27,557	199	Australia 12,766; Canada 4,748.
Semimanufactures	446	512	185	Japan 118; Taiwan 86.
Zirconium: Ore and concentrate	48	85	—	Australia 41; Japan 40.
Other:				
Ores and concentrates	3	17	17	
Oxides and hydroxides	5,253	5,879	—	Belgium-Luxembourg 2,305; Netherlands 1,327; China 750.
Ashes and residues	66,740	96,443	364	Japan 95,966; Malaysia 54.
Base metals including alloys, all forms	151	95	20	United Kingdom 22; Hong Kong 19.

See footnotes at end of table.

TABLE 3—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		611	406	—	China 228; Netherlands 82; India 44.
Artificial:					
Corundum		21	29	—	Austria 18; Japan 11.
Silicon carbide		37	74	1	Hong Kong 57; Taiwan 14.
Grinding and polishing wheels and stones		1,336	1,474	34	Hong Kong 521; Taiwan 297.
Asbestos, crude		1,911	2,074	459	Canada 1,287; Mozambique 122.
Barite and witherite		2,257	1,298	812	Singapore 213; China 202.
Boron materials: Oxides and acids		300	379	123	France 128; Italy 72.
Bromine including fluorine and iodine		6	3	—	Mainly from United Kingdom.
Cement		289,182	122,009	555	Republic of Korea 74,032; Indonesia 43,755.
Chalk		86	39	—	West Germany 22; Switzerland 9.
Clays, crude:					
Bentonite and fuller's earth		2,322	4,601	1,589	Australia 1,314; Singapore 1,005.
Fire clay		596	494	—	United Kingdom 231; China 190.
Kaolin		15,024	22,913	3,595	Indonesia 7,000; Hong Kong 4,994.
Unspecified		8,874	13,759	8,409	Singapore 1,949; Taiwan 762.
Cryolite and chiolite		—	1	—	All from Italy.
Diamond: Industrial stones:					
Natural	carats	226,862	132,950	—	Ireland 66,900; Zaire 37,350; Australia 20,900.
Synthetic	do.	4,700	13,150	—	All from Australia.
Diatomite and other infusorial earth		796	627	296	Taiwan 184; Australia 59.
Feldspar, fluorspar, related materials		6,516	3,423	24	India 1,262; China 711.
Fertilizer materials: Manufactured:					
Ammonia		166,370	141,556	3,736	Indonesia 95,025; Australia 22,953.
Nitrogenous		792,751	812,736	8,704	Indonesia 151,523; Japan 147,122.
Phosphatic		6,056	3,843	200	Jordan 3,500.
Potassic		170,137	193,550	95	Senegal 80,195; Canada 58,234.
Unspecified and mixed		951	7,327	4,426	Japan 2,085; Norway 593.
Graphite, natural		365	328	2	Japan 133; China 130.
Gypsum and plaster		127,902	7,613	805	West Germany 5,673; Japan 330.
Lime		90	575	369	United Kingdom 180; Taiwan 18.
Magnesium compounds: Magnesite, crude including calcined		29,268	24,143	77	Republic of Korea 13,131; Japan 5,037.
Meerschaum, amber, jet		—	3	3	
Mica:					
Crude including splittings and waste		134	139	38	Malaysia 36; Japan 20.
Worked including agglomerated splittings		21	12	9	Japan 2.
Nitrates, crude		98	158	—	Belgium-Luxembourg 140; West Germany 18.
Phosphates, crude	thousand tons	1,035	717	—	Senegal 367; Togo 223; Nauru 57.
Pigments, mineral:					
Natural, crude		3,491	3,565	70	India 3,070; United Kingdom 215.
Iron oxides and hydroxides, processed		1,269	951	79	West Germany 536; Spain 98.

See footnotes at end of table.

TABLE 3—Continued

PHILIPPINES: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	—	$29	—	All from Japan.
Salt and brine		93,053	52,619	180	Australia 34,398; West Germany 10,596.
Sodium compounds, n.e.s.:					
Soda ash, natural and manufactured		115,432	119,846	47,571	Kenya 44,162; Japan 18,654.
Sulfate, manufactured		14,271	17,014	90	China 8,557; Taiwan 4,301.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		810	2,618	20	Italy 1,925; China 416.
Worked		109	453	3	China 227; Italy 181.
Dolomite, chiefly refractory-grade		1,488	1,956	—	United Kingdom 1,626; Thailand 164.
Gravel and crushed rock		173	413	5	France 218; Japan 109.
Limestone other than dimension		6,453	1,308	—	Taiwan 914; Japan 273.
Quartz and quartzite		113	108	—	France 54; Australia 19; United Kingdom 11.
Sand other than metal-bearing		740	24,757	187	Australia 24,000; Japan 477.
Sulfur:					
Elemental:					
Crude including native and byproduct		17,233	8,564	2,310	Canada 4,586; Singapore 660.
Colloidal, precipitated, sublimed		1,704	14,062	6,423	Canada 7,057; Taiwan 158.
Dioxide		2	—		
Sulfuric acid		138,679	118,221	22	Japan 111,154; Spain 7,002.
Talc, steatite, soapstone, pyrophyllite		8,464	9,800	415	Republic of Korea 4,809; China 2,780.
Other:					
Crude		r593	589	—	Australia 283; Japan 264.
Slag and dross, not metal-bearing		155,074	156,203	(2)	India 54,528; Taiwan 37,100.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		29	29	1	Singapore 16; Hong Kong 8.
Carbon black		2,366	1,131	328	Taiwan 336; Republic of Korea 137.
Coal, all grades including briquets		480,048	1,255,613	168	China 748,889; Australia 504,974.
Coke and semicoke		80,379	89,736	3	Japan 77,103; Taiwan 9,955.
Petroleum:					
Crude	thousand 42-gallon barrels	62,471	67,592	—	Saudi Arabia 12,589; Iran 10,066; Kuwait 10,009.
Refinery products:					
Liquefied petroleum gas	do.	1,759	2,787	—	Saudi Arabia 1,163; Kuwait 826.
Gasoline	do.	122	53	(2)	Australia 51.
Mineral jelly and wax	do.	76	103	7	China 78; Hong Kong 10.
Kerosene and jet fuel	do.	(2)	125	—	Japan 124.
Distillate fuel oil	do.	8,593	6,258	—	Kuwait 3,139; Singapore 2,440.
Lubricants	do.	117	97	32	Singapore 27.
Residual fuel oil	do.	145	110	—	Singapore 106.
Bitumen and other residues	do.	(2)	—		
Bituminous mixtures	do.	(2)	(2)		

r Revised.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.

22.1%), and Anscor would be subject to a minimum holding of 17.2% (previously 26.2%).[11]

Landslides resulting from a typhoon in June cut off the main water supply line to a concentrator, as well as damaged the tailings line and open pit haulage roads at Atlas Consolidated's Cebu Mine, Cebu Province. Production of about 275 tons of copper concentrates was lost as a result.[12] Storms occurring in April and May also caused production losses.

Atlas Consolidated announced at midyear that it would spend $65 million for expansion of ore-handling capacity at the Carmen Mill, Toledo Mine, central Cebu Province, from 44,000 to 55,000 tons per day.[13] This would increase Atlas Consolidated's overall capacity from 69,000 tons to 80,000 tons per day.

The Philippine Associated Smelting and Refining Corp. (PASAR) planned to expand production at its copper flash smelter and electrolysis plant on the island of Leyte, which would increase output by 25% to 172,500 tons of copper cathode.[14] The expansion will be completed under contract with Finland's Outokumpu Oy's engineering subsidiary. PASAR was owned by the state-owned National Development Corp., 40%; a Japanese consortium led by Marubeni Corp., 32%; local copper producers led by Atlas Consolidated, 23%; and the International Finance Corp., 5%. About 70% of the copper concentrate feed to the smelter, built in 1983, was derived from domestic mines; cathode output was sold mainly to Japan, the Republic of Korea, and Taiwan.

Copper production, in metric tons by company, is shown in table 5.[15]

Gold.—After extensive evaluation drilling of the tailings at the site of the former Philippine Iron Mines operations at Larap, 185 km southeast of Manila, Cultus Gold NL determined that the tailings did not contain sufficient gold to be a viable commercial reprocessing operation. Cultus Gold had been awarded a contract at yearend 1988 to reprocess an estimated 10 million tons of tailings and become the first overseas company to hold a mineral processing contract with the Government.

About 4,000 miners went on strike for a 2-week period beginning on September 12 at the Benguet Corp.'s gold

TABLE 4

PHILIPPINES: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies	Location of main facilities	Capacity (thousand metric tons per year unless otherwise specified)
Cement	Davao Union Cement Corp.	Davao City, Mindanao	648
Do.	Floro Cement Corp.	Higait, Mindanao	450
Do.	Iligan Cement Corp.	Iligan City, Mindanao	420
Do.	Rizal Cement Co. Inc.	Binangonan, Luzon	964
Do.	Northern Cement Co. Inc.	Sison, Luzon	640
Do.	Republic Cement Corp.	Nrozagaray, Luzon	950
Chromite:			
Concentrate	Acoje Mining Co. Inc.	Santa Cruz, Luzon	[1]110
Do.	Alamag Processing Corp.	Llorente, Samar	[2]20
Do.	Benguet Corp.	Masinloc, Luzon	[3]300
Ferrochromium	Ferrochrome Philippines Inc.	Tagoloan, Mindanao	160
Do.	Ferro-Chemicals Inc.	Manticao, Mindanao	15
Coal	Semirara Coal Corp.	Semirara Island	1,000
Copper:			
In concentrate	Atlas Consolidated Mining and Development Co.	Toledo City, Cebu	138
Do.	Benguet Corp.	San Marcelino, Luzon	27
Do.	Far South East Gold Resources Inc.	Mankayan, Luzon	[4]32
Do.	Maricalum Mining Corp.	Sipalay, Negros	50
Do.	Marcopper Mining Corp.	Santa Cruz, Marinduque	40
Do.	North Davao Mining Corp.	Maco, Mindanao	39
Do.	Philex Mining Corp.	Tuba, Luzon	25
Metal, refined	Philippine Associated Smelting and Refining Corp. (PASAR)	Isabel, Leyte	138
Gold:			
In concentrate	Atlas Consolidated Mining and Development Corp.	Aroroy, Masbate; Toledo City, Cebu	[5]6,220
Do.	Benguet Corp.	Itogon, Luzon; San Marcelino, Luzon	[5]9,330
Do.	Far South East Gold Resources Inc.	Mankayan, Luzon	[4 5]7,775
Do.	Lepanto Consolidated Mining Co. Inc.	do.	[5]2,500
Do.	Philex Mining Corp.	Tuba, Luzon	[5]6,220
Nickel:			
In concentrate	Rio Tuba Nickel Mining Corp.	Bataraza, Palawan	10
Petroleum:			
Refineries	Caltex (Philippines) Inc.	Batangas, Luzon	[6]63
Do.	Petron Corp.	Limay, Luzon	[6]130
Steel	National Steel Corp.	Iligan, Mindanao	300

[1] Metallurgical grade.
[2] Chemical grade.
[3] Refractory grade.
[4] Under construction.
[5] Kilograms.
[6] Thousand 42-gallon barrels per day.

TABLE 5

PHILIPPINES: PRODUCTION OF COPPER, BY COMPANY

Company	1988	1989[1]
Atlas Consolidated Mining and Development Corp.	85,356	64,892
Maricalum Mining Corp.	38,711	23,795
Marcopper Mining Corp.	26,571	18,655
Philex Mining Corp.	21,912	16,720
Benguet Corp.	20,976	15,016
Lepanto Consolidated Mining Co. Inc.	13,157	10,900
North Davao Mining Corp.	11,406	9,155
Total	218,089	159,133

[1] Jan. to Oct.

operations in Benguet Province, Luzon Island. The strike concerned the extension of collective bargaining rights to workers of the new Grand Antimok Project (GAP) being developed at a site close to the existing operations. Many of the workers will be transferred from the old to the new operations.[16] Ore reserves at GAP were 11.1 million tons containing about 22 tons of recoverable gold.[17]

Benguet identified additional ore reserves of 30 million tons at its Dizon copper-gold mine in Zambales Province, Luzon Island, sufficient to extend the life of the mine for 4 years if mining proves economically feasible.[18]

Increased activity by small-scale gold miners and panners throughout the Philippines, especially in such traditional gold rush areas as the three Davao Provinces (Davao, Davao Oriental, and Davao del Sur) on Mindanao Island and Mountain Province on Luzon, produced an estimated 10 tons of gold valued at about $124 million in 1989.[19] An estimated $50 million of this production entered into the underground economy as nuggets, ingots, and even jewelry by not passing through the Central Bank of the Philippines. The Bureau of Mines and Geosciences was trying to solve the problem of unauthorized gold transfers by setting up gold-buying and gold-processing stations at strategic locations in identified gold rush areas in which small-scale miners are likely to be working in an attempt to curb illegal purchases and transfers.

Gold production in kilograms, by companies and small-scale gold panners, is shown in table 6.[20]

Ferroalloys.—A joint-venture company, Mindanao Ferroalloys Co. (Minfaco), owned by domestic producer Maria Cristina Chemical Industries (MCCI), 60%; Ssanguong Corp., 20%; Pohang Iron and Steel Co. Ltd. (Posco), 10%; and Dongil Chungong, 10%, all of the Republic of Korea, planned to convert a 27-megavolt-ampere furnace at MCCI's plant on Mindanao to high-carbon ferrosilicon FeSi production. The plant previously was producing carbides.

Conversion of the plant was scheduled to begin during the second half of 1990 with completion expected by midyear 1991. The plant's annual capacity was expected to be 13,000 tons of FeSi per year, somewhat less than one-third of Posco's needs. It was expected that virtually all of the output would be exported to the Posco works in the Republic of Korea.

Nickel.—Nonoc Mining and Industrial Corp.'s (NMIC) nickel production facilities on Nonoc Island (mine) and Marinduque Island (refinery) in Surigao del Norte Province remained mothballed despite numerous attempts to resume operations. Nonoc was restructured in 1984 with the financial backing of two Government-controlled banks, the Philippine National Bank and the Development Bank of the Philippines, because of huge debts.[21] Nonoc was subsequently closed down in March 1986. In January, the Government, through the Asset Privatization Trust (APT), sought to auction off the facilities. Dallhold Nickel Management Pty. Ltd., a local subsidiary of Australia's Bond Corp. Holdings Ltd., offered the highest bid at $320 million, $20 million more than the Government's asking price. However, Dallhold failed to provide a 10% deposit, or $32 million, and APT rejected the bid and announced another call for bids.

Dallhold again offered the best bid, but refused to make the 10% deposit because the company feared it could lose $500,000 in interest if the bid were not approved by the Government. A third round of bidding was held, with Dallhold again submitting the highest bid. However, the Government refused the offer because of Dallhold's demand for full title to the properties; foreign ownership of mining companies was limited to 40%.

A fourth tender was called at midyear and then canceled because Dallhold refused to make an offer. However, Equimark NFC Development Corp., a consortium headed by the former Nonoc owner and that included the Chinese Government's China National Nonferrous Industry Corp. (CNNIC) and three

TABLE 6

PHILIPPINES: PRODUCTION OF GOLD, BY COMPANY

Company	1988	1989[1]
Benguet Corp. (primary and byproduct)	8,563	6,953
Atlas Consolidated Mining and Development Corp. (primary and byproduct)	4,468	3,545
Philex Mining Corp. (byproduct)	4,289	3,215
Lepanto Consolidated Mining Co. Inc. (byproduct)	2,571	1,840
Surigao Consolidated Mining Co. (primary)	1,040	580
Apex Mining Co. Inc. (primary)	858	282
Marcopper Mining Corp. (byproduct)	580	361
Itogon-Suyoc Mines Inc. (primary)	419	412
Manila Mining Corp. (primary)	304	216
Benguet Exploration Inc. (primary and byproduct)	301	131
Maricalum Mining Corp. (byproduct)	288	197
North Davao Mining Corp. (byproduct)	228	202
Small-scale gold panners[e]	15,552	13,000
Total	39,461	30,934

[e] Estimated.
[1] Jan. to Oct.

Filipino businessmen, forwarded a $325 million bid. The Equimark offer agreed to specific financial terms, namely, assume all of Nonoc's $70 million debt, fund $100 million within 60 days of signing an agreement to rehabilitate Nonoc's facilities, and produce another $100 million in operating capital 90 days later.

In August, a deal was signed with Equimark, which had incorporated itself under the name Philippine Nickel Co. (Philnico). CNNIC soon pulled out of the deal, ostensibly owing to its inability to obtain international financing following China's prodemocracy suppression in Tiananmen Square, Beijing, in June. Philnico then was unable to obtain an agreement with its creditors. The APT canceled the contract at the end of September.[22]

Mineral Fuels

Coal.—Coal has been mined in the Philippines for many years, but modern methods were introduced only within the past decade. There were about 30 operating mines in 1989, held mostly by the private sector. About 25 of the mines were small underground operations using some form of room-and-pillar method. Most were primitive, nonmechanized mines with output between 10 tons per year and 30 tons per year. Typically, these mines lacked ventilation systems, sump pumps, and powered hoists; the cutting was done by pick and loaded by hand. Recovery ratios were usually very low, typically 20%, but as low as 10% if coal pillars were not extracted. This mining system is often called the Camote system.

The Government, through PNOC, had coal holdings in the Bislig and Uling Mines, Surigao del Sur Province, and in the Malangas Mine, Zanboanga del Sur Province, all on Mindanao Island.

Although the rated capacity of the Philippines' largest coal mine, the Semirara Mine at Unong, Semirara Island, was 1.2 million tons per year, it only has produced at about 60% of capacity.

Petroleum.—The petroleum industry of the Philippines consisted of three companies, all of which engaged in refining crude petroleum and marketing refined petroleum products. The companies were as follows: the Government-owned PNOC, the largest; the U.S. firm Caltex (Phils.) Inc.; and the predominantly British firm Pilipinas Shell Petroleum Corp. In 1989, these refineries produced sufficient quantities of light refinery products—gasoline, jet fuel, and kerosene—to meet, and even exceed, domestic demand. However, diesel fuel, fuel oil, and lubricants had to be augmented by imports.[23]

Oriental Petroleum and Minerals Corp. had discovery wells in North Matinloc, off Palawan Island, which were brought into production during the second and third quarters of the year.[24]

Reserves

The Philippines is rich in mineral resources. There are abundant deposits of gold, especially in Mountain and Camarines Norte Provinces on Luzon; copper in Zambales Province on Luzon and in the Visayan Islands; zinc at Zamboanga on Mindanao; high-grade chromium in Zambales and Camarines Sur Provinces on Luzon, near Surigao on Mindanao, and near Puerto Princesa on Palawan; and nickel at Hinatuan, Surigao del Norte Province on Mindanao. Ores of iron, manganese, and mercury also occur in the country. Lead and silver, as well as less common cadmium and molybdenum, mineralization occurs in association with other ores. Deposits of industrial minerals included limestone for cement on Cebu, Luzon, and Romblon; salt and asbestos on Luzon; marble on Romblon and Panay; asphalt on Leyte; gypsum on Luzon; sulfur on Luzon, Leyte, and Mindanao; phosphate rock on Cebu and Bohol; and coal on Cebu and Palawan.

INFRASTRUCTURE

The more than 300,000 square kilometers of land area in the Philippines is distributed over more than 7,000 islands. This, coupled with the fact that virtually any point on even the largest of the islands is within 100 km of the coast, dictates that sea and air transport are essential elements of the communications-transportation infrastructure. Railroads (less than 400 km, all on Luzon) and pipelines (about 300 km for refined oil products) play only a modest role, but there are more than 156,000 km of roads, including 29,000 km paved, 77,000 km loose-surface improved, and 50,000 km unimproved. Inland waterways, of which there are about 3,200 km, are relatively unimportant because of their shallowness. None can accommodate vessels with a draft greater than 1.5 meters.

Air service to the vast majority of the islands can be only by seaplane for there are only about 260 airports in the country, and most of these are on the larger islands such as Luzon and Mindanao.

The Philippines has a considerable excess of power generating capacity relative to present actual production levels, but power costs are relatively high. Generating capacity in 1988 was reportedly 6.6 million kilowatts, of which about 52% was from oil and/or coal-fired thermal plants, 34% from hydroelectric plants, and 14% from geothermal plants. Total power production in the same year was about 25 billion kilowatt hours, giving a utilization of about 43%.

Generally, infrastructure for mineral industry operations is regarded as adequate for eastern Luzon and on the islands of Cebu, Marinduque, Negros, and Palawan. Elsewhere, infrastructural development is less than ideal.

OUTLOOK

The Philippine mining sector was expected to sustain a steady, albeit small, growth in the near term. World market prices for chromium and copper were considered to continue strong because copper producers remained alert against overexpansion to prevent a glut in the market. This should enable Philippine producers to continue operations at profitable levels. Increased gold exploration and investment was expected to keep the Philippine sector stable as long as the present floor price of gold was maintained.

Increased construction activity for the past few years was expected to continue and result in ensuring strong domestic minerals demand for cement and construction materials.

The country's external debt, estimated to be $28 billion, remained at a high level in 1989. The annual debt-service ratio of goods and service exports was estimated to have increased slightly.

Inflation became a major preoccupation of the Government as year-to-year increases in the consumer price index entered the double-digit range at midyear and was estimated to be 15% at yearend.

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[1] Where necessary, values have been converted from the Philippine peso (P) to U.S. dollars at the rate of P21.80=US$1.00.

[2] Executive Order No. 211. An Order Prescribing the Interim Procedures in the Processing and Approval of Applications for the Exploration, Development and Utilization of Minerals, July 10, 1987.

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[13] ———. V. 97, No. 118, June 19, 1989, p. 1.

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[18] Mining Journal (London). V. 312, No. 8022, June 2, 1989, p. 424.

[19] South-East Asia Mining Letter. Issue 89/06, Dec. 31, 1989, p. 4.

[20] Work cited in footnote 15, pp. 2, 3.

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Philippines

Department of Environment and Natural Resources
Mines and Geo-Sciences Bureau
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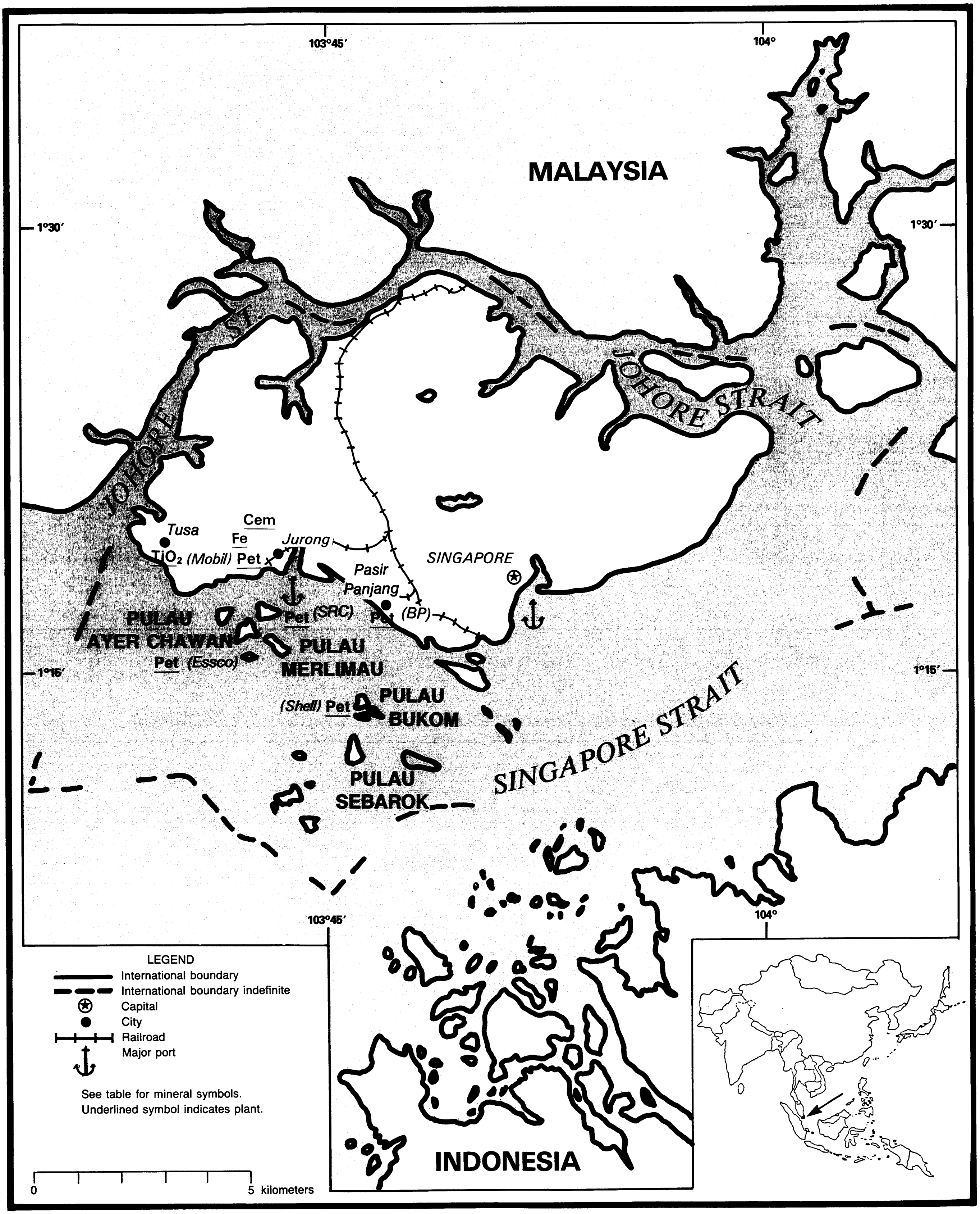
SINGAPORE

AREA 623 km² **POPULATION 2.7 million**



THE MINERAL INDUSTRY OF

SINGAPORE

By Chin S. Kuo

The Singaporean economy, powered by a buoyant financial and business services sector, grew by 8.5% in 1989. However, the manufacturing sector, which led the 2-year-old current boom, showed signs of slowing down. The country's strong economic growth, moreover, was restrained by the shortage of labor. Singapore's 1.1 million-strong work force was growing, albeit slowly. Total gross domestic product in 1989 was $52.7 billion,[1] of which quarrying contributed only $89.3 million or 0.17%.

Oil refining is one of the largest industrial sectors in Singapore, as well as in the region. The total rated refining capacity of the domestic industry is close to 1 million barrels per day. Mining is insignificant and limited solely to rock quarrying and gravel operations. The output of aggregates is consumed in the cement manufacturing and construction sectors. Most of the cement output is mainly from imported clinker from Malaysia.

There are 81 small quarrying enterprises, employing 676 miners, producing limestone and granite, of which, 14 operations with 323 employees were for granite quarrying. Other activities related to the mineral industry included 5 establishments with 370 workers in cement manufacturing, 24 establishments with 1,948 employees in nonmetallic mineral production, 10 establishments with 1,625 workers in iron and steel manufacturing, and 19 employers with 708 employees in nonferrous metal production. In addition, there were 11 companies with 3,325 workers engaged in petroleum refining and manufacturing of downstream products.

The country's investments abroad included $120 million in Shanghai, China, in the first 10 months of 1989 in hotels, shops, restaurants, and industrial projects such as textiles, plastics, and manufacturing. Resources Development Corp., which is Singapore's leading granite supplier, secured a $25 million contract for roadwork development in Papua New Guinea and a $32 million contract to build an expressway in Bangladesh.

GOVERNMENT POLICIES AND PROGRAMS

The Government's Economic Development Board (EDB) was working with the metal-finishing industry to introduce automation for process control to local electroplating operations. EDB was cooperating with MicroTeam Industries, Ltd., a local plating firm, and Ngee Ann Polytechnic Institute to develop an automation system that would be affordable to most local manufacturers. Planning for the project started in April, and the cost was estimated at $250,000. The metal finishing industry in Singapore is 50% locally owned and 50% owned by foreign manufacturing concerns.

PRODUCTION

In 1989, the country produced 1.7 million tons of cement and 7 million tons of granite. Electricity generation of 14 billion killowatt hours, all by fossil fuel-fired plants, provided the energy needs to the residential and manufacturing sectors and other industries. Natural gas production of 722-million-kilowatt-hour equivalent was equally shared by public housing and nonresidential use.

TRADE

Singapore's trade deficit was about $5.1 billion in 1989,with the value of exports estimated at $44.7 billion and imports of $49.8 billion. The current account surplus was estimated at $1.5 billion. Trade with China had been increasing at a faster pace than the year before.

COMMODITY REVIEW

Metals

Iron and Steel.—The island state's only steel manufacturing company, National Iron and Steel Mills Ltd., planned to increase its income from nonsteel activities to 50% in addition to continuing its main-line activities. The domestic construction market turned around in 1989 with a 1.3% growth. However, the company was hard hit by the dumping of steel bars in the local market and started to focus on regional markets. Total exports amounted to 38% of its sales, and a significant tonnage of steel products was shipped to Thailand, which was experiencing a construction boom. Nevertheless, the performance of the steel-related business activities was to be strengthened or remain at least the same. The company was proposing a $96 million bond issuance with warrants for the anticipated growth through the upgrading and expansion of its steel production capacity.

National Iron and Steel Mills also entered through its trading arm, NISM Trade (40%), into a joint venture with the China State Construction Engineering Corp. (40%) and a local trading firm, Tung Guan (20%). They were to explore new markets in the region, the Middle East, and Africa for Chinese building materials and machinery, overseas construction projects, and other commerce for barter trade and/or counter purchase.

TABLE 1

SINGAPORE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic	thousand tons	1,992	1,805	1,527	1,595	1,706
Iron and steel: Metal: Steel, crude[e]	do.	350	350	350	[r]425	430
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	835	1,032	824	4,060	4,000
Gasoline	do.	[r]18,700	[r]20,400	[r]16,660	[r]17,000	17,000
Jet fuel	do.	19,152	30,664	45,400	44,000	44,000
Kerosene	do.	20,320	18,430	16,275	19,375	17,500
Diesel oil	do.	57,658	65,029	69,393	70,870	71,000
Residual fuel oil	do.	81,059	69,197	74,475	59,940	60,000
Naphtha	do.	26,222	25,449	22,950	21,250	21,000
White spirit	do.	969	1,023	1,008	1,100	1,000
Lubricants	do.	3,767	4,110	4,380	4,200	4,500
Asphalt	do.	8,896	3,236	2,788	3,640	3,500
Other	do.	182	146	182	182	200
Total	do.	[r]237,760	[r]238,716	[r]254,335	245,617	243,700
Stone: Granite, broken	thousand cubic meters	6,743	5,565	7,319	6,914	7,008
Sulfur, byproduct of petroleum[e]		6,000	5,000	5,000	5,000	5,500
Tin: Metal, smelter[e]		4,000	500	1,000	1,000	3,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through June 18, 1990.
[2]In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

Tin.—The Kimetal smelter continued operations despite working solely on imported concentrates from China and other foreign materials. Output was estimated to be about 3,000 tons of tin metal.

Singapore became the world's largest delivery port for tin. Tin was delivered from Phuket in Thailand and Banka in Indonesia to the three warehouses in Singapore to fulfill Kuala Lumpur Commodity Exchanges futures contracts. Singapore is already the London Metal Exchange's only delivery port outside Europe for aluminum, copper, lead, nickel, and zinc.

Mineral Fuels

Singapore's oil-refining sector was expanding with substantial investments from abroad. The nation's refining capacity was almost fully utilized at between 700,000 and 900,000 barrels per day (bbl/d).

Caltex Asia Ltd. (30%), one of the three partners in Singapore Refining Co. (SRC), invested $100 million in upgrading the refinery at Pulau Merlimau. The other two were BP Singapore (30%) and Singapore Petroleum Co. (SPC) (40%). The expansion project included a hydrocracker that would boost its processing capacity to 220,000 bbl/d in the next few years. Current capacity of the refinery was 170,000 bbl/d. It was increased by 20,000 to 190,000 bbl/d in late 1989. SRC was also to increase oil storage space and distillation capacity. Other work will include the installation of a catalytic reformer and a new cracking plant.

Projects already underway were Shell Eastern Petroleum's $240 million residue catalytic cracker plant at Pulau Ular, Esso Singapore's $75 million visbreaker plant with a capacity of 50,000 bbl/d at Pulau Ayer Chawan, and Mobil Oil Singapore's $100 million hydrocracker with a capacity of 23,000 bbl/d. Meanwhile, SPC planned to invest $30 million in the expansion of its oil storage terminal at Jurong from its present 20,000 tons to 120,000 tons.

In October, SPC was awarded a contract valued at $500,000, beating U.S. and Japanese competitors, to process 500,000 barrels of crude oil from Oman for Taiwan's Chinese Petroleum Corp. The company also intended to explore the possibility of processing Soviet crude oil.

In secondary processing, Shell Singapore Pte.'s 10,000 kiloliters of residue was sent to Showa Shell's Yokkaichi refinery in central Japan for refining in September under a processing agreement. About the same volume would be processed monthly on a spot basis with all refined products returned to Singapore.

Singapore's petrochemical industry was turned around by the $2 billion petrochemical complex at Pulau Ayer Merbau. Petrochemical Corp. of Singapore reported $110 million operating profits in 1987 and $339 million in 1988 as a result of booming petrochemical sales worldwide.

INFRASTRUCTURE

The island of Singapore has 2,597 kilometers of roads and 38 kilometers of railroad. The modern Changi airport and the Port of Singapore handle large volumes of cargo. The port is the busiest in the world in terms of shipping tonnage. It is also a major transshipment hub, a global warehousing terminal, and a central distribution center for the Asia-Pacific region.

OUTLOOK

The only significant and important industry in Singapore is oil refining, and the country is likely to remain a major oil refining center in the region, being the third largest in the world after Rotterdam, Netherlands, and Houston, Texas. New investments for high technology will be provided by oil companies to upgrade their existing refining facilities to supply unleaded premium gasoline to the regional consumer market in countries such as Thailand and Malaysia. Strong economic growth in the region has caused some countries to depend totally or partially on Singapore for their refined oil products. Long lead time in building new refining facilities in countries such as Indonesia is a factor in favor of the stability for Singapore's oil refining industry.

OTHER SOURCES OF INFORMATION

Agency

Economic Development Board
World Trade Center
1 Maritime Square
Singapore 0409

Publication

Department of Statistics, Singapore: Monthly Digest of Statistics.

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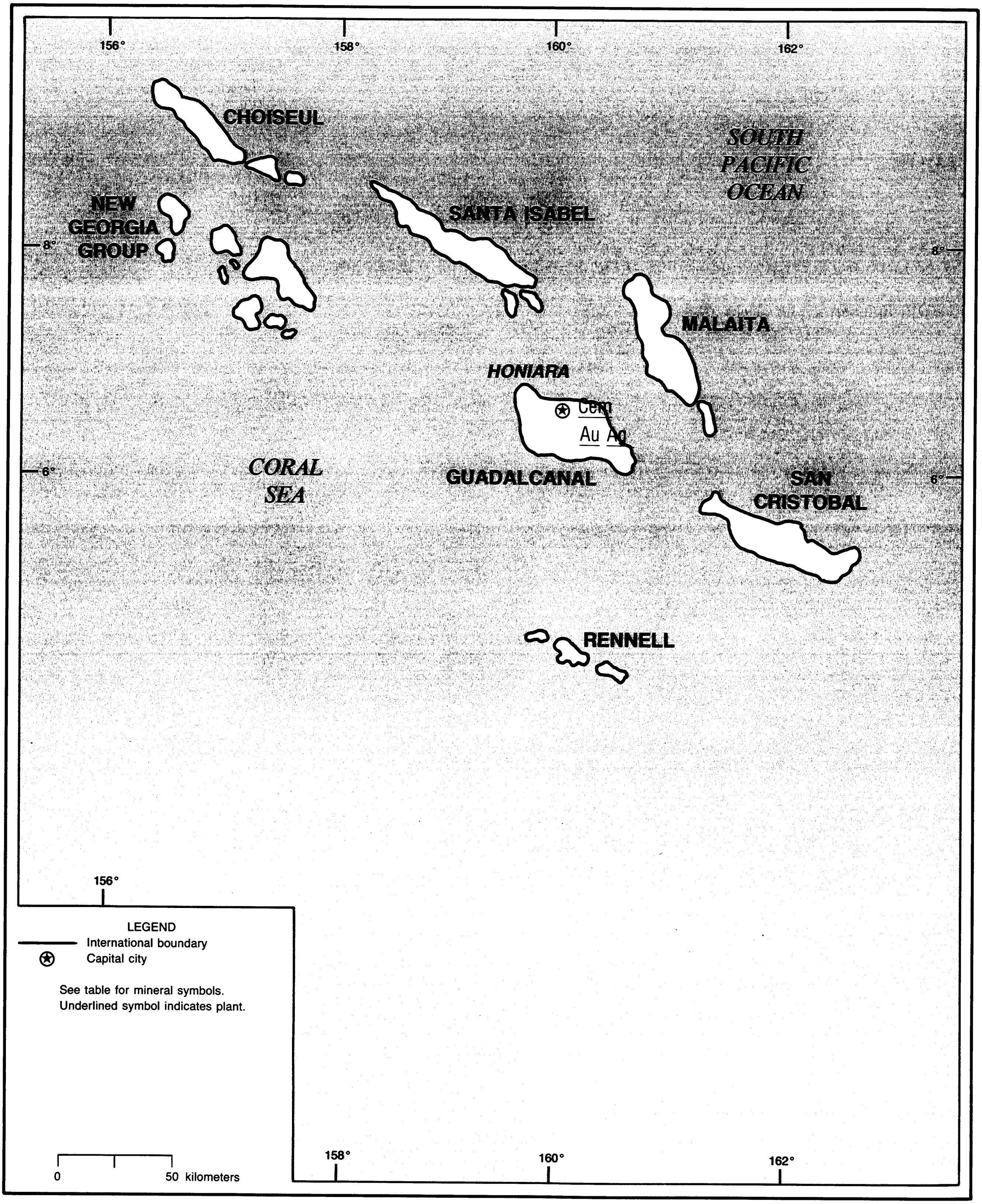
[1] Where necessary, values have been converted from Singapore dollar (S) to U.S. dollars at the rate of S$2.01 = US$1.00 for 1989.

SOLOMON ISLANDS

AREA 28,450 km² **POPULATION 325,000**



THE MINERAL INDUSTRY OF THE

SOLOMON ISLANDS

By Travis Q. Lyday

Mineral production in the Solomons continued to be limited to small quantities of clays, crushed stone, and sand and gravel used in domestic construction and minor amounts of alluvial gold, all of which were exported.

Although the Solomon Archipelago was named for the legendary gold mines of King Solomon, the Melanesian state has had only one large-scale gold operation. The operation at Mavu on the Chovohio River, 30 kilometers (km) southeast of the capital city of Honiara on Guadalcanal Island, was operated by the Australian firm Zanex Ltd. (70%) in joint venture with the local firm Mavu Gold Development Ltd. (30%). Mining began in November 1985, with a recovery plant opening in early 1986, but the operation was closed later that year owing to destruction by a tropical cyclone and disagreements with both the local landowners and the Government. Production resumed in midyear 1987. A second recovery plant was installed in 1988 to raise production capacity to 1,500 kilometers per year. Potential reserves are reported to be 40 million cubic meters of ore grading 1 gram (g) of gold per cubic meter.[1]

Arimco (Solomon Islands) Ltd., a joint venture of Australia's Arimco NL and Cyprus Minerals Ltd. of the United States, planned to start development of an open cut gold mine on its large low-grade epithermal prospect at Gold Ridge, 25 km from Honiara, by mid-1990. Production was expected to range between 1,500 and 3,100 km per year. Drilling through November 1989 resulted in estimates of potential reserves of 5 million tons of ore with grades as high as 8.3 g of gold per ton.[2]

Most of the country was covered by applications for prospecting licenses or by issued licenses. Essential elements of the transportation infrastructure include about 2,100 km of roads, including 30 km sealed, 290 km gravel, 980 km earth, and 800 km private logging and plantation roads of varied construction. There are two permanent-surface airports, out of 26 total in the country, and two shipping ports, Honiara and Ringi Cove. Electric generating capacity in 1988 was reportedly 15,000 kilowatts. Generally, infrastructure for mining operations is not in place, and each potential site must be upgraded with respect to access and logistics.

TABLE 1

SOLOMON ISLANDS: PRODUCTION OF MINERAL COMMODITIES[1 2]

Commodity		1985	1986	1987	1988	1989[p]
Gold, mine output, Au content	kilograms	65	98	[e]124	47	36
Silver, mine output, Ag content	do.	—	—	—	8	7

[e] Estimated. [p] Preliminary.

[1] Table includes data available through Aug. 6, 1990.

[2] In addition to the commodities listed, crude construction materials (common clays, sand and gravel, and stone) are produced, but output is not reported quantitatively, and available general information is inadequate to make reliable estimates of output levels.

TABLE 2

SOLOMON ISLANDS: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity
Gold	Zanex Ltd. (operator, 70%; and Mavu Gold Development Ltd., 30%)	Near Honiara, Guadalcanal	[1]1,500
Do.	Arimco (Solomon Islands) Ltd. (Arimco NL, 50%; and Cyprus Minerals Ltd., 50%)	do.	[1 2]1,500

[1] Kilograms.

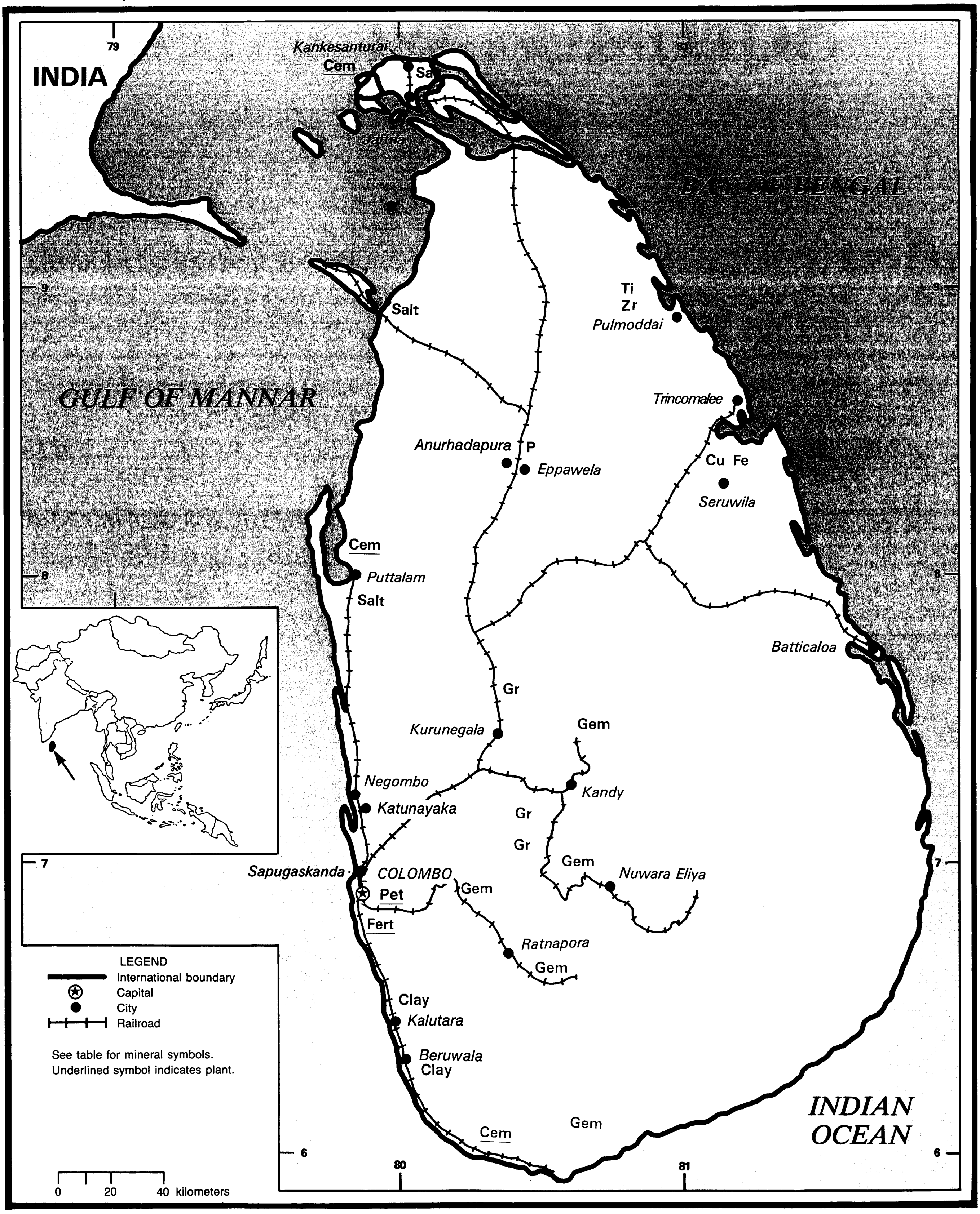
[2] Development expected to begin mid-1990.

[1] Mining Annual Review. South Pacific Islands. Min. J. (London), June 1989, p. A84.

[2] Metal Bulletin (London). No. 7434, Nov. 16, 1989, p. 15.

SRI LANKA

AREA 65,600 km² **POPULATION 17.2 million**



THE MINERAL INDUSTRY OF

SRI LANKA

By David B. Doan

In the midst of political and military turmoil throughout 1989, the mineral industries of Sri Lanka generally were forced to exert great effort to maintain the volume of production characteristic of the previous year.

Troops of the Indian Peace-Keeping Force (IPKF) entered the country in 1987 to occupy the north and east and allegedly safeguard the 3 million Tamils living there. Two years later the IPKF was enduring significant casualties in fighting Marxist guerrillas intent upon establishing an independent state. Viewed as a hostile occupation force by much of the population they came to protect, the IPKF also irritated the larger Sinhalese population to the south. Here the dormant Marxist JVP, or Peoples' Liberation Front, came back to life to portray itself as the rallying point for xenophobic passions. The JVP thus brought terrorism and suffering, previously restricted to the Tamil areas, to the remainder of the island country.[1] Urban unrest was widespread, and the countryside was no longer safe to anyone in this several-sided conflict. Although the IPKF prepared to withdraw to India in the spring of 1990, terrorism and armed conflict developed a life of its own. Sri Lankan troops were increasingly involved against the Tamil "Tigers," the insurgents from the northeast. Elsewhere, splinter-group terrorists committed mayhem, closed down businesses at will, and became targets of death squads formed to hunt them.

Overall growth of the economy continued to be slow at best and, in some sectors, indiscernible. Agriculture was hit by unfavorable weather and lagged the previous year. Mining and quarrying, suprisingly, increased by more than 5% and led all other sectors, according to Government statistics. Construction was up only 0.6% from the year before, and the gross domestic product increased only 2.3%. Civil unrest threatened to become political chaos, and food scarcities began to loom as the Government tried to hold things together.

GOVERNMENT POLICIES AND PROGRAMS

Mineral production increased in recent years both for domestic consumption and export, and to the point at which the Government recognized the potential value of sponsored development in the form of free trade zones. Projects in these zones, managed by the Greater Colombo Economic Commission (GCEC), are now permitted to have up to 100% foreign ownership, while foreign participation in business ventures outside these zones was ordinarily limited to a minority interest.

The State also set up specific territorial areas to enable both local and foreign investors to establish export-oriented industries. Foreign investments were guaranteed, and tax holidays of as much as 10 years were available. Dividends of nonresident shareholders were exempt from tax, and remittances were exempt from exchange controls. No import duties were charged on machinery and equipment.

Sri Lanka clearly was interested in encouraging foreign investment. The GCEC offered "one-stop" service to foreign investors by facilitating investor relations with Government agencies, helping with labor recruitment and utility hookups, and various other basic business needs.

PRODUCTION

Although the mining and quarrying sector led all other domestic sectors at an increase of 5.4% in 1989, it was down sharply from the 1988 increase of 9.0%, reflecting the country's domestic strife. Graphite production was about 4,200 tons, one-half that of the year before. Output of refined petroleum products was mostly down from the previous 2 years with the exception of gasoline, which at 3.13 million barrels was more than twice the production of the year 1987. Production of phosphate rock continued its long climb and at 24,440 tons was up about 6.3% from output in 1988. Continuing civil strife, however, could only be regarded as threatening to all mineral production in Sri Lanka.

TRADE

Sri Lanka was relatively open to foreign trade, having abolished most foreign-exchange and import controls in 1977 and having simplified the tariff schedule in 1984. The United States is still the country's largest trading partner, absorbing about one-quarter of Sri Lanka's total exports in 1989.

Although mineral exports from Sri Lanka grew by approximately 29% in 1988 to about \$66.2 million,[2] 1989 was not expected to see any significant increase over that amount by the time the statistics could be compiled. Gem stones alone represented about \$52.4 million or 79% of the total. Aquamarine, garnet, ruby, sapphire, and tourmaline were all exported, and topaz was expected to be added to the list by 1990.

Graphite exports were down sharply in 1989. After selling 2,560 tons worth \$2.8 million to the United States in 1988, the total sold to the same destination in 1989 was only 607 tons valued at \$687 thousand. Japanese interests, however, were said to be negotiating the purchase of 1,000 tons per month.[3]

The state-owned Ceylon Petroleum Corp. (Ceypetco) signed an agreement

TABLE 1

SRI LANKA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1985	1986	1987	1988	1989[p]
Cement, hydraulic[e] thousand tons	600	600	600	400	400
Clays:					
Ball clay	23,825	20,470	20,210	17,330	20,866
Kaolin	5,405	6,260	6,869	7,100	7,761
Brick and tile clay[e]	70,000	40,000	60,000	60,000	60,000
Clays for cement manufacture	39,123	36,322	23,277	12,487	[e]12,500
Feldspar, crude and ground	9,789	7,270	7,442	6,345	6,656
Gem stones, precious and semiprecious, other than diamond value, thousands	[e]$20,000	$23,304	$13,196	[e]$14,000	[e]$14,000
Graphite, all grades	7,413	7,453	[e]9,400	8,547	4,163
Iron and steel: Metal: Semimanufactures	9,310	10,872	33,508	[e]35,000	[e]35,000
Mica, scrap[e]	200	200	200	200	200
Nitrogen: N content of ammonia	5,400	—	—	—	—
Petroleum refinery products:					
Gasoline thousand 42-gallon barrels	1,054	1,114	1,190	[r e]2,040	3,128
Jet fuel do.	584	760	552	[r e]420	384
Kerosene do.	1,194	1,163	1,162	[r e]1,010	961
Distillate fuel oil do.	2,805	3,111	3,819	[r e]3,580	3,327
Residual fuel oil do.	4,036	4,109	4,062	[r e]2,000	—
Other do.	1,156	1,793	1,628	[r e]1,500	1,166
Refinery fuel and losses do.	316	435	395	[r e]440	553
Total do.	11,549	12,485	12,808	[r e]10,990	9,519
Phosphate rock	[e]14,000	14,977	20,600	22,995	24,440
Rare-earth metals: Monazite concentrate, gross weight[e]	200	200	200	200	200
Salt	76,858	104,278	115,274	106,794	[e]100,000
Stone:					
Limestone thousand tons	[e]1,000	649	2,044	733	608
Quartz, massive	1,566	1,090	1,190	953	961
Titanium concentrate, gross weight:					
Ilmenite	114,854	129,907	128,500	74,305	[e]75,000
Rutile	8,558	8,443	7,200	5,255	[e]5,200
Zirconium: Zircon concentrate, gross weight[e]	[3]4,061	4,000	4,000	3,000	3,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Sept. 21, 1990.
[2]In addition to the commodities listed, crude construction materials such as sand and gravel and other varieties of stone presumably are produced, but available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

to buy 750,000 tons of Iranian light crude through the Republic of Korea's Daewoo Corp., with delivery beginning in November of 1989.

STRUCTURE OF THE MINERAL INDUSTRY

The Government owned the mining and mineral processing operations as well as the related trade enterprises. The one major exception was the many nonmechanized small-scale gem stone workings, which were privately owned and operated. What was probably the country's largest mineral-industry investment, the Sri Lanka State Fertilizer Manufacturing Corp., ceased operating in 1985 but was believed under maintenance and repair. After beginning production in 1981, the plant had suffered substantial financial losses.

Although the mineral-industry labor force had consisted of 2,000 to 3,000 people out of a total labor force approaching 5 million, hostilities between the Tamil insurgents and the Government and ancillary terrorism have exerted a depressing effect on mining operations in many areas. This was particularly true with salt and cement production. Gem stone and graphite mining in central Sri Lanka evidently had been affected, as had the recovery of mineral sands in the Pulmoddai region of the northeast coast.

TABLE 2

SRI LANKA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year unless otherwise specified)
Cement	Lanka Cement Corp. (Government, 100%)	Kankesanturai	1,000.
Do.	do.	Puttalam	400.
Gem stones	State Gem Corp. (sales and trade) (Government, 100%)	Colombo	NA.
Graphite	State Mining and Mineral Development Corp. (Government, 100%)	Kahatagaha-Kolongaha Mines, 27 km northeast of Kurunegala	4.
Do.	do.	Bogala Mine, 80 km northeast of Colombo	7.
Petroleum, refinery products	Ceylon Petroleum Corp. (Government, 100%)	Sapugaskanda	50[1] petroleum.
Phosphate rock	State Mining and Mineral Development Corp. (Government, 100%)	Eppawela	20.
Titanium, ilmenite concentrate	Ceylon Mineral Sands Corp. (Government, 100%)	Pulmoddai	150.

NA Not available.
[1]Thousand 42-gallon barrels per day.

COMMODITY REVIEW

Metals

Thorium and Uranium.—An exploration program carried on by the National Aquatic Resources Agency had led to the discovery of large deposits of monazite along the coasts of Kalutara and Beruwala in the southwestern part of the country, about 50 and 60 kilometers (km) south of Colombo, respectively. The deposits were considered comparatively rich and were estimated to be worth in excess of $270 million. A spokesman for the Ministry of Fisheries observed that mineralization of the local offshore sands exceeded 2% monazite. Prior to this discovery, the principal location for such deposits was in the Pulmoddai area on the northeast coast, where political unrest was rampant.

Industrial Minerals

Gem Stones.—Having a total investment of about $675,000, a Swiss-Sri Lankan joint venture had been established for the cutting and polishing of precious stones. In the Katunayaka Free Trade Zone, about 30 km north of Colombo, the Davidov Pvt. Ltd. was scheduled for a first stage of importing and cutting diamond rough, followed by a second stage in which other precious stones would be treated. Government incentives have had the effect of increasing approved diamond-cutting units from 3 in 1986 to 13 in 1989.

Graphite.—Production at the State Mining and Mineral Development Corp.'s (SMMDC) Kolonghaha graphite mine was impaired by an act of arson when property was set on fire by marauders after locking the night shift in a single room. Damage was projected at about $550,000. Overall graphite production in 1989 was down approximately 51% at 4,163 tons.

Phosphate Rock.—Production for 1989 increased slightly more than 6% over that of the previous year. SMMDC proposed to expand the capacity of its Eppawela phosphate mine and plant from 15,000 tons per year to 35,000 tons per year.

Mineral Fuels

Petroleum.—The fact that India has had oil production in the Cauvery Basin was not lost on Sri Lankan officials, specifically from wells only 50 km northwest of Sri Lanka's Jaffna Peninsula. Although results were disappointing in both onshore and offshore drilling in Sri Lanka during the period 1973-81, optimism continued that the right combination of location and depth could be found, given sufficient exploration. At least 3 years ago, the Government, through Ceypetco, offered 11 concession blocks for further exploration and development. Block 11, extending both onshore and offshore from the Jaffna Peninsula southward to the latitude of Anurhadapura, had been of interest to several foreign entities, as was offshore Block 6 along the southeast coast. Oil price increases in 1990 international markets may stimulate renewed activity on these blocks.

Refinery Products.—Plans were advanced by Ceypetco for reconfiguration of the Sapugaskanda refinery to accommodate a broader range of crudes. Originally designed to refine Iran crude, the refinery in the future will accept heavier crudes and produce a higher proportion of gas oil and a lesser proportion of lower value residual (bunker) oil. Refinery gases that were flared would be recaptured as liquefied petroleum gas, reducing the need for propane imports. These changes and improvements were projected to maximize the output of the higher value refinery products.

Reserves

As exploration proceeds in Sri Lanka, estimates of mineral reserves must be continually upgraded. With Archean rocks (from the Earth's oldest geologic era) constituting nine-tenths of the area of the country, geochemical remobilization during metamorphism resulted in various economic mineral concentrations ranging from magnetite iron ore to gem stones. The true extent of mineralization for many of these deposits was not yet determined; thus, new reserves were discovered as geologic investigations continued.

One mineral commodity for which no method of reserve estimation had been devised is gem stones, which Sri Lanka had in profusion and variety. Most were precious and semiprecious colored stones mined from alluvial deposits in the hilly terrain of the southwest part of the country. Their presence in the streambeds and terraces demonstrated that in all probability more were still upstream in lode deposits more difficult to mine.

INFRASTRUCTURE

Unlike some smaller Asian nations, Sri Lanka had a relatively extensive network of roads and railroads capable of providing good support to mineral exploration and development. The country had about 66,200 km of highways, consisting of 24,300 km of paved surface, 28,900 of loose-surface gravel or crushed-stone surface, and about 13,000 km of drained or undrained packed-earth surface. In addition, there were several thousand km of undrained tracks. Railroads included about 1,870 km of 1.676-meter broad-gauge track, 102 km of this being double track.

Inland waterways comprise about 430 km navigable by shallow-draft boats. Principal seaports were Colombo and Trincomalee, with smaller ports around the periphery of the island. A seagoing ferry connected the smaller port of Talaimannar with the Indian port of Danushkodi. The country had 13 usable airports, 12 having paved runways. One airport had runways 2,440 to 3,659 meters in length; seven of the others had runways 1,220 to 2,430 meters long. In 1987, there was 62 km of pipeline for crude and refined products.

Electricity was generated by hydroelectric and thermal powerplants, including some fired by diesel fuel. Capacity altogether was 1,300 megawatts with about 4,200 million kilowatt hours produced per year, or approximately 250 kilowatt hours per capita. New powerplants were in various stages of study and funding.

TABLE 3

SRI LANKA: ESTIMATED MAJOR MINERAL RESERVES

(Thousand metric tons)

Ball clay	500
Dolomite	30,000
Iron ore	25,000
Graphite	40
Limestone	20,000
Phosphate rock	25,000
Silica sand	20,000
Titanium minerals:	
Ilmenite	7,200
Rutile	820

OUTLOOK

Sri Lanka has a variety of known minerals and mines and good prospects for other minerals yet to be discovered. The country's dominantly Archean geology offers many possibilities depending only on the advancement of exploration. The probabilities for discovery of petroleum both offshore and onshore are not unattractive and could go far toward relieving Sri Lanka's present degree of energy dependence. In short, this is a country that would seem to have a good future for a diverse range of mineral industries.

Unfortunately, however, Sri Lanka is torn by a violent insurgency as well as other "causes" being advanced solely by terrorism, all to such a degree that real concern is justified as to the country's survival in its present enlightened democratic form. If it can overcome its present perils, Sri Lanka possesses a sufficient mineral base, the key to a strong economic future.

[1] Marks, T. The Wall Street Journal. Aug. 16, 1989, p. A15

[2] Where necessary, values have been converted from Sri Lankan rupees (SLR) to U.S. dollars at the rate SLR 39.5 = US$1.00.

[3] Mining Journal (London). V. 313, No. 8039, Sept. 29, 1989, p. 246.

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Agencies

Sri Lanka Government
Colombo, Sri Lanka

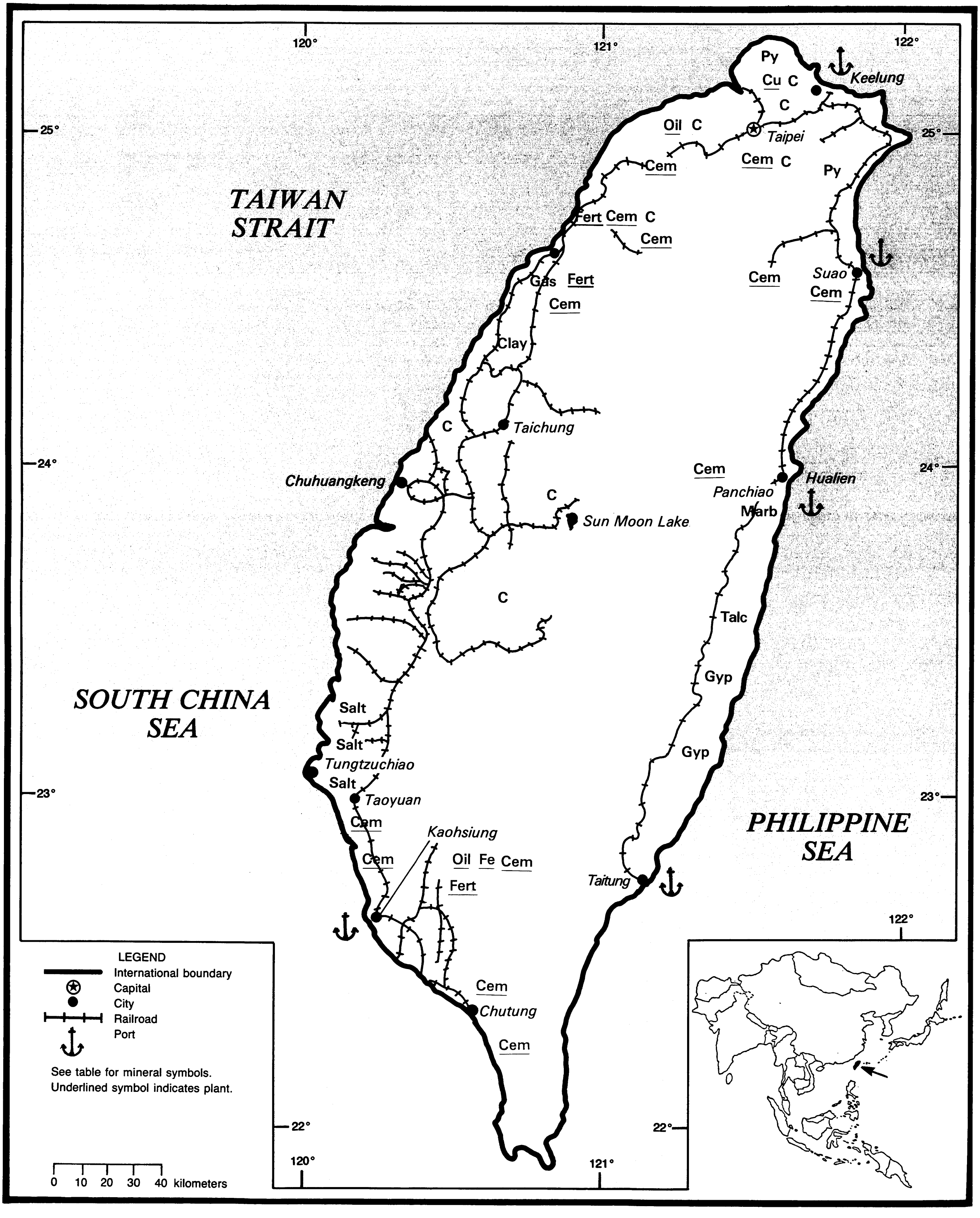
Ceylon Petroleum Corp.
P.O. Box 634
113 Galle Road
Colombo 3, Sri Lanka

Publications

Company annual reports.

TAIWAN

AREA 35,980 km² **POPULATION 20.1 million**



THE MINERAL INDUSTRY OF

TAIWAN

By Pui-Kwan Tse

Taiwan is a mineral-resource-poor country. It has capitalized on an educated and highly competent work force to produce export value added manufactures from imported materials. Taiwan's vibrant economy is reflected by a $7,500 per capita gross national product (GNP) in 1989, one of the highest in the Far East. The input of mining to GNP was only 0.3%, negligible in comparison with 34% for manufacturing. Exports in 1989 were valued at $66 billion and were composed mostly of textile and wearing apparel, electrical and electronic products, and transportation equipment and machinery, in that order. Imports in 1989 were valued at $52 billion. The cost of imports was dominated by fossil fuels, which accounted for 20% of the total value of receipts.

In terms of current dollars, Taiwan's GNP grew from $125.3 billion in 1988 to $150.3 billion in 1989.[1] Based on a population of 20.1 million, the per capita GNP reached $6,022 to $7,473 in 1989, the fourth highest in Asia after Japan, Hong Kong, and Singapore. The labor force totaled 8.4 million, composed of 5.2 million males and 3.2 million females. The unemployment rate was 1.6%, down from 1.7% in the previous year. Employment in the mining and quarrying sector decreased to 24,000 compared with 2.8 million for manufacturing, 1.6 million for commerce, 1.3 million for public administration and social services, and 1.1 million for agriculture. The value of output by the mining and quarrying sector was only 0.3% of the gross domestic product, dwarfed by the input of Taiwan's manufacturing industries of 34.1%.

The value of Taiwan's output of the mining sector is insignificant by world standards and limited to small quantities of various, low-unit-value industrial minerals, mostly limestone, marble, and dolomite. The value of the mining sector is inflated by the small amount of coal and natural gas and associated condensate domestically produced. These minerals represented only 4.6% of Taiwan's total supply of energy, equivalent to a 17-day energy supply.

Taiwan is a prominent member of the world's trading community. Its commerce is well served by a highly developed transportation infrastructure for both domestic and foreign receipts and discharges. Kaohsiung, Taiwan's largest port, accounted for 62% of the country's harbor freight traffic, followed by Keelung, with 14%. The remainder of the loading and discharging was at Su-Ao, Hwalien, and Taichung.

Aside from containerized shipments, which were the largest single class, other bulk freight loaded and discharged included cement, fertilizers, iron and steel, machinery and metal parts, mineral ores, and vehicles and vehicular parts.

The United States was Taiwan's largest trading partner, its largest export market, and its second largest import supplier. Shipments to the United States in 1989 were valued at $23.9 billion, accounting for 36.6% of total exports. Imports from the United States were valued at $12.0 billion, representing 23% of total receipts. The Government of Taiwan drafted a Trade Action Plan to reduce the country's large surplus with the United States. Proposals in the plan include tariff reductions and removal of nontariff barriers. In 1988, Taiwan imported 190,119 kilograms of gold bullion from the United States, valued at $2,878 billion. The U.S. Government viewed the purchase of gold bullion as nonmerchandise trade. Hence, exclusion of the bullion purchase from the total U.S. shipments exacerbated Taiwan's large trade surplus with the United States. In 1989, the Central Bank imported gold valued at only $18 million, none of which was from the United States.

GOVERNMENT POLICIES AND PROGRAMS

Negotiations on a copyright agreement between the United States and Taiwan began in 1987. The remaining disputed issues of the agreement were to be resolved by 1990. A bilateral patent and trademark agreement also was under consideration. Significant legal and enforcement problems exist in Taiwan, despite the Government's willingness to improve the protection of intellectual property rights.

The 15-year ban on new securities firms was lifted in May 1988. In June 1989, Taiwan's Securities and Exchange Commission (SEC) permitted foreign securities firms to apply to established branch offices in Taiwan. In October, two U.S. companies submitted applications.

In July 1989, the Legislative Yuan revised the country's Banking Law, permitting foreign banks a wider scope of business activity in Taiwan. The promulgation of the implementation regulation for banking reorganization is expected in 1990.

The Government has given high priority to the adoption of a Fair Trade Law, which is intended to regulate a broad range of economic activities, including provisions for antitrust, unfair competition, and consumer protection.

The privitization of Government-owned enterprises was launched in 1989. In April 1989, the Ministry of Economic Affairs advertised the sale of 2.3% of the shares of China Steel Corp., a state-owned enterprise. In July, the Government announced a program to denationalize 19 public enterprises that included 5 banks, 3 insuramce firms, 2 transport companies, and 2 steel operations. Because of opposition by private interest groups, further action on this program has been postponed until 1990.

PRODUCTION

Because of its very weak mineral resource base, the value of the output of the mining sector was only $490 million or 0.3% of the country's GNP in 1989. By value, the most important mine output was natural gas, followed by coal. The domestic output of mineral fuels was significant only in that it provided close to 5% of the nation's supply of energy. Mine production of metal ore, which was for copper, ended early in the decade. In terms of tonnage and value, the output of carbonate minerals, followed by clays, dominated the remainder of the output of the domestic mining industry.

There are no mining claims in the counties of Taoyuan, Taichung, Pingtung, and Penghu; in Keelung City; and Taipei Municipality. By kind of minerals, there was mining-right registration for gold, quartz crystal, clays, carbonate minerals, coal, natural gas, gem stones, and geothermal steam. All of the registrations for prospecting and mining rights were to private parties.

The large mineral- and metal-producing companies in Taiwan are state-owned enterprises. These included China Petrochemical Development Corp., China Steel Corp., Chinese Petroleum Corp., Kaohsiung Ammonium Sulfate Corp. Ltd., Taiwan Aluminium Corp., Taiwan Cement Corp., Taiwan Fertilizer Corp., Taiwan Metal Mining Corp., Taiwan Salt Works, and Tang Eng Iron Works Co. Ltd.

TRADE

The value of Taiwan's total trade increased to $118.94 billion. Exports were valued at $65.3 billion and imports at $53.7 billion, resulting in a trade surplus of $11.6 billion. The largest export destination was the United States with shipments valued at $23.9 billion, followed by Japan, $9.03 billion; Hong Kong, $6.99 billion; the Federal Republic of Germany, $2.55 billion; the United Kingdom, $2.09 billion; Singapore, $1.97 billion; Canada, $1.75 billion; the Netherlands, $1.58 billion; Australia, $1.53 billion; and France, $1.08 billion. These countries collectively accounted for 81% of the total value of shipments from Taiwan. The largest supplier of Taiwan's imports was Japan, with receipts valued at $14.87 billion, followed by the United States, $10.11 billion; the Federal Republic of Germany, $2.14 billion; Hong Kong, $1.93 billion; Australia, $1.34 billion; Saudi Arabia, $1.24 billion; Switzerland, $1.03 billion; and Canada, $0.96 billion. These countries collectively accounted for 73% of Taiwan's total receipts.

The largest export class was machinery and transportation equipment valued at $22.33 billion or 36.8% of the value of total shipments, followed by textile, apparel, and related goods, valued at $10.83 billion, composing 17.8% of total exports. The minerals and metals export categories included metal products, valued at $3.49 billion; base metals, $1.31 billion; chemicals, $1.59 billion; chemical products, $860 million; glass products, $33 million; and cement, $10 million. Altogether, these commodities accounted for 12.6% of the total value of exports. Imports of machinery and transportation equipment were valued at $16.53 billion or 33.1% of total receipts. Mineral-related imports included base metals, valued at $10.45 billion; metal products, $36 million; chemicals, $4.93 billion; chemical products, $2.32 billion; industrial mineral products, $31 million; and mineral ores, $30 million. These receipts accounted for 37.4% of total imports. Imports of fuels were coal, valued at $85 million, and crude oil, $2.22 billion.

The United States is a major trading partner of Taiwan; mutual exchange of minerals and metal is minimal. However, scrap metal from the United States is a significant component of supply for lead (about 60%) and to a much lesser extent for aluminum, copper, steel, and zinc. Two-way trade of industrial minerals is insignificant in comparision with the export value of manufactured articles and finished goods. For its metallurgical sector, Taiwan imports copper concentrates primarily from Canada and the Philippines and iron ore from Australia and Brazil.

STRUCTURE OF THE MINERAL INDUSTRY

Coal, oil, and associated natural gas are the country's most valuable mine products. However, total production is inconsequential to the country's energy needs. In terms of quantity, carbonate minerals—limestone, marble, and dolomite—dominate the nonfuel mining sector. Aside from aggregates, the remaining mine production is composed of limited quantities of a small array of industrial minerals, principally clays, feldspar, and talc. Taiwan's metal-producing sector consists only of copper, iron and steel, and nickel, and byproduct gold and silver. Raw materials for this sector are imported.

To ensure stability for the national economy, the major industrial firms requiring large capitalization in Taiwan are Government enterprises. State-run metal-producing processing and consuming operations include China Steel Corp., Tang Eng Iron Works Co. Ltd., Taiwan Metal Mining Corp., Ching Hsin Electric & Machinery Manufacturing Corp., Metal Industries Development Center, Taipei Iron Works Ltd., Taiwan Machinery Manufacturing Corp., China Shipbuilding Corp., and the Mint of China. Jurisdiction over the energy sector is exercised by the state-run enterprises of Chinese Petroleum Corp., China Petrochemical Development Corp., and Taiwan Power Co. Other Government enterprises include Kaohsiung Ammonium Sulfate Corp., Taiwan Alkali Co. Ltd., Taiwan Fertilizer Co. Ltd., and Taiwan Salt Works.

COMMODITY REVIEW

Metals

There were no domestic mining operations for metal-bearing ores in Taiwan. The country's only primary metals industry is limited to copper, iron and steel, and nickel, all of which utilize imported raw material.

Aluminum.—Primary aluminum metal production by Taiwan Aluminium

TABLE 1

TAIWAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
METALS						
Copper: Metal, refined		46,734	50,439	46,961	43,333	43,237
Gold, primary	kilograms	950	907	532	237	269
Iron and steel: Metal:						
Pig iron	thousand tons	3,429	3,740	[e]3,900	5,675	[e]6,000
Ferroalloys:						
Ferromanganese		18,508	20,040	17,026	25,822	30,623
Ferrosilicomanganese		22,688	20,933	18,944	30,745	26,510
Ferrosilicon		17,272	14,007	7,058	19,601	19,277
Steel, crude	thousand tons	5,326	5,679	5,949	8,313	9,047
Nickel, refined		2,100	8,500	8,200	8,200	8,200
Silver, primary	kilograms	11,386	12,613	9,856	8,388	6,491
INDUSTRIAL MINERALS						
Asbestos		625	—	—	—	—
Cement, hydraulic	thousand tons	14,418	14,806	15,663	17,281	18,043
Clays:						
Fire clay		63,446	64,652	76,005	131,370	85,803
Kaolin		76,605	63,228	67,525	81,879	98,115
Feldspar		11,055	26,290	28,116	19,101	9,806
Gypsum: Precipitated		2,199	2,247	1,378	2,438	3,904
Lime		105,132	109,690	105,005	105,701	[e]97,000
Mica		114	774	787	4,387	4,290
Nitrogen: N content of ammonia		206,781	265,248	243,275	278,410	222,197
Pyrite, gross weight		8	10	—	—	—
Salt, marine		173,898	136,078	99,943	111,341	169,982
Sodium compounds, n.e.s.:						
Caustic soda		386,505	365,913	378,244	332,698	186,452
Soda ash		112,018	133,358	127,332	126,828	115,572
Stone:						
Dolomite	thousand tons	231	258	340	448	419
Limestone	do.	12,722	12,462	12,407	13,653	14,069
Marble	do.	10,259	10,603	11,062	11,213	12,231
Serpentine	do.	208	234	253	328	469
Sulfur:						
S content of pyrite		4	5	—	—	—
Byproduct, all sources		42,949	62,980	89,082	86,541	76,060
Total		42,953	62,985	89,082	86,541	76,060
Talc		17,560	21,552	22,102	21,603	22,559
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		43,264	48,363	53,559	52,982	57,632
Coal, bituminous	thousand tons	1,858	1,725	1,499	1,225	784
Coke	do.	132	148	118	97	88
Gas, natural:						
Gross[e]	million cubic feet	44,000	40,000	41,000	45,000	50,000
Marketed	do.	39,731	36,111	37,325	41,087	40,642
Petroleum:						
Crude	thousand 42-gallon barrels	743	660	934	880	850

See footnotes at end of table.

TABLE 1—Continued

TAIWAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum—Continued						
Refinery products:						
Gasoline	thousand 42-gallon barrels	25,408	18,128	24,480	26,640	27,084
Kerosene	do.	282	956	547	1,201	2,032
Distillate fuel oil	do.	23,852	19,480	25,581	23,131	27,015
Residual fuel oil	do.	56,080	53,591	51,622	60,538	71,207
Lubricants	do.	856	887	1,887	969	1,038
Asphalt	do.	2,999	3,195	2,291	2,567	2,901
Other[2]	do.	9,916	3,478	4,835	6,408	14,531
Refinery fuel, losses and not reported[3]	do.	[e]30,000	[e]25,000	[e]21,680	11,176	8,695
Total	do.	149,393	125,375	132,923	132,630	154,503

[e] Estimated. [p] Preliminary.
[1] Includes data available through Mar. 19, 1990.
[2] Naphtha, solvent oil, and base oil.
[3] Includes liquefied petroleum gas and jet fuel.

Corp. (Talco), a state-owned enterprise, ceased in 1982. The Government transferred Talco to the state-owned Taiwan Power Co. (Taipower), which continued Talco's rolling operations to produce sheet and foil from imported ingot. Imports of unwrought aluminum totaled 140,000 tons. The principal suppliers were Australia, 68,000 tons; Canada, 15,000 tons; New Zealand, 11,000 tons; and the Republic of South Africa, 10,000 tons. U.S. shipments to Taiwan were 7,500 tons, valued at $17.5 million. Imports of unwrought aluminum alloys were 57,000 tons, supplied principally by the United Arab Emirates, the Republic of South Africa, the United States, Australia, Bahrain, Canada, and New Zealand, in that order. U.S. shipments to Taiwan were 7,000 tons valued at $17.5 million.

Copper.—Taiwan Metal Mining Corp. (TMMC), a state-owned enterprise, has its 50,000-ton-per-year copper smelter-refinery at Juifang. Because of the insolvency of TMMC's operation, the facilities were transferred to Taipower in 1987, which was to continue the production of copper and byproduct gold and silver for the next 10 years. All of the smelter requirements for copper concentrate are imported. Taiwan imported 118,000 tons of copper concentrate, primarily from Canada, accounting for 62,300 tons, and the Philippines, 23,000 tons. The remainder of the imports was from Chile, Mexico, India, and Turkey, in that order.

Iron and Steel.—China Steel Corp. (CSC), a state-owned enterprise, operated the country's only integrated iron and steel complex at Kaohsiung. CSC's annual production capacity of crude steel was 6.4 million tons. Tang Eng Iron Works Ltd. (Tang Eng) a state-owned enterprise, specialized in stainless steel production. Taiwan Nickel Refinery Corp. (TaiNickel) supplies Tang Eng with nickel metal for stainless steel production. Before CSC's existence, Taiwan's steel industry was composed of numerous small operations utilizing scrap metal and ship plate generated by 140 shipbreaking companies in Kaohsiung Harbor. In 1986, Taiwan's shipbreaking reached a peak of 3.69 million light displacement tons of demolition. Following a large fire in the scrapping yard during that year, the industry has drastically contracted since that incident. At yearend 1988, there were only 37 berths at Kaohsiung for breaking. On March 31, 1989, one of the shipbreaking sites at the Tajen zone closed, leaving only a total of 13 shipbreaking berths at Kaohsiung. Consequently, the small steel operations utilizing ship plate were almost extinct following the demise of the shipbreaking industry. CSC accounted for 75.1% of the country's total production of crude steel. The remainder of the output was by small operations such as Hai Kwang Steel Co., Lung Chin Steel Co., Li Chong Co., and Tung Ho Steel Enterprise Inc., all using electric furnaces.

CSC is planning a fourth-stage expansion to raise its annual production capacity to 8 million tons of crude steel. The added capacity will probably be an overseas venture. In addition to a severe space constraint at Kaohsiung, limited water is available for industrial use, as well as limited electric power. Also, air pollution is particularly bad in and around Kaohsiung, and there is strong local opposition to increased environmental degradation.

Taiwan's steel industry is dependent on foreign sources for raw materials. Imports of iron ore totaled 8.5 million tons and were primarily from Australia, Brazil, and the Republic of South Africa, in that order. Receipts of manganese ore were 170,942 tons and were primarily from the Republic of South Africa, Australia, and Gabon, in order of tonnage. Imports of ferrous scrap metal were 1.5 million tons; principal suppliers were the United States, Japan, and Hong Kong. In addition, scrap metal was produced from shipbreaking. There were 100 vessels weighing 1,026,763 tons that were

TABLE 2

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS				
Alkali and alkaline-earth metals	136	202	—	Indonesia 100; Japan 36; Singapore 30.
Aluminum:				
Ore and concentrate	2	3	—	All to Hong Kong.
Oxides and hydroxides	3,721	562	—	Republic of Korea 360; Japan 144; Kenya 18.
Metal including alloys:				
Scrap	7,969	5,211	6	Japan 5,117; Netherlands 37; Thailand 20.
Unwrought	17,254	34,753	81	Japan 30,490; Republic of Korea 1,835; Thailand 1,571.
Semimanufactures	23,682	25,329	1,401	Hong Kong 11,686; Japan 6,608; Singapore 3,226.
Antimony:				
Oxides	64	189	—	Japan 137; Netherlands 20; United Kingdom 18.
Metal including alloys, waste and scrap	3	5	([2])	Japan 4.
Arsenic: Oxides and acids	1	—		
Beryllium: Metal including alloys, all forms	12	([2])	([2])	
Cadmium: Metal including alloys, all forms kilograms	NA	33,993	59	Japan 33,934.
Chromium: Oxides and hydroxides do.	717	56	—	All to Singapore.
Cobalt:				
Oxides and hydroxides do.	150	398	—	All to Malaysia.
Metal including alloys, all forms	NA	661	154	Saudi Arabia 97; United Kingdom 64.
Columbium and tantalum: Tantalum metal including alloys, all forms	22	141	81	Japan 51; Netherlands 5.
Copper:				
Ore and concentrate	([2])	15	—	All to Hong Kong.
Matte and speiss including cement copper	NA	37	—	Japan 36.
Oxides and hydroxides	—	10	—	Malaysia 9; Japan 1.
Sulfate	250	1,192	—	Malaysia 276; New Zealand 248; Thailand 196.
Metal including alloys:				
Scrap	10,073	16,396	72	Japan 8,178; Republic of Korea 3,102; India 2,518.
Unwrought	665	2,972	998	Hong Kong 897; Japan 328.
Semimanufactures	31,653	48,297	1,838	Hong Kong 12,934; Singapore 9,159; Republic of Korea 8,430.
Gold:				
Waste and sweepings kilograms	197	12,339	1,304	Hong Kong 10,146; Singapore 889.
Metal including alloys, unwrought and partly wrought do.	120	50	6	Thailand 32; Japan 10.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	166	472	2	Japan 437; Hong Kong 19.
Metal:				
Scrap	97,755	75,239	1,373	Thailand 35,786; Japan 33,008; Netherlands 1,622.
Pig iron, cast iron, related materials	2,877	3,030	1,042	Japan 688; Indonesia 319.

See footnotes at end of table.

TABLE 2—Continued

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Ferroalloys:					
Ferrochromium		3	1,186	393	Netherlands 793.
Ferromanganese		100	1	—	All to Indonesia.
Ferronickel	value, thousands	NA	$1	—	All to Republic of Korea.
Ferrosilicon		208	318	—	Japan 188; Pakistan 98; Republic of Korea 20.
Silicon metal		3	16	(2)	Thailand 9; Indonesia 3; Hong Kong 3.
Unspecified		1,448	3,494	1,155	Netherlands 700; Japan 564.
Steel, primary forms		123,269	398,420	35	Japan 121,125; Indonesia 106,283; Republic of Korea 92,506.
Semimanufactures:					
Bars, rods, angles, shapes, sections		272,058	256,625	52,476	Sudan 41,870; Hong Kong 37,796.
Universals, plates, sheets		439,269	793,879	78,327	Japan 334,510; Republic of Korea 83,529; Hong Kong 82,223.
Hoop and strip		3,804	9,939	NA	Japan 2,823; Thailand 2,070; Hong Kong 1,925.
Rails and accessories		1,245	745	478	Thailand 96; Singapore 73.
Wire		39,627	24,241	3,885	Indonesia 7,728; Hong Kong 5,323.
Tubes, pipes, fittings		187,299	224,379	103,347	Saudi Arabia 39,558; Japan 16,953.
Castings and forgings, rough		9,895	126,974	77,433	Japan 13,659; Canada 4,617.
Lead:					
Ore and concentrate	value, thousands	(2)	$1	—	All to Hong Kong.
Oxides		63	404	—	Japan 273; Bangladesh 80; Thailand 50.
Metal including alloys:					
Scrap		1	11	—	All to Philippines.
Unwrought		16,031	30,879	1	Japan 11,702; Republic of Korea 9,603; Malaysia 2,793.
Semimanufactures		345	143	95	Canada 16; Australia 10.
Magnesium: Metal including alloys:					
Scrap		522	600	56	Japan 529; Netherlands 15.
Unwrought		19	10	1	Indonesia 4; Pakistan 4.
Semimanufactures		52	10	5	Thailand 4.
Manganese:					
Ore and concentrate, metallurgical-grade		275	6	—	All to Indonesia.
Oxides		82	59	—	United Kingdom 40; Philippines 18.
Mercury		—	44	—	All to Belgium-Luxembourg.
Molybdenum: Metal including alloys:					
Scrap	kilograms	188	12,996	—	All to Japan.
Semimanufactures	do.	19,930	2,589	1,894	United Arab Emirates 462; Republic of Korea 100.
Nickel:					
Matte and speiss		53	38	—	Japan 20; United Kingdom 18.
Oxides and hydroxides	kilograms	NA	160	—	All to Malaysia.

See footnotes at end of table.

TABLE 2—Continued

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued					
Nickel—Continued					
Metal including alloys:					
Scrap		2,180	3,891	18	Japan 2,567; Netherlands 659; United Kingdom 335.
Unwrought		1,140	2,431	—	Japan 1,679; Hong Kong 515; Australia 217.
Semimanufactures		19	84	24	United Kingdom 36; Japan 11.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	kilograms	839	4,539	555	Japan 1,829; Pakistan 1,601.
Selenium, elemental	do.	20	70	—	All to Indonesia.
Silicon, high-purity	do.	2,069	1,332	114	Sri Lanka 1,050; Hong Kong 136.
Silver:					
Waste and sweepings[3]	do.	117,044	30,473	23,048	Japan 5,000; Hong Kong 1,151.
Metal including alloys, unwrought and partly wrought	do.	544	17,513	11,033	Canada 4,159; Hong Kong 2,090.
Tin:					
Ore and concentrate	value, thousands	NA	([2])	—	All to Malaysia.
Oxides		NA	3	—	All to West Germany.
Metal including alloys:					
Scrap		16	—		
Unwrought		40	203	([2])	Japan 124; Philippines 42.
Semimanufactures		739	1,070	28	Hong Kong 429; Japan 163; Philippines 109.
Titanium:					
Oxides		11	477	235	Hong Kong 157; Canada 51.
Metal including alloys, semimanufactures	kilograms	43	3,106	—	Japan 3,000; Singapore 60; West Germany 46.
Tungsten:					
Ore and concentrate		NA	4	—	All to Japan.
Metal including alloys:					
Scrap		6	32	6	Japan 21; West Germany 3.
Unwrought		3	NA		
Semimanufactures	kilograms	28,504	946	36	Canada 379; Hong Kong 249; Singapore 155.
Uranium and thorium:					
Oxides and other compounds		—	147	—	All to Singapore.
Metals including alloys, all forms		315	449	124	Japan 88; United Kingdom 38.
Zinc:					
Oxides		4,596	6,944	1,119	Japan 2,912; Thailand 746.
Blue powder	kilograms	67,535	434	106	Hong Kong 328.
Metal including alloys:					
Scrap		40	204	—	Japan 199.
Unwrought		200	4,367	113	Hong Kong 2,783; Japan 770.
Semimanufactures		1,045	743	368	Hong Kong 70; Japan 68.
Zirconium: Oxides	kilograms	2	—		
Other:					
Ores and concentrates		467	529	—	Japan 260; Singapore 120; Thailand 90.

See footnotes at end of table.

TABLE 2—Continued

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988	
				United States	Other (principal)
METALS—Continued					
Other—Continued					
Oxides and hydroxides		NA	2,782	123	Republic of Korea 1,348; Japan 488; Hong Kong 419.
Ashes and residues		2,711	5,786	212	Japan 4,947; Sweden 183.
Base metals including alloys, all forms		806	411	75	Japan 220; Netherlands 40.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		76	245	2	Hong Kong 84; Philippines 40; Malaysia 25.
Artificial:					
Corundum		275	353	—	Japan 343.
Silicon carbide including boron carbide		54	45	—	Japan 35; Philippines 4; Hong Kong 3.
Dust and powder of precious and semiprecious stones including diamond		71	9	5	Hong Kong 1; Ireland 1.
Grinding and polishing wheels and stones		4,378	6,026	1,866	Japan 520; Singapore 479.
Asbestos, crude		27	(2)	—	NA.
Boron materials:					
Crude natural borates		2	1	—	Indonesia 1.
Oxides and acids	kilograms	200	10,600	—	Sri Lanka 10,550.
Cement	thousand tons	3,025	3,581	108	Japan 1,839; Hong Kong 1,303.
Chalk		1,350	1,508	—	Indonesia 1,490.
Clays, crude:					
Bentonite		20	11	—	Hong Kong 6; Malaysia 5.
Fire clay		3	48	—	Philippines 35; Republic of South Africa 13.
Kaolin		331	123	—	Thailand 42; Japan 40; Philippines 31.
Unspecified		954	1,143	18	Philippines 732; Thailand 107; Malaysia 101.
Cryolite and chiolite	value, thousands	NA	$1	$1	
Diamond:					
Natural:					
Gem, not set or strung	thousand carats	29,660	10,625	8,085	Saudi Arabia 2,325.
Industrial stones	do.	32,060	12,710	1,745	Japan 4,305; Portugal 3,070.
Synthetic:[4]					
Gem, not set or strung	do.	42,965	72,135	15	Thailand 53,480; Republic of Korea 11,205; Japan 3,900.
Industrial stones	do.	656,260	592,095	—	Thailand 415,530; Republic of Korea 92,970; Switzerland 24,500.
Diatomite and other infusorial earth		731	22	—	Indonesia 9; Singapore 7; Malaysia 6.
Feldspar, fluorspar, related materials		203	159	NA	Philippines 100; Indonesia 26; Singapore 18.
Fertilizer materials:					
Crude, n.e.s.		887	337	—	Belgium-Luxembourg 240; Japan 46; Australia 30.
Manufactured:					
Ammonia		93	19	—	Mainly to Hong Kong.
Nitrogenous		10,601	20,880	—	Hong Kong 14,760; Fiji 5,250; Japan 600.
Phosphatic		4,108	6,115	—	Fiji 5,100; Malaysia 1,000.
Potassic		34,511	52,024	—	Japan 18,834; Philippines 16,400; Hong Kong 10,000.
Unspecified and mixed		9,746	2,105	NA	Indonesia 846; Hong Kong 668; Japan 456.

See footnotes at end of table.

TABLE 2—Continued

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued				
Graphite, natural	178	70	—	Republic of Korea 43; Indonesia 27.
Gypsum and plaster	741	1,747	8	Hong Kong 1,000; Indonesia 454; Philippines 170.
Iodine kilograms	3,350	3,601	—	Philippines 2,300; Indonesia 1,000; Republic of Korea 300.
Lime	27	99	—	Thailand 56; Bahrain 16; Malaysia 16.
Magnesium compounds: Oxides and hydroxides	100	60	—	All to Indonesia.
Meerschaum, amber, jet	107	75	35	Japan 16; Philippines 10.
Mica:				
Crude including splittings and waste	394	183	—	New Zealand 126; Japan 51; Hong Kong 6.
Worked including agglomerated splittings	152	30	([2])	United Kingdom 17; Japan 6; Thailand 5.
Pigments, mineral:				
Natural, crude	1	NA		
Iron oxides and hydroxides, processed	134	405	2	Malaysia 150; Hong Kong 128; Indonesia 89.
Precious and semiprecious stones other than diamond:				
Natural kilograms	405,230	401,103	17,674	Hong Kong 248,733; Brazil 19,000.
Synthetic do.	53,876	68,822	38,250	West Germany 6,502; Italy 4,755.
Salt and brine	3,418	4,800	—	Mainly to Hong Kong.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	3	5,256	([2])	Republic of South Africa 5,241.
Sulfate, manufactured	20,670	20,070	—	Philippines 5,080; Malaysia 3,660; Republic of Korea 3,220.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	7,273	5,322	332	Japan 3,943; Hong Kong 517.
Worked	24,561	23,603	6,425	Japan 7,581; Saudi Arabia 5,479.
Dolomite, chiefly refractory-grade	219,630	241,609	—	Japan 199,550; Saudi Arabia 41,300; Indonesia 550.
Gravel and crushed rock	252,098	430,254	29	Japan 414,783; Malaysia 12,088.
Limestone other than dimension	3,764	932	—	Thailand 768; Hong Kong 140; Republic of Korea 10.
Quartz and quartzite	13	NA		
Sand other than metal-bearing	414,320	539,615	160	Japan 537,943; Hong Kong 607; Philippines 546.
Sulfur:				
Elemental:				
Crude including native and byproduct	599	227	—	Thailand 108; Philippines 88; Hong Kong 18.
Colloidal, precipitated, sublimed	274	76	—	Philippines 38; Indonesia 25; Malaysia 5.
Sulfuric acid	216	555	1	Republic of South Africa 200; Philippines 160; Republic of Korea 82.
Talc, steatite, soapstone, pyrophyllite	357	246	—	Indonesia 121; Philippines 65; Singapore 45.
Vermiculite	—	1	—	All to Hong Kong.
Other:				
Crude	7,988	8,911	146	Indonesia 2,203; Philippines 1,516; Thailand 1,468.
Slag and dross, not metal-bearing	141,974	201,369	—	Japan 81,654; Singapore 46,759; Philippines 43,634.

See footnotes at end of table.

TABLE 2—Continued

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		2	(2)	—	All to Ghana.
Carbon:					
Carbon black		13,735	9,882	—	Indonesia 5,440; Malaysia 1,430; Japan 1,168.
Gas carbon		6,363	174	—	Nigeria 159; Malaysia 17.
Coal, all grades including briquets		1	—		
Coke and semicoke		9,181	57,531	—	Brazil 47,052; Philippines 7,223; Japan 1,714.
Peat including briquets and litter		220	220	—	All to Japan.
Petroleum refinery products:					
Liquefied petroleum gas	42-gallon barrels	(2)	12	—	All to Philippines.
Gasoline, motor	do.	23,630	24,072	—	Liberia 3,825; Panama 3,315; unspecified 16,915.
Mineral jelly and wax	do.	787	56,774	582	Republic of Korea 46,952; Japan 8,208; Hong Kong 677.
Kerosene and jet fuel	thousand 42-gallon barrels	6,750	13,342	—	Japan 7,565; Singapore 1,901; Hong Kong 249.
Distillate fuel oil	do.	5,643	8,949	7	Japan 1,939; Panama 743; unspecified 6,125.
Lubricants	do.	839	980	113	Singapore 193; Republic of Korea 154; Hong Kong 115.
Nonlubricating oils	do.	109	117	—	Republic of Korea 77; Japan 36; Thailand 2.
Residual fuel oil	do.	(2)	1,250	—	Japan 788; U.S. Trust Territories in Pacific 271; Hong Kong 191.
Bituminous mixtures	do.	(2)	(2)	—	All to Hong Kong.
Petroleum coke	do.	727	602	—	Japan 383; Indonesia 144; Hong Kong 65.

NA Not available.
[1] Table prepared by Gio Jacarepaqua and Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] May include other precious metals.
[4] Data presented are as reported by the Inspectorate General of Customs of Taiwan; the quantity listed is believed to be for material other than diamond, because of a low unit value.

imported for scrapping. The principal suppliers were the United States, 40 vessels; Japan, 30; Spain, 15; and the Federal Republic of Germany, 10.

Industrial Minerals

The production of industrial minerals in Taiwan is by Government-owned and privately owned operations for a limited array of minerals. Salt was produced from evaporation ponds, principally around Tainan, by the Taiwan Salt Works. This Government-owned enterprise also operates facilities in Chiayi and Kaohsiung. Sulfur was recovered as a byproduct by China Petrochemical Development Corp. at its refineries in Ilan, Kaohsiung, and Taoyuan. All of the output of fine construction aggregate was by Government operations at Tainan and Taoyuan. A nearly equal quantity of dolomite was quarried by Government and private operations in Hualian and Taipei Counties. Most of the limestone and marble output was by private companies. Marble was quarried in Hualian and Ilan Counties, and limestone was quarried in Chiayi, Hualin, Hsinchu, Kaohsiung, Tainan, and Taitung. All of the output of china and fire clay, semiprecious gem stones, feldspar, mica, pyrite, quartz crystal, serpentine, and talc was by privately owned operations; the quantities produced of each are insignificant in terms of world standards. China clay was from mine operations in Hualien, Ilan, Keelung, Miaoli, Nantou, Taipei, and Taitung; fire clay in Hsinchu, Ilan, Keelung, Miaoli, Nantou, and Taipei; gem stones in Hualien and Taitung; feldspar in Hualien and Ilan; mica in Hualien, Ilan, and Taitung; pyrite in Taipei; quartz crystal in Hualien, Ilan, Miaoli, and Nantou; serpentine in Hualien and Taitung; and talc in Hualien and Ilan.

Mineral Fuels

Taiwan has a very weak resource base for fossil fuels. Mine output of coal has declined annually since 1980 and was only 0.8 million tons in 1989. All coal production was by privately owned operations in Hsinchu, Keelung, Miaoli,

TABLE 3

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988	
				United States	Other (principal)
METALS					
Alkali and alkaline-earth metals		47	67	3	Japan 41; France 22.
Aluminum:					
Ore and concentrate		36,235	39,635	40	Malaysia 38,455; Guyana 600.
Oxides and hydroxides		12,103	20,782	440	Japan 13,325; Australia 4,536; Hong Kong 1,191.
Metal including alloys:					
Scrap		23,211	64,115	46,084	Australia 2,306; Netherlands 1,998.
Unwrought		195,095	193,405	14,487	Australia 73,679; Republic of South Africa 20,876; Canada 17,562.
Semimanufactures		48,631	62,217	9,404	Japan 22,003; Australia 9,281.
Antimony:					
Oxides		1,079	1,197	352	France 285; Japan 254.
Metal including alloys, all forms		618	580	([2])	Thailand 559; Netherlands 20.
Arsenic: Oxides and acids		665	531	—	France 459; Republic of Korea 53; Belgium-Luxembourg 18.
Beryllium: Metal including alloys, all forms	kilograms	1,196	463	NA	Japan 463.
Cadmium:					
Oxides and hydroxides		340	282	—	Belgium-Luxembourg 155; Republic of Korea 102; Austria 19.
Metal including alloys, all forms	kilograms	NA	3,600	3	Japan 2,597; Australia 500; Republic of Korea 500.
Chromium:					
Ore and concentrate		20,899	12,238	—	India 4,962; Madagascar 3,905; Republic of South Africa 2,573.
Oxides and hydroxides		3,256	3,805	474	Japan 1,460; West Germany 985; Italy 604.
Cobalt:					
Oxides and hydroxides		98	109	12	Belgium-Luxembourg 71; United Kingdom 14.
Metal including alloys, all forms		NA	159	3	Zaire 66; Zambia 34; Belgium-Luxembourg 13.
Columbium and tantalum: Tantalum metal including alloys, all forms		1	17	15	Japan 2.
Copper:					
Ore and concentrate		153,155	118,023	—	Canada 62,292; Philippines 22,817; Chile 9,998.
Matte and speiss including cement copper		7	14	—	Hong Kong 8; Japan 6.
Oxides and hydroxides		—	112	22	Japan 45; Belgium-Luxembourg 26.
Sulfate		666	853	68	Japan 590; United Kingdom 61.
Metal including alloys:					
Scrap		49,693	30,479	17,219	Hong Kong 4,036; Japan 2,473.
Unwrought		166,902	176,689	8,491	Chile 71,507; Philippines 38,604; Japan 16,188.
Semimanufactures		81,080	73,736	4,379	Japan 43,912; Republic of Korea 6,048; Hong Kong 5,359.
Gold:					
Bullion	kilograms	r94,079	350,984	190,119	Hong Kong 72,276; Switzerland 37,975.
Metal including alloys, unwrought and partly wrought	do.	r34,734	11,702	1,488	Japan 5,441; Singapore 3,065.

See footnotes at end of table.

TABLE 3—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	6,141	8,477	—	Australia 5,223; Brazil 2,851; Republic of South Africa 335.
Pyrite, roasted	3	—		
Metal:				
Scrap	943,592	1,255,740	667,501	Hong Kong 213,370; Japan 177,469.
Pig iron, cast iron, related materials	643,976	760,911	3,317	Brazil 507,386; Republic of South Africa 70,726; Japan 51,154.
Ferroalloys:				
Ferrochromium	15,904	51,194	48	Republic of South Africa 50,746; Greece 140.
Ferromanganese	18,865	23,895	—	Republic of South Africa 20,654; Japan 2,599; Norway 328.
Ferronickel	520	NA	—	
Ferrosilicon	19,406	33,591	433	Republic of South Africa 15,034; Norway 6,539; Philippines 2,738.
Silicon metal	3,256	5,381	12	Republic of South Africa 2,015; Australia 909; Canada 563.
Unspecified	887	1,454	88	United Kingdom 422; Republic of South Africa 277; Brazil 126.
Steel, primary forms	1,363,772	2,185,046	9,244	Turkey 712,478; Brazil 389,799; Republic of South Africa 270,091.
Semimanufactures:				
Bars, rods, angles, shapes, sections	733,722	1,290,461	3,033	Japan 492,659; Brazil 226,794; Republic of South Africa 84,210.
Universals, plates, sheets	1,690,949	1,920,024	46,965	Japan 1,478,554; Brazil 102,939; Republic of South Africa 75,683.
Hoop and strip	44,329	48,397	1,857	Japan 43,209; West Germany 867.
Rails and accessories	28,530	24,371	96	Japan 11,322; Republic of South Africa 6,687; Republic of Korea 5,244.
Wire	33,305	30,783	2,263	Japan 15,317; Republic of Korea 7,488.
Tubes, pipes, fittings	148,153	170,294	941	Japan 94,254; West Germany 33,438; Republic of South Africa 21,035.
Castings and forgings, rough	2,289	7,259	553	Japan 4,739; West Germany 322.
Lead:				
Ore and concentrate	171	167	—	All from Indonesia.
Oxides	3,095	2,451	6	Australia 1,620; West Germany 484; France 300.
Metal including alloys:				
Scrap	79,652	80,956	28,102	Japan 20,342; Australia 10,389.
Unwrought	20,947	18,925	720	Australia 11,400; Canada 1,302; Peru 1,298.
Semimanufactures	29	128	5	Australia 62; West Germany 38; Hong Kong 12.
Magnesium: Metal including alloys:				
Scrap	—	24	18	Norway 5.
Unwrought	1,011	1,355	718	Norway 491; France 72.
Semimanufactures	77	55	52	West Germany 2.

See footnotes at end of table.

TABLE 3—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Manganese:				
Ore and concentrate, metallurgical-grade	131,704	170,943	—	Republic of South Africa 74,051; Australia 60,464; Gabon 29,896.
Oxides	3,516	2,542	2	Japan 1,032; India 797; Singapore 352.
Metal including alloys, all forms	54	461	70	Brazil 220; Hong Kong 100.
Mercury:				
Cinnabar and vermillion	39	23	—	All from Hong Kong.
Metal	9	18	4	Japan 14.
Molydbenum: Metal including alloys:				
Scrap	2	4	2	Hong Kong 2.
Unwrought kilograms	1,175	37	24	United Kingdom 13.
Semimanufactures	102	123	83	West Germany 30; Austria 4.
Nickel:				
Matte and speiss	11,256	17,539	—	Canada 17,106; Japan 433.
Oxides and hydroxides	NA	300	3	Canada 264; Finland 17; Netherlands 13.
Metal including alloys:				
Scrap	383	155	4	Canada 151.
Unwrought	6,364	3,900	7	Canada 2,451; Norway 1,153.
Semimanufactures	687	812	152	Japan 193; Canada 104.
Platinum-group metals: Metals including alloys, unwrought and partly wrought kilograms[3]	r120,801	1,678	313	Japan 704; United Kingdom 220.
Rare-earth metals including alloys, all forms	r34	31	(2)	Japan 31.
Selenium, elemental	47	20	—	Japan 17; Australia 2.
Silicon, high-purity	23	85	8	Japan 51; West Germany 23.
Silver:				
Ore and concentrate[4] value, thousands	$75	$21	—	All from United Kingdom.
Waste and sweepings[4] kilograms	510	2,030	1,630	Hong Kong 400.
Metal including alloys, unwrought and partly wrought	100	140	21	Japan 32; Australia 31; Republic of Korea 23.
Tin:				
Oxides	24	78	2	West Germany 36; Japan 28; United Kingdom 12.
Metal including alloys:				
Scrap	14	153	—	Japan 64; Malaysia 35; Singapore 32.
Unwrought	4,410	5,342	24	Malaysia 2,642; Indonesia 1,598; Thailand 232.
Semimanufactures	684	504	30	Hong Kong 320; Singapore 91; Malaysia 39.
Titanium:				
Oxides	14,481	16,440	2,672	Japan 6,872; West Germany 4,725.
Metal including alloys, semimanufactures	26	35	(2)	United Kingdom 29; Japan 5.
Tungsten:				
Ore and concentrate	NA	4,005	—	All from India.
Metal including alloys:				
Scrap	28	7	2	Japan 5.
Unwrought kilograms	122	211	201	Japan 10.
Semimanufactures	89	89	32	Japan 43; Sweden 6.

See footnotes at end of table.

TABLE 3—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Uranium and thorium:				
Oxides and other compounds	70	359	82	Japan 218; Norway 41.
Metals including alloys, all forms kilograms	82	—		
Vanadium: Oxides and hydroxides	—	7	4	Japan 3.
Zinc:				
Ore and concentrate value, thousands	$3	—		
Oxides	488	1,170	42	Japan 407; West Germany 340; Republic of Korea 185.
Blue powder	262	661	163	West Germany 180; Japan 132.
Metal including alloys:				
Scrap	110,814	151,681	96,184	West Germany 9,722; Canada 8,017.
Unwrought	84,118	81,683	199	Australia 33,691; Canada 18,721; Japan 13,408.
Semimanufactures	776	909	16	Japan 595; France 119; Belgium-Luxembourg 66.
Zirconium: Oxides	464	432	125	Japan 162; Republic of South Africa 72.
Other:				
Ores and concentrates	r37,693	46,594	2,276	Australia 25,290; Malaysia 14,967.
Oxides and hydroxides	NA	1,371	460	Japan 705; Norway 141.
Ashes and residues	50,251	61,879	29,959	Japan 21,586; Australia 2,781.
Base metals including alloys, all forms	701	304	78	Japan 99; United Kingdom 60.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	21,389	15,891	637	Indonesia 10,817; Japan 1,521; France 856.
Artificial:				
Corundum	20,130	21,832	58	Hong Kong 13,286; Japan 5,553; Austria 2,002.
Silicon carbide including boron carbide	7,037	7,919	8	Hong Kong 1,917; Japan 1,708; Netherlands 1,548.
Dust and powder of precious and semiprecious stones including diamond kilograms	1,417	2,428	724	Ireland 1,067; Japan 554.
Grinding and polishing wheels and stones	1,636	2,644	490	Italy 912; Japan 799.
Asbestos, crude	36,469	32,680	70	Canada 15,470; Republic of South Africa 13,407; Greece 2,820.
Barite and witherite	1,586	1,619	—	Thailand 1,615; West Germany 4.
Boron materials:				
Crude natural borates	2,485	2,585	484	Japan 1,639; Switzerland 240.
Oxides and acids	2,342	3,116	2,620	Italy 404; Turkey 40.
Bromine kilograms	796	80	—	West Germany 41; Japan 39.
Cement	41,796	183,335	137	Indonesia 129,078; Malaysia 33,750.
Clays, crude:				
Bentonite	20,051	23,712	19,124	Australia 1,421; Republic of Korea 1,400.
Fire clay	2,693	2,421	16	Republic of South Africa 1,746; Japan 363; Hong Kong 200.
Kaolin	156,723	149,557	66,070	Indonesia 37,410; Malaysia 15,797.
Unspecified	205,173	305,198	15,682	Hong Kong 199,184; Japan 42,592; India 19,685.
Cryolite and chiolite	68	38	—	Japan 22; Philippines 12; Denmark 4.

See footnotes at end of table.

TABLE 3—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued				
Diamond:				
Natural:				
Gem, not set or strung thousand carats	[5]25	[3]844,505	15	Canada 678,575; Brazil 164,125; France 1,565.
Industrial stones do.	5,085	265	30	Japan 155; Israel 70.
Synthetic:				
Gem, not set or strung do.	240	765	405	France 280; Switzerland 55.
Industrial stones do.	[6]560	1,250	485	Japan 565; Ireland 180.
Diatomite and other infusorial earth	4,623	7,150	4,146	Hong Kong 1,829; Japan 508.
Feldspar, fluorspar, related materials	224,733	338,580	849	Thailand 186,784; Hong Kong 60,584; Philippines 31,840.
Fertilizer materials:				
Crude, n.e.s.	181	740	109	Philippines 372; West Germany 85.
Manufactured:				
Ammonia	153,626	169,845	15,017	Saudi Arabia 82,324; Indonesia 42,497.
Nitrogenous	110,540	49,458	1,985	Saudi Arabia 28,517; Indonesia 13,134; Japan 3,928.
Phosphatic	202	150	50	Republic of South Africa 100.
Potassic	178,217	228,401	499	Canada 137,995; Israel 49,509; Jordan 40,318.
Unspecified and mixed	18,732	15,768	392	Republic of South Africa 7,577; Japan 4,789; West Germany 985.
Graphite, natural	8,390	14,890	3	Republic of Korea 12,002; India 886; Zimbabwe 796.
Gypsum and plaster	185,846	429,625	1,444	Thailand 420,978; Japan 6,341.
Iodine	33	28	NA	Japan 26; Chile 2.
Lime	17	21	—	Japan 20; Finland 1.
Magnesium compounds: Oxides and hydroxides	38,113	66,069	598	India 27,753; Malaysia 14,986; Japan 9,535.
Meerschaum, amber, jet	43	5	([2])	Hong Kong 4.
Mica:				
Crude including splittings and waste	823	888	33	Malaysia 380; Thailand 200; India 115.
Worked including agglomerated splittings	268	364	23	Japan 190; Belgium-Luxembourg 97; India 40.
Phosphates, crude	361,188	368,630	—	Jordan 284,155; Morocco 78,460; Indonesia 4,503.
Phosphorous, elemental	2,677	3,415	([2])	Republic of South Africa 1,605; West Germany 800; Netherlands 419.
Pigments, mineral:				
Natural, crude	[r]69	606	NA	Hong Kong 495; France 75.
Iron oxides and hydroxides, processed	35,667	34,334	452	Japan 27,259; West Germany 1,541; United Kingdom 947.
Potassium salts, crude	22	543	499	West Germany 44.
Precious and semiprecious stones other than diamond:				
Natural	6,527	6,106	67	Brazil 2,239; Republic of South Africa 1,489; Indonesia 1,047.
Synthetic	13	19	3	Belgium-Luxembourg 5; Japan 3.
Pyrite, unroasted	17	8	—	All from Japan.
Salt and brine	596,704	781,925	—	Australia 781,627; West Germany 184.

See footnotes at end of table.

TABLE 3—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988 United States	Sources, 1988 Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.:					
Soda ash, manufactured		49,846	108,286	89,157	Japan 4,202; Spain 3,750.
Sulfate, manufactured		1,404	4,473	920	Indonesia 1,160; Japan 1,118.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		115,940	196,098	312	Spain 27,058; India 26,823; Thailand 25,088.
Worked		1,320	6,126	23	Italy 2,708; Spain 640; Greece 552.
Dolomite, chiefly refractory-grade		1,923	2,251	—	United Kingdom 2,016; Japan 185; Norway 44.
Gravel and crushed rock		11,545	16,750	630	France 6,530; Republic of Korea 1,914; Hong Kong 1,778.
Limestone other than dimension		503,794	735,265	—	Japan 715,900; Philippines 19,361.
Quartz and quartzite		1,349	4,837	27	Japan 2,118; India 640; Hong Kong 475.
Sand other than metal-bearing		29,391	38,234	667	Malaysia 15,500; Japan 12,693; Australia 7,166.
Sulfur:					
Elemental:					
Crude including native and byproduct		17,893	59,160	3,969	Saudi Arabia 28,471; Canada 26,635.
Colloidal, precipitated, sublimed		153,152	199,815	12,382	Canada 155,611; Japan 31,156.
Dioxide		13	36	([2])	West Germany 24; Japan 11.
Sulfuric acid		159,940	203,249	237	Japan 200,125; Republic of Korea 2,851.
Talc, steatite, soapstone, pyrophyllite		22,726	37,337	4,223	India 5,144; Republic of Korea 4,786; Thailand 4,782.
Vermiculite		561	766	NA	India 334; Republic of South Africa 270; Hong Kong 162.
Other:					
Crude		[r]132,562	142,122	1,082	Republic of Korea 98,299; Japan 30,803.
Slag and dross, not metal-bearing		4,089	28,065	13	Japan 27,713; United Kingdom 112.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		170	129	120	Japan 5; West Germany 4.
Carbon:					
Carbon black		16,769	14,046	4,801	Australia 2,921; Japan 2,155.
Gas carbon		165	478	209	Japan 101; Republic of South Africa 100.
Coal, all grades including briquets	thousand tons	13,382	17,888	4,842	Australia 7,072; Republic of South Africa 4,293.
Coke and semicoke		214,172	207,130	31,846	Japan 154,953; Philippines 19,683.
Peat including briquets and litter		458	1,907	—	Sri Lanka 965; Malaysia 278; Finland 262.
Petroleum:					
Crude	thousand 42-gallon barrels	141,326	146,984	948	Saudi Arabia 58,953; Kuwait 28,672; United Arab Emirates 13,862.
Refinery products:					
Liquefied petroleum gas	do.	6,534	9,829	NA	Saudi Arabia 5,286; Kuwait 1,379; United Arab Emirates 1,184.
Gasoline, motor	do.	2,672	5,478	242	Singapore 2,969; Saudi Arabia 933; Greece 453.
Mineral jelly and wax	do.	254	296	54	Japan 126; Indonesia 51.

See footnotes at end of table.

TABLE 3—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988 United States	Sources, 1988 Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products—Continued					
Kerosene and jet fuel	thousand 42-gallon barrels	(2)	NA	NA	NA.
Distillate fuel oil	do.	5,527	26,140	17,781	Singapore 3,290; Trinidad and Tobago 1,557.
Lubricants	do.	708	884	327	Japan 231; Singapore 104.
Nonlubricating oils	do.	2,987	722	58	Republic of Korea 297; United Arab Emirates 222.
Residual fuel oil	do.	(2)	NA	NA	NA.
Bituminous mixtures	do.	2	1	(2)	Japan (2).
Petroleum coke	do.	149	178	161	Japan 13; West Germany 4.

[r] Revised. NA Not available.
[1] Table prepared by Gio Jacarepaqua and Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Data presented are as reported by the Inspectorate General of Customs of Taiwan; the material is believed to be material other than that listed because of a low unit value.
[4] May include other precious metals.
[5] Excludes unreported quantity valued at $723,000.
[6] Excludes unreported quantity valued at $31,000.

and Taipei. Approximately 44 billion cubic feet of natural gas and approximately 900,000 42-gallon barrels of associated condensate were produced from wells in Hsinchu and Miaoli by the Chinese Petroleum Corp. Less than 25% of Taiwan's total supply of energy is provided from domestic sources.

During 1979–88, the average annual growth in energy consumption was 62%. In 1989, the highest growth rates in consumption by sector were metal products, 30.1%; transportation, 12.9%, industrial minerals products, 11.2%; and chemicals, 10.9%. During 1979–89, the consumption of energy by the mining sector had an average annual decline of 1.1%. In 1989, the rate of decline was 3.9%.

The energy consumption by the "Other" category in 1989, in thousand 42-gallon barrels, was composed of miscellaneous manufacturing, 16,700; textiles, 16,600; forest products, 9,300; agriculture, 8,900; food, 6,600; and miscellaneous sectors, 89,900.

Reserves

Taiwan has a very weak minerals resource base, and mine output is limited to carbonate minerals and fossil fuels, the value of which is significant

TABLE 4

TAIWAN: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies	Location of main facilities	Capacity (thousand metric tons per year unless otherwise specified)
Cement	Asia Cement Corp.	Taipei	2,800
Do.	China Hsin Cement Corp.	Kaohsiung, Taichung, and Taoyuan	1,200
Do.	Taiwan Cement Corp.	Chutung, Kaohsiung, and Suao	5,270
Coal, bituminous	Numerous independent operators	Taipei Prefecture (74 pits)	1,200
Copper, refined	Taiwan Power Co.	Keelung	58
Marble	Taiwan Marble Co., Ltd.	Panchiao	10
Nickel	Taiwan Nickel Refinery Corp.	Kaohsiung	8
Petroleum:			
Crude	Chinese Petroleum Corp.	Chuhuangkeng and Tungtzuchiao	[1]850
Refinery products	Chinese Petrochemical Development Corp.	Taipei	[1]150,000
Steel	China Steel Corp.	Kaohsiung	6,400
Sulfur	China Petrochemical Development Corp.	Taipei	50

[1] Thousand barrels per year.

TABLE 5

TAIWAN: RESERVES OF MAJOR MINERALS

Coal	196,000
Dolomite	115,700
Limestone	395,000
Marble	299,932,000
Natural gas (thousand cubic meters)	25,920,000

only to the local economy. The geology of Taiwan has been extensively explored, and there is little prospect of funding any additional mineral resources of economic value. Taiwan's reserves of major minerals are shown in table 5, in thousand metric tons, except as indicated.

INFRASTRUCTURE

Taiwan's communications-transport system is well developed. There are five major ports—Chilung, Hualien, Kaohsiung, Saao, and Tailung. The highway network totals 18,800 km, of which 85% is hard surfaced. There are 1,075 km of common-carrier railway owned by the Government, consisting of the 708-km West Line and the 367-km East Line. A 98.25-km South Link Line to connect the West and East Lines is under construction. In addition, there are 3,800 km of industrial rail lines owned and operated by Government enterprises. Taiwan has 38 airfields, with 3 having runways more than 3,650 meters long.

OUTLOOK

Inasmuch as Taiwan lacks a strong and varied mineral resource base, the mining sector is insignificant compared with the manufacturing sector. Production of copper, as well as the recovery of byproduct gold and silver from copper refinery anode sludge, production of steel from imported raw materials, and production of nickel from imported oxide continues to be the only output of primary metals in Taiwan. To augment the output of the strong agrarian and light-industry sectors, the Government placed priority on the development of strategic export-oriented manufactures. Under the Ninth Medium Term Economic Development Plan (1986–89), development priorities are given to strengthen quality and productivity in the manufacture of automated machinery equipment, small and heavy-duty electrical machinery, transportation vehicles, and high-technology consumer electronic products. To this end, the Government encouraged foreign investments, intensified and promoted technology transfer, and implemented financial assistance to priority industries. Output by Taiwan's mining sector is expected to decline further because of depleting resources, stricter safety requirements, stringent antipollution regulations, and land use conflicts resulting from the establishment of national park areas.

OTHER SOURCES OF INFORMATION

Agencies

Mining Department, Ministry of Economic Affairs
15 Foochow Street
Taipei, Taiwan

Taiwan Provincial Bureau of Mines
Department of Reconstruction
2 Chenkiang Street
Taipei, Taiwan

Publications

Council for Economics Planning and Development, Taipei: Industry of Free China, monthly.

Ministry of Finance, Taipei: Monthly Statistics of Exports and Imports.

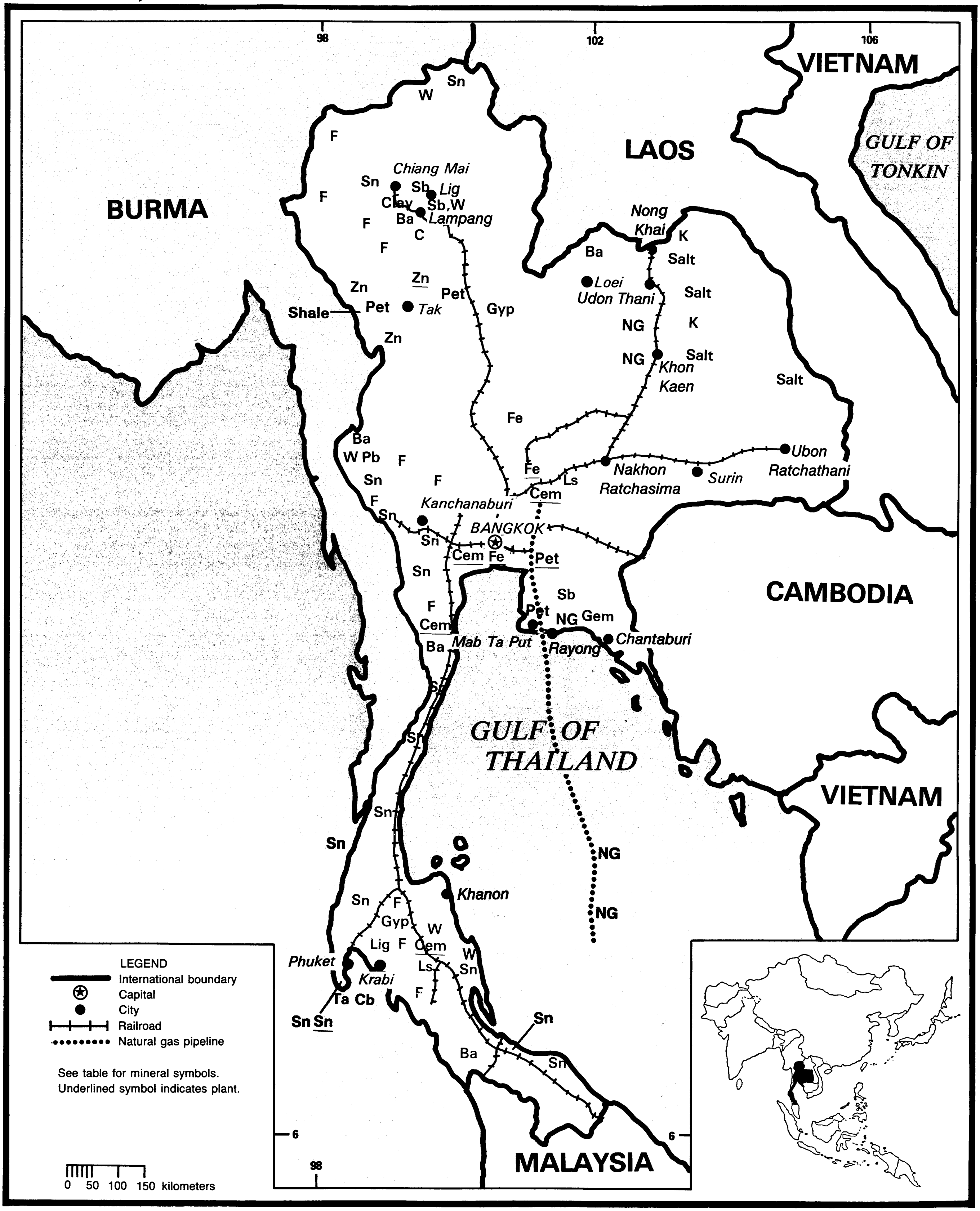
Taiwan Enterprise Press Ltd., Taipei: Businessman's Directory, annual.

Taiwan Provincial Bureau of Mines, Taipei: Reconstruction Statistics of Taiwan Province, Part III, The Mining and Quarrying, annual.

[1] Where necessary, values have been converted from New Taiwan dollars (NT$) to U.S. dollars at the rate of NT$28.56 = US$1.00 in 1988 and NT$26.50 = US$1.00 in 1989.

THAILAND

AREA 514,000 km² **POPULATION 55.5 million**



THE MINERAL INDUSTRY OF

THAILAND

By David B. Doan

The value of mineral production in Thailand rose 29% in 1989 to an estimated total of $676 million,[1] an impressive performance by any standard. However, the economic paradox of southeast Asia rolled on, with Thailand developing its resources, creating new industries, and continually improving its standard of living, while bordering countries continued to be in political and economic dysfunction.

Thailand's overall economic growth in 1989, at 10.8%, was the best in Asia and possibly the entire world. Per capita income rose from $1,032 in 1988 to $1,363 in 1989 or 32%. Growth was broadly based, as exports were up, domestic demand increased, and investment in new productive capacity was strong and diversified. Negative factors included a shortage of skilled workers, infrastructure bottlenecks, and the early stages of a cost-pushed inflation resulting from supply shortages. The consumer price index rose by 5.4% overall, but food prices were higher by more than 8%. Growth of the construction sector by 19% caused shortages of most major construction materials.[2]

GOVERNMENT POLICIES AND PROGRAMS

In recent years, the Thai Government has aimed for uniform development for overall growth of the economy, believing that uneven growth, or growth of one sector at the expense of others, would lead to economic dislocation. In particular, even small- and medium-sized enterprises are held to be necessary to the development and survival of the major industries and their export earnings, as true in mineral production as any other sector.

By the same token, the Government concluded in 1989 that the national infrastructure was inadequate to the role of supporting industry and commerce and in danger of becoming a serious detriment to economic development. Accordingly, new construction as well as rebuilding are underway for the road and railroad transport systems, particularly between Bangkok and distant points. Airports at Khon Kaen and Ubon Ratchathani would be upgraded to international status, and railroads as well as bridges would be constructed along and across the Mekong River.

An ambitious project, the Southern Seaboard Development Program (SSDP), has been put forward by the Government in a bold move to create an international trade route across the Kra Peninsula more than 1,000 kilometers (km) north of Singapore and the Straits of Malacca. A deep seaport at Krabi would be one terminus of a 180-km "land bridge" of road, rail, and pipeline systems through which bulk solids and petroleum liquids, for example, could be unloaded and shipped overland to Khanom on the east coast or vice versa. The Thai Government believes that the SSDP would stimulate new industry and development of further infrastructure, shorten shipping routes between the Mideast and the Far East, and greatly strengthen Thailand's position in international trade and shipping.

Finally, a persistent problem concerning petroleum exploration and drilling in waters off Thailand and Malaysia was resolved. At a "summit" meeting between prime ministers of the two countries, they announced the creation of a joint authority to manage development in the disputed waters.

PRODUCTION

The overall value of mineral production in the country expanded from $526 million in 1988 to an estimated total of $676 million in 1989, a gain of 29%, representing an excellent portent for downstream usages and, in a larger sense, the industrialization of Thailand. Zinc was, for the first time, the country's most valuable mineral product, followed closely by lignite and then tin as a remote third in the midst of continuing market doldrums and price instability. Basic strength in the tin industry was seen in the fact that a slight rise in price over that of the previous year brought a disproportionate increase in production.

Significantly, zinc and lignite were increasingly taken up by local consumption, along with limestone, and plans for tinplating of Thai steel suggested less reliance on world tin markets in the future. Iron ore production was up 79% at 177,000 tons, which may become more important as a local steel industry is developed. Although metallic lead was important, up 20% with nearly 19,000 tons produced, value decreased somewhat from 1988 as prices fell on world markets. Manganese ore mined was up 39% over that of 1988, with the manganese content up 29% at 3,900 tons. Tantalite and columbite recovery during tin operations were down about 12% in 1989, but the recovery of struverite with its included tantalum and columbium dropped abruptly by 87%.

Among the industrial minerals, barite production was up sharply at 88% above that of the year before, but the 76,000 tons mined was nowhere near the yearly amounts produced before the slump in petroleum activity. Gypsum and limestone production were up strongly, reflecting export demand for the former and local construction use for the latter.[3]

The mineral-fuels sector provided little in the way of change. Minor amounts of anthracite, roughly 9,000 tons, was mined in Loei Province of northeast Thailand, but this may be only a small deposit of such highly desirable coal.

TABLE 1

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989[p]
METALS						
Antimony:						
Ore and concentrate:						
Gross weight		2,917	2,397	962	1,048	1,166
Sb content[e]		1,240	1,019	409	445	495
Metal, smelter		135	386	959	1,769	2,275
Chromium: Chromite, gross weight		30	361	5	776	416
Columbium and tantalum ores and concentrates, gross weight:[2]						
Columbite and tantalite:						
Gross weight	kilograms	432,000	121,000	183,000	124,000	109,000
Cb content	do.	73,400	20,600	31,110	21,080	18,530
Ta content	do.	116,640	32,670	49,410	33,480	29,430
Stuverite:						
Gross weight	do.	309,000	241,000	423,000	788,000	99,000
Cb content	do.	24,800	19,400	34,003	63,343	7,958
Ta content		24,000	18,800	32,912	61,310	7,703
Iron and steel:						
Iron ore:						
Gross weight		93,800	37,330	97,026	99,257	177,373
Fe content		51,590	20,532	53,364	54,591	97,555
Metal: Steel:						
Crude		447,035	463,393	534,172	552,000	689,421
Semimanufactures (selected):						
Bars		319,330	303,652	319,835	356,000	498,986
Galvanized iron sheets		131,520	144,444	165,445	189,996	200,616
Tinned plates		68,175	104,433	119,342	147,337	149,478
Lead:						
Mine output, Pb content of 42.5% Pb concentrate		19,654	26,301	23,503	29,474	25,075
Metal: Ingot, secondary		7,536	9,122	11,366	15,614	18,711
Manganese ore:						
Chemical-grade, over 75% MnO_2		27	—	50	—	—
Battery- and chemical-grade, 75% MnO_2		3,930	4,001	[r]5,012	3,530	3,115
Metallurgical-grade, 46% to 50% MnO_2		455	887	4,086	4,417	7,390
Total, gross weight		4,412	4,888	9,148	7,947	11,045
Total Mn content		2,118	2,346	4,391	3,815	5,301
Rare-earth metals:						
Monazite concentrate, gross weight		663	1,609	458	590	631
Xenotime		158	28	30	101	35
Tin:						
Mine output, Sn content		16,593	16,800	14,852	14,225	14,922
Metal, smelter, primary		17,996	19,672	15,438	14,675	14,571
Titanium:						
Ilmenite concentrate, gross weight		1,078	13,489	26,278	16,455	16,955
Leucoxine concentrate, gross weight		488	797	800	1,799	30
Rutile concentrate, gross weight		110	48	92	128	—
Tungsten concentrate:						
Mine output, gross weight		1,137	922	1,269	1,173	1,086
Mine output, W content		586	[r]475	705	651	603

See footnotes at end of table.

TABLE 1—Continued

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	1987	1988	1989[p]
METALS—Continued					
Zinc:					
Mine output, gross weight	276,909	373,833	341,145	420,102	412,620
Mine output, Zn content	77,535	97,197	88,698	78,000	62,831
Metal, smelter, primary	62,108	58,552	66,868	68,600	68,376
Zirconium ore and concentrate, gross weight	1,292	1,705	1,532	5,098	1,496
INDUSTRIAL MINERALS					
Barite	230,970	142,232	33,370	40,587	76,422
Cement, hydraulic thousand tons	7,916	7,940	9,850	11,514	15,024
Clays:					
Ball clay	7,988	11,203	57,719	86,890	134,921
Kaolin, beneficated	106,704	116,037	184,179	222,964	176,281
Kaolin, nonbeneficated	—	16,118	22,389	46,724	152,266
Diatomite	410	204	177	470	1,412
Feldspar	104,586	115,163	168,881	293,678	515,206
Fluorspar:					
Crude mine output:					
High-grade	263,059	156,409	102,398	76,321	98,375
Low-grade	91,500	40,715	[r]2,154	573	[e]—
Total	354,559	197,124	[r]104,912	76,894	98,375
Salable product:					
Acid-grade (beneficiated low-grade)	35,840	11,500	—	—	[e]—
Metallurgical-grade	263,059	156,409	102,398	76,321	98,375
Total	298,899	167,909	102,398	76,321	98,375
Gypsum	1,273,459	1,665,557	3,030,919	4,549,011	5,477,237
Phosphate rock, crude	4,072	4,940	4,502	8,348	6,584
Salt:					
Rock	12,786	2,000	3,268	5,670	15,384
Other[e]	165,000	165,000	165,000	165,000	165,000
Sand, silica	152,133	153,565	153,516	242,385	296,130
Stone:					
Calcite	1,040	230	2,170	171	2,400
Dolomite	16,160	13,771	50,767	140,455	257,576
Limestone for cement manufacture only thousand tons	9,845	9,605	11,391	14,101	15,966
Marble	21,479	14,718	22,786	42,553	54,459
Marl for cement manufacture only thousand tons	—	—	296	136	535
Quartz, not further described	27,305	18,068	27,459	28,449	33,850
Shale for cement manufacture only thousand tons	1,448	1,013	1,403	2,283	2,452
Talc and related materials:					
Pyrophyllite	42,002	36,165	37,749	37,285	39,799
Talc	1,476	2,886	4,101	4,843	7,242
MINERAL FUELS AND RELATED MATERIALS					
Anthracite	3,000	2,500	8,350	15,330	8,740
Coal: Lignite thousand tons	5,149	5,545	6,929	7,274	8,899
Natural gas (gross production) million cubic meters	3,748	3,620	5,063	5,997	5,990

See footnotes at end of table.

TABLE 1—Continued

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988	1989p
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum:						
Crude	thousand 42-gallon barrels	7,918	7,738	6,108	7,437	7,793
Natural gas condensate	do.	5,202	5,207	5,541	5,433	6,731
Refinery products:						
Liquefied petroleum gas	do.	1,555	1,566	e1,600	1,931	e2,300
Gasoline	do.	12,836	13,837	e13,900	15,781	e18,800
Jet fuel	do.	6,474	7,227	e7,200	8,183	e9,760
Kerosene	do.	1,036	931	e1,000	811	e990
Distillate fuel oil	do.	21,127	23,115	e23,200	22,021	e26,260
Residual fuel oil	do.	13,353	13,768	e13,800	15,907	e18,970
Unspecified	do.	2,467	1,264	e2,000	2,447	e2,920
Total	do.	58,848	61,708	e62,700	67,081	e80,000

e Estimated. p Preliminary. r Revised.

[1] Includes data available through Aug. 4, 1989.

[2] Excludes columbium- and tantalum-bearing tin slags, which make Thailand the world's largest source of newly mined tantalum.

TRADE

Thai mineral exports in 1989 had a total value of $212 million, up a little less than 5% compared with that of 1988. Tin, again, represented the largest share of Thai mineral export revenue, but again did not come very close to the Association of Tin Producing Countries (ATPC) quota for Thailand under the Supply Rationalization Scheme. Out of the year's total tin metal production of 14,571 tons, 11,130 tons was exported for revenues of $94 million, versus the ATPC quota of 19,000 tons for the year.

Gypsum, zinc, and lead, in decreasing order, were the country's other leading exports in 1989. At almost 4.4 million tons, four-fifths of Thai gypsum production was exported for revenues of $45 million. Next in value in 1989 was 12,244 tons of metallic zinc exported for $21 million, amounting to a 3% decrease in quantity but a 67% increase in value. The producer, Padaeng Industry Co. (PDI), was expected to continue its aggressive posture in production and export of zinc and associated minerals. Although 1989 lead exports had been forecast at midyear to be worth more than $7 million, the end result was considerably less. A moderate increase in exports of antimony metal resulted in a corresponding decrease in export sales of antimony ore. Exports of columbite, dolomite, feldspar, kaolin, and marble all showed modest increases during the year.[4]

Possibly the most significant import in the entire mineral sector was petroleum, the 1988 level of about 155,000 barrels per day (bbl/d) having risen in 1989 to approximately 330,000 bbl/d. Of this, 188,000 bbl/d was crude oil and the remaining 142,000 bbl/d was refinery products.

While mineral commodities as a proportion of total exports have been declining slightly over the past 8 or 9 years, from more than 3% to less than 2%, the proportion of manufactured goods has risen from 45% to 66%. This illustrates the general trend toward greater domestic consumption of mineral products and suggests long-term stability of demand as Thailand's economy expands and industrialization continues.

STRUCTURE OF THE MINERAL INDUSTRY

Private-sector ownership accounts for the great majority of operations in the mineral industries of Thailand. Some exceptions are involved in which some part of the Government owns a minority equity position or, in a very few cases, has full ownership and control. An example of the latter is the Electricity Generating Authority of Thailand (EGAT), which operates most of the country's power-generating facilities. In addition, the Government owns and operates the big lignite mine at Mae Moh in Lampang Province, where millions of tons of lignite is provided each year to the large and growing thermal power generating complex near the mine.

Elsewhere in the mineral-fuels sector, the Government controls the petroleum leases or concessions, owning partial interests in production as well as collecting royalties.

Although the tin mining industry is mainly privately owned, production is controlled and heavily burdened by taxes on operations and revenues. Formerly Thailand's principal industry, tin mining has been overtaken by price weaknesses and the growth of other mineral industries such as zinc, petroleum, and some of the industrial minerals.

Geographically, the mineral industries are distributed virtually throughout the country, with metal resources partly concentrated in Loei and Lampang Provinces as well as the Kra Isthmus. Petroleum has, so far, been discovered in the Gulf of Thailand, a northern offshoot of the central plain, and in the central part of the Khorat basin in northeast Thailand. Industrial

TABLE 2

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988	
				United States	Other (principal)
METALS					
Alkali and alkaline-earth metals		—	47	—	Mainly to Laos.
Aluminum:					
Oxides and hydroxides		56	40	—	Bangladesh 20; Hong Kong 7; Pakistan 5.
Metal including alloys:					
Unwrought		8	17	—	Malaysia 14; Bangladesh 2.
Semimanufactures		1,443	2,193	1	Singapore 1,006; Hong Kong 477.
Antimony: Ore and concentrate		NA	3,617	939	Belgium-Luxembourg 1,404; India 332.
Arsenic:					
Oxides and acids		—	9	—	All to Burma.
Metal including alloys, all forms	kilograms	NA	625	—	Do.
Chromium: Oxides and hydroxides	do.	(2)	100	—	All to Singapore.
Cobalt: Ore and concentrate	do.	—	35	—	All to Laos.
Columbium and tantalum: Ores and concentrates		NA	3,703	780	West Germany 1,456; Netherlands 1,264.
Copper:					
Sulfate		NA	148	—	Japan 104; Finland 22; Indonesia 18.
Metal including alloys:					
Scrap		280	190	—	All to Taiwan.
Unwrought	kilograms	—	659	51	Oman 203; Singapore 161.
Semimanufactures		593	807	617	Hong Kong 104.
Gold:					
Waste and sweepings	kilograms	NA	160	156	Philippines 3; Singapore 1.
Metal including alloys, unwrought and partly wrought	do.	NA	106	(3)	Malaysia 90; Singapore 8.
Iron and steel: Metal:					
Scrap		4,925	6,318	6	Japan 4,619; Taiwan 1,261.
Pig iron, cast iron, related materials		100	670	—	Japan 668.
Ferroalloys:					
Ferrosilicon		—	60	—	All to Japan.
Silicon metal		NA	4	—	All to Burma.
Unspecified		12	—		
Steel, primary forms		1	—		
Semimanufactures:					
Bars, rods, angles, shapes, sections		19,803	NA		
Universals, plates, sheets		9,296	NA		
Hoop and strip		7	NA		
Rails and accessories		—	NA		
Wire		329	NA		
Tubes, pipes, fittings		195,911	NA		
Castings and forgings, rough		44	NA		
Lead:					
Ore and concentrate		51,247	59,665	—	Japan 23,877; Australia 11,661; Belgium-Luxembourg 6,181.
Oxides	kilograms	—	14	—	All to Singapore.
Metal including alloys:					
Unwrought	do.	—	50	—	All to Japan.
Semimanufactures		19	67	—	Mainly to Malaysia.

See footnotes at end of table.

TABLE 2—Continued

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued				
Manganese:				
Ore and concentrate: Metallurgical-grade	NA	660	—	Taiwan 500; Philippines 100; Singapore 60.
Metal including alloys, all forms	—	100	—	Mainly to Philippines.
Nickel:				
Ore and concentrate	—	3	—	All to Malaysia.
Metal including alloys:				
Unwrought	—	1	—	All to Hong Kong.
Semimanufactures	[4]1	10	5	Switzerland 2.
Rare-earth metals:				
Monazite concentrate	NA	145	—	All to France.
Xenotime	NA	20	—	All to Hong Kong.
Silver:				
Ore and concentrate kilograms	36,000	—		
Waste and sweepings[5] do.	201	10	2	Pacific Islands 6.
Metal including alloys, unwrought and partly wrought value, thousands	$477	$103	$99	United Kingdom $4.
Tin:				
Ore and concentrate	895	320	—	Republic of Korea 280; Singapore 40.
Metal including alloys:				
Scrap	NA	367	40	Japan 217; Singapore 110.
Unwrought	13,670	12,717	260	Japan 5,377; Netherlands 3,470.
Semimanufactures	1	946	80	Singapore 270; Japan 255; United Kingdom 251.
Titanium:				
Ore and concentrate	NA	2,909	—	Malaysia 1,500; Singapore 1,409.
Oxides	1	([3])	—	All to Laos.
Metal including alloys, all forms kilograms	—	311	—	All to Switzerland.
Tungsten:				
Ore and concentrate	1,179	1,068	449	Sweden 323; West Germany 116.
Metal including alloys, all forms	—	30	—	West Germany 29.
Zinc:				
Ore and concentrate	2,396	—		
Oxides	298	534	—	Singapore 234; Japan 180; Sri Lanka 50.
Metal including alloys:				
Unwrought	17,616	12,967	—	Republic of Korea 2,500; China 2,249; Taiwan 1,510.
Semimanufactures	1,053	2,571	87	Laos 1,573; Burma 534.
Zirconium: Ore and concentrate	NA	1,196	—	United Kingdom 456; Spain 320; Japan 220.
Other:				
Ores and concentrates	35,477	—		
Ashes and residues	7,505	5,427	204	India 1,834; West Germany 885.
Base metals including alloys, all forms	124	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Dust and powder of precious and semiprecious stones including diamond value, thousands	$12	$8	$2	Taiwan $5.
Grinding and polishing wheels and stones	103	188	1	Hong Kong 74; Malaysia 55.

See footnotes at end of table.

TABLE 2—Continued

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Asbestos, crude		6	—		
Barite and witherite		47,706	74,561	—	Indonesia 37,170; Singapore 19,274.
Cement		172,333	78,406	—	Laos 31,674; Hong Kong 10,197; Taiwan 8,016.
Chalk		42	([3])	—	Mainly to Laos.
Clays, crude		10,821	9,952	12	Taiwan 7,070; Malaysia 1,784.
Diamond: Natural:					
Gem, not set or strung	carats	([6])	342,974	101,358	Belgium-Luxembourg 98,296; Hong Kong 46,393.
Industrial stones		NA	21,902	—	Belgium-Luxembourg 13,118; Hong Kong 4,896.
Unsorted		NA	22,158	NA	Japan 15,418; Belgium-Luxembourg 5,525.
Diatomite and other infusorial earth		—	1	—	All to Republic of Korea.
Feldspar, fluorspar, related materials		211,186	288,857	—	Taiwan 179,681; Japan 60,855; Malaysia 11,900.
Fertilizer materials:					
Crude, n.e.s.		—	30	—	All to Brunei.
Manufactured:					
Ammonia		3	19	—	Laos 7; Hong Kong 5; Taiwan 5.
Nitrogenous		106	108	—	All to Laos.
Phosphatic		8	—		
Potassic		400	—		
Unspecified and mixed		([7])	8	—	Mainly to Laos.
Gypsum and plaster	thousand tons	1,472	3,855	—	Japan 2,555; Taiwan 429; Republic of Korea 204.
Magnesium compounds: Oxides and hydroxides		—	1	—	Mainly to Burma.
Phosphates, crude		72	—		
Pigments, mineral: Iron oxides and hydroxides, processed		—	3	—	All to Malaysia.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$380,589	$440,840	$89,439	Japan $143,938; Hong Kong $62,235.
Synthetic	do.	$15,104	$17,346	$5,298	Switzerland $4,521; Italy $3,065.
Quartz crystal, piezoelectric	kilograms	NA	35	5	Republic of Korea 30.
Salt and brine		60,578	41,139	2	Malaysia 30,607; Singapore 9,323.
Sodium compounds, n.e.s.:					
Soda ash, manufactured	kilograms	NA	150	—	All to Hong Kong.
Sulfate, manufactured		NA	38	—	Republic of Korea 36; Laos 2.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		4,026	10,357	3	Taiwan 9,910; Japan 344.
Worked		418	2,105	8	Bangladesh 737; Taiwan 630.
Dolomite, chiefly refractory-grade		20,167	100,295	—	Japan 100,000; Philippines 164.
Gravel and crushed rock		268	7,853	([3])	Laos 7,758.
Limestone other than dimension		5,877	8,157	—	Bangladesh 1,861; Singapore 540; West Germany 317.
Quartz and quartzite		22,307	26,139	—	Japan 24,800; Singapore 1,044.
Sand other than metal-bearing		—	218	—	Spain 150; Hong Kong 36; Philippines 18.

See footnotes at end of table.

TABLE 2—Continued

THAILAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental:					
Crude including native and byproduct		2,635	592	—	Philippines 500; Sri Lanka 55.
Colloidal, precipitated, sublimed		27	45	—	Mainly to Burma.
Sulfuric acid		202	259	—	Burma 145; Laos 114.
Talc, steatite, soapstone, pyrophyllite		105	1,709	—	Philippines 1,554; Singapore 81.
Other:					
Crude		3,867	15,114	—	Indonesia 12,400; Malaysia 2,300; Laos 220.
Slag and dross, not metal-bearing		5,826	12,403	307	West Germany 6,736; Netherlands 2,719.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		5	14	—	Laos 10; Indonesia 4.
Carbon black		7.456	3,949	—	India 2,246; Indonesia 804.
Coal:					
Anthracite and bituminous		1,170	181	—	Indonesia 72; Pakistan 72; Sri Lanka 36.
Briquets of anthracite and bituminous coal		—	1	—	All to Laos.
Coke and semicoke		—	3	—	Do.
Gas, natural: Condensate liquids		NA	571,915	480,291	Taiwan 91,624.
Peat including briquets and litter	kilograms	—	240	—	All to Laos.
Petroleum:					
Crude	42-gallon barrels	—	2	—	All to France.
Refinery products:					
Liquefied petroleum gas	do.	rNA	44	—	All to Laos.
Gasoline	do.	—	474,339	NA	Hong Kong 4,797; unspecified 468,014.
Mineral jelly and wax	do.	(2)	36	—	Malaysia 24; Taiwan 12.
Kerosene and jet fuel	thousand 42-gallon barrels	1,999	1,195	NA	Malaysia 9; unspecified 1,179.
Distillate fuel oil	do.	145	1	—	Mainly to Hong Kong.
Lubricants	do.	12	26	(3)	Indonesia 17; Singapore 4.
Residual fuel oil	do.	186	—		
Bitumen and other residues	do.	(3)	1	—	Mainly to Laos.
Bituminous mixtures	do.	(3)	(3)	—	All to Hong Kong.

r Revised. NA Not available.
1 Table prepared by Audrey D. Wilkes.
2 Unreported quantity valued at $1,000.
3 Less than 1/2 unit.
4 Excludes unreported quantity valued at $3,000.
5 May include other precious metals.
6 Unreported quantity valued at $68,547,000.
7 Unreported quantity valued at $186,000.

TABLE 3

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS				
Alkali and alkaline-earth metals: Alkali metals kilograms	—	2	—	Mainly from Hong Kong.
Aluminum:				
Ore and concentrate	21,714	30,426	—	China 18,340; Malaysia 12,086.
Oxides and hydroxides	19,960	25,743	391	Japan 11,458; Australia 8,281.
Metal including alloys:				
Scrap	1,499	4,716	20	Laos 4,365; Singapore 256.
Unwrought	53,735	1,062,707	2,076	Australia 1,031,999.
Semimanufactures	5,516	10,628	1,318	Japan 6,446; West Germany 833.
Antimony:				
Ore and concentrate	NA	6,045	—	Burma 5,416; China 629.
Oxides	NA	120	5	Japan 40; United Kingdom 31.
Metal including alloys, all forms kilograms	NA	465	—	Japan 240; Hong Kong 201.
Arsenic:				
Ore and concentrate	NA	80	—	All from Australia.
Oxides and acids	NA	51	—	China 32; France 19.
Metal including alloys, all forms	NA	39	—	France 20; China 14.
Beryllium: Metal including alloys, all forms kilograms	—	1	1	
Bismuth: Metal including alloys, all forms do.	NA	810	—	Belgium-Luxembourg 500; Japan 250.
Cadmium: Metal including alloys, all forms do.	NA	1,667	55	Australia 1,000; Japan 600.
Chromium:				
Ore and concentrate	174	4,492	—	Philippines 4,158; Belgium-Luxembourg 139.
Oxides and hydroxides	549	750	123	West Germany 341; United Kingdom 84.
Metal including alloys, all forms	NA	16	([2])	France 6; United Kingdom 4.
Cobalt:				
Oxides and hydroxides	13	19	—	Belgium-Luxembourg 10; United Kingdom 6.
Metal including alloys, all forms	NA	3	([2])	United Kingdom 1.
Columbium and tantalum: Tantalum metal including alloys, all forms kilograms	NA	14	4	Japan 10.
Copper:				
Ore and concentrate	—	20	—	All from Singapore.
Matte and speiss including cement copper	50	138	—	Australia 100; Burma 26.
Oxides and hydroxides	NA	285	—	Norway 216; Japan 68.
Sulfate	NA	612	—	Yugoslavia 240; Taiwan 196; Czechoslovakia 90.
Metal including alloys:				
Scrap	531	2,087	57	Laos 1,781; Kuwait 92.
Unwrought	27,303	29,533	255	Zambia 18,492; Zaire 1,700.
Semimanufactures	13,765	15,986	66	Indonesia 7,934; China 2,122.
Gold:				
Waste and sweepings value, thousands	NA	$4	$4	
Metal including alloys, unwrought and partly wrought kilograms	NA	11,208	1,120	Japan 5,359; Singapore 1,349.

See footnotes at end of table.

TABLE 3—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	120	279	—	All from Australia.
Pyrite, roasted kilograms	—	1,380	—	West Germany 880; Switzerland 500.
Metal:				
Scrap	903,323	1,158,249	76,057	Canada 154,423; China 141,751.
Pig iron, cast iron, related materials	44,751	113,085	4	China 92,087; Indonesia 17,600.
Ferroalloys:				
Ferrochromium	NA	697	18	Japan 316; Spain 129.
Ferromanganese	3,586	6,770	—	China 3,323; Australia 1,469.
Ferromolybdenum	NA	24	—	China 17; West Germany 3.
Ferrosilicon	NA	7,609	128	China 4,173; Norway 2,758.
Silicon metal	NA	23	—	Norway 20; Japan 2.
Unspecified	6,748	201	100	Japan 32; Brazil 25.
Steel, primary forms	878,170	NA		
Semimanufactures:				
Bars, rods, angles, shapes, sections	308,644	NA		
Universals, plates, sheets	1,225,942	NA		
Hoop and strip	99,977	NA		
Rails and accessories	2,459	NA		
Wire	18,238	NA		
Tubes, pipes, fittings	30,554	NA		
Castings and forgings, rough	35	NA		
Lead:				
Ore and concentrate kilograms	—	47	—	Canada 24; West Germany 23.
Oxides	585	568	—	Australia 200; West Germany 121; Japan 100.
Metal including alloys:				
Scrap	3,686	11,790	64	Kuwait 3,879; Australia 3,504.
Unwrought	13,453	12,977	(2)	Australia 7,991; Taiwan 2,062.
Semimanufactures	44	43	(2)	Japan 20; West Germany 17.
Lithium: Oxides and hydroxides	—	35	26	West Germany 8.
Magnesium: Metal including alloys, all forms	115	125	15	Norway 45; Japan 27.
Manganese:				
Ore and concentrate: Metallurgical-grade	—	100	—	All from China.
Oxides	1,207	1,288	—	Japan 422; Australia 354; China 354.
Metal including alloys, all forms	—	19	—	United Kingdom 16; Japan 2.
Mercury	11	11	(2)	Japan 6; West Germany 4.
Molybdenum:				
Oxides and hydroxides kilograms	—	5	—	Switzerland 3; West Germany 2.
Metal including alloys, all forms	(3)	2	(2)	United Kingdom 1.
Nickel:				
Matte and speiss	18	—		
Oxides and hydroxides	NA	38	1	Netherlands 25; United Kingdom 7.
Metal including alloys:				
Unwrought	776	580	5	Canada 247; Norway 188.
Semimanufactures	1,398	102	44	Sweden 12; Japan 11.

See footnotes at end of table.

TABLE 3—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$1,164	$1,816	$13	Japan $1,695; West Germany $71.
Rare-earth metals including alloys, all forms value	—	$60	$60	
Selenium, elemental kilograms	NA	8,704	—	Canada 6,400; Japan 2,300.
Silicon, high-purity value, thousands	NA	$22	—	All from Switzerland.
Silver:				
Ore and concentrate	350	—		
Waste and sweepings value, thousands	$1	$3	(2)	Japan $2.
Metal including alloys, unwrought and partly wrought do.	$8,973	$7,174	$227	West Germany $2,592; Hong Kong $1,289.
Tellurium, elemental	NA	22	—	Philippines 17; Norway 5.
Tin:				
Ore and concentrate	—	40	—	All from China.
Oxides	—	9	—	Italy 4; Japan 3.
Metal including alloys, all forms	10	30	(2)	U.S.S.R. 13; Japan 12.
Titanium:				
Ore and concentrate	NA	2,174	—	Australia 2,066; Taiwan 90.
Oxides	2,210	2,205	19	Japan 866; United Kingdom 318.
Metal including alloys, all forms	NA	73	2	France 35; Japan 30.
Tungsten: Metal including alloys, all forms	3	6	1	Japan 3; West Germany 1.
Vanadium: Oxides and hydroxides kilograms	NA	400	—	All from Japan.
Zinc:				
Ore and concentrate	—	61	—	West Germany 41; Canada 20.
Oxides	640	2,167	2	China 1,188; Taiwan 691.
Blue powder	NA	356	10	Norway 197; United Kingdom 60.
Metal including alloys:				
Scrap kilograms	—	12	—	All from United Kingdom.
Unwrought	4,792	3,833	—	Australia 3,653; Canada 52.
Semimanufactures	647	292	7	Japan 122; West Germany 67.
Zirconium: Metal including alloys, all forms kilograms	—	2	—	United Kingdom 1; West Germany 1.
Other:				
Ores and concentrates	13,818	1,357	—	China 800; Malaysia 512.
Ashes and residues	278	342	—	All from United Kingdom.
Base metals including alloys, all forms kilograms	74,000	112	2	Switzerland 106; Japan 4.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	7,287	8,981	58	Indonesia 5,439; Netherlands 1,971.
Artificial:				
Corundum	63	429	—	Italy 378; China 40.
Silicon carbide	NA	1,637	—	China 439; West Germany 351; Norway 305.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$137	$234	$6	Belgium-Luxembourg $87; Japan $87.
Grinding and polishing wheels and stones	1,701	2,535	21	China 700; Japan 640; Taiwan 430.
Asbestos, crude	71,407	109,103	2,851	Canada 57,036; Greece 11,232.

See footnotes at end of table.

TABLE 3—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Barite and witherite	kilograms	8,000	3	3	
Boron materials: Oxides and acids		200	437	377	West Germany 39; Japan 21.
Bromine	kilograms	—	95	—	Italy 58; West Germany 37.
Calcite		NA	9,347	—	Taiwan 7,305; France 998; China 950.
Cement		3,248	3,898	13	Malaysia 1,360; France 1,302.
Chalk		(2)	27	2	Japan 20.
Clays, crude		25,939	43,937	17,990	Indonesia 11,571; United Kingdom 5,850.
Cryolite and chiolite		11	20	—	All from Japan.
Diamond: Natural:					
Gem, not set or strung	value, thousands	$172,184	$291,593	$33,168	Belgium-Luxembourg $106,582; India $94,481.
Industrial stones	do.	$23	$34,237	$268	United Kingdom $14,077; Belgium-Luxembourg $11,112.
Unsorted	do.	NA	$2,623	$89	West Germany $1,132; India $640.
Diatomite and other infusorial earth		372	105	104	Switzerland (2).
Feldspar, fluorspar, related materials		4,039	1,247	—	Japan 429; Italy 318; Canada 233.
Fertilizer materials:					
Crude, n.e.s.		338	5,557	57	Republic of Korea 5,500.
Manufactured:					
Ammonia		8,593	13,303	(2)	Malaysia 7,811; Indonesia 5,245.
Nitrogenous		428,378	905,384	29,513	Japan 275,297; Malaysia 128,374.
Phosphatic		5,754	1,600	—	All from Netherlands.
Potassic		89,189	86,022	5,301	Israel 31,753; U.S.S.R. 20,250.
Unspecified and mixed		788,543	1,044,817	53,145	Republic of Korea 417,193; Norway 143,034; Romania 138,000.
Graphite, natural		1,138	665	(2)	China 255; Sri Lanka 158; Republic of Korea 110.
Gypsum and plaster		22,231	1,862	107	West Germany 1,372; United Kingdom 180.
Iodine	kilograms	NA	2,987	—	Japan 2,700; United Kingdom 34.
Kyanite and related materials		NA	209	—	Japan 189; China 20.
Lime		72	46	—	United Kingdom 45; Japan 1.
Magnesium compounds:					
Magnesite, crude		[4]22,051	18,229	3,302	China 13,151.
Oxides and hydroxides		NA	3,712	43	Japan 2,186; China 977.
Sulfate		NA	1,842	—	All from West Germany.
Mica:					
Crude including splittings and waste		274	319	36	India 157; Malaysia 40.
Worked including agglomerated splittings		46	38	11	Japan 28.
Phosphates, crude		—	1	—	All from West Germany.
Phosphorous, elemental		NA	36	—	China 22; Japan 9; West Germany 5.
Pigments, mineral:					
Natural, crude		NA	212	—	Austria 74; China 69; Netherlands 65.
Iron oxides and hydroxides, processed		3,141	3,604	175	West Germany 1,998; India 311.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$78,063	$122,385	$13,559	India $23,573; Sri Lanka $22,649.
Synthetic	do.	$10,415	$10,655	$1,564	Taiwan $5,950; Switzerland $1,454.

See footnotes at end of table.

TABLE 3—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued				
Pyrite, unroasted	16	16	([2])	Italy 12.
Quartz crystal, piezoelectric kilograms	NA	7,146	6,794	Taiwan 294; Brizil 34.
Salt and brine	1,160	846	28	United Kingdom 375; Netherlands 172.
Sodium compounds, n.e.s.:				
Soda ash, natural and manufactured	97,366	162,695	64,356	Kenya 23,450; Belgium-Luxembourg 20,250.
Sulfate, manufactured	NA	40,525	3	China 33,932; Japan 2,067.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	1,067	1,918	([2])	Republic of Korea 720; Italy 463.
Worked	1,419	1,565	346	Italy 1,180.
Dolomite, chiefly refractory-grade	468	950	—	United Kingdom 499; Norway 377.
Gravel and crushed rock	1,827	2,723	15	France 1,976; China 700.
Limestone other than dimension	35	18	—	Mainly from Taiwan.
Quartz and quartzite	209	117	—	China 50; Italy 24; Taiwan 18.
Sand other than metal-bearing	241	316	59	Japan 148; Norway 36.
Sulfur:				
Elemental:				
Crude including native and byproduct	59,013	105,046	12,390	Canada 45,438; Singapore 17,618.
Colloidal, precipitated, sublimed	224	187	([2])	West Germany 87; Taiwan 85.
Dioxide	—	21	8	Australia 7; Singapore 5.
Sulfuric acid	3,139	12,880	25	Japan 12,790.
Talc, steatite, soapstone, pyrophyllite	26,518	29,962	43	China 17,670; Republic of Korea 10,386.
Other:				
Crude	12,887	3,543	—	China 1,773; Netherlands 508; France 440.
Slag and dross, not metal-bearing	1,324	79	—	Mainly from United Kingdom.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	42	98	48	United Kingdom 50.
Carbon:				
Carbon black	4,748	6,055	371	China 2,422; Taiwan 1,248.
Gas carbon	NA	795	—	Australia 495; China 300.
Coal:				
Anthracite and bituminous	254,415	292,300	721	Australia 112,835; China 112,806.
Briquets of anthracite and bituminous coal	—	18	—	Mainly from Taiwan.
Coke and semicoke	57,088	67,963	—	Japan 37,950; China 29,317.
Gas, natural:				
Gaseous kilograms	NA	5	—	All from Singapore.
Liquefied do.	NA	46	46	
Peat including briquets and litter	2	—		
Petroleum:				
Crude thousand 42-gallon barrels	54,685	55,440	—	United Arab Emirates 15,367; Brunei 10,492; Malaysia 9,799.
Partly refined do.	NA	706	—	Kuwait 702.

See footnotes at end of table.

TABLE 3—Continued

THAILAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988 United States	Sources, 1988 Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum—Continued					
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	1,429	1,548	(2)	Singapore 705; Indonesia 526.
Gasoline	do.	2,533	2,167	—	Singapore 2,042; Bahrain 104.
Mineral jelly and wax	do.	101	104	6	China 75; Japan 11.
Kerosene and jet fuel	do.	2,737	3,160	—	All from Singapore.
Distillate fuel oil	do.	19,843	19,952	—	Singapore 19,805.
Lubricants	do.	1,888	598	21	Singapore 220; China 133; Japan 110.
Nonlubricating oils	do.	(5)	1,168	12	Singapore 713; China 233; Japan 118.
Residual fuel oil	do.	3,709	952	—	Singapore 741; Kuwait 211.
Bitumen and other residues	do.	40	34	—	Singapore 24; Japan 7.
Bituminous mixtures	do.	23	21	(2)	United Kingdom 12; Republic of Korea 7.
Petroleum coke	do.	31	2	(2)	United Kingdom 1.

NA Not available.
[1] Table prepared by Audrey D. Wilkes.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $32,000.
[4] Includes oxides and hydroxides.
[5] Included with lubricants.

minerals are distributed through too many regions to enumerate here. Many of the principal companies and operating locations are shown in table 4.

COMMODITY REVIEW

Metals

Cadmium.—Thailand's only zinc refinery, PDI, announced in midyear that it had signed an agreement with Belgium's Mechim SA for building a cadmium-extraction facility in connection with its zinc operations. To have a designed capacity of 750 tons per year, the plant was expected to cost about $11.6 million and to go on-stream very late in 1990. PDI officials said that soft cadmium prices had delayed the project, but they were probably eyeing developing markets in the United States, Europe, and Japan. In addition to its use as a coating for steel, along with some copper and brass, cadmium has enjoyed increasing significance in the production of batteries, pigments, and plastics.[5]

Copper.—Although Thailand does not mine copper, and as yet has announced no plans to do so, domestic demand amounted to between 50,000 and 60,000 tons per year, all of it imported. With consumption projected to double in the next 5 years, PDI decided to build a copper smelter that would process imported ore until ongoing exploration finds suitable copper deposits in Thailand. Projected capacity was not disclosed, but presumably would be a function of infrastructure in terms of seaport ore-handling facilities as well as exploration results.

With scarcely a pause, PDI then entered an agreement with South Korea's Poongsan Corp. to form a joint venture, Padaeng Poongsan Metals, to construct a 14,800-ton-per-year fabricated-copper and copper-alloy products plant in the Laemchaban Industrial Estate on the coast about 130 km southeast of Bangkok. The new company would be owned 51% by PDI and 49% by Poongsan, involve construction costs of $45 million, and be commissioned by December 1991. Full capacity would not be reached until 1996, at which time sales of $85 million were projected for that year. Poongsan was expected to provide technical expertise as well as equipment for melting and casting, hot and cold rolling, and slitting.[6] The new company made no disclosure of intended sources of copper feeds for its plant, nor what proportions of products were targeted for Thai consumption and for export. Even so, demand in the Indochinese and Association of Southeast Asian (ASEAN) countries could be expected to develop considerably over the next two or three decades. Poongsan admitted that its interest in Thailand was stimulated by a declining degree of competitiveness at home, where wage hikes and currency appreciation had exerted their effects on Korean pricing in the world markets.

Gold.—Still wrestling with the problem of how to define and manage gold concessions for development by private-sector companies, the Thai Ministry of Industry canceled the bid proposals submitted by five different companies near the end of the previous year and set new rules for a third round of bidding. Submittals were to be in two stages, the first to include detailed exploration and mining plans, the second to describe benefits that the respective development companies would offer to the Thai Government. The Department of Mineral Resources was authorized to cancel auctions, dictate a minimum benefit payable to the Government, and block successful bidders and leaseholders from transferring concessionary rights to other companies unless and until approved by the Department.[7] Other requirements were that a bidder must be a company, be a member of the Mining Industry Council of Thailand, have a Thai partner, and command total capital (including assets) of approximately $1.95 million.[8]

It seemed clear that the Government believed the country to possess significant gold resources and wanted to preclude amateur or opportunistic efforts at prospecting. Accordingly, several concessions were offered in Prachinburi and Chonburi Provinces and subsequently in Loei, Nongkhai, and Udon Thani Provinces of northeast Thailand.

Elsewhere, the Ministry of Industry granted a gold-mining license to Cholsin Co., associated with Aokam Tin, in a 4800-hectare concession near Narathiwat, a town on the east coast of southern Thailand about 40 km from the Malaysian border. Presumably the gold values, running 8 to 12 grams per ton, were encountered during mining of the

TABLE 4

THAILAND: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (thousand metric tons per year)
Antimony, concentrate	Associated Minerals Co. Ltd.	Bo Thang,[1] 130 km southeast of Bangkok (temporarily inactive)	6
Do.	Parasit Mining Co.	Doi Ngoem, 100 km southeast of Chiang Mai	2
Barite	American Thai Barite Co. Ltd.	Siam Mine, 200 km southeast of Phuket	25
Do.	P&S Mining Co. Ltd.	Loei Mine, 10 km northwest of Loei	70
Do.	STA Mining Co. Ltd.	STA Mine, 105 km southeast of Chiang Mai	100
Cement	Siam Cement Co. Ltd.	Kaeng Khoi, 90 km northeast of Bangkok	3,300
Do.	do.	Tambol Tabkwang, Kaeng Khoi District, 90 km northeast of Bangkok	2,800
Do.	do.	Tha Luang, 90 km northeast of Phuket	3,200
Do.	do.	Thung Song, 130 km east of Phuket	900
Fluorspar, concentrate	Phanom Thuan Mining Co. Ltd.	Phanom Thuan, 45 km north of Kanchanaburi	60
Do.	Sk Minerals Co. Ltd.	Mine is 47 km southeast of Krabi	65
Do.	Thai Fluorite Processing Co. Ltd.	Ban Lad, Phet Buri	120
Do.	United Fluorite Co. Ltd.	Salak Pra, 80 km northwest of Kanchanaburi	26
Do.	Universal Mining Co. Ltd.	Mae La Luang, 120 km west of Chiang Mai	35
Lead, concentrate	Kanchanaburi Exploration and Mining Co. Ltd.	Song Toh, 250 km northwest of Bangkok	45
Steel, rolled	Bangkok Iron & Steel Co. Ltd.	Bangkok	160
Do.	Bangkok Steel Industry Co. Ltd.	Samut Prakan Province, south of Bangkok	210
Do.	Siam Iron & Steel Co. Ltd.	Saraburi Province, 100 km north of Bangkok	220
Tantalum and columbium, in tin slag	Thailand Smelting and Refining Co. Ltd.	Phuket	NA
Tin:			
Concentrate	Numerous small companies	Offshore Andaman Sea from southern tip of Burma to south of Phuket	NA
Do.	do.	Mostly South Thailand and along southern Burma border	NA
Refined	Thailand Smelting and Refining Co. Ltd.	Phuket	38
Tungsten, concentrate	Parasit Mining Co.	Doi Ngeom, 100 km southeast of Chiang Mai	.1
Do.	Siamerican Mining Enterprise Co. Ltd.	Khao Soon, 185 km east of Phuket (temporarily inactive)	1.2
Do.	Sirithai Scheelite Thailand Co. Ltd.	Doi Mok, 120 km northeast of Chiang Mai (temporarily inactive)	.4
Zinc:			
Ore	Padaeng Industry Co. Ltd.	Mae Sod, 64 km west of Tak	350
Refined	do.	Tak	60

NA Not available.
[1] Tungsten also recovered when economical.

tin placers and did not require extensive exploration of the sort visualized in the northeast part of the country.

Later in the year, it was announced that Australia's CRA Exploration Pty. Ltd. was to join with Thailand's PDI to explore for gold in Loei and Nongkhai, the joint venture to be owned 55% by CRA and 45% by PDI. At the time of signing for the concession, CRA attempted to persuade the Government to reduce its prohibitive 10% royalty on gold produced to a level more in line with the policies of other gold-producing countries or from 1% to 2%.[9]

Meanwhile, during the year, a huge demand for gold by Thai jewelers prompted the Government to increase the gold-bullion import limits to 16,600 kilograms per year from 7,200 kilograms in 1988. At that time, Mocatta Thailand Ltd. had been appointed sole importer after a 10-year ban on all gold imports. In 1989, two other importers were appointed with Mocatta, the Gold Traders' Association and the Authorized Gold Dealer Co. All three, however, experienced increasing difficulty in achieving sales projections because of fears of retroactive taxation by Bangkok jewelers. The respective buyers have been required to obtain Finance Ministry approval to buy gold and then advance a 5% deposit on the value of every gold purchase to ensure that the metal would be used only for jewelry to be exported. During 1989, the Government let it be known it was thinking about a 3% fine on annual quotas not sold by the three importers. This would have been in addition to a 3.3% business tax on the first transaction between importer and buyer.

The net result of this tax tinkering has been a sharp rise in gold smuggling into Thailand from Hong Kong and Singapore, among other sources, and a black-market trade thriving on the age-old basis of take-it-or-leave-it and no-questions-asked.

Iron and Steel.—The most important event in the iron and steel industry of Thailand was the series of moves toward establishment of the long-considered integrated steel mill, culminating in selection of the Sahaviriya Group to build this large-scale plant. Earlier, the Government scaled down its original idea for an integrated complex by eliminating plans for pig iron production and concentrating instead on hot- and cold-rolled steel production facilities and possibly the production of slab, the raw material for hot rolling of steel. By this means, after some second thoughts about world steel-industry overcapacity, the total investment required was reduced substantially, and project viability increased.

To encourage economies of scale, the Government made it clear that only one such large integrated steel project would be supported. After the beginning of the year, the original list of six aspirants was cut to two: Siam Steel Co. and the Sahaviriya Group, a trading and finance conglomerate, both run by Sino-Thai families involved for decades in the importing of steel. Competition between the final two contenders was intense while steel users in Thailand complained that they were virtually forced to beg for steel to keep their factories operating, a distinct improvement over the global glut of steelmaking capacity in the early 1980's.[10]

Relatively cheap labor and land, two of Thailand's main attractions to foreign investors, do not afford any particular advantage to the capital-intensive and energy-intensive production of steel. Energy demand, in particular, has threatened to outstrip energy production in recent Thai experience, but the demand for steel has risen perhaps even more as the country moves toward industrialization. The construction sector[11] grew 20% during 1989 compared with 15% in 1988 and 8% in 1987. Demand for construction steel, at about 1.6 million tons, was far beyond local supply. Sahaviriya Group, the company finally selected, was expected to invest a total of $637 million in the new steel plant and formed the Sahaviriya Steel Industry Co. (SSIC) with registered capital of $156 million, about a quarter of which was paid in to initiate the project. SSIC declined to name its foreign partner but said it was no longer involved with Duferco, the Italian partner previously brought in to file the original joint application for the project.

With a world market share of as much as 50% for both canned tuna and canned pineapple and plans for canning other products such as bamboo shoots and mushrooms, Thailand increasingly consumes locally manufactured tinplate. Thai Tinplate Manufacturing (TTP) prepared to commission a new 150,000-ton-per-year capacity electrolytic tinning line at its Bangkok plant that will boost its total capacity for tinplate and nontinplated steel production to 360,000 tons per year. The new line was to be supplied by Japan's Kawasaki Heavy Industries, which owns 8% of TTP. Meanwhile, Nippon Steel confirmed persistent rumors by declaring its participation (10%) in a new tinplate venture, Siam Tinplate (STP), that aims for initial production in late 1991. Other Japanese investors in STP are Sumitomo Corp. (14.25%), Mitsubishi (12%), and Nittetsu Shoji (3.75%).[12] Thailand's leading cannery, Unicord, owns 40%, and the final 20%, not yet worked out, was believed to be coming from the Asian Development Bank and the World Bank's International Finance Corp. Clearly, at a time when TTP's capacity was slightly underutilized during a lull in the growth of tinplate consumption, the serious money being invested in STP testified to impressive faith in the future of Thai tinplate, canning, and export of food products.

Tantalum.—Among the tin producers of Southeast Asia, Thailand ore is unique in its relatively high content of tantalum-bearing minerals. The Thailand Smelting and Refining Co. Ltd. (Thaisarco) produces about 181,450 kilograms per year of tantalum in tin slags residual from the company's smelting process. More recently, depressed tin prices have stimulated better recovery techniques for tantalum-rutile and columbite-tantalite by magnetic and high-tension separators from the tin concentrates. These extracted minerals are then sold directly to traders before the depleted concentrates go to the smelter, thus lowering the tantalum yield in the resulting tin slags. In former times, Thaisarco was legally obligated by the Thai Board of Industry to sell its tin slags to the Thai Tantalum Industry Corp. (TTIC). After the 1986 destruction by fire of the TTIC plant in Phuket, Thaisarco has been free to export its tin slag, sending 70% to Bayer Starck in the Federal Republic of Germany and 30% to Fansteel Inc. in the United States.

TTIC, meanwhile, planned to build a new plant near Mab Ta Put in Rayong, about 150 km southeast of Bangkok, with Fansteel participation to the extent of at least 10%. TTIC had about 277 tons of Ta_2O_5 in tin slags stockpiled, but it was committed as collateral for a World Bank Loan.

Late in the year, the U.S. Defense Logistics Agency (DLA) began soliciting bids to supply 90,718 kilograms of Ta_2O_5 with delivery starting in 1990 and continuing through a 2-year period. This drawdown could be a stimulus to the market because only a minor amount of tantalite meets DLA's detailed specifications, and the procurement was being followed with interest.

By yearend, TTIC's collateral slags had been sold to Elders Australia to raise capital and reduce debt, Fansteel had gotten out of the tantalum business, and TTIC planned to lease Fansteel's mothballed tantalum plants at Muskogee, OK, and North Chicago, IL. TTIC would buy K_2TaF_7 from China and process it at Muskogee's sodium-reduction plant and at Chicago's powder plant. By 1992, TTIC aimed to begin operations at its new plant at Rayong, Thailand.[13]

Tin.—Traditionally Thailand's premier mineral product and leading export, tin as a mineral commodity still suffered from the collapse of the world tin market in 1985 as a consequence of the International Tin Council's artificially high price levels. The resulting overproduction and lack of demand led to market chaos and a severe contraction of the industry worldwide. Not the least of the affected countries, Thailand saw capital and labor drawn away from tin extraction and directed toward tourism, hotels, shrimp farming, real estate, rubber, and oil palms. The operating tin mines in 1989, remaining at barely 200, represented less than one-half of the precollapse total of between 400 and 500 separate operations. Furthermore, resurgent environmentalism, possibly to some extent contrived, exerted itself again by challenging tin miners in the coastal areas of South Thailand where beautiful beaches, hotels, and the tourist industry began to prevail.

Diminished as it was, the Thai tin industry nevertheless showed potential strength as tin prices firmed somewhat, early in the year, and additional "suction boats" (dredges) appeared offshore. In April 1989, the price of tin hit a high of $4.87 per pound, only to subside for the remainder of the year, standing at an average $3.06 in December and less in January 1990. Despite the soft price, the production of tin concentrates was up 28% for the year, reaching 20,372 tons valued at $125 million, the latter representing an increase of only 5% over total value for the previous year. Thus the latent strength of the industry was demonstrated by an average 5% increase in price, causing the 28% increase in production of concentrates. This was far from a bonanza for the producers, but it showed that those remaining were ready and willing to operate.

Total smelter production of the metal was 14,571 tons, of which 11,130 tons was exported, earning about $94 million, but this volume was far below the 19,000-ton export quota for Thailand established by the ATPC's supply rationalization plan. However, the growing demand for tinplate for Thailand's burgeoning canning industry resulted in other exports of preserved foods in Thai tin cans that also earned foreign exchange credits.

Zinc.—Thailand's only zinc producer, PDI, had a banner year in 1989 by producing more than 412,000 tons of zinc ore worth approximately $181 million. This placed zinc firmly in the lead as the country's most valuable mineral product, far ahead of tin at $125 million, for the second straight year. Although the quantity of zinc ore mined was about 2% less than that of 1988, increasing world zinc prices brought PDI a 43% increase in mineral product value. The recent expansion of capacity of the Padaeng plant to 70,000 tons per year further satisfied a growing market. However, with about 4.5 million tons of ore at Mae Sod, the life of that mine was being shortened from the original estimate of about 16 years. PDI can hope for possibly only one solid decade of exploration for new zinc deposits before the exhaustion of Mae Sod. Recent projections have centered on approximately 12 years of life remaining for the mine, but even this was a function of any newer increases in capacity of the refinery, such as have been rumored.

The present refinery is about 100 km from Mae Sod by road, so the present ore-trucking operation demonstrates the feasibility of such arrangements provided roads are in place or can be built. Depending on the location of new zinc deposits, the present refinery, a world model for engineering design and process technology, could conceivably be relocated. Diligent exploration for new deposits will determine the longer term future of zinc mining and refining in Thailand.

In the interim, PDI has been diversifying, as previously noted, into cadmium production, copper smelting, and gold exploration. Other possibilities are being considered, including both the production and refining of mineral-fuel commodities.

Industrial Minerals

Cement.—Demand for cement, previously described as mushrooming, was virtually skyrocketing in 1989. Production that broke through the 10-million-ton mark in 1988 rose to slightly above the 15-million-ton level in 1989 as new roads, industrial sites, office buildings, and hotels were built and more were contemplated through the next few years. At the same time, older infrastructure was being repaired where deteriorated, and the outlook for cement seemed to be without limit over the nearer term. With a gross domestic product (GDP) increase forecast to rise by 10%, construction was forecast to expand by 15% as 43,000 more hotel rooms are added and an inadequate infrastructure is bolstered. More than 100 highrise buildings valued at $1.6 billion were under construction in Bangkok and in the tourist areas of southern Thailand during the year.

Demand for cement has forced the Government to plan to import approximately 5.4 million tons through the next 2 years, which will involve tariffs of 10% on whatever is brought in. The principal producer is Siam Cement Co. (SCC), having about two-thirds of the domestic market share, whose biggest shareholder is the Crown Property Bureau, the investment manager for the Thai royal family. Profits exceeding $180 million in 1989 have turned SCC into a vehicle for diversified investment in other industries such as Toyota engines, Mitsubishi Electric television tubes, and Dow Chemical styrene monomers. At the same time, SCC means to increase its cement production by 3.6 million tons per year by 1993.[14] Other cement companies in Thailand are forming and capitalizing as they sense a demand that goes nowhere but up. Siam City Cement Co. Ltd. found itself explaining to the Securities Exchange of Thailand how it planned to increase its capitalization from $38 million to $58 million by splitting its shares and sharply reducing their par value. Grand Sunshine Real Estate sought permission from the Ministry of Industry to change its name to Grand Sunshine Cement Co. and increase its capitalization by $15.6 million to produce cement at the rate of 1.5 million tons per year. Observers were reminded of the great days of Wall Street when the United States expanded its horizons and infrastructure in the 19th century.

Fertilizer Materials.—As with many of the other Southeast Asian nations, Thailand's volume of fertilizer consumption has followed the trend in GDP expansion because of the fundamental role of the agricultural sector in the total economy. Thailand, however, differs from the other countries in terms of the rate of this expansion of fertilizer demand, having exceeded Indonesia in consumption of ammonium sulfate and Malaysia in consumption of urea. From 1974 to 1988, Thai nitrogen usage rose from 120,000 to 440,000 tons per year, increasing by a factor of about 3.7 in those 14 years. A mean growth rate of 10% per year until the year 2000 has been estimated for Thai fertilizer requirements, with a shift away from rice toward field crops, fruit trees, other tree crops, and vegetables.[15]

The most significant news for Thailand, and for that matter much of Asia, was that agreements were finally worked out for mining of the world-class potash deposit in northeast Thailand. The heavily populated Asian countries rely on intensive agricultural production for their survival. The chronic shortage of potash fertilizer has long attracted the interest of ASEAN, who will own 40% versus Thailand's 60% of the $300 million project. At Bhumnet Narong in Chaiyapum Province, carnallite-grade potash will be mined in underground operations at a depth of 150 meters at a rate tentatively projected at 1 million tons per year for about 30 years. Mineralization is thought to approximate 517 million tons distributed through about 300 square kilometers, a relatively small proportion of which is economically extractable as presently known.

Late in the year, Kemira Oy of Finland established a joint venture with Thai Central Chemical Co. Ltd. and Thai Sunrock Co. Ltd. to form Kemira Thai Co. Ltd., which will promote the sale of Kemira's NPK fertilizer products.

Gypsum.—Climbing steadily through the entire decade of the 1980's, Thai gypsum production achieved another new high at nearly 5.8 million tons, an increase of 20% over the previous year's output and a reflection of Thailand's booming export business as well as its domestic construction industry. Approximating $53 million, the value of this 1989 production was up 40% from the year before and reflected increasing demand, particularly in the export market, which consumed almost 4.4 million tons. The prospects for further growth were very good, the biggest problem having been transportation from mines in the northern part of the country, one more challenge to the continual expansion of the national infrastructure. Thai Gypsum Product Co., which manufactures gypsum board and other products, seemed to be well situated to take advantage of construction requirements, particularly if fire codes for buildings are upgraded as seems likely. Having U.S. Gypsum Corp. as a minority owner may well enhance Thai Gypsum's technological capabilities versus competitors.

Limestone.—As the chief ingredient of hydraulic cement, limestone production facilitated the boom to the extent of 15.9 million tons having a value of $53 million, both representing 13% increases above their 1988 values, and evidently a significant degree of price stability in the midst of expansion. It seemed to observers that the availability of limestone would affect the future of the cement industry as new startup companies sought their own sources of this primary component of cement in locations that were sufficiently accessible. In Thailand, a competing market for limestone is its use as aggregate for both hydraulic cement and asphalt mixtures for highway pavements, the latter a real and growing necessity.

Sand.—Silica sand in Chantaburi, about 200 km southeast of Bangkok, would be mined as the result of an agreement between Thai Petrochemical Industry Co. (TPIC) and the Swiss-based Carl Group. It was planned to create Royal Sarner Crystal Co., a joint venture owned 80% by TPIC and 20% by the Swiss. A factory at Rayong would produce basic glass that would then be refined at a second plant in Saraburi, about 60 km north-northeast of Bangkok, using Swiss technology, into crystal that would be marketed also by the Swiss. A production capacity of 4,000 tons was projected for 1990.[16]

Sulfur.—Plans were underway for installation of equipment for the removal of sulfur from petroleum at the rate of approximately 30 tons per day, which would translate to between 10,000 and 11,000 tons per year. Engineering was by Bangchak Petroleum Co. Ltd., Bangkok, for projected completion in 1990. The site, although not specified, would most likely be in the Mab Ta Put-Rayong industrial area.[17]

Mineral Fuels

Lignite.—One of the mainstays of Thailand's electric power generation, lignite was second only to zinc in value of 1989 production, or $174 million for the 8.9 million tons mined. This represented an increase of 22% in both volume and value over those of 1988, testifying not only to price stability but an impressive expansion of demand in the country's progress toward industrialization. The lignite was consumed entirely by the generating complex at Mae Moh in Lampang Province of northern Thailand, where at least seven powerplants were operating by the beginning of the year and seven more had been scheduled for construction by 1995. Other lignite deposits in southern Thailand in Krabi and Songkhla Provinces were under development, but they were far to the south of the centers of power production and consumption. Environmental consequences of lignite combustion were of increasing concern. Interest rose in the importation of hard coal for cleaner burning in plants still in the design stage. Such coal would have a substantially higher unit thermal content and thus involve a lesser volume for handling. Moreover, a higher fixed-carbon, lower volatile matter, and lower ash would be expected to burn more cleanly and yield less-deleterious products of combustion. Very minor production of anthracite in Thailand, at less than 10,000 tons in 1989, did not yet show signs of becoming an industry comparable to lignite.

Australia pursued the Thai import market aggressively, seeking to supply harder and cleaner burning coal for a 2,800-megawatt (MW) plant suggested for the Rayong area that would cost $1.1 billion. Australia proposed to supply up to 12 million tons per year of black (bituminous) coal to fire such a plant, which would be shore-based near Mab Ta Put, and thus much closer to industrial consumers than the thermal powerplants at Mae Moh.

Natural Gas.—Production was steady at 211.4 billion cubic feet (Bcf), down about one-tenth of 1% from 1988 output, in the midst of ongoing exploration both onshore and offshore. With Thailand's energy requirements expanding at the rate of 15% per year, natural gas reserves in 1989 were more significant than those of crude oil. Unocal Thailand Ltd. has a large offshore production operation in the Gulf of Thailand delivering more than 540 million cubic feet per day of gas and about 20,000 bbl/d of condensate from four separate fields. Unocal was negotiating with the Petroleum Authority of Thailand (PTT) for conclusion of a price agreement for a third contract area comprising three additional fields, possibly as a joint venture with PTT. Unocal also, in partnership with Amerada Hess and Britoil, was assessing still another field adjacent to this third area. Observers believed Unocal would maintain its current production rate for 20 years or more as newer fields are developed.[18]

After buying back the prolific "B" structure tract, having an estimated 1.7 trillion cubic feet of natural gas reserves, from Texas Pacific in 1987, PTT began negotiations in other directions. Near the end of the year, agreement was announced between PTT Exploration and Production (PTTEP) and the French oil firm Total Compagnie Francaise Des Petroles (Total) for joint development of the "B" structure, Thailand's largest known gas reservoir. Total would own 30% and be the operator. PTTEP would own 40% and negotiate sale of the remaining 30% to other companies. Plans were for piping ashore 150 million cubic feet per day beginning in 1994.

A longstanding petroleum problem was resolved during "summit" discussions between Prime Ministers Chatichai of Thailand and Mahathir of Malaysia. An 11-year impasse over the development of hydrocarbon resources in overlapping territorial waters was tentatively settled with the creation of a Joint Development Authority to be based in Songkhla, Thailand, and headed initially by a Malaysian director with a Thai deputy serving 4-year terms.

Consummation of the agreement would require changes in the laws of both countries, but no particular obstacles were foreseen. Triton Oil, a U.S. company owning the concession area, was tentatively nominated by both countries to be the developer and operator.

Petroleum, Crude.—By the production of 7.8 million barrels of crude in 1989, the industry registered an increase of nearly 5% over 1988 output as exploration continued onshore and offshore. More than 6.7 million barrels of natural gas condensate was produced, up 24% from the previous year. Thailand consumed an average of 418,000 bbl/d of liquid petroleum products, an increase of 13% compared with 1988. Diesel-fuel consumption led the list, amounting to 35% of all products.

Production of crude oil onshore is still limited to Shell's Sirikit field in central Thailand, producing about 20,000 bbl/d, and a smaller Government operation in northern Thailand. Although Shell produced some oil offshore from the Nang Nuan field in 1988, technical problems caused the suspension of operations pending further study.

At least 30 international oil companies submitted proposals for participation in partnership with PTTEP to explore and develop the highly regarded Block 5/27 Concession in the Gulf of Thailand. Although several tenders were only damaged, Shell lost the drillship *Seacrest* that sank during Typhoon Gay in November with loss of life.

Exploration continued in the Bangkok area and Surat Thani Province in southern Thailand. Other efforts in the central part of the country not far from Sirikit field have been successful, but development was slowed pending amendment of the Thai Petroleum Act giving enhanced incentives to the operators. Passage of the act in August added flexibility to royalty requirements and was seen as a stimulus to onshore exploration for crude.

Reserves

Information on mineral reserves is from Thai Government sources as well as local mining operations. As exploration continues for new mineral reserves, data on these reserves will vary accordingly. Exploration in Thailand has been aggressive and well organized, utilizing high-technology methods, and thus it is expected that the information shown may change from year to year. Potential but undetermined reserves may be significantly greater than the amounts noted, pending further analysis as in the data for clays, gypsum, and limestone, or the utilization of deeper water dredging as for tin, with attendant tantalum, and tungsten.

INFRASTRUCTURE

Thailand has 3,940 km of meter-gauge railroad, extending to most parts of the country, and 99 km of double track. The road network includes 28,016 km of paved highway, 5,123 km of loose-surface or other secondary road, and 11,386 km of additional

TABLE 5

THAILAND: RESERVES OF MAJOR MINERALS

(Thousand metric tons unless otherwise specified)

Antimony	300
Barite	7,000
Clay, kaolin	500
Fluorspar	1,000
Gas, natural million cubic meters	196,940
Gypsum	60,000
Lead	500
Lignite	675,000
Limestone	160,000
Petroleum, crude million barrels	231
Potash	30,000
Tantalum (including tin slag)	3,000
Tin	270
Tungsten	30
Zinc	3,800

routes under development in 1988. The country has 4,000 km of inland waterways, with 3,700 km of this at least 0.9 meters deep throughout the year. Otherwise, many minor waterbodies are utilized seasonally by very shallow-draft native craft, but in many places these are totally dry for significantly long periods.

The two main seaports are at Bangkok and Sattahip, the former commercial and the latter military, about 160 km south-southeast of Bangkok, where the Royal Thai Navy is headquartered. Mab Ta Put, about 40 km east of Sattahip, is being developed as a large industrial complex having included port facilities. At least 15 other minor seaports are elsewhere along the Thai coast.

The country has 129 airfields altogether, 104 of them usable at last count. Permanent, paved runways are utilized at 56 of these fields, several of them world-class commercial and military installations. Navigation aids are modern and sophisticated.

Unocal's gas wells in the Gulf of Thailand are joined with the mainland at Rayong by the world's longest undersea pipeline, about 450 km in length. Natural gas pipelines totaled 600 km in 1988; others were under construction, and still others were undergoing feasibility studies while drilling and discovery continued in the Gulf of Thailand.

OUTLOOK

Thailand is well positioned geographically, geologically, and economically for continued growth and development into an industrialized nation. The mineral industries of the country will likewise continue their critical role in the production of energy, new construction, and the further growth of base- and precious-metal production. In the future, the domestic steel industry will expand into an industrial mainstay, probably requiring iron ore from India or Laos if the latter's resources are developed.

A major concern is a tendency for the economy to become overheated with an accompanying inflation as bidding increases for materials, resources, and supplies. Domestic energy sources in terms of lignite and petroleum are already inadequate for electric power requirements and must be supplemented by substantial imports. Environmental problems have been addressed responsibly in the midst of phenomenal growth, but such factors as air pollution from burning lignite as well as water supply contamination by industrial development will require further efforts.

On the whole, Thailand bids well to grow into a major economic and industrial nation, well supported by its agricultural and mineral resources.

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[1] Where appropriate, values have been converted from Thai Baht (B) to U.S. dollars at the rate of B25.68 = US$1.00 in 1989.

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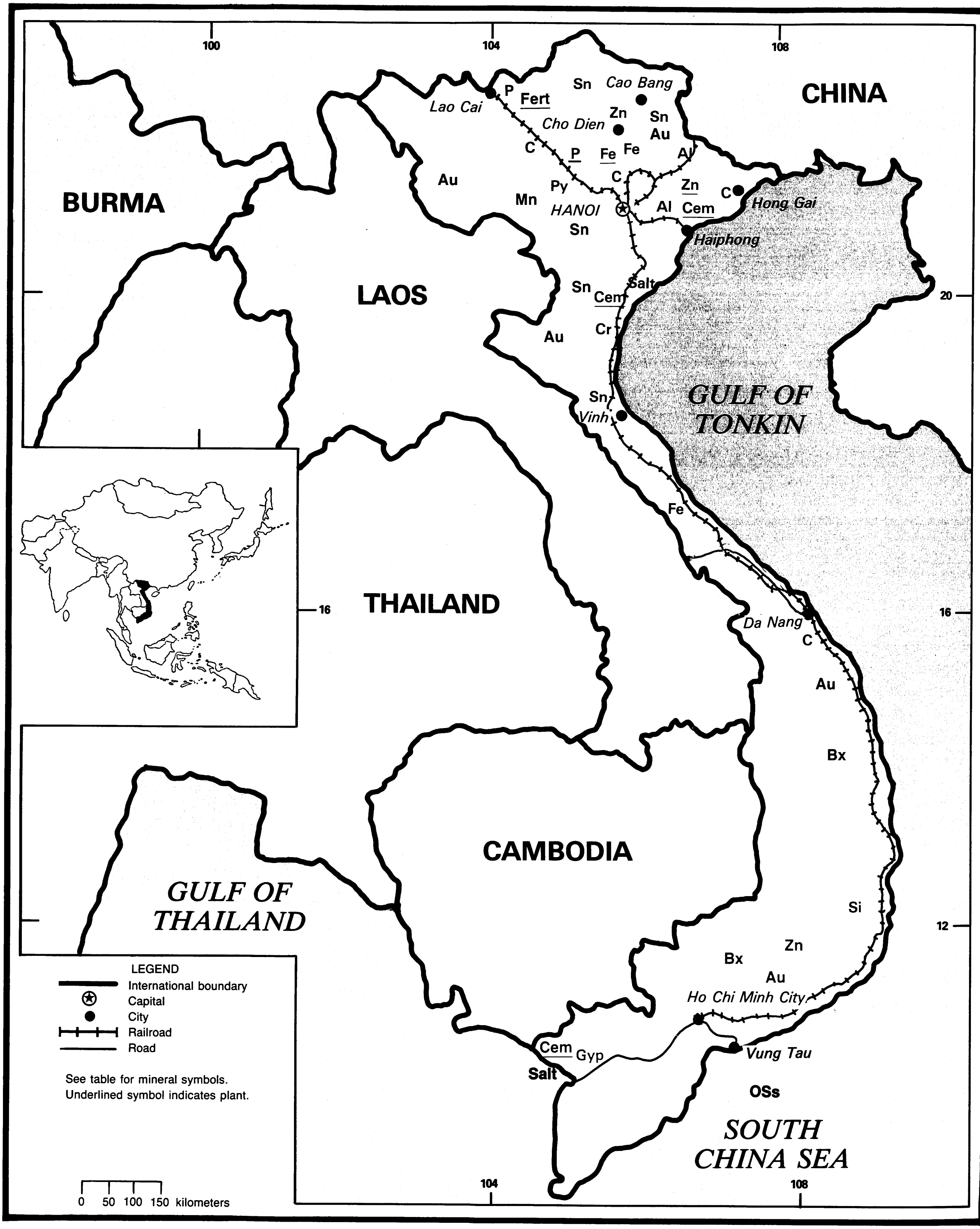
VIETNAM

AREA 330,000 km² **POPULATION 67 million**



THE MINERAL INDUSTRY OF

VIETNAM

By David B. Doan

Vietnam recovered somewhat from the natural and economic catastrophe of the previous year, the result of bad weather, crop destruction, food shortages, poor management, and roaring inflation. The most positive factor in the country's mineral industry, and arguably more so for the entire economy, was the continued development of offshore petroleum, a conspicuous increase in production, and the earning of foreign-exchange credits in return for crude exported. Otherwise credit may be due the tentative results of "doi moi", or the "renovation" campaign, much like "perestroika" in the Soviet Union. Vietnam, however, announced that it had no intention of deviating in theory from strictly socialist ways and means. Some features of doi moi seemed to involve reducing the quantity and upgrading the quality of bureaucratic overhead in certain directions, among which were to increase the productivity in agriculture, fisheries, and mining. Moreover, the Party apparatus was actually dismantled as business shifted into private hands and the Government's foreign trading organizations wound down to a supervisory and inspection role.[1]

Inflation was being tamed, having been brought down from more than 14% per month in 1988 to less than 3% per month in 1989. Vietnam's currency, the dong (D), is officially priced at D4,000 to the U.S. dollar,[2] but the freely fluctuating black-market rate has reflected lesser, and truer, conversion rates for the dong. Recently this black-market differential closed to about D4,500 to the U.S. dollar, indicating improvement in the dong and increasing confidence in the economy. Initial reports for 1989 were that the gross national product (GNP) rose 3.5% and that national income rose 3.2% above comparable statistics for the previous year.[3]

Considerable expense in support of the Vietnamese military forces in Cambodia presumably would be saved following their withdrawal to Vietnam in the autumn of 1989. However, differing opinions have been expressed in many quarters as to whether all the troops have actually departed.

GOVERNMENT POLICIES AND PROGRAMS

The Vietnam Council of Ministers, in conjunction with the Vietnam State Bank, decided in April 1989, to set new interest rates for many loan categories, including a draconian monthly rate of 6.42% on loans for mineral ore exploitation. Because checking accounts for "economic organizations and units" earn 4% per month, and 3-month time deposits by the same entities earn 5.8% per month, the mineral extraction loans can be seen in the Vietnamese banking perspective, but the mineral industries did not seem to enjoy any favoritism, let alone pampering.[4]

In July 1989, Vietnam became a full member of the International Union of Geological Sciences, its membership having been approved at the 28th International Geology Congress held in Washington, DC.

The Vietnam Law on Mineral Resources, was approved and promulgated in August. In general, ". . . the state encourages foreign organizations and individuals, international organizations and overseas Vietnamese to invest capital and technology for geological survey, mining, [and] processing of mineral resources in Vietnam in accordance with the Law on Foreign Investment" as well as exhorting citizens to invest "manpower, materials, capital, and technology" in similar pursuits. The text of the new Law on Mineral Resources is contained in eight chapters and 36 articles.[5]

At the end of the year new regulations were announced as to the tax rates for the extraction of mineral resources, including taxes of 2% to 15% on gold mined, a 2% to 10% tax on metallic resources other than gold, a 1% to 12% tax on nonmetal resources in general, a 3% to 15% tax on precious stones, and a 6% to 20% tax on petroleum crude and natural gas.[6]

PRODUCTION

By far, the greatest gain in production in Vietnam's mineral industry was in the petroleum sector, where the nearly 5.5 million barrels produced in the previous year were eclipsed by the 10.8 million barrels extracted in 1989. Further increases can be expected as joint ventures between Vietnam and foreign companies press exploration and development of new fields. In the absence of official statistical reporting by the Government, observations by visitors representing foreign business interests suggest that chromite and coal production have lagged, but that cement production has increased. The Government, in fact, praised cement workers for exceeding targeted output for 1989, but mentioned no numbers.

The other fast-growing mineral industry in Vietnam, paralleling petroleum, is the mining of gold in various parts of the country. An estimated production of 1 ton in 1989 was worth probably $12 to $13.5 million depending on world market-price fluctuations. The next few years should see increases to an annual output of 10 tons or more according to Government hopes. Policy on refining and acquisition by the Government is not yet clear, but such increased levels of production could play a fundamental role in the enhancement

TABLE 1

VIETNAM: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988	1989
Bauxite: Gross weight		6,000	6,000	6,000	6,000	6,000
Cement, hydraulic[3]	thousand tons	1,503	1,526	1,665	1,954	2,000
Chromium: Chromite		r5,000	r4,000	r4,000	r4,000	3,500
Clays: Kaolin		1,000	1,000	1,000	r700	750
Coal: Anthracite[3]	thousand tons	5,624	6,392	6,839	6,900	5,500
Gold	kilograms	—	—	500	1,000	1,200
Gypsum		25,000	25,000	25,000	25,000	25,000
Iron and steel: Metal:						
Steel, ingot	thousand tons	110	110	110	115	115
Steel, rolled	do.	50	50	50	50	50
Nitrogen: N content of ammonia		r36,000	r36,000	r36,000	r36,000	36,000
Petroleum: Crude	thousand 42-gallon barrels	—	200	600	5,475	10,850
Phosphate rock:						
Gross weight	thousand tons	4516	530	300	330	500
P_2O_5 content	do.	170	175	105	115	175
Salt	do.	4379	450	229	300	300
Tin:						
Mine output, Sn content		600	650	680	700	850
Metal, smelter		570	620	645	600	800
Zinc:						
Mine output, Zn content		5,000	5,000	5,000	5,000	5,000
Metal, smelter, primary		4,200	4,200	4,200	4,200	4,200

rRevised.
1 Table includes data available through July 15, 1990.
2 In addition to the commodities listed, iron ore was mined in the past and pig iron was produced at industrial facilities, but the status of these industries under prevailing conditions is not sufficiently clear to allow formulation of reliable estimates of output levels. Similarly, data on output of crude construction materials and natural gas are not available, and no basis is available to make reliable estimates of output levels.
3 Statistical Yearbook of Members of the Council for Mutual Assistance, Moscow, U.S.S.R.
4 Reported figure.

of Vietnam's GNP and the stabilization of its currency.

TRADE

In 1989, Vietnam earned a record 1.82 billion "rubles and dollars" from exports, up 81% from the previous year according to the Foreign Economic Relations Ministry.[7] However, no explanation of the composition of the ruble-dollar mix has been advanced for this terminology that is commonly quoted by the Government.

In monetary value, the country's exports of petroleum had to be the outstanding mineral commodity item in its trade with other countries, but it is not known what price per barrel is being received. A modest estimate of $15 per barrel would show an income to Vietnam of $162 million from petroleum alone, all of it perhaps purchased by Japan. Coal exports amounted to 600,000 tons in 1989, representing significant improvement compared with the 320,000 tons shipped the previous year. In contrast to the 1.3 million tons exported in 1979, however, there seemed to be room for improvement. China and France joined Japan as buyers, and the United Kingdom was said to be newly interested. Again, price information has not been divulged, but earnings from coal may possibly amount to about one quarter of those from petroleum crude.

STRUCTURE OF THE MINERAL INDUSTRY

Mineral resources in Vietnam are owned by the state (the "people") and, with the exception of the petroleum sector, all mines and mineral processing plants are solely owned and operated by the Government. Petroleum exploration and production have been joint ventures between Vietnam and the Soviet Union, but new arrangements also include joint ventures with companies of other foreign origin. Principal agencies dealing with mineral matters have included the General Department of Chemicals, the Ministry of Construction, the Ministry of Engineering and Metals, and the Ministry of Power and Coal. At the end of the year, however, it was announced that the Ministry of Engineering and Metals would be changed to the Ministry of Heavy Industry to unify state management in the engineering and metals; electronics; mines, geological, oil, and natural gas; and chemical resources sectors.

The labor force in mineral industries

is believed to be a significantly large part of the relatively small Vietnamese industrial sector. Heretofore, the largest mineral-industry employer has been the coal mining sector, but it is believed that the construction minerals sector, comprising about 95,000 workers, may have overtaken the former. As petroleum development progresses, this sector may eventually become the largest employer.

COMMODITY REVIEW

Metals

Bauxite.—Although production of bauxite is thought to have been at a nominal rate, estimated at about 6,000 tons per year, development may increase the level of output. Two geologically different types of bauxite are recognized, one being of Permian age in northeastern Vietnam and the other a much-younger lateritic type of Quaternary age. Further exploration would be expected to result in the discovery of additional deposits of the latter.

Chromite.—For 60 years chromite has been mined in Vietnam, presumably without interruption by wars or typhoons, at a very exposed placer mining site on the shores of the Gulf of Tonkin in Thanh Hoa Province 150 kilometers (km) south of Hanoi. Peak production was reached in 1963 when 36,000 tons was extracted, but present production has stagnated at roughly 3,500 tons per year amidst indications that the Government has realized the value of its potential chromite production to the earning of foreign-exchange credits. An Australian company, Covictory Investments Ltd., obtained approval for exploration as well as development rights pending the results of a feasibility study of the characteristics of the deposit. The mining site has access to water, power, and port facilities and is being considered also to house a plant for the production of ferrochrome.[8]

Gold.—Because of the increasing success in prospecting for gold throughout much of Vietnam, the Government has issued a directive calling for activity to be stepped up even further in an effort to multiply production severalfold.[9] Although many occurrences of both lode and placer gold have been found, previous mining has been mainly of lode gold in quartz veins and dates back long before French colonial days. Australia's Covictory Investments Ltd. has likewise negotiated a development program involving gold deposits near Da Nang. Its $10 million exploration and development program may culminate possibly in gold production at about the 1-ton-per-year level sometime in early 1990.

Iron and Steel.—Because of problems combining power shortages with poor logistical support by the national

TABLE 2

VIETNAM: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Principal destinations, 1988
METALS			
Aluminum: Metal including alloys, all forms	—	35	All to Hong Kong.
Chromium: Ore and concentrate	2,122	—	
Copper: Metal including alloys, all forms	—	285	Hong Kong 200; Thailand 85.
Iron and steel: Metal:			
Scrap	84,582	130,816	Japan 123,686; Thailand 7,130.
Ferroalloys	—	82	Thailand 72; Japan 10.
Semimanufactures	NA	69	Mainly to Belgium-Luxembourg.
Lead: Metal including alloys, unwrought	103	—	
Tin: Metal including alloys, unwrought	35	—	
INDUSTRIAL MINERALS			
Graphite, natural	—	50	All to Austria.
Gypsum and plaster	—	7	All to Malaysia.
Mica: Crude including splittings and waste	29	60	All to Japan.
Pigments, mineral: Iron oxides and hydroxides, processed	—	40	All to Hong Kong.
Precious and semiprecious stones other than diamond: Natural value, thousands	—	$23	Do.
Salt and brine	610	—	
MINERAL FUELS AND RELATED MATERIALS			
Coal: Anthracite and bituminous	86,743	95,243	Japan 89,243; Thailand 4,200; Hong Kong 1,464.
Petroleum: Crude 42-gallon barrels	1,745,941	3,256,618	All to Japan.

[p] Preliminary. NA Not available.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Vietnam, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any imports of mineral commodities from Vietnam during 1988.

TABLE 3

VIETNAM: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Principal sources, 1988
METALS			
Alkali and alkaline-earth metals	2	—	
Aluminum: Metal including alloys, all forms	62	133	Japan 121; Hong Kong 12.
Arsenic: Oxides and acids	1	—	
Chromium: Oxides and hydroxides	91	40	All from Japan.
Cobalt: Oxides and hydroxides	5	2	Do.
Copper: Metal including alloys, all forms	19	64	Do.
Gold: Metal including alloys, all forms value, thousands	—	$403	All from Hong Kong.
Iron and steel:			
Iron ore and concentrate: Pyrite, roasted	56,000	83,000	All from U.S.S.R.
Metal:			
Scrap	—	12	All from Japan.
Pig iron, cast iron, related materials	—	5	Do.
Ferroalloys	1,701	1,531	U.S.S.R. 1,347; Norway 104; Japan 80.
Steel, primary forms	—	99	Belgium-Luxembourg 54; Sweden 45.
Semimanufactures:			
Bars, rods, angles, shapes, sections	2,836	702	Hong Kong 388; Sweden 263.
Universals, plates, sheets	6,253	1,334	All from Hong Kong.
Hoop and strip	213	54	Do.
Wire	406	675	Hong Kong 361; Japan 312.
Tubes, pipes, fittings	2,049	11,612	Japan 6,565; Spain 5,000.
Castings and forgings, rough	2	—	
Unspecified	399,000	432,000	All from U.S.S.R.
Lead:			
Oxides	30	—	
Metal including alloys, all forms	12	20	All from Japan.
Manganese: Oxides	750	100	Do.
Mercury	2	—	
Nickel: Metal including alloys, all forms	11	9	Japan 5; Sweden 4.
Silver: Metal including alloys, unwrought and partly wrought value, thousands	$11	—	
Tin: Metal including alloys, all forms	—	1	All from Hong Kong.
Titanium: Oxides	263	180	Japan 150; Hong Kong 30.
Zinc:			
Oxides	191	138	All from Japan.
Metal including alloys:			
Unwrought	188	160	All from Hong Kong.
Semimanufactures	1	(2)	All from Japan.
Other: Base metals including alloys, all forms	1	—	
INDUSTRIAL MINERALS			
Abrasives, n.e.s.:			
Natural: Corundum, emery, pumice, etc.	21	—	
Dust and powder of precious and semiprecious stones including diamond value, thousands	—	$25	Japan $22; Hong Kong $3.
Grinding and polishing wheels and stones	1	9	Japan 7; Sweden 2.
Cement	62,277	31,800	Indonesia 30,100; Japan 1,700.
Clays, crude	—	500	All from Hong Kong.
Cryolite and chiolite	5	—	

See footnotes at end of table.

TABLE 3—Continued

VIETNAM: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Principal sources, 1988
INDUSTRIAL MINERALS—Continued			
Diamond: Natural: Gem not set or strung value, thousands	—	$135	All from Belgium-Luxembourg.
Diatomite and other infusorial earth	—	70	All from Japan.
Feldspar, fluorspar, related materials	—	200	Do.
Fertilizer materials: Manufactured:			
Ammonia	10	38	Do.
Nitrogenous	98,814	98,804	All from Indonesia.
Phosphatic	5,825	10,500	All from Philippines.
Unspecified and mixed	2	84,432	Hong Kong 51,992; Philippines 32,340.
Iodine including bromine and fluorine value, thousands	—	$10	All from Japan.
Magnesium compounds: Oxides and hydroxides	20	—	
Mica: Worked including agglomerated splittings	1	([3])	All from Japan.
Nitrates, crude	—	50	All from Hong Kong.
Pigments, mineral: Iron oxides and hydroxides, processed	15	10	All from Japan.
Sodium compounds, n.e.s.:			
Soda ash, natural and manufactured	547	—	
Sulfate, natural and manufactured	220	907	Hong Kong 900; Japan 7.
Stone, sand and gravel: Dimension stone, all forms	12	11	All from Japan.
Sulfur:			
Elemental, all forms	40	50	All from Hong Kong.
Sulfuric acid	5	—	
Talc, steatite, soapstone, pyrophyllite	96	14	All from France.
Other: Metalloids, unspecified[4]	2	5	All from Japan.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1	—	
Carbon black	609	55	All from Japan.
Coal: Anthracite and bituminous	38,149	5,000	All from Indonesia.
Coke and semicoke	—	100	All from Japan.
Petroleum refinery products:			
Gasoline 42-gallon barrels	51	80	All from Belgium-Luxembourg.
Mineral jelly and wax do.	2,686	16	All from Japan.
Kerosene and jet fuel do.	1,000	—	
Distillate fuel oil do.	30	—	
Lubricants do.	73,941	952	Belgium-Luxembourg 595; Sweden 357.
Bitumen and other residues do.	61	—	
Bituminous mixtures do.	—	242	All from Japan.
Unspecified do.	12,887,000	12,327,000	All from U.S.S.R.

[p] Preliminary.
[1] Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by Vietnam, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from United Nations information and data published by the partner trade countries. The United States did not report any exports of mineral commodities to Vietnam during 1988.
[2] Unreported quantity valued at $3,000.
[3] Unreported quantity valued at $2,000.
[4] Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic etc."

infrastructure, Vietnam's steel production continued to languish at a level far below its installed capacity. The country's principal steel plant at Thai Nguyen, about 65 km north of Hanoi, has not approached its 200,000-ton-per-year capacity, for example. Moreover, smaller operations could be expected to have fared even worse.

On the plus side, new iron ore deposits have been found that may give impetus to the improvement of the country's iron and steel industry. Although as many as 240 separate deposits are known, a major one at Quy Xa In Hoang Lien Son Province, about 260 km northwest of Hanoi, includes roughly 120 million tons of limonitic ore grading 54% to 55% iron. A potentially larger deposit of high-grade ore has been under study at Thach Khe in Nghe Tinh Province, about 130 km south of Hanoi.

Zinc.—As with gold, zinc has been produced in Vietnam since before French Colonial times, but mostly from one deposit at Cho Dien in Cao Bang Province that was opened in the 18th century. Situated 145 km north of Hanoi, this unusual orebody grades 40% to 50% zinc and is thought to comprise nearly 500,000 tons. Production had been discontinuous since the original discovery, but during their tenure the French extracted what they could of the desirable high-grade ore. After further inactivity in the World War II period and thereafter, systematic operations resumed in 1957. New zinc deposits have been found in various other parts of the country, but only Cho Dien is in production, providing about 10,000 tons per year of ore for smelting.

INDUSTRIAL MINERALS

Cement.—For a number of years Vietnam has been producing cement at a rate equivalent to less than half of the installed national aggregate capacity of

TABLE 4

VIETNAM: STRUCTURE OF THE MINERAL INDUSTRY

(Thousand metric tons per year)

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity
Bauxite	Basic Chemical Corp.	Lo Son, believed to be in Hai Hung Province	NA
Do.	do.	Mieu, believed to be in Hai Hung Province	NA
Cement	Ministry of Construction	Bim Son, Thanh Hoa Province, 100 kilometers south of Hanoi	1,200
Do.	do.	Huang Thach, Hai Hung Province, 50 kilometers east of Hanoi	1,000
Do.	do.	Ha Tien, Kien Giang Province, 245 kilometers west of Ho Chih Minh City	1,300
Chromite	Basic Chemical Corp.	Co Dinh, 100 kilometers north of Vinh, Thanh Hoa Province	4
Coal, anthracite	Ministry of Mines and Coal	Coc Sau, Deo Nai, Ha Tu, and Thong Nhat in the Hon Gai coal field, north of Haiphong	6,000
Fertilizer:			
Apatite	General Department of Chemicals	Lao Cai, Hoang Lien Son Province, 250 kilometers northwest of Hanoi	300
Phosphate, single superphosphate	do.	Lam Thao, Vinh Phu Province, 70 kilometers north of Hanoi	[1] 300
Iron:			
Ore	Ministry of Mines and Coal	Thach Khe, coast of Thach Ha District, Nghe Tinh Province, 175 kilometers southeast of Vinh	NA
Steel	do.	Thai Nguyen, 60 kilometers north of Hanoi	200
Tin:			
Ore	Ministry of Engineering and Metals.	Tinh Tuc mining area near Cao Bang	NA
Do.	do.	Son Duong mining area, Tuyen Province, 75 kilometers west of Hanoi	NA
Do.	do.	Qui Hop, Nghe Tinh Province, 25 kilometers north-northwest of Vinh	NA
Metal	do.	Tinh Tuc, Cao Bang	1
Zinc:			
Ore	do.	Cho Dien, Bach Thai Province	10
Do.	do.	Trang Da Mine, location unknown	NA
Metal	do.	Quang Yen, near Haiphong	6,000

NA Not available.

[1] Plant produced single superphosphate (SSP) fertilizer but it is not clear whether capacity is in P_2O_5 content or gross weight of SSP at 16% P_2O_5.

3.5 million tons per year, primarily at Bim Son, Hoang Thach, and Ha Tien. In December 1989, however, the Chairman of the Council of Ministers sent a letter of commendation to the workers of the Vietnam Cement Union for overfulfilling the state plan for 1989, but mentioned no specific production amounts. Many small or miniplants scattered through the country, managed by local officials, likewise have reported higher output and smoother operations.[10]

Fertilizer Materials.—Although Vietnam's apatite reserves are among the largest in the world, production of phosphate was virtually destroyed at Lao Cai during the 1979 war with China. With Soviet assistance, the Lao Cai mine was brought back into production at a level approximating 300,000 tons per year. In 1989, the total output from Lao Cai plus scores of other small phosphate mining operations increased to about 500,000 tons. In addition to a chronic shortage of potash, nitrate fertilizers became scarce late in the year primarily because of longstanding debts to the Soviet suppliers in conjunction with other difficulties resulting from upheavals within the Soviet Union.[11] Vietnam has consistently used less phosphate and potash in relation to its utilization of nitrogen fertilizers in comparison with both the world average and the developing-country average. The new inability to acquire nitrates from the Soviet Union boded ill for Vietnamese agriculture, particularly the rice crop being planted in early 1990. The country's position as the world's third largest rice exporter was being threatened, and once again questions of the country's economic self-sufficiency began to loom.

Gem Stones.—A joint venture in mining of gem stones was established between the Vietnam General Department of Mines and Geology, the Provincial government of Hoang Lien Son, and the B. P. Company of Thailand. Having an initial prescribed capital of $1 million and a term of cooperation expected to last for a period of 10 to 15 years, the joint-venture announcement did not specify the type of gems sought.[12]

Mineral Fuels

Coal.—Coal is Vietnam's principal source of energy for production of electric power and continues to be its most significant natural resource. Even though petroleum utilization may overtake coal as development of offshore fields progresses, many of the country's powerplants are configured for the high-quality anthracite mined in the Quang Yen Basin due east of Hanoi along the coast.

Production of coal has stagnated at a level approximating 5.5 million tons per year. The lack of increase of output reflects aging or obsolete plants and equipment, nonapplication of accepted mining-engineering techniques, and poor motivation from management on down to workers. Significant amounts of coal have been lost as flash floods decimated stockpiles and underground fires have burned in some mines for several years. In both cases, the losses were ascribed to departure from standard or prescribed techniques of mining and materials handling.[13]

The introduction of a new wage system in 1986–87, represented as a reform that would provide incentive for higher productivity, actually canceled previous allowances for basics such as food and had the overall result of sharply decreasing the average coal miner's purchasing power and stimulating unrest and discontent. Of the total of 90,000 coal miners in Vietnam, 25,000 are women. Partly with this in view, the United Nations Development Projects has agreed to contribute $351,000 to improve the miners' working environment and the workers' health in the Cam Pha coal fields in the northern border province of Quang Ninh. The Vietnam Government will advance about $45,000 to the project.

The resolution of problems facing the coal mining sector is critical to the future of Vietnam. Insufficient coal supply causes electric power shortages, particularly in the cluster of thermal powerplants surrounding Hanoi. Moreover, a significant source of foreign-exchange credits is lost if coal is not available for export. Reserves of anthracite, bituminous coal, and lignite are very large in Vietnam, representing great potential wealth. The maximum potential value is realized only if sound engineering and design are combined for mine development to enable economical production for both domestic consumption and export markets. The Government aimed for exports of 1 million tons in 1990, a substantial increase over the 600,000 tons sold abroad in 1989.

Natural Gas.—Presumably any gas associated with the increasing production of crude in offshore operations is being flared (directed into the atmosphere and burned).

A few small fields in the Red River Delta, particularly around Haiphong, produce gas for local power consumption. Rates and volumes of production are not known.

Petroleum, Crude.—By the end of 1989, Vietnam had 7 offshore oil drilling rigs and 39 producing wells in operation. Two more rigs are expected to be moved in, and 16 new holes were scheduled to be drilled in 1990. Not only is the Bach Ho (White Tiger) Field being expanded through development drilling, but two other fields, Dai Hung (Big Bear) and Rong (Dragon), are being explored. These latter two fields are farther offshore and in deeper water than Bach Ho. As of the end of the year, joint ventures in petroleum exploration and production have been established between Petrovietnam and the Total Company of France, British Petroleum (BP) and Enterprise of Britain, Shell Exploration RV of the Netherlands and Belgium, Swedish Exploration Consortium AB, and the Oil and Natural Gas Commission of India.

Bach Ho crude runs between 28° and 30° API gravity with extremely low sulfur at about 0.01%. Not having any refining facilities, Vietnam has shipped its crude to Japan and Singapore. Now, however, a refinery is nearing completion at Phu My, about 15 km north of Vung Tau, the offshore-operations logistical base on the coast southeast of Ho Chih Minh City. Installed capacity of this refinery will be 3 million tons per year of crude. Similarly, a petrochemical complex is being built at Thanh Tuy Ha, 50 km southeast of Ho Chih Minh City, that will likewise have a 3-million-ton-per-year throughput. Upon completion of these facilities, Vietnam will have new choices in export versus domestic consumption of petroleum products.[14]

Reserves

Information relating to reserves is based primarily on news broadcasts by state radio (Hanoi Domestic Service), announcements or projections by representatives of foreign business interests in

Vietnam, and Vietnamese newpaper articles, in approximately that order of significance. No feasible method exists for verification of the reserve values set forth, but in general they are consistent with what is known of the geology of the country. Future revisions should be expected as more concrete information becomes available.

INFRASTRUCTURE

Vietnam's transportation network is possibly the worst part of a generally poor national infrastructure. Although the country has about 85,000 km of roads, only 9,400 km are paved; 48,700 km are gravel or improved surface; 26,900 km are loose- or natural-surface whose passability cannot be assumed in all seasons.

A 3,066-km rail network includes 2,454 km of 1-meter (m) gauge, 151 km of standard or 1.435-m gauge, and 230 km of dual guage comprising three rails. Of the total, 224 km is not in service. The system has one line extending from Ho Chih Minh City all the way to the Chinese border. Still operating at a very low capacity, the rail lines suffer from obsolescent rolling stock, a lack of spare parts, and poor maintenance, all combining to impair the significance of rail transportation to the economy.

Movement of food, goods, and mineral commodities is slow, costly, and unreliable. Inadequate transportation is believed to exert a depressing effect on the production of cement, coal, and fertilizer, with implications in turn for power generation, construction, and food production.

Inland waterways include about 17,700 km navigable, with at least 5,100 km navigable at all times by vessels not exceeding 1.8-m draft, thus relieving internal transportation problems somewhat, particularly in the regions including the Mekong and Red River Deltas. Major seaports are Haiphong, Da Nang, and Ho Chih Minh City.

There are approximately 100 usable airports, 50 of them paved, which include 10 having runways of 2,440 to 3,659 m and 20 with runways 1,220 to 2,439 m long. Most of these readily deteriorate under tropical conditions if not maintained.

Chronic power shortages have been common in Vietnam. Installed capacity was 1,800 megawatts (MW) in 1985, 2,025 MW in 1988 and, with Soviet assistance, had been increasing at about that rate. New thermal and hydroelectric powerplants have been under construction, but actual production of electricity has been less than 100 kilowatt hours per capita and, hence, there is great room for improvement if the country is to realize industrial development. Recent progress includes the upgrading of several small hydroelectric plants and significant new activity at two major ones. The fourth and final generator has been installed at the Tri An Hydroelectric Power Plant on the Dong Nai River about 100 km northeast of Ho Chih Minh City, increasing its capacity to 400 MW and alleviating somewhat the shortage of power in that area. On the Da River, 70 km southwest of Hanoi, the second of eight 240-MW generators was started up at the Hoa Binh hydroelectric project and connected to the regional grid. The largest single project in Vietnam, this plant will eventually have an installed capacity of 1,920 MW and will control flooding and water transportation in the Red River delta.

TABLE 5

VIETNAM: ESTIMATED MAJOR MINERAL RESERVES

(Thousand metric tons unless otherwise specified)

Apatite		1,700,000
Chromite		750,000
Coal		200,000
Gold		1.5
Graphite		100
Iron ore		250,000
Kaolinite		50
Manganese		2,500
Petroleum, crude	thousand barrels	800,000
Tin		2,000
Zinc		200

OUTLOOK

The year 1989 saw the realization of some spectacular failures of centrally planned economies in Eastern Europe, in addition to the previous economic and political upheavals in the Soviet Union. Vietnam has declared itself unmoved by these failures and that it will redouble its efforts to achieve socialist goals. However, the country has displayed evidence toward realizing economic progress to almost the same extent that it has permitted private entrepeneurs to engage in capital projects. Such entrepeneurs have been both domestic and, more prominently, foreign, with specific reference to the petroleum industry.

There are current signs that the characteristic socialist bureaucracy of Vietnam is being quietly dismantled in some cases, presumably to engender greater flexibility in management and operations. The coal industry may be viewed at present as the bellweather of such efforts in the mineral industries. The degree to which coal mining, shipment, industrial utilization, and export improve may be taken as an indication of overall progress in the triumph of practical reality over socialist dialectic.

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[1] Trade, Finance, & Banker International. No. 85, May 1990, p. 42.

[2] Where necessary, the Vietnamese dong (D) has been converted into U. S. dollars at the rate of D4,500= US$1.00.

[3] Work cited in footnote 1.

[4] Hanoi Domestic Service (Broadcast in Vietnamese), 1100 G.m.t. Apr. 15, 1989.

[5] Hanoi Vietnam News Agency (Broadcast in English). 0718 G.m.t. Aug. 14, 1989.

[6] Hanoi Domestic Service (Broadcast in Vietnamese). 0500 G.m.t. Apr. 12, 1990.

[7] Summary of World Broadcasts (Far East). WO118 i, Mar. 7, 1990, p. 8.

[8] American Metal Market. V. 97, No. 84, May 1, 1989, p. 1.

[9] Mining Journal. V. 312, No. 8024, June 16, 1989, p. 471.

[10] Hanoi Domestic Service (Broadcast in Vietnamese). 2300 G.m.t. Dec. 27, 1989.

[11] Hanoi Domestic Service (Broadcast in Vietnamese). 2300 G.m.t. June 4, 1990.

[12] Hanoi Vietnam News Agency (Broadcast in English). 0618 G.m.t. Nov. 3, 1989.

[13] Hanoi NAN DHAN (in Vietnamese). June 12, 1989, p. 2.

[14] Hanoi Vietnam News Agency (Broadcast in English). 0720 G.m.t. May 2, 1990.

OTHER SOURCES OF INFORMATION

Agencies

General Department of Chemicals
Hanoi
Ministry of Construction
Hanoi
Ministry of Engineering and Metals
Hanoi
Ministry of Power and Coal
Hanoi

Map Symbols

Commodity	Symbol
Alunite	Alu
Alumina	Al
Aluminum	AL
Andalusite	And
Antimony	Sb
Arsenic	As
Asbestos	Asb
Asphalt	Asp
Barite	Ba
Bauxite	Bx
Bentonite	Bent
Beryllium	Be
Bismuth	Bi
Bitumen (Natural)	Bit
Boron	B
Bromine	Br
Cadmium	Cd
Calcium	Ca
Carbon Black	CBl
Cement	Cem
Cesium	Cs
Chromite	Cr
Clays	Clay
Coal	C
Cobalt	Co
Columbium	Cb
Copper	Cu
Corundum	Cn
Cryolite	Cry
Diamond	Dm
Diatomite	Dia
Dolomite	Dol
Emerald	Em
Feldspar	Feld
Ferroalloys	FA
Ferrochrome	FeCr
Ferromanganese	FeMn
Ferronickel	FeNi
Ferrosilicon	FeSi
Fertilizer	Fert
Fluorspar	F
Gallium	Ga
Germanium	Ge
Gold	Au
Graphite	Gr
Gypsum	Gyp
Ilmenite	Il
Indium	In
Iron and steel	Fe
Iron Ore	Fe
Kaolin	Kao
Kyanite	Ky
Lapis lazuli	Laz
Lead	Pb
Lignite	Lig
Lime	Lime
Limestone	Ls
Liquefied Natural Gas	LNG
Liquefied Petroleum Gas	LPG
Lithium	Li
Magnesite	Mag
Magnesium	Mg
Manganese	Mn
Marble and Alabaster	Marb
Mercury	Hg
Mica	M
Molybdenum	Mo
Natural Gas	NG
Natural Gas Liquids	NGL
Nepheline Syenite	Neph
Nickel	Ni
Nitrates	Nit
Nitrogen (Ammonia Plants)	N
Oil Shale	OSh
Olivine	Ol
Opal	Opal
Peat	Peat
Perlite	Per
Petroleum, Crude	Pet
Petroleum Refinery Products	Pet
Oil Sands	OSs
Phosphate	P
Pig iron	Pig
Pigments, Iron	Pigm
Platinum-Group Metals	PGM
Potash	K
Precious and Semiprecious Stones	Gem
Pumice	Pum
Pyrite	Py
Pyrophyllite	Pyrp
Quartz or Quartzite	Qtz
Rare Earths	REE
Rhenium	Re
Rutile	Ru
Salt	Salt
Sand and Gravel	Sd/Gvl
Sandstone	Ss
Selenium	Se
Sepiolite, Meerschaum	Sep
Serpentine	Serp
Shale	Sh
Silicon	Si
Sillimanite	Slm
Silver	Ag
Soapstone	Soap
Soda Ash, Trona	NaAsh
Sodium Sulfate	$NaSO_4$
Stone	Stone
Strontium	Sr
Sulfur	S
Talc	Talc
Tantalum	Ta
Tellurium	Te
Thorium	Th
Tin	Sn
Titanium	Ti
Titanium Dioxide	TiO_2
Tungsten	W
Uranium	U
Vanadium	V
Vermiculite	Verm
Wollastonite	Wo
Wonderstone	Ws
Yttrium	Y
Zinc	Zn
Zirconium	Zr

MAP LEGEND

Symbol	=	Mine, including beneficiation plants, well
Circled Symbol	=	Group of producing mines or wells
Underlined Symbol	=	Processing plant or oil refinery, including smelters and metal refineries
(Symbol)	=	Undeveloped resource

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