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MINERAL INDUSTRIES OF

ASIA AND THE PACIFIC

U.S.
DEPARTMENT
OF THE
INTERIOR

BUREAU
OF
MINES

1990

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 1990 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, Area Reports: International, contains the latest available mineral data on more than 160 foreign countries and discusses the importance of minerals to the economies of these nations. The 1990 review is presented as five 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 the 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 Mineral Perspectives Series quinquennial regional books, which have been discontinued. The U.S. 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 U.S. 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 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 of 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

Edmond Chin is Chief, Branch of Asia and the Pacific. His initial work for the Bureau was in electrochemistry and electrometallurgy. Subsequently, he was the Bureau's program manager for the Defense Production Act Program for Rutile, administered by the Office of Minerals and Solid Fuels of the Department of the Interior. Then he was commodity specialist for beryllium, cesium and rubidium, gallium, hafnium, magnesium, rare earths, and yttrium; New York State specialist; country specialist for Cameroon and Guinea; Dominican Republic, Haiti, and Jamaica; and China, Hong Kong, Indonesia, Japan, North Korea, the Republic of Korea, Malaysia, Mongolia, Philippines, Singapore, and Taiwan. He also served as the Bureau's representative to the Department's Law of the Sea Advisory Group and as a Bureau representative to the National Academy of Science's National Materials Advisory Board.

David B. Doan, geologist, has 14 years of experience with the U.S. Geological Survey and more than 25 years as a consulting geologist to industry, including fieldwork in East and Southeast Asia, and 6 years as visiting professor at the University of Maryland. Before his reassignment to the Branch of Latin America and Canada, he was 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.

Chin S. Kuo, mining engineer, has more than 10 years of experience in private industry. He is a senior country analyst in the Branch of Asia and the Pacific, specializing in countries of north Asia and southeast Asia, and has authored Bureau publications on China, North Korea, the Republic of Korea, and Singapore.

Travis Q. Lyday, geologist, has almost 20 years of industry experience. He is a senior country analyst in the Branch of Asia and the Pacific, specializing in countries of Oceania and Southeast Asia, and has authored Bureau publications on Australia, New Zealand, and Philippines, as well as Christmas Island, Fiji, Nauru, New Caledonia, Papua New Guinea, and the Solomon Islands.

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 30 papers on these subjects either in international journals or in technical publications of the Argonne National Laboratory. Dr. Tse is a senior analyst in the Branch of Asia and the Pacific and specializes in China, Hong Kong, Singapore, and Taiwan. He has authored Bureau publications on Afghanistan, China, Hong Kong, India, Pakistan, and Taiwan.

John C. Wu, economist, has close to 10 years of experience in private industry. He is a senior country analyst in the Branch of Asia and the Pacific, specializing in Japan and other countries of north Asia and southeast Asia, and has authored Bureau publications on Indonesia, Japan, Malaysia, Philippines, and Thailand, as well as Mongolia and Singapore.

For comments or further information, please contact:
Chief, the Branch of Asia and the Pacific
The Division of International Minerals
U.S. Bureau of Mines
810 7th Street, NW, MS 5205
Washington, DC 20241
Telephone: (202) 501-9691
Fax: (202) 219-2489
Telex: 9102900107 USBM INTL UQ

MINERAL INDUSTRIES OF

ASIA AND THE PACIFIC

By Staff, Branch of Asia and the Pacific

INTRODUCTION[1]

The land mass of the Asia and Pacific region comprises 11 million square miles or about 15% 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 countries in the Asia and Pacific region represent some of the most vibrant economies in the world. Japan is undisputed as one of the world's leaders in manufacturing and commerce. Hong Kong and Singapore are significant both as entrepôt and banking centers. The economies of Australia, the Republic of Korea, and Taiwan compare favorably to the level of the industrialized countries in western Europe. Indonesia, Malaysia, the Philippines, and Thailand have maintained strong economic growth during the past two decades. All these countries in the Asia and Pacific region collectively constitute a significant bloc as to raw materials production and consumption, as to manufacturing, and as to world trade.

The Asia and the Pacific region has large resources of antimony, bauxite, bismuth, copper, fluorspar, gold, graphite, iron ore, magnesite, mica, nickel, rare earths, talc, titanium, zinc, and zirconium. 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, the central Korean peninsula, and in Thailand and Burma. India and the Republic of Korea are well known for graphite and mica. Korean graphite is associated with anthracite. Talc and magnesite occur in the mafic rocks of the Liaodong and Korean peninsula.

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 bauxite, iron ore, 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 short of petroleum. However, China's fuel position is relatively strong, with large resources of coal and with resources of both onshore and offshore resources of petroleum and natural gas. Indonesia has petroleum, but it is reducing exports as internal demand increases and known reserves are drawn down. However, Indonesia is actively developing its coal resources. The Korean peninsula has no petroleum resources, but both North Korea and the Republic of Korea have developed anthracite deposits to support their steel industries. India's coal position is good, and petroleum output shows promise. Thailand continues to rely on imported petroleum, although oil shale is present and gas has been found. The Philippines has little domestic energy resources, other than local geothermal power. Brunei is noted mostly for its natural gas and to a much lesser extent for petroleum. Brunei is an important supplier of liquefied natural gas in the region, principally to Japan.

In terms of exploitation, many minerals, metals, and fuels are produced in significant quantities in Asia and the Pacific region as shown in table 1. Collectively, the area accounts for a substantial amount of the world production of antimony, barite, graphite, ilmenite and rutile, tin, and tungsten. In addition, it provides significant amounts of the world's output of antimony, bauxite, columbite-tantalite, copper, fluorspar, iron ore, magnesite, manganese, mica, nickel, pyrophyllite, rare earth minerals, salt, talc, and uranium.

The production of crude petroleum throughout Asia and the Pacific region is close to 2.3 billion barrels. China and Indonesia together account for about 67% of the total output. The remainder is primarily from Brunei, Burma, India, and Malaysia. Indonesia is the largest producer of natural gas in the area, with an output of about 44 billion cubic meters, followed by Australia with 21 billion cubic meters, and China and Malaysia with about 15 billion cubic meters.

Total coal production of the region now exceeds 1.6 billion metric tons. The production of bituminous coal accounts for almost 85% of the total output. China is the largest producer, with an output of almost 1.1 billion tons. Other major producers are India and Australia. The combined production by China, India, and Australia was about 1.5 billion tons or 93% of the area's output. Other coal production is nominal, coming from Afghanistan, Indonesia, Japan, the Koreas, Mongolia, Taiwan, and Vietnam.

Japan is by far the largest, single consumer of metals in the Asia and Pacific region. It accounts for almost 40% of the total crude steel consumption in the region and generally for 50% of the consumption of the major nonferrous metals. The second largest consumer is China, accounting for close to 30% of the total crude steel consumption and about 20% of the consumption of nonferrous metals. A bloc of countries, consisting of Australia, India, the Republic of Korea, Taiwan, and Thailand, account for virtually the bulk of the remainder of the consumption of metals. The region as a whole consumed between 15% to 35% of the total world consumption of metals. The metal demand in the Asia and Pacific region is generally equivalent

TABLE 1

ASIA AND THE PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1990

(Thousand metric tons unless otherwise specified)

Country	Aluminum			Barite	Cement	Coal		Copper	
	Bauxite	Alumina	Metal			Anthracite	Bituminous	Mine, Cu content	Refined, primary
Afghanistan	—	—	—	2	112	—	180	5	—
Australia	40,697	11,231	1,234	11	6,500	—	198,205	316	247
Bangladesh	—	—	—	—	315	—	—	—	—
Bhutan	—	—	—	—	—	—	—	—	—
Brunei	—	—	—	—	—	—	—	—	—
Burma	—	—	—	9	375	—	—	5	—
Cambodia	—	—	—	—	—	—	—	—	—
China	2,400	1,500	850	1,750	203,000	170,000	883,460	300	560
Christmas Island	—	—	—	—	—	—	—	—	—
Fiji	—	—	—	—	80	—	—	—	—
Hong Kong	—	—	—	—	1,808	—	—	—	—
India	4,473	1,601	433	707	49,000	—	213,000	58	41
Indonesia	1,206	—	186	—	13,762	—	10,769	178	—
Japan	—	481	34	—	84,445	7	8,256	13	893
Korea, North	—	—	—	100	16,000	68,000	—	15	25
Korea, Republic of	—	—	2	4	33,600	17,217	—	([1])	183
Laos	—	—	—	—	7	—	—	—	—
Malaysia	398	—	—	48	5,881	—	99	24	—
Mongolia	—	—	—	—	510	—	600	135	—
Nauru	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	107	—	—	—	—
New Caledonia	—	—	—	—	65	—	—	—	—
New Zealand	—	—	260	—	750	—	2,300	—	—
Pakistan	3	—	—	23	7,200	—	2,733	—	—
Papua New Guinea	—	—	—	—	—	—	—	170	—
Philippines	—	—	—	500	4,000	—	1,187	182	126
Singapore	—	—	—	—	1,852	—	—	—	—
Solomon Islands	—	—	—	—	—	—	—	—	—
Sri Lanka	—	—	—	—	400	—	—	—	—
Taiwan	—	—	—	—	18,459	—	480	—	16
Thailand	—	—	—	80	18,054	21	—	—	—
Vietnam	—	—	—	—	2,500	4	—	—	—
Total	49,177	14,813	2,999	3,234	468,782	255,249	1,321,269	1,396	2,091
Share of world total, percent	44	37	17	58	42	74	34	16	23
United States	W	40,105	4,048	439	71,310	2,831	855,558	1,587	1,571

See footnotes at end of table.

to that of the United States. See table 2 for metals consumption as reported by Metallgesellschaft AG and the International Iron and Steel Institute. The data highlight nine commodities for which the region accounts for from 15% to 35% of world consumption.

The focuses of the large trading areas center around north Asia and the countries of the Association of Southeast Asian Nations (ASEAN). The value of overall trade by the four dragons—Hong Kong, Japan, the Republic of Korea, and Taiwan—totaled $944.2 billion in 1990. In comparison, that of ASEAN totaled $297.1 billion. A budding trading area is centered around Guangzhou, Guangdong, in southern China. Its commerce formerly has been intertwined with the trade of Hong Kong. Because of the availability of inexpensive labor and the establishment of free trade zones, the Guangzhou area is expected to expand its role in world trade. The Asia and Pacific region as a whole enjoys a trade surplus principally owing to Japan and to a lesser extent to net exports by China, Indonesia, and Taiwan. The region collectively had a positive trade balance of $34.9 billion in 1990, compared with the trade deficit of the United States

TABLE 1—Continued

ASIA AND THE PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1990

(Thousand metric tons unless otherwise specified)

Country	Fluorspar	Gold Mine, Au content[2]	Graphite	Iodine	Iron: Ore, gross weight	Iron: Pig	Iron: Steel, crude	Lead: Mine, Pb content	Lead: Refined, primary	Magnesite	Manganese ore, Mn content
Afghanistan	—	—	—	—	—	—	—	—	—	—	—
Australia	—	242	—	—	111,349	6,125	6,666	563	212	60	1,919
Bangladesh	—	—	—	—	—	—	90	—	—	—	—
Bhutan	—	—	—	—	—	—	—	—	—	—	—
Brunei	—	—	—	—	—	—	—	—	—	—	—
Burma	—	—	—	—	—	—	—	4	3	—	—
Cambodia	—	—	—	—	—	—	—	—	—	—	—
China	1,500	100	200	([1])	168,300	62,000	66,100	315	280	2,600	3,200
Christmas Island	—	—	—	—	—	—	—	—	—	—	—
Fiji	—	4	—	—	—	—	—	—	—	—	—
Hong Kong	—	—	—	—	—	—	350	—	—	—	—
India	25	2	61	—	53,700	12,600	14,350	28	25	544	512
Indonesia	—	11	—	([1])	145	—	2,100	—	—	—	—
Japan	—	7	—	8	34	80,229	110,339	19	205	—	—
Korea, North	40	5	35	—	10,000	6,500	8,000	80	70	1,500	—
Korea, Republic of	([1])	21	100	—	298	15,339	23,125	15	61	—	—
Laos	—	—	—	—	—	—	—	—	—	—	—
Malaysia	—	3	—	—	334	—	550	—	—	—	—
Mongolia	800	—	—	—	—	—	—	—	—	—	—
Nauru	—	—	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	—	—	—	—	—	25	—
New Caledonia	—	—	—	—	—	—	—	—	—	—	—
New Zealand	—	8	—	—	2,400	200	765	—	—	—	—
Pakistan	5	—	—	—	—	1,000	1,000	—	—	4	—
Papua New Guinea	—	31	—	—	—	—	—	—	—	—	—
Philippines	—	29	—	—	—	—	300	—	—	1	3
Singapore	—	—	—	—	—	—	489	—	—	—	—
Solomon Islands	—	([1])	—	—	—	—	—	—	—	—	—
Sri Lanka	—	—	4	—	—	—	—	—	—	—	—
Taiwan	—	—	—	—	—	5,474	9,554	—	—	—	—
Thailand	100	—	—	—	129	—	685	22	—	—	12
Vietnam	—	—	—	—	—	—	120	—	—	—	—
Total	2,470	500	400	8	346,689	189,467	244,583	1,046	856	4,734	4,646
Share of world total, percent	48	25	61	47	38	35	31	31	26	544	20
United States	64	266	—	2	56,408	49,668	89,726	495	404	W	—

See footnotes at end of table.

and the European Community of $123.4 billion and $11.9 billion, respectively. The value of trade by the major countries in the region is given in table 3.

The United States is a major trading partner with a number of countries in Asia and the Pacific. In terms of the magnitude of value, the most significant countries are Australia, China, Japan, the Republic of Korea, and Taiwan. Moreover, the United States has a trade deficit with China, Japan, and Taiwan.

Japan, Republic of Korea, and Taiwan, lack a strong and varied mineral resources base, and the output of their mining sector is expected to decline because of depleting resources. Their mineral processing and manufacturing sectors, however, have much better prospects, and the demand for minerals in these countries is expected to stimulate the mining output by other countries in the region.

The mineral industry of Indonesia should continue to grow as a result of export-driven demand for coal, copper, gold, and natural gas. Furthermore, the Indonesian Government has put in place well-defined

TABLE 1—Continued

ASIA AND THE PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1990

(Thousand metric tons unless otherwise specified)

Country	Mercury, Mine, Hg content[2]	Mica	Nickel: Mine, Ni content	Nickel: Refined[3]	Petroleum, crude[4]	Natural gas[6]	Salt	Tin[2]: Mine, Sn content	Tin[2]: Refined, primary
Afghanistan	—	—	—	—	—	2,400	10	—	—
Australia	—	—	67	45	211	16,707	7,588	7,377	312
Bangladesh	—	—	—	—	1	4,814	410	—	—
Bhutan	—	—	—	—	—	—	—	—	—
Brunei	—	—	—	—	49	9,062	—	—	—
Burma	—	—	([1])	—	5	1,327	260	634	400
Cambodia	—	—	—	—	—	—	40	—	—
China	800	—	35	24	1,008	15,298	20,000	40,000	30,000
Christmas Island	—	—	—	—	—	—	—	—	—
Fiji	—	—	—	—	—	—	—	—	—
Hong Kong	—	—	—	—	—	—	—	—	—
India	—	7	—	—	228	9,345	9,503	—	—
Indonesia	—	—	68	25	534	61,134	600	30,200	30,389
Japan	—	—	—	44	4	2,060	1,377	—	816
Korea, North	—	—	—	—	—	—	580	—	—
Korea, Republic of	—	8	—	6	—	—	617	—	—
Laos	—	—	—	—	—	—	8	275	—
Malaysia	—	—	—	—	227	17,840	—	28,468	49,002
Mongolia	—	—	—	—	—	0	—	1,200	—
Nauru	—	—	—	—	—	—	—	—	—
Nepal	—	—	—	—	—	—	7	—	—
New Caledonia	—	—	88	10	—	—	—	—	—
New Zealand	—	—	—	—	10	4,814	60	—	—
Pakistan	—	—	—	—	19	14,150	777	—	—
Papua New Guinea	—	—	—	—	—	—	—	—	—
Philippines	—	—	16	—	2	—	490	—	—
Singapore	—	—	—	—	—	—	—	—	800
Solomon Islands	—	—	—	—	—	—	—	—	—
Sri Lanka	—	2	—	—	—	—	53	—	—
Taiwan	—	4	—	8	1	1,416	81	—	—
Thailand	—	—	—	—	9	538	284	14,635	15,512
Vietnam	—	—	—	—	—	—	340	900	800
Total	800	21	274	162	2,308	160,905	43,085	123,689	128,031
Share of world total, percent	[5]14	10	30	23	11	8	24	[5]56	55
United States	W	109	330	—	2,664	498,669	35,291	W	—

See footnotes at end of table.

rules and regulations on foreign investments designed to attract the required capital to help its manufacturing and energy sectors.

The mineral industry of Malaysia should continue to enjoy steady growth because of increased activity in its fuels sector, principally petroleum and natural gas. The performance of the tin sector is dependent on the world price of tin. The Malaysian Government has in place a national mineral policy, complemented with fiscal and financial incentive programs, to encourage local and foreign investment for new developments in its minerals sector.

As long as world metal prices remain strong, the Philippine mining sector is expected to sustain a steady growth. Its copper producers remain alert against overexpansion and try to stay in balance with world market demand. In addition, increased construction activity is expected to continue, ensuring strong demand for cement and construction materials.

Thailand is well positioned geographically and geologically, promising continued economic growth and development.

TABLE 1—Continued

ASIA AND THE PACIFIC: PRODUCTION OF SELECTED MINERAL COMMODITIES, 1990

(Thousand metric tons unless otherwise specified)

Country	Titanium		Tungsten	Zinc	
	Ilmenite	Rutile	Mine, W content[2]	Mine, Zn content	Refined, primary
Afghanistan	—	—	—	—	—
Australia	1,600	226	1,086	937	304
Bangladesh	—	—	—	—	—
Bhutan	—	—	—	—	—
Brunei	—	—	—	—	—
Burma	—	—	300	2	—
Cambodia-	—	—	—	—	—
China	150	—	35,000	619	470
Christmas Island	—	—	—	—	—
Fiji	—	—	—	—	—
Hong Kong	—	—	—	—	—
India	160	5	10	72	79
Indonesia	—	—	—	—	—
Japan	—	—	260	127	606
Korea, North	—	—	1,000	230	210
Korea, Republic of	—	—	1,361	23	248
Laos	—	—	—	—	—
Malaysia	502	—	—	—	—
Mongolia	—	—	500	—	—
Nauru	—	—	—	—	—
Nepal	—	—	—	—	—
New Caledonia	—	—	—	—	—
New Zealand	—	—	—	—	—
Pakistan	—	—	—	—	—
Papua New Guinea	—	—	—	—	—
Philippines	—	—	—	—	—
Singapore	—	—	—	—	—
Solomon Islands	—	—	—	—	—
Sri Lanka	75	5	—	—	—
Taiwan	—	—	—	—	—
Thailand	11	—	290	81	71
Vietnam	—	—	—	—	—
Total	2,498	236	39,807	2,091	1,992
Share of world total, percent	[5]62	[5]52	[5]98	28	29
United States	W	W	W	543	263

W Withheld to avoid disclosing company proprietary data.
[1]Less than ½ unit.
[2]Metric tons.
[3]Includes Ni content of intermediate products but excludes ferroalloy.
[4]Million 42-gallon barrels.
[5]Excludes U.S. production.
[6]Million cubic meters.

Thailand's mining sector will continue its critical role in the production of energy and new construction.

China has a diverse array of geological occurrences of metal ores, industrial minerals, and fuels. In addition, it produces significant quantities of a wide array of minerals and metals. China is a world class producer of antimony, barite, coal, fluorspar, graphite, gypsum, magnesite, rare earths, salt, and tungsten. Its mining sector is expected to grow, based on domestic demand and export capability for these commodities. However, the inadequate internal rail transport system and other infrastructure problems sometimes force exports inasmuch as some of these commodities cannot reach the domestic consumption markets easily.

The prospects for Mongolia's mining sector are dependent upon foreign financial and technical aid to develop its economy. It has large resources of coal, copper, fluorspar, molybdenum, and rare earths.

The mineral resources of the Indo-China peninsula are largely undeveloped. Burma's economy could be developed based on the exploitation of its resources of petroleum, coal, base metals, and precious metals. There are geologic indications that coal, petroleum, metallic ores, and industrial minerals are all likely prospects for development in Cambodia. Likewise, Laos has excellent prospects for major mineral development. However, its major problem is a lack of capital to develop infrastructure and industry. Vietnam has solicited and permitted foreign entrepreneurs to engage in capital projects, most prominently in the petroleum sector. The degree to which it guarantees foreign investment will determine its mine output of apatite, chromite, coal, and tin.

India has benefited from widespread mineral exploration. It is well endowed with bauxite, chromite, coal, gem stones, graphite, iron ore, manganese, mica, and talc. However, inadequate energy production as well as formidable trade regulations hamper industrial development. Nepal is geologically well positioned for the occurrence of both metallic mineralization in the Himalayas and petroleum entrapment in the subsurface of the southern margins of the country. However, the country lacks the roads and electric power to satisfy the needs of its growing population. Sri Lanka has a variety of known minerals and good prospects for other minerals yet to be discovered. Unfortunately, its economy is hampered by internal, political conflicts.

Australia eclipses the other countries in Oceania and in most of Asia as a significant world mineral resource supplier. It is a world leader in the production and export of bauxite, coal, copper, diamonds, gold, iron ore, lead, manganese, mineral sands, and zinc—and will continue to be a significant supplier of these well into the 21st century. As in New Zealand, the largest single

TABLE 2

ASIA AND THE PACIFIC: CONSUMPTION OF SELECTED METALS, 1990

	Aluminum, primary	Cadmium	Copper, refined	Lead	Magnesium	Nickel	Tin	Steel	Zinc
Australia	287,800	50	120,000	57,900	3,500	1,500	1,300	5,044	82,200
Bangladesh	15,000	NA	NA	NA	NA	NA	NA	428	10,000
Burma	NA	NA	NA	1,500	NA	NA	NA	—	NA
China	650,000	440	512,000	250,000	16,000	27,500	18,000	68,832	500,000
Hong Kong	28,800	NA	NA	4,000	NA	1,300	5,000	1,157	17,300
India	420,000	282	135,000	80,000	1,500	12,200	3,000	21,700	135,000
Indonesia	87,700	—	49,300	20,300	NA	NA	1,400	4,712	53,200
Japan	2,414,300	4,828	1,577,500	416,900	25,000	164,200	33,800	99,032	814,300
Korea, North	50,000	NA	30,000	30,000	NA	NA	NA	—	NA
Korea, Republic of	358,000	380	324,200	150,000	1,500	24,000	7,800	21,650	227,200
Malaysia	45,000	NA	60,000	34,000	NA	NA	3,300	2,817	22,600
New Zealand	26,900	—	4,700	6,900	300	200	100	687	20,000
Oceania (other)	300	NA	100	NA	NA	NA	NA	—	100
Pakistan	10,000	NA	NA	6,000	NA	NA	200	1,881	25,000
Philippines	16,600	NA	9,800	15,800	NA	NA	800	1,900	33,100
Singapore	23,200	NA	NA	5,000	NA	NA	NA	3,453	13,000
Sri Lanka	NA	NA	NA	1,800	NA	NA	NA	—	NA
Taiwan	197,700	20	297,100	74,500	1,000	18,300	4,800	15,350	79,400
Thailand	126,000	10	60,000	30,000	NA	800	2,800	4,232	66,000
Vietnam	8,000	NA	2,500	NA	NA	NA	NA	—	NA
Total	4,765,300	6,010	3,182,200	1,184,600	48,800	250,500	82,300	262,073	2,098,400
Share of world total, percent	27	31	29	21	15	30	35	33	30
United States	4,325,300	3,107	2,152,000	1,311,700	96,100	127,900	37,300	102,480	996,800

NA Not available.

Source: Metal Statistik, 1980-90; Metallgesellschaft AG; Steel Statistical Yearbook, 1991; International Iron and Steel Institute.

constraint to the mining sector is environmental concerns and aboriginal land issues that may limit any major expansion of the industry. New Caledonia will continue its role as a major supplier of ferronickel and a source of cobalt. Papua New Guinea may become one of the world's major gold producers in the 1990's with the development of the gold deposit of Lihir Island and the gold-silver deposits on Misima Island and at Porgera in Enga Province.

The most immediate challenge to the nations of Asia and the Pacific is to establish their industrial strength individually and to take advantage of both regional and world demand for their products. The mineral resources of the area are in general still underdeveloped.

Japan compares well commercially and industrially with the United States. Its industries are large and integrated and geared to world commerce.

Australia has a prosperous economy with a per capita gross domestic product of $15,000. The newly industrialized countries of the region include Hong Kong, Indonesia, Malaysia, the Republic of Korea, the Philippines, Singapore, Taiwan, and Thailand. The economies of many of these countries compare favorably to those in western Europe.

The outlook for mineral development in Asia and the Pacific includes a good potential for petroleum in coastal Asia particularly in the South China Sea and an increase in hard-rock mining in Australia, China, India, Indonesia, Papua New Guinea, and the Philippines, and in the countries of Indo-China. The mining and mineral processing industry and mineral markets of the region are sizable and continue to expand.

[1]Edmond Chin and Pui-Kwan Tse.

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TABLE 3

ASIA AND THE PACIFIC: VALUE OF TOTAL TRADE OF SELECTED COUNTRIES IN 1990

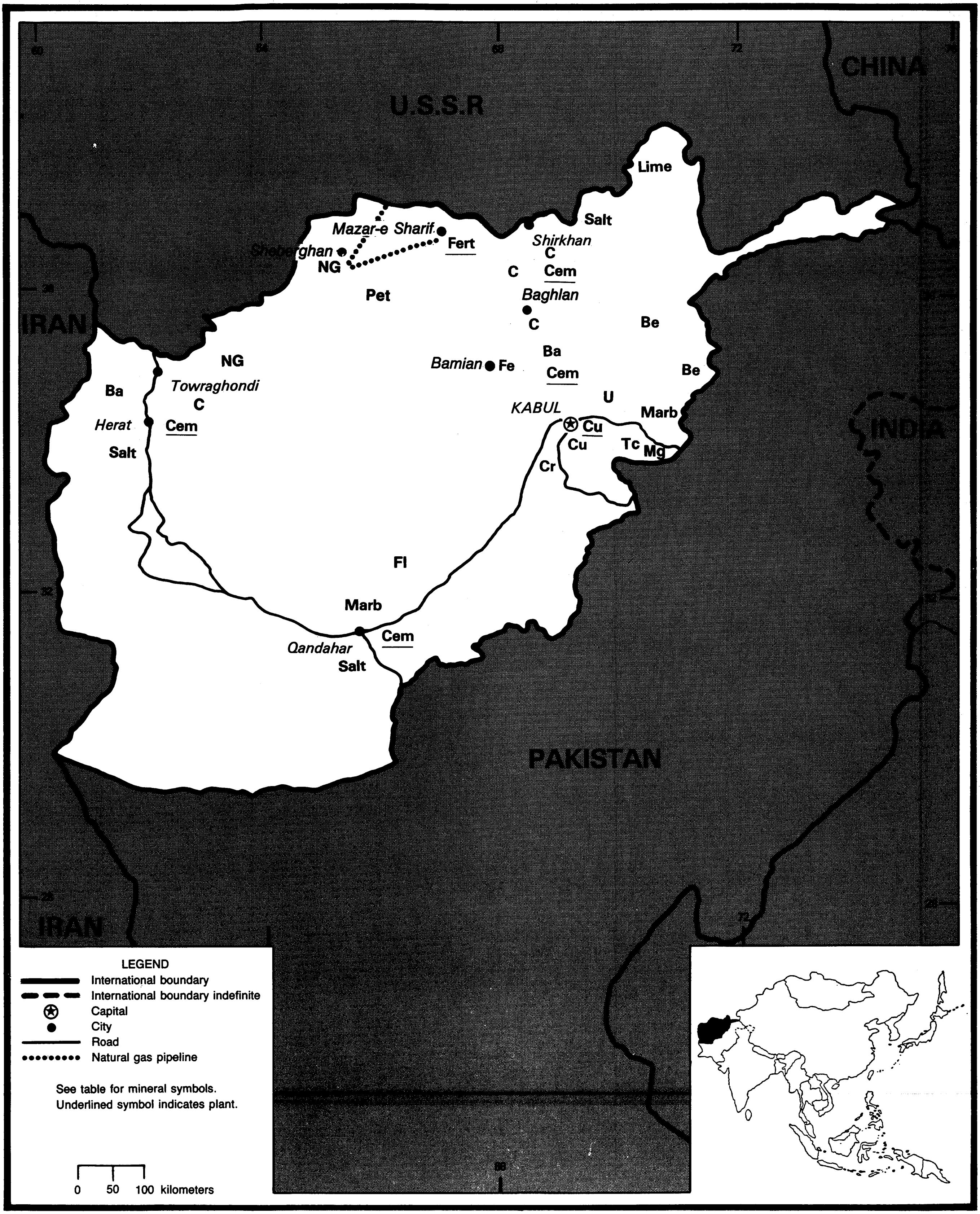
(Billion dollars)

Country	Total trade	Exports	Imports	Surplus or deficit
North Asia:				
Hong Kong	164.7	82.2	82.5	−.3
Japan	521.7	286.9	234.8	+52.1
Korea, Republic of	134.8	65.0	69.8	−4.8
Taiwan	121.9	67.1	54.8	+12.3
Total	943.1	501.2	441.9	+59.3
Continental Asia:				
China	113.8	61.3	52.5	+8.8
ASEAN:				
Brunei	3.1	1.9	1.2	+.7
Indonesia	47.5	25.7	21.8	+3.9
Malaysia	58.7	29.4	29.3	+.1
Philippines	21.1	8.1	13.0	−4.9
Singapore	113.7	52.8	60.9	−8.1
Thailand	56.2	23.1	33.1	−10.0
Total	300.3	141.0	159.3	−18.3
Southern Hemisphere:				
Australia	81.8	39.8	42.0	−2.2
New Zealand	18.9	9.4	9.5	−.1
Total	100.7	49.2	51.5	−2.3
Grand total	1,457.9	752.7	705.2	+47.5

Source: International Financial Statistics (International Monetary Fund) Monthly Bulletin of Statistics (United Nations).

AFGHANISTAN

AREA 647,500 km² **POPULATION 16.5 million**



THE MINERAL INDUSTRY OF AFGHANISTAN

By Chin S. Kuo

After the Soviet troops pulled out of Afghanistan in 1989, the country's economy has depended solely on Soviet aid, from food and consumer goods to fuel. The U.S.S.R., particularly the Soviet Central Asian Republics, supplied some $300 million[1] worth of goods per month to Afghanistan. There were severe fuel shortages in the winters of 1989-90 and 1990-91. Oil and kerosene, the latter being used in home heating, were trucked from the Soviet border and transported along the Salang highway for distribution in Afghanistan. The country was also entirely dependent on the U.S.S.R. for grain supplies.

In addition, many items for daily necessities were available in the urban black markets originating from neighboring Pakistan through commerce by smuggling goods from Peshawar to Kabul. These items ranged from medicines to clothes, toiletries, foodstuffs, and other essentials. Some goods were also flown in from India albeit on a very limited trade basis. India signed an agreement with Afghanistan in August to supply a total of 500,000 tons of grain.

The country signed a contract with North Korea to sell 20,000 tons of urea chemical fertilizer worth $242,000 from the Mazar-e Sharif Fertilizer Complex. The first shipment of 10,000 tons was made in 1990.

According to the country's geological survey department, Afghanistan has large deposits of barite, copper, gold, iron ore, lead, sulfur, talc, tin, uranium, and zinc, as well as precious and ornamental stones such as emeralds, garnets, lapis lazuli, rubies, and serpentines. The Samthi area has deposits containing an estimated 15 tons of gold. Geological surveys in the northeastern province of Badakshan revealed deposits containing nearly 20 tons of gold. Unfortunately, the country lacks the capital needed to exploit them. Only limited production of coal, natural gas, and salt was carried out in the past several years because of the civil war.

Under current statute, foreign interests are barred from participation in the national economy. However, the Government proposed an amendment to the 1987 constitution allowing foreign companies to invest in Afghanistan's energy and mineral resources. The Government also encouraged enterprises in the private sector to invest in the field of metals, chemicals, foodstuffs, textiles, and construction. With capitalization of $26 million, projects in these fields were to provide jobs for more than 700 workers.

Total cement output was only about 112,000 tons. Small-capacity plants were operated inefficiently. For instance, about 3,700 tons of cement was produced by 710 workers at the Ghowri plant in Baghlan in 1989. In 1990, the country's production of bituminous coal was estimated at 180,000 tons, of which some 14,000 tons was produced from the Karkar and Doodkash coal mines.

The largest natural gas producing facility is the Gas Extraction Complex of Khwaja Gogerdak, 25 kilometers from Sheberghan. A total of 305 workers extracted natural gas from 30 wells, and the complex produced 200 million m^3 of gas annually. Natural gas was supplied to the fertilizer and thermal powerplants of Mazar-e Sharif.

Afghanistan and the U.S.S.R. signed a cooperation protocol in October to establish and upgrade natural gas installations in Afghanistan. In addition, natural gas delivery to the U.S.S.R. resumed with the help of Soviet specialists. The country intended to export 300 million m^3 of natural gas between December 1990 and February 1991. The Government also planned to purchase equipment worth $40 million for oil and gas prospecting and geological surveying from the Soviets.

The country's infrastructure for the mineral industry is in the early stage of development. Hydropower and thermal power by natural gas contributed to the electricity-generating capacity. Near yearend, two electrical stations and one overhead transformer at a cost of $730,000 and $220,000, respectively, were completed in the city of Kabul. A power station with two 250-kilowatt units was built in the Sayedabad district of Mazar-e Sharif. A new substation in Chaman-e Huzori was near completion at a cost of more than $3 million, of which $2.5 million came from the Federal Republic of Germany and the remainder was funded by the Government. Various organizations of the United Nations also assisted the development of the country's infrastructure with $223 million.

[1]Where necessary, values have been converted from Afghan afghanis (Af) to U.S. dollars at the rate of Af55=US$1.00 for 1990.

TABLE 1

AFGHANISTAN: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

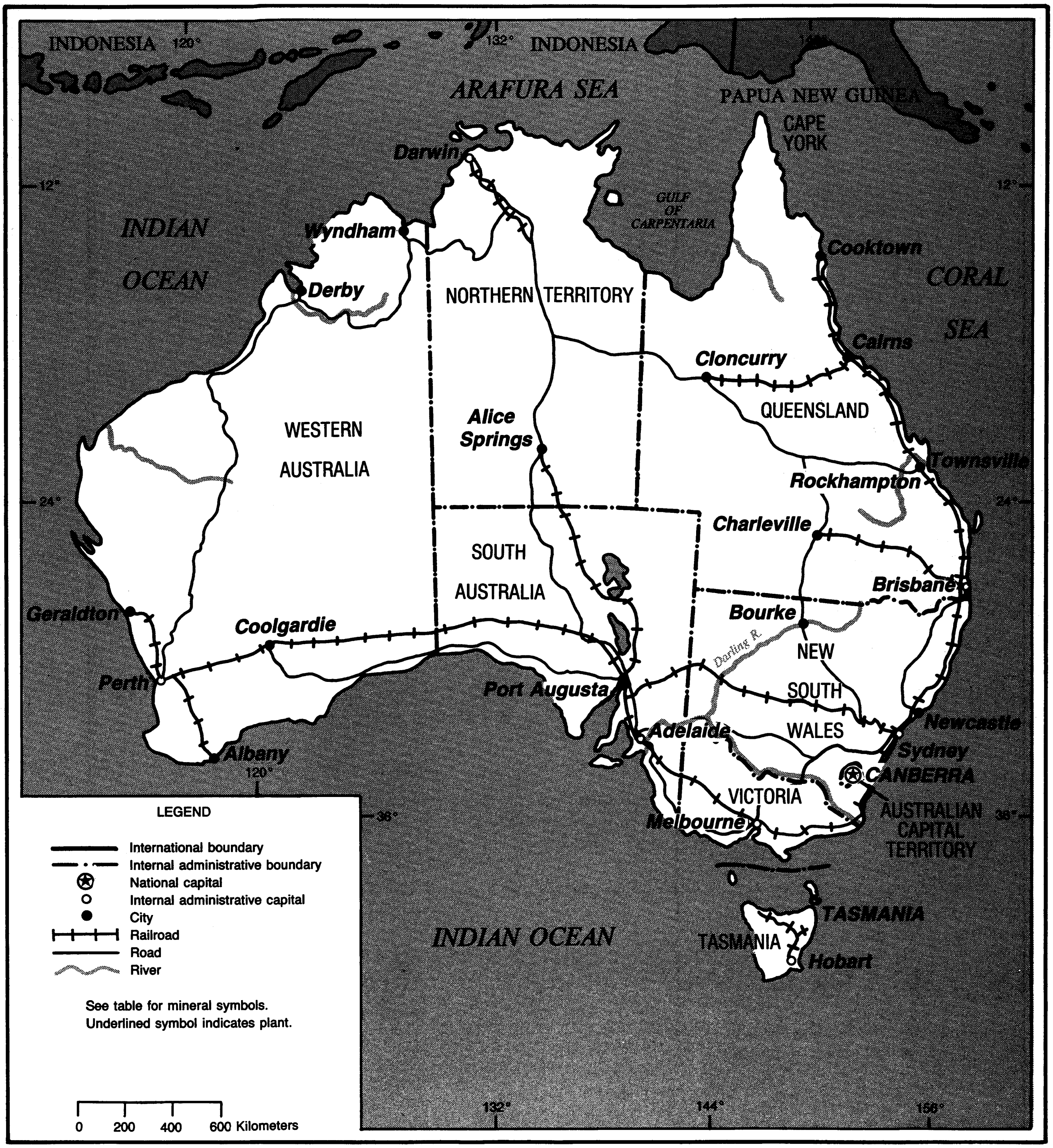
(Metric tons, unless otherwise specified)

Commodity[2]	1986	1987	1988	1989	1990
Barite	2,000	2,000	2,000	2,000	2,000
Cement, hydraulic	85,000	100,000	100,000	100,000	112,000
Coal, bituminous	160,000	r167,000	r138,000	r125,000	180,000
Copper: Mine output, Cu content	5,000	5,000	5,000	5,000	5,000
Gas, natural:					
Gross million cubic meters	3,000	3,000	3,000	2,100	2,400
Marketed do.	2,600	2,600	2,600	1,800	2,100
Gypsum	3,000	3,000	3,000	3,000	3,000
Natural gas liquids thousand 42-gallon barrels	81	r70	r35	r30	30
Nitrogen: N content of ammonia	40,000	40,000	4,000	40,000	40,000
Salt, rock	10,000	10,000	r10,000	r10,000	10,000

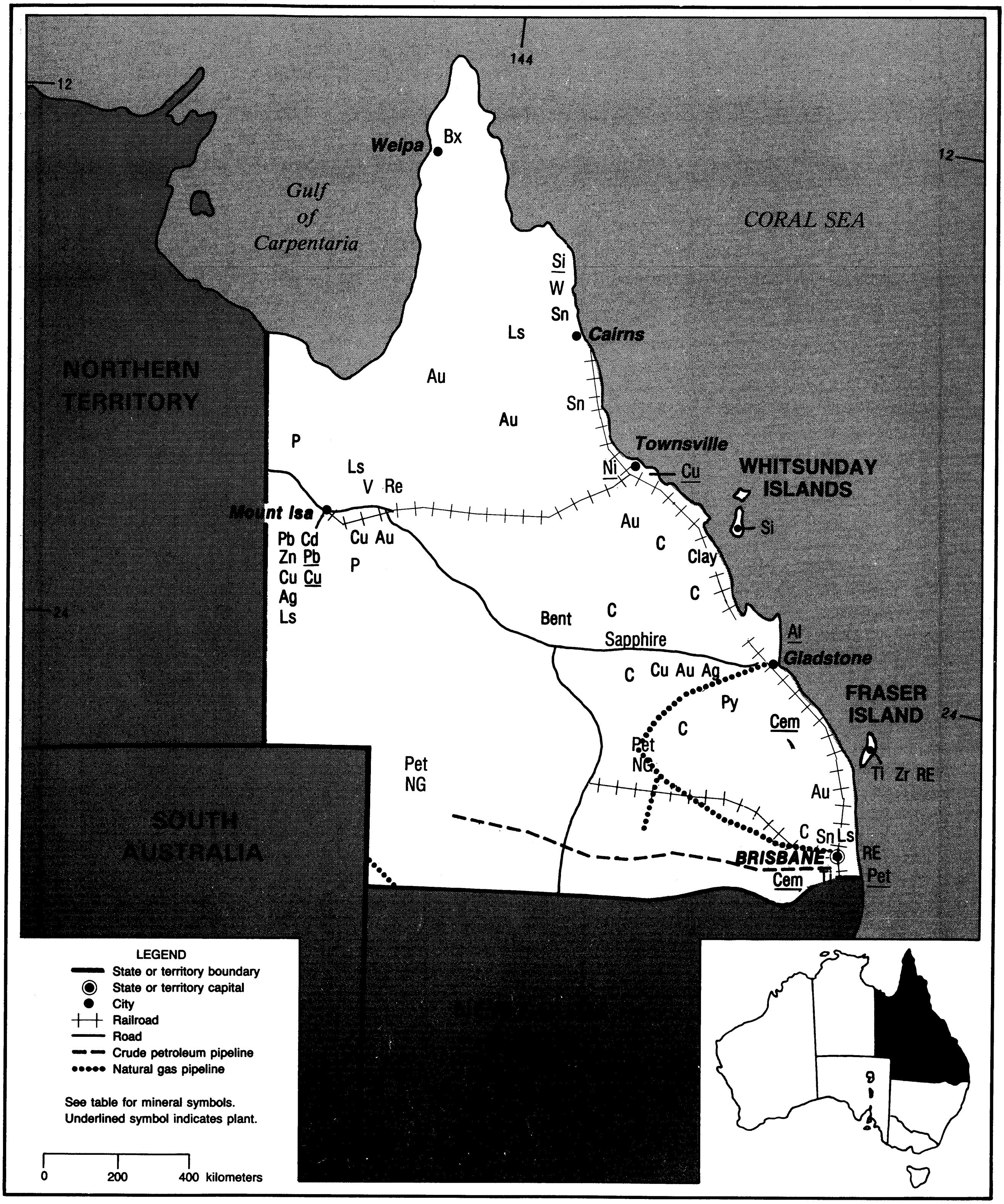
rRevised.
[1]Table includes data available through May 31, 1991.
[2]In addition to the commodities listed, asbestos, lapis lazuli, uranium, and a variety of crude construction materials (clays, stone,and sand and gravel) presumably have been produced. However, output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

AUSTRALIA

AREA 7,686,850 km² **POPULATION 16.9 million**



QUEENSLAND


144
12
24
Gulf of Carpentaria
CORAL SEA
NORTHERN TERRITORY
SOUTH AUSTRALIA
WHITSUNDAY ISLANDS
FRASER ISLAND
Weipa
Bx
Si
W
Sn
Cairns
Ls
Au
Au
Sn
Townsville
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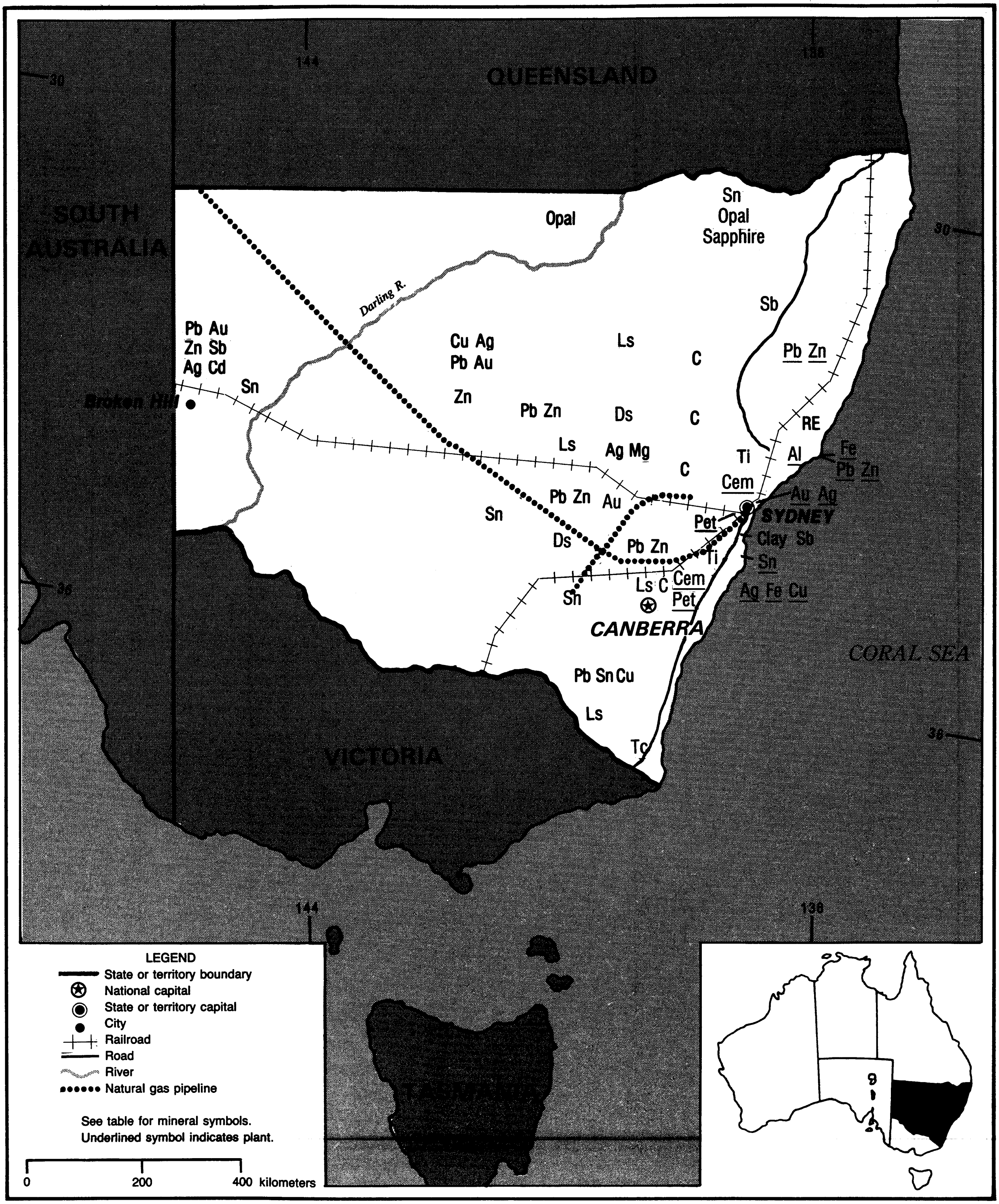
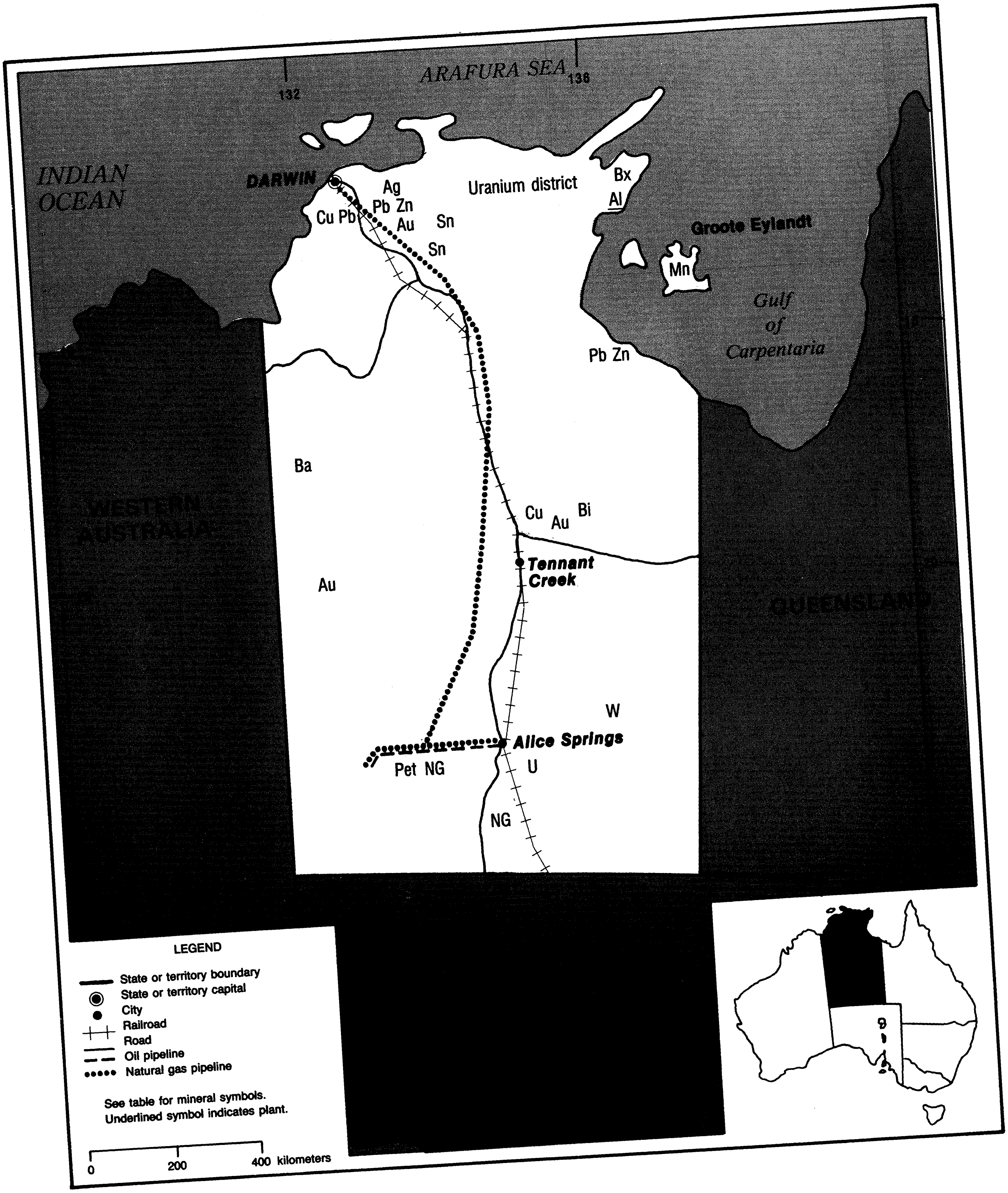
Py
C
Cem
Pet
NG
Pet
NG
Ti Zr RE
Au
C Sn Ls
BRISBANE
RE
Pet
Cem
Ti
LEGEND
State or territory boundary
State or territory capital
City
Railroad
Road
Crude petroleum pipeline
Natural gas pipeline
See table for mineral symbols.
Underlined symbol indicates plant.
0
200
400 kilometers

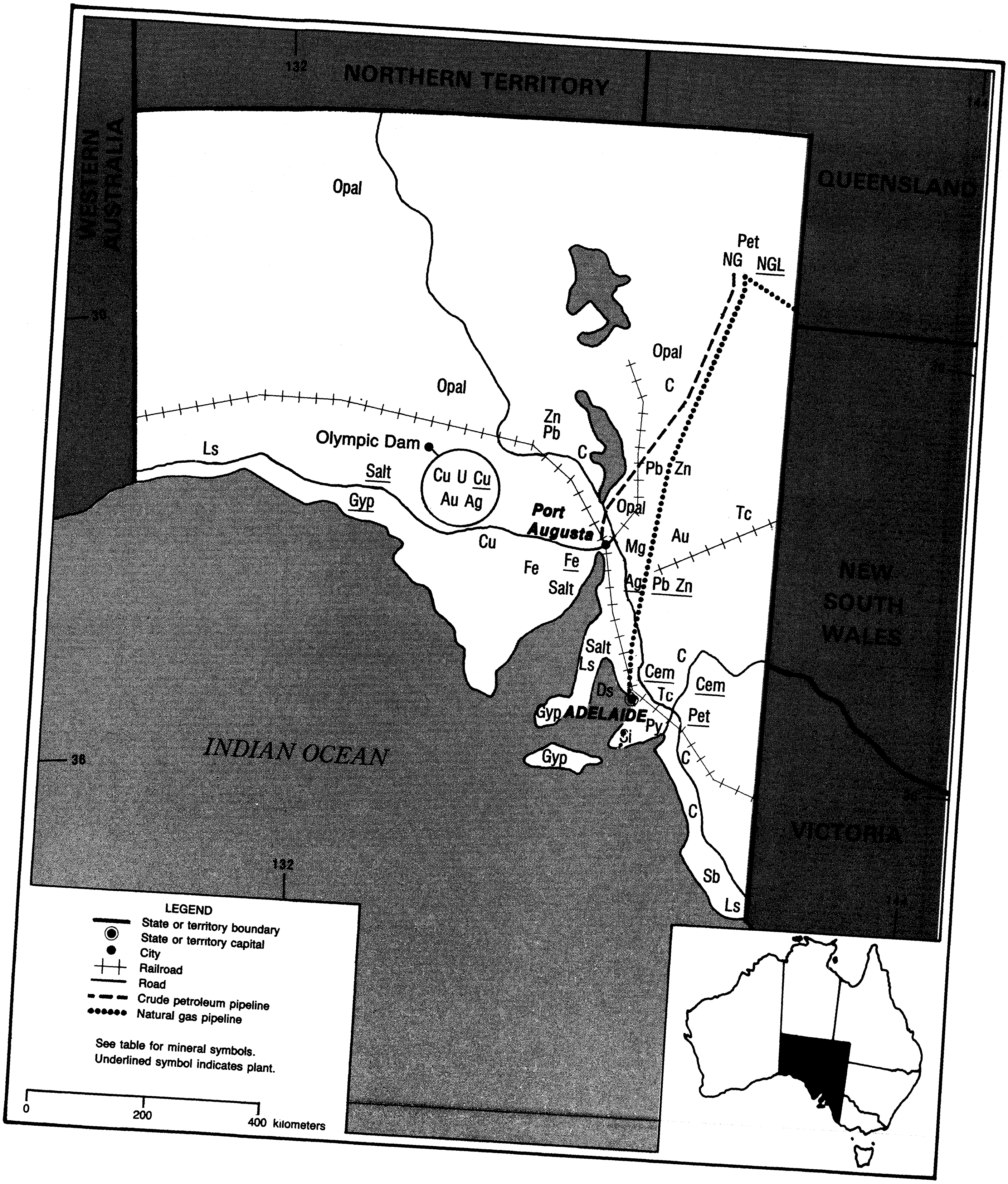
NEW SOUTH WALES



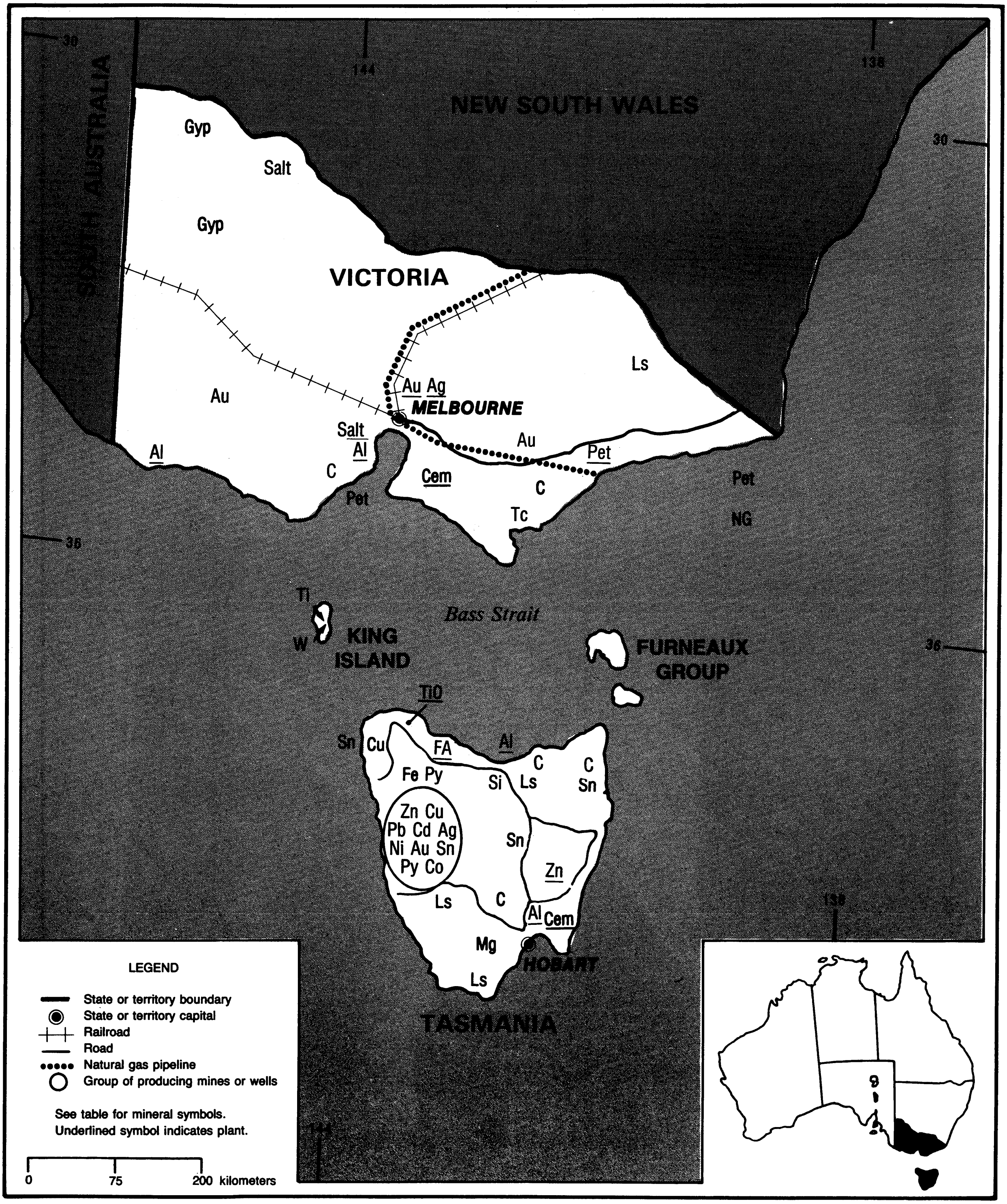
NORTHERN TERRITORY



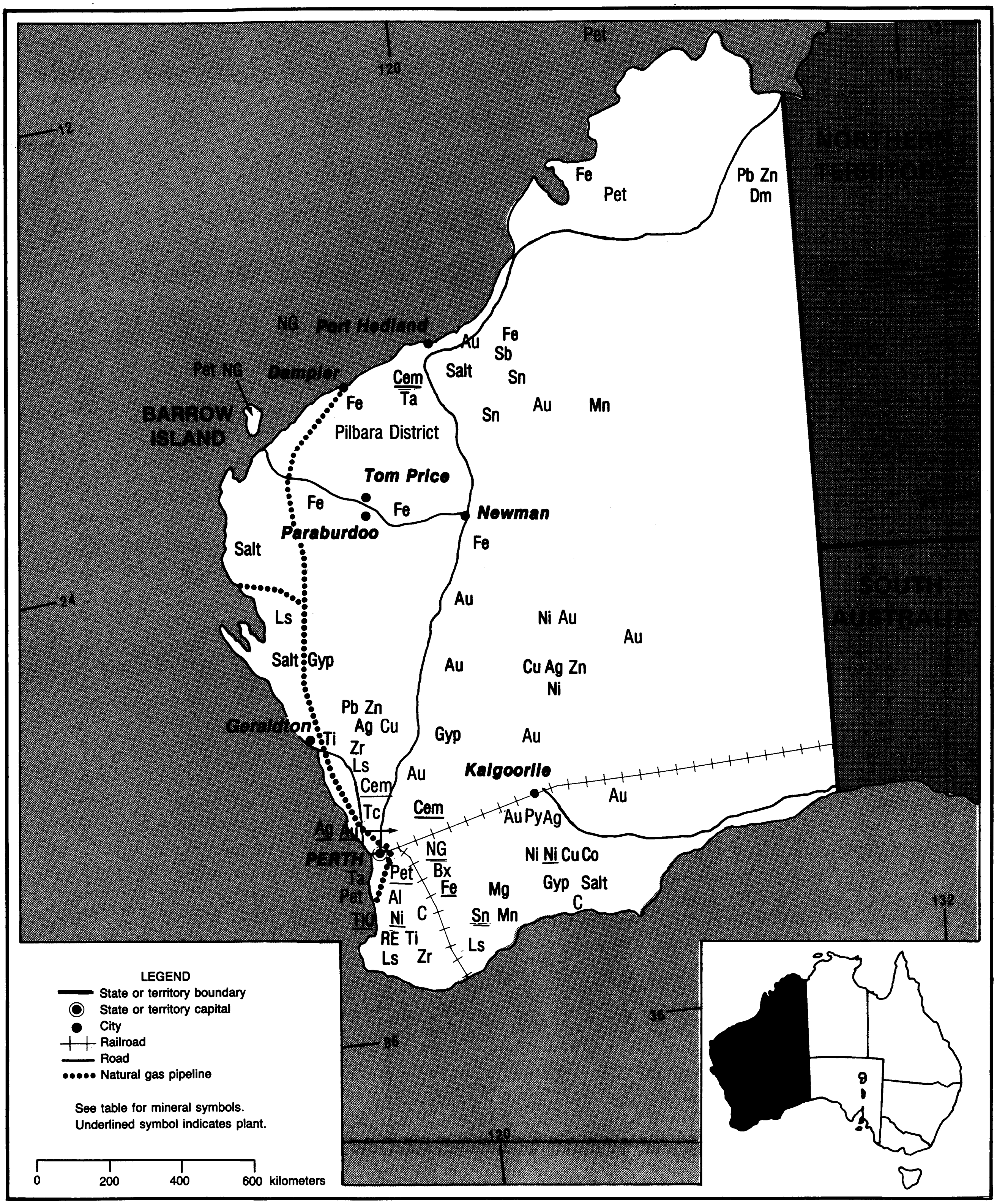
SOUTH AUSTRALIA



TASMANIA AND VICTORIA



WESTERN AUSTRALIA



THE MINERAL INDUSTRY OF AUSTRALIA

By Travis Q. Lyday

Australia is well endowed with a wide range of mineral commodities. While the country has been an important producer of base metals and gold since the last century, the Australian minerals industry has experienced a period of significant and sustained growth over the past 25 years. The growth of the Asian market, in particular the steel and base metals industries in Japan, combined with generally buoyant market conditions, placed the country among the world's main producers of a number of minerals.

The Australian minerals industry is heavily export-oriented, with about 70% of production destined for overseas markets. Mineral exports are heavily concentrated into just four commodity groups: alumina, aluminum, and bauxite; coal; gold; and iron ore.

Ownership of mineral rights in Australia is divided between State ownership in State onshore areas and Commonwealth ownership in Territories and in offshore areas. However, the Commonwealth's responsibility for minerals in the Northern Territory, except for uranium, has been transferred to the Government of the Northern Territory.

GOVERNMENT POLICIES AND PROGRAMS

Little progress was made on the Coronation Hill project debate among the mineral industry, the environmental lobby, and Government in 1990. The Government empowered, in April, the Resource Assessment Commission (RAC) to reevaluate the environmental, economic, and Aboriginal issues involved in mining at Coronation Hill, in the Kakadu Conservation Zone within Kakadu National Park in the Northern Territory. Coronation Hill is a world-class-size gold-platinum-palladium deposit in which Newmont Australia Ltd. (BHP Gold Ltd. prior to being absorbed into Newmont), 45%, acting as manager; Plutonic Resources Ltd. (formerly Pioneer Mineral Exploration Ltd.), 45%; and Norgold Ltd., 10%, had spent 5 years and an estimated \$9 million[1] on developing in strict accordance with stated Government policies and requirements. The RAC's report had not been issued by yearend, although both the mineral industry in general and the Coronation Hill joint-venture partners in particular were waiting eagerly its results.

In August, the Commonwealth Government's budget included the imposition of a resource rent tax on Bass Strait, offshore Victoria, oil production, including natural gas; and the Australia-wide deductibility of exploration expenses against the tax. The tax was retroactive to July 1, 1990.

The Federal Government announced in December that it will extend Australia's territorial sea from 3 nautical miles to 12 nautical miles to allow more effective control of the country's marine environment and resources.

PRODUCTION

In 1990, Australia was the world's leading producer of alumina, bauxite, diamond, ilmenite, mined lead, monazite, opal, rutile, sapphire, and zircon; third in iron ore and mined zinc; fourth in aluminum, gold, mined nickel, and uranium; fifth in manganese; and among the top 10 in the production of coal (6), tin (8), salt (9), and copper (10).

The output of minerals produced in 1990 generally increased, especially bauxite, copper (mined and refined), gold, iron ore, mined lead, salt, silver, uranium, and zinc. Moderate increases were recorded in the production of alumina and coal. Major decreases were recorded in the production of manganese, mineral sands (ilmenite, rutile, and zircon), and tungsten. Primary aluminum metal production and diamond mining remained about the same as those in the previous year.

The value of minerals produced in Australia was estimated to be \$19.2 billion, 7% of the \$275 billion GDP. 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 relied 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. Using plentiful resources of coal, LNG, 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.

Coal remained Australia's largest single export commodity in 1990, accounting for about one-quarter of the export value of the mineral sector. The aluminum industry, mainly alumina and bauxite, accounted for about 20% of the export value of the country's mineral exports and ranked second overall.

Total mineral export revenues for fiscal year 1990[2] were estimated to be about \$20 billion, almost 40% 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, manganese, and nickel), nonferrous metals (aluminum and tin), precious metals (gold and silver), fuel minerals (coal and uranium), to gem stones (diamond, opal, and sapphire). It is one of the world's

TABLE 1

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989[p]	1990[e]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	32,384	34,102	36,192	38,584	[2]40,697
Alumina	do.	9,423	10,109	10,511	10,800	[2]11,231
Metal, refined:						
Primary	do.	882	1,004	1,150	1,244	[2]1,234
Secondary		55,000	39,000	46,800	48,400	[2]32,900
Antimony, Sb content of ores and concentrates		1,131	1,231	1,320	1,360	[2]1,420
Bismuth, mine output, Bi content[e]		1,000	350	400	500	400
Cadmium:						
Mine output, Cd content		2,079	2,249	1,709	1,685	1,600
Metal, smelter (refined)		915	[r]944	855	696	[2]638
Cobalt:						
Mine output, analytic content of:						
Nickel ore		2,389	2,274	2,104	[e]2,000	2,000
Nickel concentrate		484	368	[e]400	[e]300	300
Zinc concentrate		41	73	70	[e]75	75
Total		2,914	2,715	[e]2,574	[e]2,375	2,375
Recoverable cobalt[e]		1,237	1,261	1,200	1,000	1,000
Columbium-tantalum concentrate, gross weight		88	159	226	555	555
Copper:						
Mine output, Cu content	thousand tons	248	233	238	296	316
Metal:						
Smelter:						
Primary	do.	170	173	178	204	[2]192
Secondary		9,178	[e]8,500	10,506	10,000	10,000
Refined:						
Primary	thousand tons	164	179	196	210	[2]247
Secondary		21,113	28,843	26,667	25,000	27,000
Gold:						
Mine output, Au content	kilograms	75,079	110,696	156,951	203,563	[2]242,299
Metal:						
Refined:						
Primary	do.	82,186	116,272	140,384	197,382	[2]254,583
Secondary	do.	1,911	[e]3,110	10,235	18,220	[2]18,670
Iron and steel:						
Iron ore:						
Gross weight	thousand tons	94,015	101,748	96,064	105,810	[2]111,349
Fe content	do.	60,082	64,798	61,244	67,313	[2]70,129
Metal:						
Pig iron	do.	5,889	5,569	5,730	6,094	[2]6,125
Ferroalloys:[3]						
Ferromanganese		60,870	51,465	58,000	67,000	70,000
Ferrosilicon[e]		19,000	18,000	18,000	20,000	20,000
Silicomanganese		22,590	42,725	[e]44,000	[e]45,000	45,000
Total[e]		102,460	112,190	120,000	125,000	125,000
Steel, crude	thousand tons	6,703	6,129	6,399	6,735	[2]6,666
Semimanufactures[e]		6,250	6,000	6,000	6,500	3,000

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989[p]	1990[e]
METALS—Continued						
Lead:						
Mine output, Pb content	thousand tons	448	489	465	495	[2]563
Metal:						
Primary:						
Bullion, for export	do.	188	197	191	183	[2]195
Refined	do.	156	202	163	193	[2]212
Total	do.	344	399	354	376	[2]407
Secondary excluding remelt	do.	15	15	17	18	20
Manganese ore (metallurgical):						
Gross weight	do.	1,649	1,853	1,985	2,124	[2]1,988
Mn content	do.	786	881	945	1,011	919
Nickel:						
Mine output, Ni content	do.	77	75	62	65	[2]67
Metal, smelter (refined Ni and Ni content of oxide)	do.	42	45	37	41	45
Platinum-group metals:[4]						
Palladium, Pd content	kilograms	428	490	412	[e]400	400
Platinum, Pt content	do.	115	130	107	[e]100	100
Total	do.	543	620	519	[e]500	500
Rare-earth metals, monazite concentrate:						
Gross weight		14,822	12,813	11,872	[re]13,000	11,000
Monazite content		13,783	[e]11,900	11,039	[re]12,000	10,200
Silver:						
Mine output, Ag content		1,023	1,119	1,117	1,075	[2]1,273
Metal, refined		336	309	297	376	[2]419
Tin:						
Mine output, Sn content[5]		8,508	7,691	7,009	7,709	[2]7,377
Metal, refined:						
Primary		1,399	563	439	424	[2]312
Secondary		320	[e]300	[e]300	[e]300	200
Titanium concentrates, gross weight:						
Ilmenite	thousand tons	1,238	1,498	1,610	1,696	1,600
Leucoxene		14,143	11,290	11,742	18,000	19,000
Rutile		215,774	246,263	230,637	243,000	226,000
Tungsten, mine output, W content		[r]1,572	[r]1,152	1,261	1,371	[2]1,086
Uranium, mine output, U content		4,154	3,780	3,531	3,656	[2]3,529
Zinc:						
Mine output, Zn content	thousand tons	712	778	759	803	937
Metal, smelter:						
Primary	do.	303	308	302	294	[2]304
Secondary[e]		4,500	4,500	3,700	[2]5,500	5,550
Zirconium concentrates, gross weight	thousand tons	452	457	480	511	442
INDUSTRIAL MINERALS						
Abrasives, natural:						
Beach pebble		1,127	1,036	[e]1,000	[e]1,000	1,500
Garnet		9,724	16,837	[e]16,000	[e]16,000	20,000
Barite		5,819	10,363	10,970	[e]11,000	11,000
Cement, hydraulic	thousand tons	5,928	[r]5,869	6,400	[re]6,500	6,500

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989[p]	1990[e]
INDUSTRIAL MINERALS—Continued						
Clays:						
Bentonite and bentonitic clay		39,933	30,392	[e]35,000	[e]35,000	35,000
Brick clay and shale	thousand tons	6,918	[6]6,105	8,483	[e]8,500	8,000
Cement clay and shale	do.	460	[6]450	[e]450	[e]500	500
Damourite clay		24	106	[e]100	[e]100	100
Fire clay[6]		30,547	24,215	[e]25,000	[e]25,000	25,000
Kaolin and ball clay[6]		187,617	176,958	[e]180,000	[re]185,000	200,000
Other[6]	thousand tons	1,746	717	[e]1,000	[e]1,000	1,000
Diamond:						
Gem	thousand carats	13,145	13,650	17,413	17,540	[2]17,331
Industrial	do.	16,066	16,683	17,413	17,540	[2]17,331
Total	do.	29,211	30,333	34,826	35,080	[2]34,662
Diatomite		9,048	[r]10,263	11,117	[e]12,000	10,000
Feldspar including nepheline syenite		10,006	11,418	15,877	[e]15,000	16,000
Gem stones, other than diamond:[e]						
Opal	value, thousands	$36,914	$62,010	$50,000	$60,000	$90,000
Sapphire	do.	$8,359	$13,500	$15,000	$15,000	$20,000
Other	do.	$2,316	$2,500	$2,500	$3,000	$800
Total	do.	$47,589	$78,010	$67,500	$78,000	$110,800
Gypsum	thousand tons	1,671	1,580	1,634	[e]1,800	1,800
Kyanite		768	1,079	[e]500	[e]500	750
Lime[e]		1,100,000	1,100,000	1,100,000	1,500,000	1,500,000
Magnesite		41,441	53,941	56,446	[re]55,000	60,000
Nitrogen: N content of ammonia		340,000	413,400	385,800	343,600	385,300
Perlite, crude		3,838	5,054	4,736	[e]5,000	5,000
Phosphate rock		35,200	9,900	13,000	8,000	[2]15,000
Salt	thousand tons	6,130	6,486	7,165	7,069	7,588
Sillimanite[7]		133	77	75	[e]80	100
Spodumene, concentrate		12,703	22,279	[re]30,000	[re]40,000	40,000
Stone, sand and gravel:						
Construction sand[8]	thousand tons	27,892	28,067	[e]28,000	[e]30,000	30,000
Gravel[8]	do.	15,900	15,365	[e]15,000	[e]15,000	15,000
Dolomite	do.	720	788	859	[e]1,000	1,000
Limestone:[e]						
For cement	do.	7,200	7,250	[2]5,512	6,000	6,000
For other uses	do.	3,550	3,550	[2]5,294	6,000	6,000
Silica in the form of quartz, quartzite, glass sand	do.	2,091	2,361	1,969	[e]2,000	2,000
Other:[8]						
Crushed and broken stone	do.	70,255	65,278	[e]65,000	[e]65,000	65,000
Dimension stone	do.	106	99	[e]100	[e]100	100
Unspecified	do.	30,663	29,203	[e]30,000	[e]30,000	30,000
Sulfur: Byproduct:						
Metallurgy	do.	[r]174	[r]194	200	[re]200	200
Petroleum	do.	10	9	[e]9	[e]10	10
Total	do.	[r]184	[r]203	[e]209	[re]210	210
Talc, chlorite, pyrophyllite, steatite		188,055	212,901	205,381	[e]200,000	205,000

See footnotes at end of table.

TABLE 1—Continued

AUSTRALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989[p]	1990[e]
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous and subbituminous	thousand tons	170,031	178,567	176,604	190,084	[2]198,205
Lignite	do.	37,637	43,517	43,450	48,252	[2]47,725
Total	do.	207,668	222,084	220,054	238,336	[2]245,930
Coke, metallurgical	do.	3,745	3,778	3,866	4,073	4,250
Fuel briquets	do.	833	814	750	[e]750	750
Gas, natural, marketed	million cubic meters	14,710	15,025	15,386	17,806	[2]20,529
Natural gas liquids	thousand 42-gallon barrels	24,723	24,426	24,649	23,706	[2]22,977
Peat[8]		7,265	9,042	10,133	[re]11,000	11,000
Petroleum:						
Crude	thousand 42-gallon barrels	187,196	200,478	189,564	178,637	[2]210,627
Refinery products:						
Gasoline:						
Aviation	do.	1,077	1,437	1,210	1,321	[2]1,352
Motor	do.	96,456	97,636	100,529	101,109	[2]103,404
Jet fuel	do.	17,225	18,387	20,627	20,039	[2]21,819
Kerosene	do.	597	382	456	[e]500	[2]849
Distillate fuel oil	do.	53,896	58,104	62,424	64,621	[2]67,521
Residual fuel oil	do.	13,162	14,031	13,237	15,108	[2]15,674
Lubricants	do.	3,358	3,873	3,902	3,969	[2]4,214
Liquefied petroleum gas	do.	4,848	4,844	4,942	5,107	[2]4,862
Bitumen	do.	3,412	3,157	3,372	3,780	[2]3,554
Unspecified	do.	5,716	7,013	7,078	6,686	[2]5,523
Refinery fuel and losses	do.	10,976	9,569	[e]9,500	[e]10,500	10,000
Total	do.	210,723	218,433	227,277	[e]232,740	238,822

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Aug. 30, 1991.
[2]Reported figure.
[3]Data are for years ending Nov. 30 of that stated for plants owned by The Broken Hill Pty. Co. Ltd.
[4]Western Australia only. Platinum-group metals content of nickel ore.
[5]Excludes tin content of copper-tin and tin-tungsten concentrates.
[6]Excludes production from Western Australia.
[7]In addition, about 7,000 tons of sillimanite clay, also known as kaolinized sillimanite, is produced, containing 40% to 48% Al_2O_3.
[8]Excludes data from some States.

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 products (e.g., cut-and-polished gem diamond) within the country. In 1990, 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 and/or refineries; one manganese ferroalloy plant; 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.

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 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 most mineral production.

COMMODITY REVIEW

Metals

Bauxite, Alumina, and Aluminum.—Australia remained for the 20th consecutive year the world's largest producer of bauxite. Bauxite, together with its value-added products alumina and aluminum, remained for the second year in a row the nation's next most important export, after coal.[3]

Nabalco Pty. Ltd. announced in March a $107 million expansion of its bauxite mine and alumina plant at Gove in the Northern Territory. Nabalco is a subsidiary of Zurich-based Swiss Aluminium Ltd., or Alusuisse, 70%, and Gove Aluminium Ltd., 30%. Apart from increasing output, the upgrade will significantly reduce the cost of alumina production at its already low-cost operation.[4]

Comalco Aluminium Ltd., a 67%-owned subsidiary of CRA Ltd., initiated early in 1990 a more serious investigation on the construction of an alumina refinery near its Weipa bauxite deposits on Cape York Peninsula in the far north of Queensland. Comalco has investigated the possibility of a Weipa refinery several times since the early 1970's.[5] In November, Comalco entered into a 50-50 joint partnership with Alcan South Pacific Ltd., a wholly owned subsidiary of Alcan Australia Ltd., to conduct an $8 million, 18-month feasibility study for a 1-Mmt/a alumina refinery.[6] If the facility were built, it would take up to 5 years to build and would be sited near the Weipa bauxite reserves owned separately by the joint-venture partners (Alcan's were not being mined).[7]

Following a temporary hold early in the year because of a downturn in the Australian economy and fears of a worldwide recession, Alcoa of Australia Ltd. announced in October the go-ahead for expansion of its 100%-owned Wagerup alumina refinery in Western Australia. The $300 million expansion will lift capacity almost 75%, from 850,000 mt/a to 1.48 Mmt/a of alumina. The project was expected to take 30 months for completion, planned for early 1993.[8]

Kemerton Aluminium Ltd., which in 1989 completed a feasibility study but had not committed itself for the construction of a 235,000-mt/a aluminum smelter, began an investigation in May into the feasibility of building both the smelter and a natural-gas-fueled power station in the Pilbara region of Western Australia. Kemerton, in 1989, intended to build the smelter and a coal-fired power station in the southwest of the State near Alcoa of Australia's alumina refinery, which also was targeted to supply alumina for the smelter. Studies conducted earlier in the year showed that it would be more cost effective to ship alumina from the Perth area to the north and use known but undeveloped offshore natural gas resources of the North West Shelf for power. The proposed smelter site, inland of the port of Dampier, is close to the vast but low-grade bauxite deposits at Mitchell Plateau in the Kimberley region held by Comalco. These deposits also could be developed along with the construction of an alumina refinery to provide feedstock for the smelter. The proposal under study was to investigate the possibility of building a 670-MW power station. If the proposed smelter and associated power station were constructed, production was planned to begin in 1995.[9]

Plans to increase the capacity at Comalco's 30%-owned Boyne Island smelter in Queensland from 230,000 mt/a aluminum to 430,000 mt/a were shelved, at least temporarily, in August following the breakdown in negotiations between Comalco and the Queensland Government concerning the purchase price of the Gladstone power station. The availability of inexpensive power was a prerequisite for the smelter's expansion, consisting of a third potline, and Comalco, operator and manager, had intended to achieve this by privatization of the Queensland-owned Gladstone station. The new potline would increase the smelter's consumption from 30% to about 60% of the station's output, necessitating an upgrade of the station. Comalco intended to sell excess power to the State grid.[10] The State Government was willing to sell the power station, but Comalco's offer was considered too low.[11]

Tomago Aluminium Co. Pty. Ltd., the operator of the consortium owning the Tomago smelter in New South Wales, launched in February a feasibility study to investigate a 50% increase in capacity, to 360,000 mt/a of aluminum, with the addition of a third 120,000-mt/a potline. The study followed an agreement on power rates with the State Electricity Commission.[12] At yearend, the joint-venture partners agreed in principle for the construction of the third potline, subject to Government approval of the development plan and environmental considerations.[13] However, the expansion would amount to a 75% increase—to 420,000 mt/a—in capacity. The third potline would contain 280 pots, constructed in stage 1 of the project, beginning early in 1991. Stage 2 of the expansion would increase the length of potlines I and II to match the third one by adding 40 additional pots to each.[14] The expansion was planned to be completed by mid-1992.

Copper.—Mine production of copper in Australia continued to be from operations that produced other metals, either as the primary product or as a coproduct.

A massive buildup of scrap copper stock permitted the Government in January to lift the embargo on copper scrap exports. The embargo, which had been in effect since 1964, was to ensure a continuous supply to Southern Copper Ltd.'s (formerly the Electrolytic Refining and Smelting Co. of Australia Pty. Ltd., or ER&S) copper smelter at Port Kembla, New South Wales. Until the stock buildup, the smelter depended on the scrap market for up to 50% of its feedstock. In addition, the modernization and expansion program to increase smelter capacity to 80,000 mt/a of copper begun in 1989 will make the smelter less reliant on scrap.[15]

The former ER&S has been smelting and refining copper at Port Kembla since 1908. The new Southern Copper name, which became effective October 1, was chosen because the Port Kembla copper smelter was the first one to be built in the Southern Hemisphere, the first heavy industry on the south coast of New South Wales, and the southern-most copper plant in the world.[16]

Agip Australia Pty. Ltd., a wholly owned subsidiary of Italy's Agip SpA, announced in midyear that it will proceed with the development of its Radio Hill copper-nickel mine and smelter project in Western Australia's Pilbara region. The venture, which at yearend needed approval of Agip's purchase of Dominion Mining Ltd.'s one-third interest by the Foreign Investment

TABLE 2

AUSTRALIA: STRUCTURE OF THE MINERAL INDUSTRY

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities[1]	Annual capacity
Alumina	Alcoa of Australia Ltd., 100%	Kwinana refinery, WA	1,600
Do.	do.	Pinjarra refinery, WA	2,800
Do.	do.	Wagerup refinery, WA	[2]1,480
Do.	Nabalco Pty. Ltd., manager. Swiss Aluminium Australia Ltd., 70%; and Gove Aluminium Ltd., 30%	Gove refinery, NT	[3]1,600
Do.	Queensland Alumina Ltd., operator. Comalco Ltd., 30.3%; Kaiser Aluminum and Chemical Corp. (Australia) Ltd., 28.3%; Alcan Australia Ltd., 21.4%; and Pechiney Australia Pty. Ltd., 20%	Gladstone refinery, QLD	3,000
Do.	Worsley Alumina Pty. Ltd., manager. Reynolds Australia Alumina Ltd., 50%; The Shell Co. of Australia Ltd., 37.5%; Kobe Alumina Associates, 10%; and Nissho-Iwai Alumina, 2.5%	Worsley refinery, WA	1,400
Aluminum	Alcan Australia Ltd., 100%	Kurri Kurri smelter, NSW	150
Do.	do.	Point Henry smelter, VIC	165
Do.	do.	Portland smelter, VIC	300
Do.	Boyne Island Smelters Ltd., manager. Comalco Ltd., 30%; Austria Metall., 20%; Sumitomo Light Metal Industries, 17%; Kobe Steel Ltd., 9.5%; Mitsubishi Corp., 9.5%; Yoshida Kogyo KK, 9.5%; and Sumitomo Aluminium Smelting Co. Ltd., 4.5%	Boyne Island smelter, QLD	230
Do.	Comalco Aluminium (Bell Bay) Ltd., operator and 82.6% owner; and Tasmanian Government, 17.4%	Bell Bay smelter, TAS	117
Do.	Tomago Aluminium Co. Pty. Ltd., manager. Gove Aluminium Finance Ltd., 35%; Pechiney Australia Pty. Ltd., 35%; Australian Mutual Provident Society, 15%; VAW Australia Pty. Ltd., 12%; and Hunter Douglas Ltd., 3%	Tomago smelter, NSW	[4]420
Bauxite[5]	Nabalco Pty. Ltd., manager. Swiss Aluminium Australia Ltd., 70%; and Gove Aluminium Ltd., 30%	Gove Mine, NT	[6]6,100
Do.	Comalco Aluminium Ltd., 100%	Weipa operations, QLD	11,000
Do.	Alcoa of Australia Ltd., 100%	Del Park/Huntly, Jarrahdale, and Willowdale Mines, WA	20,400
Do.	Worsley Alumina Pty. Ltd., manager. Reynolds Australia Alumina Ltd., 50%; The Shell Co. of Australia Ltd., 37.5%; Kobe Alumina Associates (Australia) Pty. Ltd., 10%; and Nissho-Iwai Alumina, 2.5%	Mount Saddleback (Worsley) Mine, WA	3,850
Cement	Adelaide Brighton Cement Ltd., 100%	Birkenhead Plant, SA	1,000
Do.	Australian Portland Cement Ltd., 100%	Geelong Plant, VIC	800
Do.	Blue Circle Southern Cement Ltd., 100%	Berrima Plant, NSW	1,200
Do.	Cockburn Cement Ltd., 100%	South Coogee Plant, WA	1,000
Do.	Goliath Cement Holdings Ltd., 100%	Railton Plant, TAS	1,000
Do.	The Queensland Cement and Lime Co. Ltd., 100%	Darra Plant, QLD	700
Coal, black	Austen and Butta Ltd., 100%	South Bulli underground mine, NSW	3,000
Do.	BHP-Utah Coal Ltd., 100%	Appin underground mine, NSW	2,250
Do.	do.	Cordeaux underground mine, NSW	2,500
Do.	do.	Kemira underground mine, NSW	1,000
Do.	do.	Tower underground mine, NSW	1,000
Do.	Camberwell Coal Pty. Ltd., operator. Navidale Pty. Ltd., 50%; Toyota Tsusho Mining (Australia) Pty. Ltd., 40%; and Dia Coal Mining (Australia) Pty. Ltd., 10%	Camberwell open cut, NSW	[7]2,000
Do.	Capricorn Coal Management Pty. Ltd., operator. Shell Australia Ltd., 46.75%; Minproc Energy Pty. Ltd., 26.06%; Coal Develoments (German CK) Pty. Ltd., 14.81%; and Ruhrkohle Australia Pty. Ltd., 12.38%	German Creek open cut and underground mine, QLD	6,000
Do.	Central Queensland Coal Associates, 100%. (BHP-Utah Coal Ltd., operator)	Blackwater open cut, QLD	5,000
Do.	do.	Goonyella open cut, QLD	6,000

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]	Annual capacity
Coal, black—Continued	do.	Peak Downs open cut, QLD	5,400
Do.	Coal and Allied Industries Ltd., 100%	Hunter Valley No. 1 open cut, NSW	7,000
Do.	do.	Hunter Valley No. 2 open cut, NSW	[8]3,000
Do.	Clutha Ltd., 100%	Brimstone No. 1 underground mine, NSW	2,400
Do.	Curragh Queensland Mining Ltd., operator. ARCO Coal Australia Inc., 60%; R.W. Miller and Co. Pty. Ltd., 30%; and Mitsui Coal Development (Australia) Pty. Ltd., 10%	Curragh open cut, QLD	5,300
Do.	Electricity Commission of New South Wales, 100%	Angus Place underground mine, NSW	1,300
Do.	do.	Awaba underground mine, NSW	1,000
Do.	do.	Cooranbong underground mine, NSW	1,200
Do.	do.	Munmorah underground mine, NSW	1,200
Do.	do.	Myuna underground mine, NSW	1,500
Do.	do.	Newstan underground mine, NSW	2,200
Do.	do.	Wyee underground mine, NSW	1,750
Do.	Electricity Trust of South Australia, 100%	Leigh Creek open cut mine, SA	3,000
Do.	FAI Mining Ltd., 100%	Teralba underground mine, NSW	1,200
Do.	do.	West Wallsend underground mine, NSW	1,400
Do.	Kembla Coal and Coke Pty. Ltd., 100%	Tahmoor underground mine, NSW	1,750
Do.	do.	West Cliff underground mine, NSW	3,000
Do.	Newlands Coal Pty. Ltd., operator. MIM Holdings Ltd., 75%; and Agip Coal Australia Pty. Ltd., 25%	Newlands open cut, QLD	5,000
Do.	Oakbridge Ltd., 100%	Gretley underground mine, NSW	1,000
Do.	do.	Pelton-Ellalong underground mine, NSW	2,000
Do.	Oakbridge Ltd., 80%, manager. Sumitomo Coal Mining Co. Ltd., 20% (Japan)	Baal Bone underground mine, NSW	2,000
Do.	Oakbridge Ltd., 80%, manager. Kyodo Oil, 10% (Japan); and Yukong Ltd., 10% (Korea)	Clarence underground mine, NSW	1,700
Do.	Pacific Coal Pty. Ltd., 57.19%, operator; ARCO Coal Australia Inc., 31.42%; EPDC (Australia) Pty. Ltd., 7.97%; and JCD (Australia) Pty. Ltd., 3.42%	Blair Athol open cut, QLD	8,000
Do.	Ulan Coal Mines Ltd., 100%	Ulan No. 2 underground mine, NSW	2,000
Do.	Wambo Mining Corp. Pty. Ltd., 100%	Wambo underground mine, NSW	1,400
Coal, brown	The State Electricity Commission of Victoria, 100%	Latrobe Valley open cut mines (Loy Yang, Morwell, Yallourn), VIC	45,000
Copper	Copper Refineries Pty. Ltd., 100%	Townsville refinery, QLD	[9]155
Copper, gold	North Broken Hill-Peko Ltd., 100%	Gecko Mine, NT	[10]10,000
Copper, gold, silver	Renison Goldfields Consolidated Ltd., 100%	Mount Lyell Mine, TAS	[5]1,500
Copper, gold, palladium platinum, selenium	Southern Copper Ltd., manager. Enterprise Metals Ltd., 60%; Furakawa Co. Ltd., 30%; and Nissho-Iwai Corp., 10%	Port Kembla refinery-smelter, NSW	[12 9]80
Copper, lead, zinc, gold, silver	Denehurst Ltd., operator, 100%	Woodlawn Mine, NSW	[5]500
Do.	Enterprise Metals Ltd., operator, 100%	Cobar (CSA) Mine, NSW	[5]900
Copper, zinc	Macquarie Resources Ltd., 100%	Benambra Mine, VIC	[13]45,000 [14]15,000
Copper, gold, silver, uranium	WMC (Olympic Dam Operations) Pty. Ltd., operator. WMC (Olympic Dam Corp.) Pty. Ltd., 51%; BP Minerals Ltd., 49%	Olympic Dam Mine, smelter, and refinery, SA	[15]66 [11]850 [16]555 [17]1,400
Copper, nickel	Agip Australia Pty. Ltd., 100%	Radio Hill Mine, WA	[18]11
Diamond	Argyle Diamond Mines Pty. Ltd., manager. CRA Ltd., 59.9%; and Ashton Mining Ltd., 41.1%	Argyle Mine (AK-1 pipe and alluvial deposits), WA	[19]35,000

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]	Annual capacity
Diamond—Continued	Poseidon Ltd., 100%	Bow River Mine, WA	[19]1,000
Gold[11]	ACM Gold Ltd., 100%	Golden Crown Mine, WA	1,150
Do.	do.	Wirralie Mine, QLD	3,200
Do.	ACM Gold Ltd.50%; and Placer Pacific Ltd., 50%	Big Bell Mine, WA	5,000
Do.	Alcoa of Australia Ltd., 100%	Hedges Mine, WA	4,875
Do.	Asarco Australia Ltd., 100%	Wiluna Mine, WA	4,225
Do.	Australian Gold Refineries, 100%. (State of Western Australia agency)	Kalgoorlie refinery, WA	[20]46,000
Do.	do.	Perth refinery (Newburn), WA	[20]95,000
Do.	Australmin Holdings Ltd., 100%	Tuckabianna Mine, WA	1,700
Do.	Aztec Mining Co. Ltd., operator, 62%; and Forrestania Gold NL, 38%	Bounty Mine, WA	2,500
Do.	Battle Mountain (Australia) Inc., 100%	Pajingo Mine, QLD	1,900
Do.	BHP Gold Mines Ltd., 100%	Ora Banda Mine, WA	2,650
Do.	Central Coast Exploration NL, manager, 66.67%; and Pancontinental Mining Ltd., 33.33%	Croydon Mine, QLD	4,700
Do.	Dominion Mining Ltd., 100%	Cosmo Howley Mine, NT	1,700
Do.	Dominion Mining Ltd., 75%; and Black Swan Gold Mines Ltd., 25%	Gabanintha Mine, WA	2,300
Do.	Elders Resources NZFP Ltd., 100%	Red Dome Mine, QLD	2,500
Do.	Forsayth NL, operator, 50%; and Reynolds Australia Mines Ltd., 50%	Mount Gibson Mine, WA	3,450
Do.	Golden Kilometre Mines Joint Venture, Manager. Southern Resources Ltd., 55%; Square Gold and Minerals Ltd., 25%; Mount Pleasant Gold Trust, 12.5%; and Geometals NL, 7.5%	Golden Kilometre Mine, WA	1,750
Do.	Hampton Australia Ltd., 100%	Jubilee Mine, WA	2,300
Do.	Homestake Gold of Australia, 100%	Fortnum Mine, WA	1,500
Do.	Kalgoorlie Consolidated Gold Mines Pty. Ltd., manager. Gold Mines of Kalgoorlie Ltd., 50%; and Homestake Gold of Australia Ltd., 50%	Kalgoorlie Super Pit, WA (Amalgamation of Fimiston, Mount Charlotte, and Paringa operations)	9,350
Do.	Kidston Gold Mines Ltd., manager, 70%; and public shares, 30%	Kidston Mine, QLD	7,100
Do.	Metana Minerals NL, 100%	Mount Magnet Mine, WA	2,250
Do.	do.	Galtee More Mine, WA	1,150
Do.	Newmont Australia Ltd., 70%; and BHP Gold Mines Ltd., 30%	Telfer Mine, WA	9,350
Do.	Newmont Australia Ltd., manager, 80%; and Hampton Australia Ltd., 20%	New Celebration Mine, WA	3,750
Do.	North Flinders Mines Ltd., 100%	Granites Mine, NT	3,500
Do.	Pan Australian Mining Ltd., 100%	Mount Leyshon Mine, QLD	6,000
Do.	Perseverance Corp. Ltd., 100%	Nagambie Mine, VIC	1,250
Do.	Pine Creek Goldfields Ltd., manager, 60%; and Enterprise Gold Mines NL, 40%	Pine Creek Mine, NT	3,100
Do.	Placer Pacific Ltd., manager, 60%; and Delta Gold NL, 40%	Granny Smith Mine, WA	7,300
Do.	Plutonic Resources Ltd., 100%	Plutonic Mine, WA	5,000
Do.	Renison Goldfields Consolidated Ltd., 100%	Lucky Draw Mine, NSW	1,500
Do.	Sons of Gwalia NL, 100%	Sons of Gwalia Mine, WA	2,000
Do.	Western Mining Corp., 75%; and Central Norseman Gold Corp., 25%	Stawell Mine, VIC	1,100
Do.	Zapopan NL, manager, 50%; Kumagai Gumi Co. Ltd., 30%; and Kintaro Gold Mines Pty., 20%	Tanami Mine, NT	1,900
Gold, copper	Elders Resources NZFP Ltd., manager, 25%; Cyprus Minerals Australia Co., 37.5%; and Arimco NL, 37.5%	Starra Mine, QLD	2,650 [10]10,000
Do.	Worsley Alumina Pty. Ltd., manager. Reynolds Boddington Mines Ltd., 40%; Billiton Australia Gold Ltd., 30%; BHP Gold Mines Ltd., 20%; and Kobe Alumina Associates (Australia) Pty. Ltd., 10%	Boddington Mine, WA	14,000 [21]10,000

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]	Annual capacity
Gold, copper, lead, zinc	Enterprise Metals Ltd., 100%	Peak Mine, NSW[22]	3,100 [10]2,250 [23]4,850 [24]3,600
Gold, silver	Elders Resources NZFP Ltd., manager, 60%; and Anglo American Pacific Ltd., 40%	Mount Morgan Tailings Mine, QLD	2,000 [16]750
Do.	MIM Holdings Ltd., 100%	Pacific precious-metals refinery, NSW	[20]1,900 [14]500
Do.	Paragon Resources NL., 100%	Temora Mine, NSW	2,250 [16]2,250
Iron ore	BHP-Utah Iron Ore, 100%	Koolan Island (Yampi) Mine, WA	4,000
Do.	Mount Goldsworthy Mining Associates, manager. BHP-Utah Iron Ore, 85%; C. Itoh and Co., 8%; and Mitsui and Co., 7%	Mount Goldsworthy Mine, WA (Kennedy Gap, Nimingarra, Shay Gap, Sunrise Hill, and Yarrie deposits)	6,500
Do.	do.	Yandi (formerly Yandicoogina) Mine, WA	[22]5,000
Do.	Channar Management Services, manager. Hamersley Iron Pty. Ltd., 60%; and CMIEC (Channar) Pty. Ltd., 40%, a People's Republic of China Government agency	Channar Mine, WA	3,000
Do.	Hamersley Iron Pty. Ltd., 100%	Mount Tom Price and Paraburdoo Mines, WA	42,000
Do.	Mount Newman Mining Co. Pty. Ltd., manager. BHP-Utah Iron Ore, 85%; C. Itoh and Co., 8%; and Mitsui and Co., 7%	Mount Whaleback (Mount Newman) Mine, WA	30,000
Do.	do.	Orebody 25 (Ferro Gully) and Orebody 29 (Marra Mamba) Mines, WA	5,000
Do.	Robe River Mining Co. Pty. Ltd., manager. North Broken Hill-Peko Ltd., 35%; Robe River Mining Co., 30%; Mitsui Iron Ore Development Pty. Ltd., 20%; Pannawonica Iron Associates, 10%; and Cape Lambert Iron Associates, 5%	Pannawonica-Deepdale Mines, WA	27,000
Do.	Savage River Mines, operator. Pickands Mather and Co. International, 100%	Savage River Mine, TAS	1,300
Lead	Mount Isa Mines Ltd., 100%	Mount Isa smelter, QLD	[25]210
Lead, zinc, silver	do.	Isa Mine, QLD	[5]4,600
Do.	do.	Hilton Mine, QLD	[5]1,200
Do.	Pasminco Ltd., 100%	North and Zinc Corp., or ZC, Mines, Broken Hill, NSW	[5]2,900
Lead, zinc, silver, gold, cadmium	do.	Port Pirie refinery-smelter, SA	[26]235
Lithium	Lithium Australia Ltd., 100%	Greenbushes Mine, WA	[27]84
Manganese	Groote Eylandt Mining Co. Pty. Ltd., 100%	Groote Eylandt Mine, NT	[5]2,000
Manganese alloys	Tasmanian Electro Metallurgical Co. Pty. Ltd., 100%	Bell Bay smelter, TAS	[28]190
Mineral sands	Associated Minerals Consolidated Ltd., 100%	Capel Mine and associated Capel dry processing and synthetic rutile plants, WA; Eneabba and Eneabba West Mines and associated Eneabba dry processing and Narngulu dry processing and synthetic rutile plants, WA	[29]360 [30]100 [31]170 [32]300 [33]15
Do.	Australmin Holdings Ltd., 100%	Newrybar Mine and associated Woodburn dry processing plant, NSW	[30]10 [32]10
Do.	Cable Sands (WA) Pty. Ltd., 100%	Busselton East and Waroona South Mines and associated Bunbury dry processing plant, WA	[29]200 [33]1 [32]15 [34]5
Do.	Consolidated Rutile Ltd., 100%	Amity, Bayside, and Gordon Mines on North Stradbroke Island and associated Pinkenba dry processing plant, QLD	[29]280 [32]85 [30]100 [33]1

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]	Annual capacity
Mineral Sands—Continued	Mineral Deposits Ltd., 100%	Nerong, Stockton, and Viney Creek Mines and associated Hawks Nest dry processing plant, NSW	[30]30 [32]25 [29]10
Do.	Minproc Chemical Co. Pty. Ltd., manager, 50%; and Kerr-McGee Chemical Corp., 50% (Tiwest Joint Venture)	Cooljarloo Mine and associated Chandala dry processing and synthetic rutile plants; and Kwinana titanium pigment plant, WA	[29]180 [34]9 [33]1 [30]35 [31]68 [32]60 [35]54
Do.	RZM Pty. Ltd., 100%	Nabiac Mine and associated Harrington dry processing plant; 4 mines in Tomago area and associated Tomago dry processing plant, NSW	[30]35 [32]35 [29]10
Do.	Westralian Sands Pty. Ltd., 100%	North Capel,[36] Yoganup Extended,[36] and Yoganup North Mines and associated Capel dry processing and synthetic rutile and North Capel dry processing plants, WA	[29]540 [32]50 [33]2 [31]100
Do.	Wimmera Industrial Minerals Pty. Ltd., 100%	WIM 150 (Horsham) Mine,[37] VIC	[29]250 [30]100 [32]120 [33]12
Nickel	Australian Consolidated Minerals Ltd., manager, 50%; and Outokumpu Metals and Resources Oy, 50%	Mount Keith Mine,[37] WA	[5]6,600
Nickel, cobalt	MEQ Nickel Pty. Ltd., manager, 72%; and Nickel Resources North Queensland Pty. Ltd., a subsidiary of the Queensland Government, 28%	Greenvale Mine, QLD	[5]1,300
Do.	do.	Yabulu refinery, QLD	[38]23 [39]1
Nickel	Western Mining Corp. Ltd., 100%	Kalgoorlie smelter, WA	[40]50
Do.	do.	Kambalda nickel operations, WA	[5]1,600
Do.	do.	Kwinana refinery, WA	[41]35
Do.	do.	Leinster nickel operations, WA	[5]1,000
Opal	Many small producers	Andamooka and Coober Pedy areas, SA; Lightening Ridge area, NSW	NA
Petroleum[42]	Ampol Refineries Ltd., 100%	Lytton refinery, QLD	74
Do.	BP Refinery (Bulwer Island) Pty. Ltd., 100%	Bulwer Island refinery, QLD	53
Do.	BP Refinery (Kwinana) Pty. Ltd., 100%	Kwinana refinery, WA	120
Do.	Caltex Refining Co. Pty. Ltd., 100%	Kurnell refinery, NSW	108
Do.	Petroleum Refineries (Australia) Pty. Ltd., manager. Mobil Oil Australia Ltd., 100%	Altona refinery, VIC	108
Do.	do.	Port Stanvac refinery, SA	72
Do.	Shell Refining (Australia) Pty. Ltd., 100%	Clyde refinery, NSW	91
Do.	do.	Geelong refinery, NSW	132
Salt	Dampier Salt (Operations) Pty. Ltd., 100%	Dampier and Lake McCleod Fields, WA	[43]4,500
Do.	Cargill Australia Ltd., 100%	Leslie Salt operations, WA	2,250
Steel	BHP Steel Ltd., 100%	Newcastle steelworks, NSW	1,800
Do.	do.	Port Kembla steelworks, NSW	3,800
Do.	do.	Whyalla steelworks, SA	1,100
Do.	do.	Sydney Minimill, NSW[44]	250
Tin	Renison Goldfields Consolidated Ltd., 100%	Renison Mine, TAS	[5]825
Tin, tantalum	Greenbushes Ltd., 100%	Greenbushes Mine, WA	[5]2,200
Uranium	Energy Resources of Australia Ltd., operator. North Broken Hill-Peko Ltd., 65%; and other interests, 35%	Ranger Mine, NT	[45]4,500

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]	Annual capacity
Zinc	Falcona Exploration and Mining NL, manager, 75%; and CRA Exploration Pty. Ltd., 25%	Mount Garnett Mine, QLD[44]	[5]400
Do.	Pasminco Ltd., 100%	Risdon refinery, TAS	[46]220
Do.	Sulphide Corp. Pty. Ltd., 100%	Cockle Creek refinery-smelter, NSW	[46]70
Zinc, copper	Murchison Zinc Co. Pty. Ltd., operator. Australian Consolidated Minerals Ltd., 45%; Esso Australia Resources, 35%; and Aztec Mining Co. Ltd., 20%	Scuddles (Golden Grove) Mine, WA	[5]800
Zinc, lead	BHP-Utah Minerals Inc., 100%	Cadjebut Mine, WA	[5]320
Zinc, lead, copper, silver, gold	Aberfoyle Ltd., 100%	Hellyer Mine, TAS	[5]1,250
Do.	do.	Que River Mine, TAS	[5]300
Do.	Pasminco Ltd., 100%	Rosebery Mine, TAS	[5]505
Zinc, lead, silver	Aztec Mining Co. Ltd., 100%	Woodcutters Mine, NT	[5]500
Zinc, lead, silver, copper, gold	Pasminco Ltd., 100%	Elura Mine, NSW	[5]1,250
Do.	Pancontinental Mining Ltd., manager, 50%; Outokumpu Australia Pty. Ltd., 25%; and Agip Australia Pty. Ltd., 25%	Thalanga Mine, QLD	[5]550
Zirconia	Z-Tech Pty. Ltd., 100%	Rockingham, WA	[47]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 early 1993; 1990 capacity was 850,000 tons of alumina, Al_2O_3.
[3]Capacity scheduled for early 1992; 1990 capacity was 1,400,000 tons of alumina, Al_2O_3.
[4]Capacity scheduled for mid-1992; 1990 capacity was 240,000 tons of aluminum.
[5]Ore.
[6]Capacity scheduled for early 1992; 1990 capacity was 5,100,000 tons of bauxite.
[7]Scheduled to begin production in Apr. 1991, reaching 2 million tons per year by 1993.
[8]Scheduled to begin production early in 1991, reaching 3 million tons per year by 1993.
[9]Refined copper.
[10]Tons copper-in-concentrates.
[11]Kilograms gold.
[12]Capacity scheduled for 1992; 1990 capacity was 50,000 tons of refined copper.
[13]Tons copper concentrate.
[14]Tons zinc concentrate.
[15]Capacity scheduled for yearend 1992; 1990 capacity was 46,000 tons of refined copper.
[16]Kilograms silver.
[17]Capacity scheduled for yearend 1992; 1990 capacity was 1,200 tons of triuranium octoxide, U_3O_8.
[18]Copper-nickel matte.
[19]Thousand carats.
[20]Kilograms refined gold.
[21]Tons copper concentrate capacity scheduled for 1991.
[22]Scheduled to begin production in 1992.
[23]Tons zinc-in-concentrates.
[24]Tons crude lead containing silver.
[25]Tons lead-in-concentrates.
[26]Primary lead.
[27]Spodumene concentrate.
[28]Ferromanganese and/or silicomanganese.
[29]Ilmenite.
[30]Rutile.
[31]Synthetic rutile.
[32]Zircon.
[33]Monazite.
[34]Leucoxene.
[35]Titanium dioxide, TiO_2, pigment.
[36]Closed temporarily in late 1990.
[37]Scheduled to begin production in 1993.
[38]Nickel in oxides.
[39]Cobalt in mixed sulfides.
[40]Nickel matte.
[41]Refined nickel with copper sulfide and mixed nickel-cobalt sulfides.
[42]Thousand 42-gallon barrels per day.
[43]Capacity scheduled for 1992; 1990 capacity was 3.5 million tons of solar salt.
[44]Scheduled to begin production in 1991.
[45]Tons triuranium octoxide, U_3O_8.
[46]Zinc metal.
[47]Tons high-purity zirconia, ZrO_2, powder.

Review Board, was expected to come on-stream in the last quarter of 1991. The Radio Hill Project, near Karratha, included a 150-mt/a underground mine and concentrator and an ISASMELT-process smelter, the second outside of the Mount Isa base metal complex in Queensland, to produce a matte containing 2,500 tons of nickel and 2,000 tons of copper.[17]

The Boddington Mine, Australia's largest gold mine, was scheduled to begin production of copper concentrates early in 1991. Work was begun in midyear on a flotation and leaching plant. The concentrate was to be produced from the treatment of 250,000 mt/a of supergene ore for 2 years beginning in late January 1991, rising to 500,000 mt/a in 1993 for the following 2 years. The amount of copper concentrate production was likely to vary greatly because of the complexity of the ore, with output for the first 3 years expected to be 10,000 tons, 11,000 tons, and 2,200 tons, respectively, but with increasing gold credits.[18]

The Olympic Dam joint-venture partners were considering at yearend increasing production by more than 40% at their South Australian copper-uranium mine. The plan under study was stage 2 of mine development, which would increase copper production from 46,000 mt/a to 66,000 mt/a. The joint venture was managed by WMC (Olympic Dam Operations) Pty. Ltd., owned jointly by WMC (Olympic Dam Corp.) Pty. Ltd., a subsidiary of Western Mining Corp. Holdings Ltd. (WMC), 51%, and BP Minerals Ltd. of the United Kingdom, 49%. Discussions between WMC and BP Minerals continued regarding the procedures to be adopted should BP Minerals conclude to reoffer its stake for sale again—under the joint-venture agreement, WMC has a preemptive right to buy BP Minerals' share if offered for sale.[19]

In September, approval for the construction of a $46 million smelter using ISASMELT technology developed by Mount Isa Mines Ltd.'s (MIM) wholly owned subsidiary Copper Refineries Pty. Ltd. was announced. The smelter, to be built at MIM's Hilton operations in Queensland, will reduce operating costs by an estimated 30%, as well as reduce sulfur dioxide emissions.[20]

Gold.—Australian gold production in 1990 increased for the 10th consecutive year and set a new record high for the third year in a row. Production increased primarily because producers were trying to maximize their output before the cessation of the Federal gold tax exemption on December 31. The Boddington Mine, in Western Australia, remained Australia's largest producer. The Temora Mine remained New South Wales' leading producer. The Granites Mine was the leader in the Northern Territory, displacing the Pine Creek Mine through processing capacity expansion. The Kidston Mine was still the leading producer in Queensland. Gold produced from the Olympic Dam Mine in South Australia was the most in the State, although the mine is primarily considered a copper mine. Gold output from Tasmania remained almost entirely a byproduct of base metal mining, predominantly from the Mount Lyell copper mine. The Stawell Mine was the major gold producer in Victoria.

The Granny Smith Mine, 20 km south of Laverton, Western Australia, began the commissioning process in December 1989, poured its first gold in January 1990, and was officially opened on February 1. Although production will average about 4,700 kg over the projected 8-year life of the mine, the first year's production was scheduled to be about 7,300 kg in order to take advantage of the tax exemption on gold mining profits.[21]

Enterprise Metals Ltd., a subsidiary of CRA formed in 1988 to manage CRA's interests in the Cobar region of New South Wales not absorbed into Pasminco Ltd., announced in June that it would develop the Peak Project, 8 km south of Cobar, into an underground mine. The mine was expected to begin production in 1992, becoming New South Wales' largest gold miner, producing about 3,100 kg of gold per year.[22]

Australian Gold Refineries (AGR), previously known as the Perth Mint, replaced in August its Perth Mint stamp, which acted as a guarantor of the weight and purity of each of its 400-ounce fine (99.5%-pure) gold bars with an AGR stamp on the bars produced at both its Perth and Kalgoorlie refineries in Western Australia. Most of the world's gold is traded in the form of 400-ounce bars of a minimum 99.5% purity. In addition, AGR changed the shape of its 400-ounce bars into flatter, longer bars that meet the preferences of the world's bullion dealers, especially in Asia, which accounts for about 80% of Australia's gold exports.[23]

In addition, AGR applied for its Kalgoorlie refinery to be accredited by the London Bullion Market Association (LBMA). The LBMA sets the standards for the world's gold trade. Accreditation would mean that for the first time since the discovery of the Eastern Goldfields of Western Australia in the 1890's, gold mined in that region could be sent directly to the world's bullion markets. AGR expected the refinery to be accredited in early 1991.[24]

In April, AGR ended its operations at the Perth Mint, which supplied gold bars to the world bullion markets for 91 years, and transferred all of its Perth gold refining operations to the new refinery built in 1988 at Newburn, near the Perth international airport.[25]

AGR is a division of the Western Australian Mint, which is a subsidiary of the Gold Corp. of Australia, an agency of the Western Australia State government. It is Australia's largest gold refiner, refining about 60% of Australia's gold production as well as processing gold from Fiji, New Zealand, Papua New Guinea, Saudi Arabia, and the Solomon Islands.

Plutonic Resources, formerly Pioneer Mineral, commissioned on August 6 its large open pit Plutonic Mine and treatment plant 180 km northeast of Meekatharra, Western Australia. Because the sulfide ore was softer than anticipated, resulting in higher ore production, and both the grade of the lateritic feed to the mill and the rate of gold recovery were larger than expected, production, at more than 3,000 kg, was almost twice what was forecast for the 5 months to yearend.[26]

ICI Australia Ltd.'s 25,000-mt/a sodium cyanide (NaCN) chemical plant near Gladstone, Queensland, was officially opened in August. The plant became Australia's second NaCN producer after a 50,000-mt/a plant operated by Australian Gold Reagents Pty. Ltd. was constructed in Western Australia in 1988. NaCN is an essential chemical in the extraction of gold. ICI also announced plans to begin construction of a 100,000-mt/a ammonium nitrate plant adjacent to the NaCN plant for the manufacture of explosives for the mining industry.[27]

Du Pont (Australia) Ltd.'s plans for a 45,000-mt/a NaCN plant at Kwinana, Western Australia, proceeded on schedule for a 1991 startup. Much of the production will be used by the gold mining industry of Western Australia, but about 20% of production will be exported to markets in Southeast Asia.[28]

Near yearend, Newmont, a subsidiary of the U.S.-based Newmont Mining Corp., and BHP Gold Mines Ltd., a subsidiary of The Broken Hill Pty. Co. Ltd. (BHP), announced that they would merge to form a new company, which was to be named early in 1991. The new company will have interests in seven Australian gold mines, accounting for the production of approximately 23 tons of gold, with management control of six of them. The new company was to become Australia's largest and the world's fifth largest gold producer.[29]

Iron Ore.—Australian iron ore production continued to be heavily concentrated in the Hamersley Range of the Pilbara District, Western Australia, which accounted for more than 95% of the country's total.

Shipments of iron ore began on January 9 from the Channar iron ore mine, a joint-venture operation between Hamersley Iron Pty. Ltd. and the China National Metallurgical Import and Export Corp., a trading arm of the Ministry of Metallurgical Industry and an agency of the Government of China. The iron ore was destined for the Baoshan Iron and Steel Works near Shanghai. The $210 million Channar Mine, one of China's largest investments overseas and the first new iron ore mine to be developed in the Pilbara region of Western Australia since 1973, was officially opened by Australian and Chinese officials on May 4. The mine will initially produce 3 Mmt of iron ore per year, progressively increasing to 10 Mmt/a by the turn of the century. Under the terms of the Sino-Australian joint venture, all of the ore produced will be sold to China under long-term contracts over a period of 20 years. Actually, the Channar ore was not sold as a separate product. Instead, it was conveyed 20 km to Paraburdoo for blending with the Paraburdoo product. The equivalent of Channar output was then sold.[30]

In February, BHP-Utah Iron Ore purchased the British investment firm Hanson Trust PLC's 70% interest in the Mount Goldsworthy Mine, raising its stake in the relatively small Pilbara producer to 100%. BHP-Utah exercised its preemptive right following Hanson's takeover in July 1989 of Consolidated Gold Fields PLC, which previously owned the 70%-majority interest in Mount Goldsworthy Mining Associates, the joint-venture operating company of the mine. Effective October 1, BHP-Utah sold a 15% stake to two Japanese companies, Mitsui and Co. taking 8% and C. Itoh and Co. taking 7%. BHP-Utah had been associated with the operation since 1983, when it acquired a 42.33% interest in the mine. But its share fell to 30% in 1986 when it declined to fund expansion of the mine from the Shay Gap-Sunrise Hill areas into the nearby deposits of Kennedy Gap, Nimingarra, and Yarrie. The expansion, including construction of a new crusher, beneficiation plant, rail handling facilities, and a short rail spur, extended the mine life by about 20 years.[31]

Also in February, the Iron Duke Mine was opened by BHP-Utah in the South Middleback Ranges near Whyalla, South Australia. The mine life at the scheduled production rate of 1.5 Mmt of ore per year was 20 years, but this will likely be extended with the future development of associated ore bodies at Iron Duchess and Iron Knight.[32]

BHP-Utah announced in May that it would develop a 5-Mmt/a iron ore mine at its Yandi (formerly called Yandicoogina) deposit northwest of its Mount Whaleback Mine near Newman, subject to approval of the Western Australian Government and completion of sales contracts. BHP-Utah had letters of intent for the purchase of iron ore from its sister company, BHP Steel (950,000 mt/a); four Japanese steel producers, Kawasaki Steel Corp. (1.1 Mmt/a), Kobe Steel Ltd. (600,000 mt/a), Nippon Steel Corp. (1.1 Mmt/a), and Sumitomo Metal Industries Ltd. (300,000 mt/a); and China's Baoshan steelworks (950,000 mt/a).[33] A 32-km rail spur will connect the $61 million mine with BHP-Utah's existing Newman-to-Port Hedland rail line. The mine was expected to begin production by April 1992.[34] In midyear, BHP-Utah sold a 15% stake in Yandi to two Japanese companies, Mitsui and Co. taking 8% and C. Itoh and Co. taking 7%. The sale, effective October 1, gave the parties identical ownership in the three operations of Mount Goldsworthy, Mount Whaleback, and Yandi.[35]

The Savage River Mine in Tasmania was given a 5-year renewal on life in July when Pickands Mather and Co. International assumed sole ownership. Originally, the Australian-Japanese-United States joint-venture owners were planning to shut down the mine on October 1 owing to marketing problems, but Pickands Mather negotiated for a restructuring of ownership and a new plan of operation, giving it 100% ownership and control of the mine to continue operations at a reduced rate of 1.3 million Mmt/a of salable product for 5 years. Iron ore was piped in slurry form 80 km to Port Latta on the northwest Tasmanian coast, where it was pelletized and shipped to customers in Australia, Japan, and the Republic of Korea.[36]

The Western Australian Government excised in November the Marandoo iron ore deposit, plus a corridor of land required for mine infrastructure, from the Hamersley Range National Park. Hamersley Iron, which also had earlier obtained the 50% ownership held jointly by Hancock Prospecting Pty. Ltd. and Wright Prospecting Pty. Ltd., was expected to proceed with the development of a 10-Mmt/a mine at Marandoo, about 40 km northwest of its Mount Tom Price Mine, upon favorable results of feasibility and environmental impact studies.[37]

Hamersley Iron declared force majeure on all its long-term iron ore contracts in mid-November as a result of a strike by railway workers at the rail operations running between the Mount Paraburdoo-Mount Tom Price-Channar Mines since November 1. Although production at the mines continued during the 3-week-long strike, no trains were operated between the mines and Hamersley's Dampier Port, and ore shipments had to be suspended when stockpiled ore at the port was depleted. Rail transport of the iron ore resumed November 23 when the union accepted a back-to-work order and arbitration of the dispute by the Western Australian Industrial Relations Commission. However, a separate dispute by workers at the Port of Dampier on November 24 kept iron ore from being loaded for shipment for the remainder of the month.[38]

Lead and Zinc.—All lead and zinc ore mined in Australia continued to be from operations that produced both, since the two metals occur in associated minerals in the same ore bodies.

Construction of the 750,000-mt/a concentrating mill was completed at the Hilton Mine, 20 km north of Queensland's renowned mine at Mount Isa, in December 1989, and its commissioning was begun in February 1990, thus heralding the beginning of commercial production and the ending of the 30-month "trial" mining period. The concentrator produced three concentrates: lead-silver, zinc, and low-grade middlings (LGM), all of which were thickened on-site before being transported in slurry form to Mount Isa in trucks. The lead slurry was treated at the Mount Isa lead smelter and the zinc and LGM concentrates were exported to refineries in Europe.[39]

A series of explosions in the newly commissioned purification plant suspended production at Pasminco's zinc refinery at Risdon, near Hobart in Tasmania, at the end of March for several days, with production resuming only slowly. More than 5,000 tons of zinc metal production was lost.[40] Early in October, a dispute over the restructuring of the work force at the refinery, which was in the process of undergoing upgrading and modernization, led to a 5-day strike that caused an additional 3,000 to 4,000 tons of lost production. However, the strike did not affect deliveries to consumers as sufficient stocks were on hand.[41]

The opencut operation at the Thalanga Mine near Charters Towers, Queensland, was officially opened in May, and the first zinc, lead, and copper concentrates were transported to Townsville for subsequent shipment to Japanese smelters. Development was proceeding on schedule to begin underground mining during the first quarter of 1991. Production will reach 145,000 mt/a of copper, lead, and zinc concentrates when fully operational.[42]

The Scuddles zinc-copper mine at Golden Grove, Western Australia, commenced operations on schedule in August. The Scuddles Mine was the first stage in the development of the Golden Grove polymetallic joint-venture project 550 km north of Perth. It will be the country's third largest zinc mine, after MIM's Isa Mine at Mount Isa in Queensland and Pasminco's Broken Hill operations, consisting of the North and the ZC Mines, in New South Wales, when full production is attained. In addition to copper and zinc, the mine was expected to start producing lead concentrates from its 800,000-mt/a operation by June 1991 when the underground mine becomes fully operational.[43] The concentrates will be sold under long-term contracts to refineries in Europe, Japan, and the Republic of Korea.[44]

Aztec Mining Co. Ltd. was successful in its takeover bid of Nicron Resources Ltd. in October, creating a medium-sized Australian mining company with interests in gold (Bounty Mine) as well as base metals (Scuddles zinc-copper and Woodcutters zinc-lead-silver mines).[45]

Denehurst Ltd. announced in November that it planned to construct a $4 million plant to re-treat 500,000 tons of metal-rich tailings per year from its Woodlawn Mine in New South Wales to produce 20,000 mt/a of zinc concentrate. Commissioning of the plant was expected in May 1991.[46]

Manganese.—Pilbara Port Railway Resources, a wholly owned subsidiary of Hancock Mining Ltd., and Portman Mining Ltd., a partly owned subsidiary of Pennant Resources Ltd., began production in midyear at their 50-50 joint-venture Woodie Woodie Mine near Nullagine in the Pilbara region, Western Australia. The mine was expected to produce 250,000 mt/a of ore for 5 to 6 years. Three orders totaling 80,000 tons were shipped from Port Hedland to ferroalloy producers in China, the Republic of Korea, and Taiwan by yearend, and a further 35,000-ton shipment had been ordered for delivery early in January to Japan. The ore was transported, after crushing and screening, 380 km to Port Hedland by road train.[47]

Australian Manganese Co., a wholly owned subsidiary of BHP-Utah, commissioned Australia's first electrolytic manganese dioxide (EMD) plant at Newcastle, New South Wales, in the third quarter. The plant processed manganese ore, mined at Groote Eylandt in the Gulf of Carpentaria, Northern Territory, by Groote Eylandt Mining Co. Pty. Ltd., also a wholly owned BHP-Utah subsidiary, into EMD for the manufacture of high-quality industrial batteries.[48]

Mineral Sands.—Australia's mineral sands industry included the mining and processing of high concentrations of the heavy-minerals ilmenite, leucoxene, monazite, rutile, and zircon. Australia remained the world's leading producer and exporter of mineral sands and produced an estimated 50% of world production of ilmenite, monazite, and rutile and 55% of zircon. Most of Australia's mineral sands production was sold and exported under long-term contracts, with spot sales comprising only a small part of the total market.

Australmin Holdings Ltd. commenced mining at its Newrybar Mine in the first quarter, the first mineral sands mining operation on the far north coast of New South Wales since the early 1970's when the Government began closing down operations within national park boundaries. The heavy-mineral concentrates were transported to the 20-year-old Woodburn dry processing plant, which has been extensively modified and rebuilt to comply with Australia's present environmental regulations.[49]

A pilot plant at Wimmera Industrial Minerals Pty. Ltd.'s WIM 150 mineral sands deposit in the Murray Basin southeast of Horsham, Victoria, continued testing alternative circuits for extraction of a bulk heavy-minerals concentrate and the separation of individual minerals. The plant also produced samples to be evaluated by potential customers. The company was planning development of a 20-Mmt/a dredging operation at the deposit capable of producing 100,000 tons of rutile, 120,000 tons of zircon, more than 250,000 tons of ilmenite, and 12,000 tons of monazite per year beginning in 1993.[50]

Mining commenced in September at Cable Sands (WA) Pty. Ltd.'s Busselton East deposit in Western Australia at the rate of 100,000 tons of ilmenite per year following termination in July of dredging operations at its Minninup site owing to ore depletion. Cable Sands was also planning to start mining its Jangardup deposit 50 km south of Nannup late in 1991. In early 1990, the Environmental Protection Authority granted conditional approval to mine the deposit. Expected production was 271,000 tons of predominantly ilmenite, with some zircon heavy-minerals concentrate per year.

Westralian Sands Ltd. (WSL) closed down its North Capel and Yoganup Extended Mines, which both provided feed for the company's Capel dry processing plant, south of Bunbury, in the last quarter of the year pending improvement in world demand for mineral sands products and to reduce its stock levels. Mining continued at WSL's main Yoganup North Mine.

The world's first fully integrated project from mineral sands mining to downstream processing of concentrates into titanium dioxide (TiO_2) pigment manufacturing was almost completed at yearend. Mining operations by the Tiwest joint venture, formerly called the Cooljarloo joint venture, commenced late in 1989 at Cooljarloo, 170 km north of Perth in Western Australia, using a bucket-wheel dredge. The first synthetic rutile (upgraded ilmenite) production began early in January at the Chandala dry processing plant, 60 km north of Perth. Construction of the 54,000-mt/a TiO_2 pigment plant at Kwinana, 30 km south of Perth, was on schedule for a March 1991 startup, when production of pigment for use in the paint, paper, and plastics industries was scheduled to begin.[51]

Nickel.—Australian Consolidated Minerals Ltd. (ACM) and Finland's Outokumpu Metals and Resources Oy (OMR) formed a 50-50 joint venture late in 1989 to produce nickel concentrates from ACM's Mount Keith, Western Australia, large sulfide nickel deposit for the world stainless steel industry. Preliminary plans involved a 5-Mmt-capacity open pit, mill, and concentrator to produce 20,000 tons of nickel in concentrates to feed OMR's existing metallurgical facilities at Kokkola, Finland, for the production of ferronickel.[52]

Modified proposals formulated in April increased mine production at Mount Keith to 6.6 Mmt/a, producing 140,000 tons of 20% nickel concentrate, and simultaneously constructing completely new processing infrastructure at Kokkola, including new roasters, acid plant, sintering plant, and a 70,000-mt/a ferronickel refinery.

In October, it was announced that the Mount Keith-Kokkola integrated ferronickel project would be developed in two stages to reduce initial capital outlay and financial risk. Development of the mine and concentrator, stage 1, would proceed beginning early in 1991 at a cost of about $350 million. About two-thirds of production, 18,000 tons of contained nickel in concentrate, was to be sold to OMR's wholly owned subsidiary Harjavalta Metals Oy for processing into matte and electrolytic nickel. The balance of the Mount Keith production, 10,000 tons of nickel metal in concentrates, was to be sold on world markets. Stage 2, development of the integrated facility at Kokkola, would be deferred pending additional research and development on the ferronickel process and other downstream processing alternatives.[53]

The Queensland State government increased its interest in MEQ Nickel Pty. Ltd., the majority owner of the Greenvale Mine and Yabulu refinery, to 28% in January, thereby averting MEQ Nickel from going into receivership. The Government, through State-owned Nickel Resources North Queensland Pty. Ltd., previously had a 12.5% interest.

MEQ Nickel was planning to increase production from 24,000 mt/a to 35,000 mt/a of product by expanding the roasting, drying, and washing facilities at its Yabulu hydrometallurgical refinery near Townsville and to build new port facilities at Halifax Bay, adjacent to the Yabulu plant but within the Great Barrier Reef National Park, to accommodate increased imported ore requirements.

In 1990, the Greenvale Mine provided about 50% of the Yabulu plant's needs, about 1 Mmt of ore, but Greenvale reserves were expected to be depleted by yearend 1992. The remaining ore requirements were imported through the Port of Townsville, but any additional imported tonnage would require significant infrastructure development to accommodate it. MEQ Nickel considered development of the Halifax Bay port scheme to be essential to the continuation of the refinery, as the alternative, shipping the additional ore through the Port of Townsville, would not be economically viable, and the refinery would have to close.[54]

In midyear, the Great Barrier Marine Park Authority rejected for environmental reasons MEQ Nickel's proposal to build a new transshipment port at Halifax Bay. MEQ Nickel had filed an appeal with the Administrative Appeals Tribunal by yearend and was considering other options to keep the refinery in operation.[55]

Platinum and Palladium.—No Australian mines were primary producers of platinum or palladium in 1990. A small amount was produced as a byproduct, for example, from the nickel ore operations in the Kambalda region of Western Australia.

The mining industry of Australia was hopeful this could change with development of the Coronation Hill gold-platinum-palladium project in the South Alligator River region of the Northern Territory. Partners in the project were Newmont, 45%, acting as manager; Plutonic Resources, 45%; and Norgold, a subsidiary of North Broken Hill-Peko Ltd. (NBHP), 10%. The Coronation Hill Project is within the Kakadu Conservation Zone of Kakadu National Park.

The question of whether the Government would permit mining at the site was again delayed early in the year when the matter was referred to the RAC for additional inquiry into the Kakadu Conservation Zone before final approval for mining would be given. The commission had not made a decision by yearend.

Silver.—The Western Australian Mint, which is a subsidiary of the Gold Corp. of Australia and an agency of the Western Australia State government, issued Australia's first legal tender silver bullion coin in April. The 1-ounce, 99.9%-pure silver coin was called the Kookaburra, named after the distinctive-voiced Australian bird, and was traded in line with international silver prices. The silver Australian Kookaburra completed a portfolio of Australian precious-metal coins, joining the gold Australian Nugget launched in April 1987 and the platinum Australian Koala, first released in September 1988. The 1990 mintage was limited to 300,000 coins, low by world standards for a silver bullion coin. The design of the coin was to be changed annually.[56]

Steel.—BHP Steel Ltd. was the only integrated steel producer in Australia during the year. Although ranking as the 19th largest steel producer in the world, BHP Steel's contribution to total world steel output was relatively small. It had three integrated steelworks totaling about 6.7 Mmt of steel capacity per year.

Capacity at the Newcastle steelworks in New South Wales was being increased to 3 Mmt/a with the introduction of a ladle metallurgy furnace. Work on the upgrade was to be completed early in 1991. Voest Alpine Industrieanlagenbau of Austria was selected in March as the contractor to install a slab caster at the Whyalla steelworks in South Australia, which will increase BHP Steel's continuous casting ratio from about 81% to 100%. Coupled with upgrading of the plant and rolling mills, salable steel will increase by about 100,000 mt/a.

Current output of raw steel at the Whyalla facilities was processed further into structural steels, universal sections, and rail products, although some semifinished products such as blooms and slabs were made primarily for export. The product range at BHP Steel's flagship works at Port Kembla, New South Wales, included slabs, hotrolled strip and plate, tinplate, and steel stripping for the domestic and export markets. The Newcastle plant specializes in rod and bar products, coldrolled strip, blooms, and billets.[57]

Tantalum and Tin.—The Renison Mine near Zeehan, Tasmania, celebrated in September its centennial of tin mining, although the present-day mine and concentrator dates only from 1966, from which annual capacity has been increased from about 355,000 mt/a to the present 825,000 mt/a. The Renison Mine remained the world's largest hard-rock underground tin mine and the only major tin producer still active in Australia. The final concentrate, grading about 50% tin, was shipped to Malaysia for toll smelting.[58]

In order to reduce operating costs, which have been plaguing the mine since the 1986 collapse of the International Tin Council, Renison Goldfields Consolidated Ltd. (RGC) implemented in April a major reorganization at the Renison Mine, resulting in the reduction through early retirement and voluntary retrenchment of the work force by about 18%, or 85 jobs.[59]

Greenbushes Ltd.'s Greenbushes Mine, Western Australia, remained Australia's second largest tin producer after RGC, mining tin along with tantalite from its large pegmatite opencut operation. Greenbushes operated the country's only tin smelter at the site, although this was primarily used to upgrade low levels of tantalum oxide (Ta_2O_5) in the cassiterite-tin ore to high-grade Ta_2O_5 slag marketed as tantalum glass and to convert antimony- and tantalum-containing tantalite ore to a more salable tin-antimony alloy and tantalum glass.[60]

Greenbushes was planning the development of its hard-rock project at the site, which will increase tantalum production to about 275,000 kg/a. An underground decline was in place early in the year to access the ore, and plans for the milling and crushing facilities to process the harder ore were being implemented.[61]

Tungsten.—King Island Scheelite Pty. Ltd., a wholly owned subsidiary of NBHP, closed in November its Dolphin scheelite mine on King Island in the Bass Strait off the Tasmanian coast. The mine had been a marginal operation for some time owing to depressed tungsten prices, and plans were made in 1989 to mothball the mine early in 1990. In July, an attempt was made to sell the mine, but a buyer could not be found. Outstanding sales commitments were expected to be fulfilled from existing stocks on the mainland. The Kara Mine, a small producer just south of Burnie on Tasmania's northern coast, thus became Australia's only operating scheelite mine. It was owned and operated by Tasmania Mines Ltd.[62]

Industrial Minerals

Asbestos.—Mineral Commodities Ltd. (MCL), formerly Woodsreef Mines Ltd., was negotiating with the New South Wales Government to restart chrysotile asbestos mining at its Woodsreef Mine near Barraba in northern New South Wales. MCL was planning to use a new wet process, which both increased asbestos-fiber yield and eliminated airborne dust during milling, to reprocess the mine's 25-Mmt tailings dump left when the mine closed in 1983. An estimated 1 Mmt of chrysotile fibers remain in the tailings, which MCL was planning to use for manufacturing asbestos cement.[63]

Diamond.—The mammoth Argyle Mine in the Kimberley region of Western Australia again retained, for the fifth successive year, its position as the world's biggest individual volume producer of diamond, although 1990 output from the combined treatment of AK-1 lamproite pipe ore and its derived alluvium in the lower reaches of the Smoke and Limestone Creeks that drain the pipe decreased slightly from that of 1989. In terms of value, however, production from the Argyle Mine only ranked sixth in the world because production was predominantly industrial-quality stones. About 5% of production was of gem quality, including a small proportion of very rare pink stones; 40% was near-gem-quality and 55% was industrial-quality.

The treatment plant was upgraded during the year from the original design capacity of 3 Mmt/a of lamproite ore to 6 Mmt/a of combined lamproite-alluvial ore. This was done to ensure the maintenance of output at about 35 million carats of diamond per year as mining progresses into deeper lamproite ores, which are gradually decreasing in grade.[64]

Australia's only other significant producing diamond mine, Poseidon Ltd.'s Bow River Mine 25 km northeast of Argyle, has steadily increased production since its start-up early in 1988. Poseidon acquired 80% of the mine as a result of its merger in 1989 with Freeport-McMoran Australia Ltd. and later bought Gem Exploration and Minerals Ltd.'s 20% share.

About 20% of the Bow River production was gem quality, with a consistent percentage of pink diamonds, 70% was industrial grade and 10% was bort. Bow River diamonds were recovered from buried diamondiferous gravels that originated from the AK-1 pipe.

Cluff Resources Pacific Ltd. commissioned in March a pilot plant for diamond recovery and, by yearend, had treated almost 3,000 tons of bulk material from various sample locations from its Copeton, New South Wales, prospect.

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 rough sapphire supply 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.

Between 80% and 90% of the world's natural opal was mined in Australia, 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.

A Gemstone Industry Council (GIC) was established to help the industry develop a coordinated approach to the mining, processing, marketing, and exporting of gem stones. All gem stones—diamond, sapphires, opals, and many other Australian gem stones—were to be covered by GIC. Although the GIC will be industry driven, it will have the participation of technical and educational institutions, as well as Commonwealth and State governments.[65]

Graphite.—Gwalia Consolidated Ltd. satisfactorily completed in April feasibility and pilot plant studies at its 51%-owned Munglinup graphite project 80 km east of Ravensthorpe, Western Australia, and was to proceed with development of a $10 million open pit mine initially producing 8,000 to 12,000 tons of graphite per year beginning early in 1991. Warrior International Ltd. held the remaining 49%.[66]

Salt.—Dampier Salt (Operations) Pty. Ltd. increased the production capacity at its Lake Macleod Field near Carnavon, Western Australia, by 500,000 tons to 1.5 Mmt/a. Dampier also was planning to increase production capacity at its Dampier Field in Western Australia by 500,000 tons to 3 Mmt/a over a 2-year period, lifting total capacity at its solar salt operations to 4.5 Mmt/a.[67] The Dampier salt operations at Dampier and Lake MacLeod supplied more than one-half of Australia's salt exports, 70% of which go to Japan.

The Leslie Salt Div. of Cargill Australia Ltd., a wholly owned subsidiary of Cargill Inc. of the United States, was considering an increase in production at its Port Hedland, Western Australia, operation to 2.75 Mmt/a, up from 2.25 Mmt.

Mineral Fuels

Coal.—The coal industry remained Australia's largest foreign-exchange earner, accounting for more than one-quarter of export revenues from the minerals sector and about 15% of the country's export earnings. Coking coals accounted for about 55% of shipments, but the gap with steaming coals continued to narrow. Australia was the world's sixth largest producer of coal (all grades) in 1990, ranking behind China, the United States, the U.S.S.R., the Federal Republic of Germany, and Poland. New South Wales and Queensland remained virtually Australia's only coal-exporting States, with Queensland much the larger. A large share of production in New South Wales was from underground mines, while most of the mines in Queensland were open cut.

Production in Queensland continued to be dominated by the seven opencut mines owned by the Central Queensland Coal Associates, a consortium of BHP-Utah Coal Ltd., 44.72%, manager; Queensland Coal Trust, 27.78%; Mitsubishi Development Pty. Ltd., 13.33%; Australian Mutual Provident Society, 8.61%; and Pancontinental Mining Ltd., 5.56%. These mines (Blackwater, Daunia, Goonyella, Isaac River, Norwich Park, Peak Downs, and Saraji) produced about one-half of all Queensland coal.

Australia's largest single coal mine remained Pacific Coal Pty. Ltd.'s 57.19%-owned Blair Athol open cut in Queensland, producing 8 Mmt/a of steaming coal, primarily for export to Japan. Australia's largest single underground coal mine was Austen and Butta Ltd.'s wholly owned South Bulli Mine in New South Wales, producing coking and steaming coal for export to Asian markets.

A new 2-Mmt/a underground coal mine was opened at Oaky Creek in Queensland's Bowen Basin during the third quarter. It will produce coking coal for export, contributing to the almost 2-Mmt/a existing opencut operation. Oaky Creek was a joint venture owned by MIM Holdings Ltd., 86.5%, operator; Hoogovens Delfstoffen BV of the Netherlands, 8.5%; and Empresa Nacional Siderurgica SA of Spain, 5%.[68]

New South Wales continued trying to privatize or sell its 11 State-owned mines, which produced about 15% of total output, held by the Electricity Commission of New South Wales, but potential buyers were unresponsive.

Construction began in April on the 2-Mmt/a steaming coal mine at Camberwell, New South Wales. The mine, expected to begin production in April 1991 and reach full production within 2 to 3 years, was owned by Camberwell Coal Pty. Ltd.

At yearend, production from Coal and Allied Industries Ltd.'s Hunter Valley No. 2 open cut was imminent. No. 2's operation will be integrated with the current Hunter Valley No. 1 mine to operate as the Hunter Valley Mine. The Hunter Valley Mine will produce 7.5 Mmt/a. No. 1 was producing about 7 Mmt/a on its way to produce a planned 7.5 Mmt/a. No. 2 will initially produce about 1.5 Mmt/a, increasing to 3 Mmt/a within the next 2 years as No. 1 winds down to a production level of about 3.5 Mmt/a. It will continue to produce in balance with No. 2 for the duration of its life, expected to be 15 years.[69]

Several other coal projects in New South Wales were likely to come on-stream by the mid-1990's, including Dartbrook (2.5 Mmt/a); Glennies Creek (2 Mmt/a); Maules Creek (5 Mmt/a); Springvale (2 Mmt/a); and United (2 Mmt/a), all as open cuts; and the Wakefield (2.2 Mmt/a), as an underground operation.

Petroleum and Natural Gas.—In August, the Federal Government announced the imposition of a resource rent tax on petroleum production, including natural gas, from the Gippsland Basin in Bass Strait off the Victorian coast, retroactive to July 1. The resource rent tax would include the deductibility of exploration expenses incurred throughout Australia. Previously, the resource rent tax was applicable only to offshore "greenfield" areas, areas in which there was no production prior to the resource rent tax's introduction in 1984, and deductible costs expended for exploration were non-transferable to other areas; i.e., exploration expenses incurred in the Timor Sea could not be used to offset tax payments on Bass Strait production (see 1984 Australia chapter).

Mobil Oil Australia Ltd. purchased in August all the downstream operations in Australia of Esso Australia Ltd., a wholly owned subsidiary of the U.S. oil giant Exxon Corp., including Esso's marketing and retail operations, its 50% interest in the Altona, Victoria, and Port Stanvac, South Australia, oil refineries, a coastal tanker, and various inland depots.[70]

The Australian Institute of Petroleum Ltd. (AIP) announced in November plans by the Australian oil industry to establish an $8 million Marine Oil Spills Response Center to be equipped to handle a major oil spill anywhere around the Australian coast. The cost of setting up and operating the 24-hour facility was to be borne by AIP-member companies: Ampol Ltd.; BHP-Petroleum Pty. Ltd.; BP Australia Ltd.; Caltex Oil (Australia) Pty. Ltd.; Esso Australia; Mobil Australia; The Shell Co. of Australia Ltd.; Santos Ltd.; and Woodside Petroleum Ltd. The response center was to be based at either Geelong or Melbourne on Port Phillip Bay in Victoria, the center of the Australian oil industry and its tanker movements, and will be the only major one in the Southern Hemisphere.[71]

The Australian Parliament ratified the Timor Gap treaty in which Australia and Indonesia established in 1988 a zone of cooperation for petroleum exploration and development in the Timor Sea area between the two countries prior to the establishment of a permanent seabed boundary.

The total number of petroleum exploration and development wells drilled during 1990 (242) was 8% higher than the number drilled during 1989 (224). The number of onshore exploration wells drilled in 1990 (113) was marginally more than in 1989 (109). However, the number of offshore exploration wells drilled (64) was 64% higher than the number drilled in 1989 (39), setting a new record high. The total number of development wells drilled (65) was 11 fewer than in 1989 (76). Offshore development drilling (17 wells drilled) accounted for all of the decrease compared with that in 1989 (29 wells drilled). In seismic survey activity during 1990, the total number of line km recorded (89,938) increased by 24% compared with that of 1989 (72,457). The level of offshore activity in 1990 (80,415 line km) was 30% greater than the corresponding level achieved during 1989 (62,067 line km).[72]

Uranium.—Australia was the Western World's third largest producer of uranium in 1990, producing about 10% of the world's market economy countries' production. The Commonwealth Government's uranium policy restricted production 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. Queensland Mines Ltd. had been processing and selling stockpiled ore from the third site, the Nabarlek Mine, also in the Alligator Rivers region of the

Northern Territory, until 1988, when the stockpile of high-grade ore had been exhausted. The treatment plant was placed on care and maintenance in 1989.

In September, the Industry Commission, a Government advisory body, recommended the abandonment of the 7-year-old, 3-mine policy, and the uranium issue was placed on the agenda of the Australian Labor Party's national conference to be held in June 1991.

After more than 18 months after its commissioning, all of the Olympic Dam Mine's production of triuranium octoxide (U_3O_8, or yellowcake) was consigned following the signing in June of sales agreements for the remaining 300 tons of yellowcake per year. The contracts were with Texas Utilities and Middle South of Mississippi, both utility companies in the United States. Prior to its startup, Olympic Dam had obtained long-term contracts for the supply of yellowcake with Japan's Kansai Electric Power Co. Inc. and Kyushu Electric Power Co. Inc.; the Korea Electric Power Corp.; the Swedish State Power Board; and the Central Electricity Generating Board of the United Kingdom.[73]

NBHP, a 65% owner of Energy Resources of Australia Ltd., which mines the Ranger Mine, and Pancontinental Mining Ltd. (Pancon) were considering late in the year the possibility of joint development of the undeveloped Jabiluka deposit, 15 km from the Ranger Mine, even though Federal policy effectively prevented the exploitation of any new uranium deposits by denying export licenses for the export of uranium-bearing materials. All of the other necessary mining and environmental approvals already had been given for the project to proceed, and Pancon continued to upgrade its technical studies on the deposit in preparation for underground mine development. Pancon's initial plans were to treat the Jabiluka ore at the Ranger operations to reduce capital costs and possibly circumvent the uranium-mining issue without the need for a formal change in Government policy. The Ranger open pit was likely to be mined out by mid-1993, and by developing Jabiluka, which was estimated to take more than 3 years, rather than a second Ranger pit, the operation could be seen as not to be an expansion of the industry.[74]

The Jabiluka deposit was owned by Pancon, 65%, and U.S.-based Texaco Oil Development Corp., 35%, with Pancon having the option to purchase Texaco's equity.

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-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, 16,201 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 235 principal airports with permanent-surface runways out of an aggregate of 524 in the country. International shipping ports included Adelaide, Brisbane, Cairns, Darwin, Devonport, Fremantle, Geelong, Hobart, Launceston, Mackay, Melbourne, Sydney, and Townsville. The merchant marine fleet included 17 petroleum, oils, and lubricant tankers; 2 chemical tankers; 3 liquefied gas tankers; 1 combination ore-oil tanker; and 29 bulk ore freighters.

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 1989 was 38,000,000 kW.

In remote areas where mines, mills, or smelters are usually located, an individual mining company must provide its own infrastructure, such as housing, roads, railways, port facilities, and various community services.[75]

OUTLOOK

Many sectors of the Australian mining industry, including aluminum, coal, copper, gold, iron ore, lead-zinc, manganese,

TABLE 3

AUSTRALIA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1990[1]

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Antimony		14.5
Bauxite	million metric tons	5,622
Black coal		
In situ	billion metric tons	70.9
Recoverable	Do.	51.1
Brown coal		
In situ	Do.	46.4
Recoverable	Do.	41.7
Cadmium		55.7
Cobalt		85
Columbium		3.4
Copper	million metric tons	6.7
Diamond		
Gem and near gem	million carats	380
Industrial	Do.	487
Gold	metric tons	2,129
Iron ore	billion metric tons	14.7
Lead	million metric tons	10.7
Lithium		150
Manganese ore	million metric tons	111
Mineral sands		
Ilmenite	million metric tons	80.7
Rutile	Do.	11.6
Zircon	Do.	18.0
Nickel	Do.	3.0
Petroleum, recoverable[2]		
Condensate	billion liters	114
Crude	Do.	260
Liquid petroleum gas	Do.	119
Natural gas	billion cubic meters	953
Platinum-group metals (Pd, Pt)	metric tons	22.8
Rare earths (REO plus Y_2O_3)		300
Silver		20.7
Tantalum		11.4
Tin		146.2
Tungsten		5.4
Uranium, recoverable		469
Vanadium		46
Zinc	million metric tons	17.9

[1]As of Dec. 31, 1990.
[2]As of Dec. 31, 1989.

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

mineral sands, nickel, tin, and tungsten, face an uncertain future owing to weak commodity prices, rising costs of production, large inventories on world markets, and/or insufficient infrastructure. However, Australia was expected to remain a significant world supplier of these and other mineral resources in which it is abundantly endowed well into the 21st century.

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 almost one-half of export income, increasingly strong antimining sentiment continues 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 development of large greenfield projects that will be needed to maintain the impetus of the mining and processing sectors.

The outlook for the aluminum industry in Australia—the mining of bauxite and refining it into alumina in particular—appears buoyant as the trend for lighter cars, which can only be built by introducing more aluminum and its high-strength alloys, continues. Expansions of alumina capacity at the Gladstone, Gove, Wagerup, and Worsley refineries, totaling 1.1 Mmt/a are being planned, as are similar expansions of primary aluminum capacity at the Boyne Island, Portland, and Tomago smelters, totaling 250,000 mt/a.

Declining gold prices, a shortage of exploration funds, and the end of the Federal gold tax exemption, which will bring the treatment of gold into line with other mineral commodities starting in 1991, will likely bring to an end the Australian gold boom built during the 1980's. This boom, which saw the rise of annual gold production from a base of just 5 tons at the beginning of the decade to the record-high output of more than 240 tons in 1990, was primarily based on the mining of near-surface, low-grade deposits of limited life. The boom also resulted from reworking old deposits that have become economically viable again by the treatment of the tailings of past mining operations using modern, especially carbon-in-leach and carbon-in-pulp, technology. Thus, gold production probably peaked in 1990 and will begin declining, perhaps rapidly, because of high-grading at many operations in order to beat the gold tax, as well as the exhaustion of reserves at many locations. Imposition of the gold tax will also mean even fewer funds will be available for exploration and capital investment, and this will translate into a reduction in production.

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[1]Where necessary, values have been converted from Austalian dollars (A$) to U.S. dollars at the rate of A$1.28=US$1.00.

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

[3]Mining Annual Review 1991. Australia. Min. J. (London), in press.

[4]Metal Bulletin (London). No. 7467, Mar. 19, 1990, p. 7.

[5]______. No. 7511, Aug. 30, 1990, p. 9.

[6]The Miner (Sydney). Dec. 1990, p. 6.

[7]American Metal Market (New York). V. 98, No. 219, Nov. 8, 1990, p. 2.

[8]Mining Journal (London). V. 315, No. 8091, Oct. 5, 1990, p. 257.

[9]Metal Bulletin (London). No. 7485, May 24, 1990, p. 7.

[10]______. No. 7456, Feb. 8, 1990, p. 11.

[11]Work cited in footnote 5.

[12]American Metal Market (New York). V. 98, No. 28, Feb. 9, 1990, p. 16.

[13]Metal Bulletin (London). No. 7546, Jan. 7, 1991, p. 5.

[14]Mining Journal (London). V. 315, No. 8080, July 20, 1990, p. 45.

[15]Metal Bulletin (London). No. 7450, Jan. 18, 1990, p. 13.

[16]Australian Journal of Mining (Richmond North, Australia). V. 5, No. 50, Nov. 1990, p. 33.

[17]The Miner (Sydney). Sept. 1990, p. 15.

[18]Metal Bulletin (London). No. 7508, Aug. 16, 1990, p. 5.

[19]______. No. 7534, Nov. 19, 1990, p. 7.

[20]______. No. 7525, Oct. 18, 1990, p. 9.

[21]Resource Information Unit Ltd. Register of Australian Mining, 1990/91. 1990, p. 92, Subiaco, Western Australia.

[22]Page 56 of work cited in footnote 21.

[23]Gold Gazette (Subiaco, Western Australia). V. 2, No. 84, Aug. 27, 1990, p. 4.

[24]Australian Journal of Mining (Richmond North, Australia). V. 5, No. 48, Sept. 1991, p. 13.

[25]Mining Journal (London). V. 314, No. 8071, May 25, 1990, p. 417.

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OTHER SOURCES OF INFORMATION

Agencies

Australian Bureau of Agricultural and Resource Economics
G.P.O. Box 1563
Canberra, Australian Capital Territory 2601
Australia
Telephone: (06) 246 9111
Fax: (06) 246 9699

Bureau of Mineral Resources, Geology and Geophysics
G.P.O. Box 378
Canberra, Australian Capital Territory 2601
Australia
Telephone: (06) 249 9111
Fax: (06) 248 8178

Department of Primary Industries and Energy (P.I. & E.)
G.P.O. Box 858
Canberra, Australian Capital Territory 2601
Australia
Minister for P.I. & E.:
Telephone: (06) 277 7520
Fax: (06) 273 4120
Minister for Resources:
Telephone: (06) 277 7480
Fax: (06) 273 4154

Joint Coal Board
G.P.O. Box 3842
Sydney, New South Wales 2001
Australia
Telephone: (02) 235 9666
Fax: (02) 223 1896

New South Wales Department of Minerals and Energy
P.O. Box 536
St. Leonards, New South Wales 2065
Australia
Telephone: (02) 901 8888
Fax: (02) 901 8777

Northern Territory Department of Mines and Energy
P.O. Box 2901
Darwin, Northern Territory 0801
Australia
Telephone: (089) 89 5511
Fax: (089) 81 4806

Queensland Department of Resource Industries
(Formerly Queensland Department of Mines)
G.P.O. Box 194
Brisbane, Queensland 4001
Australia
Telephone: (07) 237 1435
Fax: (07) 229 7770

South Australian Department of Mines and Energy
P.O. Box 151
Eastwood, South Australia 5063
Australia
Telephone: (08) 274 7500
Fax: (08) 272 7597

Tasmanian Department of Resources and Energy
Division of Mines and Mineral Resources
P.O. Box 56
Rosny Park, Tasmania 7018
Australia
Telephone: (002) 30 8333
Fax: (002) 44 2117

Victorian Department of Industry and Office of Economic Planning
P.O. Box 173
East Melbourne, Victoria 3002
Australia
Telephone: (03) 412 8000
Fax: (03) 419 0770

Western Australian Department of Mines
Mineral House, 100 Plain Street
East Perth, Western Australia 6004
Australia
Telephone: (09) 222 3333
Fax: (09) 222 3510

Western Australian Department of State Development
(Formerly Department of Resources Development)
170 St. Georges Terrace
Perth, Western Australia 6000
Australia
Telephone: (09) 327 5454
Fax: (09) 327 5481

Australian Mining Industry Council
216 Northbourne Avenue
Canberra, Australian Capital Territory 2602
Australia
Telephone: (06) 249 8955
Fax: (06) 247 4985

Australian Petroleum Exploration Association Ltd.
P.O. Box R225
Royal Exchange, Sydney, New South Wales 2000
Telephone: (02) 252 4222
Fax: (02) 252 4735

New South Wales Chamber of Mines, Metals and Extractive Industries
Suite 902, 9th Floor, Underwood House
37 Pitt Street
Sydney, New South Wales 2000
Telephone: (02) 247 5384
Fax: (02) 223 1215

Northern Territory Chamber of Mines & Petroleum Inc.
G.P.O. Box 510
Darwin, Northern Territory 0801
Telephone: (089) 814 486
Fax: (089) 411 625

Queensland Chamber of Mines
7th Floor, AGL House
60 Edward Street
Brisbane, Queensland 4000
Telephone: (07) 221 8722
Fax: (07) 229 4564

South Australian Chamber of Mines & Energy
P.O. Box 493
Glenside, South Australia 5065
Telephone: (08) 799 711
Fax: (08) 379 1142

Tasmanian Chamber of Mines
G.P.O. Box 937K
Hobart, Tasmania 7001
Telephone: (002) 238 600
Fax: (002) 344 841

Victorian Chamber of Mines
Suite No. 1, 6th Floor
422 Collins Street
Melbourne, Victoria 3000
Telephone: (03) 670 0714
Fax: (03) 600 0343

Chamber of Mines and Energy of Western Australia Inc.
7th Floor, 12 St. Georges Terrace
Perth, Western Australia 6000
Telephone: (09) 325 2955
Fax: (09) 221 3701

Aluminium Development Council of Australia Ltd.
Room 913, 185 Elizabeth Street
Sydney, New South Wales 2000
Australia
Telephone: (02) 264 9299

The Australasian Institute of Mining and Metallurgy
P.O. Box 122
Parkville, Victoria 3052
Australia
Telephone: (03) 347 3166
Fax: (03) 347 8525

Australian Coal Association
P.O. Box A244
Sydney South, New South Wales 2000
Australia
Telephone: (02) 267 6488
Fax: (02) 264 1121

Australian Coal Industry Research Association
P.O. Box 83
North Ryde, New South Wales 2113
Telephone: (02) 887 3777
Fax: (02) 888 9912

Australian Gold Mining Industry Council Ltd.
G.P.O. Box 2121T
Melbourne, Victoria 3001
Telephone: (03) 642 1065
Fax: (03) 614 3569

Australian Institute of Petroleum Ltd.
257 Collins Street
Melbourne, Victoria 3000
Telephone: (03) 654 1411
Fax: (03) 654 1950

Australian Lead Development Association
5th Level, 124 Exhibition Street
Melbourne, Victoria 3000
Telephone: (03) 654 1611
Fax: (03) 654 1136

Australian Mines and Metals Association Inc.
343 Little Collins Street
Melbourne, Victoria 3000
Telephone: (03) 600 0799
Fax: (03) 670 0948

Australian Mining Industry Research Association
9th Floor, 128 Exhibition Street
Melbourne, Victoria 3000
Telephone: (03) 654 8844
Fax: (03) 654 8661

Australian Tin Producers' Association
24th Floor, Goldfields House
1 Alfred Street
Sydney Cove, New South Wales 2000
Telephone: (02) 252 0512
Fax: (02) 235 0603

Australian Zinc Development Association
5th Level, 124 Exhibition Street
Melbourne, Victoria 3000
Telephone: (03) 654 1611
Fax: (03) 654 1136

Cement & Concrete Association of Australia
Level 5, 100 Walker Street
North Sydney, New South Wales 2060
Telephone: (02) 929 5866
Fax: (02) 954 0068

New South Wales Coal Association
P.O. Box A244
Sydney South, New South Wales 2000
Telephone: (02) 267 6488
Fax: (02) 264 1121

Queensland Coal Association
P.O. Box 908
Brisbane, Queensland 4001
Telephone: (07) 221 8366
Fax: (07) 229 7730

Queensland Coal Board
G.P.O. Box 384
Brisbane, Queensland 4001
Telephone: (07) 237 1521
Fax: (07) 221 6759

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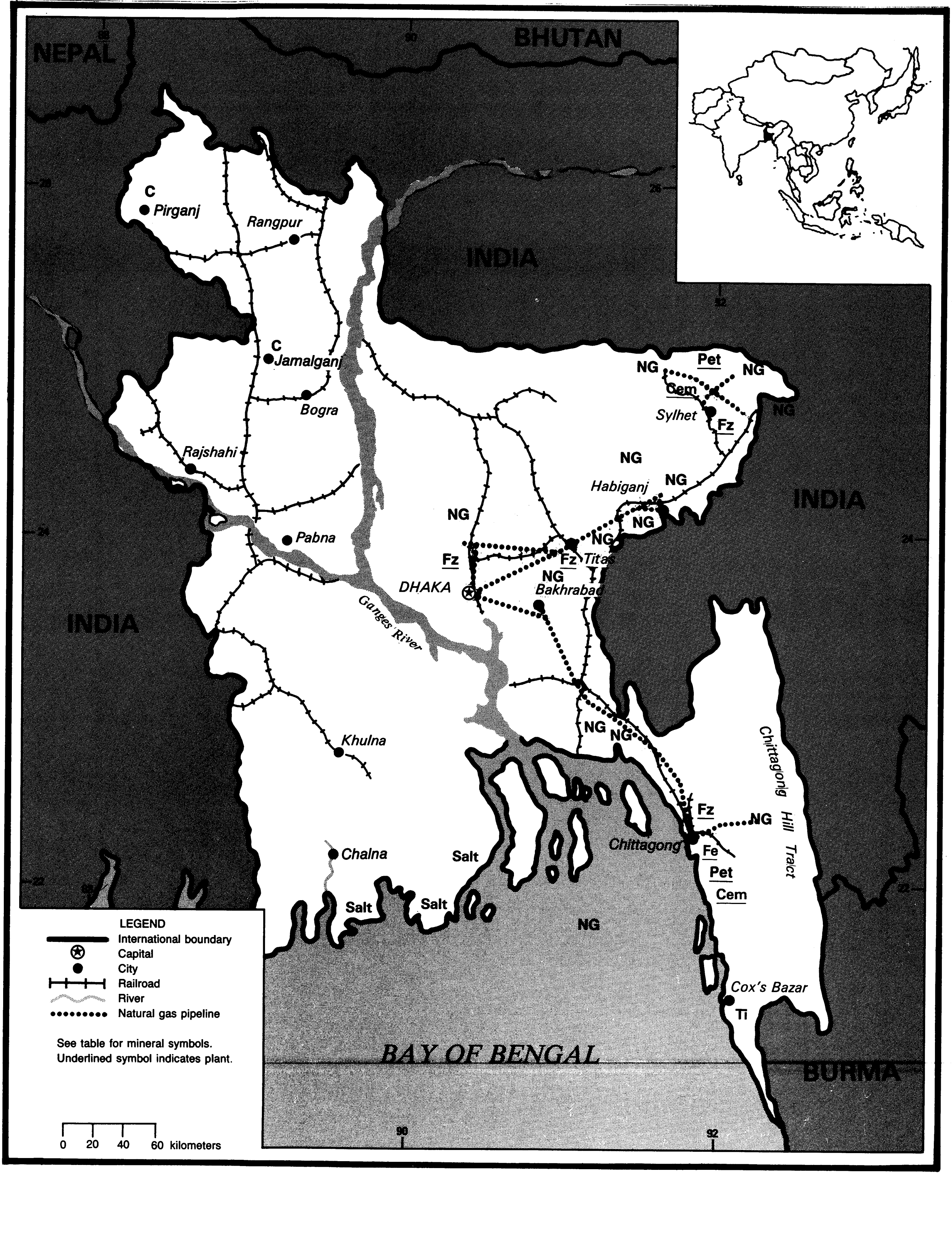
BANGLADESH

AREA 144,000 km² **POPULATION 117 million**



THE MINERAL INDUSTRY OF BANGLADESH

By David B. Doan

Still recovering from the disastrous storms and floods of 1987 and 1988, Bangladesh saw its mineral sector turn in a performance that seemed good under the circumstances. In particular, its output of natural gas, cement, and fertilizer increased significantly and boded well for the nation's needs in energy, agriculture, and the building of infrastructure.

One of the poorest and most densely populated agrarian nations in the world, Bangladesh had an annual per-capita income of less than $200,[1] unemployment of more than 30%, an average population density of about 740 persons per square kilometer (km²), and an annual population growth rate of 2.4%. A rapidly growing labor force tended to spill across the borders into India in search of work. There was little, if any, land not in tenure. The country's need for mineral and industrial development, as well as both reconstruction and new construction, was critical. Unfortunately, a chronic shortage of capital, particularly domestically generated capital, discouraged development. The World Bank issued an unusually strong warning over the Ershad Government's "particularly poor" budgetary performance.[2]

Late in 1990 President Ershad was forced to step down as a result of popular demonstrations culminating in revolts in the prisons and mobs in the streets. A new government, headed by Khaleda Zia, sought to do better for Bangladesh.

During 1990 the Government had decided to repeal the Special Powers Act, a law that had been passed in 1974 to stifle dissent against the Awami League Government of that time, but which had been used successively by every succeeding Government against opponents, primarily politicians and writers, thereby criminalizing policy differences but also influencing commercial matters. In other directions, the Government continued to promote productivity as the key to economic progress by striving to increase exports over imports in order to build foreign exchange credits. The taka was devalued by 11% during the year, while Government spending and domestic credit were curtailed to some degree. More would need to be done, however, to convince the World Bank of the country's ability to institute structural reforms sufficient to increase the economic growth rate to a sustained 5.5% or more.

Production of natural gas, now a mainstay of the country's economy, reached new highs as development continued. The fertilizer group stood out as the nitrogen content of urea and ammonia products climbed by about 65% above that of 1989. Cement production was up more than 4% from the previous year to establish another new high. Output of steel and steel products was estimated to have increased slightly in 1990 but numbers were not available.

Government officials estimated in October that Bangladesh would lose about $1.4 billion annually from the effects of the Persian Gulf crisis including repatriation expenses, cash and other assets frozen in Kuwait, high insurance costs for aviation and shipping, higher costs of imports such as fuel, and changes in exports and remittances. Quick termination of the war in early 1991 may have alleviated Bangladesh's situation but the onset of seasonal rains and flooding preempted the country's trade problems with domestic concerns.

A trade agreement was reached between Bangladesh's Kafck International, a subsidiary of the Karnaphuli Fertilizer Co., and Japan's Export-Import Bank for construction of a fertilizer plant in Chittagong. Credit on the order of $160 million would be extended, most of which would be used to buy construction materials from Japan.

All mineral production, other than foreign interests in petroleum joint ventures, was owned by the Government. The mineral industry of Bangladesh, still in an early stage, was dominated by 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 (GDP) 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.

Planning continued on the development of coal mines in western Bangladesh to ease the problem of long-distance transmission of electricity from gas-fired powerplants in the east. The Fourth Five Year Plan (1990-1995) would see the extraction of bituminous coal in Dinajpur District (probably at Pirganj) and in Faridpur District in central Bangladesh.

While development of natural gas production continued, plans were advanced to upgrade the country's sole oil refinery at Chittagong. Expansion of the 31,200- bbl/d plant will include installation of a visbreaker, a mild hydrocracker, and hydrogen units. Originally established as a joint venture with Burma in 1968, the refinery is now owned entirely by Bangladesh. The $40 million project has received support from the World Bank and will require about 3 years for completion.

Bangladesh's most significant mineral commodity was natural gas, of which the country's reserves had been estimated to exceed 400 billion m³ 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 "offshore" guesses were given some publicity, they cannot be included in any tabulation of reserves.

Coal reserves are estimated by the Government to approach 2 billion tons, at least 850 million tons in the Pirganj area and about 1 billion tons near Jamalganj.

Limestone reserves were probably large but not yet known in detail. The steel industry of Bangladesh subsisted entirely on imported scrap metal rather than domestic mineral resources. Reserves of kaolin clay were undefined but probably large. 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 accommodate 400 megawatts (MW) of electricity. Total generating capacity in 1988 was 1,570 MW from which 4,800 million kilowatt hours (kWh) was produced during that year. This was equivalent to 45 kWh 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-MW 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.

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 used wisely and effectively 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 revealing 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 and, beyond this, if certain high-value exports such as petroleum products can be offered into world markets, Bangladesh may exceed mere economic survival sufficiently to build its own capital resources for physical and social development.

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[1]Where necessary, the Bangladesh taka (T) has been converted into U.S. dollars at the rate T35.92=US$1.00. This is a predevaluation rate.

[2]Far East Economic Review. V. 151, No. 22, May 30, 1991, p. 25.

TABLE 1

BANGLADESH: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
Cement, hydraulic[3]		292,000	310,000	310,800	312,911	326,296
Clays: Kaolin[3]		2,695	12,272	10,097	7,092	[e]7,000
Gas, natural, marketed[3] [4]	million cubic meters	2,866	3,371	4,297	4,416	4,818
Iron and steel: Metal:[3]						
Steel, crude (ingot only)		95,514	82,081	81,285	86,274	[e]90,000
Steel products		111,593	129,986	121,865	107,979	[e]110,000
Nitrogen: N content of urea, ammonia, and ammonium sulfate		390,515	435,900	673,400	775,000	1,279,888
Petroleum:						
Crude	thousand 42-gallon barrels	([5])	2,050	1,687	1,287	1,191
Refinery products	do.	7,405	[e]7,610	7,411	7,688	[e]7,500
Salt, marine[e] [3]		500,000	416,000	409,000	415,000	[6]217,000
Stone: Limestone[3]		22,082	45,667	32,933	29,457	[e]30,000

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Aug. 1, 1991.
[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]Bangladesh had no oil production prior to 1987.
[6]Reported figure.

TABLE 2

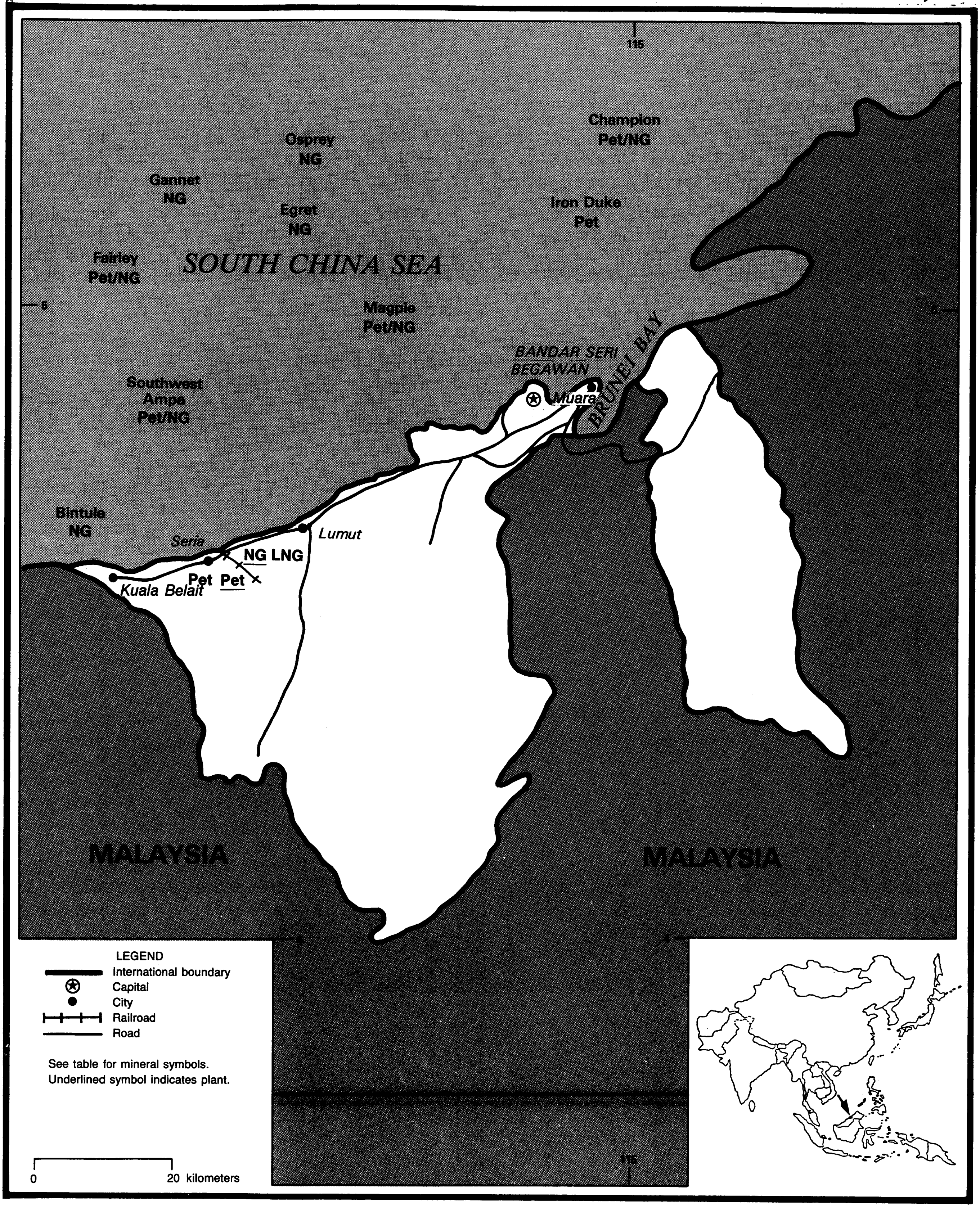
BANGLADESH: STRUCTURE OF THE MINERAL INDUSTRY[1]

Commodity	Major operating companies	Location of main facilities	Rated capacity 10^3 mtpy
Cement	Bangladesh Oil, Gas and Mineral Corp.	Chittagong	[2]200
Do.	do.	Sylhet	210
Fertilizer	Bangladesh Chemical Fertilizer Corp.	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.	Bakhrabad	[3]2.85
Do.	do.	Habiganj	[3]4.25
Do.	do.	Titas	[3]5.70
Petroleum, refined.	Eastern Refinery Ltd.	Chittagong	[4]30,000
Steel	Bangladesh Steel and Engineering Corp.	do.	[5]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]Grinding of imported clinker.
[3]Million cubic meters per day.
[4]Barrels per day.
[5]Supported entirely by imported scrap metal.

BRUNEI

AREA 5,770 km² **POPULATION 397,000**



THE MINERAL INDUSTRY OF BRUNEI

By David B. Doan

Having probably the most mineral-dominated economy of any Asian country, 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. Brunei 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 accommodated without serious disruption to the economy of Brunei. On a per-capita basis, the GDP approached \$15,000,[1] in striking contrast to most of Asia. However, with a population of about 370,000 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 several decades in the future.

During 1990, the problem of unemployment began to emerge, along with a minor degree of social unrest. Approximately 53% of the workforce was employed by the Government, but there was little room for expansion of this number. It was clear that growth of the private sector was needed, but this could not occur quickly and the unemployed were not much attracted to a return to the agricultural life. The Sultan promulgated a greater strictness of observance of the tenets of Islam, conservative values, courtesy, and abstinence from alcohol and drugs for the young and disaffected. It remained to be seen to what degree such religious renewal would offset the effects of the lack of non-manual jobs.

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. The Government hopes eventually to establish a high-technology manufacturing sector.

The Brunei Government followed a conservation policy of bringing its previously 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 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. The Government's aim was to abet the discovery of new reserves at only about the same rate that existing reserves were withdrawn by production.

Output of crude oil and natural gas seemed 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 luxury of having enough energy for its domestic needs with no urgent requirement for more. Assuming an average price of \$17 per barrel, the value of 1990 crude production would be not less than \$833 million and somewhat more if Brunei took advantage of any world price increases to the \$20 level.

The total value of natural gas extracted and marketed in 1989, based on the industry-common thermal equivalent of 1,000 British thermal units (Btu) per cubic foot and an average price of \$1.50 per million Btu, would exceed \$500 million. Although 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.

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 \$1.0 billion and \$1.4 billion, with Japan a principal buyer, followed by Singapore, the Republic of Korea, and Thailand.

Imports were mainly manufactured goods, food, machinery and transport equipment, and chemical products, primarily from the United Kingdom, Malaysia, and Singapore, in order of value.

Other than for locally consumed construction materials, Brunei's mineral industry consisted exclusively of petroleum and natural gas production. Brunei Shell Petroleum Company 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 had been allied with Elf Aquitaine in an entity called Elf-Jasra, but it was not clear whether Jackson Petroleum Co. was still involved.

Production of petroleum crude has been decreasing continually from the peak production of 95 Mbbl in 1979, with output in 1990 at slightly more than 49 Mbbl, down slightly compared with the previous year's 51.8 Mbbl. The Government has adopted a posture of stretching production into future years.

Down slightly from the previous year, production of marketed natural gas was thought to be approximately 8.692 billion m^3 in 1989 versus 8.337 billion m^3 in 1989. Total production was approximately 9.447 billion m^3 but data on flaring and other losses were not readily available. The associated condensate amounted to an estimated 3.8 million barrels. Something on the order of 7 billion m³ of natural gas was thought to have been liquefied for export. A significant discovery by Brunei Shell found gas and condensate beneath its offshore Champion field about 60 km north of Bandar Seri Begawan, leading to the assessment of other ultradeep possibilities.

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 m³ 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.

Brunei had 370 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 were suitable for boats drawing less than 1.2 m. 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 m long, the other with natural-surface runways between 1,220 and 2,439 m long. Principal seaports were at Kuala Belait and Muara.

Brunei had an installed power-generating capacity of 163 MW in 1986 and was in the process of building an additional 147-MW gas-turbine powerplant at Lumut. The country 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).

Brunei has tried to manage its resources and its economy in such a way as to be of material benefit to its people, now and in the future. The growth of its petroleum industry, however, has led to a degree of prosperity such that the population has drifted away from agricultural activity to the point that nearly 80% of its food is imported. A return to total self-sufficiency in food production has been promoted by the Government that should eventually succeed using modern techniques of cultivation and husbandry. Very few countries are as well positioned economically as Brunei.

[1]Where necessary, values have been converted from Brunei dollars (B$) to U.S. dollars at the rate of B$1.97=US$1.00.

TABLE 1

BRUNEI: PRODUCTION OF MINERAL COMMODITIES[1]

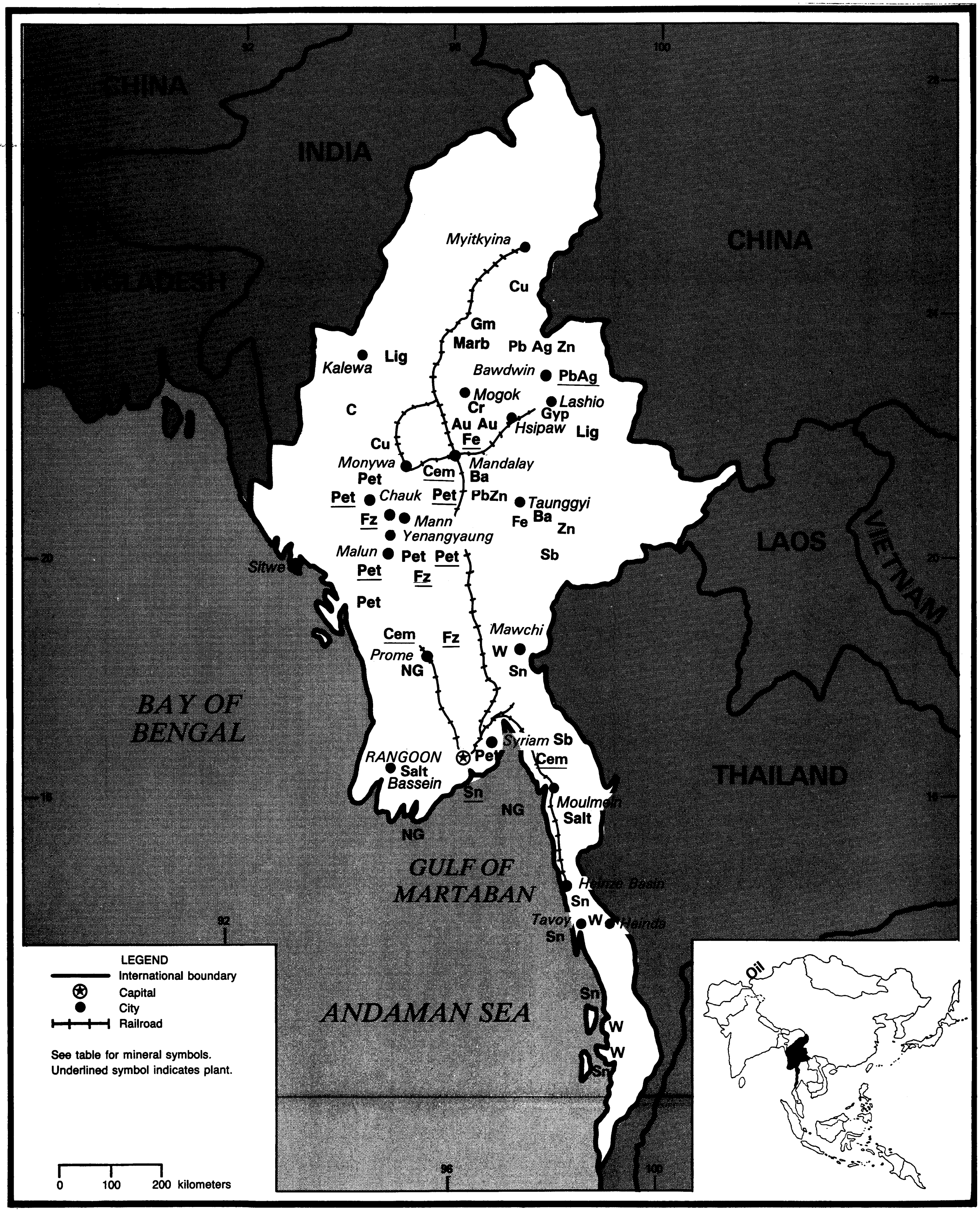
(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
Gas, natural:						
Gross[e]	million cubic meters	9,068	9,209	9,153	9,069	9,447
Marketed	do.	8,064	8,501	8,444	8,337	8,692
Natural gas liquids:[e]						
Condensate	thousand 42-gallon barrels	5,400	5,500	5,460	5,400	[3]3,814
Natural gasoline	do.	290	300	295	290	285
Liquefied petroleum gas	do.	100	100	95	100	90
Total	do.	5,790	5,900	5,850	5,790	4,189
Petroleum:						
Crude	do.	59,860	50,808	50,480	51,830	49,008
Refinery products:[e]						
Gasoline	do.	600	650	625	650	625
Distillate fuel oil	do.	400	450	432	450	440
Residual fuel oil	do.	10	10	9	10	10
Other, including refinery fuel and losses	do.	300	350	336	355	340
Total	do.	1,310	1,460	1,400	1,465	1,415

[e]Estimated. [p]Preliminary.
[1]Table includes data available through July 1, 1991.
[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.

BURMA

AREA 678,600 km² **POPULATION 42 million**



THE MINERAL INDUSTRY OF BURMA

By David B. Doan

The State Law and Order Restoration Council (SLORC), indistinguishable from an ordinary military junta, continued to dominate the political scene of Burma. It failed to recognize legitimate national elections during the year, continued its repression of the civil population, and, with one exception, did little to foster the growth and development of Burma's mineral industry. The exception was the decision by SLORC to open certain areas of the country to petroleum exploration by foreign firms.

After many years of self-imposed isolation from the normal channels of international investment, development, and trade, Burma's centrally planned economy disintegrated to the point of crisis in 1987 when the Government repudiated and demonetized all banknotes of more than 15 kyat, nominally about $2.35. 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 last straw 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 the military group, SLORC, that established itself as the Government of Burma. Rumors persist that Ne Win is still the real power, operating effectively but totally in the background.

With an economy in disarray, inflation exceeding 40%, and a deteriorating position with respect to both Government deficit and foreign debt, there were nonetheless signs of a weak recovery from the recessionary lows of the previous year, based on a slight improvement in gross domestic product. Objective economic analysis was difficult, however, because the vast overvaluation of the kyat continues to the present time. During 1990, the official rate was quoted at 5.9 kyat to the U.S. $1.00, but the open-market rate was about 70 kyat to the dollar and climbing.

The various ethnic areas such as the Shan State[1] of eastern Burma and the Kachin State of northern Burma took issue with SLORC'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, under the aegis of The Democratic Alliance of Burma, to resist the SLORC.

National elections held throughout Burma in May 1990 resulted in an overwhelming defeat for SLORC, which stonily refused to accept this result. After many days' delay, the SLORC leadership solemnly announced that power could not be transferred to the winning faction, the National League for Democracy (NLD), until Burma had a constitution. Moreover, SLORC would devise such a constitution but all this would require a long and probably unforeseeable period of time. No palpable progress was evident by the end of the year, and SLORC seemed to be playing for time. Potential opposition leaders and many of the successful candidates in the national election were arrested and incarcerated by SLORC, including the charismatic Aung San Suu Kyi, daughter of a national hero and the one visible figure representing the resistance. Aung San Suu Kyi's fame spread rapidly in 1990 after the "elections." Awarded the prestigious Sakharov Prize and rumored to be nominated in 1991 for the Nobel Peace Prize, she was becoming a symbol for a cause that SLORC could not control.

One tentative factor for initiating recovery of the country from its potential financial collapse was invoked by SLORC in 1989, more or less as an abrupt attempt to retain power by abandoning its xenophobic policies. Realizing the need for cash-flow and foreign-exchange credits, the junta entered into exploration agreements with foreign companies in a series of onshore concession blocks. As a matter of conjecture, it was thought SLORC hoped that quick and significant oil production and related income could be realized before the continuing repression of the citizens precipitated another civil upheaval.

GOVERNMENT POLICIES AND PROGRAMS

With the failure of previous isolationist and statist policies came SLORC's decision to invite foreign capital, technology, and expertise to come to Burma and develop its mineral resources. The new foreign investment law was 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 for foreign-country research and development expenses, and the repatriation of profits in hard currency.

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. Increasingly, however, other countries were declining to do business with Burma for reasons based on the oppressiveness of the regime.

New "commercial" taxes were announced in 1990, applicable to both producers and importers. As they affected mineral commodities, these taxes were listed as follows (SIC): "no commercial tax—coal, coke, natural gas, petroleum crude; 10% tax—grease, oils, lubricants, other petroleum products not elsewhere specified, petroleum coke, gypsum, barite, graphite, white clay, fire clay, clay powder, soapstone, dolomite stone ochre, bentonite, tarazo [terrazo?] stone, washed clay, lead slag, chipping stone, marble, limestone, road-building stone and sand, tin concentrates, tungsten concentrates, tin/tungsten/scheelite and mixed ores, refined lead, zinc concentrates, copper matte, nickel speiss; antimonial lead, antimony ores, lead sulphide, salt, aluminum circles and plates; 20% tax—marble products, cement, brick, brick tiles and products, fire brick, lime and lime powder, iron and steel products, miscellaneous metallic goods other than silver and platinum not elsewhere specified, silver, furnace oil; 80% tax—kerosene; 90% tax—diesel oil; 100% tax—pearl, jade, other precious stones; 115% tax—jet fuel; 170% tax—motor spirit (petrol); 180%—earth oil [sic]." How "earth oil" differs from petroleum crude is not clear. The 20% tax rate is also applied to "commodities, not elsewhere specified." A tax on gold under consideration was to be announced later after determination of the rate.

PRODUCTION

Although Government reports noted that the production of mineral commodities improved in 1990 following a similar improvement in 1989, it was not immediately clear what the degree of improvement was in either case. What was generally accepted, however, was that production was close to rock bottom during the year of civil upheaval in 1988.

Burma's production of mineral commodities had 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 had progressively crippled Burma's mineral industry.

While most of these factors did not improve in 1990, and in some cases became considerably worse, the indications were that some effort was exerted to stimulate production for the survival of the economy. Reliable production data were not generally available, so estimates have had to be made for the principal mineral commodities.

TRADE

Normally Burma has been a producer and exporter of gemstones, tin, and tungsten, but it is probable that, in 1990, most of the traffic in gemstones and jade was by smuggling them into China, India, and Thailand 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 primarily into Thailand and possibly into other neighboring countries. Otherwise, Japan was Burma's principal vendor of goods imported while China was the largest purchaser of Burmese exports. Minerals and gems were thought to be second to forest products in export value, but details were not yet available.

Despite a temporary recovery in its foreign-exchange reserves during 1990, Burma imported what it could, but its preliminary gross trade statistics showed only a modest improvement in its external trade deficit compared to that of 1989. The Government has kept tight control of foreign exchange for nonmilitary imports. Its continuing refusal to change an unrealistically overvalued currency has perpetuated trade distortions and hindered much-needed capital inflow from sources of foreign investment.

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,

TABLE 1

BURMA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989[p]	1990[e]
METALS						
Chromium: Chromite, gross weight		—	1,000	5,000	[e]5,000	1,000
Copper:						
Mine output, Cu content		[r]10,100	[r]10,600	4,700	5,080	5,100
Matte, gross weight		144	234	224	200	200
Gold, mine output[e]	kilograms	100	100	100	126	150
Iron and steel: Pig iron		2,669	[r]624	688	3,500	4,000
Lead:						
Mine output, Pb content		[r]6,600	[r]4,600	6,000	5,200	4,400
Metal:						
Refined		5,359	3,985	4,402	3,443	1,531
Antimonial lead (18% to 20% Sb)		299	305	160	300	300

See footnotes at end of table.

TABLE 1—Continued

BURMA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989[p]	1990[e]
METALS—Continued						
Nickel:						
Mine output, Ni content[e]		20	20	26	[r]20	23
Speiss, gross weight		47	50	104	80	90
Silver, mine output	kilograms	[r]13,800	26,096	9,207	6,843	6,718
Tin, mine output, Sn content:						
Of tin concentrate		600	256	102	172	191
Of tin-tungsten concentrate		895	683	427	329	443
Total		1,495	939	529	501	634
Metal: Refined		[r]649	[r]309	110	500	400
Tungsten, mine output, W content:						
Of tungsten concentrate		102	25	14	8	7
Of tin-tungsten concentrate		613	468	293	225	304
Total		715	493	307	233	311
Zinc, mine output, Zn content		4,643	2,561	1,600	1,400	2,152
INDUSTRIAL MINERALS						
Barite[3]		[r]11,578	[r]17,243	12,678	9,144	9,000
Cement, hydraulic		433,811	389,605	348,981	394,000	375,208
Clays:[3]						
Ball clay		[r]132	[r]218	247	203	200
Bentonite		[r]853	[r]297	418	711	700
Fire clay[4]		[r]2,490	[r]2,193	3,473	3,150	3,000
Industrial white clay		[r]1,130	([5])	600	—	—
Feldspar[3]		[r]3,077	[r]5,620	4,938	4,257	2,500
Graphite[3]		722	—	—	—	—
Gypsum[3]		[r]25,858	[r]22,895	31,716	31,534	30,000
Nitrogen: N content of fertilizer		133,130	117,501	112,178	120,000	125,000
Precious and semiprecious stones: Jade[3]	kilograms	[r]60,333	[r]98,623	[e]131,777	54,266	60 ,000
Salt, all types:[6]	thousand tons	[r]246	[r]257	246	262	260
Stone:[3]						
Dolomite		[r]2,398	[r]4,612	938	1,930	2,000
Limestone, crushed and broken	thousand tons	[r]813	[r]1,321	1,118	1,219	1,200
Talc and related materials: Soapstone[3]		56	([5])	—	—	—
MINERAL FUELS AND RELATED MATERIALS						
Coal, lignite		[r]38,100	[r]39,334	30,258	37,594	38,000
Gas, natural:						
Gross[e]	million cubic meters	[r]1,120	[r]1,188	[r]1,108	[r]1,133	1,034
Marketed[3]	do.	[r]1,075	[r]1,140	1,064	1,088	993
Petroleum:						
Crude (gross wellhead)[3]	thousand 42-gallon barrels	[r]8,300	[r]6,200	4,800	5,600	4,745
Refinery products[e 3]	do.	[r]4,495	[r]3,849	[r]3,137	[r]3,287	3,200

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Apr. 15, 1991.
[2]In addition to the commodities listed, pottery clay, common sand, glass sand, other varieties of crude construction stone, and other varieties of gemstones 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]Revised to zero.
[6]Brine salt production (in metric tons) as reported by the Burmese Government was as follows: 1986—47,249; 1987—57,847; 1988—59,768; and 1989—60,229.

they are Mining Enterprise No. 1 (ME1)—lead, zinc, silver, and copper; Mining Enterprise No. 2 (ME2)—tin, tungsten, and gold; Mining Enterprise No. 3 (ME3)—iron, steel, coal, nickel, and industrial minerals; Myanma Gems Enterprise (MGE)—precious and semiprecious gemstones and jade; Myanma Salt and Marine Enterprise—salt and potash; Myanma Pearl Enterprise—pearls; Department of Geological Survey & Exploration (DGSE); Department of Planning & Inspectorate— planning, mine survey, and 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. The 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

Gold.—Official interest in facilitating gold mining has increased to the point at

TABLE 2

BURMA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity[e]
Cement	Ceramic Industries Corp. China Hsin Cement Corp.	Kyangin, southern outskirts of Mandalay	240
Do.	do.	Pa-an, 160 kilometers east of Rangoon (under repair)	240
Do.	do.	Thayetmyo, 300 kilometers north-north-east of Rangoon on Irrawadday River	200
Copper, in concentrate	Mining Enterprise No. 1	Monywa	12
Fertilizer, N content	Petrochemical Industries Corp.	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	Mining Enterprise No. 3	Anisakan, 15 kilometers from Maymyo, 45 kilometers east of Mandalay	40
Steel	do.	do.	35
Lead, silver, and zinc ore	Mining Enterprise No. 1	Bawdwin	390
Lead and silver metal:			
Lead	do.	do.	10
Silver kilograms	do.	do.	122,000
Petroleum, refined	Petrochemical Industries Corp.	Mann	25,000
Do.	do.	Syriam, across river east of Rangoon	26,000
Tin:			
Concentrate	Mining Enterprise No. 2	Heinda	1
Metal	do.	Syriam, across river east of Rangoon	1
Tin and tungsten concentrate:			
Tin	do.	Heinze Basin	.6
Do.	do.	Tavoy	1
Do.	do.	Tenasserin Division coastline (five mines under development)	.9
Tungsten	do.	Heinze Basin	NA
Do.	do.	Tavoy	1
Do.	do.	Tenasserin Division coastline (five mines under development)	NA
Tungsten and tin concentrate:			
Tungsten	do.	Mawchi	.2
Tin	do.	do.	NA

[e]Estimated. NA Not available.

which efforts were planned and undertaken for systematic development, particularly of "hard-rock" or lode deposits requiring organized exploration and extraction utilizing skilled miners and heavy equipment. Following a feasibility study assisted by Australia, development was begun of the Kyaukpahtoe gold mine in Sagaing Division with technical help from Invest Import of Belgrade, Yugoslavia. Although startup of actual extraction had been projected for March 1990, the $50 million venture agreed to in 1987 was delayed while assembly of equipment continued. With a new target date of the first quarter of 1991 for starting production, the Government aimed at production of 2 mt/a of gold from the new mine.

Lead, Zinc, and Silver.—The lead-silver deposits of Bawdwin and adjacent Namtu, in the northern part of the Shan State, were long 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.

A concentrator and lead smelter were built at nearby Namtu during the 1930's which, in 1989, were little changed from their original configuration. Another concentrator of comparatively modern design was built at Bawdwin in 1981, but a lack of process-control equipment has led to a variety of metallurgical problems. The lack of spare parts has hurt 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. A 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 Mmt grading 7.5% lead, 3.5% zinc, and approximately 93 to 124 g/mt of silver. The open pit mine at Bawdwin had an estimated 10 Mmt grading 5.1% lead, 4% zinc, and 93 g/mt of silver. A significant quantity of tailings dumped along a riverbank was estimated to contain 3% to 4% lead, 2% to 3% zinc, and 85 g/mt of silver.

Remarkably, further reserves comprised roughly 2.6 million tons of slag extracted since 1911 from the Bawdwin blast furnace and containing 17.2% zinc, 2.5% lead, and 591 g/mt of silver. It is believed that reprocessing of this slag led to the peak silver production of about 26 tons reported for 1987.

Nickel.—Burma has been a very small producer of nickel, on the order of 100 mt/a or less. Two new deposits were discovered that may signal improvement provided the development capability could be organized, primarily 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 Mmt grading approximately 2% nickel in lateritic material. The other deposit was found near Kalewa with an estimated 80 Mmt grading 1.2% to 2% nickel combined with silicates. These deposits were known first in 1989 but were still being reported in 1990, as if to stimulate interest from foreign investment sources.

Tin.—ME2 continued to seek interest in tin extraction from foreign entities through joint-venture arrangements. 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. ME2 indicated official interest in opening inland areas to tin mining by foreign companies through proposals by the latter rather than formal open bidding. As of midyear, three production-sharing contracts had been signed with Thai companies. One of these, with Thailand's Sea Exploration and Mining Co., was to prospect for tin in southernmost Burma at Victoria Point.

Industrial Minerals

In March 1990, SLORC abandoned the State monopoly on gem and jade mining for the first time in many years, if not decades. MGE began awarding private concessions in the vicinity of Mogok Township, north of Mandalay, that totaled more than 200 near the end of the year. The official press reported that 159 mines were started by private operators during the summer of 1990, many involving signature bonuses of 250,000 kyat or more, the highest reportedly being 21 million kyat. Only one private mine was a drift into the subsurface, the remainder being vertical pits that were intermittently pumped dry for deeper digging.

Eight MGE mines have been operating at Mogok, seven for rubies and sapphires and the other for peridot, the gem form of olivine. An attractive moss-green crystal, peridot is not produced in large quantities because of limited world recognition and, hence, markets. Two of the ruby and/or sapphire mines as well as the peridot mine were lode deposits involving drilling and blasting several times daily. The other MGE mines were wet-pit operations utilizing potential ore dumped into partially water-filled pits and pumped out as sludge across separation screens. The Government's rich ruby and sapphire mines also produce a number of other varieties of gemstone, including spinel and amethyst. The "SLORC Ruby" was found in alluvium in a seasonally dry riverbed. Weighing 496.5 carats, it was thought to be the largest in the world, but had to be retrieved by Burmese authorities after being smuggled and nearly lost to entrepreneurs across the border in Thailand. MGE also reported the finding of the world's largest sapphire, weighing 979 carats, in its Mogok operations.

In the winter dry season of 1990, power availability at the mining sites was inadequate because of low water in a small nearby impoundment and hydroelectric plant. Several mines were shut down, and more were jeopardized by the lack of electricity to operate drills and pumps and to move sludge through screens. Greater generating capacity would probably be needed to sustain both the Government and private mining operations, but the Government clearly looked toward sales of gem stones in international markets as a source of revenue and foreign exchange.

Mineral Fuels

Petroleum Crude.—Burma's domestic demand of 35,000 bbl/d of petroleum crude overwhelmed the shrinking supply of approximately 13,000 bbl/d during 1990. The country's delicate position with respect to its meager foreign-exchange reserves did nothing to improve the prospects of importing ample quantities of crude for satisfying the need for refinery products.

In 1989, 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 (lower Irrawaddy Valley), (3) BHP of Australia in onshore Block H (parallel to Block G in the lower Irrawaddy Valley), (4) Amoco in onshore Block B of the northern Chindwin basin, and (5) Britain's Clyde and Croft for onshore Block I in the Irrawaddy Valley and Block J around Moulmein. Other signed agreements involved Japan's Idemitsu in Block D in midcountry, west of the Irrawaddy, and Petro-Canada venturing with Unocal in Block F, contiguous with the south end of Block D. The chief object 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.

Exploration activity was hindered by an extended monsoon season and generally poor logistics up country. Most of the effort was devoted to shooting seismic lines for locating exploratory drilling operations.

Late in the year it was made public that the Petroleum Authority of Thailand Exploration and Production Co. Ltd. (PTTEP) would join with Unocal in exploring the 6,200-km^2 area of Block F, taking a 10% position. It was not clear whether Unocal's previous partner, Petro-Canada Ltd., was still involved in the development of Block F.

Natural Gas.—Production of natural gas declined from approximately 1,133 Mm^3 in 1989 to 1,034 Mm^3 in 1990. PTTEP negotiated plans with SLORC for construction of a 500-km natural gas pipeline from Martaban, 15 km north of Moulmein through Three Pagoda Pass on the border to Kanchanaburi in Thailand. It was expected that the gasfield in the Gulf of Martaban could provide at least 250 thousand m^3 of gas per day, and perhaps twice that much, to feed the power generators at the other end.

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 future as exploration, assisted by foreign capital and expertise, concentrates on new target areas. The reserve estimates expressed in the accompanying table are largely by various industry observers having at least some direct experience in development of specific minerals in Burma. No good way is known for projecting Burma's probably large reserves of jade and gemstones, the latter known to include amethyst, aquamarine, citrine, peridot, ruby, sapphire, spinel, and zircon.

TABLE 3

BURMA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Copper		20,000
Lead, in ore		300
Lignite		30,000
Nickel, in ore		22,000
Petroleum, crude,	thousand barrels	51,300
Petroleum, natural gas	million cubic feet	9,430,000
Silver, in ore	kilograms	750
Tin, in ore		20
Zinc, in ore		500

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 some of the resulting refinery products back into the hinterland. Some crude is normally moved by pipelines, whose present condition may be deteriorating.

The 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 view of the country's situation, and SLORC's refusal to honor the results of the national elections clearly did not inspire confidence on the part of international lenders.

OUTLOOK

Burma's governmental decisionmaking has been preempted by SLORC, many feel illegally, and those at the top are not well-versed in the ways of business and economics. SLORC, thus far, had little or nothing in the way of previous experience and no obvious record of accomplishment.

Unrealistic exchange rates combined with an inconvertible currency do not attract investment or trade. Deficit spending by printing money will stimulate increasing inflation. It may not be inaccurate to speculate that the rice crop in 1990, fortunately a good year, was not only enabling survival but holding the economy together through export of surplus. Otherwise, the Burmese economy is that of a poor nation and the present Government is financially hard-pressed. There are no domestic investment resources, let alone current technology and expertise, to develop the resources with which this country has been endowed. The door that has been opened to the outside world cannot now be closed if Burma is to survive as a viable economy, or even as a nation in view of the Kachin and Karen movements toward autonomy. Problems undoubtedly remain, but the first step has been taken in terms of petroleum concessions. This could be a rich mineral economy, benefiting from petroleum, coal, base metals, and precious metals, if the means of development can be brought about.

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

OTHER SOURCES OF INFORMATION

Agency

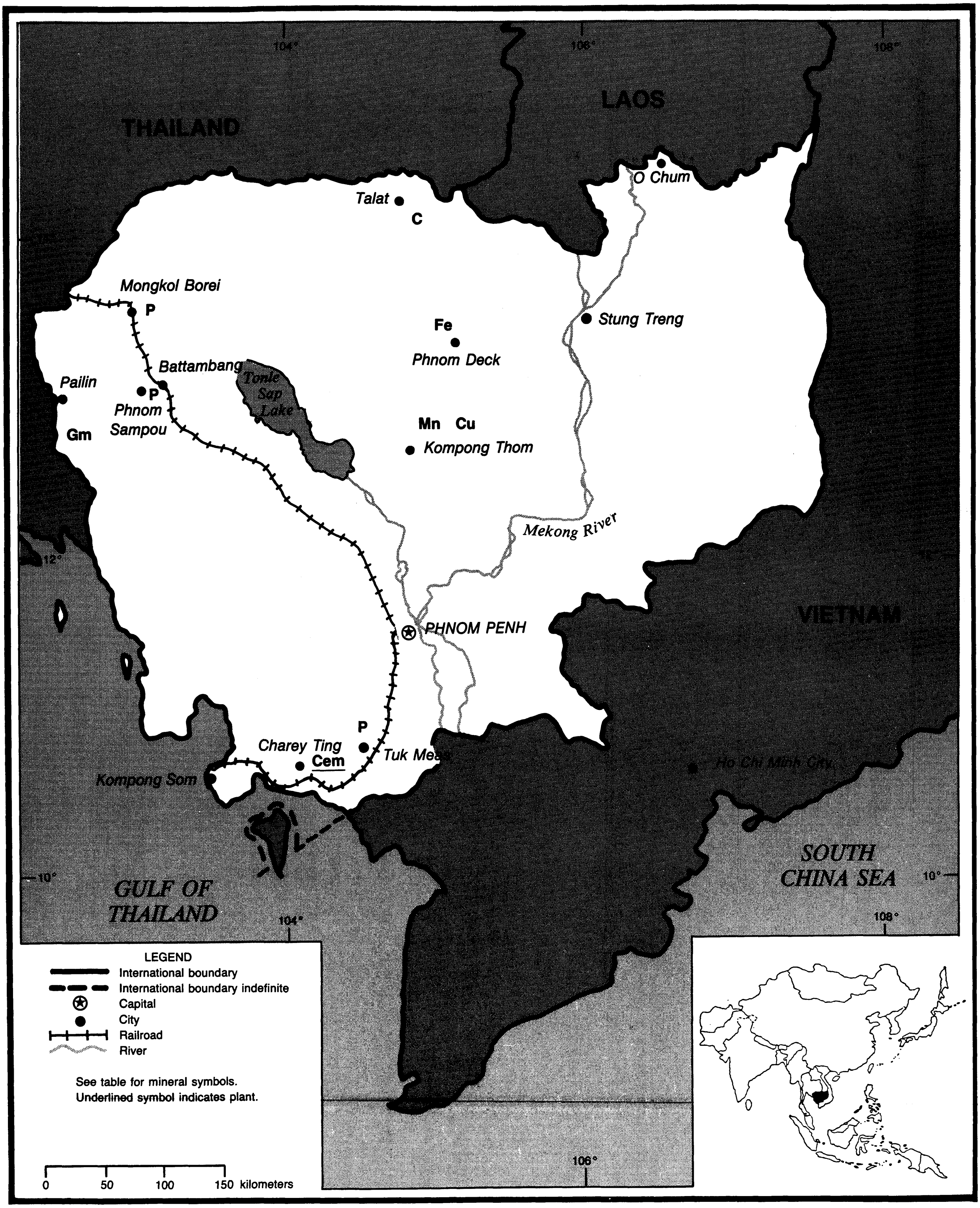
Ministry of Mines
Kanbe Road, Yankin
Rangoon 1108, Burma

Publications

Ministry of Planning and Finance, Central Statistical Organization, Rangoon: Selected Monthly Economic Indicators, Statistical Paper No. 3, bimonthly.

CAMBODIA

AREA 181,000 km² **POPULATION 7.1 million**



THE MINERAL INDUSTRY OF CAMBODIA

By David B. Doan

Continued attempts by the Government, and for that matter the United Nations Security Council members, to hold the country together and effect a peace settlement lurched onward through 1990, but mineral development went almost nowhere. The exception, as in preceding years, was for localized efforts to satisfy the need for construction materials, fertilizer, and salt. The Khmer Rouge and related groups fought on, and diplomacy endeavored to define various factions' interests and strike compromises and balances, but to little apparent avail. Each faction seemed to favor fighting a little longer to consolidate its position and gain a stronger negotiating position. The increased fighting displaced at least 150,000 people in nine provinces,[1] with dislocation of farmers severely affecting agricultural production.

The Government struggled to maintain financial stability in spite of interference in production and trade by warring factions. In September, the national bank of Cambodia announced the third devaluation of the Cambodian riel in 1990, fixing it at 510 riels to U.S. $1.00, instead of 460 riels in August and 360 riels in May, which followed 218 riels to the dollar in November 1989. Inflation was strong, based on both cost-push and demand-pull factors. The real cost of producing even simple goods tended to increase continuously, while demand burgeoned as the population recovered from almost complete demoralization from war and destruction in many parts of the country.

Although technically communist, the Government has initiated a policy that all money-losing factories would be turned over to private management, essentially as rentals to the private sector. For some months, a number of such small factories have relied on their own financial performance rather than Government subsidy.

As Cambodia endeavored to cope with the continuous destruction of war, it rebuilt what it could with what it had. Brick clays, gravel, and stone for construction were produced where possible and taken up locally as needed.

No Cambodian mineral commodities were exported, with the possible exception of unknown quantities of smuggled gem stones. What little production occurred of most minerals was consumed locally. Trade has been primarily with Vietnam and the U.S.S.R. and, not uncommonly, on a barter basis. Imports included petroleum products and, from time to time, clinker for cement manufacture, as well as corrugated iron sheets and chemical fertilizer. Exports were principally rubber, kapok, jute, red corn, beans, and art items.

Cambodia's sporadically distributed and intermittently operating mineral industry had no structure in the strictest sense.

One small plant of unknown capacity at Charey Ting, about 70 km southwest of Phnom Penh, was thought to produce cement intermittently, all of it for local consumption. Highly localized utilization of clays for brickmaking represented an industry of sorts, but the quality of the clays and articles produced was not known. The technology was simple and widely applied in many districts and provinces.

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. At Pailin, the Khmer Rouge has imposed its own rules on the gem miners and charges each about $60 for access to the mineralized area plus heavy rentals for small tracts of about 0.2 hectares each. Profits to the Khmer Rouge are said by observers to run as high as $5 million per month, much of it committed to weapons and ammunition procurement. High-quality rubies have been found increasingly, but true cornflower-blue sapphire of highest quality has been the most valuable gem stone mined thus far in Cambodia.

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. Little information was available on salt production; it was believed that the country produced at the 40,000-mt/a level from a large number of small operations.

Mineral reserves in Cambodia are poorly known. The country was known to have some coal, copper, iron, and manganese deposits, but 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.

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-m-gauge railroad, Government-owned, but of uncertain operating condition. Inland waterways included 282 km navigable to craft drawing 1.8 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 MW and produced power at the approximate level of 21 kW·h per capita. Hydroelectric power generation is projected in northeastern Cambodia where, at O Chum, a relatively small 1,000-kW plant is in the early stages of construction with help from Vietnam.

Cambodia will remain one of the poorest and most demoralized 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, fisheries, and mining. The Southeast Asian peninsula is well endowed with 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 that could help to make the country economically self-sufficient and even an exporter of mineral commodities.

Tentative interest in exploration of Cambodia for petroleum has been expressed by several international companies. This could be a first step for Cambodia in thedirection of developing its resources.

[1]Hiebert, M. The Far Eastern Economic Review. V. 150, No. 45, Nov. 8, 1990, p. 28.

TABLE 1

CAMBODIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1986	1987	1988	1989	1990[p]
Salt	40,000	40,000	40,000	40,000	40,000

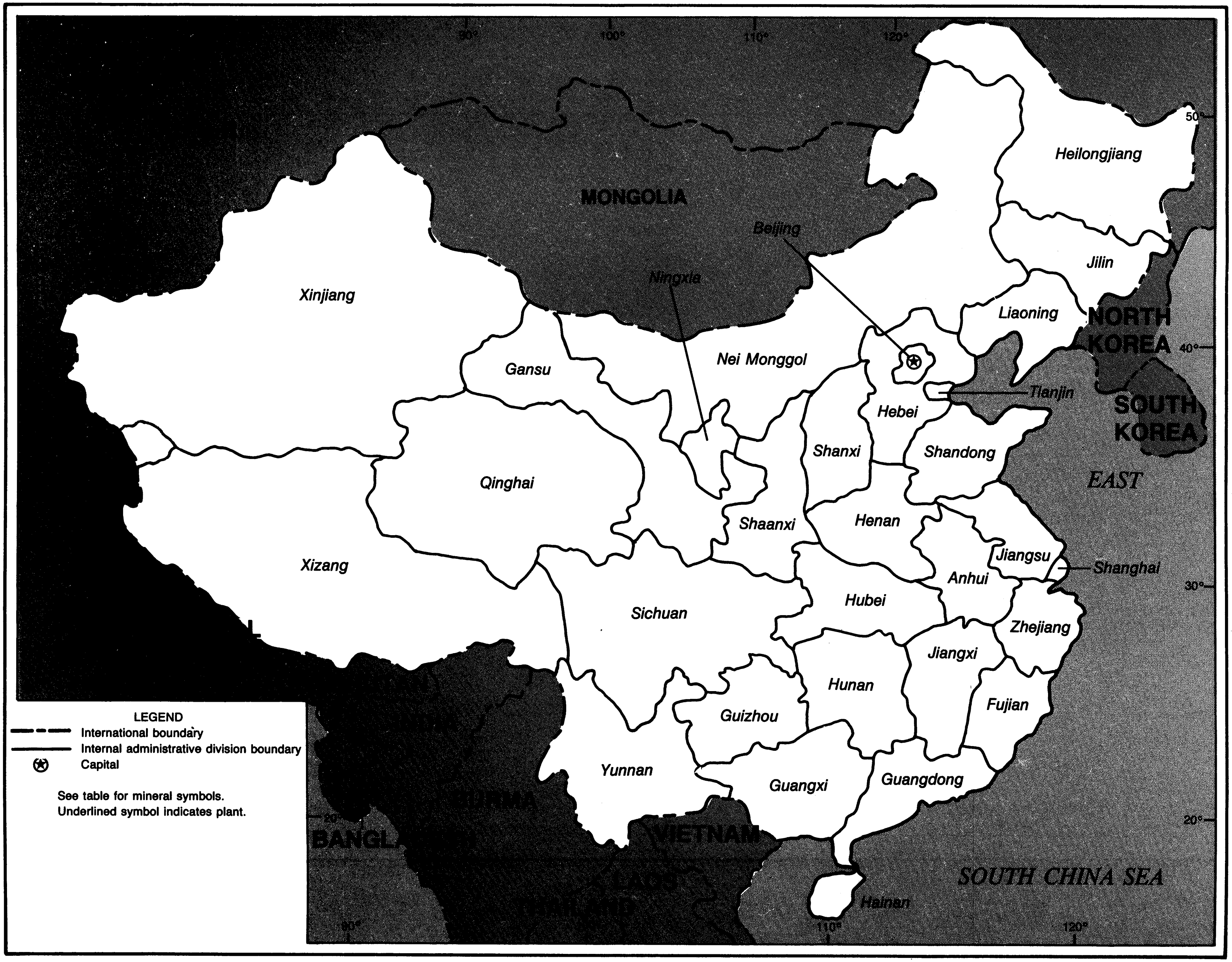
[p]Preliminary.

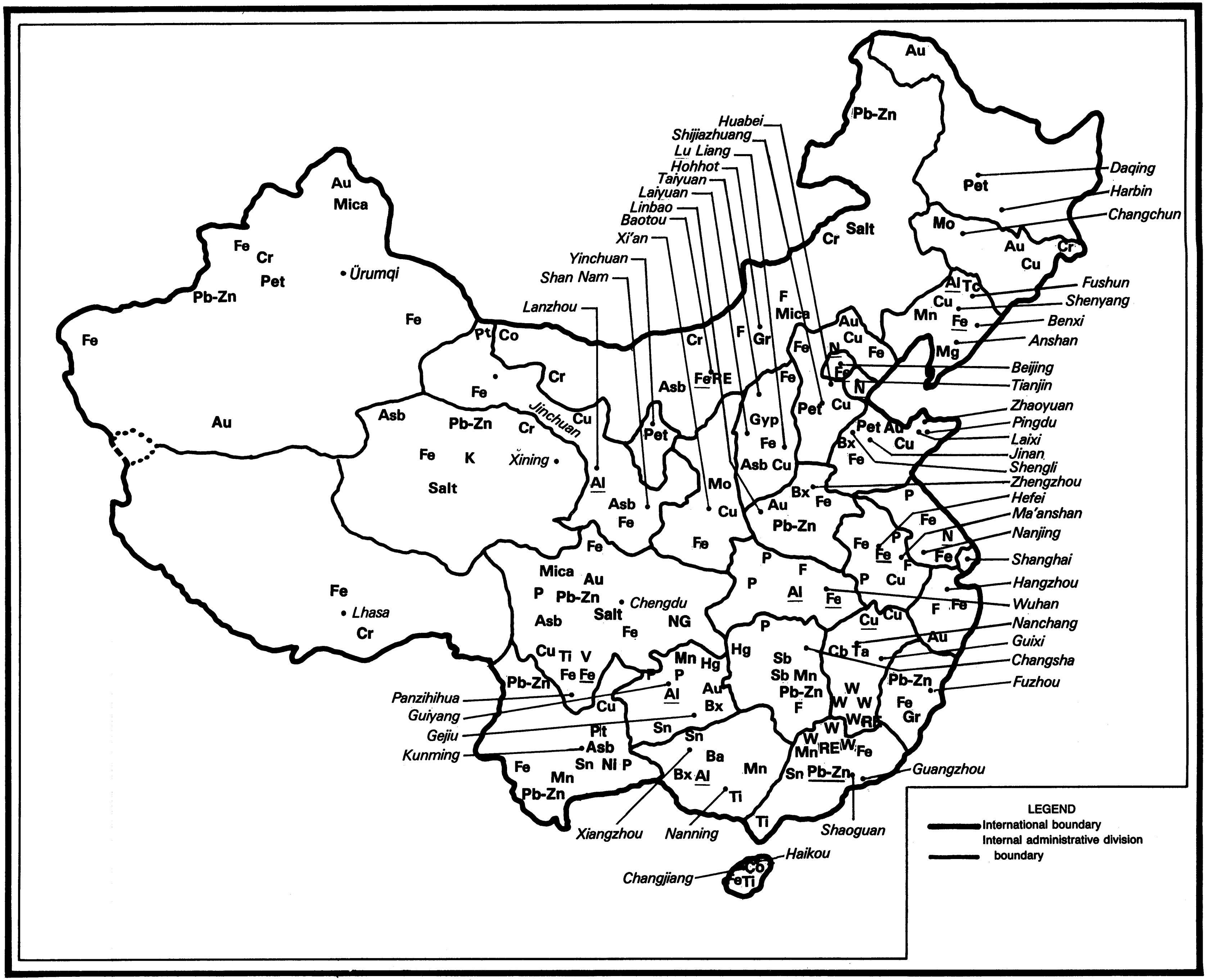
[1]Table includes data available through July 26, 1991.

[2]In addition to the commodities 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.

CHINA

AREA 9,596,960 km² **POPULATION 1.13 billion**




Daqing
Harbin
Changchun
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Shenyang
Benxi
Anshan
Beijing
Tianjin
Zhaoyuan
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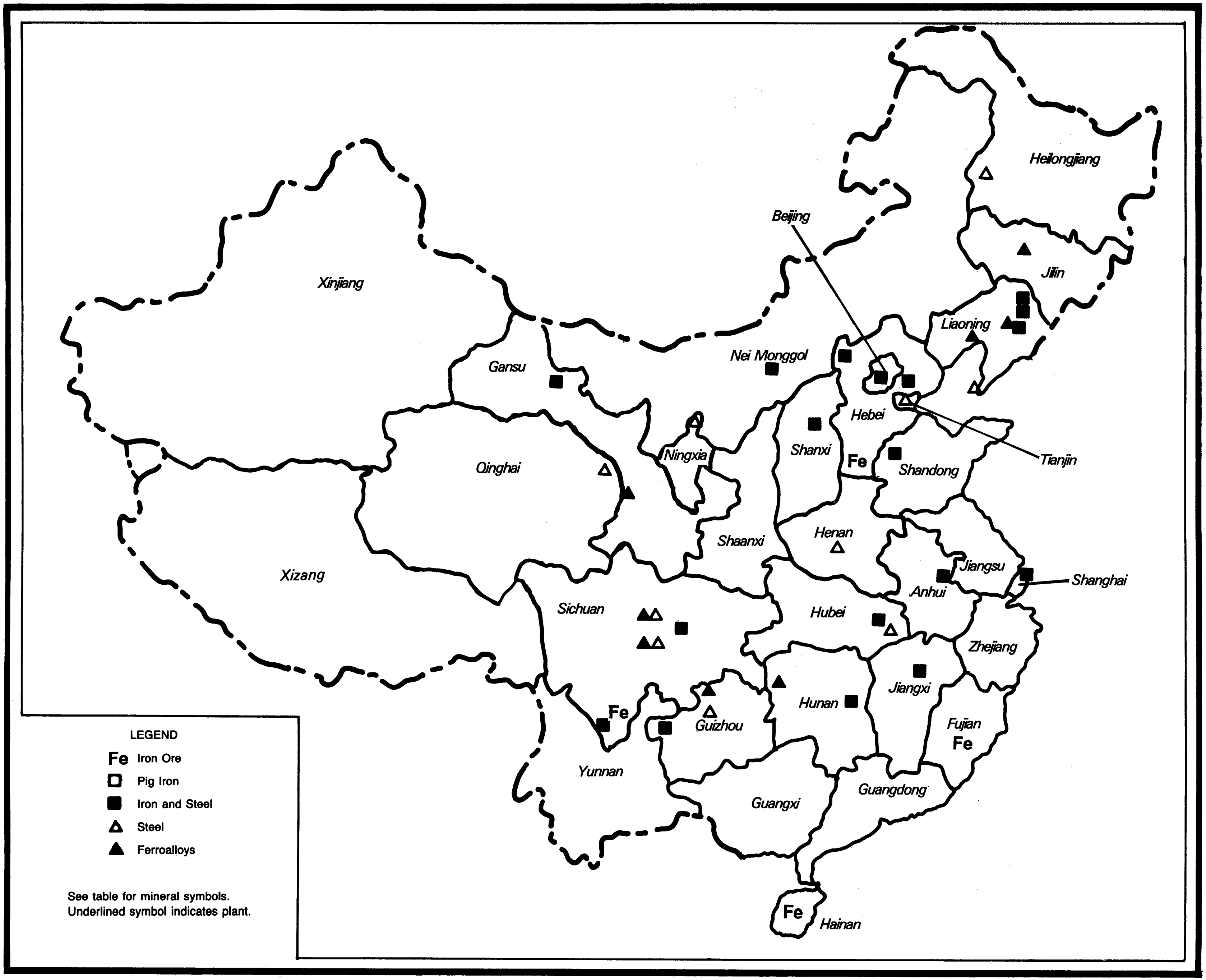
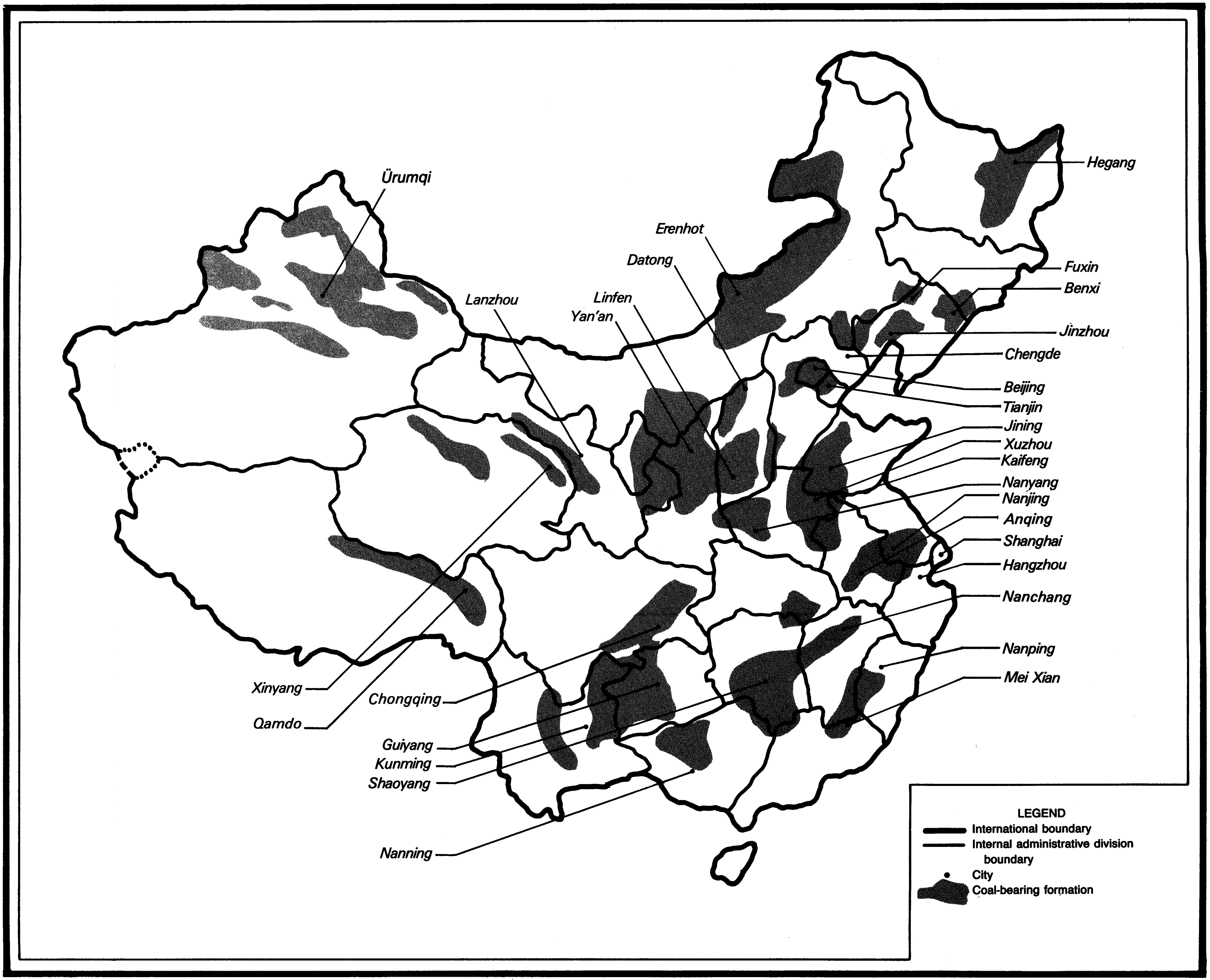
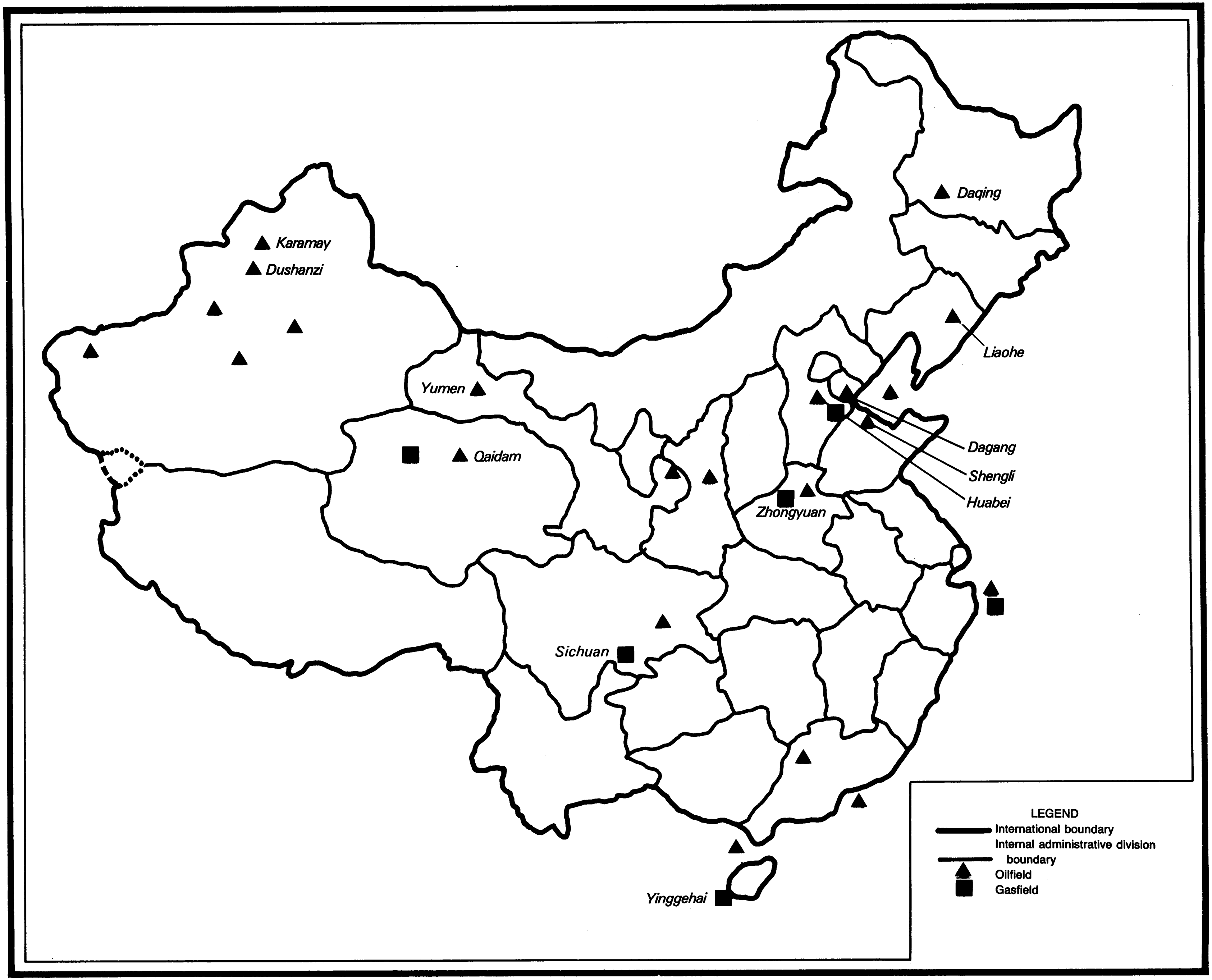
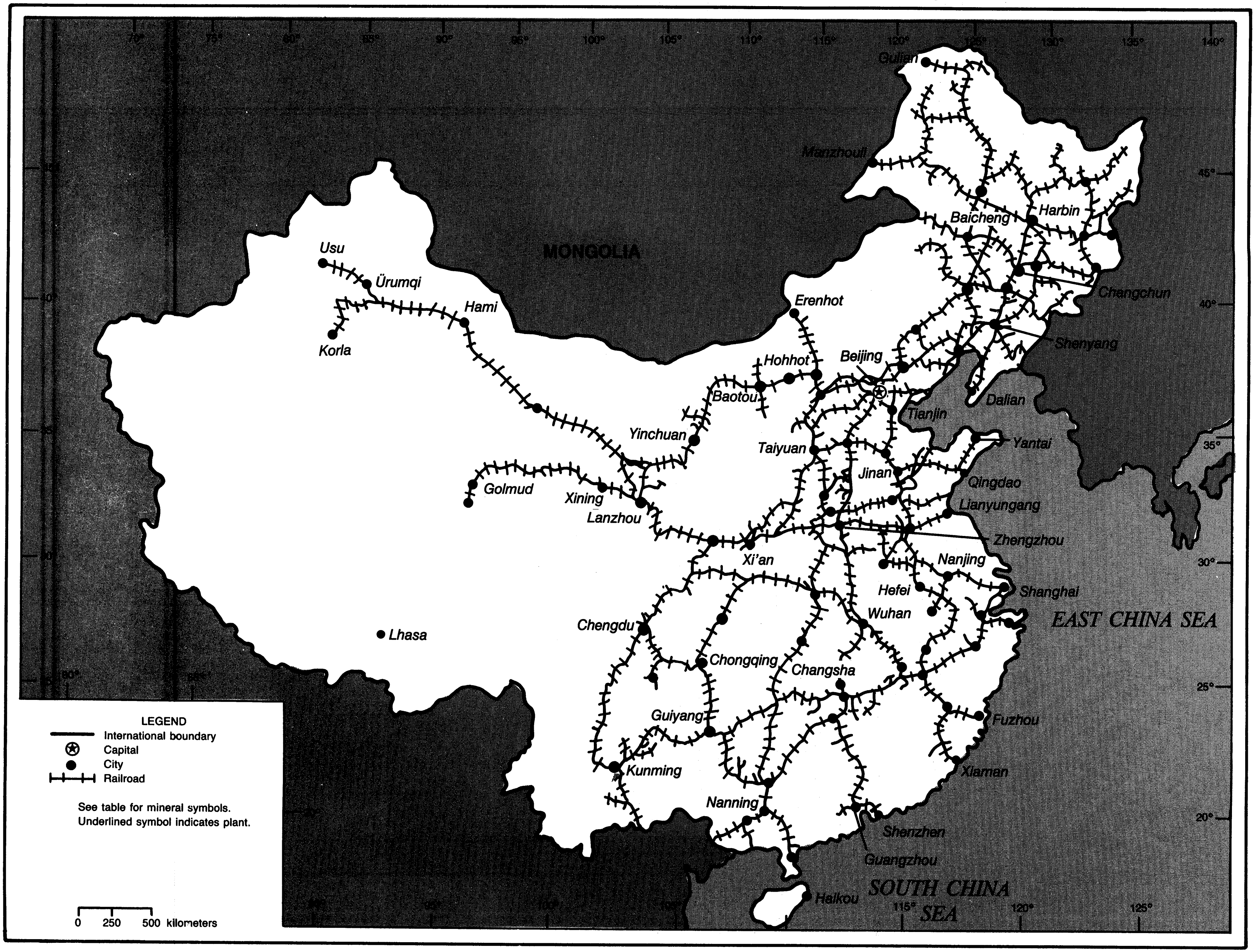
Laixi
Jinan
Shengli
Zhengzhou
Hefei
Ma'anshan
Nanjing
Shanghai
Hangzhou
Wuhan
Nanchang
Guixi
Changsha
Fuzhou
Guangzhou
Shaoguan
Haikou
Changjiang
Nanning
Xiangzhou
Kunming
Gejiu
Guiyang
Panzihihua
Chengdu
Lhasa
Ürumqi
Xining
Jinchuan
Lanzhou
Shan Nam
Yinchuan
Xi'an
Baotou
Linbao
Laiyuan
Taiyuan
Hohhot
Lu Liang
Shijiazhuang
Huabei
LEGEND
International boundary
Internal administrative division boundary


Heilongjiang
Jilin
Liaoning
Beijing
Tianjin
Nei Monggol
Hebei
Shanxi
Shandong
Fe
Xinjiang
Gansu
Qinghai
Ningxia
Shaanxi
Henan
Jiangsu
Shanghai
Anhui
Xizang
Sichuan
Hubei
Zhejiang
Hunan
Jiangxi
Fujian
Fe
Guizhou
Fe
Yunnan
Guangxi
Guangdong
Fe
Hainan
LEGEND
Fe Iron Ore
Pig Iron
Iron and Steel
Steel
Ferroalloys
See table for mineral symbols.
Underlined symbol indicates plant.



Ürumqi
Lanzhou
Linfen
Yan'an
Erenhot
Datong
Hegang
Fuxin
Benxi
Jinzhou
Chengde
Beijing
Tianjin
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


Daqing
Karamay
Dushanzi
Liaohe
Yumen
Qaidam
Dagang
Shengli
Huabei
Zhongyuan
Sichuan
Yinggehai
LEGEND
International boundary
Internal administrative division boundary
Oilfield
Gasfield



MONGOLIA
EAST CHINA SEA
SOUTH CHINA SEA
Gulian
Manzhouli
Harbin
Baicheng
Changchun
Shenyang
Erenhot
Hohhot
Beijing
Baotou
Dalian
Tianjin
Yinchuan
Taiyuan
Yantai
Jinan
Qingdao
Lianyungang
Usu
Ürumqi
Hami
Korla
Golmud
Xining
Lanzhou
Zhengzhou
Xi'an
Nanjing
Hefei
Shanghai
Wuhan
Chengdu
Lhasa
Chongqing
Changsha
Fuzhou
Guiyang
Kunming
Xiamen
Nanning
Shenzhen
Guangzhou
Haikou
LEGEND
International boundary
Capital
City
Railroad
See table for mineral symbols.
Underlined symbol indicates plant.
0 250 500 kilometers

THE MINERAL INDUSTRY OF CHINA

By Pui-Kwan Tse

The industrial production of China was at a very low level during the first quarter of 1990, but it started to pick up at the beginning of the second quarter. Moreever, a large portion of the production went to the already large Government and industrial stockpiles as no new market was found. State-run industries were concentrating on production quotas, paying little attention to quality or consumer preferences. In addition, they were seeking new loans to maintain production of goods that had little demand. One-third of Chinese state-run industries were in the red. Their profits fell 58% in the first 9 months of 1990. The Government used $8.5 billion[1] in subsidies as a bailout to keep factories running. In addition, $4.25 billion was allocated in price subsidies to control inflation.

During the 13th Central Committee of the Communist Party of China (CPC) National Congress, the State Planning Commission (SPC) stressed that the economic development of China in the nineties should emphasize economic efficiency and quality rather than quantity and speed. SPC also envisioned a transformation from a centralized planning model to a planned economy regulated by regulated by a mix of market and management mechanism. In order to improve economic efficiency, bankruptcy would be allowed for unprofitable enterprises and workers would be laid off. At the present time, China is experiencing a labor oversupply, far exceeding anticipated demand. The Government planned to use all possible means to hold the urban jobless rate at less than 3.5%, the 1990 unemployment level. Hence the Government faced an extremely difficult task to handle both the existing and the emerging job seekers.

The national retail sales index, China's main measurement of inflation, was up only 2% in 1990, a marked decrease from 6% in 1986, 7.3% in 1987, 18.5% in 1988, and 17.8% in 1989. The low inflation rate, also 2%, reflects that the Government's use of price subsidies worked to offset cost. About one-third of the Government expenditure, $20.4 billion, was used to cover losses by enterprises and for price controls. This imposed a heavy burden on Government finances. China's cummulative financial deficit totaled $14.3 billion during 1979-89. In 1990, the budgetary deficit was $1.7 billion, excluding foreign obligation and debts. In 1991, Government coffers were expected to be severely strained as China enters its peak debt repayment period, with foreign debts totaling $41.3 billion and with outstanding internal state bonds totaling renminbi (RMB) 60 billion. According to the Ministry of Finance, 1991 would be a very difficult year if efforts were not made to increase the country's economic efficiency and to tap new financial resources. To reduce the fiscal burden, the Government planned to readjust the prices of some commodities and cut state financial subsidies in 1991. To increase financial resources, the Government will introduce a new tax-and-profit assessment system in some areas in a bid to guarantee that state revenue goals to be met.

On November 17, 1990, Chinese authorities devalued the RMB by 9.57% against the U.S. dollar, i.e., RMB5.2 to U.S.$1. This devaluation of the RMB was the second in 12 months; the previous change, which occurred in December 16, 1989, amounted to a devaluation of 21.2%. The latest devaluation has considerably narrowed the gap between the official and the black-market rate. At its official foreign exchange swap centers, 1 U.S. dollar buys RMB 5.50 to 5.80. The devaluation will increase the prices of imported commodities as well as products made with imported raw materials. Owing to sluggish demand for some imported commodities, such as steel products, chemical fertilizer, and some consumer goods that are in oversupply and also burdened with large investory, the exchange rate adjustment was not expected to affect seriously the domestic price level of commodities in the next 4 to 6 months.

The GNP grew by 5%, reaching $335 billion in 1990. National income was $275 billion, 4.8% higher than that of 1989. On October 30, 1990, the State Statistics Bureau released the fourth national census. The total population in the 30 mainland Provinces, autonomous regions, and municipalities was 1.13 billion, 12.45% higher than that of 1982. The per capital GNP was $296.

The total output value of light and heavy industry reached $374.7 billion, 6% more than that of 1989. The output value of light industry was $180.5 billion, up 7.4%, while that of heavy industry increased to $194.2 billion and was up 4.6%. The relative position of output by ownership is given in table 1.

The largest growth areas in commodity production were in electronic equipment,

TABLE 1

CHINA: INDUSTRIAL OUTPUT, BY SECTOR

	1990 Output value (US$ billion)	Growth 1989 (percent)	Share of total industrial output value (percent)	
			1989	1990
State-owned	247.8	2.9	62.2	60.4
Collectively owned	107.3	6.9	33.2	33.5
Partly or wholly foreign-funded and privately owned	19.6	42.8	4.6	6.1

sugar, and soda ash. The growth rates also varied by region. The coastal Provinces, Shandong, Fujian, Jiangsu, Guangdong, and Hainan, had industrial growth rates, ranging from 9.3% to 16.9%, compared with those of the previous year. Township enterprises and partly or wholly foreign-funded and private industries accounted for faster growth rather than the state-owned and collective-owned enterprises. In the northeastern Provinces of Liaoning, Jilin, and Heilongjiang where heavy industry and state-owned large and medium-sized industrial plants are concentrated, the average industrial growth rate was 0.6% in 1990.

The high growth years of 1987-89 produced some serious structural imbalances between the coastal and inland region. Most of raw materials used by coastal provinces for industrial output were supplied by industries in the north and northeast. To compensate, some inland provincial areas offered tax breaks and low-interest loans to local commercial enterprises that promoted the use and sale of indigenously made goods, while threatening penalties if imported goods were used. In addition, locally produced and processed raw materials were being prevented from leaving the province. This disrupted the flow of important raw materials to key factories in China's major cities, such as Shanghai and Shenyang. Austerity sharpened regional protectionism and ultimately hurt economic growth in China in 1990.

The total industrial workforce was 138 million in 1990, an increase of 363,000 over that of the end of last year. State-owned enterprises employed 102 million, up 0.6% from that in 1989, while the collectively owned enterprises slashed the number of their employees by 366,000 to 34.6 million. The foreign-funded and private firms which provided much of the steam for the recovery of industrial production hired 117,000 more persons to increase their workforce to 1.43 million.

China's 1990 foreign trade increased to $115.43 billion, up 3.36% from that of the proceeding year. Exports were up 18.14% to $62.07 billion, while imports were down 9.77% to $53.36 billion over those of 1989. However, China's 1990 imports and exports would be only $38.22 billion and $51.29 billion, respectively, if shipments not involving a transfer of foreign currency were discounted. Transactions in this category include items such as gifts or donations, materials imported for processing, equipment and articles received as investment by foreign-funded enterprises, or supplies for overseas contracted projects. Notably, China recorded a trade surplus for the first time in 7 years.

GOVERNMENT POLICIES AND PROGRAMS

China's main policymaking body, the State Council, announced in December its decision to abolish subsidies on exports and overhaul its internal allocation of foreign-exchange earning. The ostensible reason for the change was to reduce China's internal deficit budgeted in 1990 and to introduce a unified trade policy for all regions.

In 1990, China approved 7,276 new direct-investment projects by foreign businessmen, an increase of 25.9% over those in 1989. By type, there were 4,093 joint ventures, 1,317 cooperative enterprises, and 1,861 foreign-owned enterprises. However, the 19 open coastal cities and Guangdong Provice accounted for 3,578 projects with foreign firms accounting for a total of $3.73 billion in direct investment, of which $1.66 billion was used for operations to be put into place and to produce.

The total fixed-asset investments by state-owned enterprises reached $48.67 billion in 1990, up 10.1% over those of last year. Key construction projects were in the energy, transportation, and telecommunications industries.

The Chinese Government is preparing to open nine heartland provinces (Sichuan, Hunan, Hubei, Jiangxi, Anhui, Hebei, Henan, Shanxi, and Shaanxi) for foreign investments. Previously, these regions were closely guarded because they accommodated most of China's defense and heavy industrial bases built during the 1960's. The Chinese Government would allow foreign investors to participate in two forms: cooperating with existing enterprises for technical updating and jointly developing local mineral resources, especically nonferrous metal mines.

The Chinese Government was planning to develop a two-tier national debt market starting from 1991 to facilitate its borrowing needs. During the country's Eighth 5-Year-Plan period (1991-95), the Government's budget deficit was expected to be maintained because of hugh expenditures needed for the country's modernization drive. The Government has relatively limited revenues to push its finances into the black; therefore, the Communist Party Central Committee has proposed using bonds to balance the Government budget for capital construction while eliminating the deficit within the regular budget. To achieve this, the Ministry of Finance has designated the uses for the borrowing funds into two major groups: one for balancing the regular budget and the other for capital construction.

In December 1990, the State Council has decided to amend the "Interim Method on Mining Registration and Management for Mining Enterprises Under Whole-People Ownership" in the original version of sections 8, 11, 12, and 16 to specify registration conditions.

PRODUCTION

Mineral fuels are the country's most important and largest minerals-producing sector in terms of quantity and value. However, the Government has stressed the development of the overall mining industry to foster economic growth. China ranks first in world coal output and fifth in oil production. Most of the output is domestically consumed. China is also a major world producer of antimony, iron and steel, mercury, rare earths, tin, and tungsten. For industrial minerals such as barite, fluorspar, magnesite, salt, and talc, China is the world's leading producer.

In the first three quarters of 1990, China had produced 364,000 tons of zinc, 89% of the annual planned target, and 200,000 tons of lead, 72% of the planned target. In the face of a sharp decrease in rare-earths sales and low prices in the international market, China, the largest rare-earths producer, had reduced its production to 16,480 tons of rare-earth oxides, a decrease of 34.7% from that of 1989.

TRADE

In January 1991, the Customs Tariff Commission, under the State Council, was to lower import duties for 40 commodities and raise import duties on 9. The commodities with lower import duties are materials needed for domestic industrial and agricultural production. The nine commodities that were to face tariff increases were mainly for telecommunication equipment.

TABLE 2

CHINA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990
METALS						
Aluminum:						
Bauxite, gross weight		1,650,000	[r]2,200,000	[r]2,300,000	[r]2,388,000	2,400,000
Alumina, gross weight		825,000	1,200,000	1,500,000	[r]1,500,000	1,500,000
Metal, refined, primary		410,000	615,000	710,000	850,000	850,000
Antimony, mine output, Sb content		15,000	15,000	25,600	[r]34,250	35,000
Bismuth, mine output, Bi content		[r]500	[r]600	[r]750	[r]750	750
Cadmium, smelter		650	680	750	800	800
Copper:						
Mine output, Cu content		185,000	250,000	[r]282,000	[r]276,000	300,000
Metal:						
Smelter, primary and secondary		225,000	300,000	400,000	450,000	450,000
Refined, primary and secondary		400,000	400,000	510,000	[r]540,000	560,000
Gold, mine output, Au content		65	70	80	90	100
Iron and steel:						
Iron ore, gross weight	thousand tons	[r]149,450	[r]161,430	[r]167,700	[r]171,850	168,300
Pig iron	do.	[r]50,640	[r]55,030	[r]57,040	57,800	62,000
Ferroalloys	do.	[r]1,597	[r]1,846	[r]1,804	[r]2,382	2,400
Steel, crude	do.	[r]52,200	[r]56,280	[r]59,430	61,200	66,100
Steel, rolled	do.	40,500	43,900	47,000	48,700	51,200
Lead:						
Mine output, Pb content		227,000	267,000	[r]312,000	[r]308,000	315,000
Metal, refined, primary and secondary		240,000	[r]245,000	[r]245,000	[r]260,000	280,000
Magnesium metal, primary		7,000	7,000	3,200	3,200	4,000
Manganese ore, gross weight	thousand tons	[r]2,700	[r]2,600	[r]3,200	[r]3,200	3,200
Mercury, mine output, Hg content		700	700	[r]940	[r]880	800
Molybdenum, mine output, Mo content		[r]10,000	[r]12,000	[r]14,400	[r]15,700	15,700
Nickel:						
Mine		25,000	25,000	[r]32,743	[r]34,250	35,000
Smelter		22,500	22,500	24,700	25,600	24,000
Silver, mine output, Ag content		90	100	110	125	130
Tin:						
Mine output, Sn content		15,000	20,000	[r]38,000	[r]40,000	40,000
Metal, smelter		15,000	20,000	29,500	29,500	30,000
Tungsten, mine output, W content		15,000	18,000	[r]45,000	[r]41,600	35,000
Zinc:						
Mine output, Zn content		396,000	458,000	[r]528,000	[r]538,000	619,000
Refined, primary and secondary		336,000	383,000	420,000	[r]451,000	470,000
INDUSTRIAL MINERALS						
Asbestos		150,000	150,000	150,000	150,000	150,000
Barite	thousand tons	1,000	1,250	1,500	1,750	1,750
Cement, hydraulic	do.	[r]166,600	[r]186,250	[r]210,140	207,000	203,000
Fluorspar		900,000	1,000,000	1,100,000	1,750,000	1,500,000
Graphite		185,000	185,000	200,000	200,000	200,000
Gypsum	thousand tons	6,500	7,200	8,100	8,100	8,000
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	[r]2,620	[r]2,630	[r]2,610	[r]2,600	2,600

See footnotes at end of table.

TABLE 2—Continued

CHINA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990
INDUSTRIAL METALS—Continued						
Nitrogen: N content of ammonia	thousand tons	15,500	16,000	r19,863	r20,681	21,000
Phosphate rock and apatite, P_2O_5 equivalent	do.	r2,940	r4,470	r5,470	r6,000	6,200
Potash, marketable, K_2O equivalent	do.	40	40	40	40	40
Salt	do.	17,300	18,000	22,000	28,000	20,000
Sodium compounds: Soda ash, natural and synthetic	do.	r2,154	r2,363	r2,609	r2,983	3,750
Sulfur:						
Native	do.	300	300	300	300	320
Content of pyrite	do.	r2,740	3,700	3,900	r4,270	4,400
Byproduct, all sources	do.	300	500	550	600	650
Total	do.	r3,340	4,500	4,750	r5,170	5,370
Talc and related materials		1,500,000	1,700,000	1,900,000	2,100,000	2,200,000
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Anthracite	thousand tons	160,000	170,000	175,000	190,000	170,000
Bituminous and lignite	do.	710,000	750,000	770,000	850,000	883,460
Total	do.	870,000	920,000	945,000	1,040,000	1,053,460
Coke, all types	do.	41,400	45,000	47,000	50,000	51,500
Gas, natural:						
Gross	billion cubic meters	r13	r14	r14	r15	15
Marketed	do.	r12	r12	r13	r13	13
Petroleum:						
Crude (including crude from oil shale)	thousand 42-gallon barrels	953,500	978,200	999,200	r1,004,000	1,008,000
Refinery products	do.	700,000	710,000	725,000	725,000	730,000

rRevised.
[1]Table includes data available through Sept. 30, 1991.
[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.

Bilateral trade totaling in excess of $1 billion by trading partners in 1990 is given in table 3.

Trading partners to whom China exported more than $1 billion worth of goods in 1990 were Hong Kong & Macau, Japan, the United States, the Federal Republic of Germany, Taiwan, the U.S.S.R., Canada, the United Kingdom, Australia, and France. Trading partners from whom China imported more than $1 billion worth of goods in 1990 were Hong Kong and Macau, Japan, the United States, the U.S.S.R., Singapore, the Federal Republic of Germany, and the Republic of Korea.

China's major export revenues were from crude oil, coal, oil products, rolled steel, and cement. However, the country continued to be dependent on imports of high-grade iron ore, pig iron, and cast iron to meet the demand of the iron and steel industry as well as to be dependent on imports of fertilizers to boost agricultural production. The imports of cooper and

TABLE 3

CHINA: VALUE OF CHINA'S BILATERAL TRADE WITH SELECT COUNTRIES IN 1990

Country	Value (billions)	Percent change 1989
Hong Kong and Macau	41.594	18.6
Japan	16.587	(12.37)
United States	11.768	(4.12)
Germany, Federal Republic of	4.531	(9.16)
U.S.S.R.	4.379	9.58
Singapore	2.832	(11.23)
Taiwan	2.573	18.48
United Kingdom	2.027	17.82
Korea, Republic of	1.943	116.37
Italy	1.905	(25.3)
Canada	1.909	28.15
Australia	1.809	(4.57)
Netherlands	1.307	8.09
Thailand	1.194	4.85
Indonesia	1.182	46.82
Malaysia	1.176	12.56

TABLE 4

CHINA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS					
Aluminum:					
Ore and concentrate[2]	thousand tons	1,251	1,492	426	Netherlands 243; Japan 184; West Germany 92.
Metal including alloys:					
Unwrought		130,378	13,411	—	Hong Kong 6,659; Japan 4,933.
Semimanufactures		28,962	6,299	303	Hong Kong 3,650; North Korea 476; Japan 443.
Copper:					
Ore and concentrate		7	—		
Metal including alloys:					
Unwrought		49,144	11,770	—	Japan 6,880; Netherlands 1,000; Hong Kong 441.
Semimanufactures		44,252	16,479	331	Hong Kong 14,182; Thailand 227; Japan 206.
Iron and steel:					
Iron ore and concentrate:					
Excluding roasted pyrite		103	2,766	—	Algeria 2,654; Japan 61; Hong Kong 50.
Pyrite, roasted	kilograms	500	58,600	—	All to Hong Kong.
Metal:					
Scrap		685,994	185,007	33	Hong Kong 53,896; Japan 47,106; Thailand 37,084.
Pig iron, cast iron, related materials	thousand tons	2,338	533	(3)	Japan 312; Thailand 71; Hong Kong 31.
Ferroalloys		459,869	193,259	12,768	Japan 94,590; Hong Kong 42,155.
Steel, primary forms		19,364	79,101	5,255	Thailand 43,669; Hong Kong 10,426.
Semimanufactures:					
Bars, rods, angles, shapes, sections		295,229	392,155	2,735	Hong Kong 204,891; Thailand 66,653.
Universals, plates, sheets		354,029	286,238	50	Japan 131,477; Thailand 96,668.
Hoop and strip		10,809	10,759	121	Singapore 4,810; Malaysia 1,449; Hong Kong 1,393.
Rails and accessories		5,897	5,996	—	Tanzania 4,989; Hong Kong 366; Japan 300.
Wire		153,554	145,276	14,893	Hong Kong 40,556; United Arab Emirates 15,854.
Tubes, pipes, fittings		187,117	228,819	49,351	Hong Kong 62,430; Iran 20,866; Singapore 13,297.
Castings and forgings, rough		28,453	20,468	3,629	Japan 8,873; Hong Kong 1,564.
Lead:					
Ore and concentrate		58,829	19,198	—	Japan 14,056; Hong Kong 5,083.
Metal including alloys:					
Unwrought		11,856	1,839	—	Japan 1,275; Hong Kong 549.
Semimanufactures		26	192	—	Japan 103; Hong Kong 46; Pakistan 32.
Manganese: Ore and concentrate		40,250	28,769	—	North Korea 20,018; Japan 4,527; Hong Kong 1,184.
Nickel:					
Ore and concentrate		—	18	—	All to Italy.
Metal including alloys:					
Unwrought		387	54	—	Singapore 36; Hong Kong 18.
Semimanufactures		2,270	1,044	—	Japan 429; Hong Kong 324; Singapore 110.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	kilograms	158,159	871	431	Hong Kong 226; Japan 107.
Silver:					
Ore and concentrate[4]	do.	21,453	5,883	—	Hong Kong 4,883; West Germany 1,000.
Metal including alloys, unwrought and partly wrought	do.	3,420	2,450	—	Hong Kong 1,906; Japan 499.
Tin:					
Ore and concentrate		23,855	21,828	775	Singapore 10,096; Hong Kong 7,533.

See footnotes at end of table.

TABLE 4—Continued

CHINA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS—Continued					
Tin:—Continued					
Metal including alloys:					
Unwrought		10,717	9,874	3,553	Hong Kong 3,093; Japan 2,108.
Semimanufactures		6,244	4,284	518	Hong Kong 1,916; Japan 1,756.
Tungsten, molybdenum, tantalum, magnesium:					
Metals including alloys, all forms		1,635	1,485	181	Netherlands 498; Hong Kong 390.
Uranium and thorium: Metal including alloys, all forms	kilograms	118,248	4,235	—	All to Pakistan.
Zinc:					
Ore and concentrate		108,175	115,266	—	Japan 86,442; Belgium-Luxembourg 9,786; Hong Kong 7,431.
Metal including alloys:					
Unwrought		13,838	20,109	—	Japan 9,932; Hong Kong 7,883; India 500.
Semimanufactures		420	1,507	—	Japan 969; Hong Kong 383; West Germany 50.
Other:					
Ores and concentrates		62,835	93,910	10,048	Japan 36,746; Hong Kong 21,406; U.S.S.R. 9,827.
Oxides and hydroxides (iron, lead, zinc, etc.)		45,354	62,210	2,525	Hong Kong 19,334; Netherlands 7,320.
Ashes and residues		9,111	8,072	—	Hong Kong 8,022; Singapore 50.
Base metals:					
Scrap		10,633	7,077	12	Hong Kong 4,594; Japan 2,437.
Unwrought and semimanufactures		115,361	107,144	20,274	Japan 40,780; Netherlands 17,316; Hong Kong 13,642.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural[5]	value, thousands	$17,947	$20,838	$1,775	Japan $10,147; Hong Kong $5,847.
Grinding and polishing wheels and stones	do.	$8,981	$10,221	$731	Hong Kong $4,547; Japan $1,019.
Asbestos, crude		570	1,889	—	Iran 1,860; Mongolia 18.
Cement		152,190	436,486	1,002	Hong Kong 356,616; Macau 66,357.
Diamond: Natural:					
Gem, not set or strung	value, thousands	$49,984	$54,668	$30	Hong Kong $43,605; Belgium-Luxembourg $6,097.
Industrial stones	do.	$316	$4,828	$149	Indonesia $3,800; Belgium-Luxembourg $544.
Fertilizer materials:					
Crude, n.e.s.		323	551	—	Japan 546; Hong Kong 5.
Manufactured:					
Nitrogenous		59,110	41,878	—	Malaysia 22,426; Singapore 5,730; Hong Kong 5,106.
Phosphatic		134,365	121,133	—	Japan 89,254; Sri Lanka 15,400; Burma 8,000.
Potassic		—	13	—	All to Burma.
Unspecified and mixed		219	1,128	—	Japan 912; Thailand 105; Rwanda 100.
Lime		74,054	80,179	—	Hong Kong 67,184; Macau 11,375; Singapore 1,482.
Phosphates, crude		158,200	194,479	6	Malaysia 83,639; Japan 26,863; Hong Kong 10,368.
Potassium salts, crude		18	—		
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$22,427	$29,699	$1,374	Hong Kong $26,996; Singapore $465.
Synthetic	do.	$1,563	$6,521	$478	Hong Kong $4,396; United Kingdom $954.
Pyrite, unroasted		200,507	230,312	3	Japan 226,252; Hong Kong 4,057.
Quartz, mica, feldspar, etc.		1,030,812	1,341,673	175,845	Japan 578,301; Hong Kong 162,440.
Salt and brine	thousand tons	382	371	—	Hong Kong 126; U.S.S.R. 78; North Korea 60.

See footnotes at end of table.

TABLE 4—Continued

CHINA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989 United States	Destinations, 1989 Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value, thousands	$15,546	$27,890	$94	Japan $22,407; Hong Kong $3,177.
Worked	do.	$55,877	$88,571	$8,522	Japan $48,743; Hong Kong $15,554.
Sand and gravel	thousand tons.	4,198	5,382	([3])	Hong Kong 4,620; Macau 713.
Calcareous stone[5]		136,237	123,629	—	North Korea 103,710; Macau 8,992; Hong Kong 8,907.
Sand other than metal-bearing	thousand tons	4,603	5,856	—	Macau 4,198; Hong Kong 1,555; Japan 103.
Sulfur: Elemental: Crude including native and byproduct		32,664	8,451	—	Thailand 8,073; Japan 110.
Other:					
Crude		1,943,853	2,214,376	717,800	Japan 754,352; Hong Kong 279,332.
Refractory minerals[5]		[r]1,803,363	2,306,427	119,391	Japan 586,484; Hong Kong 543,414.
Slag and dross, not metal-bearing		14,878	6,508	339	Japan 4,695; Hong Kong 724; United Kingdom 442.
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Anthracite	thousand tons	2,028	1,330	—	Philippines 610; Japan 263; Belgium-Luxembourg 107.
Bituminous	do.	13,598	14,008	59	Japan 4,145; Hong Kong 2,052; North Korea 1,597.
Briquets of anthracite and bituminous coal		60	1,136	—	Hong Kong 577; United Kingdom 408.
Lignite including briquets		20,142	—		
Coke and semicoke[6]	thousand tons	1,025	1,662	80	Romania 384; Japan 222; Peru 134.
Peat including briquets and litter		367	4	—	All to Japan.
Gas, natural: Gaseous	cubic meters	—	8,137	—	All to Hong Kong.
Petroleum:					
Crude	thousand 42-gallon barrels	190,131	178,035	30,692	Japan 91,886; Singapore 26,958.
Refinery products:					
Liquefied petroleum gas	value, thousands	$2,514	$1,707	—	Hong Kong $1,026; Macau $594.
Gasoline	thousand 42-gallon barrels	17,437	17,103	3,171	Singapore 6,954; Japan 6,367.
Mineral jelly and wax	do.	1,120	1,093	116	Hong Kong 132; Singapore 112.
Kerosene and jet fuel	do.	3,610	3,276	—	Japan 1,879; Hong Kong 1,333.
Distillate fuel oil	do.	10,759	11,119	—	Hong Kong 4,002; Singapore 3,626; Japan 2,852.
Lubricants	do.	1,708	1,856	189	Thailand 433; Japan 394; Hong Kong 216.
Residual fuel oil	do.	3,925	3,634	—	Japan 2,236; Hong Kong 1,398.
Petroleum bitumen, coke, etc.	do.	550	898	—	Japan 849; Canada 36.

[r]Revised
[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 ½ unit.
[4]May include other precious ores and concentrates.
[5]Not further identified.
[6]Includes retort carbon.

aluminum and their alloys were reduced to 40,251 tons and 71,771 tons, respectively, a decrease of 42.57% and 59.11% compared with that of 1989 respectively. However, China imported more chromite, copper ore, and alumina in 1990 than in 1989 to meet the growing domestic demand. China's major import and export commodities are shown in table 6.

STRUCTURE OF THE MINERAL INDUSTRY

China's large operations, which are important to the national economy, are state-owned enterprises. However, there is considerable overlapping of authority over various mineral and metal commodities. The Ministry of Metallurgical Industry (MMI) is responsible for iron ore, iron, steel, barite, and primary gold production, as well as some magnesite and dolomite mines and plants. Nonferrous metals, including byproduct gold and silver, are under the supervision of the China National Nonferrous Metals Industry Corp.

TABLE 5

CHINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS					
Aluminum:					
Ore and concentrate[2]		159,535	298,006	6,407	Australia 202,009; India 42,039; Turkey 30,250.
Metal including alloys:					
Unwrought		75,381	175,510	4,541	U.S.S.R. 77,417; Brazil 25,084; Australia 17,323.
Semimanufactures		56,320	70,812	3,340	Japan 14,602; Australia 9,142; West Germany 8,903.
Copper:					
Ore and concentrate		172,999	178,166	9,710	Chile 93,865; Canada 19,837; Mozambique 16,247.
Metal including alloys:					
Unwrought		84,368	70,082	13,959	United Kingdom 11,926; Chile 10,497.
Semimanufactures		24,622	38,568	1,548	Hong Kong 9,194; Japan 7,330; U.S.S.R. 7,153.
Iron and steel:					
Iron ore and concentrate:					
Excluding roasted pyrite	thousand tons	10,541	12,252	—	Australia 8,854; Brazil 2,515; North Korea 519.
Pyrite, roasted		—	341,063	—	Australia 138,396; India 109,287; Brazil 93,379.
Metal:					
Scrap		154,393	119,923	2,541	United Kingdom 36,700; Brazil 25,084.
Pig iron, cast iron, related materials		871,205	687,737	22	U.S.S.R. 404,618; Brazil 132,864.
Ferroalloys		710	5,499	58	Albania 3,232; Australia 500; Norway 494.
Steel, primary forms		168,684	199,420	—	U.S.S.R. 135,540; Belgium-Luxembourg 29,724.
Semimanufactures:					
Bars, rods, angles, shapes, sections	thousand tons	2,697	2,094	10	Japan 661; U.S.S.R. 467; Romania 154.
Universals, plates, sheets	do.	428	6,009	329	Japan 3,182; Brazil 513; West Germany 391.
Hoop and strip	do.	184	155	6	Japan 76; Czechoslovakia 18; West Germany 17.
Rails and accessories	do.	51	7	—	France 3; Japan 2; U.S.S.R. 2.
Wire	do.	19	42	3	Japan 11; West Germany 10; Hong Kong 5.
Tubes, pipes, fittings	do.	1,304	1,217	102	Japan 518; West Germany 223.
Castings and forgings, rough	do.	8	1	—	North Korea [3]; Italy [3].
Lead:					
Ore and concentrate		—	604	—	Burma 602; Bolivia 2.
Metal including alloys:					
Unwrought		4,577	36,374	3,483	Canada 14,206; Belgium-Luxembourg 4,046; Morocco 3,001.
Semimanufactures		229	430	7	Australia 203; Hong Kong 120.
Manganese: Ore and concentrate		276,691	424,803	—	Gabon 157,443; Mozambique 157,145; Australia 64,024.
Nickel:					
Ore and concentrate		5	—		
Metal including alloys:					
Unwrought		2,471	526	263	West Germany 75; Hong Kong 53.
Semimanufactures		4,114	3,772	726	United Kingdom 710; U.S.S.R. 297.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	kilograms	4,863	2,589	530	U.S.S.R. 1,217; United Kingdom 433.
Silver:					
Ore and concentrate[4]	do.	66,726	103,708	18,708	Mongolia 65,000; West Germany 20,000.
Metal including alloys, unwrought and partly wrought	do.	27,136	21,304	132	Hong Kong 7,981; North Korea 6,173; Japan 5,974.
Tin:					
Ore and concentrate		136	148	—	All from Burma.

See footnotes at end of table.

TABLE 5—Continued

CHINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989 United States	Sources, 1989 Other (principal)
METALS—Continued					
Tin:—Continued					
Metal including alloys:					
Unwrought		34	50	(3)	Malaysia 37; Hong Kong 11.
Semimanufactures		313	470	54	Hong Kong 231; Japan 74.
Tungsten, molybdenum, tantalum, magnesium:					
Metals including alloys, all forms		5,810	1,177	438	Norway 585; West Germany 136.
Uranium and thorium:					
Ore and concentrate	kilograms	237,750	339,750	—	Malaysia 239,750; North Korea 100,000.
Metal including alloys, all forms	do.	90	—		
Zinc:					
Ore and concentrate		—	30	—	All from Iran.
Metal including alloys:					
Unwrought		61,985	19,198	(3)	North Korea 5,033; West Germany 3,985; Switzerland 2,508.
Semimanufactures		559	1,450	54	Hong Kong 736; Thailand 248; Japan 178.
Other:					
Ores and concentrates		471,002	608,971	34	India 204,485; Albania 80,697; Turkey 66,348.
Oxides and hydroxides (iron, lead, zinc etc.)		3,972	4,201	1,537	Japan 944; Hong Kong 925.
Ashes and residues		4,223	857	187	Hong Kong 571; Macau 63.
Base metals:					
Scrap		7,587	26,896	9,793	Hong Kong 13,363; Japan 1,317.
Unwrought and semimanufactures		1,661	1,023	240	Hong Kong 281; Zaire 166; Belgium-Luxembourg 100.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural[5]	value, thousands	$628	$1,628	$98	Hong Kong $995; Japan $212.
Grinding and polishing wheels and stones	do.	$7,969	$8,258	$613	Japan $4,024; Hong Kong $2,391.
Asbestos, crude		466	500	—	Canada 262; Zimbabwe 180; Hong Kong 50.
Cement	thousand tons	1,518	1,233	(3)	North Korea 449; Hong Kong 384; U.S.S.R. 128.
Diamond: Natural:					
Gem, not set or strung	value, thousands	$37,871	$56,048	—	Hong Kong $31,068; Belgium-Luxembourg $13,223.
Industrial stones	do.	$5,847	$2,666	$417	Ireland $785; Belgium-Luxembourg $448.
Fertilizer materials:					
Crude, n.e.s.		11,112	11,769	—	Hong Kong 11,761; U.S.S.R. 5.
Manufactured:					
Nitrogenous	thousand tons	8,629	8,134	209	U.S.S.R. 2,932; Romania 847; Norway 574.
Phosphatic	do.	156	248	5	U.S.S.R. 104; Morocco 85.
Potassic	do.	2,244	1,477	74	Canada 679; Jordan 167; East Germany 125.
Unspecified and mixed	do.	3,678	4,074	2,407	U.S.S.R. 385; Norway 132; Italy 128.
Lime		160	43	(3)	Japan 16; Singapore 14; Malaysia 7.
Phosphates, crude		194,647	211,046	—	Morocco 185,343; Algeria 25,703.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$47,553	$75,247	$116	Hong Kong $34,930; Burma $29,555.
Synthetic	do.	$896	$2,358	$445	Hong Kong $601; Ireland $585.
Pyrite, unroasted		—	37,610	—	Australia 30,652; Japan 6,940.
Quartz, mica, feldspar, etc.		369	777	—	Poland 500; North Korea 160; Hong Kong 113.
Salt and brine		405	63,505	45	Australia 61,730; U.S.S.R. 972.

See footnotes at end of table.

TABLE 5—Continued

CHINA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value, thousands	$97	$58	—	Italy $25; Hong Kong $14.
Worked	do.	$21,530	$18,695	$182	Italy $7,324; Japan $4,465; Hong Kong $4,249.
Gravel and crushed rock		3,017	278	20	Hong Kong 175; U.S.S.R. 60.
Calcareous stone[5]		527	837	8	West Germany 306; Japan 206; Hong Kong 137.
Sand other than metal-bearing		118	27,401	—	Australia 18,000; New Zealand 9,000.
Sulfur: Elemental: Crude including native and byproduct		20,598	126,553	35,299	Canada 75,574; Iran 15,607.
Other:					
Crude		30,495	1,872	535	Australia 621; Hong Kong 323.
Refractory minerals[5]		6,167	21,475	4,839	Morocco 15,000; United Kingdom 699.
Slag and dross, not metal-bearing		96,411	70,506	4,946	North Korea 63,937; U.S.S.R. 1,569.
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Anthracite	thousand tons	1,597	1,522	—	North Korea 1,446; Vietnam 75.
Bituminous	do.	96	670	—	Australia 365; Mozambique 166; Canada 66.
Lignite including briquets	do.	—	99	—	All from U.S.S.R.
Coke and semicoke[6]		1,000	([7])	—	All from Japan.
Gas, natural: Gaseous	cubic meters	1,944	23,192	—	Hong Kong 13,606; Philippines 4,010; Indonesia 2,542.
Petroleum:					
Crude	thousand 42-gallon barrels	6,341	24,202	([3])	Indonesia 9,610; Oman 8,000; Malaysia 3,814.
Refinery products:					
Liquefied petroleum gas	value, thousands	$6,565	$14,550	$1,937	Hong Kong $3,970; Singapore $2,784.
Gasoline	thousand 42-gallon barrels	1,545	4,068	13	Singapore 3,301; U.S.S.R. 632.
Mineral jelly and wax	do.	6	11	([3])	East Germany 2; Malaysia 2.
Kerosene and jet fuel	do.	173	61	14	Singapore 37; Japan 8.
Distillate fuel oil	do.	17,778	29,359	690	Singapore 24,540; U.S.S.R. 1,940.
Lubricants	do.	690	810	195	Singapore 185; Hong Kong 161.
Residual fuel oil	do.	2,530	5,376	—	Singapore 4,924; Hong Kong 406; Japan 31.
Petroleum bitumen, coke, etc.	do.	1,080	886	630	Albania 225.

[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 ½ unit.
[4]May include other precious ores and concentrates.
[5]Not further identified.
[6]Includes retort carbon.
[7]Less than 1 ton.

(CNNC). The Ministry of Chemical Industry has responsibility for phosphate, sulfur, boron, salt, potassium, various inorganic salts, and chemical fertilizers. The China Non-metallic Mineral Industry Corp. is responsible for mines and processing facilities operation for a wide array of industrial minerals and its subordinate enterprise. The State Administration of Building Materials is responsible for sand and gravel, cement, dolomite, limestone, and stone aggregate use for construction. 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) are responsible for all aspects of energy exploration, production, or mining.

COMMODITY REVIEW

Metals

According to the CNNC, the total output of 10 metals—aluminum, antimony, copper, lead, magnesium, mercury, nickel, tin, titanium, and zinc was 2.3 Mmt in 1990, which was up from 2.1 Mmt in 1989.

TABLE 6

CHINA: TRADE OF SELECT MINERAL COMMODITIES IN 1990

(Metric tons unless otherwise specified)

	Exports	Value (Thousand dollars)	Percent change 1989 Quantity	Percent change 1989 Value
METALS				
Aluminum:				
Bauxite	680,315	44,150	18.4	26.4
Metal and alloys:				
Unwrought	65,125	103,770	385.0	279.0
Semimanufactures	17,764	40,840	182.0	138.2
Antimony metal, unwrought	33,368	56,960	1.1	(10.5)
Copper:				
Metal and alloys, unwrought	18,003	46,180	53.0	46.4
Semimanufactures	25,229	79,520	53.1	51.1
Iron and Steel:				
Ferrosilicon	244,386	129,940	195.9	95.9
Pig iron and cast iron	380,000	55,740	(29.4)	(20.6)
Steel:				
Bars and rods	800,963	224,790	186.9	167.9
Shapes and sections	296,909	84,480	173.9	162.9
Sheets and plates	515,007	162,800	79.9	69.3
Tube and pipe	175,009	140,800	50.6	69.0
Other	202,112	86,810	110.9	77.5
Tin:				
Metal and alloys, unwrought	10,135	64,830	2.6	(21.7)
Tungsten:				
Metal, unwrought	335	2,600	(57.6)	(16.4)
Ore	16,450	46,350	(46.8)	(56.0)
Zinc:				
Metal and alloys, unwrought	16,711	22,720	(16.9)	4.7
INDUSTRIAL METALS				
Barium:				
Barium carbonate	75,401	16,820	(10.1)	(9.9)
Barium sulfate	1,442,877	40,580	39.9	38.5
Cement	6,829,378	257,350	1,464.6	1,392.4
Clay and other refractory minerals	2,428,327	198,730	(5.3)	(14.1)
Fluorspar	1,093,847	83,530	(7.6)	(7.4)
Talc	869,755	52,080	(7.8)	(8.9)
FUELS				
Coal	17,290,000	654,150	12.7	18.1
Coke, semi-coke	1,300,000	100,200	(21.6)	(20.5)
Petroleum:				
Crude oil	23,990,000	3,389,700	(1.6)	23.2
Refinery products	5,260,000	877,370	11.1	15.8
Aluminum:				
Alumina	582,390	200,240	95.4	35.0
Metal and alloys, unwrought	71,771	127,750	(59.1)	(65.7)
Semimanufactures	43,858	153,930	(38.1)	(40.4)
Chromium: Chromite	641,267	98,310	7.6	(6.4)
Copper: Ore	242,197	124,940	35.9	17.9
Iron and Steel:				
Iron ore	14,342,625	394,130	13.9	19.5

The collective target for output in 1991 was to be 2.3 Mmt (table 8). China's state-owned and urban collectively owned mines produced a total of 3.71 Mmt of 10 different metal ores in 1989 (table 9).

Iron and Steel.—The overall world raw steel output in 1990 was down 2% on an alltime high produced in 1989. However, Chinese production rose up 9.7% more than that in 1989, to 66.1 Mmt in 1990. According to data from the International Iron and Steel Institute, China was the world's fourth largest steel producer. The rise in steel production is partly due to China's increased allocation of raw materials and funds to steel plants. The increase in production also reflects the addition of new equipment, including the introduction of blast furnaces at plants in Chongqing and Panzhihua in Sichuan Province, Tangshan in Hebei Province, and Wuyang in Henan Province. A total of three plants, one each for hot-rolling, cold-rolling, and continuous casting, were put into operation nationwide in 1990. An assessment of China's top steel firms is shown in table 10.

Because of the Government's retrenchment program on fiscal spending, which began in late 1988, there was a decline in demand for steel products, in particular by the automotive, railway, and consumer appliance sectors. The available supply of steel continued to exceed demand, with 1.29 Mmt of steel products held in producers and Government stocks in 1990. There were no buyers for this inventory. High-quality products such as rolled steel continued to be in short supply. For example, China needs 27 varieties of steel to manufacture spare parts for imported automobiles. But only three varieties can be produced by domestic firms that meet the demand in both quality and quantity. Some varieties of steel cannot be produced in China; others are substandard in technical specification. Hence, there is an imbalance in supply and demand both in quality or quantity.

This year's increase in production was in line with the targets by the MMI for the three-stage development plan for the industry in the 1990's. The first stage, lasting 2 to 3 years, emphasised relatively low-cost modernization by improving production and management techniques, and by adopting provisions to make extensive use of computer hardware and software. Plants such as Anshan and Wuhan had joined up with Nippon Steel Corp. of Japan to develop computer software to improve efficiency.

TABLE 6—Continued

CHINA: TRADE OF SELECT MINERAL COMMODITIES IN 1990

(Metric tons unless otherwise specified)

	Exports	Value (Thousand dollars)	Percent change 1989	
			Quantity	Value
FUELS—Continued				
Iron and Steel:—Continued				
Pig iron and cast iron	1,310,000	197,700	90.5	93.6
Scrap (steel)	180,000	29,130	52.9	48.9
Wire (steel)	42,925	28,460	2.2	(5.0)
Steel:				
Bar and rods	400,000	151,170	(57.3)	(57.3)
Billets and forgings	280,000	68,980	45.2	44.0
Seamless pipe	680,000	562,230	(40.6)	(44.1)
Shapes and sections	180,000	76,440	(50.5)	(43.5)
Sheets and plates	2,380,000	1,444,300	(60.4)	(60.4)
Wire rod	410,000	139,410	(47.6)	(45.9)
Others	140,000	75,630	(56.0)	(37.8)
Zinc: Metal and alloys, unwrought	4,141	5,700	(78.4)	(79.5)
INDUSTRIAL MINERALS				
Cement	400,000	17,590	(67.8)	(69.8)
Fertilizer, manufactured				
Compound fertilizers	4,629,397	964,860	13.9	6.0
Potassium chloride	2,072,805	243,100	85.5	75.9
Superphosphate	733,853	22,980	(5.6)	(4.3)
Sodium:				
Sodium bichromate	8,631	7,770	7.5	(17.6)
Sodium carbonate	210,520	41,920	(78.3)	(75.9)
Sodium hydroxide	40,536	18,050	(78.4)	(77.5)
Sodium tetraborate	351	140	(17.4)	(38.2)
Titanium dioxide	23,507	57,530	22.3	10.2
Urea	8,146,840	1,156,090	2.6	(1.2)
Unspecified	1,293,050	218,070	(34.3)	(26.7)
FUELS				
Coal	2,000,000	74,150	(12.5)	(18.4)
Electric current, thousand kwh	1,925,340	117,020	17.2	49.3
Petroleum:				
Crude oil	2,920,000	423,810	(10.4)	(9.2)
Refinery products	3,160,000	610,230	(40.9)	(37.0)

The second stage of the plan, covering 5 years, was to import foreign equipment to modernize plants. Companies such as Taiyuan in Shanxi Province and Meishan in Jiangsu Province were to buy hot-roll steel equipment from the Federal Republic of Germany and Japan to boost capacity. Other companies, such as Wuhan in Hubei Province, Anshan and Benxi in Liaoning Province, and Baoshan in Shanghai, have advanced plans for further expanding their production facilities. Wuhan is to add another steel casting plant at a cost of $865 million to supplement the two it already has. It is also building a fifth blast furnace that would increase annual output from 4.6 Mmt in 1990 to 6 Mmt in 1995. Benxi is planning to add a cold-roll steel mill to its hot-roll steel facility. The second phase development of Baoshan, to cost $552 million, is expected to be completed in July 1991. The complex will be able to produce 6.7 Mmt of steel and 6.5 Mmt of pig iron annually.

The third stage is to construct several large plants on greenfield sites. The MMI requested assistance from Japan's iron and steel sector. The Japan Iron and Steel Federation and Nippon Steel Corp. were to select sites for building iron and steel complexes in the iron ore mining districts of Hebei, Jiangsu, and Shandong Provinces. A Swedish-run trading company and a project contractor, IPASCO, is conducting a feasibility study for a joint venture with the Chinese Government on building a 200,000 mt/a flat products works in the southern part of Fujian province.

In addition to increasing quantity output, the emphasis of this modernization was also to upgrade the quality of steel being produced. At present, only 35% of China's steel output is considered equivalent to international standards. Moreover, only 20% of current steel output is produced by continuous casting, in which quality is easier to control than the outdated technique that is prevalent in China.

Nonferrous Metals.—CNNC was established in April 1983 as the operating arm of the State Administrative Bureau of Nonferrous Metals. CNNC is a large enterprise group composed of strong, state-funded units for prospecting, production, scientific research, as well as for construction. It is a state-owned, legal economic entity. According to the national economic development plans and the demand of the domestic and foreign markets, CNNC draws up and implements annual and long-term plans for nonferrous metals development and production and ensures fulfillment of the state plans both for profit making and taxation.

China has more than 300 nonferrous metal mines with a total annual ore output of 700 Mmt. CNNC manages more than 100 major mines. Of these, only 11 are large-scale mines with output more than 1 Mmt/a ore, accounting only for 10% of all output while others are small and medium mines with output of 150,000 to 500,000 Mmt/a accounting for 80% of all Chinese nonferrous ore production. The hundreds of remaining local mines account for 10% of national ore output.

According to CNNC, China produced 2.35 Mmt of 10 nonferrous metals in 1990—i.e., aluminum, antimony, copper, lead, magnesium, mercury, nickel, tin, titanium and zinc—an aggregate increase

TABLE 7

CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Aluminum	China National Nonferrous Metals Industry Corp.		
Bauxite	do.	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 Nonmetallic Minerals Industry Corp.	Gansu, Shan Nam	
Do.	do.	Nei Monggol, Baotou	
Do.	do.	Shanxi, Lai $Yuan_3$	130
Do.	do.	Shanxi, Lu Liang	
Barite.	do.	Guizhou, Xiangshou	NA
Coal	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
		Gansu:	
Do.	do.	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.

of 7.2% over that of 1989. China has become the fourth largest nonferrous metal producer in the world, ranking behind the United States, the U.S.S.R., and Canada. For the Eighth 5-Year Plan period, CNNC plans to increase the output 5% annually to reach 3 Mmt in 1995.

Based on the needs of national economic development and the large verified deposits of bauxite, the state has drawn up a strategic plan giving priority to aluminum production. During the first 11 months of 1990, China had produced 770,000 tons of aluminum, up 14% from the same period last year. By yearend, China was expected to produce 850,000 tons of aluminum. However, the national output of metal continues to fall short of demand. In addition, China imported 582,390 tons of alumina to meet its metallurgical demend in 1990. The energy required for the electrolysis of alumina in China's major aluminum plant is given in table 11.

Copper is the second major nonferrous metal production in China. According to CNNC, China produced 560,000 tons of copper contained in ore in 1990, an increase of 3.7% over that of the previous year. Copper has been in short supply in China for many years. The Government issued a ban on the export of this metal in 1988 and restricted domestic use. In 1990, China imported 242,197 tons of copper ore from other countries. To ensure the sustained development of the copper sector, the state has expanded construction of the Dexing, Wushan, and Anqing Mines, all in Jiangxi Province. At the completion expansion program in 1993, the Dexing Mine will be able to produce copper concentrate containing 130,000 mt/a of copper metal; 3.4 mt/a of gold; 10.5 mt/a of silver; 700,000 mt/a of pyrite concentrate; and 3,600 mt/a of molybdenum concentrate (grading 45% of Mo). The Anqing Mine will be able to produce 10,000 mt/a of copper contained in ore.

To meet the demand of copper in the future, Chinese geologists have actively prospected for copper and have discovered 6 large, 4 medium, and 26 small of copper deposits in Jiangxi; a large copper deposit zone near Tuoba in the Changdu region, Xizang; 47 areas containing copper occurrences in Nei Monggol; and 6 copper occurrences in the Zhongtiao Mountain area in the northern and northeastern parts of China.

Currently, China has three copper materials processing bases: Luoyang in Henan province, Shenyang in Liaoning

TABLE 7—Continued

CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Copper, refined	do.	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 billion cubic meters	China National Petroleum Corp.	Sichuan	10
Gold, refined thousand kilograms	Ministry of Metallurgical Industry	Henan, Lingbao	3
Do.	do.	Shandong, Zhaoyuan	6
Graphite	China National Nonmetallic	Shandong, Laixi	
Do.	Minerals Industry Corp.	Shandong, Pingdu	190
Iron and steel:			
Iron ore	Maanshan Iron and Steel Co	Anhui	8,000
Do.	Shoudu Iron and Steel Co	Beijing	18,000
Do.	Meishan Metallurgical Co	Shanghai	1,700
Do.	Jiuquan Iron and Steel Co	Gansu	2,700
Do.	Hainan Mining Co	Hainan	4,600
Do.	Hanxing Metallurgical Bureau	Hebei	3,200
Do.	Tangshan Iron and Steel Co	Hebei	1,800
Do.	Wuhan Iron and Steel Co	Hubei	5,100
Do.	Banshigou Iron Mine Mining Co	Jilin	1,400
Do.	Anshan Iron and Steel Co	Liaoning	26,800
Do.	Benxi Iron and Steel Co	Liaoning	13,700
Do.	Baotou Iron and Steel Co	Nei Monggol	7,800
Do.	Taiyuan Iron and Steel Co	Shanxi	3,400
Do.	Dabaoshan Mining Co	Guangdong	1,670
Do.	Panzhihua Mining Co	Sichuan	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	Liaoning	50
Do.	Shanghai Steel Co	Shanghai	180
Do.	Emei Ferroalloy Co	Sichuan	40
Crude steel	Maanshan Iron and Steel Co	Anhui	1,900
Do.	Shoudu Iron and Steel Co	Beijing	4,000
Do.	Tangshan Iron and Steel Co	Hebei	1,600
Do.	Wuhan Iron and Steel Co	Hubei	4,700
Do.	Anshan Iron and Steel Co	Liaoning	8,100
Do.	Benxi Iron and Steel Co	Liaoning	2,500
Do.	Baotou Iron and Steel Co	Nei Monggol	2,300
Do.	Baoshan Iron and Steel Co.	Shanghai	6,800
Do.	Shanghai Steel Co.	Shanghai	5,700

See footnotes at end of table.

Province, and Lanzhou in Gansu province. These three bases are far from the consuming areas of copper materials in the country. China is building a fourth base in Wusong in Shanghai, the largest consuming center of copper in the country. Wusong was expected to narrow the gap significantly between supply and demand, which has been a restrictive factor hindering the country's industrial development. The Shanghai Non-Ferrous Metal Fabrication Complex at Wusong is to be funded partially by loans from the Austrian Government, export credit from France, and loans from the municipality's Investment and Trust Corp.

The Government presently lacks capital to develop fully nonferrous metal resources. To ensure the steady growth of the nonferrous metal industry to meet the demand in the future, CNNC was seeking cooperation with foreign countries on joint development of mining operations. These include up to 100% foreign ownership and the right to appoint management and to withdraw profits according to the share of the investment. Projects available for foreign participation include placer mines, the Lanping lead and zinc mine in Yunnan province, the Chengmenshan copper mine in Jiangxi Province, the Lijiagou lead and zinc mine in Gansu Province, the Zunyi titanium mine in Guizhou Province and copper ore mines in Heilongjiang and Sichuan Provinces.

In February 1991, the State Council listed antimony, rare earths, tin, and tungsten as special minerals under state protection. The State Planning Commission (SPC), with the help of the CNNC and the committee in charge of rare-earth utilization and exploitation under the State Council, has the exclusive authority in exploitation of these four minerals. These commodities must be mined by state-owned or alternatively by collectively owned mines in areas where there are no provisions for running state-owned mines. Products made of these four minerals were to be purchased under unified state plans by units designated by SPC and the State Administration for Industry and Commerce. Foreign firms and individual foreigners are not allowed to exploit or to obtain data, mineral samples, or technology on rare earths.

Mineral Fuels

China is the world's largest coal producer and the fifth largest oil producer in the world. In 1990, the total energy output, in terms of standard fuel equivalence, was up

TABLE 7—Continued

CHINA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Crude steel	Taiyuan Iron and Steel Co. No. 2.	Shanxi	1,800
Do.	Panzhihua Iron and Steel Co	Sichuan	1,850
Do.	Tianjin Iron and Steel Co	Tianjin	1,500
Lead	China National Nonferrous Metals Industry Corp.	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 Wan₃	950
Do.	do.	Nanhai	
Potash.	Ministry of Chemical Industry	Qinghai	40
Rare earth	Ministry of Metallurgical Industry China National Nonferrous Metals	Nei Monggol, Baiyunebo	12
Do.	Industry Corp.	Jiangxi, Ganan	1
Do.	do.	Guangdong, Nanshanhai	5
Do.	do.	Shandong, Weishan	2
Salt	Ministry of Chemical Industry	Anhui	200
Do.	do.	Qinghai	320
Talc	China National NonMetallic Mineral Industry Co.	Guangxi, Longshen	130
Do.	do.	Liaoning, Haicheng	50
Do.	do.	Shandong, Qixia	5
Tin, smelter	China National Nonferrous Metals Industry Corp.	Guangxi, Dachang	5
Do.	do.	Yunnan, Geijiu	15
Tungsten concentrate.	China National Nonferrous Metals Industry Corp.	Guangdong	
Do.	do.	Guangxi	
Do.	do.	Hunan	30
Do.	do.	Jiangxi	
Do.	do.	Zhejiang	
Zinc	China National Nonferrous Metals Industry Corp.	Fujian, Liancheng	15
Do.	do.	Gansu, Baiyan	100
Do.	do.	Guangdong, Shaoquan	30
Do.	do.	Guangxi, Changpo	20
Do.	do.	Hunan, Zhuzhou	135
Do.	do.	Liaoning, Huludao	60
Do.	do.	Liaoning, Shenyang	20
Do.	do.	Yunnan, Lanping	40

NA Not available.

2.5% from that of last year. By sector, coal accounted for 10.8 billion tons, up 2.5%; crude oil, 138.3 Mmt, same as that of last year; natural gas, 15.2 billion m^3, up 1.8%; and electricity, 614.6 billion kW h, up 6% (hydroelectricity 124.5 billion kW h, up 6.3%).

China has potential coal resources of 4,490 billion tons within a depth of 2 km, of which 900 billion tons has been verified. China invested $558 million to develop its coal industry during the Seventh 5-Year Plan (1986-90), during which the daily coal output of a worker rose from 0.939 ton to 1.195 tons, an average annual increase of 5.4%. In large state-owned coal mines, mechanization increased from 22.46% in 1986 to 33.31% in 1990. In 1990, China had a total of 244 coal faces, double that of 1985.

China's oil resources are estimated to be 70 billion tons, and its natural gas reserves are approximately 30,000 billion m^3. However, the proven oil reserves account for only 16%, and the proven gas reserves are only 2.6% of the total of each. China will invest more than $21 billion for the exploration and development of new oil reserves during the Eighth 5-Year Plan period.

China has the world's largest number of wind-driven generators, with 100,000 such machines operating in Xinjiang, Nei Monggol, Gansu, Shandong, Zhejiang, and Guangdong. Collectively, they are capable of generating 8,000 kW. Additionally, solar energy power generation accounts for 1,000-kW capacity, which is mainly being generated in Nei Monggol and Xinjiang.

China National Nuclear Industrial Corp. is planning to build a fourth nuclear powerplant with a capacity of 300-MW at Qinshan, Zhejiang Province. The first 300-MW nuclear reactor in Qinshan has been completed and is expected to enter full-scale operation in 1991. Two 900-MW nuclear reactors are under construction in Daya Bay, Guangdong Province. The first of the two reactors is expected to generate electricity by October 1992, while the second will come on-line in July 1993. China and the U.S.S.R. are now negotiating construction contracts for a 1,000-MW nuclear powerplant in Liaoning.

In 1991, the central Government has pledged $4.4 billion to build a total of 75 mine shafts with an annual output capacity of 112.12 Mmt of coal and 75 power projects to generate capacity of 32.83 MkW. The state investment would account for 85% of the funds required for the coal

TABLE 8

CHINA: TARGET PRODUCTION OF NONFERROUS METALS IN 1991

(Metric tons)

Metal	Target
Aluminum	870,000
Copper	560,000
Zinc	475,000
Lead	290,000
Antimony	35,000
Tin	25,600
Nickel	23,600
Magnesium	4,200
Titanium	2,000
Mercury	700

projects and 55% of the funds needed for the power projects. The overall scheme stresses the construction and/or expansion of coal production bases in Shanxi, Shaanxi, Nei Monggol, and Ningxia as well as the construction of hydro and thermal power stations throughout the country.

Coal.—Coal accounts for 70% of China's total energy consumption and, therefore, the continued development of the coal sector was to ensure a sustained growth in the economy. Coal resources in northwest China account for 65% of the nation's total coal deposits. During the Seventh 5-Year Plan period, the state's coal exploration and development efforts have shifted from the east to the west. The major areas expected to undergo construction to expand coal production are in Nei Monggol and Shaanxi Provinces, and the Ningxia Hui Autonomous Region during the Eighth 5-Year Plan period (1991-95). China will invest more than $500 million to develop Shenfu Coalfield in Shaanxi Province and Ningdong Coalfield in the eastern part of Ningxia Hui Autonomous Region.

In 1990, there was a general market slump. The impact on the coal industry was evidenced by diminished sales and canceled orders. The inflation resulting from rising production costs had driven 67 of 68 mining bureaus into the red. An estimate of the deficit due to decreased shipments may be as much as $1.54 billion for 1990.

Shanxi Province continued to be the leading producer, accounting for 25% of the national output. In 1989, 17 state-owned mines each produced 10 Mmt or more of coal. Fourteen mines had an output of 5 to 10 Mmt and 19 mines produced 3 to 5 Mmt each. There were 80,000 local coal mines that produced about 5% of the national output. These mines are mainly near state-owned mines. Some of them operated regardless of safety regulations, and some were poorly constructed. The Ministry of Energy Resources has banned the operation of the unsafe and unlicensed mining activities. The coal output by Administrative Division in China is given in table 12.

After 7 years of construction and an investment of $100 million, the Malan Mine in Shandong, which has a yearly production capacity of 4 Mmt, has been completed and was placed in operation in June 1990.

In 1990, the largest coal contruction project has started on the development of the Jungar Coalfield. Jungar Coalfield is on the loess plateau in the eastern part of Jungar Banner in Nei Monggol Autonomous Region. The coalfield is 65 km long and 21 km wide, with a total area of 1,365 km^2 and proven reserves of 27.2 billion tons. Jungar Coalfield is a comprehensive project involving simulataneous construction of infrastructure for mining, power, and transportation. The total investment will be $800 million. The entire project will be completed by the end of 1992. The annual production capacity is 12 Mmt, and production will begin in 1993.

Contruction of the Yuanbaoshan opencast coal mine in Chifeng, Nei Monggol, was also begun in 1990. The mine's deposits cover an area of 12 km^2, with proven reserves of 562 Mmt. Capital construction of the mine is scheduled to be completed in 2 years and will reach the designed capacity of 5 Mmt in 7 years.

After more than 1 year's efforts, China has successfully drilled its first submarine coal mine in Longkou Bay in Bohai Sea. An estimated of coal reserve of 1 billion tons lies in an area of 155 km^2. Coal deposits are in four layers about 40.6 m under the seabed.

TABLE 9

CHINA: MINE OUTPUT OF SELECT METAL ORES IN 1989

	State-owned	Urban collective-owned	Total	Mine ore grade	Concentrate grade	Metal recovery ratio in ore dressing
		(Metric tons)			(Percent)	
Antimony (Sb content)	14,990	31,480	46,460	NA	NA	NA
Bauxite (Al_2O_3 content)	1,306,000	1,082,000	2,388,000	NA	62.17	81.78
Copper (Cu content)	229,450	46,050	275,500	0.83	21.56	85.48
Lead (Pb content)	165,220	142,150	307,370	NA	NA	NA
Mercury (Hg content)	630	250	880	NA	NA	NA
Molybdenum (MoS_2 content)	20,447	5,668	26,115	0.14	46.16	83.67
Nickel (Ni content)	32,500	1,750	34,250	1.33	6.05	83.71
Tin (Sn content)	23,600	16,060	39,660	0.38	43.07	58.80
Tungsten (WO_3 content)	28,599	23,924	52,483	0.27	68.74	85.00
Zinc (Zn content)	341,230	197,020	538,300	4.64	49.59	86.67

NA Not available.

TABLE 10

CHINA: SALIENT STATISTICS FOR SELECT IRON ORE PRODUCTION, PIG IRON PRODUCTION, AND CRUDE STEEL PRODUCTION

Company (Location)	Known completion and/or start-up time	Fixed assets (Rmb billion)	Number of workers (thousands)	Pig iron output (1,000 tons metric)	Steel output (1,000 tons metric)	Continuous casting (percent)	Iron ore 1,000 metric tons	Opencast mine ore grade (percent)	Underground mine ore grade (percent)	Concentrate grade (percent)	Metal recovery ration in ore dressing (percent)
Shoudu (Capital) Iron and Steel Co. (Beijing)	1920	4.3	189	3,238.2	3,765.2	35.5	16,878.9	26.68	NA	68.46	79.33
Tianjin Steel Rolling Mills (Tianjin)	—	1.2	60	1,081.4	1,413.9	30.4	NA	NA	NA	NA	NA
Tangshan Iron and Steel Co. (Hebei)	1944	1.1	49	429.0	1,507.0	30.5	1,746.7	30.17	NA	66.81	87.36
Xuanhua Iron and Steel Co. (Hebei)	1978	.5	31	621.8	174.5	NA	472.0	31.74	36.21	62.56	75.87
Taiyuan Iron and Steel Co. (Shanxi)	1939	2.5	70	1,239.5	1,684.3	7.2	3,237.1	27.90	NA	64.73	62.43
Baotou Iron and Steel Co. (Nei Mongol)	1958	3.4	76	2,309.1	2,237.6	NA	7,584.3	34.97	NA	59.48	64.78
Anshan Iron and Steel Co. (Liaoning)	1916	11.5	216	7,409.3	7,853.4	4.7	26,540.2	31.36	34.60	57.17	70.69
Benxi Iron and Steel Co. (Liaoning)	1905	4.2	98	2,876.2	2,314.0	NA	12,042.4	29.82	NA	67.38	·81.51
Shanghai Baoshan Iron and Steel Complex (Shanghai)	1985	13.3	32	3,265.3	3,657.9	8.2	NA	NA	NA	NA	NA
Shanghai Meishan Metallurgical Co. (Shanghai)	1969	.7	22	1,571.8	4.3	NA	1,673.8	NA	45.66	52.91	81.35
Shanghai Iron and Steel Works (Shanghai)	—	2.9	118	344.3	4,202.5	30.9	NA	NA	NA	NA	NA
Maanshan Iron and Steel Co. (Auhui)	1909	2.5	74	2,181.2	1,831.3	10.6	7,966.5	29.62	33.55	57.17	69.12
Wuhan Iron and Steel Co. (Hubei)	1958	6.6	135	4,440.7	4,644.0	42.0	4,936.4	44.81	39.10	58.64	78.73
Panzhihua Iron and Steel Co. (Sichuan)	1970	2.2	61	2,131.1	1,831.5	NA	8,165.0	30.95	NA	51.62	76.25
Chongqing Iron and Steel Co. (Sichuan)	1940	1.6	50	750.5	775.2	24.7	333.5	45.19	NA	55.61	50.43
Jiuquan Iron and Steel Co.(Gansu)	1970	1.3	32	603.4	364.9	47.2	2,336.4	NA	34.07	52.63	68.84

NA Not available.

In January 1991, Occidental Petroleum Corp. decided to sell its 25% stake in one of China's biggest joint ventures, the Pingshuo Mine at Antaibao, Shanxi. The mine, with a total investment of $750 million, was established in 1985. Since trial production began in 1987, the unprofitable mine has been dogged by fuel shortages, delivery delays, and bickering among the venture partners. The pullout of Occidental Petroleum Corp. in the Pingshuo venture will put pressure on China's renewed efforts to attract foreign investment.

Petroleum.—According to the State Statistical Bureau, China's output of crude petroleum remained at the same level as that of 1989, 138.3 Mmt. Onshore production totaled 137.1 Mmt compared to offshore output of 1.2 Mmt. The Daqing Oilfield in Heilongjiang accounted for 55.6 Mmt of the output; Shengli Oilfield in Shandong, 33.5 Mmt; Liaohe Oilfield in Nei Monggol, 13.5 Mmt; Xinjiang Oilfield in Xinjiang, 6.8 Mmt; Jilin Oilfield in Jilin, 3.5 Mmt. Altogether, they accounted for 80% of the national production. The output of the offshore oilfield in the Bohai Sea (Chengbei, Bozhong 28-1, and Bozhong 34-2/4) accounted for about 75% of total offshore oil production, and the South China Sea (Wei 10-3 and Huzhou 21-1) accounted for the remainder.

Although China's crude oil output has increased annually, the growth rate declined in the Seventh 5-Year Plan periodl-125 Mmt in 1985, 131 Mmt in 1986, 134 Mmt in 1987, 137 Mmt in 1988, 138 Mmt in 1989, and 138 Mmt in 1990. The rate of decline of oil output was offset by an increased work load

TABLE 11

CHINA: ENERGY CONSUMPTION FOR ALUMINUM METAL PRODUCTION

(Kilowatt hours per metric ton)

Plant	1985	1986	1987	1988
Baotou, Nei Monggol	14,659	14,579	14,654	14,496
Fushun, Liaoning	14,623	14,596	14,566	14,432
Guizhou, Guizhou	15,846	15,345	15,281	15,246
Lanzhou, Gansu	14,521	14,534	14,477	14,352
Liancheng, Anhui	14,670	14,617	14,604	14,662
Qingtongxia, Ningxia	16,073	15,958	15,900	15,961
Shandong, Shandong	14,870	14,824	14,551	14,476
Zhengzhou, Henan	14,418	14,284	14,183	14,158

and more state funds to increase productivity. For example, even though China's crude oil output increased by only 2.9 Mmt in 1988, the work load as a result of that increase was equivalent to the construction of an oilfield with an annual output of 20 Mmt. The main oilfields such as these that began operation in the sixties and seventies, offered large quantities of oil and gas, have now entered the late stage of stable yield. It is clear that the production capacity of the main oilfields is progressively decreasing. Therefore, it is necessary for China to find new reserves in order to maintain a long-term stable crude oil output to ensure the nation's economic growth. Hence, development of the Tarim Basin oilfield in Xinjiang is underway and is expected to become China's key oil supplier in the next decade and so. To develop the Tarim Basin, China is seeking foreign technical and financial cooperation to speed up its oil development. In late 1990, the United Nations Development Program agreed to provide China with a grant of $5.87 million for techological assistance to drill two deep wells in Tarim Basin as well as to train 13 Chinese technicians abroad.

China will also explore for new oil and gas deposits in 10 key areas during the Eight 5-Year Plan: the Songliao Basin; the North China Region, the East China Continental Shelf Basin; the Sichuan Basin; the Nanhai Sea; the lower reaches of the Chang Jiang overlapping Jiangsu, Zhejiang, and Anhui Provinces; the middle reaches of the Chang Jiang between Hunan and Hubei Provinces; the Eerdous (Shaan Gan-Ning) Basin over the borders of Nei Monggol, Shaanxi, Gansu, and Shanxi; and the Lun-po-la and the Baingoin Basin on the North Xizang Plateau. The major emphasis will be placed on using advanced techniques in science and technology to explore in new areas and territories for new oilfields and gasfields in traditional and atypical geologic formations and depths.

On December 10, 1990, China National Oil Development Corp. (CNODC), a subsidiary of China National Oil and Gas Corp., signed the first oil contract for joint exploration on the mainland—Dongting Basin northwest of Changsha, Hunan Province, with Santa Fe Energy Resource Inc. and Northern Michigan Exploration Co. from the United State and Petroleum Exploration Ltd. of New Zealand. The exploration will be conducted in three stages—3 years for seismic survey, 2 years for test well drilling, and 2 years for preparation and development. Under the terms of the contract, foreign firms will wholly assume the risk in the exploration stage. When commerical finds are discovered, the Chinese and the foreign partners will jointly invest in oilfield development.

Since China opened its continental shelf for international bids in 1979, China National Offshore Oil Corp. has attracted US$2.8 billion of foreign investment by signing 73 contracts and agreements with 45 oil firms from 12 countries. In the past 10 years, 170 wells have been drilled, of which 65 have found reserves and 36 formations have been found to contain oil and gas.

China has begun exploring for oil in the East China Sea and has discovered two oilfields and three formations containing oil and natural gas. Although the Dong Hai is still closed to foreign oil companies, it is expected that the area will be opened to international bidding.

Reserves

China is among the world leaders in proven deposits of antimony, barite, molybdenum, rare earths, titanium, tungsten, and vanadium. China has 55 billion tons of iron ore, with an average grade of 30% to 35% element content. However, only 5% of the ore reserves contain 35% to 50% iron. Major deposits occur in Anhui, Hebei, Liaoning, and Nei Monggol. Major gold deposits are in Shandong, Henan, Hebei, Heilongjiang, Nei Monggol, Jilin, and Hunan.

With the exception of some commodities such as chromium, cobalt, and potash, China produces significant quantities of a wide array of minerals and metals, based on its production and/or export capability for these commodities.

INFRASTRUCTURE

An inadequate transportation sector is a major factor hurting economic growth in China. China's fuel resources and raw material deposits are in the northern part of the country, and the manufacturing facilities are in the east and southern part of the country. After state quotas are fullfilled, many state-owned enterprises are temporarily idled, either to save energy or because of a shortage of raw material due to delays in shipping.

In 1990, China invested $986 million in large and medium construction projects on 49 new and old railways. A total of 285.5 km of new track was laid out, and 363.2 km of multiple-track railway was put into operation. In 1990, the total length of railways in operation across the nation was 53,340 km, with 6,370 km of electrified lines.

In spite of the rapid progress made during the past decade, China is still rather backward in its railway contruction, possessing only 5.5 m of railways per km^2 of total area and 0.48 km of railways per 10,000 population, only ranking 70th and 100th, respectively, in the world. In addition, there are many areas in the country's northwest, southwest, and even in the coastal areas that remain inaccessible to rail traffic.

TABLE 12

CHINA: COAL OUTPUT AND TRADE, BY ADMINISTRATIVE DIVISION, IN 1989

(Thousand metric tons)

Administrative division	State-owned	Urban collective-owned	Import	Export
Municipality:				
Beijing	6,140	4,030	13,810	2,940
Shanghai	0	0	22,810	0
Tianjin	0	0	12,380	0
Province:				
Anhui	23,610	7,550	8,270	5,470
Fujian	0	9,450	4,330	0
Gansu	6,640	7,510	5,090	1,040
Guangdong	0	9,820	9,080	0
Guizhou	9,420	25,540	10	4,460
Hainan	0	4	690	0
Hebei	39,980	23,250	18,430	0
Heilongjiang	46,600	29,560	4,840	14,420
Henan	42,020	39,620	4,490	22,020
Hubei	0	10,380	16,980	0
Hunan	3,000	33,900	5,520	940
Jiangsu	16,810	7,650	19,740	2,620
Jiangxi	6,580	14,060	4,200	700
Jilin	11,820	12,560	9,260	630
Liaoning	36,380	13,440	23,970	890
Qinghai	0	3,020	1,470	0
Shaanxi	13,490	18,000	2,010	4,560
Shandong	32,740	24,210	11,700	7,800
Shanxi	105,460	169,550	0	136,000
Sichuan	17,980	53,370	820	250
Yunnan	750	21,060	460	0
Zhejiang	0	1,440	11,490	0
Autonomous region:				
Guangxi	0	11,410	3,270	0
Nei Mongol	24,610	19,220	4,500	9,600
Ningxia	9,680	3,710	250	5,280
Xinjiang	4,600	15,600	0	1,600
Xizang	0	7	—	—

The Chinese Government plans to invest \$18.8 billion on construction of a high-efficiency railway transportation system to meet increasing demand in the coming 10 years. The project includes building 3,600 km of multiple track, electrification of 5,600 km of railway, and 6,100 km of new tracks. According to the plan, the project will be carried out in seven phases, as follows:

1. Transportation service for the coal bases in the northern and northwest Provinces of Shanxi, Shaanxi, and Nei Monggolia Autonomous Region will be strengthened. Some of the isolated coalfields will thus be brought into the nationwide railway network.

2. New north-south main lines to relieve the congestion on the three saturated main lines: Jing (Beijing)-Hu (Shanghai), Jing (Beijing)-Guang (Guangzhou), and Jiao (Jiaozuo, Henan Province)-Zhi (Zhicheng, Hunan Province) will be constructed.

3. Electrication of the railways will be completed between Harbin, Heilongjiang Province, and Dalian, Liaoning Province, to meet the needs of the development of China's northwest industrial bases and the booming border trade with the U.S.S.R.

4. Investment in the northwest will focus on broadening the transit capacity through the Shulehe River and Tianshui passes to support further exploration of the oilfields in Xinjiang and the economic development in Gansu and Qinghai.

5. The ongoing electrification of the railway linking the Provinces of Sichuan, Guizhou, and Yunnan will continue. A new line will be built connecting Kunming, Yunnan Province, and Nanning, Guangxi Zhuang Autonomous Region.

6. Due to the booming economics of the eastern coastal provinces, the transprovincial lines in the Provinces of Zhejiang, Jiangsu, Anhui, Fujian, and Hunan will be electrified.

7. The central and local governments will jointly raise funds to construct some local lines that are vital to local economic development to augment the national rail lines.

OUTLOOK

Although China is one of the world's leading producers of metals, industrial minerals, and fuel, it plans to increase production of various commodities in each sector. Since the early 1980's China's consumption of metals and nonmetallic mineral resources grew dramatically with the rapidly growing need for more raw materials by industry. Rates of growth of metals consumption in China between 1981 and 1990 were between two and six times those of the world for cadmium, copper, magnesium, steel, tin, and zinc. Consumption of steel rose at an average annual rate of 8.6% during the 1980's. Comsumption of crude steel is now more than 75 Mmt a year. Aluminium is the major nonferrous metal consumed.

Because the demand for raw materials is higher than supply, China is forced to fill the gap through imports. In 1990, China imported more than 14 Mmt of iron ore and 16 Mmt of fertilizers, 13.9% and 16.8% higher than those of 1989, respectively. Despite an extensive minerals base, constraints on hard currency have forced the Chinese Government to delay capital investments in mine and plant construction and plant expansion as well as to reduce the volume of imported minerals and metals in short supply.

Mineral shortages are foreseen in the 1990's, prompting the Ministry of Geology and Mineral Resources to request a 40% increase over the present national budget to boost surveying activities. To meet the predicted shortfall, China may import up to $200 billion of raw materials cumulatively to the year 2000.

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[1]Where necessary, values have been converted from renminbi (RMB) to U.S. dollars at the rate of RMB5.2 = US$1.00 for 1990.

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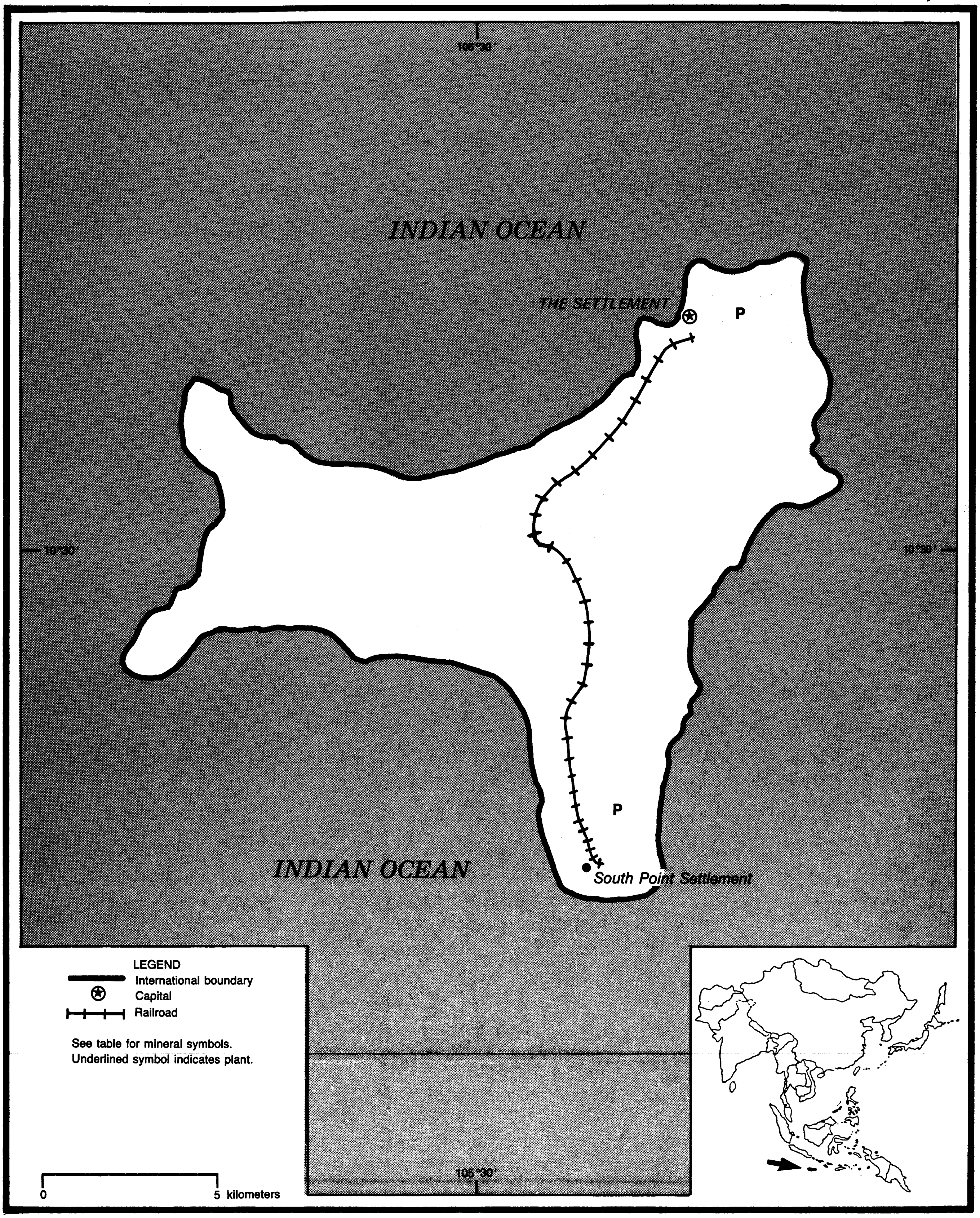
TERRITORY OF CHRISTMAS ISLAND
(Australia)

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.

A contract was awarded near yearend by the Australian Government to a joint-venture company, Phosphate Resources, to renew phosphate mining on the island. The contract requires Phosphate Resources to mine 4 million tons of mostly B-grade rock per year over the next 10 years. The bulk of the material will be exported to Asian markets, with New Zealand having first option to purchase any A-grade material produced and any surplus going to Australia.[1]

Phosphate Resources is owned by Clough Engineering Ltd., 51%; citizens of Christmas Island, 40%; and Saley Investments Pty., 9%.

There is one permanent-surface airport on the island and one shipping port, Flying Fish Cove. Electric generating capacity in 1989 was 11,000 kilowatts.[2]

[1]Industrial Minerals. No. 280, Jan. 1991, p. 8.
[2]U.S. Central Intelligence Agency. The World FactBook 1990, p. 65.

TABLE 1

CHRISTMAS ISLAND: PRODUCTION OF MINERAL COMMODITIES[1]

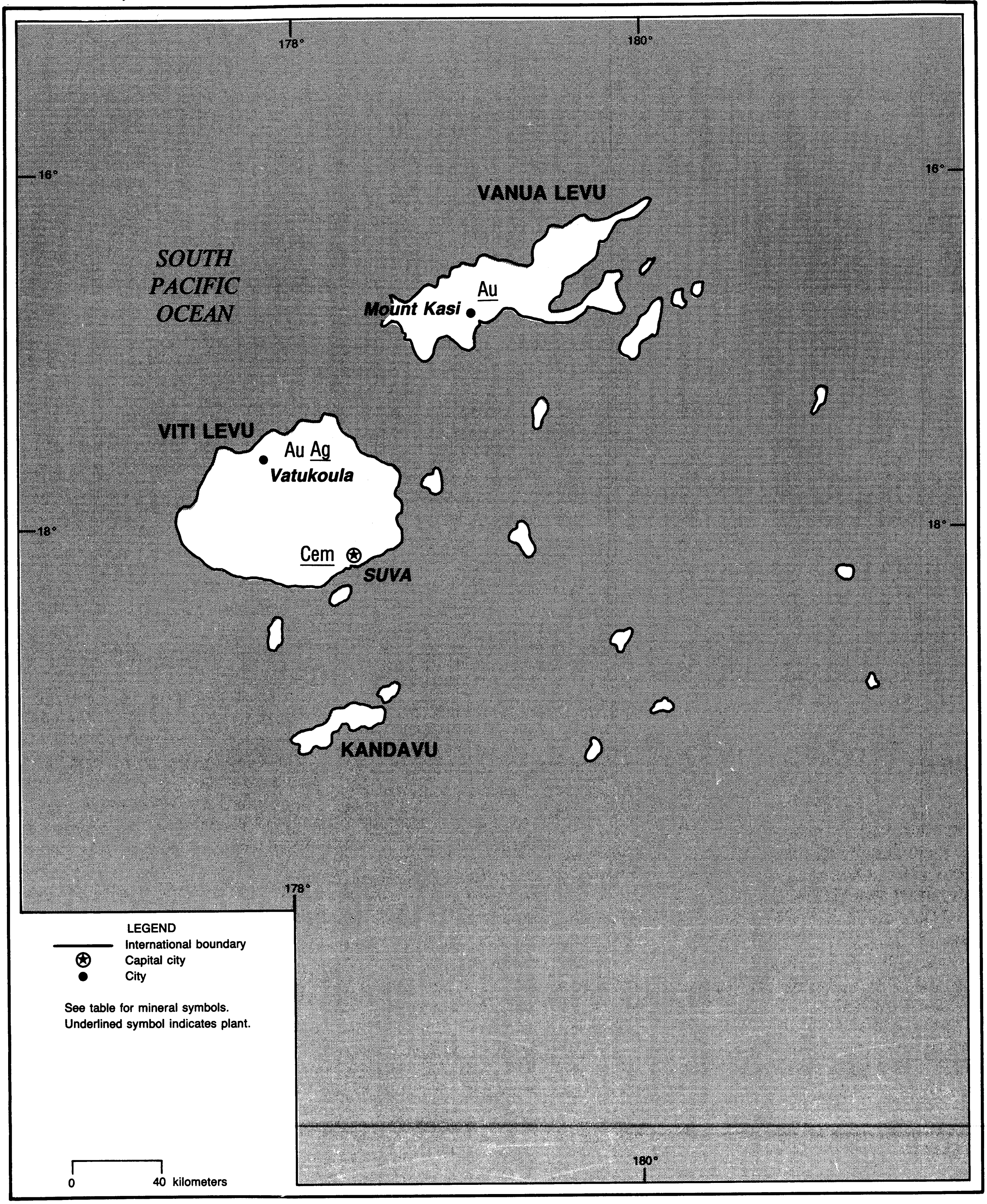
(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990
Phosphate rock, marketable:						
Gross weight	thousand tons	825	842	—	—	—
P_2O_5 content	do.	288	294	—	—	—

[1]Table includes data available through Aug. 2, 1991.
[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.

FIJI

AREA 18,270 km² **POPULATION 760,000**



THE MINERAL INDUSTRY OF FIJI

By Travis Q. Lyday

Fiji's mineral industry consists of two operating gold-silver mines, the Emperor, or Vatukoula, and the 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

The Government, through the Fiji Mineral Resources Department, was negotiating with Placer Exploration Ltd., a wholly owned subsidiary of Australia's Placer Pacific Ltd., to reexamine the copper and gold deposits at Namosi in southern Viti Levu.

PRODUCTION

The value of mine production as a contribution to the Fijian economy decreased in 1990. Gold production continued to be the dominant minerals industry business, but only accounted for less than 1% 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 Tavua Basin Mine, about 2.5 kilometers (km) south of the main Emperor workings.

TRADE

The value of unrefined gold and silver declined, becoming Fiji's third largest export, after sugar and tourism, and represented about 13% of export earnings.

STRUCTURE OF THE MINERAL INDUSTRY

The main mineral industry of Fiji is the underground/opencut gold operations at the Emperor (Vatukoula) and Tavua Basin Mines at Vatukoula, about 100 km northwest of the capital at Suva on Viti Levu Island. Both mines produce silver as a byproduct and, until 1980, the Emperor Mine 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

Both the Emperor and Tavua Basin mine sites are managed and operated by Western Mining Corp. (Fiji) Ltd. (WMCF), a wholly owned subsidiary of Australia's Melbourne-based Western Mining Corp. Holdings Ltd. (WMC). WMCF entered into a joint venture with Emperor Gold Mining Co. Ltd. (EGM), a subsidiary of the United Kingdom—registered Emperor Mines Ltd., in 1983 and holds a 20% share in the Emperor Mine. It also holds a 50% interest in the Tavua Basin Mine, with EGM owning the remainder.

At yearend, WMC announced it was selling all of its Fijian gold operations held through its subsidiary WMCF to EGM. Owing to recognition of the inefficiency and unnecessary complexity created by the differing percentage ownership of their joint ventures, the partners thought the situation would be best resolved by a single ownership. EGM would take over as manager-operator, with WMCF providing technical and managerial services for 3 years.[1]

EGM announced in July the formation of Fiji Mint Ltd. to mint legal-tender gold coins from unrefined gold mined from the Emperor Mine. The Fiji Development Bank was to take up 20% of the shares of Fiji Mint at no cost. The minted coins were to include denominations of F$100,[2] F$50, and F$25 containing one ounce, one-half ounce, and one-quarter ounce of gold, respectively.[3]

The Metal Mining Agency of Japan provided $2 million[4] for a 3-year mineral survey of the main island of Viti Levu as part of a 15-country program it is carrying out in developing countries.[5]

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, and associated silver, 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 Viti Levu, and Newmont Pty. Ltd. and Range Resources Ltd. 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.[6]

INFRASTRUCTURE

Essential elements of the islands' infrastructure include 644 km of narrow-gauge railroad belonging to the Government-owned Fiji Sugar Corp.; 3,300 km of roads,

TABLE 1

FIJI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	1988	1989	1990[p]
Cement, hydraulic	92,278	[r]58,700	44,200	58,000	[e]80,000
Gold, mine output, Au content kilograms	2,952	2,962	4,273	4,221	4,115
Lime[2]	2,305	—	—	[e]2,000	—
Silver, mine output, Ag content kilograms	531	843	995	1,055	775
Stone, sand and gravel:					
Coral sand for cement manufacture	[e]160,900	[e]85,585	65,114	82,487	175,492
River sand for cement manufacture	[e]39,500	[e]24,250	14,157	25,365	22,661
River sand and gravel, n.e.s. cubic meters	[e]577,500	254,713	210,000	230,780	838,756
Quarried stone do.	[e]160,000	66,832	49,711	65,849	152,455

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Aug. 2, 1991.
[2]Produced from an unreported amount of domestically quarried limestone.

TABLE 2

FIJI: STRUCTURE OF THE MINERAL INDUSTRY

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Cement	Fiji Industries Ltd., owner and operator, 100%	Suva, Viti Levu	105
Gold	Western Mining Corp. (Fiji) Ltd., operator and manager, 20%; and Emperor Gold Mining Co. Ltd., 80%	Vatukoula, Viti Levu	[1]625
Do.	Western Mining Corp. (Fiji) Ltd., operator and manager, 50%; and Emperor Gold Mining Co. Ltd., 50%	Tavua Basin, Viti Levu	[2]1,710

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

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 1989 was reportedly 215,000 kilowatts, about 440 kWh per capita.[7]

Generally, infrastructure for mineral industry operations is 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 of 18,000 square km was under active exploration and governed by more than 80 exploration licenses—a level of tenements as high as it has ever been. Production of gold has increased significantly in the years since the coups and is expected to increase in the near term as the Tavua Basin Mine continues to be developed.

[1]Mining Journal (London). V. 316, No. 8105, Jan. 18, 1991, p. 51.
[2]One Fijian dollar (F$) equals approximately US$0.67.
[3]South Seas Digest (Sydney). V. 10, No. 9, July 20, 1990, p. 3.
[4]Where necessary, values have been converted from the Fijian dollar (F$) to U.S. dollars at the rate of F$1.49=US$1.00.
[5]Pacific Islands Monthly (Suva, Fiji). V. 60, No. 10, Oct. 1990, p. 35.
[6]Australian Journal of Mining (Richmond North, Australia). V. 4, No. 37, Oct. 1989, p. 64.
[7]U.S. Central Intelligence Agency. The World Fact Book 1990, p. 100.

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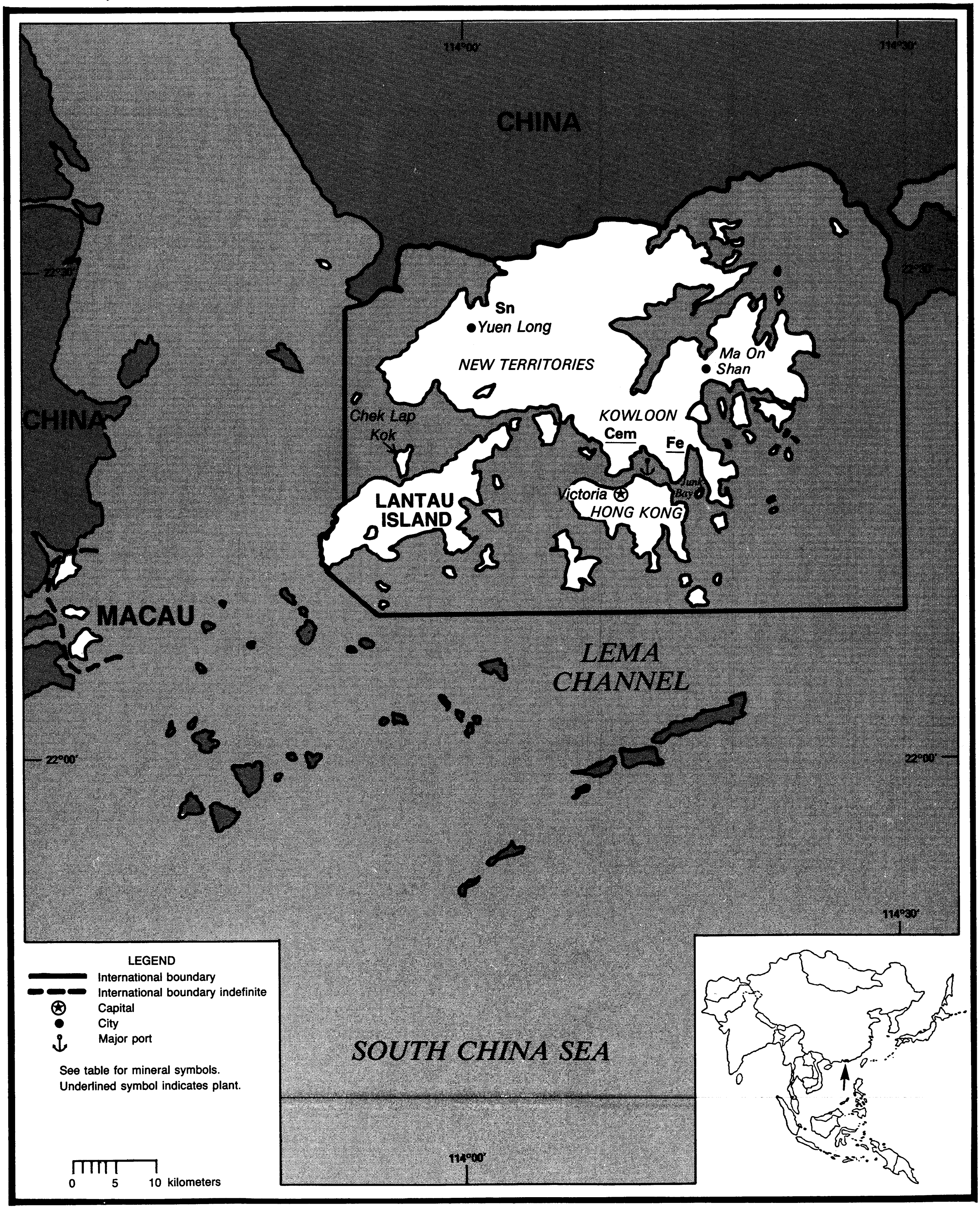
Department of Mineral Resources
Private Mail Bag
Suva, Fiji
Telephone: 383 611
Fax: 370 039

HONG KONG AND MACAU

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



THE MINERAL INDUSTRY OF HONG KONG AND MACAU

By Pui-Kwan Tse

Because of its limited natural resources, Hong Kong and Macau derived its requirements—food, fuel, capital goods, materials, and water—from other countries. Light industry was the bulwark of the economy for these countries. Hong Kong is an important shipping, marketing, and finance center in Asia. In the past 5 years, Hong Kong's competitiveness in the manufacturing of light consumer goods has slipped inasmuch as wages have increased and much of the production has shifted to southern China, mostly in Guangdong Province. About 70% of foreign investment in Guangdong Province comes from Hong Kong and Macau registered companies.

Hong Kong ranks behind Singapore as the second largest container port in the world. It became an important port to China when China began its open door policy to the West a decade ago. In 1990, more than one-fourth of the $82.1[1] billion total export value of goods shipped from Hong Kong went to China. More than one-third of the $82.5 billion of Hong Kong's total imports came from China, and most of these were for reexport to Western countries. The United States was Hong Kong's largest export market, second largest for reexport, and fourth largest supplier for imports behind China, Japan, and Taiwan. The metals industry accounted for only a small proportion of the total trade value. In 1990, the total metal industry trade value was $4 billion. Metals trade was mainly ferrosilicon, aluminum ingot, and steel products.

In April 1990, the Chinese authorities in Beijing formally approved the Draft Basic Law setting the constitutional framework under which Hong Kong, as a Special Administrative Region within China, will be governed after July 1, 1997. The Basic Law provides for Hong Kong to exercise a high degree of autonomy for 50 years up to the year 2047, except in specific areas such as foreign affairs and defense, with the current economic system remaining basically unchanged. However, following the 1989 political disturbances in China, there was concern that Hong Kong will not be able to exercise the principle of "one country, two systems" after 1997. This concern is reflected by the increase in the number of skilled professionals and middle managers emigrating to the Australia, Canada, and the United States.

The mineral industry of Hong Kong is insignificant compared to the textile and plastic sectors. In 1990, a Hong Kong-based metals trading company, Mainland Metals and Minerals, had begun operation of a tin smelter in Yuen Long. Currently, the plant produces 400 tons of tin metal per month from two electric furnaces. When fully operational, the output from the two furnaces is expected to reach 600 mt/month. The company plans to add a third furnace to increase its total production capacity to 1,000 mt/month. The smelter was designed to process mainly Chinese "dirty" concentrates, but an undertermined proportion of clean material would be added for blending purposes.

Hong Kong's economy slowed in 1990; the annual rate of growth of the GDP was 2.4%. Higher wages and inflation contributed to the slower growth by reducing Hong Kong's competitivenes as a low-cost manufacturing center for textiles, toys, watches, and electronics. Many of these goods are now produced in southern China or Southeast Asia.

Hong Kong employs the latest equipment in telecommunications and plans to open its market even further to advanced telecommunications services. The breakthrough agreement between Britain and China on the $16.7 billion airport construction has contributed to the rebuilding of the deep confidence in the colony's financial and political future. These may hone the competitive edge that Hong Kong's service sector needs to continue to thrive in the 1990's.

[1]Where necessary, values have been converted from Hong Kong dollar (HK$) to U.S. dollars at the rate of HK$7.8=US$1.00 for 1990.

TABLE 1

HONG KONG: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
Cement, hydraulic	thousand tons	2,236	2,226	2,189	2,141	1,808
Clays:						
Kaolin		850	—	—	—	—
Other		68,737	92,504	61,888	44,562	16,587
Feldspar		35,208	22,853	11,050	5,152	3,820
Iron and steel: Metal: Steel, crude[e]		[r]260,000	[r]280,000	[r]300,000	320,000	350,000
Quartz		33	—	—	—	—

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

[1]Table includes data available through Aug. 6, 1991.

[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.

TABLE 2

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

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS				
Alkali and alkaline-earth metals	176	165	—	France 106; Taiwan 35; Republic of Korea 8.
Aluminum:				
Ore and concentrate	15,010	16,654	—	Taiwan 12,274; Indonesia 3,522; Republic of Korea 708.
Oxides and hydroxides	20,137	133,729	—	Taiwan 80,000; Republic of Korea 40,153; China 12,560.
Metal including alloys:				
Scrap	31,928	30,240	233	Japan 23,091; China 4,716.
Unwrought	77,616	26,412	12	China 10,454; Republic of Korea 3,146; Thailand 2,719.
Semimanufactures	48,511	51,176	2,763	China 34,376; Taiwan 5,715.
Arsenic: Oxides and acids	574	228	75	New Zealand 53; Indonesia 45.
Beryllium: Metal including alloys, all forms value, thousands	$1			
Chromium: Oxides and hydroxides	544	755	92	Taiwan 179; China 133.
Cobalt: Oxides and hydroxides	14	33	—	China 20; Singapore 8.
Columbium and tantalum: Tantalum metal including alloys, all forms	7	8	—	Mainly to West Germany.
Copper:				
Oxides and hydroxides	384	252	—	China 247; West Germany 5.
Sulfate	445	1,367	105	Republic of Korea 487; Australia 298.
Metal including alloys:				
Scrap	62,368	69,625	88	China 32,388; Japan 16,215.
Unwrought	32,888	6,598	21	China 4,193; Taiwan 1,430.
Semimanufactures	40,474	40,964	192	China 34,676; Taiwan 1,283.
Gold:				
Waste and sweepings value, thousands	$10,652	$6,795	$168	Australia $3,272; Taiwan $1,240.
Metal including alloys, unwrought and partly wrought kilograms	23,333	15,112	35	Vietnam 4,582; United Kingdom 2,962; Thailand 2,502.
Iron and steel: Metal:				
Scrap	428,310	474,286	33	Taiwan 214,880; Indonesia 107,293.
Pig iron, cast iron, related materials	5,634	1,770	—	China 1,259; Taiwan 460.
Ferroalloys:				
Ferromanganese	4,297	8,585	100	Taiwan 2,147; North Korea 2,000.
Ferrosilicon	82,494	38,408	100	Republic of Korea 13,066; Taiwan 10,079.
Unspecified	9,753	18,697	388	Indonesia 5,279; Japan 4,229.
Steel, primary forms	34,934	7,444	—	Taiwan 7,229; Thailand 215.
Semimanufactures:				
Bars, rods, angles, shapes, sections	201,360	177,743	23	China 96,190; Macau 38,511.
Universals, plates, sheets	320,449	342,105	1	China 308,954.
Hoop and strip	85,997	94,156	43	China 88,929.
Rails and accessories	468	1,238	—	North Korea 850; Taiwan 366.
Wire	28,335	35,949	11	China 31,887.
Tubes, pipes, fittings	39,388	47,275	198	China 31,370; Japan 3,649.
Castings and forgings, rough	3,245	3,930	1,095	Taiwan 1,614; China 864.
Lead:				
Ore and concentrate	143	5,083	—	All to China.
Oxides	295	152	—	Indonesia 100; China 32; Australia 20.

See footnotes at end of table.

TABLE 2—Continued

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

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS—Continued					
Lead:—Continued					
Metal including alloys:					
Scrap		3,266	3,476	—	China 3,083; Taiwan 331.
Unwrought		5,691	2,071	—	China 1,910; Republic of Korea 63; Thailand 51.
Semimanufactures		98	165	—	China 130; Macau 14.
Magnesium: Metal including alloys:					
Scrap		12	6	—	All to Japan.
Unwrought		292	157	—	China 100; India 37; Taiwan 20.
Manganese:					
Ore and concentrate		629	461	—	All to Republic of Korea.
Oxides		3,199	3,949	—	Republic of South Africa 898; Nigeria 811; China 531.
Mercury		81	73	—	Australia 36; Netherlands 17; China 7.
Molybdenum: Metal including alloys:					
Unwrought		26	15	4	Taiwan 10.
Nickel:					
Oxides and hydroxides		39	81	—	Republic of Korea 63; Philippines 4; Singapore 4.
Metal including alloys:					
Scrap		526	252	—	China 150; Philippines 92; Japan 7.
Unwrought		4,979	5,301	62	Taiwan 1,191; Singapore 1,108; Netherlands 1,090.
Semimanufactures		135	159	—	China 128; Taiwan 23.
Platinum-group metals:					
Waste and sweepings	value, thousands	$5,994	$10,773	$8,137	United Kingdom $2,399.
Metals including alloys, unwrought and partly wrought	kilograms	2,217	1,101	75	China 335; Taiwan 212; Japan 167.
Silver:					
Waste and sweepings	value, thousands	$30,364	$6,410	—	United Kingdom $2,786; West Germany $2,216.
Metal including alloys, unwrought and partly wrought	kilograms	45,332	42,361	360	Taiwan 16,615; Thailand 7,903; China 7,754.
Tin:					
Ore and concentrate		16,248	18,449	211	Malaysia 4,246; Mexico 3,745; China 3,679.
Oxides	kilograms	2,000	146	—	All to China.
Metal including alloys:					
Scrap		61	122	—	Taiwan 95; Philippines 12.
Unwrought		3,149			
Semimanufactures		706			
Titanium: Oxides		13,210	14,544	684	China 5,297; India 1,537; Netherlands 1,127.
Tungsten:					
Ore and concentrate		2,008	3,925	1,437	Republic of Korea 1,304; Singapore 276.
Metal including alloys:					
Scrap		29	8	—	Netherlands 5; Singapore 3.
Unwrought and semimanufactures		7			
Uranium and thorium: Oxides and other compounds		98	321	11	Japan 178; France 45; China 41.
Zinc:					
Ore and concentrate		—	7,042	—	Republic of Korea 4,163; China 2,879.
Oxides		3,747	9,046	1,642	China 1,577; Netherlands 1,518.
Blue powder		102	42	—	Japan 18; Taiwan 18.

See footnotes at end of table.

TABLE 2—Continued

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

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
METALS—Continued					
Zinc:—Continued					
Metal including alloys:					
Scrap		1,105	3,911	—	China 3,612; Japan 177.
Unwrought		29,924	37,922	361	China 14,772; Japan 8,704; Republic of Korea 8,247.
Semimanufactures		130	332	—	China 316; Taiwan 11.
Other:					
Ores and concentrates		5,115	12,891	230	Taiwan 3,666; Malaysia 1,870; Thailand 1,279.
Metalloids, unspecified[2]		36,276	24,287	3,718	Japan 5,246; United Kingdom 2,774.
Ashes and residues		2,235	4,385	—	China 3,818; Taiwan 214.
Base metals including alloys, all forms		9,265	5,943	215	Republic of Korea 2,189; China 2,046.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		19,872	28,394	—	Japan 17,242; Macau 5,716; India 776.
Artificial:					
Corundum		40,010	39,384	276	Taiwan 15,296; Republic of Korea 12,843.
Silicon carbide		5,786	6,620	994	Taiwan 2,140; Indonesia 1,132.
Dust and powder of precious and semiprecious stones including diamond	value, thousands	$776	$2,388	$352	Republic of Korea $778; Taiwan $501.
Grinding and polishing wheels and stones		3,336	3,126	99	Indonesia 1,073; China 803.
Asbestos, crude		187	23	—	All to China.
Barite and witherite		5,941	5,400	209	Japan 1,264; Republic of South Africa 1,017; Republic of Korea 771.
Boron materials: Oxides and acids		3,011	299	—	China 165; North Korea 33,653; Philippines 13,516.
Cement	thousand tons	967	922	—	Macau 549; China 359.
Chalk		1			
Clays, crude:					
Kaolin		263,611	325,633	—	Taiwan 262,680; Republic of Korea 33,653; Philippines 13,516.
Unspecified		20,457	31,896	—	Taiwan 24,680; Republic of Korea 4,990; Indonesia 1,848.
Diamond: Natural:					
Gem, not set or strung	carats	1,247,673	1,590,197	361,100	Belgium-Luxembourg 464,377; Thailand 213,787.
Industrial stones	do.	122,784	117,865	16	Belgium-Luxembourg 53,141; Italy 22,750.
Diatomite and other infusorial earth		1,440	1,972	8	China 1,852; India 44.
Feldspar, fluorspar, related materials		79,524	105,673	—	Taiwan 85,384; Indonesia 12,487; Republic of Korea 7,063.
Fertilizer materials:					
Crude, n.e.s.		259	175	—	China 137; Taiwan 19; Japan 11.
Manufactured:					
Ammonia		919	145	—	China 102; Republic of Korea 20.
Nitrogenous		53,981	92,804	—	All to China.
Phosphatic		181			
Potassic		5,100	273	—	Do.
Unspecified and mixed		100,954	4,972	—	China 4,884; Vietnam 37.
Graphite, natural		3,930	3,840	177	Taiwan 2,196; Republic of Korea 929.
Gypsum and plaster		2,928	19,859	7	Macau 16,849; China 1,997.
Iodine	kilograms	15,201	12,763	—	China 11,180; North Korea 1,450.
Lime		5	30	—	All to China.

See footnotes at end of table.

TABLE 2—Continued

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

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989 United States	Destinations, 1989 Other (principal)
INDUSTRIAL MINERALS—Continued				
Magnesium compounds:				
Magnesite, crude	33,371	22,380	—	Taiwan 12,569; Indonesia 5,432; Republic of South Africa 2,216.
Oxides and hydroxides	8,734	6,229	—	China 2,273; Republic of Korea 1,550; Taiwan 1,409.
Mica:				
Crude including splittings and waste	751	1,135	—	Taiwan 800; Indonesia 301.
Worked including agglomerated splittings	362	456	6	China 427; Indonesia 15.
Nitrates, crude	1,000	394	—	India 144; Indonesia 60; Philippines 57.
Pigments, mineral:				
Natural, crude	457	268	—	Indonesia 225; Dominican Republic 43.
Iron oxides and hydroxides, processed	6,364	9,565	—	China 2,082; Egypt 1,983; Indonesia 1,856.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$172,617	$222,660	$46,559	Japan $76,663; Thailand $39,320.
Synthetic do.	$1,580	$3,553	$584	China $694; Taiwan $669.
Salt and brine	1,757	4,745	—	China 4,604; Papua New Guinea 82.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	108,458	191,156	—	China 191,025; Republic of South Africa 80.
Sulfate, manufactured	23,993	9,899	—	Republic of Korea 3,630; Indonesia 1,644; Australia 1,148.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	25,642	63,337	962	Taiwan 46,306; China 5,731.
Worked	15,477	16,051	1,507	China 7,288; Taiwan 2,167.
Dolomite, chiefly refractorygrade	69			
Gravel and crushed rock	6,058	4,345	—	China 1,884; Taiwan 1,862.
Limestone other than dimension	955	2,175	—	China 1,958; Republic of South Africa 117.
Quartz and quartzite	1,771	4,010	—	Taiwan 3,944; Cote d'Ivoire 25.
Sand other than metal-bearing	582	3,622	—	Taiwan 2,824; China 770.
Sulfur:				
Elemental:				
Crude including native and byproduct	54			
Colloidal, precipitated, sublimed	169	169	—	Sri Lanka 60; China 39; Indonesia 25.
Sulfuric acid	301	373	—	China 362.
Talc, steatite, soapstone, pyrophyllite	50,559	50,991	—	Taiwan 35,321; Indonesia 12,038; Republic of Korea 1,680.
Other:				
Crude	3,780	4,433	—	Taiwan 3,168; Republic of Korea 1,119; China 101.
Slag and dross, not metalbearing	87	35	([3])	Mainly to China.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	51	10	—	Mainly to China.
Carbon black	7,028	6,463	—	Indonesia 3,626; Taiwan 1,387; Zimbabwe 583.
Coal: Anthracite	66			
Coke and semicoke	373	70	—	All to Philippines.
Petroleum refinery products:				
Liquefied petroleum gas thousand 42-gallon barrels	192	324	—	China 254; Macau 70.
Gasoline do.	265	737	—	China 626; Macau 111.

See footnotes at end of table.

TABLE 2—Continued

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

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum refinery products:—Continued					
Mineral jelly and wax	do.	208	238	—	Republic of South Africa 73; Taiwan 40; Republic of Korea 28.
Kerosene and jet fuel	do.	58	355	—	Singapore 200; Japan 73; China 60.
Distillate fuel oil	do.	3,056	9,150	—	China 8,964; Macau 185.
Lubricants	do.	571	748	([3])	China 559; Taiwan 101.
Nonlubricating oils	do.	257	24	—	Indonesia 17; China 5.
Residual fuel oil	do.	3,812	5,954	—	China 4,898; Macau 902; Japan 153.
Bitumen and other residues	do.	3	4	—	Macau 3.
Bituminous mixtures	do.	1	1	—	China ([3]); Macau ([3]).

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

TABLE 3

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
METALS					
Alkali and alkaline-earth metals		380	357	([2])	Mainly from China.
Aluminum:					
Ore and concentrate		16,471	17,289	—	China 17,075; United Kingdom 214.
Oxides and hydroxides		84,029	182,850	1,343	China 106,025; Japan 75,305.
Metal including alloys:					
Scrap		5,512	5,660	1,434	China 2,314; Macau 602.
Unwrought		111,187	52,889	2,675	China 17,010; Canada 13,289.
Semimanufactures		82,629	81,784	12,593	Japan 12,405; Taiwan 11,681.
Arsenic: Oxides and acids		471	327	—	China 226; North Korea 100.
Beryllium: Metal including alloys, all forms	value, thousands	$22	$162	—	China $161; Japan $1.
Chromium: Oxides and hydroxides		1,090	1,279	60	China 786; West Germany 216.
Cobalt: Oxides and hydroxides		32	164	—	West Germany 140; China 22.
Columbium and tantalum: Tantalum metal including alloys all forms		17	2	([2])	Mainly from China.
Copper:					
Oxides and hydroxides		375	371	38	Norway 135; Italy 108.
Sulfate		923	1,644	18	China 1,141; France 225.
Metal including alloys:					
Scrap		22,409	33,759	12,159	China 14,082; Taiwan 2,842.
Unwrought		30,542	9,207	1,283	China 2,292; Australia 1,060.
Semimanufactures		120,028	111,887	2,652	Japan 29,412; Taiwan 25,446.

See footnotes at end of table.

TABLE 3—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989 United States	Sources, 1989 Other (principal)
METALS—Continued					
Gold:					
Waste and sweepings	value, thousands	$1,750	$5,749	$4,912	Malaysia $461; China $297.
Metal including alloys, unwrought and partly wrought	kilograms	464,257	439,173	70,806	Switzerland 133,001; United Kingdom 98,636.
Iron and steel: Metal:					
Scrap		86,071	76,445	5,686	China 53,967; Vietnam 9,379.
Pig iron, cast iron, related materials		9,027	5,323	90	North Korea 3,442; China 669.
Ferroalloys:					
Ferromanganese		8,731	8,923	—	China 8,023; Republic of South Africa 700.
Ferrosilicon		96,300	35,836	—	China 31,975; Taiwan 1,688.
Unspecified		13,433	21,319	—	China 20,006; Republic of South Africa 1,212.
Steel, primary forms		189,684	108,297	—	Brazil 75,990; Republic of South Africa 20,028.
Semimanufactures:					
Bars, rods, angles, shapes, sections		1,676,643	1,279,432	207	Brazil 314; China 204; Republic of South Africa 112.
Universals, plates, sheets		1,388,158	824,335	33,403	Japan 424,000; Taiwan 58,514.
Hoop and strip		96,097	64,135	1,044	Japan 47,345; China 3,238.
Rails and accessories[3]		2,892	2,292	—	Republic of Korea 1,350; China 366.
Wire		79,655	82,015	186	China 39,356; Republic of Korea 8,842.
Tubes, pipes, fittings		223,076	209,871	814	China 66,815; Japan 43,910.
Castings and forgings, rough		20,947	25,007	102	China 24,303; United Kingdom 215.
Lead:					
Ore and concentrate		50	5,146	—	All from China.
Oxides		406	271	—	China 217; West Germany 16.
Metal including alloys:					
Scrap		1,461	2,241	105	Japan 1,149; Canada 282.
Unwrought		7,781	5,543	148	Australia 1,582; China 1,452.
Semimanufactures		227	220	9	China 60; Republic of South Africa 59.
Magnesium: Metal including alloys:					
Unwrought		322	56	—	China 32; North Korea 20.
Semimanufactures	value, thousands	$1	$2	$1	West Germany $1.
Manganese:					
Ore and concentrate		629	580	—	All from China.
Oxides		4,816	3,336	16	China 2,080; Japan 476.
Mercury		158	80	([2])	China 75; United Kingdom 3.
Molybdenum: Metal including alloys, all forms		61	5	—	All from China.
Nickel:					
Oxides and hydroxides		150	78	41	China 36.
Metal including alloys:					
Scrap		222	63	—	Taiwan 38; China 14; United Kingdom 11.
Unwrought		7,026	6,078	85	Norway 2,214; China 1,921.
Semimanufactures		181	250	6	Canada 50; France 50.
Platinum-group metals:					
Waste and sweepings	value, thousands	$3,388	$2,843	—	Republic of Korea $2,718; China $92.
Metals including alloys, unwrought and partly wrought	kilograms	3,318	2,085	63	United Kingdom 745; West Germany 451.
Silver:					
Waste and sweepings	value, thousands	$637	$159	$125	Philippines $21; Taiwan $10.

See footnotes at end of table.

TABLE 3—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
METALS—Continued					
Silver:—Continued					
Metal including alloys, unwrought and partly wrought	kilograms	87,375	173,327	14,215	West Germany 40,450; Canada 26,403.
Tin:					
Ore and concentrate		18,308	20,457	—	All from China.
Oxides		1	100	—	Do.
Metal including alloys:					
Scrap		90	132	—	China 63; Malaysia 63.
Unwrought		6,152	6,877	5	China 6,580; Malaysia 97.
Semimanufactures		1,030	1,725	8	China 1,105; Singapore 383.
Titanium: Oxides		20,906	24,014	4,266	China 10,808; Australia 3,397.
Tungsten:					
Ore and concentrate		1,419	3,658	—	All from China.
Metal including alloys:					
Scrap		27	3	—	Do.
Semimanufactures		12	14	2	China 8; Japan 3.
Uranium and thorium: Oxides and other compounds		154	620	24	China 542; Spain 16.
Zinc:					
Ore and concentrate		19	6,435	—	All from China.
Oxides		4,151	10,692	7	China 9,256; Republic of Korea 438.
Blue powder		160	97	4	West Germany 36; Republic of Korea 22.
Metal including alloys:					
Scrap		1,176	3,647	810	China 1,939; Taiwan 85.
Unwrought		65,499	55,237	331	China 22,230; Australia 9,009.
Semimanufactures		590	666	1	West Germany 152; Belgium-Luxembourg 131.
Other:					
Ores and concentrates		6,669	17,401	—	China 17,012; Malaysia 100.
Metalloids, unspecified[4]		31,524	23,327	118	China 22,746; U.S.S.R. 171.
Ashes and residues		8,748	8,290	128	China 7,450; Netherlands 185.
Base metals including alloys, all forms		11,101	15,744	1	China 15,191; Republic of South Africa 162.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		62,549	88,796	528	Indonesia 79,283; China 3,484.
Artificial:					
Corundum		42,455	39,925	338	China 38,402; Japan 629.
Silicon carbide		5,419	6,026	72	China 5,911; Norway 17.
Dust and powder of precious and semi-precious stones including diamond	value, thousands	$413	$601	$41	United Kingdom $448; Ireland $31.
Grinding and polishing wheels and stones		5,164	4,608	260	China 2,580; Japan 633.
Asbestos, crude		221	78	—	All from Canada.
Barite and witherite		6,450	6,703	—	China 6,379; Japan 182; Thailand 72.
Boron materials: Oxides and acids		3,280	737	355	China 181; Italy 180.
Bromine including fluorine		5	—		
Cement	thousand tons	4,738	4,814	([2])	Japan 2,708; Republic of Korea 765.
Chalk		—	8	8	

See footnotes at end of table.

TABLE 3—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989 United States	Sources, 1989 Other (principal)
INDUSTRIAL MINERALS—Continued					
Clays, crude:					
Kaolin		265,948	388,503	1,302	China 380,932; Taiwan 2,542.
Unspecified		56,351	53,934	1,851	China 47,058; France 3,953.
Diamond: Natural:					
Gem, not set or strung	thousand carats	3,008	3,115	205	India 1,400; Israel 640; Belgium-Luxembourg 543.
Industrial stones	do.	654	227	16	Netherlands 109; Belgium-Luxembourg 101.
Diatomite and other infusorial earth		2,330	2,716	1,564	China 1,070; Taiwan 38.
Feldspar, fluorspar, related materials		85,947	126,087	—	China 125,810; Indonesia 150.
Fertilizer materials:					
Crude, n.e.s.		802	1,103	54	Netherlands 467; West Germany 407.
Manufactured:					
Ammonia		3,496	3,050	1	China 2,926; United Kingdom 55.
Nitrogenous		84,077	71,929	103	Saudi Arabia 22,714; U.S.S.R. 19,759.
Phosphatic		264	—		
Unspecified and mixed		80,268	10,969	197	West Germany 8,501; Taiwan 1,541.
Graphite, natural		2,995	4,593	—	China 4,575; Republic of Korea 18.
Gypsum and plaster		113,482	132,623	1,375	Thailand 96,585; Australia 22,400.
Iodine	kilograms	15,800	11,940	1,000	Netherlands 8,000; Belgium-Luxembourg 1,500.
Lime		46,059	35,458	—	China 35,437; Taiwan 16.
Magnesium compounds:					
Magnesite, crude		37,176	22,759	—	China 20,799; Taiwan 1,042; Indonesia 796.
Oxides and hydroxides		10,287	7,611	—	China 7,306; France 159; Singapore 80.
Mica:					
Crude including splittings and waste		68	317	1	China 263; United Kingdom 51.
Worked including agglomerated splittings		1,722	1,708	—	Belgium-Luxembourg 823; Japan 381; France 266.
Nitrates, crude		1,328	814	18	China 556; Belgium-Luxembourg 240.
Phosphates, crude		35	—		
Pigments, mineral:					
Natural, crude		791	211	—	China 192; Japan 15.
Iron oxides and hydroxides, processed		9,594	11,441	1,196	China 7,092; Japan 1,685.
Potassium salts, crude		—	5	—	All from China.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$145,056	$155,285	$24,056	Thailand $33,903; India $25,092.
Synthetic	do.	$3,734	$7,300	$163	China $2,105; Japan $1,888.
Salt and brine		131,362	156,456	132	China 133,446; West Germany 7,923.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		163,896	245,300	142,924	China 50,815; West Germany 23,511.
Sulfate, manufactured		68,407	63,302	—	China 60,933; Taiwan 2,200.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		41,539	71,162	—	China 65,417; Taiwan 3,012; Italy 2,341.
Worked		70,583	79,106	127	Italy 50,419; China 13,173.
Dolomite, chiefly refractory-grade		—	220	—	All from United Kingdom.
Gravel and crushed rock	thousand tons	6,754	6,937	—	China 6,931; Philippines 4.
Limestone other than dimension		31,564	43,244	—	China 43,043; Taiwan 100.
Quartz and quartzite		2,011	2,267	—	China 2,165; West Germany 54.

See footnotes at end of table.

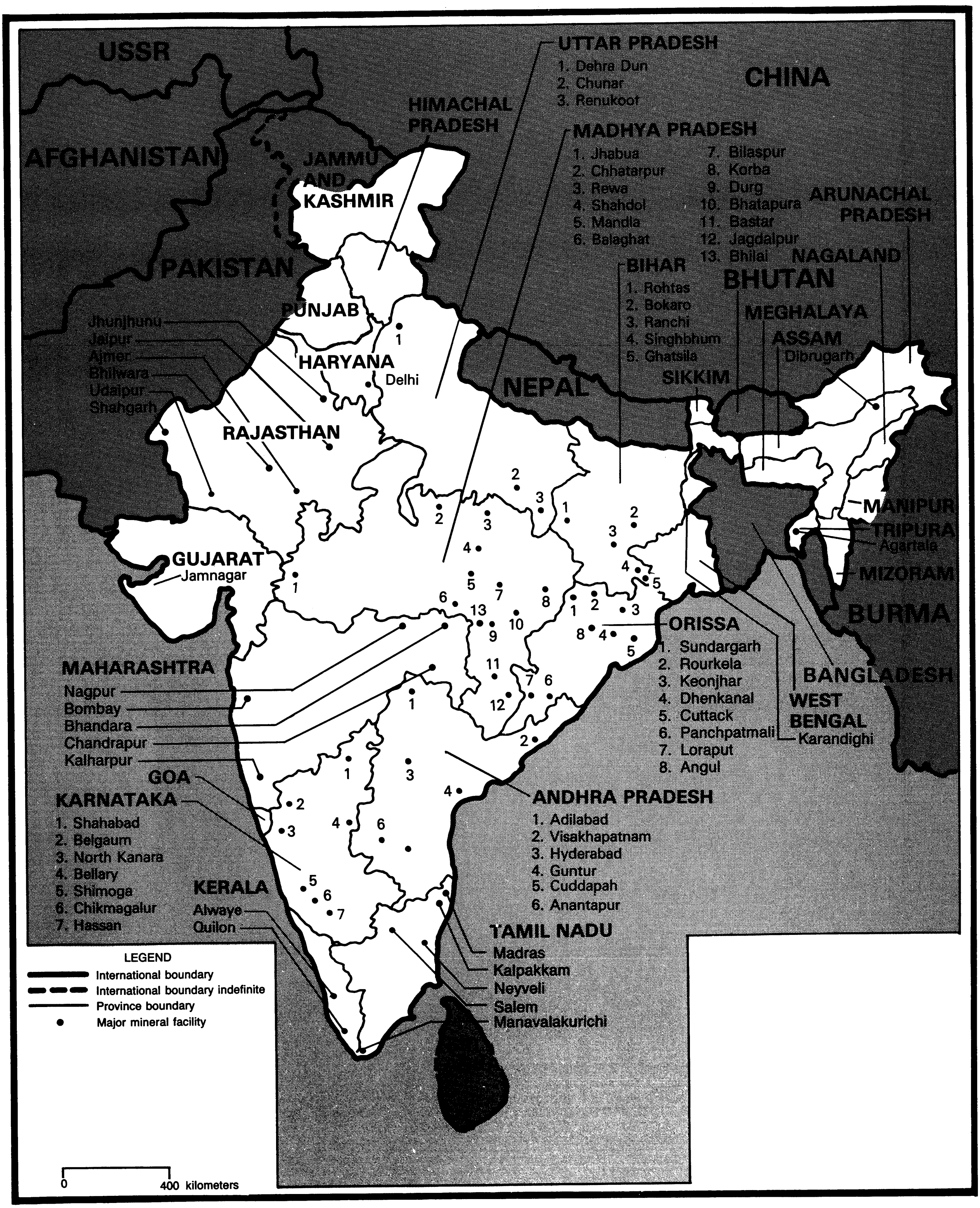
TABLE 3—Continued

HONG KONG: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

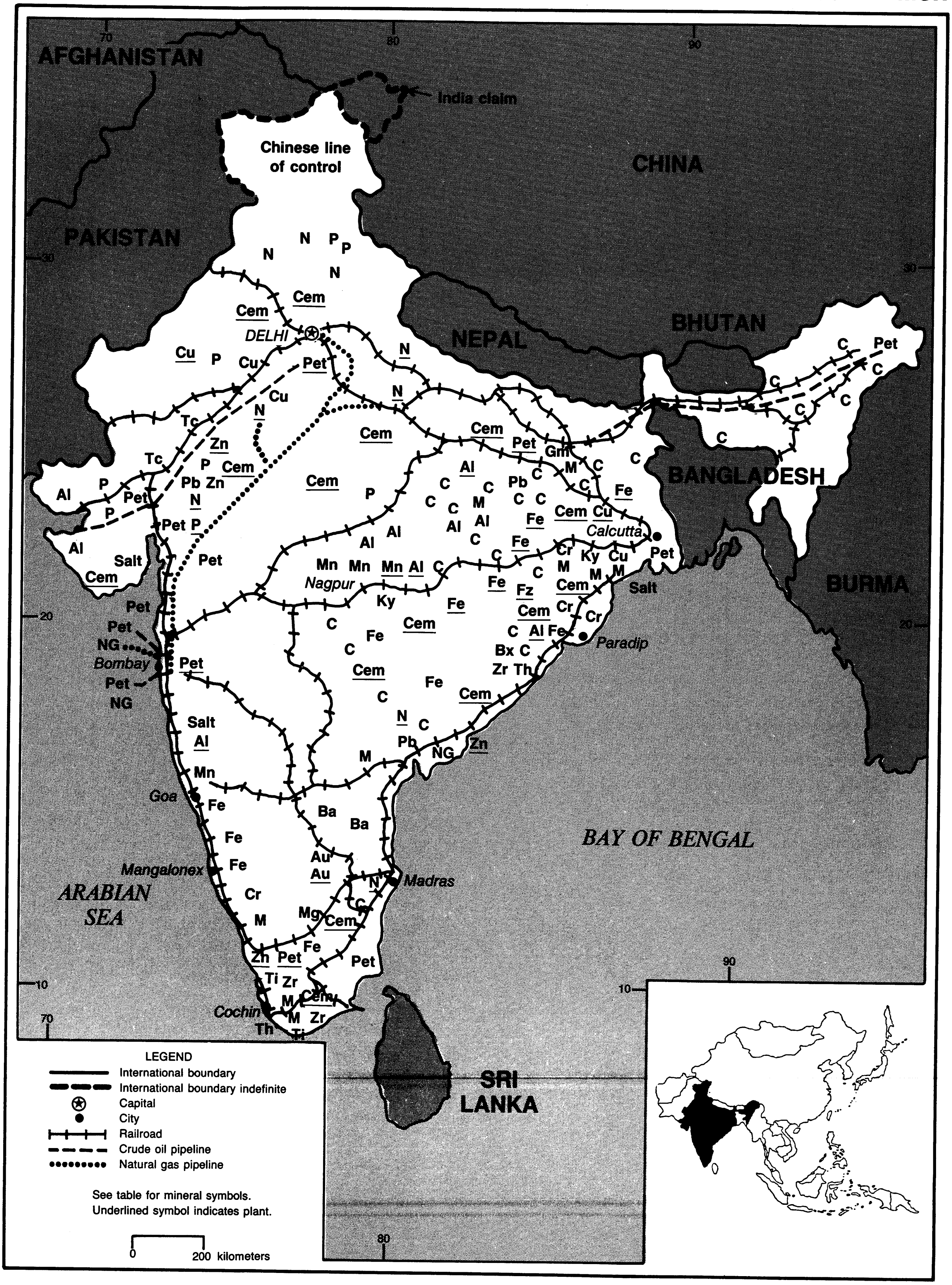
Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:—Continued					
Sand other than metal-bearing	thousand tons	1,584	1,424	110	China 1,422; Taiwan 623.
Sulfur:					
Elemental:					
Crude including native and byproduct		345	344	9	China 263; West Germany 54.
Colloidal, precipitated, sublimed		262	849	1	Republic of Korea 432; West Germany 353.
Dioxide	kilograms	100	—		
Sulfuric acid		7,056	5,064	46	China 4,884; West Germany 79.
Talc, steatite, soapstone, pyrophyllite		49,804	51,514	451	China 49,777; Taiwan 780.
Other:					
Crude		6,741	9,155	1,166	China 7,160; Republic of South Africa 524.
Slag and dross, not metal-bearing		814	491	—	China 443; Thailand 48.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		78	11	1	Singapore 10.
Carbon black		6,448	5,969	518	China 4,676; West Germany 343.
Coal: Anthracite and bituminous	thousand tons	9,267	9,928	—	Republic of South Africa 4,822; Australia 3,010.
Coke and semicoke		2,290	587	—	China 302; Japan 177.
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	2,043	2,375	(2)	Philippines 1,564; Singapore 467.
Gasoline:					
Aviation	do.	1	1	—	All from Australia.
Motor	do.	1,931	2,699	—	Singapore 2,167; Japan 284.
Naphtha including white spirit	do.	2,446	2,446	(2)	Singapore 2,236; Japan 204.
Mineral jelly and wax	do.	279	300	—	China 285.
Kerosene and jet fuel	do.	11,150	13,129	—	Singapore 10,494; China 1,381.
Distillate fuel oil	do.	14,502	21,243	—	Singapore 12,843; China 4,598; Japan 1,523.
Lubricants	do.	792	1,230	31	Singapore 546; Australia 274.
Nonlubricating oils	do.	174	43	—	China 34; Singapore 4.
Residual fuel oil	do.	14,944	19,199	371	Singapore 14,809; China 1,439.
Bitumen and other residues	do.	230	349	(2)	Singapore 222; Taiwan 93.
Bituminous mixtures	do.	2	4	(2)	United Kingdom 2.

[1]Table prepared by Audrey D. Wilkes.
[2]Less than ½ unit.
[3]Excludes unreported quantities valued at $178,000 in 1988 and $804,000 in 1989.
[4]Reported under SITC item 522.120 as "selenium, tellurium, phosphorus, arsenic, silicon and boron."


USSR
CHINA
AFGHANISTAN
PAKISTAN
NEPAL
BHUTAN
BANGLADESH
BURMA
UTTAR PRADESH
1. Dehra Dun
2. Chunar
3. Renukoot
HIMACHAL PRADESH
JAMMU AND KASHMIR
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
ARUNACHAL PRADESH
NAGALAND
BIHAR
1. Rohtas
2. Bokaro
3. Ranchi
4. Singhbhum
5. Ghatsila
MEGHALAYA
ASSAM
Dibrugarh
SIKKIM
PUNJAB
HARYANA
Delhi
Jhunjhunu
Jaipur
Ajmer
Bhilwara
Udaipur
Shahgarh
RAJASTHAN
GUJARAT
Jamnagar
MANIPUR
TRIPURA
Agartala
MIZORAM
ORISSA
1. Sundargarh
2. Rourkela
3. Keonjhar
4. Dhenkanal
5. Cuttack
6. Panchpatmali
7. Loraput
8. Angul
WEST BENGAL
Karandighi
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 851 million**



THE MINERAL INDUSTRY OF INDIA

By Pui-Kwan Tse

India, the second most populous country in the world, faced another political upheaval in 1990. After the election victory in November 1989 over the Gandhi regime, Prime Minister V. P. Singh's Government was deposed on a parliamentary no-confidence motion on November 1990. A new Government was formed under Chandra Shekhar, a veteran socialist, who controlled only 66 of Parliament's 524 members. In 1990, the country was driven by crisis: the Hindu-Muslim tension over a Bharatiya Janata Party (BJP)-sponsored temple project; higher cost of living widespread throughout the country; separatist violence in the Kashmir valley, in Punjab, and in the northeastern State of Assam; and the threat of war with Pakistan.

In 1990, India's economy faltered, reflecting the prevailing political uncertainty. The real growth in GNP was 4.5%, against 5.1% in 1989, and the bugetary deficit was estimated at more than $10 billion, while the inflation rate was 12%. The per capital income was estimated to be $230[1] in 1990. India's economy faced a variety of urgent problems: external financial markets were leery of lending new money to India until an International Monetary Fund (IMF) program is in place; restraints on imports were affecting industrial production and the export sector; and there is no clear industrial policy that favored India's ability to attract foreign investment. Additionally, inflation, rising at the end of Gandhi's regime at 7% annually, climbed higher to 16%. There were two fuel price increases—the first of 15% followed the national budget, presented in March, and the second of 30% followed the Gulf crisis. There were 244 State-owned enterprises in India with a total investment of $55 billion. Only 131 posted a profit in fiscal year 1989-90, while 98 recorded losses and 15 broke even. In 1990, the 98 losers registered deficits totaling $2.17 billion. With a foreign debt of $72 billion, India became the world's third largest debtor after Brazil and Mexico. Foreign exchange reserves dropped from $20.5 billion in 1980 to about $2 billion in 1990. To earn foreign exchange, India needs to export, and paradoxically, in order to do this, the country needs foreign exchange for investment. Therefore, the Government has given a green light to private industries to build new and more efficient mineral-processing plants and has also considered joint ventures with other countries to develop its mineral industries.

GOVERNMENT POLICIES AND PROGRAMS

The Government owns and operates most major mines, processing plants, and most of the mineral-based industries. The fundamental operating rules and procedures for the mineral industries are the Mines Act of 1952 and its amendments; the Minimum Wages Act of 1948 and its amendments; the Mineral Concession Rules of 1960; the Mines Labor Welfare Fund Act of 1976; and the Oil Mines Regulations of 1983.

In 1990, the new national mineral policy for ferrous, non-ferrous, and nonnuclear fuel sectors was formulated to strike a balance between conservation and mineral development. The guiding principle in the strategy of developing any mineral deposit at any location would be the economic cost. In a conservation measure, recycling of metallic scrap and the utilization of low-grade minerals, mineral wastes, and rejects were to be encouraged.

Thirteen mineral commodities—chrome, copper, diamonds, gold, iron ore, lead, manganese, molybdenum, nickel, platinum-group metals, sulfur, tungsten, and zinc—were exclusively reserved for exploration and processing by the Government. The development of minor minerals was to be undertaken through the initiative and enterprise of the private sector, even though the State will continue to play an active role in their mining and processing. The induction of foreign technology and participation in exploration for high-value and rare minerals would be pursued. In the case of joint ventures, the controlling interest would remain with Indian companies.

New mining leases were not to be granted without proper mining plans, including environmental considerations and issues. This condition would apply to both public- and private-sector parties. The environmental safeguards were to be approved and enforced under statutory authority.

The policy also emphasized certain new aspects such as mineral exploitation in territorial waters and in the adjoining seabed. The Geological Survey of India has been designated the principal agency for geological mapping and identification of mineral resources, and the Department of Ocean Development is responsible for seabed exploration and the development of mining and mining techniques.

Effective December 27, 1990, the Government has allowed the exports of metals and their oxides of rare earths, scandium, and yttrium; oxides and peroxides of strontium and lithium; and perchlorate of chromium, gallium, germanium, hafnium, indium, niobium, sodium, rhenium, and thallium. The Government also allowed Bharat Gold Mines Ltd. (BGML) to sell carat gold pendants to the general public.

PRODUCTION

The overall industrial production growth rate between April and December of 1990 was better than the same period of 1989 (8.9% vs. 5.8%). Power generation during that period increased 7.2% compared with 11.8% in the corresponding period in 1989. The Indian steel industry is in its transition phase. With more remunerative prices and a liberal licensing of small plants based on electric arc furnaces utilizing metal scrap, numerous mini-steel plants came on-stream. The mini-steel plants accounted for 30% of the country's total steel output. An inappropriate product mix, power shortages, and imbalances in output were responsible for low profitability and idle capacity in the industry. The nonferrous sector is not as well positioned and as stable as its ferrous counterpart. With the exception of aluminum, the nonferrous metals sector suffered from supply problems. The shortage of copper was likely to persist because of delays in stepping up domestic production. Lead and zinc were not much better off than copper. However, a more pronounced rise in lead production was being accomplished from imported concentrates. The main handicap of the nonferrous metal industry continued to be the shortage of power. The industry attempts to install captive generating capacity wherever feasible.

TRADE

The Indian Government continued its trade policy for metals and minerals by promoting exports to the maximum extent and restricting imports. The shortage of foreign exchange in India had led the Ministry of Finance to order importers of ferrous and nonferrous metals to make deposits in cash rupees, equivalent to 133% of the value of the letter of credit taken out for any import order. The ruling applied to all importing sectors but barred priority areas that included fertilizers. For any importer planning to reexport goods in value-added form, the deposit was reduced to 50% as the re-exported product would be earning the country much-needed foreign exchange. This move led to a drastic fall in import orders. This change did not appear to have any effect, however, in the production of metals and minerals in 1990. Production by the steel industry, which is dependent on imported scrap steel from other countries, is expected to drop more than 30% in 1991.

India's trade deficit was \$5.45 billion during the first 10 months (April through January) for fiscal year 1990-91, with exports estimated at \$14.80 billion and imports at \$20.25 billion. The increase in the trade deficit was attributed largely to the decrease in export growth and an increase in the cost of petroleum imports. In 1990, petroleum imports accounted for 24% of India's total imports, vis-a-vis, that of only 18% in 1989.

India and China signed a trade protocol as a means to step up to more significant economic exchanges. A key feature in the agreement was to resume border trade from transit points in Uttar Pradesh and Tibet. The new protocol has set a goal of bilateral trade of \$1 billion within 3 years. India will export chrome, iron ore, urea, telecommunications systems and software to China and import petroleum as well as silk from China.

STRUCTURE OF THE MINERAL INDUSTRY

There are two main categories of Indian ownership and management in the mining industry: Government-owned and privately owned. The India mining industry produces more than 70 mineral commodities, representing many ores, metals, industrial minerals, and fuels. The entire industry is in various stages of expansion, and the rate of growth depends on several factors: location of resources, capital investment, and accessibility to advanced technologies in mining, processing, and production.

There were more than 4,200 operating mines in India; however, the majority of these mines were small, manually operated surface pits with relatively low output, which accounted for approximately 70% of the output of industrial minerals, 18% of metallic minerals, and 12% of mineral fuels.

In the nonfuel sector, more than 300 underground mines were in production for 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. Most of them were in manual operations. The coal sector has been gradually undergoing a transition from manual to semimechanized operations.

Total employment in the mining and quarrying exceeds 1 million, 4.5% of the total employed labor force. Although the public sector employs about 90% of the total, the private-sector employment has been increasing in the past 2 years.

COMMODITY REVIEW

Metals

Aluminum and Bauxite.—India has the potential to become a major exporter of aluminum. However, the problem of power shortage and absence of cheap hydroelectric power has hindered India's aluminum industry. Electricity from the power grids is always in short supply, so that producers are forced to increase their reliance on captive power even though this is more expensive. India has a total smelter capacity of 610,000 mt/a of aluminum: National Aluminium Co. (NALCO), 218,000 mt/a; Bharat Aluminium Co. (BALCO), 100,000 mt/a; Hindalco Industries Ltd. (HINDALCO), 150,000 mt/a; Indian Aluminium Co. (INDAL), 117,000 mt/a; and Madras Aluminium Co. (MALCO), 25,000 mt/a. INDAL, a private enterprise, is planning to set up its own powerplants to meet the requirements of its smelters at Hirakud in Orissa and Belgaum in Kanataka. Inadequate smelting capacity along with acute power shortage have forced the industry to export alumina, rather than aluminum or value-added items manufactured from metal. In 1990, India produced a little more than 433,000 tons of aluminum ingot, an increase of 2.3% compared with that of the previous year. Estimated consumption in 1990 was 420,000 tons.

In fiscal 1990-91, the Government-owned NALCO, the largest aluminum enterprise in India, produced 151,000 tons of aluminum, up from 135,000 tons the previous year; and 652,000 tons of alumina, down from 739,000 tons the previous year. The decrease in alumina production was due to severe cyclones that affected production in May and June 1990. The production targets for fiscal 1991-92 were 780,000 tons of alumina and 190,000 tons of metal. The company has received a Project Investment Board approval for its aluminum expansion plans. The expansion involves a total investment of \$670 million to increase its output of bauxite from 2.4 Mmt/a to 4.8 Mmt/a; alumina from 800,000 mt/a to 1.35 Mmt/a; metal production from 218,000 mt/a to 333,000 mt/a; and the capacity of the captive powerplant from 600 MW to 960 MW.

HINDALCO, a privately owned and India's second largest aluminum producer, was looking to diversify into other metal production, gearing up for the growing domestic economy. The company is concentrating on downstream activity in foil production, which is pending Government approval and an entree into steel production. Also, pending Government approval, HINDALCO plans to add 100,000 mt/a in its metal production capacity.

INDAL, which is owned 39% by Alcan, also plans to increase its alumina output at its Belgaum, Karnataka, refinery from 180,000 mt/a to 220,000 by October 1992; the project has been submitted for Government approval. After several years of modernization, the company's refinery plant in Muri, Bihar, has increased its alumina output from an initial 30,000 mt/a to 75,000 mt/a. INDAL is the only Indian aluminum producer that transforms all of its primary production into value-added products such as sheet, chemical-grade alumina, and extrusions. A new rolling mill was to be added to the Belur rolling mill to increase the output from 24,000 mt/a to 45,000 mt/a by the end of 1992. The company is also to modernize its foil mill and extrusions plant at Kalwa, Matharashtra, and Alipuram, Kerala, respectively.

The Broad for Industrial and Financial Reconstruction had recommended that

TABLE 1

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	[r]2,662	[r]2,779	3,961	4,768	4,473
Alumina, Al_2O_3 equivalent	do.	383	425	776	1,947	1,601
Metal, primary		257,096	265,000	375,000	423,400	433,270
Cadmium metal		160	214	237	275	277
Chromium: Chromite, gross weight		629,671	[r]623,591	[r]820,863	1,002,659	939,000
Copper:						
Mine output, Cu content		48,103	56,529	55,429	57,376	[e]58,200
Metal, primary:						
Smelter		39,074	32,923	[r]44,284	42,456	40,667
Refinery:						
Electrolytic (cathode)		[r]35,832	30,027	[r]38,914	41,041	40,598
Fire refined		1,056	780	1,186	802	[e]1,000
Total		[r]36,888	[r]30,807	[r]40,100	41,843	41,598
Gold metal, smelter	kilograms	[r]1,931	[r]1,864	1,942	1,827	1,983
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	47,800	51,018	49,961	53,418	53,697
Iron content	do.	29,923	31,937	31,226	33,440	[e]33,600
Metal:						
Pig iron	do.	10,509	10,893	11,735	12,080	[e]12,600
Ferroalloys:						
Ferrochromium (including charge chrome)		[r]84,096	[r]93,944	140,262	135,000	122,000
Ferromanganese		[r]179,910	[r]173,259	138,331	149,139	[e]180,000
Ferrochromium-silicon		9,493	12,321	2,769	11,384	7,316
Ferrosilicon		50,096	[r]50,747	46,721	73,751	65,000
Silicomanganese		24,782	37,504	52,895	75,469	57,000
Silicon metal		642	1,445	686	[e]700	[e]1,600
Other		617	529	445	386	[e]400
Steel, crude:						
Steel ingots	thousand tons	11,332	12,605	12,682	12,452	[e]14,000
Steel castings	do.	95	278	340	330	[e]350
Total	do.	11,427	12,883	13,022	12,782	[e]14,350
Semimanufactures[3]	do.	7,753	8,600	9,501	9,241	[e]10,500
Lead:						
Mine output, Pb content		37,578	[e]36,725	30,522	26,500	[e]28,000
Metal, refined:						
Primary		19,933	20,669	18,833	21,260	24,747
Secondary		11,300	12,126	9,889	13,469	14,090
Total		31,233	32,795	28,722	34,729	38,837
Manganese:						
Ore and concentrate, gross weight	thousand tons	1,213	1,302	1,333	1,334	1,385
Mn content		455,287	484,865	493,058	496,861	512,000
Rare-earth metals: Monazite concentrate, gross weight[e]		4,000	4,000	4,000	4,300	4,500
Selenium	kilograms	[e]4,800	4,026	5,103	4,261	3,840
Silver, mine and smelter output	do.	35,271	37,946	40,958	35,499	33,206

See footnotes at end of table.

TABLE 1—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
METALS—Continued						
Titanium concentrates, gross weight[e]						
Ilmenite		140,000	140,000	140,000	160,000	160,000
Rutile		7,000	7,000	5,000	5,000	5,000
Tungsten, mine output, W content		23	26	19	12	[e]10
Zinc:						
Mine output, concentrate:						
Gross weight		[r]89,510	104,809	118,056	127,043	137,649
Zn content		[r]46,545	54,500	61,389	65,384	[e]71,580
Metal:						
Primary		[r]73,828	68,899	68,940	71,572	79,093
Secondary[e]		200	200	200	200	200
Total[e]		[r]74,028	69,099	69,140	71,772	79,293
Zirconium concentrate: Zircon, gross weight[e]		16,000	16,000	16,000	17,200	18,000
INDUSTRIAL MINERALS						
Abrasives, natural, n.e.s.:						
Corundum, natural		968	469	669	254	410
Garnet		5,366	[4]6,699	4,311	5,652	4,422
Jasper		2,426	4,407	3,915	5,535	[e]4,650
Asbestos		25,236	29,110	31,123	37,984	25,958
Barite		344,000	247,000	445,604	553,000	707,000
Bromine, elemental		1,229	1,182	1,242	1,272	[e]1,300
Cement, hydraulic	thousand tons	[5]36,400	36,980	40,700	46,000	49,000
Chalk		106,708	101,641	109,782	119,000	128,000
Clays:						
Ball clay		277,460	279,912	330,126	266,000	245,000
Diaspore		11,580	11,018	10,901	15,301	7,701
Fire clay		583,000	634,000	596,835	618,000	445,000
Kaolin:						
Direct salable, crude	thousand tons	[r]647	[r]602	471	520	516
Processed	do.	101	[r]94	107	110	104
Total	do.	[r]748	[r]696	578	630	620
Other[e]	do.	100	100	100	100	100
Diamond:[e]						
Gem	thousand carats	13	16	[r]11	[r]12	15
Industrial	do.	[r]3	3	3	3	3
Total	do.	[r]16	19	[r]14	[r]15	18
Feldspar		[r]48,264	49,663	57,656	59,000	[e]54,000
Fluorspar:						
Concentrates:						
Acid-grade		[e]7,624	[e]8,261	8,823	10,300	[e]9,500
Metallurgical-grade		[e]4,109	[e]4,448	6,772	12,589	[e]12,200
Total		11,733	12,709	15,595	22,889	[e]21,700
Other fluorspar materials, graded		6,841	5,790	4,797	5,176	[e]3,900
Gem stones excluding diamond:						
Agate including chalcedony pebble		[e]776	752	812	788	631
Garnet	kilograms	5,021	2,007	1,390	2,483	2,005
Graphite[6]		38,412	42,589	57,325	58,000	61,000
Gypsum		[r]1,640,443	[r]1,733,720	1,424,674	1,564,000	1,657,000

See footnotes at end of table.

TABLE 1—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
INDUSTRIAL MINERALS—Continued						
Kyanite and related materials:						
Andalusite		732	122	—	—	—
Kyanite		32,394	39,959	35,773	40,009	38,313
Sillimanite		14,905	12,756	15,377	17,398	17,072
Lime[e]		600,000	700,000	750,000	790,000	800,000
Magnesite		422,000	430,000	507,873	491,000	544,000
Mica:[7]						
Crude		4,746	4,240	3,839	4,195	3,860
Scrap and waste		2,773	6,307	3,694	3,108	2,822
Total		7,519	10,547	7,533	7,303	6,682
Nitrogen: N content of ammonia[5]	thousand tons	4,933	5,300	6,205	6,661	7,022
Phosphate rock including apatite		667,070	679,419	739,000	703,716	659,000
Pigments, mineral: Natural: Ocher		98,668	145,245	151,781	173,366	126,000
Pyrites, gross weight		20,773	36,000	29,656	38,867	[e]40,000
Salt:						
Rock salt	thousand tons	2	1	4	3	[e]3
Other	do.	10,116	9,900	[e]9,200	[e]9,600	[e]9,500
Total	do.	10,118	9,901	[r e]9,204	[e]9,603	[e]9,503
Sodium carbonate		873,600	969,600	1,098,200	1,343,500	[e]1,400,000
Stone, sand and gravel:[8]						
Calcite		26,318	37,194	32,951	40,326	55,000
Dolomite	thousand tons	2,139	2,233	2,211	2,417	2,505
Limestone	do.	52,562	57,170	62,998	64,032	66,931
Quartz and quartzite	do.	274	299	r/305	326	285
Sand:						
Calcareous	thousand tons	571	147	[r]63	106	175
Silica	do.	1,111	1,016	[r]1,606	1,239	1,139
Other	do.	1,113	3,639	[r]1,195	1,242	[e]1,300
Slate		6,483	6,637	7,732	14,606	[e]18,000
Sulfur:						
Content of pyrites		8,309	14,400	[r]11,862	15,546	[e]21,300
Byproduct:						
From metallurgical plants[e]		120,000	120,000	125,000	125,000	125,000
From oil refineries		[e]1,000	—	[e]1,000	4,500	[e]4,560
Total[e]		129,309	134,400	[r]137,862	145,046	150,860
Talc and related materials:						
Pyrophyllite		[r]58,884	[r]51,724	64,923	93,000	80,000
Steatite (soapstone)		[r]378,683	[r]359,448	417,493	414,286	[e]416,000
Vermiculite		[r]4,933	[r]2,439	4,052	3,075	1,769
Wollastonite		23,770	31,021	34,286	44,042	61,386
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Bituminous	thousand tons	162,800	177,220	189,000	199,000	213,000
Lignite	do.	7,900	8,311	12,600	13,400	14,000
Total	do.	170,700	185,531	201,600	212,400	227,000
Coke:[e]						
Coke oven and beehive	do.	13,000	13,000	13,000	13,000	13,000

See footnotes at end of table.

TABLE 1—Continued

INDIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Coke:[e] —Continued						
Gashouse	do.	100	100	100	100	100
Other, soft	do.	200	200	200	200	200
Total	do.	13,300	13,300	13,300	13,300	13,300
Gas, natural:						
Gross	million cubic meters	[e]10,201	[e]9,918	8,813	10,493	10,245
Marketable[9]	do.	6,577	6,338	7,457	6,700	[e]6,560
Petroleum:						
Crude	thousand 42-gallon barrels	228,416	220,929	230,680	250,700	227,800
Refinery products:						
Liquefied petroleum gases	do.	16,564	18,130	19,905	[e]20,500	[e]20,000
Gasoline	do.	20,944	22,585	22,950	[e]23,200	[e]23,000
Kerosene and jet fuel	do.	48,767	54,152	53,697	[e]54,000	[e]53,000
Distillate fuel oil	do.	121,911	122,777	122,337	[e]123,000	[e]122,000
Residual fuel oil	do.	52,800	57,416	56,803	[e]57,200	[e]56,000
Lubricants	do.	3,346	3,549	4,039	[e]4,100	[e]4,000
Other	do.	59,103	66,201	67,286	[e]68,000	[e]67,000
Total	do.	323,435	344,810	347,017	[e]350,000	[e]345,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Oct. 22, 1991.
[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. 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]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.
[5]Data are for fiscal year beginning Apr. 1 of that stated.
[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.

TABLE 2

INDIA: EXPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1985-86	1986-87	Destinations, 1986-87	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	36,436	85,148	—	East Germany 40,644; Saudi Arabia 21,555; Romania 17,000.
Oxides and hydroxides	40,967	39,756	—	U.S.S.R. 39,395; Japan 321.
Metal including alloys, all forms	13,509	7,173	—	U.S.S.R. 5,044; Sri Lanka 816; Bangladesh 623.
Cadmium: Metal including alloys, all forms	7	—		
Chromium:				
Ore and concentrate	229,729	119,084	—	Japan 64,989; Taiwan 22,800; China 22,290.
Metal including alloys, all forms	8,600	6,001	—	All to Japan.

See footnotes at end of table.

TABLE 2—Continued

INDIA: EXPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1985-86	1986-87	Destinations, 1986-87	
			United States	Other (principal)
METALS—Continued				
Copper:				
Ore and concentrate	45,350	7,900	500	Spain 4,400; Canada 3,000.
Metal including alloys, all forms	1,729	337	58	Singapore 54; Yemen 50; Sri Lanka 43.
Iron and steel:				
Iron ore and concentrate including roasted pyrite thousand tons	30,150	28,226	—	Japan 18,789; Romania 3,564; Republic of Korea 2,364.
Metal:				
Scrap	64,182	37,969	—	Philippines 33,469; Panama 4,500.
Pig iron, cast iron, related materials	221	449	339	Kenya 51; United Kingdom 18.
Ferroalloys:				
Ferromanganese	5,330	—		
Ferrosilicon	10	18	NA	NA.
Silicon metal	12	20	—	Mainly to United Kingdom.
Unspecified	180	—		
Steel, primary forms	95,122	86,844	54,555	U.S.S.R. 8,862; Saudi Arabia 5,002.
Lead: Metal including alloys, all forms	13	207	—	United Arab Emirates 176; United Kingdom 25.
Magnesium: Metal including alloys, all forms	2	120	NA	NA.
Manganese:				
Ore and concentrate, metallurgical-grade	486,380	221,918	—	Japan 92,086; Republic of Korea 56,830; Romania 41,000.
Oxides	33	10	—	All to Bangladesh.
Metal including alloys, all forms	3	—		
Nickel: Metal including alloys, all forms	14	1	—	Mainly to United Arab Emirates.
Tin: Metal including alloys, all forms	73	79	NA	United Arab Emirates 39; Republic of Korea 12.
Titanium: Ore and concentrate	17,956	14,605	5,097	Japan 6,600; Netherlands 2,908.
Vanadium: Ore and concentrate[3]	—	100	—	All to Netherlands.
Zinc: Metal including alloys, all forms	70	39	—	Thailand 17; Sri Lanka 12; Bangladesh 8.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Natural: Corundum, emery, pumice, etc.	752	589	NA	NA.
Asbestos, crude	126	34	—	Indonesia 11; Sri Lanka 10; West Germany 7.
Barite and witherite	374,927	25,614	680	U.S.S.R. 8,698; United Arab Emirates 8,502; Oman 7,300.
Boron materials:				
Sodium borate	443	486	NA	NA.
Oxides and acids	21	62	—	Thailand 45; Sri Lanka 17.
Cement	47,659	26,817	—	Nepal 10,238; unspecified 16,579.
Chalk	133	395	—	Bangladesh 374; Nepal 11.
Clays, crude:				
Bentonite	21,348	6,843	—	Saudi Arabia 4,150; United Arab Emirates 1,436; Poland 500.
Fire clay	966	369	—	Bangladesh 243; Kenya 100.
Kaolin	8,329	5,715	—	Bangladesh 5,098; Japan 200; Egypt 120.
Unspecified	1,084	825	—	Bangladesh 55; Malaysia 55; unspecified 611.
Diamond: Gem, not set or strung value, thousands	$1,126,606	$1,541,468	$664,567	Hong Kong $229,890; Japan $227,137.

See footnotes at end of table.

TABLE 2—Continued

INDIA: EXPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1985-86	1986-87	Destinations, 1986-87: United States	Destinations, 1986-87: Other (principal)
INDUSTRIAL MINERALS—Continued					
Feldspar		16,781	20,033	—	Malaysia 10,118; Bangladesh 4,513; Taiwan 2,096.
Graphite, natural		1,045	1,028	123	Japan 262; United Kingdom 213; Australia 157.
Gypsum and plaster		3,449	724	—	Bangladesh 510; Oman 110; Nepal 60.
Kyanite and related materials: Sillimanite		r23	19	—	NA.
Magnesium compounds:					
Magnesite, crude		14	—		
Oxides and hydroxides		1,357	2,192	—	United Kingdom 1,548; Japan 596; Bangladesh 30.
Mica:					
Crude including splittings and waste		18,107	19,868	2,333	Belgium-Luxembourg 5,818; Japan 3,624; France 3,179.
Worked including agglomerated splittings		15,779	18,476	2,110	West Germany 4,486; Japan 3,555; U.S.S.R. 1,405.
Phosphorus, elemental		102	192	84	Egypt 67; Republic of Korea 38.
Pigments, mineral:					
Natural, crude		860	115	—	Philippines 39; Bangladesh 35; Singapore 32.
Iron oxides and hydroxides, processed		3,619	5,029	—	Philippines 1,884; United Kingdom 1,025; Egypt 438.
Precious and semiprecious stones other than diamond: Natural:					
Emerald	value, thousands	$1,608	$11,050	$5,369	Switzerland $1,485; Hong Kong $1,351.
Other	do.	$21,955	$20,093	$7,987	Hong Kong $2,640; Japan $1,747.
Salt and brine		15,915	19,698	—	Bangladesh 10,050; Sri Lanka 6,500; Nepal 2,948.
Sodium compounds, n.e.s.: Carbonate, manufactured		350	402	NA	NA.
Stone, sand and gravel:					
Dimension stone, all forms		r371,809	422,271	3,481	Japan 195,512; Italy 95,001; West Germany 28,379.
Dolomite, chiefly refractory-grade		7,786	7,569	—	Bangladesh 7,023; Saudi Arabia 506.
Limestone other than dimension		230,488	213,553	—	Bangladesh 202,451; Nepal 8,435.
Quartz and quartzite		70,775	67,689	—	Japan 66,317; Bangladesh 1,059.
Sand other than metal-bearing		8,435	3,350	—	United Arab Emirates 2,863; Maldives 208.
Sulfur: Elemental: Crude including native and byproduct		1	2	—	All to Australia.
Talc, steatite, soapstone, pyrophyllite		12,444	12,340	—	Kenya 2,564; Bangladesh 1,808; Austria 1,517.
Vermiculite		1,044	2,274	—	Saudi Arabia 1,122; Kuwait 832; Taiwan 184.
MINERAL FUELS AND RELATED MATERIALS					
Coal, all grades including briquets	thousand tons	190	102	—	Nepal 57; Bangladesh 45.
Coke and semicoke		3,745	6,551	NA	NA.
Petroleum:					
Crude	thousand 42-gallon barrels	3,929	—		
Refinery products:[4]					
Light distillates:					
Naphtha	do.	15,266	18,870	NA	NA.
Other	do.	136	145	NA	NA.
Middle distillates	do.	970	1,149	NA	NA.
Heavy ends	do.	140	666	NA	NA.

[r]Revised. NA Not available.
[1]Table prepared by Audrey D. Wilkes.
[2]Data are for Indian fiscal years Apr. 1 through Mar. 31 and have been compiled from the Indian Minerals Yearbook 1990.
[3]May include other unspecified ores.
[4]Defined as provided in data source.

TABLE 3

INDIA: IMPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1985-86	1986-87	Sources, 1986-87 United States	Sources, 1986-87 Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	368	1,196	72	West Germany 695; United Kingdom 219; Japan 132.
Metal including alloys, all forms	69,976	118,431	531	Brazil 26,008; Bahrain 23,015; Indonesia 11,975.
Antimony: Metal including alloys, all forms	993	949	—	China 601; Netherlands 138; Taiwan 80.
Cadmium: Metal including alloys, all forms	64	50	—	Australia 40; Japan 8.
Chromium:				
Ore and concentrate	—	18,496	—	All from Madagascar.
Metal including alloys, all forms	28	52	1	France 25; United Kingdom 19.
Cobalt: Metal including alloys, all forms	134	244	3	Zambia 95; Zaire 70; West Germany 19.
Copper:				
Ore and concentrate	88	56	—	NA.
Metal including alloys, all forms	142,377	114,573	9,407	Zambia 34,085; Zaire 12,578; Singapore 12,133.
Iron and steel:				
Ore and concentrate	—	50,767	—	Malaysia 50,766.
Metal:				
Scrap	1,331,719	2,103,291	935,224	Netherlands 355,276; United Kingdom 270,593.
Pig iron, cast iron, related materials	21,360	44,810	1,010	Brazil 36,670; Australia 3,000; Japan 2,000.
Ferroalloys:				
Ferrochromium	11,390	4,600	223	West Germany 2,062; Japan 1,068.
Ferromanganese	962	109	—	West Germany 62; France 44; Sweden 3.
Ferromolybdenum	2	5	—	All from United Kingdom.
Ferronickel	23,324	29,854	289	France 7,024; Netherlands 6,444; Columbia 5,596.
Ferrosilicomanganese	—	158	10	France 99; Spain 49.
Ferrosilicon	300	7,342	—	Brazil 7,019; West Germany 151; United Kingdom 101.
Silicon metal	2,152	2,291	—	Portugal 783; Canada 454; France 312.
Unspecified	1,430	1,293	NA	NA.
Steel, primary forms	2,302,074	3,048,340	59,805	Japan 1,236,954; West Germany 481,875; Spain 197,550.
Lead:				
Ore and concentrate	384	6,062	—	Iran 3,629; Morroco 2,370.
Metal including alloys, all forms	48,222	52,804	3,019	Australia 38,450; West Germany 2,994.
Magnesium: Metal including alloys, all forms	753	633	58	Norway 270; France 234.
Manganese:				
Ore and concentrate:				
Battery-grade	r250	—		
Metallurgical-grade	4,559	3,954	—	Singapore 1,900; Gabon 1,350; Brazil 604.
Oxides	647	350	23	Japan 259; Belgium-Luxembourg 68.
Metal including alloys, all forms	235	130	3	France 38; Japan 36; China 29.
Molybdenum: Metal including alloys, all forms	6	4	(3)	West Germany 2; France 1.
Nickel:				
Ore and concentrate	3,367	1,155	—	Cuba 506; Australia 337; Netherlands 157.

See footnotes at end of table.

TABLE 3—Continued

INDIA: IMPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity	1985-86	1986-87	Sources, 1986-87: United States	Sources, 1986-87: Other (principal)
METALS—Continued				
Nickel:—Continued				
Metal including alloys, all forms	7,507	7,168	352	U.S.S.R. 1,429; Canada 1,085; United Kingdom 888.
Platinum-group metals: Metals including alloys, unwrought and partly wrought kilograms	197	202	—	U.S.S.R. 172; United Kingdom 30.
Selenium, elemental	28	13	—	Japan 6; Bulgaria 2; Canada 2.
Silver: Metal including alloys, unwrought and partly wrought kilograms	720	106	([3])	United Kingdom 80; Japan 11.
Tin: Metal including alloys, all forms	14,228	12,274	1,419	United Kingdom 3,166; Malaysia 2,479.
Titanium:				
Ore and concentrate	155	4	—	All from West Germany.
Oxides	5,286	12,103	2,669	United Kingdom 2,685; West Germany 2,575.
Tungsten:				
Ore and concentrate	475	360	—	Burma 192; Canada 64; Singapore 50.
Metal including alloys, all forms	47	36	15	Japan 5; West Germany 5; Netherlands 4.
Vanadium: Ore and concentrate[4]	895	763	245	United Kingdom 158; Chile 74; West Germany 61.
Zinc:				
Ore and concentrate	12,550	19,714	—	Australia 11,109; Canada 7,513; Peru 1,000.
Metal including alloys, all forms	80,927	64,510	671	U.S.S.R. 12,863; Australia 12,667; Zaire 7,931.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	6	—		
Silicon carbide	139	116	1	United Kingdom 96; West Germany 11.
Asbestos, crude	77,874	72,942	1,096	Canada 34,170; Brazil 11,201; U.S.S.R. 10,564.
Boron materials:				
Crude natural borates[5]	9,089	20,557	15,756	Turkey 4,800.
Oxides and acids	4	6	—	NA.
Cement	321,078	230,602	—	Indonesia 146,718; Poland 32,330; Republic of Korea 27,379.
Clays, crude:				
Bentonite	43	46	46	
Kaolin	93	111	59	United Kingdom 36; West Germany 16.
Unspecified	1,673	1,926	52	United Kingdom 994; Nepal 399; Japan 231.
Cryolite and chiolite	—	260	259	NA.
Diamond:				
Gem, not set or strung value, thousands	$867,310	$1,141,324	—	Belgium-Luxembourg $699,856; United Kingdom $282,136.
Industrial stones do.	r$311	$427	$142	United Kingdom $139; West Germany $40.
Diatomite and other infusorial earth	23	158	NA	NA.
Fertilizer materials: Manufactured:				
Phosphatic	[6]804,800	NA		
Potassic	1,089,577	1,176,470	21,556	Canada 413,364; East Germany 275,310; Jordan 242,554.
Fluorspar	8,807	24,921	—	China 21,950; Taiwan 2,012; Japan 500.
Graphite, natural	621	388	—	Sri Lanka 166; Japan 138; West Germany 48.

See footnotes at end of table.

TABLE 3—Continued

INDIA: IMPORTS OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity		1985-86	1986-87	Sources, 1986-87	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Gypsum and plaster		23	509	9	Japan 500.
Kyanite and related material		—	5	—	All from United Kingdom.
Magnesium compounds:					
Magnesite, crude		169	121	—	Singapore 100; Japan 18; West Germany 3.
Oxides and hydroxides		9,517	31,200	—	Brazil 10,420; China 9,255; Japan 6,383.
Mica:					
Crude including splittings and waste		3	—		
Worked including agglomerated splittings		25	75	2	West Germany 52; Austria 11.
Phosphates, crude	thousand tons	1,849	2,034	289	Jordan 984; Morocco 456; Senegal 200.
Phosphorus, elemental		222	534	—	China 462; United Kingdom 55.
Pigments, mineral:					
Natural, crude		30	—		
Iron oxides and hydroxides, processed		197	18	(3)	Mainly from West Germany.
Potassium salts, crude		55,006	89,316	NA	NA.
Precious and semiprecious stones other than diamond: Natural:					
Emerald	value, thousands	$11,764	$18,062	$9,006	Switzerland $2,381; West Germany $2,159.
Other	do.	$11,997	$13,132	$5,187	West Germany $2,219; Brazil $1,731.
Salt and brine		37,704	13,539	—	Pakistan 13,448; unspecified 85.
Stone, sand and gravel:					
Dimension stone, all forms		256	444	—	Italy 247; Nepal 78.
Limestone other than dimension		—	43,717	—	All from Japan.
Quartz and quartzite		70,775	NA		
Sand:					
Other than metal-bearing		r109	2,788	52	United Kingdom 1,519; West Germany 540.
Silica sand		763	245	220	West Germany 16; Sweden 9.
Sulfur: Elemental:					
Crude including native and byproduct		989,860	1,067,140	66,606	Saudi Arabia 318,438; Canada 211,301; Poland 151,845.
Colloidal, precipitated, sublimed		28	159	—	West Germany 120; United Kingdom 33.
Talc, steatite, soapstone, pyrophyllite		157	114	—	All from Nepal.
MINERAL FUELS AND RELATED MATERIALS					
Coal, all grades including briquets	thousand tons	2,396	2,347	—	Australia 2,015; Poland 306; Japan 22.
Coke and semicoke		53,028	200,533	—	Australia 150,015; Japan 175.
Petroleum, crude	thousand 42-gallon barrels	111,924	113,753	—	Saudi Arabia 40,917; United Arab Emirates 13,961.

rRevised. NA Not available.
[1]Table prepared by Audrey D. Wilkes.
[2]Data are for Indian fiscal years Apr. 1 through Mar. 31 and have been compiled from the Indian Minerals Yearbook 1990.
[3]Less than 1/2 unit.
[4]May include other unspecified ores.
[5]Includes "sodium borate" and "other borates."
[6]P2O5 content. Data from the Fertiliser Association of India, New Delhi. Fertiliser Statistics, 1987-88, p. I-172.

TABLE 4

INDIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Aluminum:			
Bauxite	Bharat Aluminium Co. Ltd.	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.	Ranchi, Bihar	[e]300
Do.	do.	Shandol, Madhya Pradesh	[e]300
Do.	Indian Aluminium Co. Ltd.	Kalharpur, Maharashtra	[e]250
Do.	do.	Ranchi, Bihar	[e]250
Do.	Madras Aluminium Co. Ltd.	Salem, Tamil Nadu	150
Do.	Minerals & Minerals Ltd.	Ranchi, Bihar	[e]200
Do.	National Aluminium Co. Ltd.	Panchpatmali, Orissa	2,400
Metal	Bharat Aluminium Co. Ltd.	Korba, Madhya Pradesh	100
Do.	Hindalco Aluminium Co. Ltd.	Renukoot, Uttar Pradesh	150
Do.	Indian Aluminium Co. Ltd.	Alipuram, Kerala	20
Do.	do.	Belgaum, Karnataka	73
Do.	do.	Hirakud, Orissa	24
Do.	Madras Aluminum Co. Ltd.	Metturdam, Tamil Nadu	25
Do.	National Aluminium Co. Ltd.	Angul, Dhenkanal District, Orissa	218
Barite	Andhra Pradesh Mining Corp. Ltd.	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:			
Public-sector	Bihar State Industrial Development Corp.	Rohtas-Palaman, Bihar	760
Do.	Cement Corp. of India Ltd.	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.	Rourkela, Orissa	2,140
Do.	Uttar Pradesh State Cement Corp	Chunar, Uttar Pradesh	840
Private-sector	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.	do.	Dhenkanal District, Orissa	[e]75
Do.	Mysore Minerals Ltd.	Hassan District, Karnataka	[e]125
Do.	Orissa Mining Corp.	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 4—Continued

INDIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Coal:			
Bituminous	Coal India Ltd:		
Do.	Bharat Coking Coal Ltd.	105 mines in Bihar, Orissa, and Uttar Pradesh	
Do.	Eastern Coalfields Ltd.	187 mines in Bihar and West Bengal	
Do.	Northern Coalfields Ltd.	61 mines in Madhya Pradesh and Uttar Pradesh	160,000
Do.	Southeastern Coalfields Ltd.	44 mines in Andhra Pradesh and Orissa	
Do.	Western Coalfields Ltd.	55 mines in Madhya Pradesh, Maharashtra, and Orissa	
Lignite	Neyveli Lignite Corp.	Neyveli, Tamil Nadu	8,000
Copper:			
Ore	Hindustan Copper Ltd.	Khetri copper complex, Jhunjhunu District,	
		Rajasthan:	
Do.	do.	Khetri Mine	825
Do.	do.	Kolihan Mine	825
Do.	do.	Chandmari Mine	330
Do.	do.	Indian copper complex, Singhbhum, District, Bihar:	
Do.	do.	Mosabani Mine	
Do.	do.	Pathargora Mine	
Do.	do.	Surda Mine	1,800
Do	do.	Kendadih Mine	
Do.	do.	Rakha Mine	
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	
Do.	Dempo Mining Corp. Ltd.	do.	[e]7,000
Do.	V.M. Salgaocar & Bros. Pvt. Ltd.	do.	
Do.	Indian Iron & Steel Co. Ltd.	Singhbhum District, Bihar	[e]2,500
Do.	Kudremukh Iron Ore Co. Ltd.	Chikmagalur District, Karnataka	7,500
Do.	National Mineral Development Corp. Ltd.	Bellary District, Karnataka	3,000
Do.	Steel Authority of India Ltd.	Singhbhum District, Bihar	[e]3,500
Do.	do.	Bastar and Durg District, Madhya Pradesh	[e]7,000
Do.	do.	Keonjhar District, Orissa	[e]3,000
Do.	Tata Iron & Steel Co. Ltd.	Singhbhum District, Bihar	[e]3,500
Do.	do.	Keonjhar District, Orissa	[e]2,000
Steel, primary	Steel Authority of India, Ltd.	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
Kyanite	Hindustan Copper Ltd.	Lapso, Singhbhum District, Bihar	[e]22
Do.	Maharashtra Mineral Corp. Ltd.	Dahegaon, Bhandara District, Maharashtra.	
Do.	Maharashtra State Mining Corp. Ltd.	Bhandara, Maharashtra	[e]28
Do.	S.M. Khola	do.	
Lead:			
Concentrate	Hindustan Zinc Ltd.	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

See footnotes at end of table.

TABLE 4—Continued

INDIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Magnesite	Burn Standard Co. Ltd.	Salem, Tamil Nadu	
Do.	Dalmia Magnesite Corp.	do.	400
Do.	Tamil Nadu Magnesite Ltd.	do.	
Manganese ore[2]	Aryan Mining & Trading Corp.	Sundargarh, Orissa	
Do.	Eastern Mining Co.	North Kanara, Karnataka	
Do.	J.A. Trivedi Bros.	Balaghat, Madhya Pradesh	
Do.	Manganese ore (India) Ltd.	Adilabad, Andhra Pradesh	
Do.	do.	Balaghat, Madhya Pradesh	
Do.	do.	Bhandara, Maharashtra	
Do.	do.	Keonjhar, Orissa	
Do.	Mangilah, Rungta (Pvt.) Ltd.	do.	
Do.	Mysore Minerals Ltd.	North Kanara, Karnataka	
Do.	do.	Shimoga, Karnataka	
Do.	Orissa Manganese & MInerals (Pvt.) Ltd.	Sundargarh, Orissa	1,500
Do.	Orissa Mineral Development Co. Ltd.	Koraput, Orissa	
Do.	Orissa Mining Corp. Ltd.	Keonjhar, Orissa	
Do.	do.	Koraput, Orissa	
Do.	R.B.S. Shreeram Durga Prasad & Falechand Marsingdas	Vizianagaram, Visakhapatnam District, Andhra Pradesh	
Do.	Rungta Mines (Pvt.) Lts.	Keonjhar, Orissa	
Do.	Sandur Manganese & Iron Ores Ltd.	Bellary, Karnataka	
Do.	Serajuddin & Co.	Keonjhar, Orissa	
Do.	S. Lall & Co.	do.	
Do.	Tata Iron & Steel Co. Ltd.	Keonjhar, Orissa	
Do.	do.	Sundargarh, Orissa	
Phosphate rock	Hindustan Zinc Ltd.	Udaipur District, Rajasthan	
Do.	Madhya Pradesh State Mining Corp. Ltd.	Jhabua, Madhya Pradesh	
Do.	do.	Chhatarpur, Madhya Pradesh	
Do.	Pyrites Phosphates & Chemicals Ltd.	Dehra Dun, Uttar Pradesh	800
Do.	Rajasthan State Mineral Development Corp. Ltd.	Udaipur District, Rajasthan	
Do.	Rajasthan State Mines & Minerals Ltd.	do.	
Titanium, ilmenite concentrate	Kerala Minerals & Metals Ltd.	Chavara, Quilon District, Kerala	100
Do.	Indian Rare Earths Ltd.	do.	200
Do.	do.	Ganjam, Orissa, 100 km south of Dhenkanal	220
Do.	do.	Manavalakurichi, Tamil Nadu	65
Zinc:			
Concentrate	Hindustan Zinc Ltd.	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.	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 Mmt, for 17% of capacity; 32 mines, 0.5 to 1.0 Mmt, for 17%; 80 mines, 0.3 to 0.5 Mmt, for 24%; 254 mines, 0.1 to 0.3 Mmt, for 39%; and the remaining mines, less than 0.1 Mmt.

[2]Capacity of clusters of surface mines varies extremely, depending on demand.

MALCO's operation was uneconomical to operate its metal plant because of high power cost and its size of production. Despite the closure of the smelter, the company continued production of alumina and sold it in the domestic market.

Copper.—Hindustan Copper Ltd. (HCL), a State-owned identity and the sole primary copper producer in India, has an integrated operation starting from detailed exploration of mineral deposits to development of mines, mining, smelting, and refining copper with recovery of valued byproducts. HCL has seven manufacturing units—Khetri Copper Complex at Jhunjhunu in Rajasthan, Indian Copper Complex at Singhbhum in Bihar, Rakha Copper Project at Singhbhum in Bihar, Dariba Copper Project at Alwar in Rajasthan, Chandmari Copper Project at Jhunjhunu in Rajasthan, Malanjkhan Copper Project at Balaghar in Madhya Pradesh, and Taloja Copper Project at Raigad in Maharashtra. Total copper mineral resources in India are estimated at 6.29 Mmt contained in 566 Mmt of ore in 74 deposits and prospects. More than 90% of the copper resources is confined to three States—Bihar, 46%; Rajasthan, 20%; and Madhya Pradesh, 25%.

The copper industry is also faced with high costs, and the prevailing prices do not reflect actual production costs. The very high cost of power and labor make copper production an uneconomic activity when compared to the international prices. The Government has emphasized to producing companies the urgency and importance of this as a precondition to further expansion of production activities.

The construction of the plant at Taloja, Raigarh District, Maharashtra, for production of electrolytic tough pitch copper wire rods has been completed, and trial production commenced during December 1989; commercial production began in April 1990. The plant design was based on imported copper cathodes technology from Southwire Co. of the United States. The installed capacity is 60,000 mt/a in stage 1, and there are plans to increase output to the licenced capacity of 80,000 mt/a. In 1990, Taloja plant produced 28,000 tons of copper wire rod.

The Malanjkhand Copper Complex in Madhya Pradesh is the largest copper opencast mine in India, with a designed capacity of 2 Mmt of ore and a matching concentrate plant of 23,000 tons of copper metal per year. HCL has considered expanding Malanjkhand's mine and smelter to its designed capacity; the feasibility study will be completed in June 1991. Copper ore reserve is estimated at 287 Mmt with an ore grade of 1.3%. A portion of the concentrates produced by Malanjkhand was used as fed for the Khetri smelter.

The Khetri Copper Complex, with installed operating capacity of 31,000 mt/a of electrolytic-grade copper, produced 1.75 Mmt of ore, and 20,850 tons of wirebar in 1990. Bishi Metal Exploration, a company associated with Mitsubishi, Japan, completed a feasibility study on assessing ore resources in Banwas, near Khetri. Banwas has 20 Mmt of copper ore reserves grading 2% Cu content. Bishi was also examining the feasibility for building an integrated mining and smelting complex in Khetri to expand its capacity from 31,000 mt/a to 45,000 mt/a of copper.

Gold.—In 1990, India produced 1,983 kg of gold, an increase of 8.5% from that of previous year. The Indian Government lifted its ban on gold imports and allows nonresident Indians to bring in as personal baggage up to 250 g of gold. These imports were to supplement domestic supplies and meet the rising demand from gold-hungry Indian consumers. In 1990, the estimated consumption of gold was 250 tons, but India produced less than 10% of that demand. The remainder was met partly by recycling and most of it by smuggling. It was estimated that about 170 tons of gold was smuggled into India in 1990.

The abolition of the Gold Control Act was a set back to the country's two primary gold producers—the Bharat Gold Mines (BGML) and Hutti Gold Mines (HGML). The cost of production of gold by BGML and HGML is higher than the international market price. The production costs for HGML was $157 to produce 10 g of gold, while the cost for BGML was $378. In comparison, the international price for gold is $140. The high costs are basically due to the low grade of ore and the increasing depth of mining operations. The gold content is 5 g/mt of ore mined in Hutti at a depth of 700 m, which is better than that of BGML, where the gold is mined at a depth of 3,000 m with gold content of 3.5 g/mt of ore.

The Geological Survey of India (GSI) has located a number of small gold deposits. These include Chigaragunta (1.35 Mmt grading 2.52 g/mt); Amgiri (36,000 tons grading 2.5g/mt); Old Visanatham (135,000 tons grading 5.1 g/mt) in Andhra Pradesh; Hosur Champion East (438,000 tons grading 2.84 g/mtn); Budhini (210,000 tons grading 2.16 g/mt); Mysore (90,000 tons grading 2.72 g/mt); Champion West Lode (1.19 Mmt grading 2.3 g/mt); and Kuorderkocha (515,000 ton grading 2.96 g/mt) in Karnataka.

HGML has discovered a high-grade ore mine in the sprawling mountainous area in Raichur, Karnataka, that had been abandoned 35 years ago. The deposit is estimated to contain about 5.5 Mmt of ore. The shaft is expected to yield an average of 7 g/mt of gold. The 976-m shaft will be ready for reuse within 2 years' time.

Iron and Steel.—There has been a severe shortage of hot-rolled steel sheets, and several industries using these sheets have been forced to close. The output by the six integrated steel plants—five in the public sector run by the Steel Authority of India (SAIL) and one in the private sector owned by Tata Iron and Steel Co. (TISCO)—and mini-steel mills of pig iron and salable steel were 1.35 Mmt and 13.13 Mmt, respectively, in fiscal 1989-90. Annual demand for pig iron is 1.8 Mmt. In 1990-91, the total output was estimated to be 1.2 Mmt, and there is likely to be a shortfall of 600,000 tons. The production of salable steel was also projected at 14 Mmt: SAIL—Bhilai, 2.85 Mmt; Bokaro, 2.92 Mmt, Durgapur 0.75 Mmt; Indian Iron and Steel Co. (IISCO), 0.34 Mmt; and Rourkela 1.06 Mmt; and TISCO—2.05 Mmt; Visakhapatnam Steel Plant (VSP) 179,000 tons; and the mini-steel plants, 3.85 Mmt. The demand for steel in 1990-91 is expected to be 16 Mmt.

More than 175 private-sector mini-steel mills use both direct-reduction and electric arc furnaces. Altogether, with about 14,000 rerollers, they accounted for the production of 4.1 Mmt of salable steel in 1989-90. At present, total installed capacity is about 5.7 Mmt. Only four mills have a capacity of 150,000 mt/a. Some mills have the capacity of 35 to 40 mt/a, but most have only annual capacity in the range of 5 to 10 mt/a. These small furnaces are energy intensive—average energy consumption is 700 kW·h/mt of steel. Owing to the inadequacy of public investment funds coupled with the relatively low cost of installing mini-steel mills, the Indian Government has liberalized procedures for investment both for modernization and expansion of existing facilities and for setting of new mills. The maximum new capacity was to exceed 1 Mmt/a. These mills were to use either electric arc furnaces or blast furnaces to produce pig iron and steel.

After many years of delay, one of the two 3,200-m^3 blast furnaces in VPS was put into operation and produced 6,000 tons of pig iron in 1990. The cost was three times the original estimate, and the projected crude steel capacity was reduced from 3.4 Mmt/a to 3.0 Mmt/a. After completion in 1993, the plant will produce 2.7 Mmt of finished steel consisting of bars and rods and 555,000 tons of pig iron. VSP is using a mix of technologies from the U.S.S.R. and Western countries. Blast furnace coke produced in India is characterized by its low strength, high ash content, and uneven quality. To ensure improved quality, VSP blended 20% of imported coking coal with domestic coals and used U.S.S.R.'s pneumo-mechanical separation technique to prepare the coking coal. Equipment was also imported from France, the Federal Republic of Germany, Italy, and the United Kingdom. VSP is the first major integrated steel plant in India to adopt 100% continuous casting. The labor productivity target is 230 tons per workeryear, which is much higher than the current 75 to 85 tons per workeryear in the Indian steel industry.

Lead and Zinc.—Lead and zinc deposits occur in a variety of geological environments in the Precambrian Peninsular Shield. However, more than 95% of the ore reserves is in Rajasthan. In 1990, the demand for lead and zinc was 80,000 tons and 170,000 tons, respectively, while the production of lead and zinc was 38,000 tons and 80,000 tons, respectively, requiring a domestic balance to be met by imports.

India has three zinc smelters—Debari, Rajasthan, and Visakhapatnam, Andhra Pradesh, both owned by the public-sector Hindustan Zinc Ltd. (HZL), and Alwaye, Kerala, owned by Cominco Binani Zinc Ltd. (CBZ)—with a total capacity of 96,000 mt/a. HZL has invested $375 million to build a lead and zinc smelter at Chanderiya in Rajasthan, which will put into production in May 1991. The new smelter was designed to produce 35,000 mt/a of lead and 70,000 mt/a of zinc. Financing for the project was from aid granted by the British Government. In return for the investment, HZL is expected to buy spare parts from the United Kingdom to maintain the British-developed Imperial Smelting Technology that will run the plant. Officials hoped that the new integrated complex would make India about 80% self-sufficient for zinc consumption and 65% for lead consumption.

Magnesium.—In 1990, two companies from the south, Southern Magnesium and Chemicals Ltd. (SMCL) and Tamil Nadu Magnesium and Marine Chemicals Ltd. (TNMMCL), began production of magnesium metal for the first time in India. SMCL is headquartered in Secunderabad, Andhra Pradesh, and its production plant is at Rajahmundry, Andra Pradesh. This is a joint venture between the Andhra Pradesh Industrial Development Corp. and an NRI group. TNMMCL is a public-sector company, a subsidy of the Tamil Nadu Industrial Development Corp.

Both magnesium producers have been licensed for a capacity of 2,000 mt/a each. The production process used by SMCL was developed by the National Metallurgical Laboratory, Jamshedpur, using the Pidgeon process. Dolomite is reduced by ferrosilicon in a furnace using gas, oil, or electricity. Dolomite is obtained from a mine in the Warangal District, with estimated reserve to last for 50 years. TNMMCL concentrates seawater from the Bay of Bengal to obtain bittern. The mother liquors are treated with calcium hydroxide to precipitate magnesium hydroxide. The residue is calcined to yield magnesium oxide, which is then chlorinated to yield magnesium chloride. Magnesium is obtained by electrolysis of magnesium chloride. The Pidgeon process is more expensive and more difficult to control than the electrolytic process. However, a higher-purity magnesium is obtained from the Pidgeon process.

Tin.—Madhya Pradesh State Mining Corp. (MPSMC) announced plans to build a tin smelting plant a Jagdalpur in Bastar District, Madhya Pradesh. The new plant will cost $1.5 million and will produce 100 mt/a of tin metal in 1992. The decision to build the smelter came after the successful operation of a pilot plant operated as a joint venture between the Metallurgy Division of the Bhabha Atomic Research Center and the MPSMC. The smelter will use locally sourced concentrates from a MPSMC mine.

Tungsten.—India's demand for tungsten concentrates was to increase from 3,400 tons in 1989-90 to 4,800 tons in 1994-95. Therefore, the country's Eighth 5-Year Plan working group has recommended the expansion of the country's tungsten industry, including increasing the existing milling capacity in Degana, Rajasthan, and developing the scheelite-wolframite deposit at Kuhi-Khobna in Maharashtra. In January 1991, HZL has undertaken production of tungsten from Rajasthan State Tungsten Development Corp. Ltd. (RDTDC), a subsidy of Rajasthan State Mineral Development Corp. Ltd. RDTDC had been operating the tungsten mine at Degana, Rajasthan, which produced 20 to 30 mt/a of concentrate, that currently has been incurring losses. HZL plans to mechanize the open pit mine, which will increase production from 30 mt/a to 500 mt/a in the near future.

Mineral Fuels

Coal.—India produced 213 Mmt of bituminous and anthracite coal in 1990, an increase of 7% compared with 1989 output, and was targeted to increase to 300 Mmt in 1995 and to 400 Mmt by the year 2000. Power shortage had affected coal production in India. Owing to low production from Coal India Ltd. (CIL), SAIL plants have been forced to import an alltime high of 4.5 Mmt of low-ash prime coking coal from Australia, New Zealand, Poland, and the U.S.S.R.

In order to meet the production target in 1995, the Government of India has allocated $7.5 billion for the Eighth 5-Year Plan period for coal industries. Approximately 70% of the funding would be spent on procurement of equipment, while 80% of the targeted coal production would come from improved mechanized mines through the deployment of modern mining equipment.

India and China agreed to broaden bilateral trade to expand their $300 million trade and agreed to have joint ventures in the extraction of coking coal and high-quality iron ore. China was to buy up to 1.2 Mmt of high-quality iron ore from India, which it badly needs. In return, India will import petroleum products, worth up to $5 million, from China as well as up to 50,000 tons of coking coal.

Jharia Coalfield, the only prime coking coal mine in India, remained under fire. There were 70 incidences of known mine fires that were still alive with the span of 17 km^2 in Jharia. The fires have resulted in a loss of 37 Mmt of coking coal. Jharia has a reserve of 10,000 Mmt of coking coal and 7,000 Mmt of noncoking coal. These fires cause heavy environmental pollution problems and serious damage to land and scarce water resources in the area.

Oil and Gas.—India's crude oil production fell short of the Seventh 5-Year Plan (1984-85 to 1989-90) target of 1,140 million barrels even though oil production increased from 220 million barrels in 1984-85 to 34

258 million barrels in 1989-90. During this period, India's self-sufficiency in oil declined from 80% to 60%. The sharp decline in this period was because oil companies—the Oil and Natural Gas Commission (ONGC) of the public sector; responsible for 90% of the offshore and onshore oil and gas exploration, Chevron/Texaco, Broken Hill Proprietary, and Shell—failed to locate and bring into production new oil deposits. Also, higher demand from the expanding middle class and overproduction and poor reservoir management at India's premier oilfield and gasfield, the Bombay High (BH) were chronic problems.

In 1990-91, India's domestic crude oil production fell 23 million barrels short of the original 251 million barrels goal for two reasons—the political unrest in Assan and the loss of about 100 wells in BH. BH produces about 160 million barrels of crude oil annually, although there has been a slight decline in production since 1988. Overexploitation of BH has damaged several oil wells between 1987 and 1989. An appointed committee from the India Government recommended a temporary shutdown of the damaged wells for repairs to avert irrecoverable loss of reserves, estimated at 450 to 1,100 million barrels. Repair of these wells could take up to 5 years and will reduce BH's crude oil production of 19 million barrels yearly. The Indian Government hopes that new exploration finds, 80 kilometers southwest of Bombay near Heera at a water depth of 40, may be capable of producing at the rate of 6 to 8 million barrels annually. Estimated reserves were 350 to 420 million barrels of oil.

Under the country's Eighth 5-Year Plan, the Indian Government has drawn up an ambitious $6 billion plan to increase crude oil production capacity from 255 million barrels in 1989-90 to 365 million barrels in 1994-95. The country still will fall short of oil self-sufficiency, in which the Government estimates the demand for petroleum products will be 575 million barrels by 1994-95. The plan is to develop oil and gas reserves in western offshore sites for development into an integrated project. These sites include the Neelam, Panna, Mukta oilfields and gasfields and the Mid and South Tapti gasfield.

The Krishna-Godavari and Cauvery basins in the coastal States of Andhra Pradesh and Tamil Nadu are emerging as a major source of oil and gas in the southern region. These basins have a total area of 59,000 km² and contain about 11,400 million barrels of hydrocarbon reserves. ONGC has invested $2.16 billion to raise production from 15 million barrels to 45 million barrels and to increase the operative rigs from 20 to 55 by 1994-95. ONGC also plans to construct a pipeline network connecting the gasfield in the Krishna-Godavari and Cauvery basins with consumers.

Reserves

The country's mineral resources have not been fully delineated. There are many areas where large deposits of bauxite, coal, gas, iron ore, limestone, and oil are still likely to be found. Iron ore deposits, mainly in the form of hematite or magnetite, occur in Bihar, eastern Madhya Pradesh, Orissa, Karnataka, and Tamil Nadu. Bauxite deposits are mainly in Orissa and Andra Pradesh. They also occur in Matharashtra, Tamil Nadu, Bihar, and Gujarat. Low-grade copper deposits are in Rajasthan, Madhya Pradesh, Bihar, and Andra Pradesh. Lead and zinc deposits are in Rajasthan and Bihar. Nickel and chromium ore reserves exist in Orissa. Gold is produced only in small amounts in Karnataka, and diamonds are mined in Madhya Pradesh. The ilmenite sands in Kerala and Tamil Nadu contain a large amount of thorium.

TABLE 5

INDIA: ESTIMATED RESERVES OF MAJOR MINERAL COMMODITIES FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Bauxite		1,000,000
Barite		35,000
Chromite ore and concentrate		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		e100,000
Manganese ore		154,000
Natural gas	billion cubic meters	647
Petroleum crude	million barrels	5,307
Phosphate rock		102,000
Salt		(1)
Talc and related minerals		15,000
Titanium, in concentrates		62,000
Zinc, in concentrate		4,813
Zircon, in concentrates		1,420

eEstimated.
1Essentially all from seawater.

INFRASTRUCTURE

India's road network includes 515,000 km of hard-surface two-lane roads and approximately 1.12 M 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 accommodate the 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 (1.00-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 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 electric 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 terrains in various 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 phosphate and potash; and mineral fuels such as 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. But India's formidable and confusing plexus of trade regulations and restrictions, including arbitrary tariff schedules, may defeat the kind of trade relations that the country would seem to need to progress.

[1]Where necessary, values have been converted from Indian rupees (Rs) to U.S. dollars at the rate of Rs18.50=US$1.00.

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Ministry of Steel and Mines
27 Jawaharlal Nehru
Calcutta 700 016, India

Indian Bureau of Mines
New Secretariat Building
Nagpur 440 001, 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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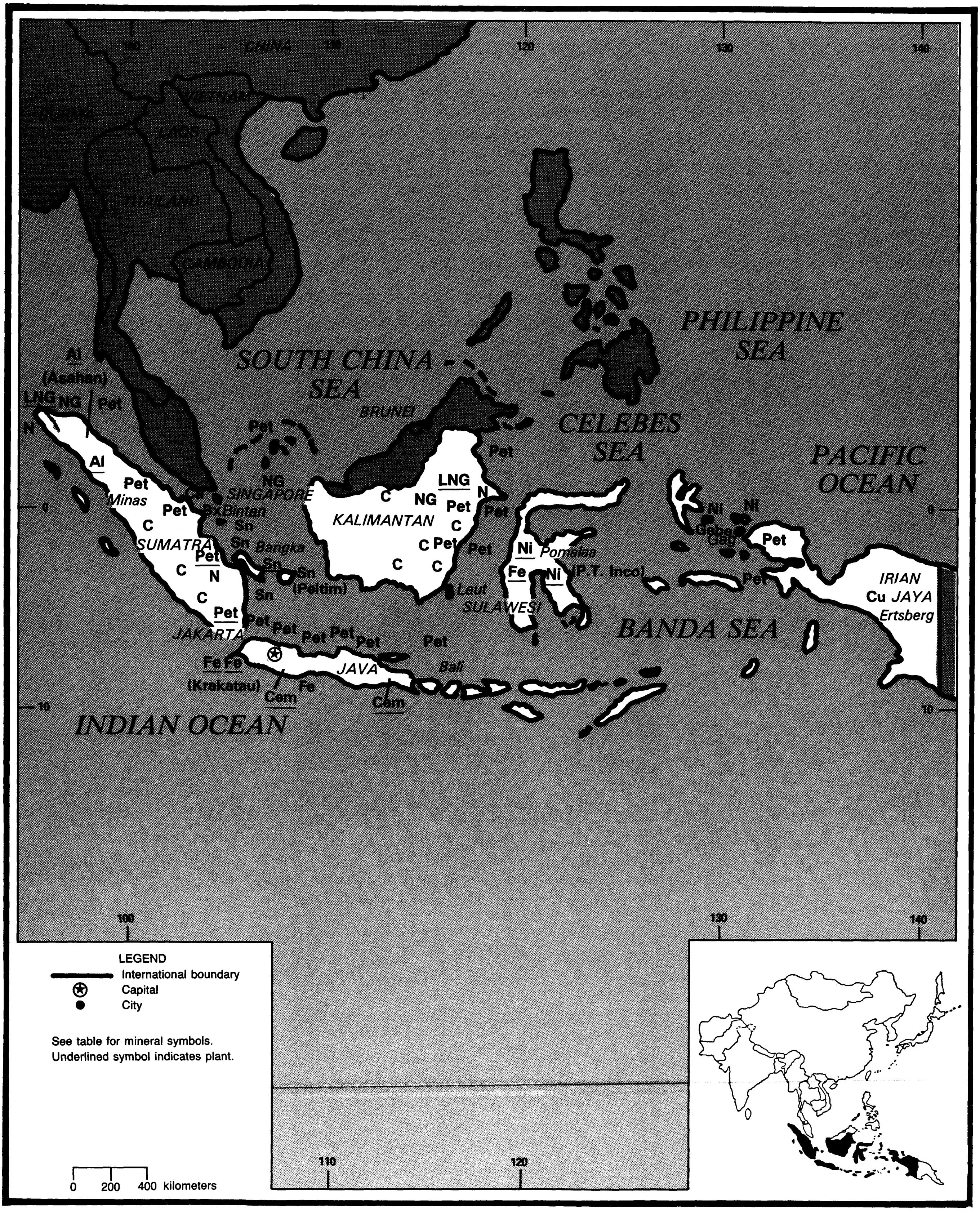
INDONESIA

AREA 1,919,440 km² **POPULATION 190.1 million**



THE MINERAL INDUSTRY OF INDONESIA

By Chin S. Kuo

Indonesia registered an economic growth of 7.0% in 1990 under the Government's program of economic deregulation.[1] Due to the fast pace of economic activity and rapid growth in the money supply, the nation's inflation rate was pushed to 9.5%. Higher fuel prices, the Government raised on an average of 18% in May were also contributing factors.

The strong performance of the non-oil and gas sector continued to contribute to the economic growth, although the petroleum sector's shrinking role remained important to the GDP. The oil and gas sector is well established, and output is capable to meet domestic demand as well as export shipments. In the past few years, though, the development of the domestic coal sector has been rapid. Indonesia has abundant reserves of nonfuel mineral resources, ample for its own needs and for export.

GOVERNMENT POLICIES AND PROGRAMS

The contribution of the private mining sector to the state revenues in the form of taxes and royalties has.risen steadily and was expected to continue to increase in the future. The Government encouraged greater participation by foreign mining companies in regional development, labor force training, technology transfer, and in the promotion of vertical integration to increase the added value of minerals by creating a better investment atmosphere.

The Government began to provide financial incentives for mining companies operating in eastern frontier areas such as the islands of Sumba and Timor and the Province of Irian Jaya. Under new regulations, tax breaks involve exemption of property taxes until commercial production. Fixed assets can be depreciated at 12.5% per year, rather than at 5%, and fringe benefits for employees became tax deductible. For existing projects with additional investment of 50% of the initial capital, a 50% cut in property taxes is available for the first 8 years of a project's life. Investors may be allowed to carry forward business losses for up to 8 years. Other incentives to encourage foreign and domestic investors for gold and other metal mining were being considered. However, foreign firms may no longer apply for new coal mining licenses.

In another measure, the Government removed tariffs of 20% to 30% on most kinds of cement imports to ease area shortages, particularly in West Java. The country's cement production exceeded consumption by about 3 Mmt.

PRODUCTION

Output of oil and natural gas had gradually increased over the past 2 years: crude and condensate production totaled 1.5 Mbbl/d in 1990, a 3% increase, and gas production increased by 10% over that of 1989. About 65 Mbbl of condensate and 2.6 Mmt of LPG were produced from the country's gas resources, largely for export.

However, output from the remaining sectors of the mining industry showed mixed results: tin and nickel production fell slightly, while that for copper and gold improved. Production of industrial minerals rose as a result of demand generated by booming domestic construction.

Coal production increased as coal contractors and large Government mines expanded their operations. Coal played an increasingly important role in Indonesia's domestic energy mix as well as contributing to its export earnings.

TRADE

Export earnings growth slowed in 1990, in part owing to lower world prices for Indonesia's natural resource-based products. Low prices adversely affected the country's nickel export revenue. But at more than \$250 million,[2] nickel ranked second to copper as the country's leading mineral export. However, the doubling of world oil prices due to the Persian Gulf war increased export earnings and Government revenues. The country exported about 60% of its oil production. Natural gas production exceeded 57 billion m³ in 1990. LNG exports, which represented about one-half of total gas production, increased by about 10% in 1990 to more than 20 million tons and went to Japan, the Republic of Korea, and Taiwan. In order to meet the current strong demand by the construction industry, the Government eliminated import duties on cement and banned its export.

STRUCTURE OF THE MINERAL INDUSTRY

Operations in the mineral industry are conducted by either state-owned companies or local and foreign companies that either obtain work contracts or operate under production-sharing contracts with the Government. Pertamina (oil and gas), P.T. Tambang Timah (tin), P.T. Aneka Tambang (bauxite and nickel), P.T. Indocement (cement), and P.T. Tambang Batubara and P.T. Tambang Batubara Bukit Asam (both for coal) are all state-owned companies. Two major foreign mining companies are engaged in large-scale mining and processing of copper and nickel, namely Freeport Indonesia Inc. and P.T. International Nickel Indonesia (P.T. Inco).

There were 165,000 workers employed by the mineral industry. Employment in the oil and gas industry was the largest, followed by those in the industrial minerals sector, and in the tin industry. There was a lack of skilled labor reportedly in the concession areas of Freeport Indonesia and P.T. Inco as these companies operated more advanced equipment and facilities.

COMMODITY REVIEW

Metals

Aluminum.—P.T. Inalum continued operating its 225,000-mt/a primary smelter at Kuala Tanjung, northern Sumatra, at 80% of capacity. Production of high-grade ingot was down because of the insufficient water reservoir level needed to generate power. The water supply of Lake Toba had dropped to a level that prevented generating 500 MW of electric power needed by the \$2.1 million smelter. Inalum imported alumina mainly from Australia. About 60% of the smelter's production went to Japan, and the rest was used domestically. The Japanese hold a 58.87% stake in the operation through Nippon Asahan Aluminum. A \$28 million

TABLE 1

INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
METALS						
Aluminum:						
Bauxite, gross weight	thousand tons	650	635	513	862	1,206
Metal, primary		218,772	202,002	184,859	196,869	185,863
Chromite sand, dry basis		—	—	7,636	7,635	[e]8,000
Copper, mine output, Cu content		95,781	102,058	121,472	143,970	178,115
Gold, mine output, Au content[2]	kilograms	3,304	3,643	4,738	6,155	11,158
Iron and steel:						
Iron sand, dry basis		153,271	193,986	202,748	142,654	145,401
Metal:						
Ferroalloys: Ferronickel		22,554	8,354	26,852	26,058	25,025
Steel, crude		1,500,000	1,453,000	2,050,000	[e]2,000,000	[e]2,100,000
Manganese ore		6,612	1,855	10,957	9,364	9,417
Nickel:						
Mine output, Ni content[3]		53,679	57,764	57,982	62,987	68,308
Metallurgical products:						
Matte: Ni content		27,975	26,508	28,864	29,030	24,949
Ferronickel: Ni content		4,518	1,683	4,905	4,964	5,005
Silver, mine output, Ag content	kilograms	46,596	50,485	58,336	73,884	67,315
Tin:						
Mine output, Sn content		24,497	26,093	29,590	31,263	30,200
Metal		22,083	24,200	28,365	29,916	30,389
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	10,941	11,844	12,242	14,099	13,762
Clays:						
Bentonite		5,730	7,962	8,266	3,863	5,914
Fireclay		2,134,856	2,356,327	2,222,420	1,730,834	[e]1,800,000
Kaolin powder		132,240	122,046	147,109	157,122	112,423
Diamond:[e]						
Industrial stones	thousand carats	22	22	22	25	23
Gem	do.	6	7	7	7	7
Total	do.	28	29	29	32	30
Feldspar		17,995	15,019	11,388	13,025	19,779
Gypsum		532	1,367	894	449	58
Iodine	kilograms	5,790	8,227	9,753	14,275	59,820
Nitrogen: N content of ammonia		2,298,500	2,363,900	2,366,700	2,526,400	[e]2,600,000
Phosphate rock		608	3,098	411	10,549	1,600
Salt, all types[e]	thousand tons	600	600	600	600	600
Stone:						
Dolomite		—	38,492	70,043	68,731	10,537
Granite	thousand tons	1,422	1,181	1,122	1,195	[e]1,200
Limestone	do.	12,784	15,966	13,430	10,199	9,510
Marble	square meters	3,530	5,645	2,369	1,112	1,013
Quartz sand and silica stone		782,620	877,579	421,126	301,706	165,198
Sulfur, elemental		4,525	3,941	4,321	3,890	3,628
Zeolite		—	—	626	640	[e]600

See footnotes at end of table.

TABLE 1—Continued

INDONESIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
MINERAL FUELS AND RELATED MATERIALS						
Asphalt rock, natural		242,055	84,889	—	—	—
Coal	thousand tons	2,601	2,979	4,095	8,812	10,769
Gas, natural:						
Gross	million cubic feet	1,628,860	1,731,083	1,846,861	1,975,421	2,158,921
Marketed	do.	1,113,286	1,188,358	1,312,090	1,397,873	[e]1,500,000
Petroleum:						
Crude including field condensate	thousand 42-gallon barrels	507,228	479,057	491,509	514,184	533,666
Refinery products:						
Liquefied petroleum gas	do.	2,787	3,905	3,130	3,245	[e]3,200
Gasoline	do.	28,119	30,007	32,026	36,580	[e]37,000
Jet fuel	do.	1,631	3,763	5,795	7,223	[e]8,000
Naphtha	do.	17,306	17,309	17,471	12,696	[e]13,000
Paraffin wax	do.	116	152	192	143	[e]150
Kerosene	do.	43,043	42,207	41,413	43,500	[e]43,000
Distillate fuel oil	do.	73,490	77,355	79,628	84,307	[e]85,000
Lubricants	do.	1,574	1,574	1,462	1,504	[e]1,500
Residual fuel oil	do.	30,221	42,245	47,241	40,565	[e]41,000
Unfinished oil requiring further processing	do.	22,621	1,663	1,565	[e]1,600	[e]1,700
Refinery fuel and losses	do.	10,004	12,790	13,677	13,409	[e]13,500
Unspecified	do.	2,533	1,806	4,790	2,046	[e]2,100
Total	do.	233,445	234,776	248,390	[e]246,818	[e]249,150

[e]Estimated. [p]Preliminary.
[1]Table includes data available through June 20, 1991.
[2]Includes Au content of copper ore and output by Government-controlled foreign contractors' operations. Gold output by operators of so-called People's 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.

TABLE 2

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	466,517	843,476	293,976	Japan 549,499.
Metal including alloys:				
Scrap	2,297	167	—	All to Japan.
Unwrought	125,628	142,885	100	Japan 137,116; Malaysia 3,023.
Semimanufactures	787,901	709,578	—	Singapore 687,676; Japan 18,671.
Chromium: Ore and concentrate	80	15,198	—	Philippines 9,000; Australia 3,600; Singapore 2,560.
Cobalt:				
Ore and concentrate	—	44,000	—	All to Australia.
Oxides and hydroxides	—	4	—	All to Singapore.

See footnotes at end of table.

TABLE 2—Continued

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989 United States	Destinations, 1989 Other (principal)
METALS—Continued				
Copper:				
Ore and concentrate	299,665	321,745	—	Japan 240,173; Republic of Korea 29,936; West Germany 21,941.
Metal including alloys, all forms	18,368	25,291	NA	Thailand 15,927; Republic of Korea 2,539; Hong Kong 1,772.
Gold: Metal including alloys, unwrought and partly wrought	22	NA		
Iron and steel:				
Metal:				
Scrap	5,024	420	—	Japan 368; Malaysia 18.
Pig iron, cast iron, related materials	138,408	53,687	—	Japan 43,844; Thailand 9,840.
Ferroalloys:				
Ferromanganese	—	2,441	—	NA.
Ferrosilicon	828	4,322	—	Japan 1,480; Malaysia 250.
Ferronickel	—	25,238	—	Japan 12,593; Netherlands 11,508.
Unspecified	—	4	—	All to Singapore.
Steel, primary forms	266,503	31,452	—	Japan 375; unspecified 31,077.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	251,670	459,067	1,323	Japan 252,102; Republic of Korea 92,402.
Clad, plated, coated	191,477	35,625	222	Iraq 18,838; Singapore 5,884; Hong Kong 5,354.
Of alloy steel	—	1,576	—	All to Burma.
Bars, rods, angles, shapes, sections	—	261,748	20,083	Iraq 112,195; Japan 57,943; Thailand 37,821.
Rails and accessories	193	505	—	Japan 501.
Wire	141,824	279	175	Australia 69; Japan 18.
Tubes, pipes, fittings	37	9,274	1,493	Japan 3,076; Singapore 2,501.
Lead:				
Ore and concentrate	95	20	—	All to Singapore.
Metal including alloys, all forms	966	4,940	—	Taiwan 3,077; Malaysia 1,090; Japan 342.
Manganese:				
Ore and concentrate:[2] Metallurgical-grade	5,720	16,020	—	NA.
Oxides	386	—		
Molybdenum: Ore and concentrate	NA	43,010	—	Australia 43,000; Singapore 10.
Nickel:				
Ore and concentrate	1,253,611	1,081,531	—	Japan 819,588; Australia 251,293.
Matte and speiss	58,769	38,166	100	Japan 38,066.
Metal including alloys, all forms	—	3,956	—	All to Japan.
Platinum-group metals: Metal including alloys, unwrought and partly wrought value, thousands	—	$400	—	West Germany $230; Japan $170.
Silver: Metal including alloys, unwrought and partly wrought do.	—	$9	$9	
Tin:				
Ore and concentrate	1,139	766	—	Malaysia 503; United Kingdom 262.

See footnotes at end of table.

TABLE 2—Continued

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS—Continued				
Tin:—Continued				
Metal including alloys:				
Scrap	259	—		
Unwrought	26,990	29,714	—	Singapore 24,594; Netherlands 3,340; West Germany 800.
Semimanufactures	90	845	—	Mainly to Singapore.
Titanium: Oxides	—	5	—	All to Singapore.
Tungsten:				
Metal including alloys, all forms kilograms	601	1,000	—	All to Netherlands.
Zinc:				
Oxide	—	18	—	NA.
Metal including alloys:				
Scrap	507	109	—	Japan 88; Singapore 21.
Unwrought and semimanufactures	214	398	—	Taiwan 146; Thailand 63; India 58.
Zirconium: Ore and concentrate	—	115	—	All to Singapore.
Other:				
Ores and concentrates	97,499	1,843	—	Singapore 1,801; Republic of Korea 42.
Ashes and residues	38	19	—	Singapore 10; West Germany 9.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	89,804	119,125	6,797	Hong Kong 73,323; Taiwan 13,462.
Grinding and polishing wheels and stones	1,225	153	—	Singapore 62; Malaysia 50; Hong Kong 21.
Barite and witherite	2,178	7,695	—	All to Singapore.
Cement thousand tons	3,066	4,233	12	Bangladesh 1,019; Singapore 471; Taiwan 462.
Chalk	—	17	—	United Kingdom 9; Australia 8.
Clays, crude:				
Bentonite	5,544	12,114	—	Singapore 6,775; Malaysia 5,337.
Kaolin	82,682	121,468	—	Japan 47,888; Malaysia 16,071.
Unspecified	1,687	4	—	Mainly to Italy.
Cryolite and chiolite	—	285	—	All to Malaysia.
Diamond, natural: Gem, not set or strung value, thousands	—	$106	—	Thailand $44; Belgium-Luxembourg $31; Singapore $31.
Diatomite and other infusorial earth	—	61	—	NA.
Feldspar, flourspar, related materials	21	15	—	All to Thailand.
Fertilizer materials:				
Crude, n.e.s.	3,801	2,238	—	Japan 1,958; China 179.
Manufactured:				
Ammonia	309,326	315,417	—	Philippines 138,051; Taiwan 104,856; Malaysia 31,689.
Nitrogenous	1,055,462	1,476,964	—	China 376,382; Philippines 240,952; Vietnam 217,090.
Phosphatic	4,285	663	—	Taiwan 555; Japan 100.
Unspecified and mixed	35	4,000	—	Mainly to Japan.
Gypsum and plaster	166,213	110,753	—	All to Philippines.
Iodine including fluorine and bromine	—	13	—	All to India.

See footnotes at end of table.

TABLE 2—Continued

INDONESIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989 United States	Destinations, 1989 Other (principal)
INDUSTRIAL MATERIALS—Continued					
Mica: Crude including splittings and waste		6	6	—	All to Singapore.
Phosphates, crude		11,789	13,192	—	Taiwan 8,079; Singapore 4,210; Japan 581.
Pigments, mineral: Iron oxides and hydroxides, processed		—	40	—	NA.
Precious and semiprecious stones other than diamond: Natural	kilograms	11,285	7,000	—	NA.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		138	150	—	All to Malaysia.
Sulfate, manufactured		9,885	7,058	—	Singapore 5,978; Thailand 980.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	thousand tons	874	983	(3)	Singapore 962; Vietnam 11.
Worked		7,728	7,725	1,290	Australia 2,600; Japan 1,075; Papua New Guinea 976.
Dolomite, chiefly refractory-grade		—	40	—	NA.
Gravel and crushed rock		756	4,546	52	Hong Kong 2,112; Japan 1,046.
Quartz and quartzite		24,600	6,390	—	Japan 6,200.
Sand other than metal-bearing	thousand tons	24,088	3,664	—	Singapore 3,354; Hong Kong 310.
Sulfur:					
Elemental:					
Crude including native and byproduct		8	—		
Colloidal, precipitated, sublimed		855	—		
Sulfuric acid		30	20	—	NA.
Other:					
Crude		24	73	—	NA.
Slag and dross, not metal-bearing		14	—		
MINERAL FUELS AND RELATED MATERIALS					
Carbon:					
Carbon black		13	—		
Gas carbon		296	566	—	Republic of Korea 387; Taiwan 179.
Coal:					
Anthracite and bituminous	thousand tons	1,361	2,392	—	Malaysia 481; Japan 415; Bangladesh 256.
Briquets of anthracite and bituminous coal		—	94,669	—	Thailand 16,500; Bangladesh 12,500; unspecified 60,669.
Gas, natural: Liquefied	thousand tons	18,884	19,497	—	Japan 17,363; Republic of Korea 2,133.
Peat including briquets and litter		—	25	—	NA.
Petroleum:					
Crude	thousand 42-gallon barrels	276,518	287,656	72,298	Japan 157,203; China 12,267; Republic of Korea 10,895.
Refinery products:					
Liquefied petroleum gas	do.	10,713	26,309	9	Japan 22,575; Singapore 1,339.
Gasoline	do.	—	13,818	1,480	Japan 10,949; Philippines 926.
Mineral jelly and wax	do.	38	23	—	Thailand 8; Malaysia 4.
Distillate fuel oil	do.	1,701	37	—	All to Japan.
Lubricants	do.	111	71	—	Japan 63; Thailand 7.
Residual fuel oil	do.	46,078	38,583	6,899	Japan 30,244; Republic of Korea 1,152.
Bitumen and other residues	do.	1,963	—		
Petroleum coke	do.	—	934	261	Japan 169; Netherlands 158.

NA Not available.
[1]Table prepared by Audrey D. Wilkes.
[2]Includes manganiferous iron ore and concentrate.
[3]Less than 1/2 unit.

TABLE 3

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS				
Alkali and alkaline-earth metals	3	32	—	West Germany 41; Hong Kong 39; China 36.
Aluminum:				
Ore and concentrate	—	22	2	China 20.
Oxides and hydroxides	332,175	432,544	179	Australia 401,626; India 10,091.
Metal including alloys:				
Scrap	64	191	33	Singapore 114; Hong Kong 25.
Unwrought	6,818	7,580	1,334	Australia 4,497; United Arab Emirates 522.
Semimanufactures	58,592	15,367	83	Singapore 3,534; Japan 2,838; Taiwan 1,827.
Antimony: Metal including alloys, all forms	—	150	—	Thailand 41; Hong Kong 39; China 36.
Arsenic: Oxides and acids	101	NA		
Bismuth: Metal including alloys, all forms	—	1	—	Mainly from Japan.
Chromium:				
Ore and concentrate	25	95	—	Australia 64; Japan 11.
Oxides and hydroxides	585	540	35	West Germany 126; United Kingdom 105; China 101.
Cobalt:				
Ore and concentrate	—	50	—	All from Singapore.
Oxides and hydroxides	24	30	(2)	Japan 9; Belgium-Luxembourg 6.
Metal including alloys, all forms	—	10	—	United Kingdom 5; West Germany 5.
Columbium and tantalum: Tantalum metal including alloys, all forms value, thousands	$23	—		
Copper:				
Ore and concentrate	150	638	560	Singapore 78.
Matte and speiss including cement copper	7	—		
Sulfate	534	NA		
Metal including alloys:				
Scrap	140	99	81	Japan 17.
Unwrought	31,021	39,867	—	Chile 16,434; Zambia 12,510; Philippines 4,183.
Semimanufactures	6,693	8,371	230	Japan 2,664; West Germany 552; China 447.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	128	275,606	—	Brazil 275,075; Netherlands 221.
Pyrite, roasted thousand tons	766	2,123	—	Sweden 1,437; Brazil 488; India 132.
Metal:				
Scrap	584,708	718,653	27,498	Australia 241,175; Vietnam 112,517.
Pig iron, cast iron, related materials	201,861	283,548	152	Trinidad and Tobago 72,573; Iran 54,500; China 42,234.
Ferroalloys:				
Ferromanganese	6,760	21,565	80	China 7,405; Australia 6,595; Mozambique 3,407.
Ferrosilicomanganese	9,754	11,709	—	China 4,596; Mozambique 2,081; Hong Kong 1,065.
Ferrosilicon	331	1,415	—	China 762; Philippines 251; Hong Kong 211.
Unspecified	355	369	23	Japan 84; Brazil 75.
Steel, primary forms	326,278	363,987	11,301	Brazil 98,827; Republic of Korea 72,066.

See footnotes at end of table.

TABLE 3—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
METALS—Continued				
Iron and Steel—Continued				
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	172,324	455,720	2,304	Japan 299,818; Republic of Korea 101,735.
Clad, plated, coated	731,988	63,962	12	China 305; Republic of Korea 101; Japan 57.
Of alloy steel	15,320	27,828	398	Japan 17,594; Republic of Korea 3,438.
Bars, rods, angles, shapes, sections	19,550	139,687	1,197	Japan 59,600; Republic of Korea 28,292.
Rails and accessories	21,524	5,236	—	Republic of Korea 1,982; Japan 1,707.
Wire	122,532	22,294	12	Republic of Korea 9,505; Taiwan 4,987; Japan 3,710.
Tubes, pipes, fittings	5,316	193,601	8,887	Japan 78,296; West Germany 21,935; Mexico 20,825.
Lead:				
Oxides	962	1,026	—	Singapore 274; Republic of Korea 273; Mexico 200.
Metal including alloys:				
Scrap	752	12,044	—	Australia 4,280; Singapore 1,755; Belgium-Luxembourg 1,505.
Unwrought	15,339	14,517	17	Australia 11,082; United Kingdom 1,309.
Semimanufactures	60	359	1	West Germany 264; Japan 27.
Magnesium: Metal including alloys, all forms	158	225	52	Norway 73; Japan 41.
Manganese:				
Ore and concentrate:[3] Metallurgical-grade	1,680	1,380	—	Singapore 1,357; West Germany 17.
Oxides	20,217	17,872	626	Singapore 12,323; Japan 4,354.
Metal including alloys, all forms	—	57	—	United Kingdom 38; Japan 13.
Mercury	55	86	([2])	Japan 31; China 30.
Molybdenum:				
Ore and concentrate	—	104	—	All from West Germany.
Metal including alloys, all forms	11	—		
Nickel:				
Ore and concentrate	—	4	—	All from Japan.
Matte and speiss	4	—		
Metal including alloys:				
Scrap	21	3	—	Singapore 2; China 1:
Unwrought	65	124	—	Finland 43; Japan 42; West Germany 22.
Semimanufactures	657	472	17	China 182; West Germnay 67; Japan 52.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	([2])	$100	$6	Malaysia $88.
Rare-earth metals including alloys, all forms	21	NA		
Silver: Metal including alloys, unwrought and parly wrought value, thousands	$15	$191	—	West Germnay $186; Netherlands $5.
Tin:				
Oxides	26	—		
Ash and residue containing tin	83	NA		
Metal including alloys, all forms	246	653	4	Republic of Korea 15; unspecified 620.

See footnotes at end of table.

TABLE 3—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS—Continued				
Titanium:				
Ore and concentrate	—	1,056	—	Australia 1,054; Japan 2.
Oxides	2,610	4,645	225	Republic of Korea 1,035; West Germany 745; Japan 523.
Tungsten:				
Ore and concentrate	—	1	—	All from Hong Kong.
Metal including alloys, all forms	28	NA		
Uranium and thorium:				
Ore and concentrate	—	$68	—	All from United Kingdom.
Oxides and other compounds	186	NA		
Metal including alloys, all forms value, thousands	$83	NA		
Vanadium: Oxides and hydroxides	9	—		
Zinc:				
Ore and concentrate	([2])	—		
Oxides	376	559	5	Republic of Korea 150; Japan 76; China 44.
Metal including alloys:				
Scrap	936	476	—	Singapore 386; Thailand 90.
Unwrought	51,705	44,615	30	Australia 34,883; Canada 6,333.
Semimanufactures	671	908	37	Singapore 434; Norway 138; China 113.
Zirconium:				
Ore and concentrate	—	360	—	United Kingdom 186; Hong Kong 68.
Metal including alloys, all forms	—	46	—	Malaysia 36; Australia 10.
Other:				
Ores and concentrates	1,413	562	—	Australia 287; Malaysia 150.
Ashes and residues	490	1,158	66	Japan 663; Singapore 159; Malaysia 96.
Base metals including alloys, all forms	151	4	—	United Kingdom 2; West Germany 1.
Metalloids[4]	413	1,046	22	China 429; West Germany 318.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	1,448	802	8	Hong Kong 336; China 309.
Artificial:				
Corundum	321	377	—	Japan 173; United Kingdom 131.
Silicon carbide[5]	538	NA		
Dust and powder of precious and semi-precious stones including diamond value, thousands	$4	$36	—	All from Japan.
Grinding and polishing wheels and stones	3,284	4,626	72	China 2,645; Japan 574.
Asbestos, crude	18,698	21,265	26	Canada 9,175; Brazil 4,866; Zimbabwe 3,901.
Barite and witherite	33,197	62,085	554	Thailand 46,677; unspecified 13,317.
Boron materials:				
Crude natural borates	16	372	346	Turkey 20.
Oxides and acids	358	611	253	Italy 182; Turkey 119.
Cement	2,110	2,273	20	China 49; Japan 35; unspecified 2,150.
Chalk	1,748	2,339	—	Taiwan 2,298; Malaysia 21.
Clays, crude	55,705	77,350	31,332	China 18,932; Australia 5,349; Japan 4,233.
Cryolite and chiolite	13	18	—	All from Japan.

See footnotes at end of table.

TABLE 3—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Diamond: Natural: Gem, not set or strung value, thousands	—	$40	—	All from Belgium-Luxembourg.
Diatomite and other infusorial earth	2,045	1,337	981	Republic of Korea 147; Japan 142.
Feldspar, fluorspar, related materials	16,000	22,677	—	China 12,861; India 3,185; Japan 2,778.
Fertilizer materials:				
Crude, n.e.s.	439	5,885	109	Malaysia 4,530; West Germany 904.
Manufactured:				
Ammonia	12	8	1	Singapore 5; Japan 1.
Nitrogenous	6,430	603	126	Australia 574; Singapore 41.
Phosphatic	932	277,611	78	Iraq 78,365; Romania 66,878.
Potassic	523,257	364,462	213	Jordan 19,338; U.S.S.R. 98,838; Canada 91,940.
Unspecified and mixed	36,027	84,979	315	U.S.S.R. 42,912; Iraq 16,580; Republic of Korea 10,145.
Graphite, natural	448	780	—	Republic of Korea 403; China 92; Taiwan 84.
Gypsum and plaster	92,531	141,630	66	Thailand 131,962; France 2,475.
Iodine	21	NA		
Kyanite and related materials	98	NA		
Lime	265	132	44	Singapore 28; Romania 23.
Magnesium compounds:				
Magnesite, crude	—	205	1	West Germany 103; Taiwan 101.
Oxides and hydroxides	6,664	16,690	5	China 6,987; Hong kong 4,439; Japan 1,431.
Mica:				
Crude including splittings and waste	440	505	181	Malaysia 69; France 46; Japan 42.
Worked including agglomerated splittings	24			
Nitrates, crude	1,543	3,065	—	Chile 2,686; Belgium-Luxembourg 221.
Phosphates, crude thousand tons	1,036	886	33	Jordan 469; Morocco 300.
Pigments, mineral:				
Natural, crude	3,232	NA		
Iron oxides and hydroxides, processed	5,150	6,313	176	China 2,463; West Germany 2,325; Japan 501.
Potassium salts, crude	2	10,500	—	All from Canada.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	—	$5	—	Malaysia $4.
Synthetic do.	$3	$37	$6	Hong Kong $28; Singapore $3.
Pyrite, unroasted	—	5	—	All from Japan.
Salt and brine	757	175,809	9	Australia 175,100; China 212.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	199,785	209,819	151,986	France 13,244; Japan 11,883; East Germany 9,605.
Sulfate, manufactured	15,605	33,951	5,383	China 13,217; Japan 3,517.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	15,293	26,184	—	China 11,558; Italy 9,360.
Worked	5,069	2,664	—	Taiwan 1,724; China 305;
Dolomite, chiefly refractory-grade	5,069	8,185	—	United Kingdom 4,519; Japan 1,557; Netherlands 1,174.
Gravel and crushed rock	1,576	4,020	1,161	France 2,355; Singapore 188.

See footnotes at end of table.

TABLE 3—Continued

INDONESIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel:—Continued				
Limestone other than dimension	15	2,425	(2)	Taiwan 1,827; United Kingdom 357.
Quartz and quartzite	553	477	7	Sweden 195; Singapore 160.
Sand other than metal-bearing	6,036	10,050	5,875	Malaysia 2,801; Taiwan 633.
Sulfur:				
Elemental:				
Crude including native and byproduct	61,970	50,143	19	Singapore 30,936; Republic of Korea 2,484; Hong Kong 2,067.
Colloidal, precipitated, sublimed	283,607	250,436	27,514	Canada 213,520; Iraq 9,005.
Dioxide	50	20	(2)	Australia 9; Netherlands 8.
Sulfuric acid	26	210	12	Japan 107; China 60.
Talc, steatite, soapstone, pyrophyllite	28,569	28,082	40	China 20,231; Hong Kong 3,024.
Vermiculite including perlite	—	1,269	117	Japan 559; Republic of Korea 282.
Other:				
Crude	22,966	63,741	81	West Germany 43,795; East Germany 15,673.
Slag and dross, not metal-bearing	42,686	35,942	176	China 18,535; Japan 13,962.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	613	32,165	137	Taiwan 23,113; Singapore 8,692.
Carbon:				
Carbon black	41,551	50,957	4,208	Australia 16,271; Republic of Korea 10,347.
Gas carbon	154	NA		
Coal:				
Anthracite and bituminous thousand tons	1,035	1,312	49	Australia 932; China 266.
Lignite including briquets	587	864	649	Republic of Korea 56; France 48; China 46.
Coke and semicoke	31,798	[6]42,844	19	China 11,976; Japan 9,157; Australia 8,786.
Peat including briquets and litter	99	—		
Petroleum:				
Crude thousand 42-gallon barrels	30,452	34,693	—	Iraq 16,777; Iran 8,140; Malaysia 4,480.
Partly refined do.	164	NA		
Refinery products:				
Liquefied petroleum gas do.	(2)	(2)		
Gasoline do.	330	5,857	(2)	Singapore 5,098; Saudi Arabia 469.
Mineral jelly and wax do.	49	50	4	China 14; West Germany 11.
Kerosene and jet fuel including white spirit do.	1,235	1,157	26	Singapore 742; Malaysia 122.
Distillate fuel oil do.	9,963	11,384	(2)	Singapore 6,054; Saudi Arabia 1,534; Kuwait 1,451.
Lubricants do.	679	836	316	Singapore 168; Malaysia 106.
Residual fuel oil do.	3,469	3,422	—	All from Singapore.
Bitumen and other residues do.	974	1,927	—	Singapore 1,865; China 12.
Bituminous mixtures do.	19	14	1	Singapore 7; United Kingdom 2.
Petroleum coke do.	201	209	209	

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.

TABLE 4

INDONESIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons per year unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Aluminum:			
Bauxite	P.T. Aneka Tambang	Kijang, Bintan Island	1,300
Metal	P.T. Indonesia Asahan Aluminum	Kual Tanjun, North Sumatra	225
Cement	P.T. Indocement	Citeureup, West Java	7,700
	P.T. Semen Cibinong	Narogong, East Java	1,500
	P.T. Semen Gresik	Gresik, East Java	1,500
	P.T. Semen Padang	Indarung, West Java	1,530
Coal	P.T. Allied Indo Coal	Parambahan, West Sumatra	500
	P.T. Tambang Batubara Bukit Asam	Bukit Asam, South Sumatra	4,000
	Perum Tambang Batubara	Ombilin, West Sumatra	1,000
Copper, concentrate	Freeport Indonesia, Inc.	Ertsberg and Grasber, Irian Java	350
Granite	P.T. Karium Granite	Karium Island	2,000
Petroleum, crude thousand barrels per day	Atlantic Richfield Indonesia, offshore West Java	Arjuna and Arimbi,	170
Do.	Maxus Southeast Asia Ltd.	Cinta and Rama, offshore South-east Sumatra	95
Do.	PERTAMINA	Jatibarang, West Java and Bunyu, offshore East Kalimantan	80
Do.	P.T. Caltex Pacific Indonesia	Minas, Duri, and Bangko, Central Sumatra	700
Do.	Total Indonesie	Handi and Bakapai onshore and offshore East Kalimantan	180
Gas:			
Natural million cubic feet per day	Mobil Oil Indonesia, Inc.	Arun, Aceh in North Sumatra	1,700
Do.	Roy M. Huffington	Badak, East Lalimantan	1,000
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.	Bontang, East Kalimantan	7,900
Nickel:			
In ore	P.T. Aneka Tambang	Pomalaa, South Sulawesi; and on Gebe Island, Moluccas	34
In matte	P.T. International Nickel Indonesia	Soroako, South Sulawesi	48
Nitrogen	P.T. Asean-Aceh Fertilizer	Lhokseumawe, North Sumatra	506
Do.	P.T. Pupuk Iskandar Muda	Lhokseumawe, North Sumatra	506
Do.	P.T. Pupuk Kalimantan Timur	Bontang, East Kalimantan	1,012
Do.	P.T. Pupuk Sriwijawa	Palembang, South North Sumatra	1,438
Steel, crude	P.T. Krakatau Steel	Cilegon, West Java	2,000
Tin:			
In ore	P.T. Koba Tin (Government,	Koba, Bangka Island	6
Do.	P.T. Tambang Timah	Onshore and offshore the islands of Bangka, Belitung, and Singkep	32
Metal, refined	Peleburan Timah Indonesia	Mentok, Bangka Island	32

aluminum casting facility was being built near the smelter and was scheduled to be completed by 1992. It would produce 30,000 mt/a of extrusion billet and 20,000 mt/a of foundry alloys for the domestic market. The joint-venture plant is controlled by Inter Asia Commodities Ltd. and P.T. Aldevco.

P.T. Imelda Udama, a $2 million joint venture, planned to produce 600 mt/month of aluminum alloy in Java, starting in April 1991. It is owned by Sumitomo Corp. of Japan (20%); Ahresty Corp. (15%), a Japanese producer of light alloy diecasting; and P.T. Nonferindo Utama (65%).

Construction on a 40% Indonesian-owned, $59 million aluminum rolling mill funded by Comcraft Services of the United Kingdom was expected to start early in 1991 and come on-stream in late 1993. The 25,000-mt/a plant at Ceraboon, northwest of Jakarta, would produce 7,000 mt/a of foil and 18,000 mt/a of sheet and coil. The capacity for foil output at the Indonesian-owned Alumindo plant was being doubled from 5,000 mt/a to 10,000 mt/a.

Chromite.—P.T. Aneka Tambang, a state-owned mining company, developed a chromite mine near Wosu Port on Sulawesi Island and started production in 1990 of metallurgical- and refractory-grade chromite ore. The company planned to ship the metallurgical-grade chromite to Japan and the foundry sand-grade to Gebe Island, Maluku, to be used in cast iron production.

Copper.—Freeport Indonesia Inc. planned to raise its ore capacity to 52,000 mt/d to increase copper and gold production by mid-1992, with 32,000 mt/d coming from the Grasberg ore body. At this operating level, it would be the fifth largest single copper-gold operation in the world. Currently, Freeport Indonesia ran at 31,700 mt/d and produced an estimated 169,000 tons of copper, 9.2 tons of gold, and 60 tons of silver in 1990. Output was to increase to 40,000 mt/d in 1991. Its parent company, Freeport-McMoRan Copper and Gold Inc., planned to finalize a new 30-year contract with the Indonesian Government to expand the $550 million Grasberg Project operation in Irian Jaya and reduce ownership in the Indonesian subsidiary to 80%. Ten percent of the common stock would be sold to Indonesian investors, and the Government would increase its share to 10%. A 150,000-mt/a copper smelter project was under consideration at an estimated cost of $400 million for operation by 1994.[3]

The Grasberg ore body was estimated to have ore reserves of 267 Mmt, and output began in early 1990. Production from Grasberg averaged 16,500 mt/d during the fourth quarter of 1990, a 13% increase over that of the previous quarter. During the second half of 1990, proven ore reserves were increased by 90 Mmt to 357 Mmt at an average grade of 1.53% copper, 1.97 g gold, and 3.24 g silver per ton of ore. The Grasberg Mine now possesses the largest published gold reserve of any single operating mine in the world.[4]

Domestic consumption of copper metal was about 40,000 tons. Freeport Indonesia was Indonesia's sole producer of copper ore and the bulk of its concentrates were sent to Japanese smelters. Some went to the Republic of Korea.

Gold.—CRA of Australia acquired 67.95% interest in the $194 million Kelian Project in East Kalimantan. Kalimantan Gold of Australia held 22.05% and P.T. Buana Jaya Raya Jakarta Mining Co. the remaining 10%. Mine construction was on schedule, and initial production was to begin at the end of the year. It was to process 6 million mt/a of ore to produce 7,500 kg of gold. Proven and probable reserves at Kelian totaled 53.5 Mmt at an average grade of 1.97 g gold per ton.

The Kasongan contract of work, held by Jason Kasongan Pty. (42.5%), Pelsart Kasongan Pty. (42.5%), both of Australia, and Indonesian interests (15%), was to reassess open pit minable reserves at the Mirah gold project in Kalimantan. The probable reserve was estimated to be 3.6 Mmt grading 2.1 g gold and 52 g silver per ton of ore.

A $34 million gold, silver, and barite open pit mine with a capacity of 600,000 mt/a of ore was brought on-stream in late 1990 at Lerokis on the island of Wetar in Maluku Province. The mine is operated by P.T. Prima Lirang Mining and owned by Billiton International Metals of Netherlands (90%) and P.T. Prima Maluku Indah (10%). Planned average annual output was 1,700 kg of gold, 24,900 kg of silver, and 160,000 tons of barite. Total reserves were calculated at 5 Mmt grading 40% barite and 4 g gold and 100 g silver per ton.

Freeport Indonesia planned to produce 15 tons of gold annually in 1992 as compared with the original projection in 1989 of 5 tons for 1992. The gold from copper concentrate was expected to be 1 g/mt of concentrate. The Cikotok Mine in West Java and the Lusang Mine in Bengkulu had an average gold of 2.5 g/mt and 4 g/mt in copper concentrate, respectively.

Jason Mining Ltd. of Australia has 10% interest with Pelsart Pty. Ltd. (20%), Duval Indonesia (60%), and P.T. Gunung Muro Perkasa (10%) in the Mount Muro gold project in Central Kalimantan. Mine development at a cost of $56 million was deemed feasible with a 2-year construction timetable.

Iron and Steel.—State-owned P.T. Krakatau Steel, the largest integrated steelmaker in southeast Asia, began its $600 million expansion project in Cilegon, West Java, which was expected to be completed by 1993. To be funded in part by loans from Government banks, the expansion, when completed, should end most steel imports. Projected annual capacity for sponge iron would be 2.3 Mmt; for steel slabs, 1.8 Mmt; for hot-rolled coils, 1.8 Mmt; and for wire, 220,000 tons. To support the expansion project, Krakatau Steel doubled the handling capacity of iron pellets and coal at its port in West Java, expanded electric generating capacity to 700 MV, and was to acquire shares in overseas companies to guarantee a steady supply of iron pellets for its operations. A $2 to $3 billion project for a second integrated mill was also under study.

Other expansion programs were underway or completed by Ispat Indo and P.T. Budidharma. Operators of at least seven rolling mills invested or planned to invest upstream in steelmaking facilities. P.T. Budidharma moved upstream with the construction of an electric melting shop and conti-caster. The rebar capacity would rise from 120,000 mt/a to 150,000 mt/a.

P.T. Sumimagne Utama, a joint venture between Japanese and Indonesian steel companies, started construction of Indonesia's first ferrite plant to produce 450 mt/month of ferrite magnets and 1,000 mt/month of magnetic materials. The plant was expected to be operational in late 1991. The joint venture is owned by Sumitomo Special Metals Co. Ltd. (55%), Sumitomo Corp. (25%), P.T. Saota Panji Manggala (10%), and P.T. Krakatau Industrial Estate Cilegon (10%).

The Government planned to nationalize P.T. Cold Rolling Mill Indonesia by buying out the equity held by P.T. Kaolin Indah Utama (40%) and P.T. Sestiacier SA (20%). It already has a 40% stake in the $825 million mill that produced 500,000 tons of cold-rolled sheet and coil in 1990, well below annual capacity of 850,000 tons. The mill is at Cilegon, 85 km west of Jakarta, and fed with hot-rolled steel from Krakatau Steel.

An international consortium, P.T. PSP Mitracorp Industries, planned to spend $20 million building a plant to make steel pipes in Indonesia. It would be owned by Pusan Steel Pipe Corp. (45%) and Samsung Co. (10%) of the Republic of Korea, P.T. Mitracorp Pacific Nusantara (40%), and Mitsubishi (5%) of Japan.

Nickel.—P.T. Inco had an explosion with a death toll of six at one of its plant's electric furnaces in Soroako on the island of Sulawesi in August. The damaged furnace was repaired by yearend, and production has resumed. The company produced 27,100 tons of nickel in matte (77% to 80%) in 1990. Early in the year, a $70 million expansion project in the mine and smelter, scheduled for completion by the fourth quarter, was started for a 64% increase in output over that of 1989. The expansion project included a fourth kiln line and an additional, larger transformer to supply power to the smelter furnaces. P.T. Inco's reserves were estimated at 72 Mmt of nickel ore. Its production costs were probably the lowest of any producer in the Western World. Inco Ltd. of Toronto's stake in P.T. Inco is 58.19%.

Nickel was also produced from two mines operated by state-owned P.T. Aneka Tambang. Ore exports from the Gebe Island Mine increased slightly in 1990 to 1.7 Mmt. Breakdowns in Aneka Tambang's single-line smelting plant at Pomalaa kept ferronickel output short of its 5,000-mt\a nickel capacity.[5] The company announced a $112 million project to more than double the Pomalaa smelter's output by yearend 1993.

Tin.—The country's production of tin in concentrate declined 3.4% to 30,200 tons in 1990, while smelter output increased slightly to 30,400 tons.[6] Exports gained 2% to 26,000 tons. Indonesia is the world's second largest tin producer after Brazil and the largest producer in the Association of Tin Producing Countries that include Australia, Bolivia, Malaysia, Nigeria, Thailand, and Zaire. Brazil and China, two large tin producers, are not members of this association.

State-owned P.T. Tambang Timah accounted for 75% of Indonesia's tin production and operated the country's only tin smelter with a capacity of 32,500 mt/a at Mentok, Bangka Island. It also ran tin mines on Singkep, Bangka, and Belitung Islands. Up to 40% of the annual production of 23,800 tons came from leased mines to local operators, of which it retained ownerships. Tin output was about 22,500 tons for 1990 and was expected to be 5% less in 1991. The company sought World Bank financial assistance in the amount of $500 million, which involved rejuvenating costs for its fleet of 31 dredges and workshops, to improve operations, and to reconstruct production facilities. It planned a 5-year modernization project beginning in 1991 to cut production costs and increase the annual output capacity to between 27,000 and 30,000 tons.

In an effort to double efficiency in tin production by 1995, the company was to concentrate on its mining operations at Bangka, South Sumatra, and all offshore sites and to transferr its onshore mining operations at Belitung, South Sumatra, and Singkep, Riau, to private companies, beginning as early as 1991. The cost of production at these two sites was higher than the price of tin on the international market. Other measures included restructuring of the company's organization, improving and developing employee skills, and moving its headquarters from Jakarta to a location closer to operational sites on Bangka Island.

P.T. Koba Tin mined an onshore tin deposit on southeast Bangka Island and is a joint venture between a subsidiary of Renison Goldfield Consolidated of Australia (75%) and P.T. Tambah Timah (25%). The company had an estimated production capacity of 8,000 to 8,500 mt/a. The only other operating tin producer was P.T. Gunung Ki-Kara Mining that ran a small underground and open pit mine on Belitung Island. The company is a joint venture owned predominately by Indonesian and British interests.

Industrial Minerals

Acorn Securities Ltd. of Australia proposed to finance and develop the Southeast Kalimantan Diamond Project by raising $26 million through a combination of debt and equity. Acorn was to maintain an interest of 72.5% in the project and rename itself Indonesian Diamond Corp. Ltd. The feasibility study called for an operating level associated with a 0.74 m^3-bucket ladder dredge instead of the original 0.45 m^3-bucket ladder dredge. Projected average annual production was expected to be 117,000 carats for the first 5 years of operations. Estimated capital costs included onshore processing and supporting facilities, working capital, and the dredge. The proven gravel reserves were estimated to be 2.94 Mm^3 at an average grade of 0.103 carats/m^3. There was 933,000 m^3 at 0.068 carat/m^3 in the Danau Channel, 1.81 Mm^3 at 0.110 carat/m^3 in the main channel, and 197,000 m^3 at 0.207 carat/m^3 in the southern channel.

Mineral Fuels

Coal.—Two state-owned coal companies, Perum Tambang Batubara and P.T. Tambang Batubara Bukit Asam, were merged under Government order and named P.T. Bukit Asam. The combined coal production rose 57% to 4.4 Mmt in 1990. Perum had operated mines in western Sumatra, and P.T. Tambang Batubara Bukit Asam operated mines in southern Sumatra.

Total coal production in the country was 13 Mmt, and exports totaled 4.5 Mmt and were shipped to Japan, the Republic of Korea, and Taiwan. By the end of 1994, Indonesia was expected to produce 25 Mmt/a of coal and would be a significant exporter of coal in the 1990's. There are 10 private coal companies, 9 of them foreign or with foreign participation, chiefly Australian. Five of the companies collectively were producing about 5 Mmt, with 3.4 Mmt of the output for overseas sale.

P.T. Indonesia Bulk Terminal planned to expand its Pulau Laut Coal Terminal facility to load bulk carriers of 180,000 dwt at a rate of 4,000 mt/h. Construction was scheduled for completion in September 1992.

Indonesia's total coal resources, ranging from bituminous to lignite, amounted to more than 30 billion tons. It was reported that the Kawai district in West Aceh had an estimated coal reserve of 710 Mmt. About 10% of the 100 km^2 of coal deposits was being exploited with an annual production of 1.2 Mmt.

Liquefied Natural Gas.—Total Indonesie and Inpex of Japan produced from Mahakam in eastern Kalimantan 84,600 bbl/d of oil and 13.95 Mm^3/d of gas that was supplied to the Bontang LNG plant. Conoco Indonesia, Inc. flowed 4,900 bbl/d of oil and 0.40 Mm^3/d of gas from its production-sharing contract area in the South Natuna Sea. Occidental Berau Indonesia found a gas flow of 0.68 Mm^3/d in its Roabiba-1 well in shallow waters off Irian Jaya. Occidental owns 40% of the block and Nippon Oil Exploration Berau and Sun Oil Berau Indonesia, 30% each. Asamera Overseas Ltd. flowed 0.74 Mm^3/d of gas in southern Sumatra. Asamera holds 54% of the block, Bow Valley Industries, 36%; and Pertamina, 10%. Japan Petroleum Exploration Co. and Osaka Gas Co. were to develop jointly the Universe Gas & Oil project in East Kalimantan.

Pertamina signed a contract to supply 2 Mmt of LNG annually to three Japanese utility firms for 20 years. Delivery to Tokyo Gas, Osaka Gas, and Toho Gas was expected to begin in 1994 from the Bontang LNG plant in eastern Kalimantan. Pertamina was to supply additional LNG to Tokyo Electric Power Co. Inc. and Tohoku Electric Power Co. for 14 years. Pertamina also sold 1.5 Mmt/a of LNG to Taiwan and 2 Mmt/a to the Republic of Korea on a long-term basis. Korea Gas Corp. agreed to buy an additional 3.5 Mmt/a in stages beginning in 1992. Indonesia exported 20.7 Mmt of LNG and was the world's largest exporter of the commodity. The country was to increase exports to about 22 Mmt in 1991.

Meanwhile, production of LNG would be increased by 50% to 30 Mmt/a over the next two decades, compared with 20 Mmt now. The new Natuna gasfield near Singapore would be brought into operation, adding to existing proven reserves of 821 billion m^3. The Government was considering construction of a pipeline to transport natural gas from the Natuna field to the Arun LNG plant in Sumatra, instead of setting up a new LNG complex in Natuna. A pipeline would also be built to link the Natuna field to the industrial island of Batam and to the Duri onshore oilfield in Sumatra.

Petroleum.—Indonesia imposed a temporary production curtailment for crude oil by 40,000 bbl/d for 3 months, equivalent to a 3.11% cut of the country's April production in 1990. Pertamina was to cut production of Widuri crude oil by 68,000 bbl/d to 190,000 bbl/d, beginning in 1991, because of difficulties in marketing the heavy, low-sulfur-grade crude oil.

The country agreed to sell the Republic of Korea 50,000 bbl/d of light crude oil on a long-term basis after November, when additional crude production came on-stream.

During the year, Pertamina planned to construct three oil refineries at a total cost of $5.1 billion. Together with existing plants, the country's total processing capacity would reach 830,000 bbl/d. The Irian Jaya refinery in Sorong, with a capacity of 120,000 bbl/d, was to be built at a cost of $1.8 billion by Nichimen of Japan, Unocal, and Total Indonesie. The $1.5 billion Riau refinery in Tanjung Uban would be constructed by the joint-venture partners of Pertamina, C. Itoh of Japan, and an unidentified U.S. company to process 120,000 bbl/d of oil. The third refinery, having also a capacity of 120,000 bbl/d and to be in Riau's Sungai Pakning, would involve a $1.8 billion venture between Chevron of the United States and Far East Oil Trading, a partnership of Pertamina, Kanematsu Corp., and Mitsui & Co. of Japan. Currently under construction was a $1.8 billion refinery in West Java's Balongan with a capacity of 125,000 bbl/d. This is a joint-venture project between Pertamina, Foster Wheeler of the United Kingdom, British Petroleum, Far East Oil Trading, JGC Corp., and Mitsui & Co.

Pertamina signed one production-sharing contract with Mobil of the United States and BHP of Australia and one technical assistance contract with P.T. Humpuss Patragas in August. In addition, Pertamina also extended the 1968 contract for Conoco's Natuna Sea B block until the year 2018. Pertamina was to have signed 20 new exploration contracts with foreign operators at a total investment of $800 million during 1990.

Oil exploration activities continued to accelerate in 1990 as 20 new production-sharing contracts were signed. In addition, eight oil producers received 20-year extensions to their original contracts. Fifty foreign oil companies now operate 90 contracts in active exploration or production.

Reserves

Indonesia's major mineral commodities are bauxite, coal, copper, crude oil, natural gas, nickel, and tin. Nickel reserves are large and mainly in South Sulawesi, on Gebe Island, and on Gag Island. Tin reserves are also large and found onshore and offshore Bangka Island and around nearby islands of Belitung, Karimum, Kundur, and Singkep. There are significant reserves of bauxite, which is concentrated on Bintan Island and West Kalimantan; coal in West and South Sumatra; and copper in the Ertsberg and Grasberg areas of Irian Jaya. Crude oil and natural gas are onshore and offshore Sumatra, offshore North Java, and onshore and offshore East Kalimantan.

INFRASTRUCTURE

In general, Indonesia's infrastructure serving the mineral industry is adequate for mine or mill output to reach domestic markets and for export. However, in some regions such as Kalimantan and Sumatra where gold and coal mining has been active, development of transportation and materials handling systems needs to be accelerated.

The Government owns all 6,964 km of railroads, some of which is double track and some electrified. The total length of highways is 119,500 km, mostly under local jurisdiction. The island country has about 21,600 km of inland waterways. Pipelines to transport crude oil and natural gas are well-developed and measured 2,505 km and 1,703 km, respectively. Coal terminals in use or being built are at Tarahan in South Sumatra, Laut Island off South Kalimantan, and Teluk Bayur on the western coast of Sumatra. In addition, an iron ore receiving port at Cigading in West Java is being expanded.

The country is to increase electrical output from current 29 billion kW to 42.7 billion kW by the end of 1994. The completion date of several new powerplants under construction in Java and Bali has been pushed forward. The first phase construction of the State Electricity Co.'s powerplant in Gresik near Surabaya is scheduled to be completed by the end of 1992.

TABLE 5

INDONESIA: RESERVES OF MAJOR MINERALS

Commodity		Reserves
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.

OUTLOOK

The country's mineral industry is expected to continue to grow because of strong demand for its mineral products from domestic and overseas markets. Despite the array of metals being mined and processed, the Government mainly plans to concentrate on steel and aluminum. The demand for steel products has been increasing continuously for the past 5 years. In particular, the demand for structural steel has increased by 5% yearly and that for steel plates and sheets by 7%. State-owned Krakatau Steel is an integrated steelmaking company that manufactures most steel products, except galvanized sheets. It works jointly with P.T. Tambang Timah to produce tin sheets and tinplates for internal use and export to Asian and European countries.

Massive investment ($2 billion) in P.T. Inalum is being considered by the Government to ensure an adequate supply of electricity by building a dam in Asahan, North Sumatra, a hydropower plant, and power transmission system, as well as an electrolysis plant for producing refined aluminum.

The current, robust rate of growth of the Indonesian economy may be slowed if the development of basic infrastructure is not accelerated. For instance, there is an infrastructure shortage in Kalimantan in the gold prospecting areas. Further increase in coal export relies on construction of major infrastructure developments being planned in the coal sector.

Although being an oil exporter, Indonesia must still import part of its refined products to meet the increasing domestic demand. Pertamina plans to more than double its existing refining capacity and make the country virtually self-sufficient in refined products.

Indonesia's contract-of-work system of exploration and development still is not seeing many new mines being placed into operation. This is partly due to legal and financial difficulties with the system. The Government is striving to create a favorable investment climate for private and foreign mining companies by providing tax relief and other incentives.

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[1]U.S. Dep. of Commerce. Foreign Economic Trends—Indonesia. Mar. 1991, pp. 11.

[2]Where necessary, values have been converted from Indonesian rupiahs (Rp) to U.S. dollars at the rate of Rp1,858=US$1.00 for 1990.

[3]U.S. Embassy, Jakarta, Indonesia. Industrial Outlook Report—Copper. State Dep. Telegram 2592, Mar. 1991, pp. 8

[4]Freeport-McMoRan Copper & Gold, Inc., Reno, Nevada. Company news release, Jan. 1991, pp. 2.

[5]U.S. Embassy, Jakarta, Indonesia. Industrial Outlook Report—Nickel. State Dept. Telegram 4479, Apr. 1991, pp. 4.

[6]U.S. Embassy, Jakarta, Indonesia. Industrial Outlook Report—Tin. State Dept. Telegram 1452, Feb. 1991, pp. 2.

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Department of Mines and Energy J1. Jend. Gatot Subroto kav.49 Jakarta 12790, Indonesia

Directorate of Mineral Resources and Geological Research and Development Center J1. Diponegoro 57 Bandung 40122, Indonesia

Directorate General of Oil and Gas J1. M.H. Thamrin No. 1 Jakarta Pusat, Indonesia

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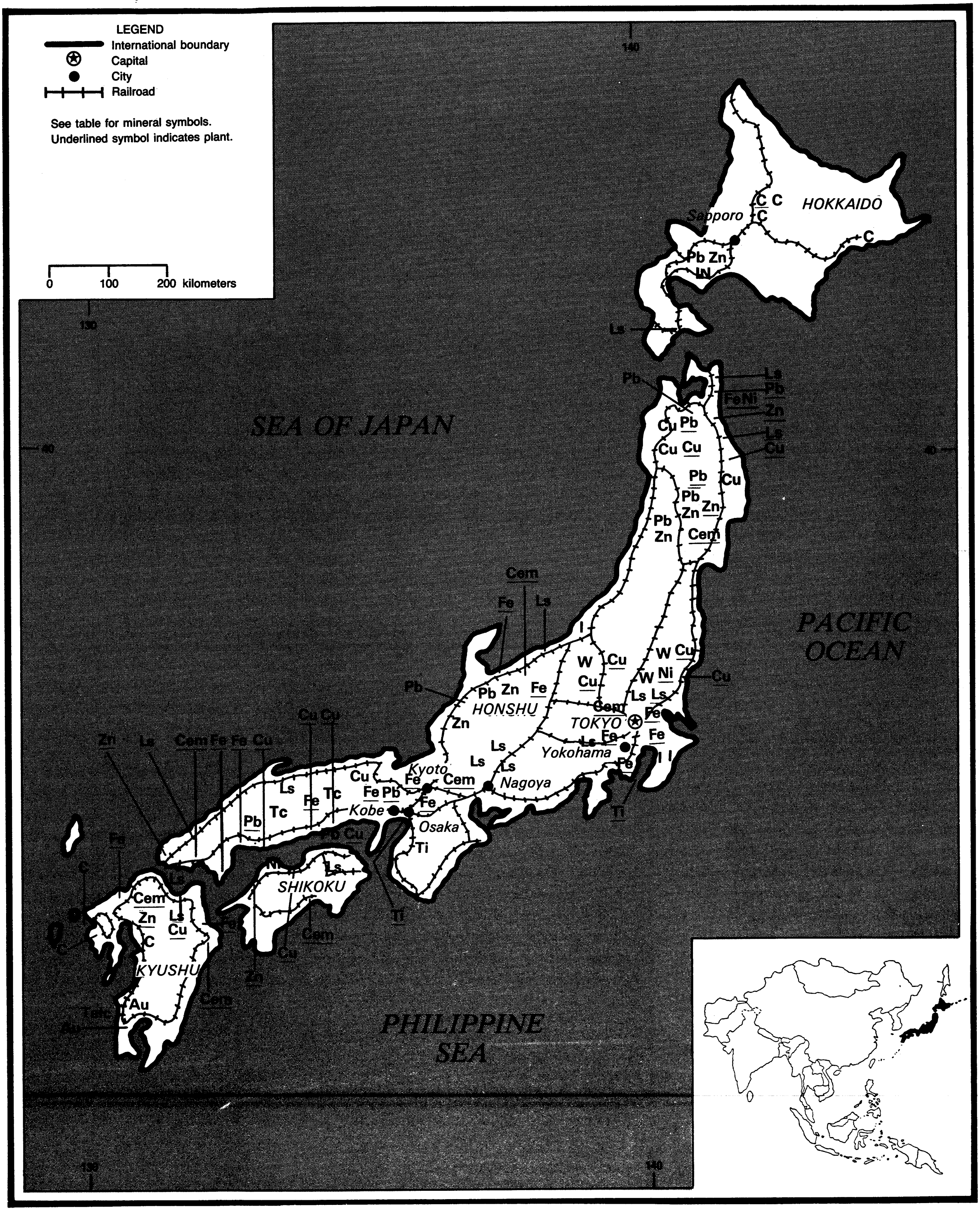
JAPAN

AREA 377,835 km² **POPULATION 124.0 million**



THE MINERAL INDUSTRY OF JAPAN

By John C. Wu

In 1990, Japan was the world's largest producer of indium metal, iodine, electrolytic manganese dioxide, pyrophyllite, selenium metal, and tellurium metal. It was the world's second largest producer of cadmium metal, high-purity gallium metal, pig iron, steel, titanium sponge, and zinc metal; and the third largest producer of cement, copper metal, limestone, and nickel metal. Japan was also one of the world's top six producers of bismuth metal, bromine, lime, primary magnesium, and silica sand. Ore reserves of crude petroleum, natural gas, and most nonfuel minerals in Japan are very small. However, its reserves of iodine, limestone, and silica stone and sand are large and of world significance.

Japan is a major world market for metals and minerals. It is a large consumer of primary aluminum, cadmium metal, chromite, coal, cobalt metal, copper concentrate and metal, diamond, ferrochromium, iron ore, ilmenite and rutile, industrial salt, LNG, manganese ore, nickel ore and matte, crude petroleum, potash, phosphate rock, precious metals, rare earths, and zircon. On the other hand, Japan is a major exporter of cement, manufactured fertilizer materials, iodine, electrolytic manganese dioxide, high-purity rare metal products, iron and steel products, and titanium sponge and mill products.

The mining sector of Japan's mineral industry continued to shrink in 1990 because of mine closures and production cutbacks due to high production costs and increased imports. The value of output by the mining sector was estimated at $10 billion[1] and accounted for less than 0.4% of Japan's GDP in 1990. According to Japan's Economic Planning Agency, Japan's GDP in 1990 was about $2.9 trillion. However, the mineral processing sector expanded slightly in 1990 and continued to play an important role in providing the basic materials for the large manufacturing sector, thereby sustaining a steady growth of Japanese economy in 1990.

Japan remained an important market for U.S. exports of primary aluminum, beryllium metal, coal, copper (concentrate and refined), ferrous and nonferrous scrap metals, lithium products, primary magnesium, molybdenum concentrate, phosphate rock, rare earths, soda ash, tantalum products, and refined petroleum products, especially diesel fuel and kerosene. On the other hand, Japan continued to be an important supplier of fabricated aluminum mill and copper mill products, cement, iodine, iron oxide, high-purity rare metals, high-quality steel products, and titanium sponge and mill products to the United States.

Japan's mineral commodity imports, including metallic ore and scrap, coal, crude and refined petroleum, LNG, iron and steel products, and nonferrous metals, rose 19.2% to $80.3 billion in 1990, according to the Ministry of Finance. Japan's mineral commodity exports, including metallic and industrial mineral products, dropped 7.6% to $22.8 billion in 1990. Japan suffered a larger mineral trade deficit of $57.5 billion in 1990 compared with $42.7 billion in 1989 mainly due to more imports of mineral fuels, which rose to $56.7 billion from $43.1 billion in 1989, and less exports of iron and steel products, which dropped to $12.5 billion from $14.8 billion in 1989.

Of total imports of mineral fuels in 1990, $31.6 billion was for crude and partially refined petroleum, $9.7 billion for refined petroleum products, $6.7 billion for LNG, $6.2 billion for anthracite and bituminous coal, and $2.5 billion for other fuels. Imports of metallic ore and scrap totaled $9.1 billion, of which $3.4 billion was for iron ore, and $5.7 billion for nonferrous ore and ferrous and nonferrous scrap. Iron and steel products and nonferrous metals imports were $4.6 billion and $9.9 billion, respectively, in 1990. Japan's metal exports totaled $19.5 billion, of which $12.5 billion was iron and steel products and $7.0 billion, nonferrous and other metals. Exports of industrial mineral products totaled $3.2 billion in 1990.

GOVERNMENT POLICIES AND PROGRAMS

The Ministry of International Trade and Industry (MITI) announced a new mineral policy for the 1990's in June 1990. In addition to the policy objective of securing a stable supply of raw materials, MITI expanded its 1990's policy objectives to include securing a stable supply of metals, ensuring an efficient distribution of nonferrous metals, stockpiling of rare metals, and helping to maintain a stable price in the world metal market.[2]

To secure a stable supply of raw materials, the Government actively encourages and assists private companies to conduct overseas and domestic minerals exploration. Assistance is also given to develop technology for exploration of deep-sea mineral resources; to develop new technologies for remote sensing, mining deep ore bodies, processing low-grade ores, and metal recycling; and to increase information collection and analysis for forecasting capability.

To secure a stable supply of metal, the Government seeks to strengthen the competitiveness of domestic metal producers and to extend technical assistance to metal producers of developing countries for controlling their mining-related pollution. To ensure a fair distribution of nonferrous metal, the Government is to establish a regional metal trading market in Japan similar to the London Metal Exchange. In the stockpile of rare metals, the Government is to review stockpile goals and objectives in response to changing market conditions. The Government is to cooperate with both metal producing and consuming countries in stabilizing metal prices in the world market.

In implementing the policy, Japan continued to build its rare 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 the Metal Mining Agency of Japan (MMAJ), by fiscal year 1990 ending March 1991, the stockpile of the seven metals by the Government program is to reach a 38.1-day supply using the 1986 consumption base, and the private program, a 16.3-day supply. In October, MITI's Mining Industry Council reportedly was to review the existing stockpile program because of budgetary constraints. The issues to be reviewed reportedly included a scaling down of stockpile goals, the types of metal to be stockpiled, the mechanism of drawing down the stockpile, and establishing flexibility in budgetary appropriation. To increase its mineral information gathering capability, MITI boosted its budget for the Mineral Resources Information Center of MMAJ in fiscal year 1991. Beginning in April 1991, MMAJ is to open a new branch office in Vancouver, Canada. MMAJ has branch offices in Bangkok, Thailand; Beijing, China; Canberra, Australia; Lima, Peru; London, United Kingdom; Manila, Philippines; Mexico City, Mexico; Nairobi, Kenya; New York, United States; Paris, France; and Rio de Janeiro, Brazil.

In an effort to restrain damages to the global environment, the Government announced that all Japanese concessions, yen-loan funded by the Ministry of Foreign Affairs through its Overseas Economic Cooperation Fund (OECF), will require an environmental impact assessment. OECF published the guidelines for considering environmental protection in October. The new regulations cover pollution, the natural environment, and the social environment and are applicable to 16 types of yen-loan projects, including cement and fertilizer plants, flood control, forestry, mining, irrigation, and a wide variety of infrastructure construction.[3]

PRODUCTION

Mine production of all nonferrous minerals, except gold and lead, declined from that of 1989 because of closure of the Uchinotai Mine in Akita Prefecture and continuing production cutback at several major nonferrous mines operated in the Prefectures of Akita, Gifu, and Iwate. Increased gold production was mainly due to increased ore output at the Hishikari Mine, Kagoshima Prefecture in southern Kyushu. Mine production of most construction-related materials continued the upward trend of 1989 because of strong demand by the construction industry.

In the mineral fuels sector, coal output dropped to a record low in 1990 because of the permanent closure of the Minami-Oyubari Mine in Hokkaido to comply with the Government's Eighth National Coal Policy. The Minami-Oyubari Mine, Japan's last coking coal mine, was closed by Mitsubishi Coal Mining Co. in April. At the end of 1990, there were only six major coal mines remaining in Japan. Production of natural gas rose slightly, while crude petroleum continued to decline in 1990. However, because of the stepup in the development of the Iwafune Oilfield offshore Niigata Prefecture in the Japan Sea, production of natural gas and crude petroleum is expected to increase substantially in 1991.

In the mineral processing sector, production of most metals and industrial minerals, such as cement, soda ash, and sulfur, was higher than that of 1989 because of a stronger demand reflecting a continued growth in the Japanese economy in 1990. The decline in production of lead and several minor metals, specifically bismuth, cadmium, germanium, and indium, was due to unfavorable market conditions in 1990.

TRADE

Japan remained a major world importer of energy, nonfuel minerals, and nonferrous metals and a major world exporter of processed minerals in 1990. Because of increased imports of mineral fuels, Japan had a larger mineral trade deficit in 1990. Japan's larger mineral trade deficit in 1990 was mainly caused by larger quantities of imported crude petroleum, refined petroleum products, and LNG as well as higher energy prices in the world market resulting from the Persian Gulf crisis during the second half of 1990.

Because of continued economic growth resulting from a further expansion in domestic demand in 1990, imports of mineral fuels, including coal, crude and partially refined petroleum, LNG, and petroleum products, rose from $43.1 billion in 1989 to $56.7 billion, accounting for 24.2% of total imports in 1990. However, because of lower metal prices in the world market, imports of minerals and ores, iron and steel products, nonferrous metals, and metal scrap dropped from $24.3 billion in 1989 to $23.6 billion, accounting for 11.5% of total imports in 1990.

Total exports of minerals commodities, including iron and steel, nonferrous metals, and industrial minerals, declined from $24.6 billion in 1989 to $22.8 billion, accounting for 8% of total exports in 1990. Exports of iron and steel dropped from $14.8 billion in 1989 to $12.5 billion because of reduced exports to China, the Republic of Korea, the U.S.S.R., and Taiwan. Exports of nonferrous metals and industrial minerals rose from $9.8 billion in 1989 to $10.3 billion.

The United States remained the most important trade partner of Japan because of its significant role in supplying Japan with a wide variety of raw materials, foodstuffs, and manufactured products. In overall merchandise trade, Japan's exports to the United State declined from $93.2 billion in 1989 to $90.3 billion, accounting for 31% of Japan's total exports in 1990. Imports from the United States rose from $48.2 billion in 1989 to $52.4 billion, accounting for 22% of Japan's total imports in 1990. Despite an increase in imports from the United States, Japan had a merchandise trade surplus of close to $38 billion with the United States because of increased exports of transport machinery, especially passenger cars, in 1990.

STRUCTURE OF THE MINERAL INDUSTRY

In terms of the number of establishments, employment, and gross values of production, Japan's mineral industry consisted of a small nonferrous metal mining sector, a small-size coal mining sector, a large industrial mineral mining sector, and a world-class ferrous and nonferrous minerals processing sector. Mining and mineral processing businesses are owned and operated by private companies incorporated in Japan. The Government extends financial and technical assistance to the mineral industry, which follows Government policy guidelines during depressed market conditions.

Because of the restructuring program resulting from the depressed market conditions domestically and internationally in the 1980's, industry output capacity and employment had been reduced considerably. Contraction in coal, nonferrous

TABLE 1

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
METALS						
Aluminum:						
Alumina, gross weight	thousand tons	607	[r]359	415	482	481
Metal:						
Primary:						
Regular grades	do.	140	41	35	35	34
High-purity	do.	8	12	14	16	16
Secondary[2]	do.	[r]865	[r]1,032	[r]1,309	1,353	1,458
Antimony:						
Oxide		[r]9,705	9,805	10,661	10,327	10,994
Metal		194	196	185	173	216
Arsenic, white (equivalent of arsenic acid)[e]		500	500	500	500	500
Bismuth		640	546	524	502	442
Cadmium, refined		2,489	2,450	2,614	2,694	2,451
Chromium:						
Chromite, gross weight		10,642	11,815	9,508	11,674	8,075
Metal		2,987	[r]2,864	[r]3,045	3,620	[e]3,700
Cobalt metal		1,338	124	109	99	199
Columbium and tantalum: Tantalum metal		66	87	123	92	[e]90
Copper:						
Mine output, Cu content		34,924	23,817	16,666	14,650	13,030
Metal:						
Blister and anode:						
Primary		827,700	871,000	854,600	882,300	893,200
Secondary		[r]134,400	109,200	139,400	123,200	147,400
Total		962,100	980,200	994,000	1,005,500	1,040,600
Refined:						
Primary		827,657	870,994	854,608	882,263	893,133
Secondary		115,380	109,355	100,500	107,303	114,843
Total		943,037	980,349	955,108	989,566	1,007,976
Gallium metal:						
Primary		10	10	6	6	6
Secondary		10	16	28	32	37
Germanium:						
Oxide		14	13	14	13	12
Metal		9	5	4	4	3
Gold:						
Mine output, Au content	kilograms	10,280	8,590	[r]7,308	6,097	7,303
Metal:						
Primary	do.	48,979	56,058	92,029	110,330	108,152
Secondary[3]	do.	105,901	133,856	166,121	190,586	[e]213,000
Total	do.	154,880	189,914	258,150	300,916	[e]321,152
Indium metal	do.	18,000	27,207	[r]48,388	49,465	48,077
Iron and steel:						
Iron ore and iron sand concentrate:						
Gross weight	thousand tons	291	266	[r]97	41	34
Fe content	do.	182	167	[r]61	25	22
Roasted pyrite concentrate (50% or more Fe):						
Gross weight	do.	205	210	214	211	210
Fe content	do.	127	135	136	132	131

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
METALS—Continued						
Iron and steel—Continued						
Metal:						
Pig iron and blast furnace ferroalloys	thousand tons	74,651	73,418	79,295	80,197	80,229
Electric-furnace ferroalloys:						
Ferrochrome		280,548	263,988	295,406	324,371	293,345
Ferromanganese		359,044	332,286	378,351	394,055	452,434
Ferronickel		200,311	203,143	242,276	275,341	234,311
Ferrosilicon		107,236	73,706	73,767	74,936	62,599
Silicomanganese		148,429	91,896	106,970	122,192	77,465
Other:						
Calcium silicon		2,005	1,419	1,360	808	514
Ferrocolumbium		862	714	649	737	984
Ferromolybdenum		1,894	2,032	2,656	2,784	3,366
Ferrotungsten		122	96	91	77	46
Ferrovanadium		2,867	2,639	3,776	3,127	3,706
Unspecified		2,015	1,384	1,761	3,578	3,462
Total		1,105,333	973,303	1,107,063	1,202,006	1,132,232
Steel, crude	thousand tons	98,275	98,513	105,681	107,909	110,339
Semimanufactures, hot-rolled:						
Of ordinary steels	do.	78,136	78,825	84,100	86,687	88,911
Of special steels	do.	15,004	14,871	16,396	15,875	16,311
Lead:						
Mine output, Pb content		40,327	27,870	[r]22,899	18,595	18,727
Metal, refined:						
Primary		232,732	218,770	217,711	207,735	204,881
Secondary		128,720	119,730	[r]122,246	125,624	124,106
Total		361,452	338,500	[r]339,971	333,359	328,987
Magnesium metal:						
Primary		8,116	8,180	[r]10,019	12,075	12,843
Secondary		[r]14,415	[r]10,124	[r]15,099	20,270	[e]22,500
Manganese:						
Ore and concentrate:						
Gross weight		5,905	—	80	[e]100	[e]100
Mn content		1,535	—	17	[r] [e]21	[e]21
Oxide		57,159	66,731	67,460	55,628	51,473
Metal		3,854	[r]3,678	[r]3,933	4,498	4,571
Molybdenum metal		586	624	652	707	686
Nickel metal:						
Refined		[r]24,632	21,397	19,961	21,939	22,274
Ni content of nickel oxide sinter		[r]18,900	[r]22,475	[r]24,744	21,144	21,500
Ni content of ferronickel		49,630	49,405	57,556	62,834	56,474
Total		[r]93,162	[r]93,277	[r]102,261	105,917	100,248
Platinum-group metals:						
Palladium metal	kilograms	1,453	1,417	1,170	821	1,047
Platinum metal	do.	663	753	647	1,031	1,425
Rare-earth oxide:						
Cerium	do.	712,916	2,299,212	2,677,462	2,933,170	[e]3,100,000
Europium	do.	NA	2,485	6,234	7,673	[e]8,000

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
METALS—Continued						
Rare-earth oxide—Continued						
Gadolinium	do.	NA	31,571	48,835	49,887	[e]50,000
Lanthanum	do.	209,526	280,680	362,694	308,804	[e]310,000
Neodymium	do.	NA	188,459	207,009	247,337	[e]250,000
Praseodymium	do.	NA	17,803	18,815	28,073	[e]30,000
Samarium	do.	NA	52,526	115,330	114,490	[e]115,000
Terbium	do.	NA	4,220	7,644	8,483	[e]8,000
Yttrium	do.	NA	176,425	316,586	353,842	[e]350,000
Total	do.	922,452	3,053,381	3,760,609	4,051,759	[e]4,221,000
Selenium, elemental		427	481	471	470	495
Silicon, high-purity		2,094	1,671	1,545	1,759	2,155
Silver:						
Mine output, Ag content	kilograms	351,270	281,020	251,971	155,792	149,920
Metal:						
Primary	do.	1,724,615	1,845,318	1,837,277	1,986,928	2,089,033
Secondary[3]	do.	113,482	142,186	161,991	166,564	229,319
Total	do.	1,838,097	1,987,504	1,999,268	2,153,492	2,318,352
Tellurium, elemental		56	[r]53	[r]55	51	50
Tin:						
Mine output, Sn content		500	86	—	—	—
Metal, smelter		1,280	895	846	808	816
Titanium:						
Metal		14,481	10,083	16,408	21,341	25,630
Oxide		222,941	[r]239,401	259,875	283,184	285,851
Tungsten:						
Mine output, W content		579	259	266	296	260
Metal		2,557	2,713	3,481	3,758	4,176
Uranium metal[e]	kilograms	([4])	([4])	([4])	—	—
Vanadium metal[5]		[r]689	728	[r]728	868	[e]700
Zinc:						
Mine output, Zn content		222,071	165,675	147,217	131,794	127,273
Oxide		68,277	73,434	83,312	84,034	83,174
Metal:						
Primary		[r]626,074	591,516	601,082	591,142	605,718
Secondary		[r]127,662	116,865	124,702	123,536	125,884
Total		753,736	708,381	725,784	714,678	731,602
Zirconium:						
Metal[e]		45	45	45	45	45
Oxide		[e]6,700	7,430	7,345	7,100	[e]6,800
INDUSTRIAL MINERALS						
Asbestos		[r]5,610	[r]5,207	[r e]5,000	[r e]5,000	[e]5,000
Barite		52,848	31,625	—	—	—
Bromine, elemental[e]		15,000	15,000	15,000	15,000	15,000
Cement, hydraulic	thousand tons	71,264	71,551	77,554	79,717	84,445
Clays:						
Bentonite		478,254	468,705	455,137	526,131	549,414
Fire clay		1,004,150	907,342	961,354	942,199	922,755
Kaolin		203,983	172,781	157,771	165,696	165,532

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
INDUSTRIAL MINERALS—Continued						
Feldspar and related materials:						
Feldspar		32,063	33,754	29,465	43,137	57,877
Aplite		457,375	466,429	[r]526,285	562,823	536,205
Gypsum	thousand tons	[e]6,400	5,438	[e]6,300	[e]6,300	[e]6,400
Iodine, elemental		7,389	7,014	7,451	7,592	7,581
Lime: Quicklime	thousand tons	6,717	6,745	7,726	8,486	8,983
Nitrogen: N content of ammonia	do.	1,508	1,556	1,524	1,539	1,531
Perlite[e]		75,000	75,000	75,000	77,000	77,000
Salt, all types	thousand tons	1,370	1,397	1,363	1,367	1,377
Silica sand		3,925,411	3,892,322	4,200,410	4,377,941	4,430,641
Silica stone	thousand tons	13,637	14,291	16,215	17,230	17,896
Sodium compounds, n.e.s.:						
Soda ash		1,020,849	1,098,465	1,083,121	1,105,308	1,134,825
Sulfate		253,450	255,313	246,541	256,393	253,131
Stone, crushed and broken:						
Dolomite	thousand tons	3,953	3,834	5,423	5,465	5,371
Limestone	do.	162,358	165,957	182,468	190,854	198,224
Sulfur:						
S content of pyrite	do.	158	79	[r]71	62	53
Byproduct:						
Of metallurgy	do.	[r]1,255	[r] [e]1,250	[r] [e]1,268	1,320	1,336
Of petroleum	do.	985	[r] [e]1,020	[r] [e]1,093	1,176	1,268
Talc and related materials:						
Talc		63,851	55,899	[r]49,797	55,665	61,550
Pyrophyllite		1,270,112	1,241,069	1,244,491	1,233,600	1,213,195
Vermiculite[e]		15,000	15,000	15,000	15,000	15,000
MINERAL FUELS AND RELATED MATERIALS						
Carbon black	thousand tons	616	629	720	779	783
Coal:						
Anthracite	do.	13	10	9	8	7
Bituminous[6]	do.	15,999	13,039	11,214	10,179	8,256
Total	do.	16,012	13,049	11,223	10,187	8,263
Coke including breeze:						
Metallurgical	do.	45,132	43,717	47,727	46,899	46,067
Gashouse including breeze	do.	3,006	2,716	2,907	2,896	1,414
Fuel briquets, all grades	do.	241	200	185	159	128
Gas, natural:						
Gross[7]	million cubic meters	2,105	2,168	2,097	2,009	2,044
Marketed	do.	2,208	2,350	2,294	2,155	2,189
Natural gas liquids:						
Natural gasoline	thousand 42-gallon barrels	56	57	56	55	[e]55
Liquefied petroleum gas from natural gas (field plants only)[e]	do.	300	300	300	250	250
Peat[e]		60	60	60	60	60
Petroleum:						
Crude	thousand 42-gallon barrels	4,629	4,453	4,353	4,032	3,975
Refinery products:						
Gasoline:						
Aviation	do.	82	57	57	80	78
Other	do.	214,866	216,136	222,904	241,723	265,137

See footnotes at end of table.

TABLE 1—Continued

JAPAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum—Continued						
Refinery products—Continued						
Asphalt and bitumen	do.	33,418	34,436	35,758	36,085	38,902
Distillate fuel oil	do.	164,308	158,685	160,730	174,705	201,150
Jet fuel	do.	25,285	25,348	24,272	26,335	27,933
Kerosene	do.	151,484	126,003	132,300	128,488	145,415
Liquefied petroleum gas	do.	44,010	45,029	46,784	46,809	51,233
Lubricants	do.	11,730	12,271	12,743	12,561	15,762
Naphtha	do.	60,822	55,250	55,061	56,287	68,310
Paraffin[e]	do.	980	900	1,000	1,000	1,200
Petroleum coke	do.	956	824	937	792	[e]900
Refinery fuel and losses[8]	do.	136,458	140,464	133,961	[e]140,000	[e]150,000
Residual fuel oil	do.	386,452	378,659	399,899	422,159	451,118
Unfinished oils	do.	40,452	43,161	47,677	53,218	[e]57,000
Total	do.	[e]1,271,779	[e]1,237,223	[e]1,274,083	[r] [e]1,340,242	[e]1,474,138

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through Sept. 22, 1991.
[2]Includes unalloyed ingot, alloyed ingot, billet, and mother alloys.
[3]Recovered from scrap, waste, and returned by end users.
[4]Revised to zero.
[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.

metal mining, iron and steel, fertilizer materials, and cement was more drastic than other sectors because of the appreciation of yen, higher domestic production costs, and lower import mineral prices.

According to MITI, coal was produced from 7 large-scale major mines and 15 small-scale mines mainly in the Hokkaido and Kyushu areas with total capacity of 11 Mmt/a and work force of 5,730 in 1989. With the closure of the Minami-Oyubari Mine in Hokkaido and a small-scale mine in Honshu, the remaining 6 large-scale and 14 small-scale mines had a total capacity of 9.4 Mmt/a and work force of 4,750 in 1990. The number and employment of operating nonferrous metal mines also declined to 26 and 2,465, respectively, in 1990 from 27 and 2,693, respectively, in 1989.

In line with the overall industrial restructuring program, the steel industry continued implementing reduction in employment and production capacity in 1990. The steel industry reduced its capacity to 136.9 Mmt/a from 141.6 Mmt/a and reduced its work force by 1,413 workers to 294,138 in 1990. However, because of increased domestic demand for copper, lead, and zinc, the nonferrous metal smelting and refining industry was expected to boost its capacity in 1991.

According to the Statistics Bureau of Japan's Management and Coordination Agency, the number of persons employed by the mining industry in 1990 had been reduced to about 60,000 or about 0.1% of the Japanese labor force of 62.5 million, compared with 95,000 persons or about 0.2% of 58 million in 1985.

COMMODITY REVIEW

Metals

Aluminum.—Production of primary aluminum by Nippon Light Metal Co. Ltd. was small and remained insignificant when compared with Japan's requirement for primary aluminum. Japan relied on primary aluminum imports to meet 99% of its domestic demand in 1990.

In 1990, Japan remained the world's largest importer of primary aluminum and one of the dominant forces in the world market. Its imports of primary aluminum reached a record high at 2.4 Mmt (in metal content of primary aluminum and alloyed ingots) accounting for 31% of the primary aluminum traded in the world in 1990. According to MITI, demand for primary aluminum increased 7.4% to 2.6 Mmt in 1990.

According to the Ministry of Finance, imports of primary aluminum totaled 2,653,063 tons in 1990, of which 108,888 tons was high-grade ingots; 1,874,885 tons, regular-grade ingots; and 669,290 tons, alloyed ingots. Because of its heavy reliance on imports, Japan widely diversified its overseas sources of primary aluminum into more than 50 countries. However, about 84% of Japan's primary aluminum imports was from eight major producing countries. In 1990, the United States displaced Australia as the top supplier, accounting for

TABLE 2

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS					
Alkali and alkaline-earth metals		422	373	(2)	India 262; Taiwan 51.
Aluminum:					
Ore and concentrate		954	1,192	—	Republic of Korea 1,030; Philippines 162.
Oxides and hydroxides		198,269	249,465	6,993	Republic of Korea 87,107; Canada 78,548.
Metal including alloys:					
Scrap		7,334	9,893	198	Taiwan 4,838; Republic of Korea 1,715.
Unwrought		3,433	2,947	154	Thailand 1,914; Taiwan 208.
Semimanufactures		134,593	136,748	40,679	Taiwan 21,950; Republic of Korea 20,380.
Antimony:					
Oxides and hydroxides		728	713	3	Taiwan 209; Republic of Korea 116; China 57.
Metal including alloys, all forms		19	16	7	Singapore 4; Sweden 2.
Arsenic: Elemental		5	14	2	Indonesia 9; United Kingdom 2.
Beryllium: Metal including alloys, all forms	kilograms	424	1,447	1	Switzerland 1,445.
Bismuth: Metal including alloys, all forms		68	16	1	Netherlands 5; Hong Kong 3.
Cadmium: Metal including alloys, all forms		158	141	(2)	Netherlands 123.
Chromium:					
Ore and concentrate		298	2,429	—	China 2,000; Singapore 272; Republic of Korea 137.
Oxides and hydroxides		3,954	3,761	542	Republic of Korea 1,683; Taiwan 828.
Metal including alloys, all forms		2,014	2,322	1,047	Netherlands 536; Belgium-Luxembourg 282.
Cobalt:					
Oxides and hydroxides		48	21	—	Republic of Korea 6; New Zealand 5; Taiwan 3.
Metal including alloys, all forms		207	356	74	West Germany 72; Republic of Korea 45.
Columbium and tantalum: Tantalum metal including alloys, all forms .		30	22	5	West Germany 9; Republic of Korea 4.
Copper:					
Oxides and hydroxides		982	879	39	Singapore 323; Taiwan 158.
Sulfate		888	797	129	Taiwan 571; Hong Kong 40.
Metal including alloys:					
Scrap		6,933	18,816	80	Taiwan 6,123; Republic of Korea 5,578.
Unwrought		78,494	68,625	25,484	Taiwan 20,147; Republic of Korea 12,016.
Semimanufactures		192,215	191,487	28,367	Taiwan 40,352; Singapore 37,663.
Germanium: Metal including alloys, all forms	kilograms	213	482	(2)	Singapore 476.
Gold:					
Ore and concentrate[3]		12	—		
Waste and sweepings-grams		639	28,161	—	All to Hong Kong.
Metal including alloys, unwrought and partly wrought	kilograms	11,241	18,135	3,443	Singapore 5,118; Taiwan 2,832.
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite		8	—		
Metal:					
Scrap		415,616	586,786	59	Republic of Korea 401,431; Taiwan 141,718.
Pig iron, cast iron, related materials		42,695	25,115	6,635	Taiwan 6,200; Republic of Korea 4,495.
Ferroalloys:					
Ferrochromium		4,450	1,123	779	Belgium-Luxembourg 85; Pakistan 82.
Ferromanganese		12,849	12,055	3,944	Qatar 2,500; Malaysia 2,000; Netherlands 1,600.
Ferronickel		15	62	—	Republic of Korea 39; Italy 19.
Ferrosilicon		4,868	2,764	—	Republic of Korea 1,479; Taiwan 734.
Silicon metal		115	281	82	Republic of Korea 157; Australia 23.
Unspecified		6,614	8,239	1,678	Republic of Korea 1,881; Indonesia 1,227.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Steel, primary forms	thousand tons	159	149	63	Taiwan 58; Republic of Korea 17.
Semimanufactures:					
Flat-rolled products:					
Of iron or nonalloy steel:					
Not clad, plated, coated	do.	9,011	[4]7,880	659	China 2,129; Republic of Korea 847.
Clad, plated, coated	do.	3,965	3,367	1,050	China 380; Taiwan 379.
Of alloy steel	do.	1,836	[5]1,094	206	Republic of Korea 246; China 150.
Bars, rods, angles, shapes, sections	do.	3,344	2,758	563	Taiwan 515; China 489.
Rails and accessories	do.	171	140	68	Canada 35; Taiwan 9.
Wire	do.	196	[6]151	45	Libya 39; Hong Kong 8.
Tubes, pipes, fittings	do.	4,637	3,249	460	U.S.S.R. 744; China 479.
Lead:					
Oxides		117	292	1	Republic of Korea 228; China 31.
Metal including alloys:					
Scrap		23,998	23,971	—	Taiwan 16,085; Republic of Korea 3,465.
Unwrought		1,286	1,407	—	Taiwan 1,221; Hong Kong 59.
Semimanufactures		317	302	12	Taiwan 92; China 37.
Lithium: Oxides and hydroxides		7	3	—	Malaysia 1; Taiwan 1.
Magnesium: Metal including alloys, all forms		84	120	([2])	Singapore 40; Indonesia 24; Belgium-Luxembourg 18.
Manganese:					
Ore and concentrate, metallurgical-grade		929	55	—	Taiwan 40; Republic of Korea 15.
Oxides		45,739	32,987	127	U.S.S.R. 6,030; Indonesia 3,993; Singapore 2,770.
Metal including alloys, all forms		136	982	([2])	Indonesia 905; Australia 40.
Mercury		191	205	—	Netherlands 155; Indonesia 21.
Molybdenum:					
Oxides and hydroxides		12	29	9	India 15; Taiwan 4.
Metal including alloys, all forms		62	94	1	Republic of Korea 33; West Germany 20.
Nickel:					
Matte and speiss		288	18	—	Mainly to India.
Oxides and hydroxides		163	186	13	Netherlands 44; Indonesia 38.
Metal including alloys:					
Scrap		150	129	38	Republic of Korea 63; United Kingdom 24.
Unwrought		544	128	([2])	Singapore 54; Indonesia 42.
Semimanufactures		2,201	1,989	327	Hong Kong 255; Taiwan 253.
Platinum-group metals:					
Waste and sweepings	value, thousands	$126	$805	—	United Kingdom $445; West Germany $361.
Metals including alloys, unwrought and partly wrought	kilograms	8,826	4,504	1,284	Australia 990; Taiwan 955.
Rare-earth:					
Compounds		804	1,069	127	Singapore 356; Taiwan 290.
Metals		8	2	([2])	Republic of Korea 1.
Selenium, elemental		273	374	84	China 93; Netherlands 63.
Silicon, high-purity		263	368	54	Malaysia 149; Republic of Korea 34.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS—Continued				
Silver:				
Waste and sweepings value, thousands	$573	$1,944	(2)	Mainly to West Germany.
Metal including alloys, unwrought and partly wrought kilograms	91,303	582,431	2,024	Singapore 324,891; Taiwan 216,151.
Tin: Metal including alloys:				
Scrap	68	108	—	Australia 30; Belgium-Luxembourg 24; Philippines 24.
Unwrought	119	484	1	Republic of Korea 427; United Kingdom 37.
Semimanufactures	441	346	11	Hong Kong 83; Singapore 62.
Titanium:				
Ore and concentrate	97	53	—	Taiwan 38; Belgium-Luxembourg 15.
Oxides	30,905	39,801	3,557	Singapore 16,018; Taiwan 8,838.
Metal including alloys, all forms	10,760	13,585	3,366	United Kingdom 3,640; France 2,802.
Tungsten: Metal including alloys, all forms	313	590	269	West Germany 148; Austria 27.
Uranium and thorium: Oxides and other compounds	47	23	—	Mainly to United Kingdom.
Vanadium: Oxides and hydroxides	71	163	—	Netherlands 86; Belgium-Luxembourg 50.
Zinc:				
Oxides	1,292	925	199	Republic of Korea 205; Indonesia 161.
Metal including alloys:				
Scrap	5,017	5,973	—	Taiwan 4,911; Philippines 609; Republic of Korea 395.
Unwrought	26,642	21,927	13	Taiwan 8,610; Philippines 5,453.
Semimanufactures	1,562	1,998	87	Taiwan 745; Ethiopia 200.
Zirconium:				
Ore and concentrate	172	376	—	China 96; Thailand 92; Republic of Korea 85.
Metal including alloys, all forms	38	74	61	U.S.S.R. 7; West Germany 6.
Other:				
Ores and concentrates	1,013	—		
Oxides and hydroxides	369	548	202	Republic of Korea 284; Taiwan 51.
Ashes and residues	5,463	8,204	814	United Kingdom 2,096; Republic of Korea 1,342.
Base metals including alloys, all forms	5	15	3	West Germany 5; Republic of Korea 4.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	11,063	12,569	2	Republic of Korea 8,312; Taiwan 1,827.
Artificial:				
Corundum	29,561	30,165	3,145	Republic of Korea 14,543; Australia 4,033.
Silicon carbide	6,395	6,402	228	Republic of Korea 4,275; Taiwan 1,591.
Dust and powder of precious and semi-precious stones including diamond kilograms	6,034	4,479	1,039	Thailand 2,016; Republic of Korea 442.
Grinding and polishing wheels and stones	7,644	8,336	1,817	Republic of Korea 1,064; Taiwan 884; Hong Kong 814.
Asbestos, crude	72	50	—	Taiwan 25; Indonesia 6; Tunisia 6.
Barite and witherite	7	306	—	All to Republic of Korea.
Boron materials:				
Crude natural borates	1,719	2,464	—	All to Taiwan.
Elemental[7]	39	8	1	Netherlands 5; Canada 1.
Oxides and acids	150	179	1	Republic of Korea 143; Taiwan 17.
Bromine[8]	3	8	1	Thailand 7.
Cement thousand tons	3,399	6,576	2,316	Hong Kong 2,717; Singapore 802.
Chalk	748	751	—	All to Republic of Korea.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Clays, crude:					
Bentonite		1,163	1,510	(2)	Iraq 625; Indonesia 322; China 165.
Chamotte or dinas earth		1,051	558	—	Republic of Korea 248; Taiwan 166; Thailand 137.
Fire clay		4,969	5,064	—	Republic of Korea 3,770; Bangladesh 267; Nigeria 263.
Kaolin		7,061	7,145	7	Taiwan 4,614; Indonesia 1,233.
Unspecified		44,739	41,556	65	Taiwan 24,048; Republic of Korea 6,897.
Cryolite and chiolite		12	5	—	All to Republic of Korea.
Diamond: Natural:					
Gem, not set or strung	carats	3,797	2,411	9	Belgium-Luxembourg 1,569; Hong Kong 752.
Industrial stones	do.	38,820	109,076	500	Republic of Korea 44,375; West Germany 28,000.
Diatomite and other infusorial earth		1,986	2,541	10	Taiwan 585; Iraq 405; Thailand 345.
Feldspar, fluorspar, related materials:					
Feldspar		28,841	34,369	—	Taiwan 26,272; Singapore 4,100; Indonesia 1,713.
Fluorspar		1,558	506	—	Indonesia 260; Taiwan 167; Philippines 66.
Unspecified		4	—		
Fertilizer materials:					
Crude, n.e.s.		35	302	—	Taiwan 267; Republic of Korea 17.
Manufactured:					
Ammonia		242	146	2	Republic of Korea 99; Nigeria 26.
Nitrogenous		870,354	705,268	1,242	Thailand 239,176; Philippines 170,037.
Phosphatic		1,814	37,771	4	Burma 32,900; Somalia 1,375.
Potassic		1,187	1,350	—	Philippines 557; Zaire 452.
Unspecified and mixed		129,816	137,538	3,685	Thailand 39,206; Sri Lanka 22,650.
Graphite, natural		1,767	2,059	277	Taiwan 402; West Germany 361.
Gypsum and plaster		5,896	5,946	19	Indonesia 1,558; Taiwan 1,362; Philippines 1,293.
Iodine		6,120	6,136	2,300	United Kingdom 1,120; France 760.
Kyanite and related materials		5,207	4,925	511	Republic of Korea 3,341; Taiwan 448.
Lime		11,601	9,736	12	Papua New Guinea 8,537; Taiwan 490. 20,573.
Magnesium compounds:					
Magnesite, crude		307	307	72	Taiwan 173; Republic of Korea 30.
Oxides and hydroxides		102,460	121,575	10,743	Australia 20,701; Republic of Korea 20,573.
Mica:					
Crude including splittings and waste		529	577	19	Republic of Korea 280; Taiwan 144.
Worked including agglomerated splittings		106	173	38	Taiwan 73; Hong Kong 32.
Phosphates, crude		4	33	—	All to Indonesia.
Phosphorus, elemental		242	213	2	Philippines 100; Indonesia 40.
Pigments, mineral:					
Natural, crude		45	74	—	Taiwan 52; Republic of Korea 17.
Iron oxides and hydroxides, processed		33,927	32,736	3,509	Taiwan 11,498; Republic of Korea 11,199.
Precious and semiprecious stones other than diamond:					
Natural	kilograms	47,488	24,389	20	Republic of Korea 10,847; Taiwan 5,847.
Synthetic	do.	30,374	145,942	4,071	West Germany 102,959; Malaysia 12,366.
Pyrite, unroasted		400	8,200	—	China 8,000; Australia 200.
Quartz crystal, piezoelectric		112	58,307	4,226	Taiwan 10,778; Republic of Korea 10,401.
Salt and brine		656	1,036	176	U.S.S.R. 310; North Korea 183; Republic of Korea 158.

See footnotes at end of table.

TABLE 2—Continued

JAPAN: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.:					
Soda ash, manufactured		116,831	1,323	114	Republic of Korea 1,174.
Sulfate, manufactured		14,547	17,355	36	Republic of Korea 10,296; Indonesia 3,478.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		1,417	1,323	114	Republic of Korea 1,174.
Worked		1,906	2,270	112	Hong Kong 1,419; Republic of Korea 343.
Dolomite, chiefly refractory-grade		1,920	2,460	—	Indonesia 1,640; Taiwan 686.
Gravel and crushed rock		77,533	50,229	62	Australia 48,000; Republic of Korea 713.
Limestone other than dimension		1,842,980	1,476,665	596	Australia 924,592; Taiwan 539,873.
Quartz and quartzite		24,265	15,877	6	Taiwan 14,555; Republic of Korea 421.
Sand other than metal-bearing		4,477	3,780	47	Taiwan 1,863; Singapore 564.
Sulfur:					
Elemental:					
Crude including native and byproduct		170,366	262,621	769	Republic of Korea 234,952; Taiwan 24,064.
Colloidal, precipitated, sublimed		2,294	1,656	29	Taiwan 331; Republic of Korea 330.
Sulfuric acid		526,032	800,441	143,719	Taiwan 198,906; Philippines 189,788.
Talc, steatite, soapstone, pyrophyllite		2,658	2,476	220	Republic of Korea 623; Taiwan 566.
Vermiculite[9]		16,065	21,323	—	Republic of Korea 18,419; Taiwan 2,440.
Other:					
Crude		11,013	8,009	([2])	Taiwan 3,436; Republic of Korea 1,398; Indonesia 1,223.
Slag and dross, not metal-bearing		850,642	914,674	36,300	Republic of Korea 424,178; Singapore 234,132.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		5	19	—	Thailand 15; Philippines 4.
Carbon black		9,991	8,528	703	Republic of Korea 2,597; Taiwan 1,653.
Coal, all grades including briquets		1,304	1,153	—	Thailand 823; Taiwan 101.
Coke and semicoke	thousand tons	2,898	2,506	1,140	Brazil 438; Philippines 236.
Peat including briquets and litter		40	28	—	Mainly to Taiwan.
Petroleum refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	10	285	222	Hong Kong 56.
Gasoline	do.	925	3,170	([2])	Republic of Korea 1,177; Singapore 794; Hong Kong 702.
Mineral jelly and wax	do.	429	396	51	India 59; Taiwan 59; Republic of Korea 57.
Kerosene and jet fuel	do.	428	3,041	3	Hong Kong 1,180; Iran 905; Republic of Korea 728.
Distillate fuel oil	do.	1,156	4,992	([2])	Republic of Korea 2,516; Hong Kong 1,626.
Lubricants	do.	1,465	1,654	4	Republic of Korea 792; Singapore 256.
Nonlubricating oils	do.	103	113	1	Taiwan 73; Republic of Korea 7.
Residual fuel oil	do.	953	4,631	([2])	Republic of Korea 2,046; Hong Kong 1,435.
Bitumen and other residues	do.	22	24	—	Hong Kong 10; Thailand 9.
Bituminous mixtures	do.	2	2	—	Thailand 1.
Petroleum coke	do.	514	489	135	U.S.S.R. 197; Netherlands 74.

[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]Less than 1/2 unit.
[3]May include other precious metals.
[4]Excludes unreported quantity valued at $135,711,000.
[5]Excludes unreported quantity valued at $570,637,000.
[6]Excludes unreported quantity valued at $62,845,000.
[7]Includes tellurium.
[8]Includes fluorine.
[9]Includes perlite and chlorites.

TABLE 3

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989 United States	Sources, 1989 Other (principal)
METALS					
Alkali and alkaline-earth metals		95	93	54	United Kingdom 22; West Germany 9.
Aluminum:					
Ore and concentrate	thousand tons	2,149	2,269	—	Australia 1,435; Indonesia 594; Malaysia 123.
Oxides and hydroxides		72,048	76,961	19,401	Australia 48,041; West Germany 3,485.
Metal including alloys:					
Scrap		399,154	400,226	260,685	Australia 33,169; Hong Kong 22,476.
Unwrought	thousand tons	2,292	2,363	493	Australia 567; Venezuela 201.
Semimanufactures		88,294	80,321	22,489	Taiwan 6,118; Bahrain 5,867.
Antimony:					
Ore and concentrate		6,376	4,978	—	Bolivia 2,370; China 2,089; Australia 401.
Oxides		6,201	7,268	81	China 4,161; United Kingdom 2,169.
Metal including alloys, all forms		5,817	6,225	—	China 6,082; Thailand 90; Mexico 51.
Arsenic:					
Elemental		9	30	1	China 27; Sweden 2.
Oxides and acids		104	315	—	France 173; Republic of Korea 125.
Beryllium:					
Oxides and hydroxides		73	73	60	China 13.
Metal including alloys, all forms	kilograms	861	2,144	2,123	United Kingdom 21.
Bismuth: Metal including alloys, all forms		326	408	—	China 136; Mexico 120; Republic of Korea 95.
Cadmium: Metal including alloys, all forms		2,545	2,908	97	Belgium-Luxembourg 860; Republic of Korea 705.
Chromium:					
Ore and concentrate		976,168	1,043,468	—	Republic of South Africa 597,381; India 119,049.
Oxides and hydroxides		2,513	2,217	651	West Germany 954; U.S.S.R. 290.
Metal including alloys, all forms		725	830	130	United Kingdom 510; France 95.
Cobalt:					
Oxides and hydroxides		445	449	36	Belgium-Luxembourg 257; Finland 64.
Metal including alloys, all forms		4,934	3,376	78	Zaire 1,613; Belgium-Luxembourg 795.
Columbium and tantalum:					
Ore and concentrate[2]		1,172	1,110	([3])	Canada 744; Thailand 143; Zaire 68.
Tantalum metal including alloys, all forms		107	64	43	West Germany 15.
Copper:					
Ore and concentrate	thousand tons	3,436	3,376	553	Canada 884; Philippines 450.
Matte and speiss including cement copper		65	179	—	All from Taiwan.
Oxides and hydroxides		658	646	421	Norway 100; Australia 40.
Sulfate		229	139	([3])	Thailand 85; France 32.
Metal including alloys:					
Scrap		108,438	82,247	31,001	Singapore 8,722; Saudi Arabia 6,399.
Unwrought		448,851	515,214	49,388	Zambia 145,550; Chile 145,185.
Semimanufactures		35,170	39,358	3,463	Taiwan 25,111; Republic of Korea 6,620.
Germanium:					
Oxides		775	875	97	United Kingdom 731; France 35.
Metal including alloys, all forms	kilograms	4,403	1,099	54	France 600; China 212.
Gold:					
Waste and sweepings	kilograms	2,246	2,260	—	Singapore 1,226; Republic of Korea 970.
Metal including alloys, unwrought and partly wrought	do.	293,784	284,273	8,901	Switzerland 130,400; Australia 50,504.
Indium: Metal including alloys, all forms		30	32	4	France 13; Canada 5; China 5.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS—Continued				
Iron and steel:				
Iron ore and concentrate, excluding roasted pyrite thousand tons	123,377	127,709	(3)	Australia 56,275; Brazil 29,520; India 21,219.
Metal:				
Scrap do.	1,789	1,157	313	Vietnam 248; U.S.S.R. 213.
Pig iron, cast iron, related materials do.	2,918	2,274	17	Brazil 745; U.S.S.R. 706; China 474.
Ferroalloys:				
Ferrochromium	473,707	477,080	—	Republic of South Africa 282,992; Philippines 52,766.
Ferromanganese	27,383	21,786	—	Republic of South Africa 8,276; China 4,822; France 2,969.
Ferromolybdenum	1,486	1,322	—	Chile 619; Austria 464; China 102.
Ferronickel	48,664	52,073	70	New Caledonia 25,685; Indonesia 12,555.
Ferrosilicochromium	17,511	14,018	—	China 7,699; Zimbabwe 3,443; Republic of South Africa 2,361.
Ferrosilicomanganese	158,410	274,282	3,378	China 150,936; Republic of South Africa 41,856.
Ferrosilicon	539,846	406,901	8,405	Brazil 140,201; Norway 76,694; China 75,607.
Silicon metal	132,749	135,319	2,534	China 64,740; Brazil 29,369.
Unspecified	29,519	27,501	2,615	China 7,687; Brazil 7,449.
Steel, primary forms	559,232	727,686	80,790	Republic of Korea 401,991; Brazil 164,287.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	4,638,295	4,978,194	512,166	Republic of Korea 1,908,904; Brazil 526,200.
Clad, plated, coated	102,945	258,551	8,977	Republic of Korea 207,156; Taiwan 20,552.
Of alloy steel	26,114	[4]20,208	966	Republic of Korea 5,812; West Germany 4,295.
Bars, rods, angles, shapes, sections	1,068,541	743,228	3,710	Republic of Korea 302,762; Brazil 96,550.
Rails and accessories	7,069	6,540	(3)	Republic of Korea 5,611; United Kingdom 365.
Wire	74,137	69,575	1,841	Republic of Korea 57,786; Taiwan 6,213.
Tubes, pipes, fittings	390,153	454,974	1,742	Republic of Korea 381,217; Taiwan 33,908.
Lead:				
Ore and concentrate	279,537	298,964	5,452	Canada 110,724; Australia 71,191.
Oxides	26,233	37,388	10	Mexico 17,618; Republic of Korea 8,296.
Metal including alloys:				
Scrap	17	—		
Unwrought	75,774	83,093	865	Mexico 22,391; Australia 14,607.
Semimanufactures	236	93	36	West Germany 34; United Kingdom 19.
Lithium: Oxides and hydroxides	935	1,020	914	China 67; U.S.S.R. 20.
Magnesium: Metal including alloys:				
Scrap	699	643	75	Taiwan 456; Republic of Korea 35.
Unwrought	15,305	13,847	10,675	Norway 2,634.
Semimanufactures	658	457	383	Republic of Korea 68.
Manganese:				
Ore and concentrate, metallurgical-grade thousand tons	1,922	1,939	(3)	Republic of South Africa 1,027; Australia 552.
Oxides	3,309	4,494	122	Belgium-Luxembourg 2,864; China 797.
Metal including alloys, all forms	9,893	10,739	1,138	Republic of South Africa 8,531; China 975.
Mercury	40	62	(3)	China 25; Belgium-Luxembourg 15.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS—Continued				
Molybdenum:				
Ore and concentrate	22,987	23,106	6,037	Chile 8,000; Canada 6,885.
Oxides and hydroxides	351	352	351	West Germany 1.
Metal including alloys, all forms	661	606	274	West Germany 184; Austria 57.
Nickel:				
Ore and concentrate thousand tons	3,266	3,828	—	New Caledonia 1,787; Indonesia 1,185; Philippines 855.
Matte and speiss	62,658	59,923	—	Indonesia 35,734; Australia 21,609.
Oxides and hydroxides	290	283	11	Canada 261; China 6.
Metal including alloys:				
Scrap	3,578	2,241	803	Taiwan 838; United Kingdom 123.
Unwrought	34,327	38,255	145	U.S.S.R. 13,024; Norway 6,653; Zimbabwe 5,799.
Semimanufactures	6,966	6,891	1,244	United Kingdom 3,247; Canada 1,676.
Platinum-group metals:				
Waste and sweepings kilograms	4,537	5,294	971	Taiwan 4,111; Australia 151.
Metals including alloys, unwrought and partly wrought do.	76,522	63,083	6,573	U.S.S.R. 15,216; United Kingdom 11,554.
Rare-earth:				
Compounds	14,555	11,712	3,100	China 4,356; France 1,536.
Metals including alloys, all forms	468	337	17	China 242; Brazil 69.
Selenium, elemental	33	58	—	Philippines 46; Netherlands 9.
Silicon, high-purity	91	103	33	Denmark 16; France 16.
Silver:				
Ore and concentrate	7,207	9,142	—	Peru 6,830; Australia 2,312.
Waste and sweepings	21	38	7	Malaysia 16; Singapore 13.
Metal including alloys, unwrought and partly wrought	1,015	1,265	123	Mexico 610; Peru 282.
Tellurium, elemental	(9/)	—		
Tin:				
Oxides	17	7	—	All from United Kingdom.
Metal including alloys:				
Scrap	2	21	—	Mainly from Taiwan.
Unwrought	35,517	35,683	17	Malaysia 13,042; Indonesia 9,515.
Semimanufactures	33	60	5	Singapore 34; Hong Kong 16.
Titanium:				
Ore and concentrate	642,209	616,090	—	Malaysia 239,491; Australia 173,278; India 69,304.
Oxides	6,784	17,200	178	Australia 9,681; Republic of Korea 2,541.
Metal including alloys, all forms	923	1,062	380	U.S.S.R. 514; Netherlands 85.
Tungsten:				
Ore and concentrate	2,785	2,316	—	Portugal 939; China 626; Australia 328.
Metal including alloys, all forms	465	378	39	Republic of Korea 243; West Germany 56.
Uranium and thorium:				
Ore and concentrate	39	60	—	All from Malaysia.
Oxides and other compounds kilograms	2,730	4,434	514	United Kingdom 2,019; France 1,260.
Vanadium:				
Oxides and hydroxides	5,339	4,313	31	Republic of South Africa 3,991; China 225.
Metal including alloys, all forms	173	154	34	West Germany 119.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
METALS—Continued					
Zinc:					
Ore and concentrate	thousand tons	1,068	1,029	31	Australia 526; Canada 153; Peru 153.
Oxides		10,959	14,171	33	Republic of Korea 6,050; Taiwan 3,238.
Metal including alloys:					
Scrap		764	759	49	Singapore 397; Hong Kong 140.
Unwrought		130,302	150,714	1	Republic of Korea 73,073; North Korea 37,740.
Semimanufactures		1,338	2,136	56	France 1,108; Singapore 333.
Zirconium:					
Ore and concentrate		197,592	172,848	2,667	Australia 140,533; Republic of South Africa 22,570.
Metal including alloys, all forms		510	641	343	France 278; U.S.S.R. 13.
Other:					
Ores and concentrates		23,002	32,893	25,878	Australia 4,971.
Ashes and residues		67,178	69,616	11,896	Australia 9,841; Taiwan 8,870.
Base metals including alloys, all forms		101	111	39	Brazil 29; West Germany 20.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		7,137	9,171	1,783	India 6,584; China 622.
Artificial:					
Corundum		71,620	87,529	275	China 59,676; Hungary 11,288.
Silicon carbide		49,824	65,868	464	China 43,813; West Germany 5,088.
Dust and powder of precious and semiprecious stones excluding diamond	kilograms	573,070	824,600	448,336	India 360,000; Iran 12,000.
Grinding and polishing wheels and stones		1,228	1,582	198	Taiwan 525; Italy 274.
Asbestos, crude		320,393	295,168	11,875	Canada 91,079; Republic of South Africa 84,281.
Barite and witherite		91,355	129,383	66	China 112,110; India 17,101.
Boron materials:					
Crude natural borates		52,180	65,854	—	Turkey 64,787; U.S.S.R. 1,067.
Elemental		11	—		
Oxides and acids		30,735	28,075	18,527	Italy 4,616; Turkey 4,002.
Bromine[5]		4,871	5,926	802	Israel 5,124.
Cement		3,602,270	3,724,428	169	Republic of Korea 2,023,536; Taiwan 1,596,075.
Chalk		(2)	—		
Clays, crude	thousand tons	1,321	1,468	865	China 236; Brazil 105.
Cryolite and chiolite		357	375	—	Denmark 306; Greenland 68.
Diamond:					
Natural:					
Gem, not set or strung	thousand carats	3,385	3,353	119	India 1,734; Belgium-Luxembourg 631.
Industrial stones	do.	631	655	215	Belgium-Luxembourg 127; Zaire 102.
Dust and powder	do.	1,810	2,072	293	Ireland 896; Zaire 494.
Synthetic: Dust and powder	do.	49,242	53,842	23,961	Ireland 29,190; U.S.S.R. 375.
Diatomite and other infusorial earth		6,860	5,327	5,241	China 70; Ireland 16.
Feldspar, fluorspar, related materials:					
Feldspar		11,709	4,298	1	China 2,706; India 805.
Fluorspar		609,113	708,957	—	China 561,434; Republic of South Africa 61,694; Thailand 54,723.
Unspecified		11,191	10,250	(3)	Norway 8,474; Canada 1,776.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
INDUSTRIAL MINERALS—Continued					
Fertilizer materials:					
Crude, n.e.s.		21,884	19,630	—	Republic of Korea 11,233; Indonesia 3,147; Philippines 2,416.
Manufactured:					
Ammonia	kilograms	998	418	—	All from West Germany.
Nitrogenous		285,777	285,614	22,930	Qatar 108,862; Indonesia 56,574.
Phosphatic		185,619	167,581	56,541	China 94,686; Republic of Korea 14,944.
Potassic		1,278,208	1,253,565	144,129	Canada 597,432; U.S.S.R. 165,803.
Unspecified and mixed		665,057	657,324	520,072	Republic of Korea 110,721.
Graphite, natural		98,611	119,251	885	China 65,204; Republic of Korea 36,926.
Gypsum and plaster		2,914,046	3,259,030	705	Thailand 2,777,546; Mexico 368,393.
Iodine		59	291	183	Chile 108.
Kyanite and related materials		36,060	39,583	3,685	Republic of South Africa 31,697; India 1,305.
Lime		(3)	—		
Magnesium compounds:					
Magnesite, crude		12,199	735	—	
Oxides and hydroxides		387,973	429,395	81	China 393,570; North Koea 18,863.
Other		3,432	3,530	—	West Germany 3,312; Belgium-Luxembourg 162.
Mica:					
Crude including splittings and waste		21,122	24,253	198	China 9,982; India 6,351.
Worked including agglomerated splittings		324	239	(3)	India 236; Republic of Korea 2.
Phosphates, crude	thousand tons	1,821	1,590	805	Morocco 526; Jordan 221.
Phosphorus, elemental		20,191	24,372	8,906	Italy 3,334; U.S.S.R. 3,040.
Pigments, mineral:					
Natural, crude		1,084	673	—	China 604; United Kingdom 34; France 33.
Iron oxides and hydroxides, processed		13,164	15,745	4,447	West Germany 6,427; Brazil 1,460.
Precious and semiprecious stones other than diamond:					
Natural	kilograms	853,818	785,915	32,031	Brazil 406,774; Republic of South Africa 103,032.
Synthetic	do.	49,569	46,891	42,636	Hong Kong 1,434; Switzerland 834.
Pyrite, unroasted		259,652	327,863	—	China 234,430; Australia 72,567.
Quartz crystal, piezoelectric		54	128	84	Brazil 16; West Germany 14.
Salt and brine	thousand tons	7,229	7,703	(3)	Australia 4,080; Mexico 3,524.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		330	182	—	France 180; United Kingdom 2.
Sulfate, manufactured		5,601	1,848	1,661	China 187.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		1,656,968	1,461,256	42,616	China 378,236; Republic of Korea 363,649.
Worked		456,970	635,214	1,683	China 235,300; Republic of Korea 203,542.
Dolomite, chiefly refractory-grade		964,774	1,214,976	4,040	Republic of Korea 309,442; Philippines 269,299.
Gravel and crushed rock		455,671	419,961	150	Taiwan 348,015; China 30,799.
Limestone other than dimension		881	5,860	24	Philippines 5,041; France 794.
Quartz and quartzite		126,014	121,399	1,884	India 61,743; Thailand 24,800.
Sand other than metal-bearing		2,250,441	2,304,139	1,586	Australia 1,398,821; Taiwan 426,912.

See footnotes at end of table.

TABLE 3—Continued

JAPAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental:					
Crude including native and byproduct		2,305	287	—	Republic of Korea 207; Italy 40.
Colloidal, precipitated, sublimed-		110	160	(3)	China 110; France 36.
Sulfuric acid		47	17	—	All from Republic of Korea.
Talc, steatite, soapstone, pyrophyllite		660,570	763,535	25,977	China 595,284; Australia 131,236.
Vermiculite[6]		30,403	33,325	217	Republic of South Africa 18,759; China 13,914.
Other:					
Crude		373,998	383,404	13,093	Republic of Korea 200,582; China 37,805.
Slag and dross, not metal-bearing		378,899	359,950	2,451	Taiwan 84,195; Republic of Korea 82,926.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		3,391	3,791	2,722	Trinidad and Tobago 1,069.
Carbon black		24,133	33,412	12,054	Republic of Korea 13,994; West Germany
Coal:					
Anthracite and bituminous	thousand tons	104,181	78,291	11,414	Australia 48,891; Canada 19,334.
Lignite including briquets		32,455	26,737	805	U.S.S.R. 20,893; Australia 4,307.
Coke and semicoke		220,134	383,070	(3)	China 197,263; Australia 145,992.
Gas, natural: Liquefied	thousand tons	31,032	32,358	988	Indonesia 16,451; Malaysia 6,476.
Peat including briquets and litter		51,407	60,347	239	Canada 55,363; West Germany 2,377.
Petroleum:					
Crude	thousand 42-gallon barrels	1,180,759	1,263,598	(3)	United Arab Emirates 263,363; Saudi Arabia 227,699.
Refinery products:					
Liquefied petroleum gas	do.	147,978	162,450	2	Saudi Arabia 67,187; United Arab Emirates 33,517.
Gasoline	do.	172,235	178,812	2,366	Saudi Arabia 62,049; Kuwait 28,426.
Mineral jelly and wax	do.	113	92	49	Republic of South Africa 25; United Kingdom 5.
Kerosene and jet fuel	do.	71,089	78,140	6,811	Saudi Arabia 19,431; Singapore 16,819.
Distillate fuel oil	do.	23,645	46,925	4,071	Saudi Arabia 18,086; Kuwait 8,603.
Lubricants	do.	974	2,216	257	Singapore 1,257; Republic of Korea 353.
Nonlubricants	do.	352	334	201	France 66; Netherlands 39.
Residual fuel oil	do.	103,792	97,103	4,832	Indonesia 32,069; Singapore 14,492.
Bitumen and other residues	do.	956	1,279	1,250	Taiwan 28.
Bituminous mixtures	do.	43	12	4	Republic of Korea 4; United Kingdom 3.
Petroleum coke	do.	22,997	24,271	20,750	Kuwait 1,823; China 634.

[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]Includes vanadium ore and concentrate.
[3]Less than 1/2 unit.
[4]Excludes unreported quantity valued at $3,611,000.
[5]Includes fluorine.
[6]Includes perlite and chlorites.

22% of Japan's total primary aluminum imports, followed by Australia, 20%; Brazil, 11%; Venezuela, 9%; New Zealand, 8%; Canada, 6%; and Indonesia and the United Arab Emirates, 4% each.

According to the Japan Aluminium Federation, Japan is expected to raise the percentage share of primary aluminum imports from its captive overseas import sources (equity participation) to more than one-third of total imports, when the Alouette project in Quebec, Canada, comes on-stream in 1992.

In an effort to secure a stable overseas supply to meet the rapidly growing Japanese demand for primary aluminum, Mitsubishi Corp. and Reynold Metals Co. of the United States reportedly began a feasibility study for building a 200,000-mt/a primary aluminum smelter in eastern Venezuela. If the project should materialized and be completed in the mid-1990's, almost all output of the smelter would be exported to Japan. According to the Japan

TABLE 4

JAPAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Coal	Hokutan Sorachi Coal Mining Co. Ltd.	Sorachi, Hokkaido Prefecture	800
Do.	Mitsui Coal Mining Co. Ltd.	Ashibetsu, Hokkaido Prefecture, and Miike, Kyushu	4,600
Do.	Matsushima Coal Mining Co. Ltd.	Ikeshima, Kyushu	1,300
Do.	Sumitomo Akabira Coal Co. Ltdd.	Akabira, Hokkaido Prefecture	670
Do.	Taiheiyo Coal Mining Co. Ltd.	Kushiro, 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
Refined	Hibi Kyodo Smelting Co. Ltd.	Tamano, Okayama Prefecture	168
Do.	Mitsubishi Materials Corp.	Naoshima, Kagawa Prefecture	137
Do.	Nippon Mining Co. Ltd.	Hitachi,Ibaraki Prefecture, and Saganoseki, Oita Prefecture	300
Do.	Onahama Smelting and Refining Co. Ltd.	Onahama, Fukushima Prefecture	251
Do.	Sumitomo Metal Mining Co. Ltd.	Besshi, Ehime Prefecture	192
Gold:			
In concentrate, kilograms	Mitsui Kushikino Mining Co. Ltd.	Kushikino, Kagoshima Prefecture	200
Do. do.	Sumitomo Metal Mining Co. Ltd.	Hishikari, Kagoshima Prefecture	7,000
Refined do.	Mitsibishi Materials Corp.	Naoshima, Kagawa Prefecture	60,000
Do. do.	Nippon Mining Co. Ltd.	Hitachi, Ibaraki Prefecture	15,000
Do. do.	Sumitomo Metal Mining Co. Ltd.	Niihama, Ehime Prefecture	30,000
Limestone	Mitsubishi Materials Corp.	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.)	Toyoha, Hokkaido Prefecture	10
Do.	Toyoha Mining Co. Ltd. (subsidiary of Nippon Mining Co. Ltd.)	Toyoha, Hokkaido Prefecture	10
Refined	Kamioka Mining and Smelting Co. Ltd.	Kamioka, Gifu Prefecture	31.2
Do.	Mitsubishi Cominco Smelting Co. Ltd.	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

TABLE 4—Continued

JAPAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
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	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.	Matsuzaka, Mie Prefecture	36
Refined	Sumitomo Metal Mining Co. Ltd.	Niihama, Ehime Prefecture	27.9
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, Fukuoka Prefecture; Kimitsu, Chiba Prefecture; and Nagoya, Aichi Prefecture	48,800
Do.	Sumitomo Metal Industries	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	10.8
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
Refined	Akita Smelting Co. Ltd.	Iijima, Akita Prefecture	156
Do.	Mitsubishi Materials Corp.	Akita, Akita Prefecture	106
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

Metal Bulletin, the total cost of the new smelter was estimated at more than $1 billion and would be a joint venture of Mitsubishi, Reynold Metals, and two Venezuelan partners.[4]

Domestic demand for primary aluminum rose by 7.4% to a new record at 2.6 Mmt in 1990 mainly owing to a 7% increase in demand for aluminum-rolled mill products, which amounted to 1.9 Mmt in 1990.

According to MITI, in 1990, consumption of primary aluminum for aluminum rolling accounted for 73%; for secondary remelting, 14%; for aluminum casting, 4%; for wire and cable, 3%; and other, 6%.

TABLE 5

OVERSEAS ALUMINUM SMELTING OPERATIONS

Company and country	Japanese equity participation (percent)	Annual capacity	Japanese share
		(metric tons)	
Alcan Smelters and Chemical Ltd., Canada	Owned 50% by Nippon Light Metal Co. Ltd.	90,000	45,000
Aluminerie Alouette Inc., Canada	Owned 13.33% by Kobe Steel Ltd. and 6.67% by Marubeni Corp. The Alouette project was still under construction and scheduled to come on-stream in April 1992	215,000	43,000
Aluminio Brasileiro Ltda., Brazil	Owned 49% by Nippon Amazon Aluminium Co., a 31-member Japanese consortium	320,000	160,000
Boyne Smelter Ltd. Australia	Owned 17% by Sumitomo Light Metal Industries, Ltd., 9.5% by Kobe Steel, 9.5% by Mitsubishi Corp., 9.5% by Yoshida Industries Ltd., and 4.5% by Sumitomo Chemical Co., Ltd.	230,000	115,000
Industria Venezolana de Aluminio C.A., Venezuela	Owned 7% by Showa Denko K.K., 4% by Kobe Steel, 4% by Sumitomo Chemical, Mitsubishi Aluminium Co. Ltd. and Mitsubishi Materials Corp., 2% each, and Marubeni, 1%	450,000	170,000
New Zealand Aluminium Smelters Ltd., New Zealand	Owned 20.64% by Sumitomo Chemical	244,000	50,000
P.T. Indonesia Asahan Aluminum, Indonesia	Owned 59% by Nippon Asahan Aluminium Co., a 13-member Japanese consortium	225,000	[e]120,000
Total	XX	1,774,000	703,000

[e]Estimated. XX Not applicable.

Source: Japan Aluminium Federation (Tokyo).

TABLE 6

JAPAN: DEMAND FOR ALUMINUM PRODUCTS, BY SECTOR

(Thousand metric tons)

Sector	Actual		Projected	
	1985	1989	1993	1995
Transportation equipment	779	1,057	1,529	1,974
Construction	770	908	934	997
Fabricated products	106	135	151	162
Aluminum foil	128	151	168	178
Food containers	153	271	356	416
Telecommunication equipment	169	192	209	219
Machinery	127	142	155	162
Electric power companies	42	48	50	51
Kitchen utensils	32	33	33	33
Chemical tanks and containers	8	9	9	9
Other	282	463	503	555
Other	202	463	503	555
Total	2,527	3,409	4,097	4,756

Source: Ministry of International Trade and Industry (Tokyo).

According to a MITI forecast made in 1990, demand for all aluminum products is projected to grow at an annual rate of 4.7% in the 1989-93 period and at 5.7% in the 1989-95 period. Among the major end-use sectors, the transportation equipment and food containers are projected to grow at an annual rate of 9.7% and 7.1%, respectively, in the 1989-93 period and at 11.0% and 7.4%, respectively, in the 1989-95 period.[5]

The transportation equipment sector includes automobiles, motorcycles, rolling stock, cargo containers, bicycles, ships, and aircraft. The food container sector includes beverage cans and container caps. The fabricated products sector includes aluminum printing plates, spray cans slab, nameplates, sporting and recreational supplies, and furniture parts.

Bismuth.—Japan was the world's fourth largest producer of bismuth metal in 1990. Bismuth metal, recovered as a byproduct of lead smelting, continued the 1989 downward trend because of decreased mine output of bismuth-bearing ore from domestic skarn and Kuroko (black ore) deposits. Since 1984, more than 65% of Japan's bismuth metal was produced from imported lead and zinc ore originating from Australia, Canada, and Peru. As a result of dwindling reserves of domestic bismuth-bearing skarn and Kuroko deposits, the Geological Survey of Japan reported that as of 1990, its estimate of Japan's bismuth reserves were 8,745 tons[6].

In 1990, bismuth metal was produced mainly by Dowa Mining Co. Ltd., Mitsui Mining and Smelting Co. Ltd., and Nippon Mining Co. Ltd. at their lead and zinc processing plants. Domestic demand for bismuth totaled 450 tons, of which 53% was for ferrite manufacturing, 18% for metallurgical additives, 8% for low-melting alloys, 5% for pharmaceutical, and 16% for other uses.

Chromium.—Chromium ore produced by Nippon Chrome Industries Ltd. from the Wakamatsu Mine in Tottori Prefecture decreased from that of 1989 and remained small when compared with Japan's total consumption. Japan continued to rely on imports in 1990 to meet 99% of its chromium ore requirements and 59% of its ferrochromium requirements.

Imports of metallurgical- and refractory-grade chromite decreased by more than 24% to 789,225 tons in 1990 mainly because of reduced consumption by the iron and steel industry. The Republic of South Africa remained the dominant supplier of chromite, accounting for 68% of total imports in 1990. Other important suppliers of chromite were Madagascar, 7%; the Philippines, 5%; and India, 3%.

According to MITI, consumption of chromite by the ferroalloy industry dropped to 605,087 tons from 654,242 tons in 1989. Production of ferrochromium was by five ferroalloy-producing companies in 1990. Japan Metal and Chemical Co. Ltd. operated with a total capacity of 109,400 mt/a at Kita Kyushu in Fukuoka Prefecture and at Oguni in Yamagata Prefecture. NKK Corp. operated with a 96,000-mt/a capacity at Toyama in Toyama Prefecture. Nippon Denko K.K. operated with a 77,990-mt/a capacity at Hokuriku in Toyama Prefecture. Pacific Metals Co. Ltd. operated with a 49,000-mt/a capacity at Hachinohe in Aomori Prefecture. Showa Denko K.K. operated with a 75,700-mt/a capacity at Chichibu in Saitama Prefecture and at Shunan in Yamaguchi Prefecture.

Imports of ferrochromium decreased by more than 7% to 441,672 tons in 1990 because of a weaker demand for ferrochromium by the specialty steel industry. The Republic of South Africa remained the dominant supplier of ferrochromium, providing 62% in 1990. Other suppliers were the Philippines, 11 %; India, 10%; Zimbabwe, 7%; and China, 2%.

Japan was the world's leading producer of chromium metal in 1990. Production of chromium metal with 99.95% purity was by Nippon Denko K.K., which operated a 700-mt/a plant using the aluminothermic process at Tokushima in Tokushima Prefecture and Tosoh Corp., which operated a 3,600-mt/a plant using the electrolytic process at Yamagata in Yamagata Prefecture. An explosion reportedly occurred in December in the bag filters in the flat milling facility of Tosoh's Yamagata plant. However, production resumed after a 2-week shutdown for repair.

In May, Tosoh brought on-stream a new 600-mt/a high-purity chromium powder production facility at its Yamagata plant site. The new production technology was jointly developed with Plansee AG, an Austrian company that specializes in powder metallurgy. According to Tosoh, the potential applications of high-purity chromium powder include high-temperature electrode materials, such as ignition plugs for automobiles and electrodes for dry-type metal plating; high-temperature materials, such as electrodes, flame-spray material, structural material for high-temperature reactor and glass molds; and corrosion-resistant materials, used in heat exchangers and rollers for thin-sheet metal plating.[7]

Cobalt.—Japan continued to rely on imports to meet its requirement for cobalt. Cobalt metal production by Sumitomo Metal Mining Co. Ltd. rose sharply in 1990 owing to a large quantity of cobalt precipitate accumulated in 1989 during the early stage of renovation of its nickel-cobalt refining facilities. Sumitomo Metal Mining recovered cobalt from the precipitate resulting from its nickel electrolytic refining operation in Niihama in Ehime Prefecture on Shikoku Island. In addition to cobalt metal, Sumitomo Metal Mining also produces cobalt oxide and cobalt salts and compounds. Nippon Mining Co. Ltd.'s Nikko cobalt-nickel refinery in Ibaraki Prefecture remained shut down owing to lack of raw material.

To meet the domestic demand for cobalt metal, Japan imported cobalt, in decreasing order, mainly from Zaire, Zambia, Belgium, and Norway in 1990. Imports of cobalt metal, including powder and scrap, rose sharply to 4,537 tons from 3,342 tons in 1989 because of a two-digit percentage increase in demand in all end-use sectors of cobalt metal in 1990.

TABLE 7

JAPAN: CONSUMPTION OF COBALT, BY END USE

(Metric tons)

End use	1988	1989	1990
Catalysts	277	373	416
Cemented carbides	256	302	345
Magnetic materials	596	555	647
Specialty steels	675	787	890
Other	528	568	696
Total	2,332	2,585	2,994

Source: Ministry of International Trade and Industry (Tokyo). Yearbook of Minerals and Nonferrous Metals Statistics, 1990, p. 175.

Copper, Lead, and Zinc.—Japan's import reliance of copper, lead, and zinc rose considerably when its domestic mine output declined and domestic demand expanded in 1990. Because of the strong Japanese yen, domestic high-cost producers of nonferrous minerals were forced to further scale down their mining operations. The Uchinotai Mine, one of Japan's major nonferrous metal mines in Akita Prefecture, was closed permanently in March by the Uchinotai Mining Co. Ltd. owing to unprofitable operation and depletion of high-grade "black ore" (a typical complex ore of copper, lead, and zinc in Japan). The Uchinotai Mine, formerly operated by Dowa Mining Co. Ltd. as the Kosaka Mine, had been in operation since 1959 and had produced a total of about 12 Mmt of black ore in the past 30 years.

The remaining five major nonferrous metal mines in 1990, believed to be more efficient and competitive, were the Hanaoka Mine in Akita Prefecture, the Kamaishi Mine in Iwate Prefecture, the Kamioka Mine in Gifu Prefecture, the Nurukawa Mine in Aomori Prefecture, and the Toyoha Mine in Hokkaido Prefecture. The Toyoha Mine, Japan's second largest lead-zinc mine, reportedly will start producing copper from a newly discovered nearby lead-zinc-copper ore vein beginning in 1991. In 1990, MMAJ announced that it had discovered a high-grade lead-zinc deposit at Jozankei near the Toyoha Mine in Hokkaido. MMAJ planned to conduct further exploration in 1991.

In overseas exploration, MMAJ concluded a 3-year joint exploration of lead and zinc with Consejo Recrusos Minerales of Mexico in the Tizapa area of the Arceris district in Mexico. According to MMAJ, about 3 Mmt of ore averaging 10% lead and zinc associated copper, gold, and silver values had been ascertained in the area. The feasibility study for commercial mining will begin in 1991.

In April, Mitsui Mining & Smelting Co. Ltd. and Mitsui & Co. reached a 10-year joint-venture agreement with Cyprus Minerals Co. of the United States to initiate large-scale exploration for copper, lead, and zinc in several of the concession areas held by Cyprus in Arizona, Colorado, and New Mexico. A joint venture called Western Zinc Co. was established by Cyprus (50%), Mitsui Mining & Smelting (35%), and Mitsui & Co. (15%) to begin exploration in 1990. The exploration cost, which will be shared according to their equity participation, was estimated at $7 million for the first 5 years.[8]

Japan remained the world's largest importer of copper in 1990. Imports of copper ore and concentrate, refined copper, and copper scrap all reached record-high levels in 1990.

TABLE 8

JAPAN: IMPORTS OF COPPER IN 1990, BY FORM AND ORIGIN

(Metric tons)

Source	Copper concentrate	Copper scrap	Unwrought	
	Gross weight		Unrefined	Refined
Australia	240,578	2,655	—	40,719
Canada	969,720	686	—	3,044
Chile	334,699	—	—	194,701
Indonesia	263,735	58	—	198
Malaysia	112,525	4,114	—	—
Mexico	33,663	—	—	99
Papua New Guinea	250,016	—	—	—
Peru	103,994	—	25,736	31,786
Philippines	430,053	3,578	—	57,630
Portugal	129,306	—	—	—
U.S.S.R.	70,814	91	—	5,337
United States	455,287	36,668	—	102,676
Zambia	—	—	—	156,312
Other	128,145	32,128	1,692	26,283
Total	3,522,535	79,978	27,428	618,785

Source: Ministry of Finance (Tokyo). Japan Imports and Exports, Commodity by Country, Dec. 1990.

In 1990, imports of lead ore and concentrate dropped 6% to 279,535 tons, of which 28% came from Canada, 27% from Australia, 24% from Peru, 8% from the Republic of South Africa, 6% from Thailand, and 7% from other countries. Imports of zinc ore and concentrate rose 15% to 1,186,231 tons, of which 52% came from Australia, 19% from Peru, 11% from Canada, 7% from the United States, 3% from China, and 8% other countries. The United States became one of Japan's major zinc ore suppliers when the Red Dog zinc mine in Alaska began shipping zinc concentrate to Japan in the fall of 1990. Imports of refined lead and zinc increased by 18% and 6% to 70,243 tons and 140,470 tons, respectively, in 1990. The principal suppliers of refined lead in 1990 were Peru, 26%; Mexico, 20%; Australia, 14%; China, 11%; the U.S.S.R. and Canada, 10% each. The major suppliers of slab zinc were North Korea, 32%; the Republic of Korea, 18%; Canada, 16%; Australia, 13%; China, 10%; Mexico, 5%; and Peru 4%.

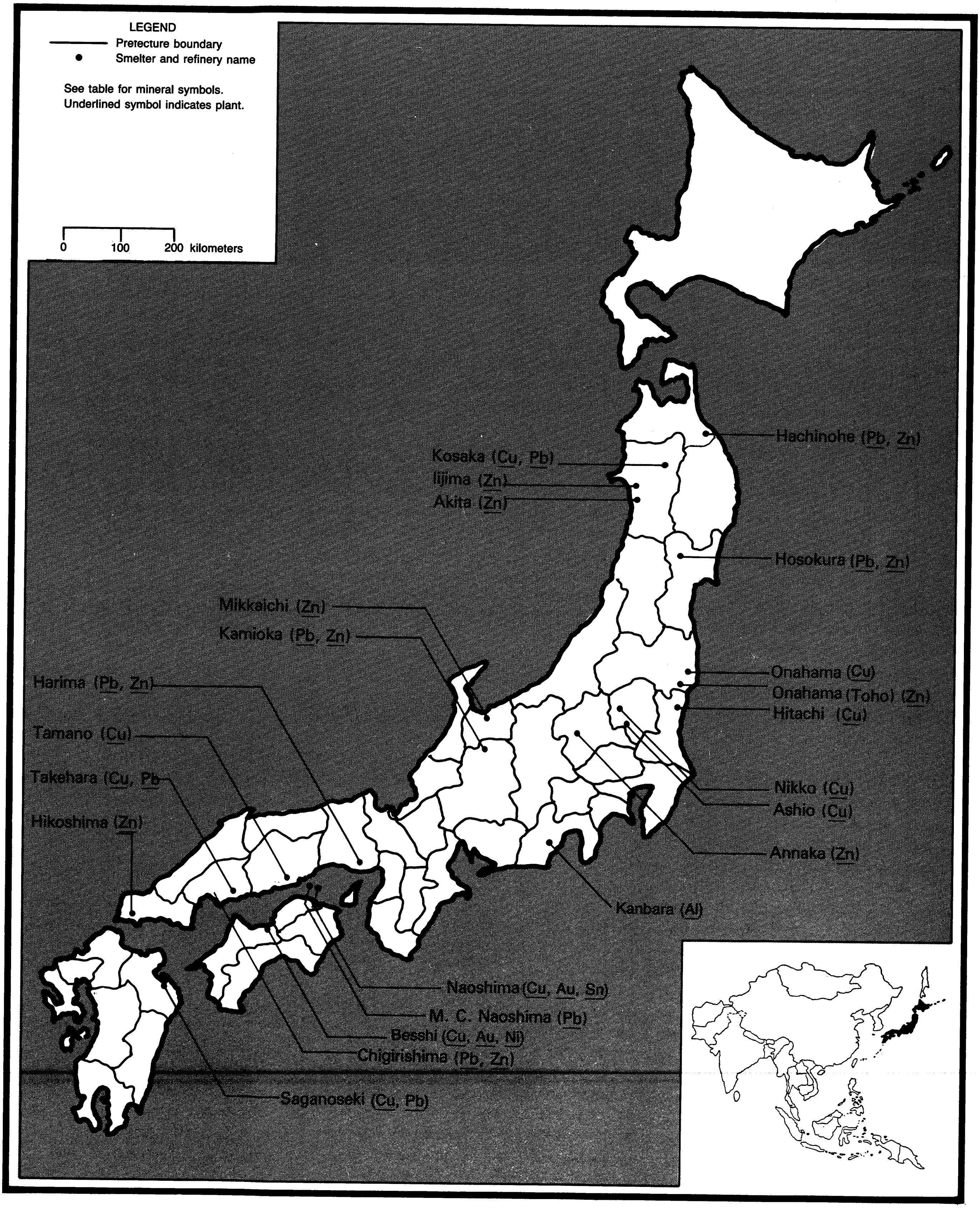
To secure overseas supply of raw materials for the expanding domestic nonferrous smelting industry, Mitsubishi Metal Corp. signed a contract with Atlas in September to provide a $30 million loan for securing a 15-year supply of copper concentrate from Atlas's Toledo Mine on Cebu Island at the rate of 130,000 mt/a. The loan, to be repaid in 12 years, reportedly will be used by Atlas for its debt restructuring.

In October, Furukawa Co. Ltd., a major copper producer, and Nissho Iwai Corp., a major trading company, jointly provided a $10 million financing to Denehurst Ltd. of Australia for development of the Currawang base metal mine near the Woodlawn base metal mine in South Wales. Denehurst is expected to ship a portion of the output to Japan when the new mine begins production in April 1991. Furukawa had doubled its equity holding in Denehurst to 16% in 1990.

In December, Nippon Mining Co. Ltd., a major nonferrous metals producer, and Sumitomo Corp., a major trading company, entered into an agreement to provide about $6 million to Bethlehem Resources Corp. and Goldnev Resources Inc. of Canada to reopen their Goldstream Mine in British Columbia in 1991. In return, Nippon Mining is expected receive 65,000 mt/a supply of copper concentrate and 7,000 mt/a of zinc concentrate for 6 years beginning in mid-1991, when the copper-zinc mine resumes operation.

FIGURE 1

JAPAN: LOCATION OF MAJOR NONFERROUS SMELTING AND REFINING PLANTS



Metal Mining Agency of Japan (Tokyo) publication adapted from *Mining Activities of Japan, 1990.*

TABLE 9

JAPAN: SOURCE OF MATERIALS USED IN THE PRODUCTION OF COPPER, LEAD, AND ZINC

(Metric tons)

Commodity and/or source	1988	1989	1990
Copper, refined:			
Domestic ore	8,501	6,547	5,881
Imported ore[1]	846,107	875,716	887,252
Scrap	57,629	58,496	60,289
Other	42,871	48,807	54,554
Total	955,108	989,566	1,007,976
Lead, refined:			
Domestic ore	41,380	38,052	39,041
Imported ore	176,331	169,683	165,840
Scrap	8,605	9,495	7,877
Other	41,079	42,748	48,258
Secondary recovery	72,562	73,381	67,971
Total	339,957	333,359	328,987
Zinc, slab:			
Domestic ore	152,744	135,407	129,294
Imported ore	448,338	455,735	476,424
Scrap	21,585	24,425	23,283
Other	55,508	48,940	58,460
Secondary recovery	47,609	50,171	44,141
Total	725,784	714,678	731,602

[1]Includes blister.

Source: Ministry of International Trade and Industry (Tokyo). Yearbook of Minerals and Nonferrous Metals Statistics, 1988-90, annual.

In April, Mitsubishi Metal awarded the engineering contract for construction of a 150,000-mt/a new copper smelter, a 500,000-mt/a sulfuric acid plant, office buildings, and utility generating plant to Fluor Daniel Corp. of the United States. By yearend, one of three key permits reportedly had been approved by the Texas Water Commission for the use of Galveston Bay water and for water discharge into the bay. However, a general permit from the U.S. Army Corps of Engineering and an air permit from the Texas Air Control Board and the U.S. Environmental Protection Agency were still pending. As a result, construction work had been delayed until 1991.

To integrate its copper smelting and refining operations in the United States, Mitsubishi Metal raised its equity holding from 20% to 80% and assumed management of Cox Creek Refining Co. of Baltimore, MD, by acquiring the difference in equity from Cox Creek's president and other shareholders in September. Mitsubishi Metal is expected to make additional capital investments to modernize the 85,000-mt/a refining facilities after construction of its Texas City smelter in Texas is completed in 1993.

In December, Mistubishi Metal and Mitsubishi Mining & Cement Co. Ltd. merged into one company called Mitsubishi Materials Corp., with an annual sales of $6 billion and a work force of about 9,100. Mitsubishi Materials, which ranked as Japan's largest nonsteel materials producer in 1990, is engaged primarily in production and fabrication of nonferrous and rare metals; in the production of chemicals; cement, building and construction materials; and ceramics.

To meet increased domestic demand for refined copper, refined lead, and slab zinc, Nippon Mining was expected to raise its total copper refining capacity by 10% at the Hitachi plant in Ibaraki Prefecture to 132,000 mt/a and at the Saganoseki plant in Oita Prefecture to 198,000 mt/a by early 1991. The company was also expected to expand capacity of the copper smelter at its Saganoseki plant to 330,000 mt/a from 300,000 mt/a by installing new equipment to treat additional sulfuric acid gas for recovery of copper by February 1991.

In April, Hibi Kyodo Smelting Co. Ltd. announced that it planned to launch a $17 million expansion program to raise its copper smelting and refining capacities by 10% to 20% from 196,000 mt/a and 137,000 mt/a, respectively, at its Tamano plant in Okayama Prefecture in 1991.

In August, Dowa Mining Co. Ltd. completed a $7 million renovation project for its 25,200-mt/a lead smelter at its Kosaka nonferrous metals smelting and refining complex in Akita Prefecture. In August, Mitsubishi Materials announced that it planned to spend $27 million for renovating and upgrading the 42,000-mt/a lead smelter at its Naoshima nonferrous metals smelting and refining complex on Naoshima Island in Kagawa Prefecture by February 1992.

In June, a feasibility study was initiated by Nippon Mining for the construction of a 120,000-mt/a zinc refinery and a 60,000-mt/a lead smelter at Yomakomai in Hokkaido Prefecture with joint participation with Mitsui Mining and Smelting and M.I.M. Holdings Ltd. of Australia. The cost estimate of this new lead and zinc smelting and refining project reportedly was revised upward by 40% to $486 million. Meanwhile, Mitsui Mining and Smelting, one of the Nippon Mining's partners, announced in September that it had decided to expand the 72,000-mt/a zinc refining capacity at its Kamioka plant in Gifu Prefecture by 30% to 93,600 mt/a and the 84,000-mt/a zinc refining capacity at its Hikosima plant in Yamaguchi Prefecture by 50% to 126,000 mt/a by late 1991.

In September, Dowa Mining also announced that it planned to expand the 156,000-mt/a zinc refinery of its Akita Smelter Co. Ltd. at Iijima in Akita Prefecture to 234,000 mt/a at an estimate cost of $160 million by early 1993.

Domestic consumption for refined copper continued the 1989 upward trend and reached a new high at 1,607,726 tons, of which 71% was for wire and cable, 28% for brass mill products, and 1% for other. Exports of refined copper rose 54% to 50,737 tons in 1990. Overall stocks of refined copper declined by 1.3% to 107,061 tons at the end of 1990.

Domestic demand for refined lead increased 2.4% to 307,034 tons in 1990, of which 64% was for storage batteries, 21% for inorganic chemicals, 5% for solders, 3% for lead pipe and sheet, and 7% for other. Exports of primary lead rose slightly to 25 tons from 22 tons in 1989. Overall stocks of primary lead dropped by 9% to 26,246 tons at the end of 1990.

Domestic demand for zinc slab rose by 1% to 785,544 tons, of which 47% was for sheet galvanizing; 15% for tube, wire, and general galvanizing; 14% for zinc diecastings; 13% for brass mill products; and 11% for other. Exports of zinc metal rose 19% to 21,254 tons in 1990. Overall stocks of zinc slab dropped 8% to 88,041 tons at the end of 1990.

Gallium.—Japan was a worlds' leading consumer and one of the world's major producer of high-purity gallium metal in 1990. Because of the availability of low-cost chloride recycling technology and increased domestic demand, secondary production of gallium reached a record high in 1990. 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 estimated at 37,000 kg in 1990. Consumption of high-purity gallium metal was estimated at 63,000 kg in 1990.

To meet increased demand, imports of gallium metal rose 23% to 20,009 kg in 1990, of which 15,583 kg was high-purity gallium metal and 4,426 kg was crude gallium metal (intermediate grade). In 1990, the suppliers of high-purity gallium metal were International Gallium GmbH of the Federal Republic of Germany, 6,070 kg; Rhone-Poulenc S.A. of France, 9,463 kg; and the U.S.S.R., 50 kg. The suppliers of crude gallium metal were Metal Impemex of Czechoslovakia, 220 kg; China National Nonferrous Metals Import and Export Corp., 1,519 kg; Aluminium Kervaell of Hungary, 2,639 kg; and the United States, 48 kg.[9]

Gold and Silver.—Mine production of gold rebounded to the 1988 level mainly owing to increased ore output at the Hishikari gold mine in Kagoshima Prefecture of southern Kyushu, while mine production of silver dropped to a new low because of the further decline in recovery of silver as a byproduct from major nonferrous metal mines.

After the discovery of the Yamada gold deposit near the Hishikari Mine in 1988, Sumitomo Metal Mining announced in September that it had discovered another new vein of gold-bearing ore nearby. The newly discovered Sanjin gold deposits, lying about 250 meters below the surface with a seam thickness varying between 10 and 40 meters, has estimated reserves of 700,000 tons of ore averaging 70 g of gold per ton of ore. The company planned to spend about $7 million for exploration drilling of the Sanjin deposit beginning in April 1992. Total reserves at and around the Hishikari Mines, according to Sumitomo Metal Mining, were estimated at 250 tons of gold.

Japan's production of gold metal decreased, while that of silver metal reached a record high in 1990. There were five metal producers of gold and silver in 1990. Dowa Mining was at its Kosaka precious-metals refinery in Akita Prefecture. Mitsubishi Materials was at its Naoshima precious-metals refinery in Kagawa Prefecture. Mitsui Mining and Smelting was at its Takehara precious-metals refinery in Hiroshima Prefecture. Nippon Mining was at its Saganoseki precious-metals refinery in Oita Prefecture. Sumitomo Metal Mining was at its Toyo smelting and refining facilities in Ehime Prefecture. Sludge from domestic copper refineries and foreign sources were used as raw materials for gold and silver recovery.

Japan continued to rely on imports to meet 50% of its gold metal demand and 28% of its silver metal demand in 1990. Despite a weaker demand, imports of gold metal rose 6.6% to 302,902 kg. Of the total gold imported in 1990, 30% was from Switzerland, 23% from Australia, 17% from Canada, 11% from United Kingdom, 6% from the U.S.S.R., 2% each from the United States and the Republic of Korea, and 9% from other countries. Imports of silver metal rose by 9.1% to 932 tons because of increased domestic demand for photographic materials, fabricated products, silverware, and jewelry. The United States, Peru, and Mexico were the three dominant suppliers of silver metal, providing 35%, 27% and 22%, respectively, in 1990. Other important suppliers of silver in 1990 were Australia, 7%, and the United Kingdom and Chile, 2% each.

Indium.—Japan remained the world's largest producer of indium in 1990. The primary sources of raw material for indium metal production were from the Toyoha Mine, a tin-polymetallic type deposit, in Hokkaido and the Mount Pleasant Mine, a fine-grained porphyry deposit, in New Brunswick of Canada. According to Japan's Rare Metal News, primary metal was produced mainly by Nippon Mining at its Saganoseki refinery in Oita Prefecture of northeastern Kyushu. Secondary recovery using scrap indium phosphide, compound semiconductors containing indium, and zinc residues obtained from zinc refineries was by Dowa Mining at its Kosaka refinery in Akita Prefecture, Mitsui Mining and Smelting at its Takehara refinery in Hiroshima Prefecture, and Sumitomo Metal Mining at its Harima refinery in Hyogo Prefecture.

Because of the continued growth in demand by the manufacturers of indium-tin oxide (ITO), imports of indium, including ingot, powder, and scrap, rose from 31.5 tons in 1989 to 36 tons in 1990. China, France, Italy, and the United States were the principal suppliers of indium to Japan in 1990.

Iron and Steel.—Mine production of iron sand and roasted pyrite dropped to a record low in 1990. Japan's iron and steel industry continued to rely on imports to meet virtually all of its raw requirements. Imports of iron ore, including iron sand, pellet, and sinter, dropped by 1.9% to 125.2 Mmt in 1990 owing to a higher iron ore price, while imports of pig iron rose 43.5% to 3.3 Mmt in 1990 owing to a lower pig iron price in 1990. Australia, Brazil, and India remained the three dominant sources of iron ore, providing 43%, 24%, and 17%, respectively, in 1990. The U.S.S.R., Brazil, and China were the three major suppliers of pig iron, accounting for 41%, 32%, and 13%, respectively, in 1990. Japan also imported about 1 Mmt of iron and steel scrap principally from the United States and U.S.S.R. in 1990. According to the Ministry of Finance, Japan's import c.i.f. price per ton of iron ore rose to $26.93 from $24.64 per in 1989, import c.i.f. price per ton of pig iron dropped to $166.56 from $172.60 per ton in 1989, and import c.i.f. price per ton of iron and steel scrap dropped to $313.13 from $342.03 in 1989.

In July, four major Japanese steel producers had reached a major purchase agreement with Broken Hill Proprietary Co. of Australia to purchase 3.1 Mmt/a of iron ore over 7 years from the Yandicoogina Mine in Australia beginning in April 1992. The Yandicoogina Mine, about 90 km north of Mount Newman, is capable of producing 5 Mmt/a of iron ore and has reserves of about 320 Mmt. The four Japanese steel companies are Kawasaki

TABLE 10

JAPAN: SUPPLY AND DEMAND FOR GOLD AND SILVER

(Gold in kilograms, silver in metric tons)

Item	1989	1990
Gold:		
Supply:		
Domestic production	110,330	108,152
Imports	284,235	302,902
Secondary recovery	190,586	213,000
Total supply	585,151	624,054
Demand:		
Demand for industrial use:		
Dental and medical	14,582	e15,000
Electrical, electronic, and communications apparatus	43,121	e45,000
Gold plating	16,741	e17,000
Gilding	2,257	e2,000
Jewelry	109,261	e100,000
Decorations and badges	928	e1,000
Pottery and porcelain	r4,345	e4,000
Fountain pens	r550	e1,000
Watches	3,995	e4,000
Subtotal	195,780	e189,000
Demand for industrial arts and crafts	3,588	4,031
Demand for investment and other:		
Private investment	215,097	e180,000
Other	152,654	e160,000
Total domestic demand	567,024	e529,000
Exports	18,127	e20,000
Total demand	585,151	e549,000
Silver:		
Supply:		
Beginning stock	842	1,159
Primary metal production	1,987	2,089
Metal imports	853	932
Secondary recovery	167	229
Total supply	3,850	4,409
Demand:		
Silver nitrate for photography	1,704	1,757
Silver nitrate for other uses	278	279
Electrical contacts	295	302
Brazing alloy	141	140
Electroplating	117	127
Rolled products	215	236
Jewelry and silverware	110	118
Other	322	363
Total domestic demand	3,182	3,321
Exports	1	(1)
Total demand	3,183	3,321
Ending stock	1,159	1,396

eEstimated by Sumishyo Gold Co. rRevised.

1Less than one unit.

Sources: Arumu Publishing Co. Ltd. (Tokyo). Industrial Rare Metals, Annual Review. No. 101, 1990, p. 178; and Ministry of International Trade and Industry, Ministry of Finance, and Japan Mining Industry Association.

TABLE 11

JAPAN: CONSUMPTION OF INDIUM, BY END USE

(Metric tons)

End use	1988	1989	1990
Bearing	1.2	1.3	1.4
Dental amalgams	3.0	3.0	3.0
Electrical contacts	2.6	2.6	2.7
Fluorescent materials	8.0	10.0	11.0
Indium-tin oxide	3.1	3.6	4.7
Semiconductors	5.3	5.7	6.2
Solder, fusible alloys	4.5	4.5	5.0
Transparent electrodes	15.0	17.0	20.0
Others[1]	9.1	10.0	9.0
Total	51.8	57.7	63.0

1Includes glass coating, other uses, and exports.

Source: The Rare Metal News (Tokyo). No. 1588, Apr. 1, 1991, p. 2.

Steel Corp., Kobe Steel Ltd., Nippon Steel Corp., and Sumitomo Metal Industries Ltd.

Consumption of iron ore, including iron sand, pellet, and sinter by blast furnaces, increased to 132.2 Mmt from 131.6 Mmt in 1989. In 1990, about 98.6% of pig iron production was for steelmaking and 1.4 % was for foundry uses. The pig iron sector continued its rationalization program in 1990. According to MITI, the industry scrapped two blast furnaces, and one electric furnace during the first half of 1990. By the end of 1990, the total number of furnaces, including blast furnaces, electric furnaces, and other furnaces for pig iron production, was reduced to 47 from 50 in 1989, reducing the pig iron production capacity to 98.5 Mmt/a from 101.9 Mmt/a in 1989.

Japan remained the world's second largest pig iron and crude steel producer, accounting for 15.2% and 14.3%, respectively, of the world production in 1990. Nippon Steel, which celebrated its 20th birthday in March, continued to maintain its position as the largest steelmaker in the Western World in 1990.

Because of a steady growth in domestic demand for steel by the automobile, construction, and shipbuilding industries, crude steel output reached a 10-year high in 1990. Of the crude steel produced in 1990, 68.6% was processed by the basic oxygen furnaces and 31.4% by the electric furnaces. The steelmaking sector, according to MITI, scrapped 3 of its 75 basic oxygen furnaces and 6 of its 490 electric

TABLE 12

JAPAN: CRUDE STEEL PRODUCTION AND RANKING OF THE TOP SEVEN COMPANIES

	Output million metric tons		Company ranking in market economy countries	
	1989	1990	1989	1990
Nippon Steel Corp.	28.38	28.76	1	1
NKK Corp.	12.28	12.11	7	6
Sumitomo Metal Industries Ltd.	11.00	11.14	12	8
Kawasaki Steel Corp.	11.01	11.12	11	10
Kobe Steel Ltd.	6.45	6.56	18	15
Nisshin Steel Co. Ltd.	3.45	3.60	35	31
Tokyo Steel Manufacturing Co. Ltd.	3.42	3.48	36	32
Total	75.99	76.77	XX	XX

XX Not applicable.

Source: Metal Bulletin (London). No. 7560, Feb. 25, 1991, p.19.

furnaces. By the end of 1990, the overall crude steel production capacity was reduced to 136.9 Mmt/a from 141.6 Mmt/a in 1989 and the industry's labor force was also cut by 1,413 to 294,138 workers.

Despite a further shrinking of its production capacity, Japan's iron and steel industry continued to invest heavily in domestic as well as in overseas' plants and equipment in 1990. According to a MITI's survey conducted in September on the industry spending, the iron and steel industry planned to invest $6.3 billion in fiscal year 1990 (April 1990-March 1991) compared with $5.4 billion in fiscal year 1989. The industry's capital spending in fiscal year 1990 was to focus on new equipment for production of high value-added products, such as surface-treated steel/plates and steel sheets as well as plant renovation, maintenance, and repair. In overseas investment, NKK Corp., which already owned 50% equity share in National Steel Corp. of the United States, bought another 20% equity share from National Steel for $147 million in April. As of 1990, NKK, planned to make additional investment to bolster the financial position of National Steel in coming years.

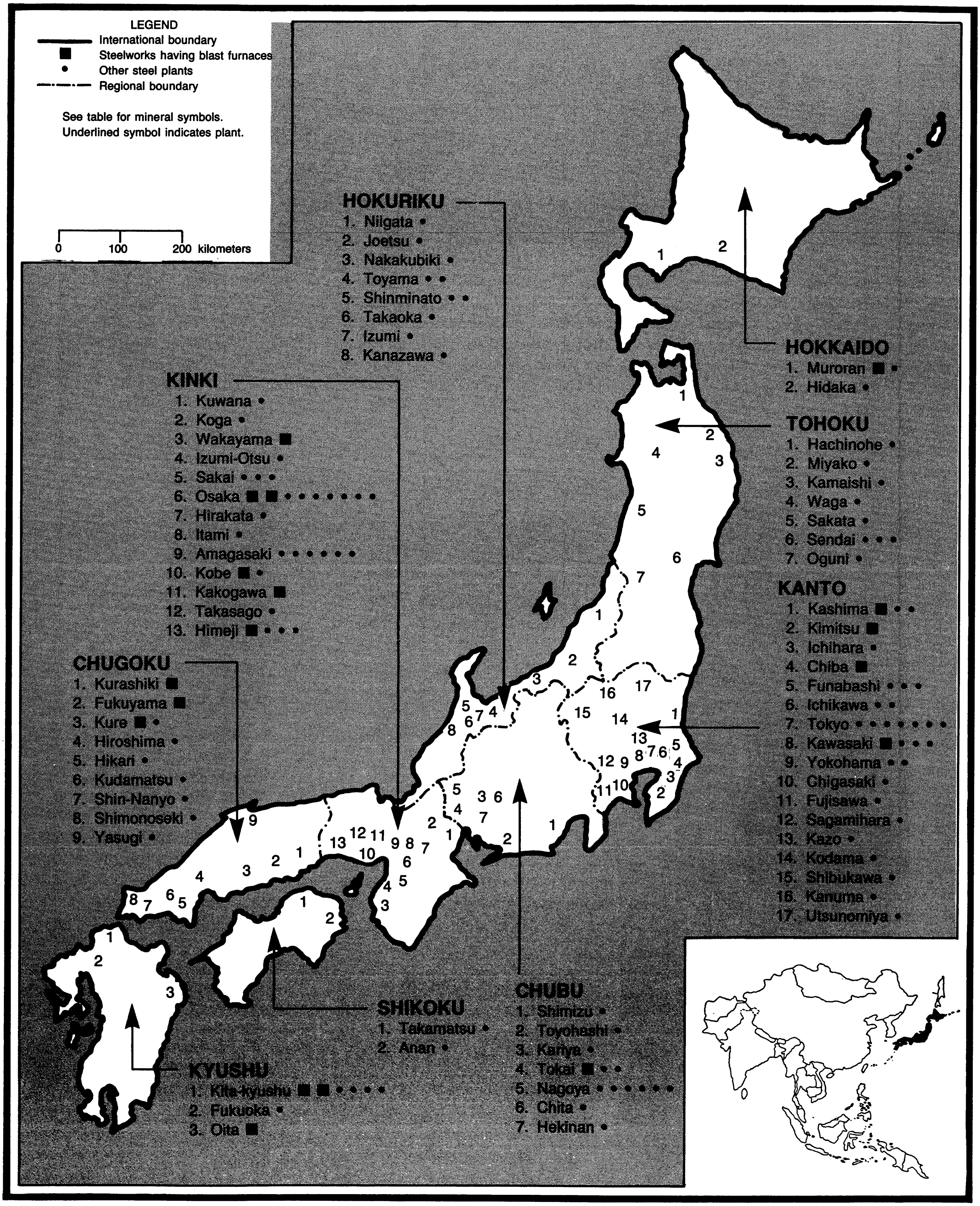
Benefiting from the continued strength of Japan's construction and automobile industries and the recovery of shipbuilding, electric appliances, and machinery industries, domestic steel consumption reached a record high in 1990. According to the Japan Iron and Steel Federation (JISF), Japan's apparent steel consumption, in crude steel equivalent, broke the previous year's record and reached 99 Mmt in 1990. However, exports of steel, in crude steel equivalent, plunged to a 21-year low of 18.9 Mmt in 1990.

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 automotive industries.

Exports of iron and steel products declined for the fifth year in a row by 15.7% to 17 Mmt, the lowest level in 21 years. Reduced exports were caused by the strengthened yen, increased production costs, and more than 50% cutback in iron and steel imports by China and the U.S.S.R. in 1990. According to JISF, the lack of hard currency and economic difficulties in China and the U.S.S.R. were the principal reasons for the steep decline in exports to those two countries. Exports

FIGURE 2

JAPAN: LOCATION OF MAJOR STEELWORKS



The Japan Iron and Steel Federation (Tokyo) publication adapted from *The Steel Industry of Japan, 1990.*

TABLE 13

JAPAN: DOMESTIC ORDERS FOR ORDINARY STEEL AND SPECIALTY STEEL PRODUCTS, BY END USE

(Thousand metric tons)

End use	Ordinary		Specialty	
	1989	1990	1989	1990
Automobiles	11,642	12,239	2,707	2,811
Construction	17,006	18,464	607	700
Conversion and processing	3,600	3,668	3,911	4,044
Electric machinery	3,030	3,128	116	124
Home and office equipment	920	952	265	249
Industrial machinery	2,159	2,427	1,307	1,401
Rolling stock	44	50	32	30
Shipbuilding	2,305	2,586	127	148
Steel dealers	22,335	24,247	1,372	1,333
Tanks and containers	2,292	2,360	34	26
Other	345	346	83	79
Total	65,678	70,467	10,561	10,945

Source: Ministry of International Trade and Industry (Tokyo). Iron and Steel Statistics, monthly, Apr. 1991, pp. 68-69.

to the United States also registered a 6% drop in 1990. However, exports of iron and steel to southeast Asia, especially to Indonesia, Malaysia, and Thailand, showed a significant increase in 1990 because of the construction boom in those countries. Of the total exports in 1990, 13.5 Mmt was ordinary steel products, 2.8 Mmt, specialty steel products; and 0.7 Mmt, other. Export earnings from iron and steel products plunged by 15.4% to $12.5 billion in 1990. However, the average export price was $783 per ton compared with $773 per ton in 1989 due to increased exports of high value-added steel products in 1990.

Imports of iron and steel products rose to a record high at 11.7 Mmt in 1990. Of the total imports, 6.0 Mmt was ordinary steel products, 3.3 Mmt was pig iron, 1.2 Mmt was ferroalloy, and 1.2 Mmt was steel slab, semimanufactured, wire, and specialty steel products. Imports of hot-rolled wide strips and plate accounted for 66% of ordinary steel products imports in 1990. The major suppliers of ordinary steel products to Japan in 1990 were the Republic of Korea, 45%; Taiwan, 10%; Brazil, 8%; and the United States, 7%. Japan's imports of ordinary steel products from the United States decreased to 413,700 tons from 525,189 tons in 1989.

Despite increased sales in the domestic market, most major steel/makers reported a lower pretax profit owing to increased raw materials and labor costs, increased competition, and decreased exports in 1990. According to interim reports of the top five steel/makers during the first half of 1990, pretax profit of Nippon Steel's fell by 13%, NKK declined by 30%, Kawasaki Steel and Sumitomo Metal Industries both dropped by 16%. Kobe Steel Ltd. was the only major steel/maker to report a 7% increase in pretax profit for the first half of 1990.

In the short term, the iron and steel industry will continued to benefit from increased Government spending in public works. However, some industry observers in Japan stressed that the Japanese steel/makers will continue to face the growing competition from steel/makers of the newly industrialized countries, falling exports, and decreasing demand by domestic manufacturing industries, especially for automobiles and household appliances. These manufacturing industries are moving some of their production facilities to the United States and Southeast Asian countries. As a result, Japan's steel production is expected to move to a lower level than that of 1989-90 in the next 2 to 3 years.

Magnesium.—Production of primary magnesium broke the previous year's record high owing to the continued growth in consumption of magnesium in aluminum alloying and stronger demand for magnesium diecastings. Primary magnesium was produced by Ube Industries Ltd., with an annual capacity of 9,000 mt/a at Ube in Yamaguchi Prefecture and Nichiju M.A. Co. Ltd., with an annual capacity of 4,800 mt/a at Takaoka in Toyama Prefecture.

Imports of primary magnesium rose by 19.3% to 16,515 tons in 1990. The United States, Norway, and Canada remained the three principal suppliers, accounting for 64%, 28%, and 3%, respectively in 1990.

Manganese.—Kita Hoshi Mining Co. Ltd., which operated a small-scale manganese mine at Nodata Magawa in Iwate Prefecture, was estimated to have an annual output of 100 tons in 1989 and 1990. Japan continued to rely on imports for virtually all of its manganese ore requirements in 1990.

Imports of manganese ore totaled 1,356,011 tons in 1990, of which 14,061 tons was high-grade manganese dioxide ore and 1,341,950 tons, metallurgical-grade manganese ore. Australia and the Republic of South Africa remained the two dominant suppliers of manganese ore, providing 44% and 45%, respectively, in 1990. Japan also imported 290,732 tons of ferruginous manganese ore for production of pig iron in 1990 principally from the Republic of South Africa.

The overall consumption of metallurgical-grade manganese ore and ferruginous manganese totaled 1,544,647 tons in 1990.

Production of manganese metal by Tosoh Corp. and Chuo Denki Kogyo Co. declined slightly in 1990. In 1989, Japan imported 10,739 tons of manganese metal mainly from the Republic of South Africa (8,531 tons), the United States (1,138 tons), and China (976 tons) for the manufacturing of nonferrous metal alloys and specialty steel. Consumption of manganese metal, according to the TEX Report Ltd. of Japan, was 8,457 tons in 1989, of which 52% was for production of nonferrous metal alloys, 26% for production of specialty steel, 14% for production of welding rod, and 8% for chemical and other uses.

Production of electrolytic manganese dioxide (EMD) continued to decline in 1990 because of worldwide excess capacity. However, domestic consumption of EMD rose by 12.4% to 25,456 tons in 1990. Japan ceased exports of EMD to the United States since 1989 owing to the imposition of a heavy antidumping duty by the United States against two major Japanese EMD

TABLE 14

JAPAN: SUPPLY AND DEMAND FOR PRIMARY MAGNESIUM

(Metric tons)

	1988	1989	1990
Supply:			
Production	10,019	12,075	12,843
Imports	15,305	13,846	16,516
Total	25,324	25,921	29,359
Demand:			
Aluminum alloys	2,841	3,095	3,632
Aluminum mill products	13,095	14,159	16,333
Magnesium	719	789	749
Magnesium anticorrosion agent	226	32	44
Magnesium castings	250	225	267
Magnesium diecastings	640	650	1,073
Nodular cast iron	2,587	2,828	2,926
Others	2,283	2,309	2,040
Total domestic demand	22,641	24,087	27,064
Exports	38	54	20
Total demand	22,679	24,141	27,084

Source: Japan Light Metal Association (Tokyo). The Rare Metal News (Tokyo). No 1590, Apr. 16, 1991, p. 6

TABLE 15

JAPAN: CONSUMPTION OF MANGANESE ORES, BY END USE

(Metric tons)

End use	1988	1989	1990
Metallurgical-grade manganese:			
Iron and steel sector:			
Ferroalloys	707,594	753,109	804,547
Pig iron	1,526	32,698	20,916
Sinter	39,713	40,193	22,273
Steel	378,407	335,083	258,711
Subtotal	1,127,240	1,161,083	1,106,507
Other uses	47,322	36,764	45,194
Total	1,174,562	1,197,847	1,151,701
Ferruginous manganese:			
Iron and steel sector:			
Ferroalloys	133,924	138,408	138,635
Pig iron	117,666	120,554	80,085
Sinter	74,119	54,810	47,430
Steel	128,136	121,332	126,796
Total	405,567	479,417	392,946

Source: Ministry of International Trade and Industry (Tokyo). Yearbook of Iron and Steel Statistics, 1990, p. 76, and p. 81.

producers, Mitsui Mining and Smelting and Tosoh Corp. As a result, total exports of EMD dropped from 45,219 tons in 1988 to 30,123 tons in 1990, the lowest level since 1981. During 1987-88, exports of EMD to the United States were about 15,000 tons, annually.

Mercury.—Japan stopped primary production of mercury in 1974. Most of the domestic requirements for mercury was met by inventory, secondary production, and imports. According to MITI, total supply of mercury in 1990 comprised carried-over stock of 201,648 kg, secondary recovery of 5,838 kg, and imports of 33,830 kg. In 1990, domestic demand for mercury totaled 143,258 kg, of which 65% was for production of dry cell batteries, 13% for thermometer and other measuring instruments, 12% for inorganic pharmaceuticals, and 10% for other uses.

In November, MITI announced guidelines to reduce and eventually eliminate the use of mercury because of its environmental hazard for production of manganese batteries beginning in April 1991 and reduce and eliminate use of alkaline batteries starting April 1992. Under the guidelines, however, the mercury batteries used for hearing aids will not be affected. The use of mercury prevents corrosion of battery cathodes. Several major Japanese dry cell batteries producers reportedly had developed anticorrosive alternatives.

Nickel.—Japan remained the world's third largest producer of nickel metal in 1990, but all of its raw material requirements for production of nickel products were met by imports. In 1990, imports of nickel ore dropped by 12.8% to 3.3 Mmt containing 54,570 tons of nickel. The three supplying countries in 1990 were New Caledonia, 47%; Indonesia, 30%; and the Philippines, 23%.

In order to secure a long-term supply of nickel ore from New Caledonia for its Hyuga ferronickel plant in Miyazaki Prefecture, Sumitomo Metal Mining acquired a 21% equity interest in EST Ballande SA, a nickel ore producer in New Caledonia, from French Banque Indosuez for $26.2 million in July. Nomura Trading Co. Ltd. of Japan, an import agent for Sumitomo Metal Mining, reportedly also acquired a 2% stake in EST Ballande.

Consumption of nickel ore by the iron and steel industry, mainly for the production of ferronickel, totaled 2.4 Mmt in 1990 compared with 2.7 Mmt in 1989. Imports of ferronickel dropped by 19.5% to 41,941 tons in 1990. The major suppliers of ferronickel in 1990 were New Caledonia, 20,839 tons; Indonesia, 12,273 tons; the Dominican Republic, 4,821 tons; and Colombia, 3,302 tons. Consumption of ferronickel for production of stainless and other specialty steels totaled 296,330 tons, compared with 299,827 tons in 1989.

Imports of nickel matte for the production of refined nickel and nickel oxide rose by 7.3% to 59,835 tons in 1990, of which 63% was from Indonesia and 37% from Australia. In 1990, Japan also imported 2,456 tons of nickel oxide principally from

Australia. Production of nickel oxide by Tokyo Nickel Co. Ltd. at its Matsusake plant in Mie Prefecture remained at about the same level as that of 1989 and was equivalent to about 60% of its capacity in 1990.

Production of refined nickel by Sumitomo Metal Mining at its Niihama plant in Ehime Prefecture increased in 1990. Sumitomo Metal Mining converted part of its Niihama cobalt refinery for nickel refining and successfully produced 3,960 tons of refined nickel using the newly developed Matte Chorine Leaching Electrowinning (MCLE) process in 1990. According to the company, the MCLE process has a 30% higher recovery rate than the conventional electrolytic refining method.

To meet the domestic demand for refined nickel, Japan imported 44,069 tons of refined nickel and 5,056 tons of nickel powder and flake in 1990. The major suppliers of refined nickel in 1990 were the U.S.S.R., 38%; Norway and Zimbabwe, 15% each; Canada, 12%; the United Kingdom and Australia, 5% each; and Finland and other countries, 10%. The United Kingdom and Canada remained the two dominant suppliers of nickel powder and flake, providing 52% and 44%, respectively, in 1990.

Rare Earths.—Japan remained a major world consumer of rare earths. All of Japan's rare-earth requirements were met by imports. For domestic production of rare-earth products, Japan imported both ore and rare-earth chlorides. Japan also imported rare-earth products to meet its domestic demand. Despite an increase in overall demand for rare-earth products, imports of both crude rare earths and seven rare-earth products declined in 1990.

In 1990, imports of bastnaesite were all from the United States. Imports of rare-earth chlorides were mainly from Malaysia, 1,191 tons; the United States, 434 tons; China, 167 tons; India, 100 tons; Brazil, 96 tons; and other countries, 15 tons. According to the Ministry of Finance, the quantity and value of crude rare earths and rare-earth product imports were 9,456 tons and $92.2 million, respectively, in 1990, compared with 12,547 tons and $149.5 million, respectively, in 1989. The major suppliers in 1990 were the United States, 25%; China, 24%; Malaysia, 22%; France, 14%; and the U.S.S.R., 8%.

In January, a joint-venture firm, called Sumikin Molycorp Inc., was established in Japan by Sumitomo Metal Industries (67%) and Molycorp Inc. of the United States (33%) to produce and market lanthanide and yttrium products in Japan. The Tokyo-based Sumitomo Metal Industries is one of the world's leading steel producers, while the Los Angeles-based Molycorp is one of the world's leading producers of bastnaesite. Molycorp operates a bastnaesite mine at Mountain Pass in California and processing plants at Washington and York in Pennsylvania and at Louviers in Colorado.[10]

TABLE 16

JAPAN: SUPPLY AND DEMAND FOR REFINED NICKEL

(Metric tons)

Item	1988	1989	1990
Supply:			
Beginning stock	15,250	11,934	12,315
Production	19,961	21,939	22,275
Imports[1]	39,350	42,934	49,125
Total supply	74,561	76,807	83,715
Demand:			
Batteries	2,896	2,924	2,919
Catalyst	437	521	499
Coinage	1,222	733	172
Exports	525	114	68
Galvanized sheet	6,256	5,906	6,085
Magnetic material	2,860	2,821	3,252
Nonferrous alloy	3,439	4,000	4,912
Other	2,253	2,503	3,695
Rolled sheet	773	801	958
Specialty steel	42,526	42,270	43,022
Total demand	63,187	62,593	65,582
Ending stock	11,934	12,315	12,123

[1]Included refined nickel ingots, powder, and flakes.

Source: The Ministry of International Trade and Industry (Tokyo). Yearbook of Minerals and Nonferrous Metals Statistics, 1990, p. 173.

TABLE 17

JAPAN: IMPORTS OF RARE-EARTH MATERIALS AND YTTRIUM OXIDE

(Metric tons)

Item	1988	1989	1990
Bastnaesite ore and concentrate	1,500	1,400	1,400
Rare-earth chlorides	5,254	2,294	2,003
Rare-earth products:			
Cerium oxide	481	704	790
Lanthanum oxide	196	258	249
Rare-earth metals	468	337	180
Rare-earth compounds	5,328	4,863	3,774
Pyrophoric alloys	427	498	383
Cerium compounds	2,607	2,816	1,559
Yttrium oxide	688	776	518

Source: Ministry of Finance (Tokyo). The Rare Metal News (Tokyo), No. 1590, Apr. 16, 1991, p. 5.

Domestic production of rare-earth products reached a record high in 1990. In 1990, there were nine producers of rare-earth products. Santoku Metal Industry Co. Ltd. was in Hyogo. Nippon Yttrium Co. Lt. was in Tokyo. Nissan Rare Earth Chemicals Co. Ltd. was in Saitama. Seimi Chemical Co. Ltd. was in Kanagawa. Shin-Etsu Chemical Industry Ltd. was in Fukui. Tokoku Metals & Chemicals Co. Ltd. was in Fukushima. Mitsui Metal & Mining Co. Ltd. was in Fukuoka. Dowa Mining Co. was in Akita. Nippon Rare Earths Co. Ltd. was in Ehime.

In 1990, the National Research Institute for Metal of Japan's Science and Technology Agency announced that a new processing technology had been successfully developed for high-purity refining of rare-earth metal using laser purification and selective ionization. According to the Institute, the new technology involves vaporizing a rare-earth metal with a beam of electrons, then directing a laser into the metal vapor to purify the metal. By altering the wavelength of the laser, different types of rare-earth metal can then be separated. With this new processing technology, the amount of praseodymium as an impurity in neodymium can be reduced to 0.09% from 1.5%. However, the new process needs further research before the commercial operation can be commenced.[11]

Applications of rare earths in the 1950's and the 1960's were limited to the use of rare-earth fluorides for arc carbon, misch metal for pyrophoric alloys, and cerium and lanthanium oxides for a glass polishing agent, an additive to optical lens, and phosphors in television manufacturing. Application of rare earths in magnetic materials began in the 1970's and greatly expanded in the 1980's.

According to MMAJ, cerium oxide was used mainly as a polishing agent for television (TV) tube glass, plate glass, and optical glass; decoloring of TV tube glass; and as a catalyst for automobile exhaust control, when used with lanthanum. Lanthanum oxide was used as an additive to optical lens and ceramic condensers. Samarium and neodymium oxides were used for the manufacture of magnetic materials for computer printers and monitors. Europium oxide and yttrium oxide were used as a red phosphor in the manufacture of color TV tubes and tricolor fluorescent lamps. Misch metal was used for the manufacture of auto parts and pyrophoric alloys for cigarette lighters.

TABLE 18

JAPAN: CONSUMPTION OF RARE-EARTH PRODUCTS AND YTTRIUM OXIDE

(Metric tons)

Products	1988	1989	1990
Cerium oxide	3,100	3,300	3,350
Europium oxide	11	11	12
Lanthanum oxide	400	420	440
Misch metal	230	230	230
Neodymium oxide	([1])	550	650
Rare-earth fluoride	50	([1])	([1])
Samarium oxide [2]	370	365	340
Other rare earths	[3]610	[4]120	[4]120
Yttrium oxide	270	280	290
Total	5,041	5,276	5,432

[1]Included in other rare earths.
[2]Includes recycled scrap.
[3]Includes gadolinium oxide, neodymium oxide, praseodymium oxide, and terbium oxide.
[4]Includes gadolinium oxide, praseodymium, rare-earth fluoride, and terbium oxide.

Source: Japan Society of Newer Metals (Tokyo). The Rare Metal News, No. 1590 Apr. 16, 1991, p. 4.

Titanium.—Japan was the second largest producer of titanium sponge and one of the major producer of titanium dioxide pigment in the world. However, all of Japan's raw material requirements were met by imports. In 1990, Japan continued to import from Australia about 21,000 tons of rutile; 757,595 tons of ilmenite principally from Australia, 33%; Malaysia, 22%; and Canada, 14%; and about 145,000 tons of titanium slag principally from the Republic of South Africa. All the rutile was consumed by the producers of titanium sponge. Ilmenite was consumed principally by the titanium dioxide producers for the production of pigment and synthetic rutile. A small amount of ilmenite was consumed as a blast furnace additive in the steel industry.

Production of titanium sponge reached an alltime high in 1990 owing to a stronger domestic demand by the manufacturers of power generating machinery and increased exports to the Republic of Korea and the United Kingdom. According to Osaka Titanium, its sponge metal production capacity will be expanded by 1,800 mt/a to 15,000 mt/a by the spring of 1991.

According to the Society, total shipments of titanium sponge rose by 13.6% to 25,086 tons in 1990, of which 18,615 tons was for the domestic market and 6,471 tons for exports. According to the Ministry of Finance, titanium sponge was exported mainly to the United Kingdom, 3,504 tons; France, 1,210 tons; the United States, 923 tons; the Federal Republic of Germany, 681 tons; and the Republic of Korea, 77 tons. Japan also exported 1,706 tons of titanium scrap and powder principally to the United States, 913 tons, and the United Kingdom, 498 tons, in 1990.

For production of titanium dioxide pigment, Japan consumed about 564,000 tons of ilmenite and about 145,000 tons of titanium slag in 1990. Production of titanium dioxide pigment in 1990 broke the previous record because of the continued growth in the domestic demand by the paint, printing ink, synthetic resin, and paper industries. According to the Rare Metal News of Japan, the capacity of the titanium dioxide industry expanded by 6.4% to 333,000 mt/a in 1990. In 1990, Ishihara Sangyo Co. Ltd. has a capacity of 154,800 mt/a. Teika Co. Ltd. (formerly Tekoku Kako Co. Ltd.) has a capacity of 48,600 mt/a. Sakai Chemical Industry Co. Ltd. has a capacity of 43,200 mt/a. Furukawa Mining Co. Ltd. has a capacity of 23,400 mt/a. Tohkem Products (formerly Tohoku Chemical Industry Co. Ltd.) has a capacity of 30,000 mt/a. Titan Kogyo Co. Ltd. has a capacity of 16,800 mt/a. Fuji Titanium Industry Co. Ltd. has a capacity of 16,200 mt/a.

Industrial Minerals

Cement.—Japan remained the world's third largest cement producer after China

TABLE 19

JAPAN: SUPPLY AND DEMAND FOR TITANIUM DIOXIDE

(Metric tons)

Item	1988	1989	1990
Production	259,875	283,184	285,851
Imports	45,953	67,906	60,722
Domestic demand:			
Ceramic condensers	2,810	2,658	2,220
Chemical fibers	4,704	4,697	4,790
Paint	99,622	108,409	109,185
Paper	15,915	18,310	19,332
Printing ink	34,858	38,477	38,853
Rubber	3,848	3,694	3,586
Synthetic resin	16,868	19,173	20,677
Other	19,488	17,954	19,560
Exports	62,265	62,857	63,985
Producers stock	9,333	16,288	19,951

Source: Japan Titanium Dioxide Industry Association (Tokyo). Roskill's Letter From Japan (London). No. 180, Apr. 1991, p. 16.

and the U.S.S.R. in 1990. Because of the continued growth in demand for cement for urban construction of private residential and office buildings as well as for public works projects in the Tokyo and Osaka metropolitan areas, cement production reached its highest level since 1980. As a result of increased domestic sales and reduced imports, the industry's profitability improved considerably in 1990. However, the cement industry continued its third restructuring program to increase productivity and to diversify into ceramics, real estate development, and food processing.

According to the Cement Association of Japan, the cement industry consists of 23 companies operating 41 plants with a total clinker capacity of 87.8 Mmt/a and a work force of 6,949 in 1990. Labor productivity rose to 10,834 tons of clinker per worker in 1990 from 10,090 tons of clinker per worker in 1989. The average clinker plant capacity was 2.14 Mmt/a. Among the 41 plants, 30 plants had an annual clinker capacity of between 1.5 Mmt/a and 3.5 Mmt/a. Only six plants had a capacity of 1 Mmt/a or less and four had capacity of 4 Mmt/a or more.

The industry consumed 89.1 Mmt of limestone, 18.8 Mmt of clay, 4.7 Mmt of silica stone, 4.3 Mmt of ore slag, and 3.2 Mmt of gypsum in 1990. Total energy consumption by the industry included 8.7 Mmt of coal, 769,000 tons of petroleum coke, 313,000 kL of heavy fuel oil, 13,000 tons of coking coal, and 9,083.3 MkW·h of electricity. In 1990, energy consumption per ton of cement produced was 113.6 kg of fuel (mainly coal and petroleum coke) in coal equivalent and 102.2 kW·h of electricity.

Domestic consumption of cement rose to 81.6 Mmt from 75.1 Mmt in 1989, while exports of cement, including clinker, dropped to 6.3 Mmt from 6.6 Mmt in 1989. Of the total domestic demand for cement, 70% was for ready-mixed concrete, 15% for cement products, 4% for civil engineering works, 2% for public and private buildings, 1% for construction of roads and ports, and 8% for other uses.

In 1990, exports of clinker rose from 2.2 Mmt in 1989 to 2.5 Mmt and were valued at $76.2 million. Exports of portland cement dropped from 4.4 Mmt in 1989 to 3.7 Mmt and were valued at $118.6 million. Imports of portland cement declined from 3.6 Mmt in 1989 to 2.5 Mmt and were valued at $115.5 million. Average import c.i.f. price per ton of portland cement also decreased from $46.44 in 1989 to $45.69.

For the first time in 25 years, Japan's Fair Trade Commission had indicted eight major cement suppliers in April for conspiring to price fixing in the $375 million Hokkaido cement market over the past several years. The companies accused for violating the Anti-monopoly Act were Denki Kagaku Kogyo Co. Ltd., Mitsubishi Materials Corp., Nihon Cement Co. Ltd., Nittetsu Cement Co. Ltd., Onoda Cement Co. Ltd., Sumitomo Cement Co. Ltd., Tohoku Kaihatsu Co. Ltd., and Ube Industries Ltd.[12]

In May, an antidumping petition was filed by the Ad Hoc Committee of Southern California Producers of Gray Portland Cement of the United States against Japanese producers. The petition alleged that imports of gray portland cement and cement clinker from Japan were being or were likely to be sold in the United States at less than fair values and that imports of gray cement and cement clinker were materially injuring or threatening material injury to a U.S. industry. Japan's exports of portland cement to the United States totaled 1.5 Mmt or about 39% of its total exports of portland cement in 1990. A final determination by the U.S. Department of Commerce on its investigation was scheduled for March 1991.

Following Onoda Cement Co. Ltd.'s expansion of its overseas cement production facilities, Mitsubishi Materials reportedly planned to set up a $133 million joint-venture cement plant with Yantai Building Materials Corp. of China in Shandong to take advantage of abundant coal resources and lower labor cost there. According to the Japan Economic Journal, the joint cement plant in China would have an annual capacity of 1.5 Mmt and was expected to begin production in 1993 at the earliest. Mitsubishi Materials, which acquired $72 million of Venezuela's Government external debt auction for $38.6 million in November 1989, reportedly was to acquire 16.7% of Vencemos Pertigalete CA through a debt-for-equity swap. Vencemos operated a 1.7-Mmt/a cement plant at Carretera Guanta Cumana in Venezuela.[13]

Diamond.—Sumitomo Coal Mining Co. Ltd. announced in November that it planned to build a polycrystalline synthetic diamond production plant in an abandoned coal mine in Hokkaido in 1991. Polycrystalline synthetic diamond provides greater precision in cutting and polishing than monocrystalline because of its finer surfaces. According to Sumitomo Coal Mining, major applications of polycrystalline included polishing of magnetic tapes and magnetic heads and precision cutting of pipes for sophisticated applications in chemical and nuclear plants. The company planned initial sales of 2 million carats per year.

Limestone.—Japan is self-sufficient in limestone. Its annual output ranks the third largest in the world. Because of the continued growth in demand by the cement and construction industries, production of limestone broke the previous year's record level of 191 Mmt in 1989 and reached a new record of 198 Mmt in 1990. According to the Limestone Association of Japan, the leading producers in 1990 were Mitsubishi Materials (formerly 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 5% to 204 Mmt in 1990 following a 6% increase in 1989. Of the total demand for limestone in 1990, 46% was for cement production, 29% for construction materials and aggregate, 11% for iron and steel making, 6% for production of lime, and 8% for other.

Sulfur.—Japan is self-sufficient in sulfur and was one of the world's major producers in 1990. Most sulfur production was recovered as a byproduct of petroleum refining and nonferrous metal smelting. Recovery of sulfur as a byproduct of petroleum refining was by 33 oil refineries, owned and operated by 18 oil companies, with a total sulfur recovery capacity of 8,057 mt/d. The top six sulfur-recovering oil companies, as of March 31, 1990, were Idemitsu Kosan Co. Ltd., with 1,715 mt/d, followed by Cosmo Oil Co. Ltd. with 1,205 mt/d; Nippon Petroleum Refining Co. Ltd., 740 mt/d; Nippon Mining Co. Ltd., 550 mt/d; Mitsubishi Oil Co. Ltd., 492 mt/d; and Tonen Corp., 462 mt/d.

Recovery of sulfur, in the form of sulfuric acid, according to the Sulfuric Acid Association of Japan, was by 46 sulfuric acid plants owned and operated by 41 companies. Sixteen companies produced sulfuric acid from nonferrous metal smelting complexes at 18 locations, 3 companies from 3 pyrite roasting plants, 9 companies from sulfur roasting plants at 11 locations, and 13 companies from desulfurization operations of flue gas, coke-oven gas, and sludge at 14 locations.

Sulfur produced by the petroleum refineries was largely consumed in the domestic market for production of sulfuric acid. In 1990, Japan exported 389,444 tons of sulfur principally to the Republic of Korea and Taiwan. In 1990, consumption of sulfuric acid, according to the Association, was mainly for industrial use, accounting for 75%, and for chemical fertilizer, accounting for 25%. In 1990, Japan exported 731,543 tons of sulfuric acid mainly to the Republic of Korea, the Philippines, Taiwan, and the United States.

Mineral Fuels

Coal.—Japan's coal production continued to shrink and reached its lowest level since 1902. The industry had achieved the Eighth National Coal Policy's goal 2 years ahead of schedule for bringing down the domestic coal production to below the 10 Mmt level in 1990. In line with the Government Coal Policy, the Minami-Oyubari Mine near Yubari City in Hokkaido, Japan's last major coking coal mine, was shut down permanently by Mitsubishi Coal Mining Co. Ltd. in April. The mine produced 711,000 tons of coking coal in fiscal year 1989, ending March 1990. With the closure of the Minami-Oyubari Mine and a small-scale coal mine in 1990, the total number of operating coal mines have been reduced from 22 in 1989 to 20; of these, 6 were ranked as large-scale collieries.

There were six major coal mines operating in 1990. The Akabira Mine in Hokkaido operated by Sumitomo Coal Mining Co. Ltd. The Ashibetsu Mine in Hokkaido and the Miike Mine in Kyushu operated by Mitsui Coal Mining Co. Ltd. The Ikeshima Mine in Kyushu operated by Matsushima Coal Mining Co. Ltd. The Kushiro Mine in Hokkaido operated by Taiheiyo Coal Mining Co. Ltd. The Sorachi Mine in Hokkaido operated by Hokutan Sorachi Coal Mining Co. Ltd. According to the Japan Economic Journal, all six major coal producers suffered from financial problems resulting from decreased sales and were facing the difficult task of retraining coal miners for new jobs.

In 1990, the industry produced 111,413 tons of coking coal, 8,144,730 tons of steam coal, and 6,748 tons of anthracite. Of the total coal produced in 1990, 58% was from the Hokkaido area and 42% from the Kyushu and Honshu areas. The average heating value declined to 5,760 kcal/kg from 5,920 kcal/kg in 1989 owing to reduced output of coking coal. The industry's employment declined by 979 to 4,751 at the end of 1990, and its labor productivity, as measured by metric tons per month per miner, rose to 137.9 from 124.1 in 1989.

Japan was the world's largest coal importer. Coal imports rose by 2% to a new record at 103.6 Mmt in 1990, when the total steam coal demand by the cement and utility industries rose by 4% to 43.7 Mmt, and the domestic production of steam coal dropped by 13% to 8.1 Mmt. Coal imports in 1990 included 67.6 Mmt of coking coal, 34.2 Mmt of steam coal, and 1.8 Mmt of anthracite. Japan relied on imports to meet 91% of its coal requirement in 1990, compared with 85% in 1986, the year before the industry began implementing the Eighth National Coal Policy.

TABLE 20

JAPAN: COAL IMPORTS, BY SOURCE

(Thousand metric tons)

	Anthracite		Bituminous			
			Coking		Steam	
	1989	1990	1989	1990	1989	1990
Australia	179	263	30,003	29,643	21,939	24,231
Canada	—	—	17,721	17,600	1,318	1,320
China	409	603	1,163	1,301	2,414	2,655
Colombia	—	—	198	85	—	35
Indonesia	—	—	91	240	324	664
Korea, North	456	483	—	—	—	—
New Zealand	—	—	347	183	—	—
South Africa, Republic of	187	127	3,532	3,375	1,234	1,301
United States	—	—	10,137	9,649	1,727	1,345
U.S.S.R.	353	180	5,499	5,482	2,165	2,665
Vietnam	108	150	—	—	—	—
Other	—	—	—	—	5	—
Total	1,692	1,806	68,691	67,558	31,126	34,216

Source: Ministry of International Trade and Industry (Tokyo). Yearbook of Production, Supply and Demand of Petroleum, Coal, and Coke, 1990, pp. 158-161.

Overall consumption of coal increased slightly from that of 1989. In 1990, despite a decrease in demand for coking coal by the iron and steel industry, the increase in demand for steam coal by the cement and utility industries in 1990 more than offset the overall decrease in demand by the iron and steel industry. The upward trend in steam coal demand by the cement and utility industry is expected to continue, according to a MITI's long-term energy forecast, while the downward trend in coking coal demand is also expected to continue beyond the year 2000. The projected downward trend in demand for coking coal, according to MITI, was based on the assumption that the Japanese pig iron production will decline and that the iron and steel industry is expected to adopt the pulverized coal injection method, which will result in reduction of coking coal consumption in iron smelting.

Petroleum and Natural Gas.—Japan remained the world's largest importer of natural gas and crude petroleum in 1990. Its domestic production of natural gas and crude petroleum was negligible when compared to its huge requirements for crude petroleum, refined petroleum products, and LNG. In late 1990, a small, new offshore oilfield, called Off-Iwafune Oilfield, off Niigata Prefecture in the Sea of Japan, was brought on-stream by a joint venture of Japan Petroleum Exploration Co., Niigata Oil Exploration Co., Mitsubishi Gas Chemical Co., and Japex Offshore Ltd. Peak oil and gas production of this new oilfield was expected to reach 6,920 bbl/d and 300,158 m^3/d. Because of strong demand for gasoline and diesel by passenger cars and trucks and increased use of heavy fuel oil for power generation by the utility industry, consumption of crude petroleum and natural gas rose by 9% to 1,264.6 Mbblm and by 7% to 53.1 billion m^3, respectively, in 1990. To meet a stronger demand in 1990, according to MITI, imports of crude petroleum rose by 9.1% to 1,438.9 Mbbl, the highest since 1979. Imports of natural gas, in the form of LNG, broke the previous year's record and reached 50.6 billion m^3. However, imports of refined petroleum products, which included diesel, gasoline, heavy fuel oil, jet fuel, kerosene, and naphtha, dropped by 12.6% to 279.9 million barrels, because of increased domestic production of these refined petroleum products in 1990.

Crude petroleum imports came mainly from the Middle East region (71.5%) and Asia (23.5%). In 1990, the main supplying countries of crude petroleum were the United Arab Emirates, 21%; Saudi Arabia, 18%; Indonesia, 12%; Iran, 10%; China, 7%; and Oman and Qatar, 6% each. Iraq, which provided 6% of Japan's crude petroleum imports in 1989, supplied only 4% in 1990 because of Japan's sanctions against Iraq's August invasion of Kuwait.

Imports of LNG were from Indonesia, 49.0%; Malaysia, 18.6%; Brunei, 15.0 %; Australia, 8.2%; United Arab Emirates, 6.2%; and the United States, 3%. Australia, which began delivery of LNG from its Northwest Shelf LNG production facility in August 1989, boosted its share of Japan's LNG imports to 8.2% in 1990 from 2% in 1989.

Imports of refined petroleum products, including diesel, gasoline, heavy fuel oil, jet fuel, kerosene, naphtha, and lubricants, came mainly from Saudi Arabia, 23.1%; Singapore, 15.1%; Indonesia, 14.7%; United Arab Emirates, 11.0 %; Kuwait, 10.0%; the Republic of Korea, 3.9%; China, 3.7%; and the United States, 3%.

According to MITI, the demand for refined petroleum products rose 4% to 1.4 billion barrels in 1990, of which 279.6 Mbbl were gasoline; 195.7 Mbbl, naphtha; 22.9 Mbbl, jet fuel; 165.6 Mbbl, kerosene; 233.8 Mbbl, diesel; 468.4 Mbbl, heavy fuel oil; and 15.3 Mbbl, lubricants. Consumption of domestically produced natural gas totaled 2.5 billion cubic meters in 1990, of which 35.8% was consumed by the gas industry,

TABLE 21

JAPAN: COAL CONSUMPTION, BY SECTOR

(Thousand metric tons)

Sector	1988	1989	1990
Manufacturing:			
Cement, ceramics, other	16,319	17,599	18,196
Of which:			
Domestic	764	491	472
Imported	15,555	17,108	17,724
Coke	5,293	5,106	5,133
Of which:			
Domestic	271	187	127
Imported	5,022	4,919	5,006
Iron and steel	66,448	64,306	63,875
Of which:			
Domestic	781	658	292
Imported	65,667	63,648	63,582
Utilities:			
Electric power	23,917	24,527	25,472
Of which:			
Domestic	9,537	9,326	8,780
Imported	14,380	15,201	16,691
Gas	869	841	725
Of which:			
Domestic	290	214	163
Imported	579	627	562
Other	1,198	908	565
Of which:			
Domestic	1,164	884	520
Imported	34	24	45
Total consumption	114,044	113,287	113,966
Of which:			
Domestic	12,807	11,760	10,354
Imported	101,237	101,527	103,611

Source: Ministry of International Trade and Industry (Tokyo). Energy Production and Demand Monthly Statistics, May 1991, pp. 12-13.

24.5% by the utility industry, 20.5% by the chemical industry, 13.7% by the oil and gas industries, and 5.5% by other manufacturing and service industries. Additionally, Japan consumed 35.6 Mmt or 50.6 billion cubic meters of imported natural gas in the form of LNG in 1990, of which 75% was consumed by the utility industry for power generation, 23% by the city gas industry for household use, and 2% by the iron and steel industry for steelmaking.

Japan, already importing about 70% of the world LNG production in 1990, signed an agreement with PERTAMINA of Indonesia to purchase an additional 2 Mmt/a of LNG for 20 years beginning in 1994 and is expected to proceed with another big LNG project in Qatar to satisfy its growing appetite for LNG, because LNG is considered less polluting but more efficient than nuclear fuel and coal in power generation. Chubu Electric Power Co., which had expressed willingness to purchase 4 Mmt/a of LNG over a 25-year period, was the key figure for renewed interest in the long-stalled Qatar LNG project. The 6-Mmt/a Qatar LNG Project, jointly owned by Qatar General Petroleum Corp. (70%), British Petroleum (7.5%), Compagnie Francaise des Petroles-Total (7.5%), Mitsui and Co. (7.5%), and Marubeni Corp. (7.5%), is expected to cost between $4 and $5 billion. Chubu Electric power reportedly is expected to sign a purchase contract with the joint-venture firm in the first half of 1991.

Reserves

Japan's ore reserves for limestone and other industrial minerals, such as iodine, pyrophyllite, and silica stone, are large and of world significance. With the exception of gold and zinc, its ore reserves for other minerals, especially oil and gas, and metallic minerals are negligible.

TABLE 22

JAPAN: RESERVES OF MAJOR MINERALS

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Coal		7,000,000
Copper ore, content		316
Dolomite[1]		989,012
Gold ore, content	kilogram	558,000
Iodine		[e]1,800
Lead ore, content		660
Limestone[2]		61,675,776
Pyrophyllite		143,611
Silica stone[3]		1,065,661
Silica sand[4]		361,337
Zinc ore, 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 Natural Resources and Energy.

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 Mkm, of which 65% is paved, and a railroad network of 27,327 km, of which 93% is 1.067-m 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 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 United States, and the U.S.S.R. 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 composed of 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 the terminals and warehouses, 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 power/plants as well as 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 nonferrous metal mining and coal mining sectors are expected to continue the 1990 downward trend because of the ongoing restructuring programs proposed by the Government. However, mining activities for gold and limestone are expected to be higher in 1991. 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 five major nonferrous mines in the Prefectures of Akita, Aomori, Gifu, Hokkaido, and Iwate. Coal output is expected to drop to about 8 Mmt in 1991, after the shutdown of the Minami Oyubari Mine in Hokkaido by Mitsubishi Coal Mining Co. Ltd. in 1990. According to the Limestone Association of Japan, mine production of limestone, silica stone, and other construction materials is expected to move higher in 1991 because of the expected strong demand for these mineral products by the construction industry.

Outlook for the mineral processing sector, however, is brighter than that of the mining sector. Because of continuing expansion of the Japanese economy, most ferrous and nonferrous mineral processing plants are expected to operate at a slightly higher rate in 1991. According to Japan Iron and Steel Federation, production of crude steel is expected to reach slightly above the 110-Mmt level of 1990 because of further growth in steel demand by the 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 moderately, with an anticipated slower economic growth in 1991. However, production of cement is expected to increase to between 82 Mmt and 83 Mmt in 1991 because of the continuing high level of urban construction activities in the Osaka and Tokyo metropolitan areas.

Because of decreasing domestic mine production of nonfuel minerals and mineral fuels and the continuing growth in the Japanese economy, imports of minerals and metals are expected to increase in 1991. 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 actively to participate in joint exploration and development of minerals in both developed and developing countries. The targeted countries are Australia, Brazil, Canada, Chile, China, Peru, Mexico, Mongolia, and the United States. The targeted minerals included coal, crude petroleum, base metals, 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 Y144.79=US$1.00 in 1990.

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Ministry of International Trade and Industry
Agency of Natural Resources and Energy
Basic Industries Bureau
Research and Statistics Department
1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo 100

Metal Mining Agency of Japan
Tokiwa Building, 1-24-14, Toranomon, Minato-ku, Tokyo 105
Geological Survey of Japan
1-1-3 Higashi, Yatabe, Ibaraki 305

Publications

Ministry of International Trade and Industry, Tokyo:
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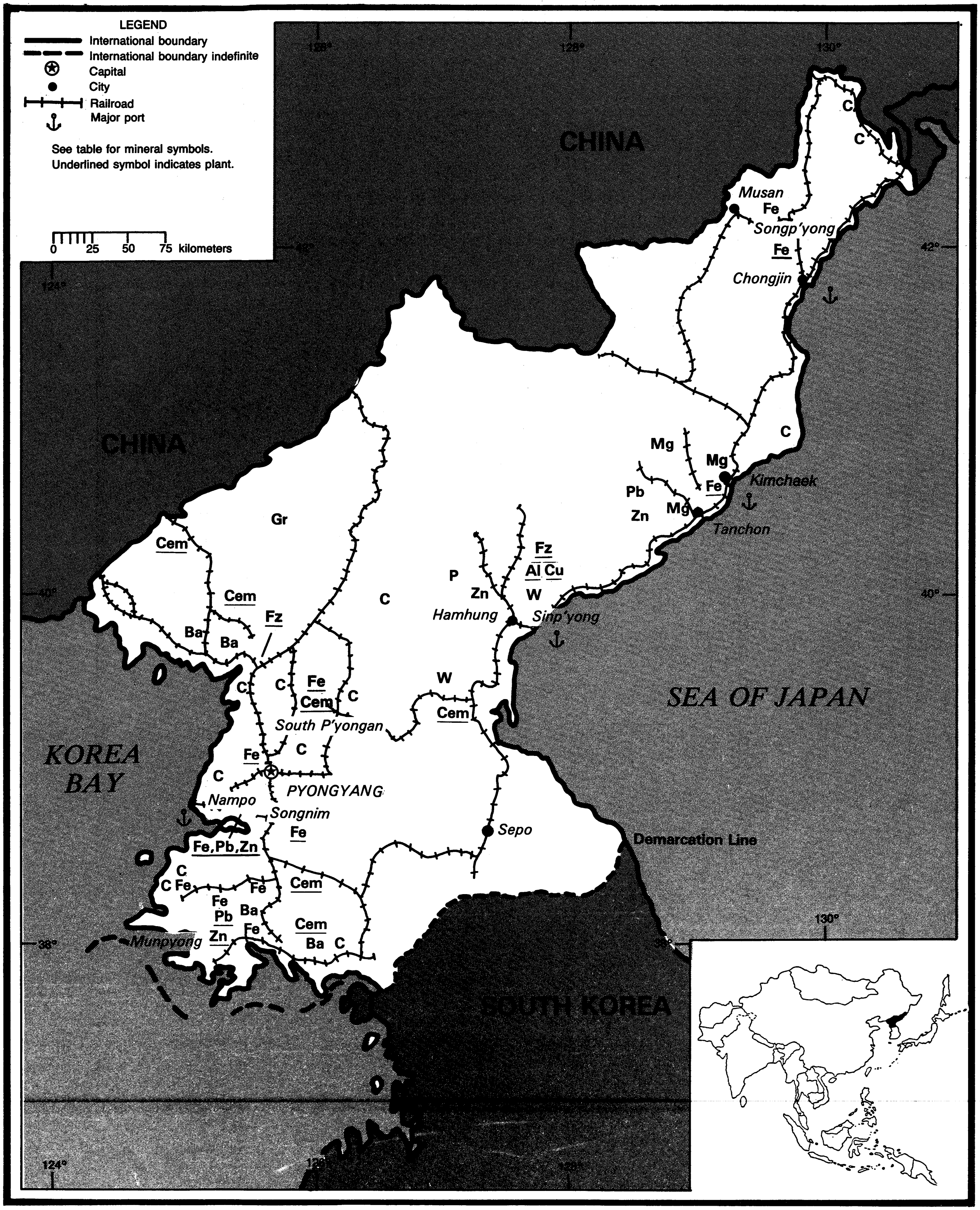
NORTH KOREA

AREA 120,540 km² **POPULATION 21.8 million**



THE MINERAL INDUSTRY OF NORTH KOREA

By Chin S. Kuo

During the year, there were indications that North Korea might be trying to end decades of isolation in order to help boost its lagging economy. The annual economic growth was estimated currently at about 2%. The Government clearly needed to open up the country for economic help in terms of capital inflow and merchandise trade with neighboring countries such as the Republic of Korea and Japan. The country had a total foreign debt estimated at about $5 billion,[1] military expenditures that ran up 24% of its GNP of $21 billion, and a lack of hard currency. The Republic of Korea was willing to provide $35 million in investments to support trade with North Korea. Socialist countries such as China and the U.S.S.R. have historically helped North Korea in its economic development.

The ambitious target of the third 7-year economic plan (1987-93) had to be scaled back because of an overall energy shortage. Analysts believed that up to 50% of the country's industry might be standing idle. New construction and limited expansion in industrial capacity were made, but industrial productivity remained generally low. Heavy industry was emphasized in 1990 as a key sector for development.

More than 80% of the country's exports were minerals, mostly gold and magnesite, metallurgical products, and semifinished manufactures. Import items were petroleum, machinery and equipment, coking coal, and grain. Major trading partners included the U.S.S.R., China, Japan, the Federal Republic of Germany, Hong Kong, and Singapore, in order of trade value. Imports from the U.S.S.R. were mostly oil products, cotton, steel, and 800,000 tons of grain.

Iron and tungsten deposits have been discovered in Hochon, Popdong, Hoeryong, and other areas. A new anthracite seam was found in Nampo area. Manganese, nickel, tantalum, tin, tungsten, and zirconium, and many metal-bearing ores have been located in central and west North Korea.

In the iron and steel sector, the Musan mining complex produced 10 Mmt/a of iron ore and was to turn out 15 Mmt/a in the future when expansion projects were completed. A new steelworks with a capacity of 2 Mmt/a was being constructed in the Kangson district. A steel facility with a capacity of 3 Mmt/a was planned for construction at Taedonggang. Expansions at Kimchaek, Hwanghae, and Chollima were to increase capacity collectively by 4.5 Mmt/a. A production process with automation and remote control, installed at the Chongjin steelworks, was commissioned in October. A small steel mill with a capacity of 10,000 mt/a of structural steel was being built in Yanggang Province. The Chong-pyong Mine in South Hamgyong Province was commissioned to produce ores in February.

North Korea produced about 200,000 mt/a of high-grade (99.97%) electrolytic zinc from smelters in Nampo, Hungnam, and Munpyong. Both the Hungnam and Munpyong smelters processed concentrates from the Komdok lead-zinc mining complex. One-half of the output was to be exported worldwide through an Osaka-based Japanese trading company that signed an agreement with the country's Ministry of Mining for marketing rights of zinc and other metals, including gold. About 50,000 tons of zinc would be exported to Japan and the balance to Europe and the United States. Other Tokyo-based trading companies were to continue to import zinc and other metals from North Korea. In addition, the Munpyong smelter also produced about 500 kg of gold per year. The country was expediting the development of nonferrous metal mines in the ore-rich northern inland area. One of the operations, Sinpa Mine, went into operation in February.

The country's building materials industry expanded with the commissioning of the Sangwon cement complex that had a capacity of 2 Mmt/a. The Sariwon cement complex produced 10 Mmt of cement. The Sunchon cement complex increased its annual cement production capacity by 200,000 tons. A new, large, high-grade silica mine was developed at Sunchon to ensure a steady source for cement manufacturing. A thermal generator and a kiln were completed at the Haeju cement complex in December.

In fertilizer manufacturing, North Korea's production capacity for both apatite and phosphate fertilizer were to increase 50% when current expansion projects were completed. The Sariwon fertilizer complex turned out 510,000 tons of potassic fertilizer per year at full capacity. A second stage of expansion at the Sunchon vinalon complex was underway. It produced nitrogen fertilizer and other chemical products such as vinalon, methanol, vinyl chloride, and caustic soda using indigenous raw materials. A new fertilizer complex was being built to produce nitrogen and phosphate fertilizers in Manpo, Chagang Province. Expansion of the Hungnam fertilizer complex was also underway.

Coal mines in South Pyongan Province, which contributed the biggest share (60%) of the country's coal production, increased output slightly, notably those under the Tokchon, Sunchon, Kaechon, and Auju district coal mining complexes. The Anju district coal mining complex was the country's leading producer. A large-scale open pit coal mine was being developed in the Anju district. The Chonsong and Chikdong coal mines in the Sunchon district were commissioned ahead of schedule. In 1990, a new coal mine with two shafts and several pits at Hamyon came on- stream. The Hwapung coal mine in west North Korea and the Soksong and Kukdong coal mines in the north were also placed into operation. Large coal deposits were found in the Paekam district and in the Kangdong district. North Korea relies on coal as its main energy source. Rapid growth in domestic coal production and strong domestic demand were both forecast for the 1990s. However, an inadequate transport system was expected to restrict coal export to a moderate level.

The country's power generating capacity increased by 1 MkW with the construction of 10 hydro- and thermal-power facilities. Thermal powerplants were under construction in Pyongyang and other industrial complexes, while hydropower stations were on major rivers such as the Nam, Kumya, Orang, and Ryesong.

[1]Where necessary, values have been converted from Korean won (W) to U.S. dollars at the rate of W2.00=US$1.00 for 1990.

TABLE 1

NORTH KOREA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990
METALS						
Aluminum metal ingot, primary		10,000	10,000	10,000	10,000	—
Cadmium metal, smelter		100	100	100	100	100
Copper:						
Mine output, Cu content		10,000	12,000	12,000	12,000	15,00
Metal:						
Smelter:						
Primary		15,000	25,000	24,000	25,000	25,000
Secondary		5,000	5,000	5,000	5,000	5,000
Total		20,000	30,000	29,000	30,000	30,000
Refined:						
Primary		24,000	25,000	24,000	25,000	25,000
Secondary		10,000	10,000	10,000	10,000	10,000
Total		34,000	35,000	34,000	35,000	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	8,500	8,500	9,000	9,500	10,000
Fe content	do.	4,000	4,000	4,200	4,400	4,700
Metal:						
Pig iron	do.	6,500	6,500	6,500	6,500	6,500
Ferroalloys, furnace type unspecified	do.	120	120	120	120	120
Steel, crude	do.	6,600	6,700	6,800	7,300	8,000
Lead:						
Mine output, Pb content		85,000	90,000	90,000	80,000	80,000
Metal:						
Smelter, primary only		60,000	64,000	64,000	65,000	65,000
Refined:						
Primary		60,000	64,000	64,000	70,000	70,000
Secondary		5,000	6,000	6,000	5,000	6,000
Total		65,000	70,000	70,000	75,000	76,000
Silver, mine output, Ag content	kilograms	50	50	50	50	50
Tungsten, mine output, W content		1,000	500	500	500	1,000
Zinc:						
Mine output, Zn content		225,000	220,000	225,000	230,000	230,000
Metal, primary		180,000	210,000	210,000	210,000	200,000
INDUSTRIAL MINERALS						
Barite		100,000	100,000	100,000	100,000	100,000
Cement, hydraulic	thousand tons	8,000	9,000	12,000	16,000	16,000
Fluorspar		40,000	40,000	40,000	40,000	40,000
Graphite		25,000	25,000	25,000	35,000	35,000
Magnesite, crude	thousand tons	1,500	1,500	1,500	1,500	1,500
Nitrogen, N content of ammonia	do.	450	450	500	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	580,000
Sulfur	thousand tons	230	230	230	230	230
Talc, soapstone, pyrophyllite		100,000	100,000	100,000	100,000	170,000

See footnotes at end of table.

TABLE 1—Continued

NORTH KOREA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Anthracite	thousand tons	48,000	55,000	62,000	65,000	68,000
Lignite	do.	14,000	15,000	18,000	20,000	22,000
Total	do.	62,000	70,000	80,000	85,000	90,000
Coke	do.	3,000	3,000	3,000	3,000	3,000
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	7,700	7,700	8,000	8,300	8,500
Jet fuel and kerosene	do.	1,600	1,600	1,700	1,800	1,800
Distillate fuel oil	do.	7,100	7,100	7,400	7,700	7,800
Residual fuel oil	do.	4,000	4,000	4,100	4,200	4,200
Refinery fuel and other products	do.	2,000	2,000	2,100	2,200	2,200
Total	do.	22,400	22,400	23,300	24,200	24,500

[1]Table includes data available through June 21, 1991.
[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.

TABLE 2

NORTH KOREA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Principal destinations, 1989	
				United States	Other (principal)
METALS					
Aluminum: Metal including alloys, all forms		5,997	5,844	—	Japan 5,249; Hong Kong 343; China 232.
Cadmium: Metal including alloys, all forms		37	—		
Cobalt: Oxides and hydroxides		—	1	—	All to Indonesia.
Copper: Metal including alloys, all forms		1,170	1,451	—	Singapore 854; China 299; Japan 279.
Gold: Metal including alloys, unwrought and partly wrought	value, thousands	$71,731	$6,465	—	Spain $3,677; West Germany $2,788.
Iron and steel:					
Iron ore and concentrate including roasted pyrite		1,088,323	519,198	—	All to China.
Metal:					
Scrap		24,966	21,274	—	Japan 21,211; China 63.
Pig iron, cast iron, related materials		64,258	47,615	—	Japan 34,190; China 9,983; Hong Kong 3,442.
Ferroalloys		6,925	4,063	—	All to Japan.
Steel, primary forms		25,198	20,895	—	Japan 11,050; China 7,496; Indonesia 2,140.
Semimanufactures:					
Bars, rods, angles, shapes, sections		21,404	7,149	—	China 6,345; Indonesia 672; Hong Kong 132.
Universals, plates, sheets		159,707	88,764	—	China 79,838; Hong Kong 8,926.
Hoop and strip		4	312	—	All to China.
Rails and accesories		—	25	—	All to Indonesia.
Wire		82	62	—	Indonesia 42; Cyprus 20.
Tubes, pipes, fittings		4,699	17,202	75	West Germany 14,325; China 1,900; France 485.
Castings and forgings, rough		434	536	—	All to China.
Unspecified		187,000	87,598	—	Japan 83,347; Indonesia 3,757.

See footnotes at end of table.

TABLE 2—Continued

NORTH KOREA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Principal destinations, 1989	
			United States	Other (principal)
METALS—Continued				
Lead:				
Ore and concentrate	1,860	—		
Metal including alloys, all forms	11,469	6,046	—	Japan 4,980; Hong Kong 649; China 417.
Magnesium: Metal including alloys, all forms	114	128	—	Japan 108; Hong Kong 20.
Nickel: Metal including alloys, all forms	236	30	—	All to Japan.
Silver: Metal including alloys, unwrought and partly wrought[2] value, thousands	$9,526	$2,806	—	Hong Kong $1,475; China $1,151; United Kingdom $94.
Titanium: Oxides	17	53	—	All to Indonesia.
Uranium and thorium: Ore and concentrate value, thousands	—	$57	—	All to China.
Zinc:				
Ore and concentrate	1,950	NA		
Oxide	—	3	—	All to Indonesia.
Metal including alloys, all forms	84,636	71,918	—	Japan 37,740; Singapore 26,219; China 5,033.
Other:				
Ores and concentrates	—	20	—	All to Hong Kong.
Ashes and residues	3,564	3,449	—	Japan 3,123; Singapore 326.
Base metals including alloys, all forms	—	10	—	do.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones value, thousands	$2	—		
Bromine	—	20	—	All to France.
Cement	911,131	715,258	—	China 448, 665; U.S.S.R. 220,000; Japan 35,437.
Clays, crude	8,566	2,454	—	Japan 2,354; Hong Kong 100.
Feldspar, fluorspar, related materials	1,983	810	—	Japan 650; China 160.
Fertilizer materials: Manufactured:				
Nitrogenous	72,060	34,744	—	All to China.
Unspecified and mixed	9	2,291	—	do.
Graphite, natural	8,996	12,097		Japan 7,845; Austria 4,252.
Gypsum and plaster	—	18	—	All to Indonesia.
Lime	—	11,156	—	All to Hong Kong.
Magnesium compounds:				
Magnesite, crude	9,064	—		
Oxides and hydroxides	104,190	93,596	—	West Germany 62,848; Japan 18,863; Spain 8,165.
Precious and semiprecious stones other than diamond: Synthetic value, thousands	$12	—		
Quartz, piezoelectric do.	—	$1	—	All to West Germany.
Sodium compounds: Soda ash	—	215	—	All to China.
Stone, sand and gravel:				
Dimension stone, all forms	15,352	13,943	—	All to Japan.
Gravel and crushed rock	318	—		
Quartz and quartzite	1,756	1,556	—	do.
Sand other than metal-bearing	—	836	—	do.

See footnotes at end of table.

TABLE 2—Continued

NORTH KOREA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Principal destinations, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur: Elemental including native and byproduct		36	1	—	All to Indonesia.
Talc, steatite, soapstone, pyrophyllite		2,556	3,270	—	Japan 3,194; Hong Kong 38; Indonesia 38.
Other:					
Crude		7	955	—	All to Japan.
Slag and dross, not metal-bearing		115,619	77,276	—	China 63,937; Japan 13,339.
MINERAL FUELS AND RELATED MATERIALS					
Carbon black		540	50	—	All to China.
Coal, all grades including briquets		497,794	1,948,012	—	China 1,446,415; Japan 501,597.
Coke and semicoke		—	190,000	—	All to U.S.S.R.
Petroleum:					
Partly refined	42-gallon barrels	189	—		
Refinery products:					
Distillate fuel oil	do.	—	169,782	—	All to China.
Residual fuel oil	do.	1,734,000	156,943	—	Hong Kong 116,943; Japan 40,000.
Bituminous mixtures	do.	85	—		

[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.
[2]May include other precious metals.

TABLE 3

NORTH KOREA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Principal sources, 1989
METALS				
Aluminum:				
Ore and concentrate		—	5,159	All from China.
Oxides and hydroxides		12,395	7,659	Japan 6,601; China 1,058.
Metal including alloys:				
Scrap		15	19	All from Canada.
Unwrought		203	243	All from Singapore.
Semimanufactures		2,184	608	China 476; Japan 129.
Antimony: Oxides	value, thousands	—	$1	All from West Germany.
Chromium:				
Ore and concentrate		21,000	7,700	All from Turkey.
Oxides and hydroxides		6	29	Singapore 20; Japan 5; China 4.
Cobalt:				
Oxides and hydroxides	value, thousands	—	$10	Japan $8; West Germany $2.
Metal including alloys, all forms		—	13	All from Singapore.
Columbium and tantalum: Tantalum metal including alloys, all forms		1	([2])	All from China.
Copper:				
Ore and concentrate		58,350	—	

See footnotes at end of table.

TABLE 3—Continued

NORTH KOREA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Principal sources, 1989
METALS—Continued			
Copper:—Continued			
Metal including alloys:			
Scrap	19	18	All from Canada.
Unwrought	750	179	Singapore 178; Japan 1.
Semimanufactures	329	561	Turkey 400; Singapore 101; China 50.
Germanium: Metal including alloys, all forms value, thousands	$4	$41	All from West Germany.
Gold: Metal including alloys, unwrought and partly wrought kilograms	1,453	9	Do.
Iron and steel: Metal:			
Scrap	382	—	
Ferroalloys:			
Ferromanganese	1,000	—	
Unspecified	12,357	421	China 400; Netherlands 21.
Semimanufactures:			
Bars, rods, angles, shapes, sections	339	2	All from West Germany.
Universals, plates, sheets	3,727	2	All from China.
Hoop and strip	193	—	
Rails and accessories	257	717	Singapore 465; Japan 252.
Wire	825	43	Japan 41; France 1.
Tubes, pipes, fittings	9,387	3,262	China 2,466; Japan 537; Italy 96.
Unspecified	43,994	5,752	West Germany 3,172; Japan 2,404.
Lead:			
Ore and concentrate	20,016	—	
Oxides	11	16	Singapore 13; Japan 3.
Metal including alloys, all forms	3,398	1,328	Singapore 1,327; Japan 1.
Magnesium: Metal including alloys, all forms	—	4	All from Japan.
Manganese:			
Ore and concentrate	60,325	20,018	All from China.
Oxides	109	50	All from Singapore.
Mercury	1	3	Do.
Molybdenum: Metal including alloys, all forms	1	—	
Nickel:			
Ore and concentrate	20,364	10,650	All from Indonesia.
Metal:			
Unwrought	4	10	Singapore 6; Japan 4.
Semimanufactures	45	—	
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	NA	$52	All from West Germany.
Silver: Metal including alloys, unwrought and partly wrought do.	NA	$3	All from Japan.
Tin:			
Ore and concentrate	40	—	
Metal:			
Unwrought	181	60	Singapore 59; Japan 1.
Semimanufactures	20	8	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	1988	1989	Principal sources, 1989
METALS—Continued			
Titanium:			
Oxides	40	41	West Germany 39; Japan 2.
Metal including alloys, all forms	8	2	All from Japan.
Tungsten:			
Ore and concentrate	NA	149	All from Singapore.
Metal including alloys, all forms kilograms	828	(3)	All from Japan.
Zinc:			
Ore and concentrate	16,630	6,380	China 6,379; West Germany 1.
Metal including alloys, all forms	205	1,015	All from Singapore.
Zirconium: Metal including alloys, all forms value, thousands	—	$15	All from West Germany.
Other:			
Oxides and hydroxides	—	(4)	All from Japan.
Ashes and residues	—	28	All from Netherlands.
Base metals including alloys, all forms	192	[5]18	All from Canada.
INDUSTRIAL MINERALS			
Abrasives, n.e.s.:			
Natural: Corundum, emery, pumice, etc.	21	11	All from Japan.
Artificial: Corundum	75	4	Do.
Dust and powder of precious and semi-precious stones excluding diamond value, thousands	$49	$53	Singapore $33; Japan $14; West Germany $6.
Grinding and polishing wheels and stones	138	[6]36	Japan 35; West Germany 1.
Asbestos, crude	—	60	All from Greece.
Boron materials: Oxides and acids	2	22	China 20; Japan 2.
Cement	60	—	
Clays, crude	1,309	—	
Diamond: Natural:			
Gem, not set or strung value, thousands	$61	$355	All from Belgium-Luxembourg.
Industrial stones do.	$6	$49	All from West Germany.
Diatomite and other infusorial earth	—	6	West Germany 4; Japan 2.
Fertilizer materials:			
Crude, n.e.s.	4,100	—	
Manufactured:			
Phosphatic	—	57,256	Tunisia 57,250; Japan 6.
Potassic	32,000	—	
Unspecified and mixed	—	4	All from Japan.
Graphite	—	18	All from Belgium-Luxembourg.
Gypsum and plaster	—	103,711	All from China.
Iodine including bromine and fluorine	6	—	
Magnesium compounds: Oxides and hydroxides	—	25	All from West Germany.
Mica:			
Crude including splittings and waste	4	—	
Worked including agglomerated splittings	4	8	Japan 6; Singapore 2.
Phosphorus, elemental	30	20	All from Japan.
Pigments, mineral: Iron oxides and hydroxides, processed	—	3	All from Singapore.

See footnotes at end of table.

TABLE 3—Continued

NORTH KOREA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Principal sources, 1989
INDUSTRIAL MINERALS—Continued				
Precious and semiprecious stones other than diamond: Natural	value, thousands	$1	$29	All from West Germany.
Salt and brine		119,261	60,023	China 59,840; Japan 183.
Sodium compounds, n.e.s.: Soda ash, natural and manufactured		1,020	4,692	China 2,430; Yugoslavia 2,262.
Stone, sand and gravel:				
Dimension stone, all forms		730	1,324	Italy 1,314; France 8.
Quartz and quartzite		12	—	
Calcareous stone, n.e.s		105,793	—	
Sand other than metal-bearing		1	—	
Sulfur:				
Elemental, all forms		4,611	2,678	Singapore 2,661; Japan 17.
Sulfuric acid		6	15	Yugoslavia 9; Japan 6.
Talc, steatite, soapstone, pyrophyllite		358	6,305	China 5,694; Colombia 608.
Other:				
Crude		20	—	
Metalloids, unspecified [7]		30	—	
MINERAL FUELS AND RELATED MATERIALS				
Carbon black		510	1,060	All from China.
Coal, all grades including briquets		2,597,174	1,596,919	Do.
Coke and semicoke		283,823	228,201	U.S.S.R. 190,000; China 38,201.
Petroleum:				
Crude	thousand 42-gallon barrels	13,479	7,836	All from China.
Refinery products:				
Liquefied petroleum gas	42-gallon barrels	12	441	Singapore 348; Netherlands 93.
Gasoline	do.	28,152	32,050	China 32,037; Japan 13.
Mineral jelly and wax	do.	1,306	1,418	Singapore 575; China 441; Yugoslavia 386.
Kerosene and jet fuel	do.	—	419	Japan 264; Yugoslavia 155.
Distillate fuel oil	do.	—	938	Greece 709; Japan 214; China 15.
Lubricants	do.	35,280	40,176	China 32,130; Japan 2,903; Singapore 2,667.
Residual fuel oil	do.	185,354	12,049	Greece 8,325; Japan 3,724.
Bitumen and other residues	do.	NA	79,986	Singpore 79,986; China 303.
Petroleum coke	do.	NA	4,241	China 4,131; West Germany 110.
Unspecified	do.	896,000	—	

NA Not available.

[1]Table prepared by Audrey D. Wilkes. Owing to a lack of official trade data published by North Korea, this table shouldnot 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 1989.

[2]Unreported quantity valued at $13,000.

[3]Unreported quantity valued at $2,000.

[4]Less than 1/2 unit.

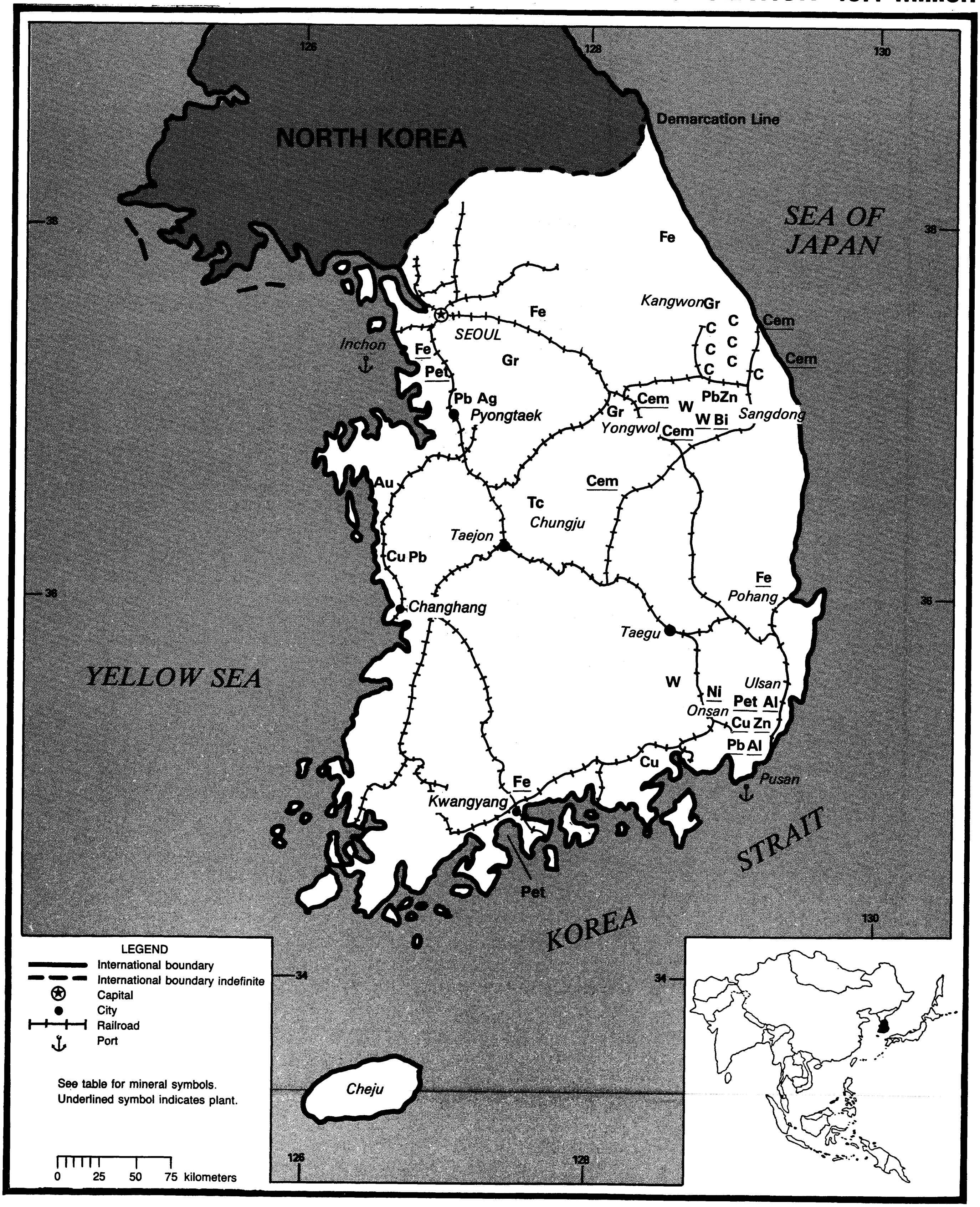
[5]Excludes unreported quantity valued at $307,000 exported by China.

[6]Excludes unreported quantity valued at $3,000 exported by China.

[7]Reported under SITC item number as "selenium, tellurium, phosphorus, arsenic, etc."

REPUBLIC OF KOREA

AREA 98,480 km² **POPULATION 43.1 million**



The Mineral Industry of the Republic of Korea

By Chin S. Kuo

The Republic of Korea's GNP in 1990 was estimated at $233.8 billion,[1] representing an increase of 9% over that of 1989. Per capita GNP grew by 16% to $5,477. Higher economic growth was deterred because of sluggish exports, combined with rising costs principally wages.

Industrial production from the mining sector continued to decline since 1987, contributing only 2.57% to the nation's industrial output. Production by the coal and metals sectors was less, 17% and 15%, respectively, compared with the level of output in 1989. However, basic metal industries showed a 12% increase in their products over those of 1989: iron and steel, 12%, and nonferrous metals, 11%.

The country is highly dependent on imports of raw materials and energy. The only indigenous raw material of significance is low-grade anthracite, which together with bituminous coal met 28% of the total energy supply. Hydropower and nuclear energy contributed 2% and 10%, respectively, to the country's energy requirements.

Direct overseas investment by Korean companies reached $800 million in 1990, surpassing the record of $492 million set in 1989. The companies stepped up efforts to move their operations abroad, seeking better access to foreign markets while avoiding unfavorable domestic investment conditions such as a strong won and high wages.

Firms in the Republic of Korea were active in searching for antimony, chromium, coal, magnesium, tin, and other minerals outside the country. Pohang Iron and Steel Co. (Posco) set up Posa and Poscan in Australia and Canada, respectively, to mine iron ore and coal. Posco planned to build a $700 million joint-venture (50-50) cold-rolled steel plant with a capacity of 820,000 mt/a in Johor, Malaysia. Completion of the plant was scheduled for early 1995. It also formed a consortium with Sunkyong Ltd. and Korea Mining Corp. to invest in the development of chromite deposits and in the construction of a ferrochrome plant in Turkey. Posco was to construct a 13,000-mt/a alloy steel plant in a joint venture with a domestic steel producer in the Philippines. Sammi Steel signed a letter of intent to buy a 23.5% stake in the stainless clad bar project in Aberneath, South Wales, United Kingdom. Camborne Industries is the Canadian-owned holding company of Aberneath Industries. The mill would produce 22,000 tons of stainless clad material and 7,000 tons of solid stainless sections and tubes in 1992.

Hyundai Corp. was engaged in a feasibility study to start a joint tungsten refining plant with China. Poongsan Corp. entered a $46.7 million joint venture (49-51) with Padaeng Industry Co. of Thailand to manufacture 15,000 tons annually of copper and brass products in Chon Buri.

Daewood Corp. filed an application with the Government of Yemen to construct a 60,000-mt/a steel pipe mill near that country's port of Al Hudaydah at a cost of about $1.3 million. Under a joint-venture arrangement with a local partner, Daewood would take the minority share. Korea Iron and Steel Wire Inc. formed a locally incorporated firm Kiswire in Johor, Malaysia, to build a wire rope plant with 34,000 mt/a capacity.

Samsung planned to purchase a 30% interest in a $1.5 billion oil refinery in Malacca with Malaysia's State oil company, Petronas, and other foreign investors. The proposed refinery was to have a capacity of 200,000 bbl/d and was expected to come on-stream in 1992.

GOVERNMENT POLICIES AND PROGRAMS

The Government eased the country's steel bar shortage by lowering import duties from 10% to 5% in January, with an import ceiling of 200,000 tons and to 2% in May with a ceiling of 500,000 tons. In order to reduce rising energy consumption, the Government planned to impose a new gasoline tax at the beginning of 1991. The proposed tax would raise gasoline prices more than 20%. Other measures proposed included increasing electric power rates for luxury businesses.

PRODUCTION

The country's most abundant mineral resource is anthracite. Because of mine closures, production of anthracite decreased by 17% to 15.8 million tons. Metal ore output also indicated a decline; iron, lead, and tungsten ore production was 4%, 21%, and 31%, respectively, less than the tonnage achieved in 1989, while zinc production increased 3%. Graphite production was also off 4% to 93,840 tons.

CONSUMPTION

Based on available data, the country's mineral consumption in 1989 showed significant increases of 47% for titanium, 46% for tungsten, and 39% for gold over those in 1988. However, the use of chromium, antimony, and molybdenum was much less than the previous year, decreasing 56%, 41%, and 32%, respectivey. In the industrial minerals sector, the demand for marble and andalusite was so strong that the tonnages absorbed in the domestic market increased by two/fold and 2.5 times, respectively, compared with those of 1988. The utilization of mica and gypsum fell off considerably, 67% and 51%, respectively. The consumption of anthracite for 1989 was 22.8 Mmt mostly (88%) used in residential and commercial heating, with the rest (11%) used by industrial manufacturing and powerplants.

TRADE

The country ran a trade deficit of $5.5 billion in 1990, its first trade shortfall in 5 years. Exports increased 1.8% to $63.5 billion from those of 1989, while imports jumped 12.8% to $69 billion. The current account turned to a deficit of $2.3 billion for the first time in 5 years.

TABLE 1

REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
METALS						
Aluminum, primary		18,643	21,654	17,500	17,500	2,000
Bismuth metal		136	145	132	96	79
Cadmium, smelter		—	—	490	[e]500	[e]500
Copper:						
Mine output, Cu content		220	178	36	4	53
Metal:						
Smelter		165,024	157,923	169,000	179,890	185,563
Refined, primary		157,846	154,591	168,334	178,665	[e]183,000
Gold metal	kilograms	4,648	7,600	11,121	14,270	20,760
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	582	470	390	334	298
Fe content	do.	326	263	218	187	180
Metal:						
Pig iron	do.	9,017	11,057	12,577	14,846	15,339
Ferroalloys:						
Ferromanganese		53,721	58,044	75,924	85,329	84,000
Ferrosilicon		30,939	12,646	8,909	4,582	2,000
Other		66,499	90,382	89,966	101,818	9,000
Total		151,159	161,072	174,799	191,729	185,000
Steel, crude	thousand tons	14,554	16,782	19,117	21,873	23,125
Lead:						
Mine output, Pb content		11,864	13,998	14,457	16,535	14,857
Metal, smelter		22,890	62,593	60,799	[e]60,000	[e]61,000
Manganese ore and concentrate:						
Gross weight		177	91	—	—	—
Mn content		71	36	—	—	—
Molybdenum, mine output, Mo content		315	325	144	132	103
Silver metal	kilograms	156,586	209,058	226,687	239,214	238,236
Tin, mine output, Sn content		1	3	—	—	—
Tungsten, mine output, W content		2,455	2,375	2,029	1,701	1,361
Zinc:						
Mine output, Zn content		37,282	23,530	21,820	23,202	22,792
Metal, primary		127,439	186,078	223,000	240,184	248,244
INDUSTRIAL MINERALS						
Asbestos		2,983	2,518	2,428	2,361	1,534
Barite		3,778	2,942	2,573	3,735	[e]3,800
Cement, hydraulic	thousand tons	23,403	25,662	28,995	30,474	33,600
Clays: Kaolin		849,742	630,945	832,110	1,219,174	1,446,598
Diatomaceous earth		54,841	64,783	71,952	75,019	55,445
Feldspar		130,895	180,269	241,511	232,607	237,447
Fluorspar, metallurgical-grade		243	63	261	856	560
Graphite:						
Crystalline		641	838	678	1,186	[e]1,000
Amorphous		96,577	106,507	107,767	100,282	98,987
Total		97,218	107,345	108,445	101,468	99,987
Kyanite and related materials: Andalusite		33	85	112	19	[e]20
Mica: All grades		41,997	31,938	18,848	7,888	[e]8,000

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
INDUSTRIAL MINERALS—Continued						
Nitrogen: N content of ammonia		426,778	474,891	506,471	480,310	411,287
Salt		729,000	664,000	1,020,000	830,000	616,681
Soda ash, manufactured		264,213	[e]288,500	[e]280,000	[e]280,000	[e]280,000
Stone, sand and gravel:						
Limestone	thousand tons	38,060	41,675	46,377	48,011	48,851
Quartzite	do.	885	1,235	1,379	1,554	1,452
Sand including glass sand	do.	1,233	1,350	1,488	1,358	1,408
Talc and related materials:						
Pyrophyllite		587,049	690,819	673,776	770,298	657,611
Talc		210,631	161,052	146,478	162,098	181,600
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		120,534	146,758	183,346	193,358	215,300
Coal: Anthracite	thousand tons	24,253	24,273	24,295	20,785	17,217
Coke[e]	do.	5,100	5,100	5,200	5,500	[e]5,500
Fuel briquets: Anthracite briquets		20,595	23,587	22,926	18,700	18,779
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	9,821	10,936	13,618	18,309	23,984
Jet fuel	do.	9,662	[e]9,500	[e]9,500	[e]9,600	[e]9,600
Kerosene	do.	9,559	7,966	10,619	13,161	13,873
Distillate fuel oil	do.	58,859	60,296	73,504	88,577	94,814
Residual fuel oil	do.	75,937	[e]73,400	[e]75,000	100,320	98,634
Lubricants	do.	7,317	[e]7,100	[e]7,300	[e]7,400	[e]7,400
Other	do.	13,576	[e]15,000	[e]15,000	[e]16,000	[e]17,000
Refinery fuel and losses[e]	do.	4,000	4,000	4,000	4,000	4,000
Total[e]	do.	188,731	188,198	208,541	257,367	269,305

[e]Estimated. [p]Preliminary.
[1]Includes data available through May 14, 1991.

An agreement between the country and China to exchange trade offices was signed in Beijing on October 20. Two-way trade between the two nations was about $4 billion. The country was reportedly to start importing enriched uranium directly from the U.S.S.R. for a total of up to 400 tons by the end of the decade. As much as one-third of the Soviet material would be paid by barter trade.

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 were gradually to go public, with part of the Government interest being transferred to private interest. The structure of the mineral industry is presented in table 4.

The number of persons employed in the mining sector decreased significantly to 74,000 at yearend compared with a high of 187,000 in 1986. The mineral industry labor is skilled and highly productive, in particular, metal ore mining operations. Miners are dominated by male workers, accounting for 90% of the work force. About 98% of the work force is under 50 years of age.

COMMODITY REVIEW

Metals

Aluminum.—Hyundai Corp. signed an agreement with Raznoimport of the U.S.S.R. to import 1,500 tons of aluminum ingot, which would be used by its affiliate, Aluminium of Korea (Koralu). Operation of Koralu's 18,000 mt/a primary smelter was suspended in March. Koralu had to import ingot for its casting and alloy operations. Hyundai reportedly was planning to import quantities of Soviet nickel, copper, and other nonferrous metals as well. Koralu was building a new rolling mill in Ulsan; the first stage of the project with a capacity of 100,000 mt/a was to come onstream by October 1992, and the eventual capacity of 250,000 mt/a could be reached in 1995. Choil Aluminum currently operated an 80,000-mt/a rolling mill at Taegu in the southeast, and Hyosung Metals operated a 50,000-mt/a plant near Ulsan.

Copper.—The country's copper consumption was 240,000 tons in 1990, of which 200,000 tons was supplied by Lucky Metals Corp. Lucky Metals was negotiating

TABLE 2

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989 United States	Destinations, 1989 Other (principal)
METALS				
Aluminum:				
Ore and concentrate	2	—		
Oxides and hydroxides	168	182	—	Bangladesh 49; Philippines 35; Pakistan 23.
Metal including alloys:				
Scrap	352	456	95	Japan 358.
Unwrought	7,643	3,819	17	Japan 1,791; Singapore 608.
Semimanufactures	164,433	24,875	545	Hong Kong 9,242; Philippines 4,657; Japan 4,384.
Antimony:				
Oxides	39	116	—	All to Japan.
Metal including alloys, all forms	2	—		
Arsenic: Oxides and acids	133	125	—	Do.
Bismuth: Metal including alloys, all forms	180	161	12	Japan 94; Netherlands 51.
Cadmium: Metal including alloys, all forms	731	828	17	Japan 726; Netherlands 85.
Chromium:				
Oxides and hydroxides	66	(2)	(2)	
Metal including alloys, all forms kilograms	72	1,198	1,198	
Cobalt:				
Oxides and hydroxides	16	47	—	All to Canada.
Metal including alloys, all forms	32	—		
Columbium and tantalum: Tantalum metal including alloys, all forms kilograms	—	5,494	—	All to Japan.
Copper:				
Oxides and hydroxides	12	NA		
Sulfate	18	198		
Metal including alloys:				
Scrap	1,274	2,080	—	Japan 1,336; Singapore 654; Hong Kong 52.
Unwrought	20,979	35,225	600	Taiwan 12,514; Japan 10,261.
Semimanufactures	93,911	37,971	710	Hong Kong 14,188; Japan 6,766.
Germanium: Metal including alloys, all forms kilograms	—	1	1	
Gold:				
Waste and sweepings value, thousands	$68	$623	$27	West Germany $588.
Metal including alloys, unwrought and partly wrought kilograms	6,551	11,282	22	Philippines 4,099; Hong Kong 2,894.
Iron and steel:				
Metal:				
Scrap	40,440	19,272	2,424	Japan 8,476; Taiwan 4,081; Hong Kong 4,061.
Pig iron, cast iron, related materials	78,528	2,408	—	Japan 1,958; Italy 219.
Ferroalloys:				
Ferromanganese	—	2,209	49	Taiwan 1,760; Thailand 400.
Ferrosilicomanganese	—	1,622	—	Japan 922; Taiwan 600; Thailand 100.
Ferrosilicon	302	—		
Silicon metal	—	32	—	Mainly to Australia.
Unspecified	—	300	—	All to Philippines.
Steel, primary forms thousand tons	353	804	50	Japan 409; Indonesia 183.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
METALS—Continued					
Iron and steel:—Continued					
Metal:—Continued					
Semimanufactures:					
Flat-rolled products:					
Of iron or nonalloy steel:					
Not clad, plated, coated	thousand tons	3,601	3,876	356	Japan 2,019; Singapore 152.
Clad, plated, coated	do.	323	507	99	Japan 235; Saudi Arabia 25.
Of alloy steel	do.	47	51	10	Japan 8; Taiwan 6.
Bars, rods, angles, shapes, sections	do.	1,285	1,277	100	Japan 313; Taiwan 193; Thailand 97.
Rails and accessories	do.	48	34	2	Taiwan 10; Japan 7; Canada 5.
Wire	do.	149	156	7	Japan 59; Indonesia 10.
Tubes, pipes, fittings	do.	1,780	865	325	Japan 390.
Lead:					
Ore and concentrate		—	4,560	—	All to Japan.
Oxides		9,756	8,626	—	Japan 8,296; Indonesia 270.
Metal including alloys:					
Scrap		1,068	1,234	—	United Kingdom 520; Japan 515.
Unwrought		3,504	5,493	1,695	Japan 3,311; Hong Kong 250.
Semimanufactures		138	103	1	Japan 50; Saudi Arabia 29.
Magnesium: Metal including alloys:					
Scrap		—	45	—	All to Japan.
Unwrought		123	67	—	Japan 35; Bahrain 18; Singapore 13.
Semimanufactures		133	114	—	All to Japan.
Manganese:					
Oxides		44	46	—	Sri Lanka 28; Japan 18.
Metal including alloys, all forms		1	—		
Mercury	kilograms	138	69	—	All to Pakistan.
Molybdenum:					
Metal including alloys:					
Scrap		3	1	—	All to Japan.
Semimanufactures		18	1	—	Mainly to Hong Kong.
Nickel: Metal including alloys:					
Scrap		881	1,392	4	Japan 1,387.
Unwrought		—	1,152	264	Belgium-Luxembourg 854; Japan 34.
Semimanufactures		63	11	([2])	Japan 7.
Platinum-group metals:					
Waste and sweepings	value, thousands	$3,635	$4,062	—	Hong Kong $2,628; West Germany $528.
Metals including alloys, unwrought and partly wrought	kilograms	99	2,019	45	Japan 1,943; United Kingdom 31.
Selenium, elemental		24	55	10	Netherlands 30; West Germany 5.
Silicon, high-purity		9	12	1	Japan 1; unspecified 10.
Silver:					
Ore and concentrate		—	81	—	All to Japan.
Waste and sweepings[3]	value, thousands	$177	$92	—	Japan $47; United Kingdom $45.
Metal including alloys, unwrought and partly wrought	kilograms	81,472	87,257	6	Japan 65,226; Taiwan 7,985.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989	
			United States	Other (principal)
METALS—Continued				
Tin: Metal including alloys:				
Scrap	—	747	—	Philippines 336; West Germany 296; Japan 115.
Unwrought	553	332	—	Japan 280; Taiwan 50.
Semimanufactures	32	70		Japan 34; Pakistan 13.
Titanium:				
Ore and concentrate	147,350	146,708	—	Japan 146,583; Philippines 74.
Oxides	3,584	5,263	88	Japan 2,604; Indonesia 918.
Metal including alloys, all forms	25	11	(2)	Mainly to Japan.
Tungsten:				
Ore and concentrate	203	48	—	Japan 28; West Germany 20.
Oxides and hydroxides	50	17	—	All to West Germany.
Metal including alloys:				
Scrap	37	237	200	Japan 22; Belgium-Luxembourg 15.
Unwrought	291	285	—	Japan 227; United Kingdom 24.
Semimanufactures	1	4	—	Japan 2; Saudi Arabia 1.
Uranium and thorium: Oxides and other compounds kilograms	1	—		
Vanadium: Metal including alloys, all forms	181	2	—	All to Uruguay.
Zinc:				
Oxides	6,155	7,908	—	Japan 6,129; India 341.
Blue powder	r772	964	—	Hong Kong 443; Singapore 209; Taiwan 108.
Ash and residue containing zinc	42	55	38	Japan 17.
Metal including alloys:				
Unwrought	70,657	73,583	3,261	Japan 34,700; Taiwan 3,261.
Semimanufactures	r153	136	8	Palau Islands 24; unspecified 57.
Zirconium: Ore and concentrate	—	225	—	Japan 219; Spain 6.
Other:				
Oxides and hydroxides	126	184		Taiwan 162; Australia 14.
Ashes and residues	8,463	13,134	38	Australia 10,938; Japan 14.
Base metals including alloys, all forms kilograms	5	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	5	226	13	Hong Kong 210.
Dust and powder of precious and semi-precious stones including diamond kilograms	1,223	12,005	1	India 10,000; Hong Kong 2,000.
Grinding and polishing wheels and stones	2,456	2,292	225	Australia 645; Canada 339.
Boron: Oxides and acids	—	4	—	Bangladesh 2; Libya 1.
Cement thousand tons	3,681	3,701	383	Japan 2,204; Hong Kong 800.
Clays, crude:				
Bentonite	4,608	3,727	—	Thailand 2,616; Taiwan 720; Japan 120.
Chamotte earth	12,897	16,095	—	Japan 16,035; Taiwan 60.
Fire clay	2	4	—	All to Malaysia.
Kaolin	48,180	46,854	—	Japan 40,792; Taiwan 6,008.
Unspecified	11	1,266	—	Indonesia 1,250; Thailand 16.
Cryolite and chiolite	—	3	—	All to Nigeria.
Diamond: Natural:				
Gem, not set or strung carats	3,515	2,185	55	Hong Kong 1,700; Belgium-Luxembourg 165.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989 United States	Destinations, 1989 Other (principal)
INDUSTRIAL MINERALS—Continued				
Diatomite and other infusorial earth	100	228	—	Indonesia 120; Japan 108.
Feldspar	24,100	6,611	—	All to Taiwan.
Fertilizer materials:				
Crude, n.e.s.	1,039	499	—	All to Japan.
Manufactured:				
Ammonia	1	9	—	Libya 4; Singapore 4.
Nitrogenous	186,330	228,420	—	Philippines 59,535; Thailand 53,125; Fiji 52,900.
Phosphatic	92,959	27,228	—	Japan 20,540; Fiji 6,600.
Potassic	55,300	48,280	—	Japan 24,427; Fiji 2,200; unspecified 21,500.
Unspecified and mixed thousand tons	1,127	799	—	Thailand 511; Japan 102; Philippines 67.
Fluorspar	—	34	—	Indonesia 20; Nigeria 9.
Graphite, natural	51,537	52,629	6,600	Japan 36,958; Taiwan 5,196.
Gypsum and plaster	11,289	16,565	—	Japan 16,200; Sri Lanka 288.
Kyanite and related materials: Mullite	12	NA		
Lime	—	53	—	Japan 50; Libya 3.
Magnesium compounds:				
Magnesite, crude	—	2	—	All to Japan.
Oxides and hydroxides	768	3,241	—	Hong Kong 3,000; Japan 148.
Mercury kilograms	138	69	—	All to Pakistan.
Mica: Worked including agglomerated splittings	37	312	13	Japan 288.
Phosphates, crude	1,652	—		
Pigments, mineral: Iron oxides and hydroxides, processed	287	40	—	Japan 32; Jordan 8.
Precious and semiprecious stones other than diamond:				
Natural kilograms	51,827	34,092	2,972	Hong Kong 15,071; Japan 14,963.
Synthetic do.	r9,457	23,326	4,112	Japan 10,645; Hong Kong 5,476.
Quartz crystal, piezoelectric grams	5,700	—		
Salt and brine	14,467	24,157	412	Japan 20,195; Singapore 24.
Sodium compounds, n.e.s.: Soda ash, manufactured	356	2	—	Mainly to Pakistan.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	331,926	398,825	—	Japan 349,061; Taiwan 48,531.
Worked	364,289	217,888	149	Japan 216,036; Singapore 408.
Dolomite, chiefly refractory-grade	224,230	305,531	—	All to Japan.
Gravel and crushed rock	874	585	—	Japan 546; Taiwan 39.
Limestone other than dimension	—	698	—	All to Indonesia.
Quartz and quartzite	7,870	5,506	—	Japan 5,470; Singapore 18; Sri Lanka 18.
Sand other than metal-bearing	45	27	—	All to Japan.
Sulfur:				
Elemental:				
Crude including native and byproduct	5,191	5,605	—	Indonesia 2,432; Malaysia 828; Hong Kong 432.
Colloidal, precipitated, sublimed	37	184	—	Japan 150; Indonesia 34.
Sulfuric acid	14,925	64,382	—	Taiwan 64,340.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF KOREA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Talc, steatite, soapstone, pyrophyllite		r257,975	293,762	1,963	Japan 169,500; Taiwan 101,128.
Vermiculite[4]		400	—		
Other:					
Crude		r83,322	90,168	34	Japan 5,811; Taiwan 37,431.
Slag and dross, not metal-bearing		79,219	81,920	19	Japan 81,901.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		17	150	—	All to Fiji.
Carbon black		28,363	37,055	—	Japan 13,858; Indonesia 11,917.
Coal:					
Anthracite		20	—		
Bituminous		210	210	—	Taiwan 128; Thailand 82.
Coke and semicoke		3,163	3,629	—	Japan 3,200; Thailand 200.
Petroleum:					
Refinery products:					
Liquefied petroleum gas	thousand 42-gallon barrels	16	370	—	Japan 299; Hong Kong 47.
Gasoline	do.	4,551	4,436	1,109	Japan 3,309.
Naphtha	do.	9,115	6,704	—	Japan 6,660.
Mineral jelly and wax	do.	10	10	—	Turkey 3; Japan 2.
Kerosene and jet fuel	do.	1,100	1,582	—	Japan 544; unspecified 1,033.
Distillate fuel oil	do.	7,447	8,382	431	Japan 6,253; Singapore 648.
Lubricants	do.	453	467	7	Indonesia 48; Libya 21; unspecified 336.
Residual fuel oil	do.	12,330	13,714	1,521	Japan 11,195; Guam 499.
Bitumen and other residues	do.	42	27	—	Hong Kong 16; Singapore 5.
Bituminous mixtures	do.	18	4	—	Japan 2; Thailand 1.

rRevised. NA Not available.
[1]Table prepared by 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	1988	1989	Sources, 1989	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkali metals	91	74	([2])	France 43; Japan 31.
Alkaline-earth metals	28	77	66	Japan 5; Ireland 4.
Aluminum:				
Ore and concentrate	24,733	31,320	—	Hong Kong 11,425; Guyana 5,014; Japan 1,810.
Oxides and hydroxides	118,474	138,176	547	Japan 83,353; Australia 49,897.
Ash and residue containing aluminum	623	213	—	Japan 166; Bahrain 27; New Zealand 20.
Metal including alloys: Scrap	27,840	55,601	22,339	United Arab Emirates 22,550; Saudi Arabia 4,123.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS—Continued				
Aluminum:—Continued				
Metal including alloys:—Continued				
Unwrought	266,575	485,558	29,055	Singapore 207,050; Australia 131,460.
Semimanufactures	54,588	74,149	20,702	Japan 20,773; Bahrain 7,144.
Antimony:				
Ore and concentrate	3,780	2,568	—	Panama 101; Hong Kong 99; unspecified 2,368.
Oxides	416	527	(2)	United Kingdom 250; Japan 124; France 10.
Metal including alloys, all forms	416	645	(2)	Taiwan 40; Hong Kong 22; unspecified 581.
Arsenic:				
Elemental	15	37	(2)	United Kingdom 2; unspecified 34.
Oxides and acids	1	—		
Beryllium: Metal including alloys, all forms kilograms	300	489	91	Japan 398.
Bismuth: Metal including alloys, all forms do.	100	2,119	61	Japan 58; unspecified 2,000.
Cadmium: Metal including alloys, all forms	38	258	61	Japan 106; United Kingdom 41.
Cesium and rubidium: Metal including alloys, all forms value, thousands	$10	—		
Chromium:				
Ore and concentrate	7,408	3,250	36	Philippines 2,686; unspecified 528.
Oxides and hydroxides	2,814	2,725	481	Japan 1,642; United Kingdom 234.
Metal including alloys, all forms	118	83	(2)	Japan 71; Netherlands 4.
Cobalt:				
Oxides and hydroxides	65	73	6	Belgium-Luxembourg 20; Finland 15.
Metal including alloys, all forms	404	437	17	Zaire 286; Belgium-Luxembourg 81.
Columbium and tantalum:				
Ore and concentrate kilograms	50	—		
Metal including alloys, all forms:				
Columbium do.	41	43	—	Japan 36; Australia 7.
Tantalum	3	3	(2)	Japan 2.
Copper:				
Ore and concentrate	346,370	463,175	53,266	Canada 124,068; Papua New Guinea 97,144.
Matte and speiss including cement copper	25,114	13,086	5,845	Chile 4,582; Portugal 1,997.
Oxides and hydroxides	1,213	1,411	1,139	Australia 175; Norway 40.
Sulfate	351	1,081	(2)	Taiwan 80; West Germany 36; unspecified 930.
Ash and residue containing copper	22,230	11,017	—	Japan 11,000; Spain 17.
Metal including alloys:				
Scrap	129,098	126,010	64,083	Malaysia 9,736; Singapore 9,366.
Unwrought	147,960	109,176	2,646	Chile 60,954; Philippines 17,066.
Semimanufactures	43,030	45,842	841	Japan 26,620; Taiwan 18,935.
Gallium: Metal including alloys, all forms kilograms	110	276	1	Japan 257; West Germany 18.
Germanium:				
Oxides do.	291	64	—	West Germany 61; Japan 3.
Metal including alloys, all forms do.	36	19	17	West Germany 2.
Gold:				
Ore and concentrate	417	5,292	—	Philippines 4,910; Colombia 375.
Waste and sweepings value, thousands	$136	$268	$268	

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS—Continued				
Gold:—Continued				
Metal including alloys, unwrought and partly wrought kilograms	7,397	13,757	862	Australia 6,145; West Germany 5,711.
Hafnium: Metal including alloys, all forms do.	5	15	15	
Indium: Metal including alloys, all forms do.	263	321	119	Japan 91; Peru 62.
Iron and steel:				
Iron ore and concentrate: Excluding roasted pyrite thousand tons	20,228	21,685	—	Australia 8,478; Brazil 6,165; Peru 2,452.
Metal:				
Scrap do.	3,892	4,062	2,673	Japan 393; Australia 255; unspecified 332.
Pig iron, cast iron, related materials do.	2,790	1,084	1	Japan 5; unspecified 760.
Ferroalloys:				
Ferrocolumbium	278	97	—	Brazil 76; United Kingdom 12.
Ferrochromium	16,290	60,775	11	India 10,953; Japan 4,554; unspecified 37,879.
Ferromanganese	3,743	4,296	—	Norway 1,400; Italy 714; unspecified 1,500.
Ferromolybdenum	946	1,030	146	Netherlands 298; Chile 203.
Ferronickel	946	18,882	—	Dominica 9,054; New Caledonia 9,008.
Ferrosilicochromium	18	490	—	Zimbabwe 480; France 10.
Ferrosilicomanganese	—	2,572	—	Norway 1,598; Spain 500; France 440.
Ferrosilicon	68,440	63,889	7,649	Norway 5,926; Brazil 5,574; Philippines 3,018.
Ferrovanadium	492	226	—	Belgium-Luxembourg 95; Austria 41; Netherlands 35.
Silicon metal	4,082	4,916	12	Australia 923; Brazil 360; unspecified 2,948.
Unspecified	6,550	3,251	123	Japan 973; France 642.
Steel, primary forms thousand tons	632	394	9	Brazil 268; Canada 33.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	1,786,664	2,013,407	334,264	Japan 894,334; Canada 226,798.
Clad, plated, coated	307,142	339,063	64,943	Japan 213,419; West Germany 19,445.
Of alloy steel	674,210	557,104	9,437	Japan 424,932; West Germany 60,437.
Bars, rods, angles, shapes, sections	[r]765,235	443,130	12,569	Japan 248,063; Brazil 30,867.
Rails and accessories	2,420	10,359	5	Canada 4,241; Japan 4,229.
Wire	17,042	3,317	7	Japan 2,550; France 224.
Tubes, pipes, fittings	223,093	149,876	733	Japan 100,283; West Germany 6,578.
Lead:				
Ore and concentrate	1,994	—		
Oxides	9	260	8	Japan 235; West Germany 11.
Ash and residue containing lead	155	123	10	Australia 80.
Metal including alloys:				
Scrap	53,902	41,971	11,836	Saudi Arabia 10,164; Australia 7,125.
Unwrought	87,181	96,988	4,154	Australia 40,411; Mexico 22,814.
Semimanufactures	313	62	31	Japan 27.
Lithium:				
Oxides and hydroxides	153	129	129	Japan[2].
Metal including alloys, all forms kilograms	366	170	150	Japan 20.
Magnesium: Metal including alloys:				
Scrap	17	126	82	Canada 30; Japan 14.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
METALS—Continued					
Magnesium: Meal including alloys:—Continued					
Unwrought		1,673	1,101	828	Norway 216.
Semimanufactures		370	1,296	1,216	Canada 40.
Manganese:					
Ore and concentrate:					
Battery-grade		5,172	5,071	—	Singapore 3,707; Japan 180.
Metallurgical-grade		386,639	503,252	272	Australia 194,147; India 155,109.
Oxides		3,969	4,314	46	Japan 1,739; Belgium-Luxembourg 867.
Metal including alloys, all forms		697	823	45	Taiwan 55; Hong Kong 54; unspecified 626.
Mercury		34	31	7	Japan 10; Algeria 4.
Molybdenum:					
Ore and concentrate		13,520	560	33	Canada 413; Chile 52.
Oxides and hydroxides		(2)	(2)	—	All from West Germany.
Metal including alloys:					
Unwrought		3	13	2	Japan 7; United Kingdom 3.
Semimanufactures		54	170	12	Japan 125; Austria 29.
Nickel:					
Matte and speiss		(3)	6,600	(2)	Canada 6,596.
Oxides and hydroxides		99	98	3	Canada 45; Japan 43.
Metal including alloys:					
Scrap		2,077	1,781	241	Japan 947; United Kingdom 149.
Unwrought		5,260	8,164	14	Norway 1,420; Australia 1,396.
Semimanufactures		1,099	1,054	75	Japan 544; France 107.
Platinum-group metals:					
Waste and sweepings	value, thousands	$115	$47	$43	Japan $4.
Metals including alloys, unwrought and partly wrought:					
Palladium	kilograms	333	NA		
Platinum	do.	405	482	365	United Kingdom 67; West Germany 53.
Rhodium	do.	48	NA		
Iridium, osmium, ruthenium	do.	17	NA		
Unspecified	do.	—	649	293	West Germany 140; Japan 156.
Rare-earth metals including alloys, all forms		35	4	(2)	Brazil 1; Taiwan 1.
Selenium, elemental		10	7	(2)	Mainly from Japan.
Silicon, high-purity		472	72	45	Japan 26.
Silver:					
Waste and sweepings[4]		$28	$13	—	Japan $12; Hong Kong $1.
Metal including alloys, unwrought and partly wrought	kilograms	66,760	146,668	30,802	Australia 21,831; Japan 21,218.
Tellurium, elemental	do.	274	736	—	Japan 580; West Germany 156.
Tin:					
Ore and concentrate		4,123	3,691	—	Taiwan 312; Singapore 140; unspecified 3,137.
Oxides		4	2	—	Mainly from Japan.
Metal including alloys:					
Scrap		40	16	—	All from Japan.
Unwrought		4,924	10,380	—	Malaysia 8,996; Indonesia 550; Japan 40.
Semimanufactures		326	690	9	Japan 610; Malaysia 38.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
METALS—Continued				
Titanium:				
Ore and concentrate	62,117	68,908	18	Australia 26,881; Malaysia 20,952; Thailand 19,021.
Oxides	4,710	6,969	370	Japan 2,817; West Germany 1,294.
Metal including alloys:				
Scrap	7	—		
Unwrought	93	12	1	Japan 2; unspecified 9.
Semimanufactures	386	745	289	Japan 286; United Kingdom 107.
Tungsten:				
Ore and concentrate	—	2,115	—	Australia 60; unspecified 2,010.
Oxides and hydroxides	489	510	—	All from Taiwan.
Metal including alloys:				
Unwrought	1	3	1	Japan 1.
Semimanufactures	66	75	14	Japan 48; Italy 6.
Uranium and thorium:				
Oxides and other compounds	80	(2)	(2)	
Uranium metal including alloys, all forms value, thousands	$9	—		
Vanadium:				
Oxides and hydroxides	7	37	—	Mainly from Japan.
Metal including alloys, all forms kilograms	106	84	18	Hong Kong 50; Japan 16.
Zinc:				
Ore and concentrate	456,345	449,999	2,539	Australia 241,013; Canada 123,542.
Oxides	660	1,038	96	Taiwan 288; Japan 205.
Blue powder	17	83	—	Taiwan 82.
Matte	2,358	19,173	4,791	Japan 5,417; Australia 3,249.
Ash and residue containing zinc	1,289	3,490	74	Malaysia 983; Saudi Arabia 674; Norway 500.
Metal including alloys:				
Scrap	12,881	2,890	626	Netherlands 1,217; Japan 362.
Unwrought	20,453	20,345	40	Belgium-Luxembourg 4,029; Mexico 2,267.
Semimanufactures	1,175	1,330	2	Peru 793; Japan 466.
Zirconium:				
Ore and concentrate	24,430	21,813	185	Australia 14,123; unspecified 7,002.
Oxides	41	66	1	United Kingdom 23; Japan 22; France 20.
Metal including alloys:				
Scrap kilograms	66	50	—	All from Japan.
Unwrought	7	(2)	(2)	West Germany[2].
Semimanufactures	45	76	53	Canada 18.
Other:				
Ores and concentrates	34	330	—	All unspecified.
Oxides and hydroxides	28	16	—	Japan 10; United Kingdom 6.
Ashes and residues	11,225	301	147	Japan 35; Belgium-Luxembourg 23.
Base metals including alloys, all forms	6	50	10	Australia 40.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	608,889	19,773	912	Japan 8,189; Indonesia 5,279; India 5,174.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Abrasives, n.e.s.:—Continued					
Artifical:					
Corundum		34,845	36,178	511	Japan 14,387; Austria 3,492.
Silicon carbide		12,168	14,237	38	Japan 3,937; West Germany 2,099.
Dust and powder of precious and semi-precious stones excluding diamond	kilograms	5,797	4,513	1,080	Ireland 2,895; Japan 428.
Grinding and polishing wheels and stones		1,418	1,715	130	Japan 1,098; West Germany 123.
Asbestos, crude		87,470	77,475	239	Canada 47,691; Zimbabwe 2,322.
Barite and witherite		3,533	4,148	—	Thailand 2,178; United Kingdom 860; Ireland 382.
Boron materials:					
Crude natural borates		2,185	2,603	2,383	Netherlands 220.
Elemental	kilograms	433	138	138	
Oxides and acids		3,467	3,315	1,961	Italy 738; Chile 450.
Bromine		286	192	48	Italy 53.
Cement		164,714	404,610	36	Indonesia 300,731; Saudi Arabia 36,897.
Chalk		15,896	23,641	—	France 23,540; Belgium-Luxembourg 69.
Clays, crude:					
Bentonite		10,728	6,892	5,709	Australia 901; Singapore 163.
Chamotte earth		7,109	11,544	1,139	Hong Kong 5,725; unspecified 4,332.
Fire clay		199	311	86	Japan 125.
Kaolin		148,077	145,944	79,870	Hong Kong 13,987; Japan 10,946.
Unspecified		13,376	6,219	1,912	Hong Kong 3,426; Japan 280.
Cryolite and chiolite		21	46	—	Japan 35; Denmark 11.
Diamond:					
Natural:					
Gem, not set or strung	carats	14,980	14,600	965	Belgium-Luxembourg 2,140; Republic of South Africa 1,505; unspecified 6,730.
Industrial stones	do.	235,115	215,720	181,155	Japan 7,915; Switzerland 6,000; unspecified 16,650.
Dust and powder	kilograms	249	31	2	Ireland 27.
Synthetic:					
Gem, not set or strung	carats	175,050	109,185	43,435	West Germany 55,750; Taiwan 10,000.
Dust and powder	kilograms	4,038	4,483	1,078	Ireland 2,868; Japan 428.
Diatomite and other infusorial earth		345	417	132	Japan 209; Thailand 76.
Feldspar, fluorspar, related materials:					
Feldspar		2,849	2,329	18	Japan 1,443; Hong Kong 420.
Fluorspar		50,453	74,503	19	Thailand 29,081; Taiwan 9,178.
Unspecified		21	10	—	All from Japan.
Fertilizer materials: Manufactured:					
Ammonia		397,495	618,064	195,048	Saudi Arabia 125,128; Qatar 84,613.
Nitrogenous		29,879	123,023	—	Saudi Arabia 26,264; unspecified 79,717.
Phosphatic		500	3,500	—	All from Japan.
Potassic		662,938	680,151	626	Canada 478,275; Jordan 103,600.
Unspecified and mixed		1,011	17,172	16,431	Belgium-Luxembourg 92; unspecified 576.
Graphite, natural		5,942	6,341	1	Hong Kong 202; unspecified 79,717.
Gypsum and plaster		395,177	203,261	1,130	Thailand 193,747; Morocco 80,000.
Iodine		11	13	([2])	Japan 9; Chile 4.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Kyanite and related materials:					
Andalusite		3,269	9,609	1,843	Hong Kong 298; Japan 130; unspecified 7,302.
Kyanite		1,561	2,104	1,803	Sweden 301.
Mullite		4,710	5,157	1,507	Japan 3,630; Brazil 20.
Lime		103	26	(2)	Mainly from Japan.
Magnesium compounds:					
Magnesite, crude		3,870	489	80	Japan 191; unspecified 217.
Oxides and hydroxides		r85,519	91,494	825	Japan 19,578; unspecified 60,658.
Other		388	810	—	West Germany 800; Japan 10.
Mica:					
Crude including splittings and waste		1,925	2,123	319	Malaysia 880; India 584.
Worked including agglomerated splittings		401	1,374	(2)	Japan 1,235; Belgium-Luxembourg 65.
Nitrates, crude		8,202	15,162	411	Chile 8,137; West Germany 6,240.
Phosphates, crude	thousand tons	1,653	1,544	1,254	Jordan 141.
Phosphorus, elemental		3,539	3,310	2,189	France 116; unspecified 911.
Pigments, mineral:					
Natural, crude		158	141	21	Austria 80; United Kingdom 33.
Iron oxides and hydroxides, processed		22,401	24,081	2,934	Japan 11,208; Belgium-Luxembourg 3,221.
Precious and semiprecious stones other than diamond:					
Natural	kilograms	303,675	443,163	55,192	Hong Kong 196,600; Brazil 94,272.
Synthetic	do.	224,111	428,994	174,717	Japan 204,134; Taiwan 17,654.
Quartz crystal, piezoelectric	do.	10,365	1,903	101	Japan 1,802.
Salt and brine	thousand tons	1,053	1,039	—	Australia 761; Mexico 160.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		110,654	146,929	137,500	West Germany 234; unspecified 8,992.
Sulfate, manufactured		80,677	96,735	70	Japan 10,463; Taiwan 7,701.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		75,875	133,403	7,470	Guatemala 85,899; India 10,083.
Worked		17,701	26,592	869	Italy 18,649; Spain 1,571.
Dolomite, chiefly refractory-grade		876	974	—	United Kingdom 715; Norway 197.
Gravel and crushed rock		2,481	5,618	40	France 2,989; Japan 1,839.
Limestone other than dimension		89,594	2,489	11	Japan 2,478.
Quartz and quartzite		1,862	2,544	163	Sweden 848; Japan 646.
Sand other than metal-bearing		389,436	468,432	812	Australia 372,291; Malaysia 89,450.
Sulfur:					
Elemental:					
Crude including native and byproduct		585,328	554,925	11	Canada 312,360; Japan 231,367.
Colloidal, precipitated, sublimed		2,531	2,830	2,073	Japan 726; West Germany 27.
Dioxide		—	1	—	All from Japan.
Sulfuric acid		44,414	98,175	1,802	Japan 96,370.
Talc, steatite, soapstone, pyrophyllite		96,313	123,409	5,733	Australia 5,248; unspecified 108,244.
Vermiculite[5]		22,072	27,864	227	Japan 18,027; Philippines 1,031.
Other:					
Crude		55,106	41,110	1,304	Japan 13,797; Australia 5,509.
Slag and dross, not metal-bearing		308,942	444,959	18	Japan 443,375; United Kingdom 1,546.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF KOREA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		201	207	207	
Carbon black		9,297	7,138	2,368	Japan 2,619; West Germany 1,031.
Coal:					
Anthracite	thousand tons	2,803	1,517	31	Australia 23; unspecified 1,451.
Bituminous	do.	21,913	23,500	3,617	Australia 7,854; Canada 5,373.
Briquets of anthracite and bituminous coal		1	34	—	All from Japan.
Lignite including briquets		20,989	31,053	—	All from Australia.
Coke and semicoke		189,044	402,862	1,037	Australia 249,653; Japan 108,131.
Gas, natural: Liquefied	thousand tons	1,898	2,015	(2)	Mainly from Indonesia.
Peat including briquets and litter		181	298	—	Mainly from Canada.
Petroleum:					
Crude	thousand 42-gallon barrels	237,414	289,583	202	Oman 68,763; United Arab Emirates 48,320.
Refinery products:					
Liquefied petroleum gas	do.	14,427	19,459	(2)	Saudi Arabia 9,549; Kuwait 4,556.
Gasoline	do.	24,468	3,534	86	Belgium-Luxembourg 2,857; Japan 259.
Naphtha	do.	7,635	6,553	—	Kuwait 2,134; Saudi Arabia 1,097; Japan 976.
Mineral jelly and wax	do.	124	146	8	Japan 59; unspecified 65.
Kerosene and jet fuel	do.	r1,132	5,782	740	Singapore 1,284; Kuwait 912.
Distillate fuel oil	do.	9,306	7,915	1,421	Japan 2,188; Saudi Arabia 2,183.
Lubricants	do.	2,671	201	58	Japan 101; Singapore 19.
Residual fuel oil	do.	12,165	16,453	5,385	Japan 3,535; Singapore 2,718.
Bitumen and other residues	do.	—	15	(2)	Mainly from Singapore.
Bituminous mixtures	do.	118	6	1	United Kingdom 5.
Petroleum coke	do.	1,125	880	723	Canada 128.

rRevised. NA Not available.
[1]Table prepared by Audrey D. Wilkes.
[2]Less than 1/2 unit.
[3]Unreported quantity reported at $10,000.

contracts for a total of 500,000 tons of imported concentrate needed for feed at its Onsan smelter in 1991.

Iron and Steel.—Posco commissioned its 3-Mmt/a hot strip mill at Kwangyang in late August. It also commissioned phase 3 expansion projects at Kwangyang in December that added 2.7-Mmt/a to raw steel capacity. Together, with the capacity at Pohang, Posco reached 17.2-Mmt/a capacity, making it the third largest steelmaker in the world. Work was to start on phase 4 in January 1991, which would increase capacity by another 3.3-Mmt/a. Construction of a new coke plant, with an annual capacity of 1.46-Mmt under phase 4 expansion, was started in October. USS-Posco Industries, a joint venture of USX Corp. of the United States and Posco, has operated a new $450 million flat-roll facility at Pittsburg, California, since 1989. It produces cold-rolled and galvanized sheet and tinplate. Output capacity is rated at 1.35 Mmt/a. About 500,000 tons of hot band from Posco's operations in Korea was used as feedstock in 1990.

Hwan Yung Steel Co. installed a new 60-ton electric arc furnace and a 300,000-mt/a capacity billet caster in Dangjin, Chungchong Province. Kia Steel awarded a contract to Mannesmann Demag of the Federal Republic of Germany to construct an electric steel mill with a capacity of 280,000 mt/a on the country's west coast. The mill was expected to go on-stream in spring 1992. The country's total electric steelmaking capacity was to increase by 1.2 Mmt/a to reach 7.3 Mmt/a in 1992. Minimill operations, buoyed by higher prices and strong demand, however, posted only moderate returns in 1990.

Inchon Iron and Steel Co. Ltd. awarded a contract to Production Machinery Corp. of the United States to install a continuous annealing and pickling line to increase production capacity to 90,000 mt/a for a stainless steel cold-rolled strip mill. Inchon also produced about 1.6 Mmt of carbon steel annually.

The country's manganese ore imports for ferroalloys production were about 340,000 tons. Plant consumption was down to 397,000 tons, but still greater than imports.

TABLE 4

REPUBLIC OF KOREA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

Commodity	Major operating companies	Location of main facilities	Annual capacity
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.	Onsan	150
Graphite	Kaerion Graphite Ltd.	Kangwon	25
	Wolmyong Mining Co.	do.	26
Lead, metal	Lucky Metals Co. Ltd.	Changhang	15
	Korea Zinc Co. Ltd.	Onsan	80
Nickel, metal	Korea Nickel Corp.	do.	12
Steel	Pohang Iron and Steel Co. Ltd.	Kwangyang	5,400
	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
	Young Poong Corp.	Sukpo	75

NA Not available.

Inventories were being utilized for the shortfall. The total ferroalloys production was about 189,000 tons in 1990.

PMX Inc., wholly owned by Poongsan Metals, planned startup for a new copper, brass, and stainless steel plant in Cedar Rapids, Iowa, in January 1992. Production capacities would be 180,000 mt/a of stainless flats, 6,000 mt/month of brass, and 6,000 mt/month of copper. This would be the second Korean-owned stainless operation in North America, the first being Sammi Steel. Meanwhile, Sammi Steel commissioned a new 500,000-mt/a rolling mill and other facilities at its Changwon plant, west of Pusan, for special steel bars and wire rods. Sammi Steel would supply 40% to 50% of the country's demand for special steel bars, which averaged about 1.5 Mmt/a.

Han Bo Steel Industry Co. planned a $1.9 billion project to install six new minimills at Asan, 60 km south of Inchon, in Chungchong Province. Startup was scheduled for late 1995. The project included three bar mills at a combined capacity of 1.3 Mmt/a, a heavy plate-mill at 500,000 mt/a, and a beam mill at 500,000 mt/a.

The country's imports of steel bars were from Brazil, China, Turkey, and the United States. Daewood was reportedly studying a plan to import some 10,000 tons of small bars from North Korea. A small Seoul-based trading firm, Sejin Co., imported 2,000 tons of steel bars from the north. A week of strikes led to a shutdown on March 30 at the leading electric steelmaker, Kangwon Industries, Ltd., for 4 days. Kangwon Industries produces about 800,000 mt/a of steel bars, accounting for 20% of the nation's output.

Three major producers of coated sheets, Union Steel, Pohang Steel Industries, and Dongbu Steel, exported products to Taiwan, having that country's market share of 4% in 1989 and 14% in 1990. Dongbu Steel operated a cold-rolling mill and a 410,000-mt/a continuous hot-dip galvanizing line in Inchon. Some of the output is used for feed for its two prepainted sheet lines that have a capacity of 170,000 mt/month. Hwa Sung Metal completed construction of a 500-mt/a color stainless sheet line at its plant near Inchon at a cost of $700,000. The new line supplements the output by Sammi Steel, which has a capacity of 400 mt/a.

Pohang Special Tinplate Co. dedicated a new 120,000-mt/a electrolytic tinning line at its plant near Pohang in August. The company was established in April 1988 and is owned by Posco (51%) and Dong Il (49%). Three other tinplate producers—Dongyang Tinplate, Dongbu Steel, and Shinhwa Silup—have a combined capacity of 480,000-mt/a. However, domestic consumption was only 280,000 tons and exports were 50,000 tons.

Pusan Steel Pipe Corp. commissioned a new 8,000-mt/a pipe mill in Seoul in March and planned to increase production to 15,000 mt/a later in 1990. The company planned to export 30% to 40% of its output to Japan and the United States. It aimed to increase its share of the American pipe market to $60 million per year. Hyundai Steel Pipe intended to export to the same countries in addition to the EC. It commissioned a 10,000-mt/a stainless pipe plant at its Ulsan Works in December 1989 and produced 3,000 tons in 1990, of which 1,000 tons was exported. The country had a stainless pipe capacity of more than 80,000-mt/a, while the domestic demand only reached 50,000 mt/a.

Lead and Zinc.—Lucky Metals closed its aging Changhang lead smelter in June, while Korea Zinc Co. Ltd. planned to commission a new 110,000-mt/a smelter at Onsan in the second half of 1991. It also planned to use Sirosmelt technology to recover zinc, lead, and other metals from residues. This plant would have a capacity of 120,000 mt/a. Korea Zinc was also to build a 60,000-mt/a QSL lead plant for commissioning in mid-1991 and a second Sirosmelt smelter, with a capacity of 100,000 mt/a, to process slags from this operation.

Industrial Minerals

Fertilizer.—Fertilizer application per hectare in the country is one of the highest in the world. Annual fertilizer consumption was believed to remain steady at about 1

Mmt and would be stable or slightly increased in the future, depending on the economic conditions surrounding agriculture.

Talc.—The Dong Yang underground mine is the largest talc producer in the country. Its mills at Ju Duk produced 160,000 tons in 1989, about 20% of which was exported. The Dae Heung Mine was being developed by Il Shin Industrial Co. and scheduled to reach 60,000 mt/a in capacity in 1991.

Titanium Dioxide.—Hankook Titanium Industrial Co. planned to build a new 10,000 mt/a plant in Onsan at a cost of $30 million. Ilmenite was to be imported from Australia, China, and Malaysia and processed into a less pure form of titanium dioxide at a plant in Inchon. Completion of the facility was scheduled for the end of 1991. Meanwhile, Hanyang Chemical Co. and E. I. du Pont de Nemours & Co. Inc. of the United States formed a joint venture to construct a titanium dioxide plant, also in Onsan, with a capacity to process 600,000 mt/a of rutile.

Mineral Fuels

Coal.—The country's anthracite demand fell to 20.3 Mmt, a drop of 10.9% from that of 1989. This was attributable to the switch in the home energy consumption pattern from coal briquettes to oil and gas. Meanwhile, coal production was reduced by 2 Mmt by further closings of the remaining 121 coal mines. Imports of anthracite were also reduced to 600,000 tons in 1990. Anthracite accounted for 14.5% of the country's energy consumption, and bituminous coal accounted for 13.2%.

Liquefied Natural Gas.—A sharp rise in electricity use caused by soaring demand from household and business sectors prompted Government plans to build two LNG-fueled powerplants near Inchon by 1992. The Government remained confident that a natural gasfield southeast of the port of Pusan could supply an average of 50 Mm^3/d of natural gas for at least 15 years with an outlay of $430 million to develop the field. Meanwhile, Korea Gas Corp. signed a contract with Petronas, the Malaysian State oil company, to import LNG at 1 Mmt/a from 1995 over a 20-year period. About 700,000 tons was sought for delivery during 1992-94. The Government had signed a contract to buy 780,000 tons of LNG from Indonesia to fuel powerplants; 340,000 tons of LNG was delivered in 1990, with the remainder to be delivered in 1991.

Petroleum.—Ssangyong Oil Refining Co., the country's third largest refining operation, was to set up a 50-50 joint-venture company, Han Saudi Oil Refining Co., with Saudi Arabian Oil Co. to process Saudi crude, using Ssangyong's facilities in the Republic of Korea, and market petroleum products throughout the Far East. Ssangyong was expected to take about 175,000 bbl/d for its refining operations. In November, Ssangyong completed its 100,000 bbl/d oil refining facilities, and Yukong Ltd. started its new refining facilities with a capacity of 150,000 bbl/d, thus increasing the nation's refining capacity by 250,000 bbl/d to 1.035 Mbbl/d.

State-owned Korea Petroleum Development Corp. was to start the exploration drilling of the fifth continental block off the southern island of Cheju. The company's seismic survey, conducted in 1984, suggested three potential sites for oil occurrences in the block.

The Government alone had about 40 Mbbl in crude reserve, which would last 40 days. Together with five oil refineries, there was a sufficient stockpile of crude and petroleum products to supply the nation for 60 to 70 days. Domestic consumption of crude averaged 900,000 bbl/d. The Government hoped to reduce its dependency on crude by increasing the amount of electricity generated by nuclear power and coal from the current 63.7% to 86.2% by the year 2001.

Honam Oil Refinery Co. started construction of distillate fuel oil hydrodesulfurizer facilities with a capacity of 40,000 bbl/d. The company was to finish building the desulfurization unit by the end of 1991 at an investment of $8 million.

Reserves

The Republic of Korea is not a mineral-rich country; 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 only significant in terms of world output but not in reserve tonnage. Industrial minerals individually accounting for a large share of world production include diatomaceous earth, feldspar, graphite, mica, pyrophyllite, and talc. Major mineral reserves of the country are tabulated as shown in table 5.

TABLE 5

REPUBLIC OF KOREA: RESERVES OF MAJOR MINERALS

Major minerals	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

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.

OUTLOOK

With the completion of the third stage of Kwangyang works in December, crude steel production is expected to be more than 26 million tons in 1991. This increase in steel production will be absorbed by brisk demand by the domestic steel-consuming industries. Steel exports will suffer another year of little or no growth. The steel industry will face myriad problems and challenges in 1991 and beyond: rising costs from higher oil prices, employment costs, and customers' demand for better products and services. Posco, for instance, will turn its attention to modernizing equipment, increasing productivity, reducing energy consumption, and developing new products. Internationally, the steel industry hopes to establish new cooperative relations, promote steel trade liberalization, and investigate new investment opportunities in other areas of the world.

The country is undergoing a major expansion of its petrochemical-refining facilities. Capacity is expected to be more than 1.2 mbbl/d by 1992, twice the projected domestic demand. Producers expect to export excess production.

[1]Where necessary, values have been converted from Korean won (W) to U.S. dollars at the rate of W716=US$1.00 for 1990.

OTHER SOURCES OF INFORMATION

Agencies

Korea Institute of Energy and Resources
219-5, Garibong-dong
Kuro-gu, Seoul

Ministry of Energy and Resources
1, Chungang-dong
Kwach on
Kyonggi, Seoul

Ministry of Trade and Industry
1, Chungang-dong
Kwach on
Kyonggi, Seoul

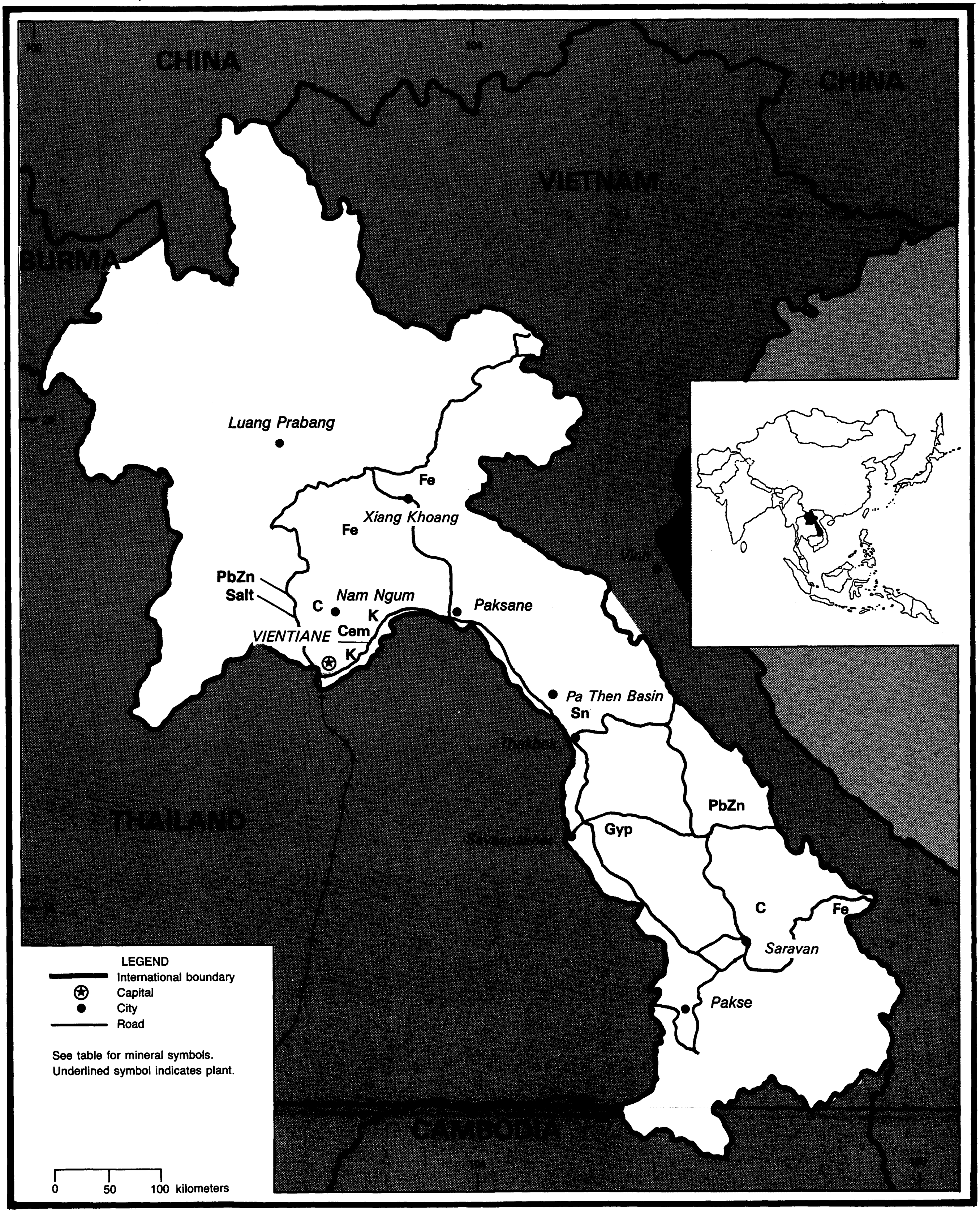
Publications

Economic Planning Board, Seoul:
Monthly Statistics of Korea

Ministry of Energy and Resources, Seoul:
Yearbook of Energy Statistics

LAOS

AREA 236,800 km² **POPULATION 4.1 million**



THE MINERAL INDUSTRY OF LAOS

By David B. Doan

Laos is small with a miniscule mineral industry but, during 1990, it made some progress in organizing for mineral development. Its agrarian economy, much of it slash-and-burn cropping, supported the great majority of the Lao people. The Government's recognition of the need for mineral exploration and development led to the adoption of legal measures designed to encourage both domestic and foreign participation. With an estimated per capita GDP of about $140[1] coupled with an inflation rate of 19% in 1988 and almost 60% in 1989, the country obviously could benefit from tapping 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.

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 not clear that these goals had been achieved. The future role of the U.S.S.R., heretofore the largest provider of aid to Laos, seemed likely to diminish.

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.

Last year an agreement was negotiated for a project financed by the United Nations Development Program (UNDP) to strengthen the capability of the Department of Geology and Mines, of the Ministry of Industry and Handicrafts, for mineral exploration and development.

Laos was not a major trading nation and barely a subordinate one as far as world mineral commodities were concerned. Something on the order of 800 tons of its relatively minor tin production was offered as barter to the U.S.S.R. in return for 100,000 tons of fuel oil. Gypsum was largely sold to neighboring Vietnam. Probably the most significant export of Laos was electricity. Most of the production by the 150-MW Nam Ngum hydroelectric plant, 65 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.

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. Other commodities, however, such as coal and gem stones, which were beginning to receive attention from potential capital sources in other countries, did not make any significant progress during the year.

For reasons involving difficulty of access, general lack of infrastructure, high capital cost of development, and questions as to potential utilization, Laos' large iron deposits near Xiang Khoang remained essentially undisturbed. Future customers for this ore might include either Thailand or Vietnam pending growth of their respective steel industries. Exploration for gold was carried on particularly in the region about 60 km northwest of Vientiane. Tin continued to be mined by cottage-industry methods in the area of the Pa Then basin north of Thakhek, but only on a scale approximating 500 mt/a.

Gypsum mining yielded about 90,000 tons in 1990 according to local news broadcasts, 90% of it shipped across the border to Vietnam. Gem stones were "mined," or at least collected in streambeds, sporadically throughout the southern part of the country.

Coal was mined near Bo Chan (location unknown) in Vientiane Province at the rate of about 1,500 mt/a, but the Government said that it could increase production to 15,000 mt/a if it had investment capital and vehicles. Petroleum exploration activity in the Savannakhet Basin of southern Laos was expected to lead to drilling no sooner than 1993. Agreements had been signed with Hunt Oil Co. of Dallas, Texas, and a British-French partnership comprising Enterprise Oil Plc., of London, and Cie. Francaise des Petroles, Paris. A third entity, Shlapak Development Corp. of the United States, signed with the Government during 1990 for a concession area comprising Vientiane Province and two adjoining ones, the largest concession yet granted for oil and gas exploration.

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.

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 had 4,590 km of navigable inland waterways, essentially the Mekong River and its tributaries. Another 2,890 km of waterway was seasonally navigable by craft drawing 0.5 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 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 mt/a of refined petroleum products.

Power was generated by the 150-MW Nam Ngum hydroelectric plant, but other than for what was consumed locally in the Vientiane area, most of the output was exported to Thailand. An additional 3-MW capacity was distributed among several small hydroelectric plants, and about 14 MW of capacity was provided by a number of diesel units in several parts of the country.

Assistance in construction of new roads was being extended by the World Bank and the United States. Japan made a gift to Laos

TABLE 1

LAOS: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990
Cement (from imported clinker)		4,000	4,500	4,500	[3]6,875	6,500
Gem stones (sapphires)	carats	3,000	8,000	15,000	[3]32,825	30,000
Gypsum		130,000	70,000	[3]80,000	[3]104,000	90,000
Salt, rock		30,000	13,000	30,000	[3]7,950	8,000
Tin, mine output, Sn content		550	450	[3]300	[3]281	[3]500

[1]Table includes data available through August 1, 1991.
[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.

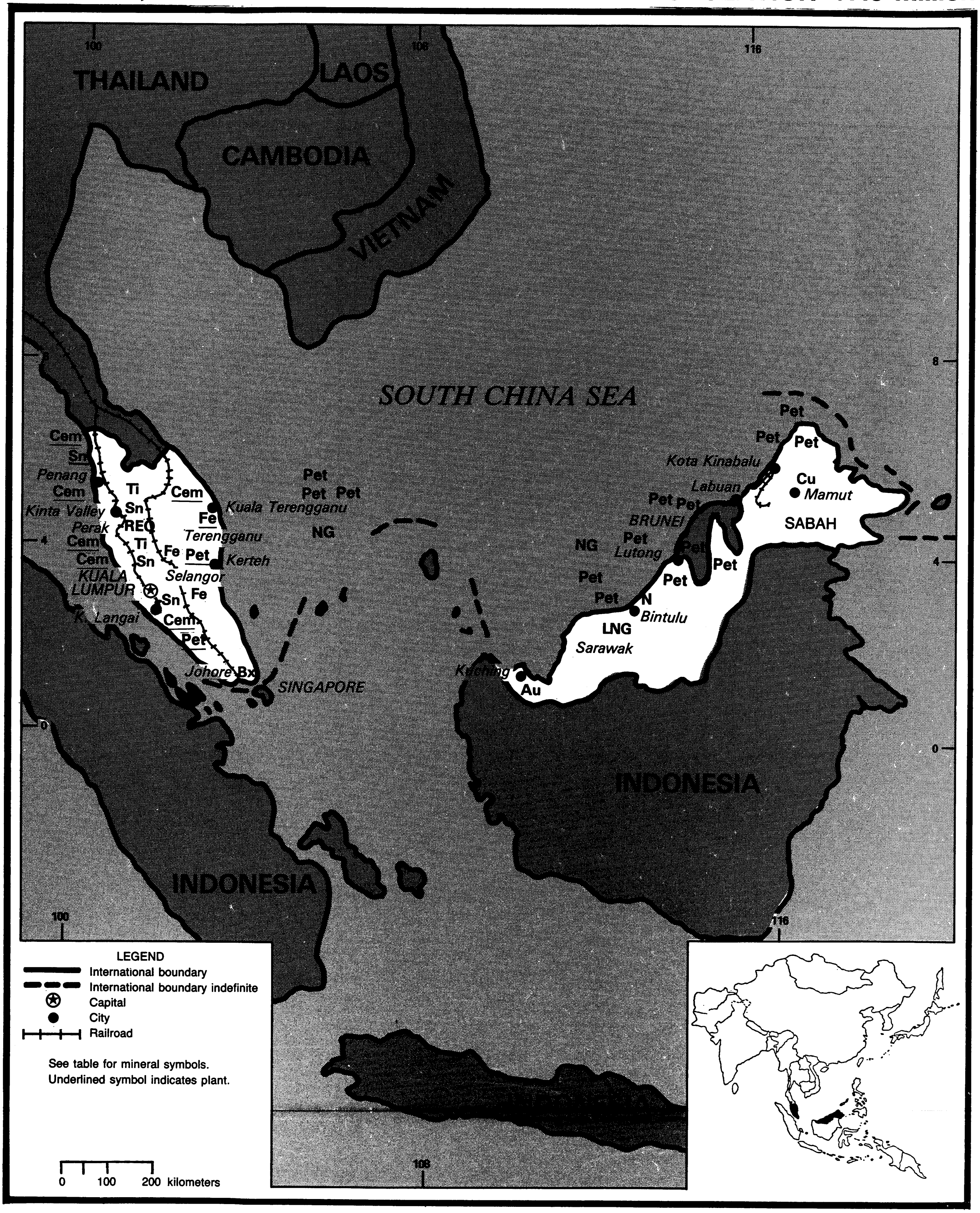
of 50 buses for Vientiane municipal commuters. The United States was planning further assistance that included upgrading of schools, hospitals, irrigation networks, telecommunications, and the construction of a small hydroelectric powerplant.

Laos is only verging on social, political, and industrial development and consolidation. The country has seemingly 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. Foreign petroleum concessionaires may bring in enough new capital to help start the process of capital formation as a necessary precursor to development.

[1]Where necessary, values have been converted from the Lao kip (K) to U.S. dollars at the rate of K1,200=US$1.00.

MALAYSIA

AREA 329,750 km² **POPULATION 17.5 million**



THE MINERAL INDUSTRY OF MALAYSIA

By John C. Wu

Malaysia's important minerals resources include bauxite, clay, copper, ilmenite, iron ore, natural gas, petroleum, rare earths, and tin. Of these minerals, only its tin reserves are ranked the world's largest. In past years, several tin deposits, polymetallic sulfate deposits of copper-lead-zinc, and deposits of gold and silver as well as deposits of iron ore had been identified for further exploration and development in central and eastern peninsular Malaysia.

In 1990, Malaysia was 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. The mining industry remained an important sector of the Malaysian economy in 1990. Despite a major setback in the tin industry, Malaysia's mining industry continued to expand mainly because of increased output of crude petroleum and natural gas.

The output of the mining industry grew an estimated 4.8% in 1990 compared with a 9.4% real growth in Malaysia's GDP in 1990.[1] The economic growth of 1990, fueled mainly by the manufacturing and construction sectors, had been the highest since 1976. The total value of mineral production was estimated at $2.8 billion[2] in 1978 constant dollars and accounted for about 10% of the Malaysian real GDP, which was estimated at $27.8 billion in 1990.

Malaysia continued to export most of its mineral products to Japan and neighboring southeast Asian countries. In 1990, exports of mineral products to western European countries rose considerably because of the opening of the London Tin Exchange and increased demand for the other Malaysian mineral products by France, the Federal Republic of Germany, and the Netherlands. Malaysia's tin exports to the United States declined in 1990 owing to a weak U.S. demand and the disposal of the tin stockpile on the U.S. market by the U.S. Defense Logistics Agency. However, Malaysia remained one of the important suppliers of crude petroleum, intermediary rare-earth products, and tin to the United States.

Malaysia remained a net exporter of mineral products in 1990. Malaysia exported all of its coal, copper concentrate, ilmenite, rare earths, and zircon concentrate and exported more than 90% of its tin. Malaysia also exported about 80% of its bauxite, natural gas, and silica sand and exported more than 70% of its crude petroleum production. Export earnings from crude petroleum and natural gas accounted for 18% of the Malaysian export earnings in 1990. Malaysia imports of nonfuel minerals, such as iron ore and tin concentrate, were mostly reexported after smelting. However, a considerable quantity of coal, heavy crude petroleum, and industrial minerals, including gypsum, phosphate rock, potash, and salt, were imported annually for domestic consumption.

In 1990, two major investment plans were announced in the mineral fuels sector. These investment plans included a $5 billion expansion project to double LNG production capacity in Sarawak and construction of a $1.7 billion petroleum refining complex in Malacca. Two major investment plans were announced in the nonfuel mineral sector. These investment plans included construction of a $700 million aluminum smelter in Sarawak and a $3.2 billion integrated steel mill in Terengganu. In late 1990, a $195 million expansion project of an existing integrated steel mill was started at Talok Kalong in Teregganu. However, the development of the Mengapur copper project in Pahang, which was originally planned to begin in late 1990, was postponed indefinitely because of metallurgical problems.

GOVERNMENT POLICIES AND PROGRAMS

In 1971, the Government established the New Economic Policy (NEP) to eradicate poverty and to end the identification of economic function with race in Malaysia. The NEP included broad affirmative action programs in employment, education, government contracting, and ownership of corporate equity in Malaysia. Under the NEP, at least 30% of corporate equity is to be held by Bumiputras (the ethnic Malays and other indigenous Malaysians). However, to cope with the Malaysian economic slowdown and to boost business confidence in the mid-1980's, the Government introduced equity ownership incentives in October 1986 to relax the guidelines affecting foreign investors.

Under the 1986 guidelines, the foreign investors applying before the end of December 1990 for starting new projects (except in the plastic injection molding and metal stamping sectors) will be allowed to retain 100% of the equity in their Malaysian subsidiary, if the projects would export at least 50% of the output or hire at least 350 full-time Malaysian employees. The NEP was scheduled to expire in 1990, except that the 1986 guidelines affecting foreign investors was extended until December 31, 1991.

The Ministry of Finance announced in December that, under the 1991 National Budget, it will abolish the export and import duties on tin and export duties on all other mineral ores and concentrates effective in January 1991. Prior to 1991, the export duties on mineral products range from 10% to 15%. To encourage mineral exploration and production of mineral fuels, the Government will allow companies operating with production-sharing contracts signed after 1985 to increase their export tax exemption from 20% to 50% effective in April 1991.[3] To streamline the Malaysian mining industry and offer new incentives to foreign investors, the Government was expected to announce a national mineral policy in June 1991.

PRODUCTION

The oil and gas industry continued to dominate the mineral industry of Malaysia in 1990. The output of both crude petroleum and natural gas reached a record high 1990. The country's tin industry suffered a setback because of a sharp drop in the tin price on the Kuala Lumpur Tin Market in 1990. The total number of workers employed by the tin industry dropped to a record low in 1990. As a result of reduced tin production, the output of tin byproducts such as ilmenite and zircon concentrate also declined considerably. Output of copper concentrate at the Mamut Mine in Sabah and washed bauxite in the Pengerang area of Johor increased slightly. Production of silica sand in the Bintulu area continued to move higher because of increased export and domestic consumption in 1990. The output of cement reached a record high in 1990 because of increased domestic construction activity. Production of other industrial minerals such as barite and kaolin also increased owing to a stronger demand in the domestic market.

TRADE

Malaysia continued to enjoy a mineral trade surplus in 1990. Export earnings of crude petroleum and natural gas in the form of LNG were valued at about $5 billion, accounting for more than 98% of the total mineral export earnings and about 18% of the country's total merchandise exports. In 1990, because of the Persian Gulf crisis, both the volume and value of crude petroleum exports reached record highs. Exports of LNG also reached a new record because of increased shipments to Japan and other countries. Exports of refined tin was lower than that of 1989 because of the export restriction imposed by the Association of Tin Producing Countries (ATPC).

Malaysia continued to import heavier crude petroleum from the Middle East to meet the requirement for the domestic refineries. However, imports of crude petroleum were lower than those of 1989 because of reduced domestic requirement in 1990. Other important minerals imports in 1990 were iron ore and tin concentrate for reexport after processing and cement, gypsum, phosphate rock, potash, sodium carbonate, and sulfur for domestic consumption.

STRUCTURE OF THE MINERAL INDUSTRY

The structure of Malaysia's mineral industry remained unchanged in 1990. However, the output capacity of the oil and gas industry was expanded considerably, and capacity of the tin industry contracted substantially. The cement industry's capacity increased slightly when Kedah Cement Sdn. Bhd. raised its capacity by 300,000-mt/a in 1990.

According to an estimate by the Malaysian Ministry of Human Resources, the total number of persons employed by the mining and quarrying industry rose to 39,100 from 38,300 in 1989, despite a drop in the tin industry's employment. According to the Malaysian Department of Mines, the number of workers employed by the major minerals, excluding oil and gas, were 110 in barite, 210 in bauxite, 300 in coal, 1,100 in copper, 780 in gold, 130 in iron ore, 410 in kaolin, 164 in silica sand, and 8,840 in tin. Malaysia's total labor force rose from 6.8 million to 7.0 million in 1990, while the unemployment rate dropped to 6.3% from 7.1% in 1989.

COMMODITY REVIEW

Metals

Aluminum and Bauxite.—Mine production of bauxite rebounded considerably in 1990 owing to increased exports. Johore Mining and Stevedoring Co. Sdn. Bhd. (JMSC), Malaysia's sole bauxite producer, operated a multiple-bench open pit mine and a washing plant with a work force of about 200 at Bukit Raja around Pengerang Highway north of Sungai Rengit, east of Johor Baharu. The washing plant is capable of milling 1 Mmt/a of ore and producing 500,000 tons of washed bauxite with 10% water content. JMSC had been operating in the Pengerang area since 1962. Because of depleting ore reserves in its leasing area, JMSC reportedly was negotiating with the Government in 1990 for obtaining additional concession acreage in the Kota Tinggi District to extend its bauxite mining operation.

The company produced three grades of bauxite. The refractory-grade containing 46% aluminum oxide (Al_2O_3), 8% silica (SiO_2), and less than 10% iron oxide accounted for 25% of production and was consumed mainly by the domestic cement manufacturers. The chemical-grade containing 48% Al_2O_3 , 8% SiO_2, and less than 3% iron oxide accounted for 10% of production and was exported to Japan, Thailand, and the United States. The metallurgical-grade containing 50% Al_2O_3, 5% SiO_2 maximum, and less than 8% iron oxide accounted for 65% of production and was exported mainly to the United States.

In September 1990, a consortium of local investment groups and Hydro-Aluminium of Norway announced that it plans to build a $700 million aluminum smelter in Bintulu, Sarawak, in 1992. Hydro-Aluminium, which is expected to hold 25% to 30% stake in the project, will provide technology for construction of the 120,000-mt/a smelter. Islamic Development Bank reportedly is to finance the project. According to the Ministry of Trade and Industry, local partners included Chew Swee Lun Holding Co., the Sarawak State Government, Bintulu Development Authority, and the Federal Government of Malaysia. Under the project's plan, natural gas from the Central Luconia Gasfield off Sarawak will be the power source of the planned smelter, and raw material will be imported from Australia. Malaysia imported annually about 35,000 tons of primary metal and aluminum semimanufactures to meet the domestic demand owing to lack of smelting capacity. Under the project's plan, about 75% of the projected smelter output will be exported to Europe, Japan, and the United States.[4]

Copper.—Mine production of copper from the Mamut Mine in Sabah increased slightly in 1990. Mined ore averaged 0.5% copper, 0.5 gram of gold per ton of ore, and 3 to 4 grams of silver per ton of ore. In 1990, production of copper concentrate was about 102,000 tons containing about 24,000 tons of copper, 1,586 kg of gold, and 12,500 kg of silver. All copper concentrate was exported to Mitsubishi Metal Corp. of Japan.

The open pit copper mine, which is about 15 km north of Ranau in Sabah, has been in operation since 1975. Following a major equity restructuring in 1987, the copper mining operation was taken over by the Mamut Copper Mining Sdn. Bhd. from the Overseas Mineral Resources Development Bhd, a joint venture company of a Japanese consortium and Sabah State government. The Mamut Mine, which was expected to cease operation by 1992 because of ore depletion, reportedly will continue operating for at least 7 to 8 more years owing to the discovery of additional ore reserves in the pit in 1989. Employment at the Mamut Mine was about 1,100 workers in 1990.

TABLE 1

MALAYSIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
METALS						
Aluminum: Bauxite, gross weight	thousand tons	566	482	361	355	398
Antimony, mine output, Sb content (Sarawak)		—	129	—	—	—
Columbium and tantalum concentrate, gross weight:		215	228	—	—	4
Cb content of columbium[e]		32	34	—	—	1
Ta content of tantalum[e]		15	16	—	—	—
Copper, mine output, Cu content (Sabah)		28,301	29,861	22,014	23,565	[e]24,000
Gold, mine output, Au content:						
Malaya	kilograms	275	484	717	678	869
Sabah	do.	2,217	2,713	1,773	1,926	1,586
Sarawak	do.	226	315	439	255	139
Total	do.	2,718	3,512	2,929	2,859	2,594
Iron and steel:						
Iron ore and concentrate	thousand tons	208	161	132	193	334
Steel, crude[e]	do.	750	750	550	550	550
Rare-earth metals: Monazite, gross weight		5,959	2,908	2,920	2,948	3,323
Silver, mine output, Ag content:						
Sabah	kilograms	14,065	15,480	10,490	12,686	12,451
Sarawak[3]	do.	[r]250	317	285	199	[e]200
Total	do.	14,315	15,797	10,775	12,885	[e]12,651
Tin:						
Mine output, Sn content		29,135	30,388	28,866	32,034	28,468
Metal, smelter		43,788	44,363	49,945	50,630	[e]50,000
Titanium: Ilmenite concentrate, gross weight		414,941	509,202	486,305	533,637	501,585
Tungsten, mine output, W content		4	—	—	—	—
Zirconium: Zircon concentrate, gross weight		12,633	17,828	25,671	18,704	4,279
INDUSTRIAL MINERALS						
Barite		17,677	38,935	38,766	36,526	48,291
Cement, hydraulic	thousand tons	3,569	3,316	3,775	4,794	[e]5,800
Clays: Kaolin		85,052	96,882	116,869	108,347	152,972
Nitrogen: N content of ammonia		250,600	321,300	300,600	278,900	228,800
Silica sand		217,125	360,070	418,818	452,025	686,604
MINERAL FUELS AND RELATED MATERIALS						
Coal	thousand tons	—	—	28	112	99
Gas, natural:[4]						
Gross	million cubic meters	14,894	16,433	16,730	18,683	[e]18,900
Net[5]	do.	11,783	12,944	13,123	13,964	14,230
Petroleum:[4]						
Crude	thousand 42-gallon barrels	183,814	181,724	198,343	214,938	[e]228,600
Refinery product:						
Gasoline	do.	8,808	9,130	9,804	10,979	[e]11,000
Jet fuel[e]	do.	2,700	2,900	3,000	[6]2,766	3,000
Kerosene	do.	3,876	3,943	4,041	4,580	[e]4,600
Distillate fuel oil	do.	10,293	10,183	10,753	15,619	[e]15,600
Residual fuel oil	do.	8,298	8,350	9,107	10,802	[e]11,000
Other[e7]	do.	11,500	12,000	12,500	[6]9,596	10,000
Total[e]	do.	45,475	46,506	49,205	54,342	[e]55,200

[e]Estimated. [p]Preliminary. [r]Revised.
[1]All production is from Peninsular Malaysia (Malaya) unless otherwise specified. Table includes data available through May 15, 1991.
[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]Includes production from Malaya, Sabah, and Sarawak.
[5]Gross less volume of reinjected and flared.
[6]Reported figure.
[7]Includes LPG, naphthas, and lubricants.

TABLE 2

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989 United States	Destinations, 1989 Other (principal)
METALS					
Alkali and alkaline-earth metals:					
Alkali Metals		—	2	—	Mainly to Indonesia.
Aluminum:					
Ore and concentrate		222,100	321,750	98,450	Japan 175,900; Taiwan 26,200.
Oxides and hydroxides		11	10	—	Mainly to Singapore.
Metal including alloys:					
Scrap		11,249	5,127	135	Japan 3,127; Singapore 1,053.
Unwrought		368	243	—	Singapore 123; Hong Kong 61.
Semimanufactures		16,259	16,003	50	Singapore 9,119; Hong Kong 2,003.
Arsenic: Oxides and acids		—	29	—	All to Singapore.
Bismuth: Metal including alloys, all forms		12	(2)	—	Do.
Chromium: Oxides and hydroxides		5	1	—	Do.
Cobalt: Metal including alloys, all forms		—	13	3	United Arab Emirates 8; Singapore 2.
Columbium and tantalum: Ores and concentrates		23	192	12	Singapore 180.
Copper:					
Ore and concentrate		85,872	102,168	—	All to Japan.
Matte and speiss including cement copper		18	—	—	
Sulfate		—	111	—	Mainly to Singapore.
Metal including alloys:					
Scrap		17,922	24,617	36	Singapore 12,754; Republic of Korea 5,096; Japan 3,166.
Unwrought		163	542	—	Republic of Korea 482; Australia 26.
Semimanufactures		19,193	27,086	48	Singapore 17,744; Thailand 4,195.
Gold:					
Waste and sweepings	kilograms	431	645	313	Singapore 330.
Metal including alloys, unwrought and partly wrought	do.	1,103	893	182	Singapore 617; Hong Kong 40.
Iron and steel:					
Iron ore and concentrate including roasted pyrite		1,429	2,044	—	Singapore 1,792; Thailand 210.
Metal:					
Scrap		80,912	75,276	—	Singapore 61,910; Indonesia 6,250; India 5,044.
Pig iron, cast iron, related materials		444,367	434,985	1	India 179,293; Italy 82,207; Philippines 47,073.
Ferroalloys		195	4	(2)	Mainly to Singapore.
Steel, primary forms		49,534	118,300	—	Taiwan 49,699; Thailand 49,029.
Semimanufactures:					
Flat-rolled products:					
Of iron or nonalloy steel:					
Not clad, plated, coated		4,163	7,352	—	Singapore 6,765; Brunei 378.
Clad, plated, coated		2,910	10,228	15	Singapore 7,085; United Arab Emirates 1,525.
Of alloy steel		511	841	—	Singapore 824.
Bars, rods, angles, shapes, sections		299,273	170,572	1,346	Singapore 106,344; Thailand 30,184.
Rails and accessories		351	221	(2)	Singapore 141; Thailand 43.
Wire		7,463	16,592	196	Hong Kong 6,074; Singapore 2,906; Thailand 2,163.
Tubes, pipes, fittings		50,021	47,541	4,052	Singapore 25,301; Thailand 9,968.
Lead:					
Ore and concentrate		—	2	—	All to Thailand.
Oxides		1	18	—	Mainly 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		1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS—Continued					
Lead—Continued					
Metal including alloys:					
Scrap		1,089	2,791	—	Singapore 2,743; Japan 45.
Unwrought		2,210	1,900	—	Singapore 732; Indonesia 680; Bangladesh 294.
Semimanufactures		281	271	(2)	Taiwan 100; Philippines 73; Singapore 72.
Magnesium: Metal including alloys, all forms		42	107	—	Papua New Guinea 90; Italy 17.
Manganese: Oxides		16	1	—	All to Singapore.
Mercury		2	(2)	—	All to West Germany.
Nickel:					
Matte and speiss		2	—		
Metal including alloys:					
Scrap		103	182	—	Singapore 101; Hong Kong 47; Taiwan 23.
Unwrought		—	23	(2)	Mainly to Singapore.
Semimanufactures		134	25	(2)	Singapore 15; Republic of Korea 6.
Platinum-group metals:					
Waste and sweepings	do.	$101	$48	$48	
Metals including alloys, unwrought and partly wrought	kilograms	161,173	116,815	111,767	United Kingdom 5,047.
Rare-earth metals:					
Monazite concentrate		139	560	—	France 400; Netherlands 100; Japan 60.
Metals including alloys, all forms		18	—	—	
Selenium, elemental	value, thousands	$28	$9	—	Mainly to United Kingdom.
Silver:					
Waste and sweepings	do.	$1,802	$1,315	$656	United Kingdom $315; Singapore $214.
Metal including alloys, unwrought and partly wrought	kilograms	831	1,220	298	Singapore 919.
Tin: Metal including alloys:					
Scrap		505	396	—	Singapore 292; Hong Kong 84.
Unwrought		49,586	50,255	5,195	Netherlands 14,879; Japan 12,855.
Semimanufactures		368	543	11	United Kingdom 210; Hong Kong 103.
Titanium:					
Ore and concentrate		377,360	352,245	—	Japan 265,007; Republic of Korea 31,073; Spain 15,237.
Oxides		105	233	—	Singapore 139; Thailand 61; Indonesia 28.
Metal including alloys, all forms		1	5	—	Mainly to Singapore.
Tungsten: Metal including alloys, all forms		1	(2)	—	All to Singapore.
Zinc:					
Oxides		469	1,931	—	Republic of Korea 1,403; Singapore 333.
Metal including alloys:					
Scrap		385	492	—	Singapore 302; India 120; Taiwan 70.
Unwrought		11	43	—	Hong Kong 20; Thailand 19.
Semimanufactures		115	177	—	Singapore 73; Taiwan 43.
Zirconium: Ore and concentrate		28,263	15,073	—	Japan 4,030; U.S.S.R. 2,215; Taiwan 2,018.
Other: Ashes and residues		20,927	13,244	—	Singapore 7,310; West Germany 3,079;
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		52	16	—	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		1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
INDUSTRIAL MINERALS—Continued					
Abrasives, n.e.s.—Continued					
Artificial:					
Corundum		—	1	—	All to Australia.
Silicon carbide		13	1	—	All to Singapore.
Dust and powder of precious and semiprecious stones including diamond	value, thousands	$286	$1	—	Mainly to Singapore.
Grinding and polishing wheels and stones	do.	$100	$1,796	$1,438	Taiwan $71; Philippines $66.
Asbestos, crude		(2)	3	—	All to Singapore.
Barite and witherite		1,438	1,268	—	Do.
Boron materials:					
Crude natural borates		26	14	—	Thailand 12.
Elemental[3]	value, thousands	$2	—	—	
Oxides and acids		12	5	—	Mainly to Thailand.
Cement	thousand tons	2,006	2,021	—	Singapore 879; Bangladesh 420; Sri Lanka 298.
Chalk		1,685	928	—	Singapore 884; Thailand 43.
Clays, crude		61,121	98,035	—	Taiwan 46,706; Japan 29,784; Singapore 16,080.
Cryolite and chiolite		16	—	—	
Diamond: Natural:					
Gem, not set or strung	value, thousands	$24,817	$47,992	—	BelgiumLuxembourg $47,501; Singapore $401.
Industrial stones	do.	$4,631	$20	—	All to Hong Kong.
Diatomite and other infusorial earth		9	7	—	All to Singapore.
Feldspar		40	94	—	Republic of Korea 86; Switzerland 7.
Fertilizer materials:					
Crude, n.e.s.		315	1,872	—	Indonesia 1,664; Hong Kong 100; Singapore 56.
Manufactured:					
Ammonia		31,929	18,759	—	Thailand 8,827; Philippines 8,167; Singapore 1,761.
Nitrogenous		370,320	490,429	43,355	Thailand 186,963; Australia 170,671.
Phosphatic		538	292	—	Papua New Guinea 200; Singapore 90.
Potassic		8,334	18,420	—	Thailand 11,919; Sri Lanka 5,222; Singapore 1,264.
Unspecified and mixed		10,063	8,281	—	Indonesia 4,603; Singapore 3,631.
Flourspar		15	—	—	
Graphite, natural		4	3	—	All to Singapore.
Gypsum and plaster		703	885	—	Do.
Kyanite and related materials		13	—	—	
Lime		8,153	20,025	—	Singapore 19,124; Papua New Guinea 601.
Magnesium compounds:					
Oxides and hydroxides		19	—	—	
Other		—	15	—	Singapore 10; Papua New Guinea 5.
Mica:					
Crude including splittings and waste		2,421	2,650	—	Republic of Korea 1,217; Japan 699; Taiwan 481.
Worked including agglomerated splittings		89	—	—	
Nitrates, crude		1	22	—	Singapore 21; Papua New Guinea 1.
Phosphates, crude		6,726	2,100	—	Hong Kong 1,155; Singapore 594; China 350.
Phosphorus, elemental	value, thousands	—	$35	—	Mainly to Japan.
Pigments, mineral: Iron oxides and hydroxides, processed		17	755	—	Mainly to Singapore.
Potassium salts, crude		2	—	—	

See footnotes at end of table.

TABLE 2—Continued

MALAYSIA: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
INDUSTRIAL MINERALS—Continued					
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$2,221	$107	$2	Thailand $92.
Synthetic	do.	(2)	$99	—	Japan $97.
Pyrite, unroasted		—	7	—	All to Hong Kong.
Quartz, piezoelectric	value, thousands	$3,123	$2,128	(2)	Japan $2,125.
Salt and brine		878	2,698	(2)	Thailand 1,377; Singapore 1,096.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		152	1,980	—	Mainly to Indonesia.
Sulfate, manufactured		133	268	—	Thailand 260; Singapore 6.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		561,472	249,190	3	Singapore 212,351; Indonesia 30,816.
Worked		4,405	5,885	540	Singapore 3,128; Australia 920.
Dolomite, chiefly refractory-grade		98	1,223	—	Indonesia 1,000; Papua New Guinea 200.
Gravel and crushed rock		171,196	307,404	—	Brunei 279,338; Singapore 16,074.
Limestone other than dimension		48,849	48,293	—	Singapore 44,687; Thailand 2,286; Bangladesh 700.
Quartz and quartzite		10	16	—	Mainly to Singapore.
Sand other than metal-bearing	thousand tons	2,295	1,501	(2)	Singapore 1,052; Japan 305.
Sulfur:					
Elemental:					
Crude including native and byproduct		—	91	—	Singapore 84; India 6.
Colloidal, precipitated, sublimed		9	25	—	Taiwan 20; Philippines 2.
Sulfuric acid		375	710	—	Singapore 429; China 176; Hong Kong 103.
Talc, steatite, soapstone, pyrophyllite		32	132	—	Thailand 122.
Other:					
Crude		46	135	—	Netherlands 60; Taiwan 40; Singapore 33.
Slag and dross, not metal-bearing		11,187	4,771	—	Singapore 4,674; Netherlands 60.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		33	99	—	Singapore 62; Thailand 36.
Carbon black		4,594	6,520	—	Indonesia 5,236; Singapore 456.
Coal, all grades including briquets		22,084	66,605	—	Taiwan 53,644; North Korea 8,000.
Coke and semicoke		24	17	—	Singapore 13; Indonesia 4.
Gas, natural:					
Gaseous		231	80	—	Japan 70; Burma 9.
Liquefied	thousand tons	6,118	6,478	—	All to Japan.
Peat, including briquets and litter		542	457	—	Taiwan 246; Singapore 68; Japan 60.
Petroleum:					
Crude	thousand 42-gallon barrels	153,696	157,660	10,784	Singapore 44,986; Japan 28,640; Republic of Korea 28,326.
Refinery products:					
Liquefied petroleum gas	do.	1,448	2,926	—	Japan 1,787; Thailand 456; Republic of Korea 386.
Gasoline	do.	3,410	4,172	1	Japan 2,941; Singapore 905.
Kerosene and jet fuel	do.	3,631	3,462	—	Japan 2,723; Singapore 739.
Distillate fuel oil	do.	1,784	1,201	—	Indonesia 687; Singapore 387; Philippines 92.
Lubricants	do.	10	14	—	Brunei 4; Hong Kong 3; Singapore 3.
Residual fuel oil	do.	7,071	8,676	—	Singapore 6,802; Japan 1,874.
Bitumen and other residues	do.	(2)	29	—	Singapore 28.
Bituminous mixtures	do.	7	18	—	Singapore 14; Hong Kong 2.

[1]Table prepared by Audrey D. Wilkes.
[2]Less than 1/2 unit.
[3]May include tellurium.

TABLE 3

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS				
Alkali and alkaline-earth metals	21	6	(2)	West Germany 3.
Aluminum:				
Ore and concentrate	2,457	2,418	5	China 2,410.
Oxides and hydroxides	18,661	16,298	48	Australia 14,683; United Kingdom 399; China 337.
Metal including alloys:				
Scrap	3,462	2,448	—	Singapore 2,115; Thailand 191.
Unwrought	173,574	129,185	3,134	Australia 74,167; Japan 25,448.
Semimanufactures	13,480	16,498	1,341	Japan 7,712; Australia 1,610.
Antimony:				
Oxides	23	44	—	Japan 43.
Metal including alloys, all forms	152	220	—	Thailand 168; Hong Kong 41.
Arsenic:				
Elemental value, thousands	$74	$29	—	Mainly from Japan.
Oxides and acids	127	5	1	Japan 2; Singapore 1.
Beryllium: Metal including alloys, all forms	(2)	40	23	Hong Kong 13.
Bismuth: Metal including alloys, all forms value, thousands	$38	$24	$3	United Kingdom $12; Hong Kong $7.
Cadmium: Metal including alloys, all forms	6	11	2	Australia 4; Hong Kong 2.
Chromium:				
Ore and concentrate	394	403	—	Indonesia 268; Japan 127.
Oxides and hydroxides	418	268	10	United Kingdom 100; Netherlands 52; India 50.
Metal including alloys, all forms	5	7	—	Japan 4; West Germany 3.
Cobalt:				
Ore and concentrate	—	1	—	All from Singapore.
Oxides and hydroxides	24	21	2	China 5; Taiwan 5; Singapore 3.
Metal including alloys, all forms	331	431	6	Canada 359; United Kingdom 45.
Columbium and tantalum:				
Ores and concentrates	7	77	—	All from Thailand.
Tantalum metal including alloys, all forms	—	9	(2)	Japan 8.
Copper:				
Ore and concentrate	148	19	(2)	Singapore 15; Taiwan 2.
Matte and speiss including cement copper	59	30	—	Australia 21; Singapore 6.
Oxides and hydroxides	218	257	6	Singapore 137; Taiwan 35; United Kingdom 31.
Sulfate	1,411	1,350	3	U.S.S.R. 740; Taiwan 334; China 99.
Metal including alloys:				
Scrap	1,694	2,229	46	Thailand 1,183; Singapore 614; Netherlands 208.
Unwrought	32,879	48,495	672	Chile 16,177; Zambia 12,023; Republic of Korea 6,410.
Semimanufactures	25,998	60,979	1,908	Japan 37,428; Singapore 10,085.
Germanium: Metal including alloys, all forms	1	7	—	All from Japan.
Gold:				
Waste and sweepings value, thousands	$21	$155	—	Singapore $125; U.S.S.R. $30.
Metal including alloys, unwrought and partly wrought kilograms	22,606	71,275	996	United Kingdom 32,926; Singapore 16,908.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	449,460	912,266	103	Brazil 763,166; Norway 148,661.
Pyrite, roasted	8	— —		

See footnotes at end of table.

TABLE 3—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS—Continued				
Iron and steel:—Continued				
Metal:				
Scrap	488,552	718,172	288,958	Singapore 114,781; Australia 109,810.
Pig iron, cast iron, related materials	70,559	72,937	33	U.S.S.R. 51,429; China 15,242.
Ferroalloys:				
Ferromanganese	17,222	7,611	61	Japan 3,176; India 2,359.
Ferrosilicomanganese	5,396	5,851	28	China 2,394; India 1,037.
Ferrosilicon	4,424	6,075	9	China 1,523; Brazil 1,008; Japan 684.
Silicon metal value, thousands	$44,817	$57,342	$12,948	Japan $44,102; China $76.
Unspecified	1,047	2,198	70	Thailand 1,046; China 702.
Steel, primary forms	127,859	149,860	28	Brazil 122,998; Netherlands 21,410.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	831,013	925,262	1,309	Japan 449,279; Republic of Korea 181,017; Brazil 127,808.
Clad, plated, coated	147,978	151,476	5,819	Japan 97,225; Australia 22,765; Republic of Korea 7,985.
Of alloy steel	48,032	65,446	849	Japan 54,389; Republic of Korea 3,131.
Bars, rods, angles, shapes, sections	160,914	222,623	3,660	Japan 74,486; Republic of Korea 24,209.
Rails and accessories	1,408	23,608	269	Poland 10,969; Australia 5,736; Republic of Korea 2,570.
Wire	12,020	13,152	478	China 5,984; Australia 1,569; Japan 1,431.
Tubes, pipes, fittings	160,647	233,455	7,061	Japan 93,895; West Germany 44,253.
Lead:				
Ore and concentrate	15	250	—	Singapore 231; West Germany 19.
Oxides	209	517	1	Taiwan 320; Spain 40; China 35.
Metal including alloys:				
Scrap	4,558	2,541	—	United Kingdom 2,473; Singapore 40.
Unwrought	14,797	20,492	2,082	Australia 6,787; Brazil 5,127; United Kingdom 4,153.
Semimanufactures	4,189	4,745	17	Taiwan 1,650; Japan 1,324; Singapore 1,005.
Lithium: Oxides and hydroxides	1	6	5	Japan 1.
Magnesium: Metal including alloys, all forms	32	100	1	Japan 45; Norway 12; France 11.
Manganese:				
Ore and concentrate	933	985	2	Ghana 354; Republic of South Africa 352.
Oxides	1,486	1,898	11	Japan 746; Singapore 726.
Metal including alloys, all forms	7	83	—	China 55; United Kingdom 11.
Mercury	4	28	(2)	Japan 18; Algeria 7.
Molybdenum:				
Ore and concentrate	13	88	—	Australia 52; Singapore 36.
Metal including alloys, all forms	62	263	3	United Kingdom 172; Brazil 30.
Nickel:				
Ore and concentrate	404	6	—	Singapore 4; Australia 1.
Matte and speiss	98	107	—	Norway 53; Finland 21; Singapore 14.
Oxides and hydroxides	12	7	—	China 4; Taiwan 2.
Metal including alloys:				
Scrap	16	2	—	Mainly from Singapore.
Unwrought	170	157	2	Norway 54; Finland 33.
Semimanufactures	757	1,373	202	Singapore 356; Japan 312.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$646	$969	$27	Singapore $712; United Kingdom $228.

See footnotes at end of table.

TABLE 3—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS—Continued					
Rare-earth metals:					
Monazite concentrate		62	137	—	Sri Lanka 57; Indonesia 40; Thailand 40.
Xenotime concentrate		—	6	—	All from Thailand.
Selenium, elemental	value, thousands	$141	$94	(2)	United Kingdom $56; Japan $31.
Silicon, highpurity	do.	$8,454	$1,052	$1,045	Japan $7.
Silver:					
Ore and concentrate[3]	do.	$15	$2	—	Indonesia $1.
Waste and sweepings[3]	do.	$38	$18	$6	Japan $5; Hong Kong $3.
Metal including alloys, unwrought and partly wrought	do.	$3,542	$2,644	$230	Hong Kong $996; Singapore $684; Japan $614.
Tin:					
Ore and concentrate		40,030	42,398	470	Australia 15,775; China 9,688; Canada 5,315.
Metal including alloys:					
Scrap		11	134	1	United Kingdom 71; Singapore 33.
Unwrought		1,469	1,041	353	Singapore 389; Thailand 130.
Semimanufactures		411	414	19	Singapore 158; Hong Kong 103; Japan 100.
Titanium:					
Ore and concentrate		20,661	5,400	—	Thailand 4,742; Australia 557.
Oxides		6,678	10,735	1,599	United Kingdom 2,672; Australia 2,601.
Metal including alloys, all forms		14	105	14	Japan 50; United Kingdom 23.
Tungsten:					
Ore and concentrate		(2)	3	1	Singapore 2.
Metal including alloys, all forms		282	335	29	Japan 93; West Germany 85; Singapore 72.
Uranium and thorium:					
Thorium ore and concentrate	value, thousands	$1	$1	—	All from Singapore.
Oxides and other compounds	do.	$371	$263	$7	Canada $164; United Kingdom $61.
Vanadium: Oxides and hydroxides		3	3	2	Japan 1.
Zinc:					
Ore and concentrate		32	6	(2)	Mainly from United Kingdom.
Oxides		625	865	15	China 360; Taiwan 160; West Germany 101.
Metal including alloys:					
Scrap		204	127	43	Singapore 56; Canada 18.
Unwrought		23,969	21,400	18	Australia 12,252; Republic of Korea 2,705; Thailand 2,334.
Semimanufactures		1,096	1,655	3	Singapore 1,183; Australia 491.
Zirconium: Ore and concentrate		709	3,146	10	China 1,274; Japan 914.
Other:					
Ores and concentrates		7	11	—	Thailand 9; Japan 2.
Ashes and residues		7,217	9,527	112	Singapore 6,559; Japan 1,882.
Base metals including alloys, all forms		(2)	—	—	
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural:					
Corundum, emery, pumice, etc.		1,836	4,080	37	Indonesia 3,719; Hong Kong 83; Taiwan 54.
Silicon carbide		519	861	—	Japan 550; West Germany 163; Norway 57.
Artificial: Corundum		1,900	16,859	15,656	Australia 661; Brazil 338; Italy 108.
Dust and powder of precious and semiprecious stones including diamond	value, thousands	$55	$252	(2)	Japan $146; West Germany $94.
Grinding and polishing wheels and stones	do.	$5,427	$6,297	$371	Japan $2,249; Italy $978; China $716.

See footnotes at end of table.

TABLE 3—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
INDUSTRIAL MINERALS—Continued					
Asbestos, crude		21,050	28,276	173	Canada 20,985; Greece 3,624.
Barite and witherite		737	699	—	Thailand 418; United Kingdom 153.
Boron materials:					
Crude natural borates		111	104	71	Singapore 28.
Oxides and acids		952	746	241	China 198; Chile 146; Italy 124.
Bromine including fluorine	value, thousands	$22	$10	(2)	Singapore $6; West Germany $2.
Cement		35,292	36,618	1,976	Indonesia 20,491; Singapore 12,595.
Chalk		474	222	22	United Kingdom 150; West Germany 35.
Clays, crude		58,778	97,055	15,028	India 38,214; Indonesia 17,833; United Kingdom 14,499.
Cryolite and chiolite		9	1	—	All from Taiwan.
Diamond: Natural:					
Gem, not set or strung	value, thousands	$43,022	$66,866	$101	Belgium-Luxembourg $44,350; United Kingdom $11,513.
Industrial stones	do.	$1,574	$371	$3	Hong Kong $170; Belgium-Luxembourg $145.
Diatomite and other infusorial earth		937	1,062	868	Japan 93; West Germany 29.
Feldspar		33,154	43,996	251	Thailand 23,508; India 14,606.
Fertilizer materials:					
Crude, n.e.s.		32,132	25,552	152	Singapore 23,646; Japan 1,112.
Manufactured:					
Ammonia		5,051	31,523	226	Indonesia 30,541; Singapore 531.
Nitrogenous		513,209	558,538	4	Indonesia 282,066; Belgium-Luxembourg 85,100; Japan 71,616.
Phosphatic		14,128	15,779	235	China 8,007; Romania 3,610; West Germany 1,935.
Potassic		824,440	635,334	68	Canada 314,827; U.S.S.R. 229,484.
Unspecified and mixed		221,264	173,912	5,278	West Germany 56,091; Belgium-Luxembourg 38,339.
Fluorspar		1,660	1,784	1	China 1,331; Thailand 442.
Graphite, natural		697	718	28	West Germany 460; China 77.
Gypsum and plaster		178,214	223,265	853	Thailand 214,709; West Germany 2,324.
Iodine	value, thousands	$35	$45	$3	Japan $10; Thailand $10.
Kyanite and related materials		214	139	33	United Kingdom 44; Singapore 42.
Lime		5,460	6,215	18	Thailand 6,006; Singapore 157.
Magnesium compounds:					
Magnesite, crude including calcined		11,696	13,840	14	China 10,779; West Germany 1,753.
Other		31,069	44,973	—	West Germany 39,823; China 5,150.
Mica:					
Crude including splittings and waste		3,114	328	27	China 144; India 78.
Worked including agglomerated splittings		43	24	—	France 10; Japan 8; Singapore 4.
Nitrates, crude		606	208	(2)	Chile 129; China 40.
Phosphates, crude		359,419	376,161	—	Jordan 206,916; China 82,152; Morocco 67,390.
Phosphorus, elemental	value, thousands	$4,737	$4,917	(2)	U.S.S.R. $3,171; China $1,099.
Pigments, mineral:					
Natural, crude		140	5,171	—	West Germany 5,000; Austria 106.
Iron oxides and hydroxides, processed		3,984	3,369	52	West Germany 1,168; Spain 531; Japan 467.
Potassium salts, crude		—	5	—	Mainly from Japan.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$1,854	$1,140	$6	Hong Kong $501; Thailand $311; India $140.
Synthetic	do.	$111	$371	$192	Japan $111; Thailand $57.
Pyrite, unroasted		15	1,831	16	Thailand 1,312; India 500.
Quartz, piezoelectric	value, thousands	$418	$6,552	$459	Japan $6,080.
Salt and brine		210,757	230,225	209	Australia 109,169; India 70,242.

See footnotes at end of table.

TABLE 3—Continued

MALAYSIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.:					
Soda ash, natural and manufactured		42,892	61,102	23,234	Japan 34,427; Poland 1,906; China 1,112.
Sulfate, manufactured		30,428	34,681	58	China 26,099; Indonesia 3,547.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		8,445	1,175	1	China 668; Italy 194.
Worked		3,926	5,306	117	Italy 3,983; Taiwan 249.
Dolomite, chiefly refractory-grade		2,056	19,053	—	Taiwan 19,000; Norway 51.
Gravel and crushed rock		2,323	3,651	381	France 824; New Zealand 750; China 439.
Limestone other than dimension		1,295	84	—	Singapore 60; United Kingdom 6.
Quartz and quartzite		323	1,371	6	China 1,220; Japan 40.
Sand other than metal-bearing		1,768	2,062	129	Japan 1,402; Singapore 154.
Sulfur:					
Elemental:					
Crude including native and byproduct		4,025	6,709	39	Canada 3,300; Singapore 965.
Colloidal, precipitated, sublimed		15,297	27,873	1	Singapore 23,320; Jordan 4,000.
Dioxide		16	15	(2)	Australia 12; Singapore 2.
Sulfuric acid		1,191	900	65	Singapore 533; West Germany 153.
Talc, steatite, soapstone, pyrophyllite		13,757	22,714	851	China 17,860; Italy 1,610; Republic of Korea 1,577.
Other:					
Crude		449	323	76	Canada 72; Japan 42.
Slag and dross, not metal-bearing		40,068	34,569	8	Japan 29,500; Singapore 13,303.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		8,088	9,102	108	Singapore 8,141; Australia 633.
Carbon:					
Carbon black		36,504	10,332	7,574	Australia 1,334; Taiwan 470.
Gas carbon		7	—	—	
Coal:					
Anthracite and bituminous including briquets		708,282	1,209,814	139	Australia 445,422; China 356,052; Indonesia 348,296.
Lignite including briquets		127,647	186,180	—	China 107,563; Indonesia 78,612.
Coke and semicoke		48,734	53,650	6	Australia 33,375; Japan 14,676.
Peat including briquets and litter		144	34	8	Taiwan 16; Thailand 10.
Petroleum:					
Crude	thousand 42-gallon barrels	11,082	7,516	—	Saudi Arabia 3,529; United Arab Emirates 2,075; Kuwait 1,527.
Refinery products:					
Liquefied petroleum gas	do.	4,886	2,111	(2)	Singapore 2,030.
Gasoline	do.	9,823	12,707	8	Singapore 10,343; Kuwait 2,293.
Mineral jelly and wax	do.	77	87	7	China 23; Japan 23.
Kerosene and jet fuel	do.	1,648	1,485	(2)	Singapore 1,481; Brunei 2.
Distillate fuel oil	do.	6,878	8,238	(2)	Singapore 8,202; Indonesia 24.
Lubricants	do.	1,009	1,213	26	Singapore 940; Australia 86.
Residual fuel oil	do.	12,699	15,292	(2)	Singapore 13,229; Kuwait 1,044.
Bitumen and other residues	do.	381	514	1	Singapore 508.
Bituminous mixtures	do.	9	2	(2)	Mainly from United Kingdom.
Petroleum coke	do.	4	21	20	NA.

NA Not available.
[1]Table prepared by Audrey D. Wilkes.
[2]Less than 1/2 unit.
[3]May include other precious metals.

TABLE 4

MALAYSIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating company	Location of main facilities	Annual capacity
Bauxite	Johore Mining and Stevedoring Co. Sdn. Bhd.	Bukit Raja-Pengerang, Johor	500
Cement	Associated Pan Malaysia Cement Sdn. Bhd.	Rawang, Selangor, and Kanthan, Perak	2,500
Do.	Cement Industries Malaysia Sdn. Bhd.	Kangar, Perlis	1,000
Do.	Kedah Cement Sdn. Bhd.	Langwai, Kedah	1,500
Do.	Perak-Hanjong Cement Sdn. Bhd.	Padang Rengas, Perak	1,200
Do.	Tasek Cement Bhd.	Ipoh, Perak.	1,100
Copper, concentrate	Mamut Copper Mining Sdn. Bhd.	Mamut, Sabah	120
Gas:			
Natural million cubic meters per day	Esso Production Malaysia Inc.	Offshore Terengganu	8.5
Do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	2.8
Do.	Sarawak Shell Bhd.	Offshore Sarawak	38.5
Liquefied	Malaysia LNG Sdn. Bhd.	Tanjung Kidurong, Bintulu, Sarawak	7,500
Petroleum, crude million 42-gallon barrels per day	Esso Production Malaysia, Inc.	Offshore Terengganu	380
Do.	Sabah Shell Petroleum C. Ltd.	Offshore Sabah	100
Do.	Sarawak Shell Bhd.	Offshore Sarawak	180
Tin:			
Concentrate	Malaysia Mining Corp. Bhd.	Concentrated in the States of Perak and Selangor	12
Refined	Datuk Keramat Smelting Bhd.	George Town, Penang	40
Do.	Malaysia Smelting Corp. Bhd.	Butterworth, Penang	60

Malaysia Mining Corp. (MMC) was expected to complete the feasibility study for its Mengapur Project in early 1991. The Mengapur deposit, northeast of Maran on East-West Highway and about 40 km west of Kuantan in Pahang, reportedly has several million metric tons of low-grade sulfide and oxide ores containing copper, gold, lead, silver, and zinc, with small amounts of antimony, bismuth, molybdenum, tin, and tungsten. According to a preliminary estimate by MMC, to develop an open pit mine and related infrastructure will cost about $350 million. Various tasks of the feasibility study carried out by MMC at the Mengapur site, in past years, included mineralogical and metallurgical tests. A 250-kg/h pilot plant was constructed at Mengapur for processing the skarn-type sulfide ore. Mine layout and detailed pit design for Zone A, a sulfide ore pit as well as a flotation works, were also undertaken by MMC in 1990.[5]

Gold.—Gold production declined in 1990 mainly because of reduced recovery of gold as a byproduct of copper mining operations. Of the total gold production, 60% was produced from the Mamut copper mine in Sabah, and 40% was from about 30 small-scale mines in the States of Kelantan, Pahang, and Sarawak. A very small amount of gold was being recovered as a byproduct of tin mining in 1990.

PKB-MMC Sdn. Bhd., which is 49% owned by MMC and 51% by Permodalan Kelantan Bhd., commenced a small-scale palong (sluice) operation in mid-1989 at Pulai in southern Kelantan following a period of test runs in 1988. Because of the low level of gold production of about 1 kg/wk, the joint venture project reportedly incurred a loss in 1989. Gold mining at the Pulai alluvial deposit was expected to produce 300 kg/a with 6 to 7 years of mine life.

In past years, MMC signed several agreements with State governments for gold exploration in the Mersing area of Johor, in the Sungai Pergau and Sungai Sokor areas of Kelantan, in the Hulu Perak area of Perak, and in the Rusila and Sungai Marang areas of Terengganu. In 1990, the State governments of Kelantan and Pahang also signed agreements with companies from Australia, France, and the United Kingdom to explore for gold and other minerals in southern Kelantan and in the Districts of Lipis, Raub, Bentong, Temerloh, and Jerantut in Pahang.[6]

Iron and Steel.—Iron ore production rose sharply from that of 1989 and topped the 350,000-ton level for the first time in 8 years. Increased iron ore production was attributed to the opening of two new mines in the States of Johor and Perak in the spring of 1990. According to Malaysia's Department of Mines, iron content of domestic ore was about 60% of iron oxide (Fe_2O_3). Most iron ore was consumed by the Malayawata Steel Bhd. at Prai in Penang. In 1990, a small quantity of iron ore was exported to China.

In July, the State government of Terengganu signed a joint-venture agreement with Anshan Iron and Steel Co. of China to revive the abandoned Bukit Besi iron mine, about 85 km south of Kuala Terengganu. The export-grade iron ore from the Bukit Besi Mine had been worked out 20 years ago. However, according to a preliminary investigation conducted by a Chinese survey team from Anshan Iron and Steel in early 1990, the Bukit Besi Mine reportedly still has sufficient reserves, with 60% of Fe_2O_3 content, to support a 1.2 Mmt/a mining operation for 30 years. A followup detailed investigation by a second team of Chinese engineers on the potential for prolonging the mine life was underway.

Under the same joint-venture agreement with the Terengganu State government, Anshan Iron and Steel proposed to build a 200,000-mt/a cold-rolling steel mill at

Telok Kalong in Kemaman, Terengganu, by late 1992. The proposed joint-venture project, pending approval by the Federal Government, should begin plant construction in 1991. The joint-venture firm will be owned 51% by Mentri Besar Inc., the investment arm of the Terengganu State government, 33% by Anshan Iron and Steel, and 16% by Anshan Iron and Steel (Malaysia) Sdn. Bhd.[7]

In May, China Steel Corp. of Taiwan signed the letters of intent with the Government of Malaysia and Lion Corp. Bhd., the 44% majority shareholder of Amalgamated Steel Mills Bhd., to build jointly a $3.2 billion integrated steel mill capable of producing 2.5 Mmt/a of flat steel products, such as steel coils, sheets, and plates in Terengganu. According to a plan proposed by China Steel, construction of the steel mill facilities will begin in July of 1991 after ratification by the Government of Malaysia. The proposed joint-venture steel mill will be owned 51% by the Malaysian partners led by Lion Corp. and 49% by China Steel.

In early 1990, Pohang Iron and Steel Co. (POSCO) of the Republic of Korea also proposed to the Government of Malaysia to build a $930 million cold-roll steel mill, with an annual capacity of 820,000 tons in Johor. However, POSCO reportedly postponed its plan because of the more ambitious proposal by China Steel.

To revive its failed, Japanese-designed direct-reduced-iron (DRI) plant at Telok Kalong, Perwaja Terengganu Sdn. Bhd. (PTSB), a State-owned steel producer, awarded a contract to a consortium of Ferrostaal AG/Man Gutehoffnungshutte AG of the Federal Republic of Germany and Hylsa SA de CV Monterrey of Mexico in late 1990. The contract involved revamping of the faulty 600,000-mt/a DRI plant with the HYL-III process and building a second DRI with the same capacity by the first quarter of 1993.

According to the Managing Director of PTSB, after completion of the $195 million DRI expansion project, PTSB will be able to reduce reliance on scrap imports and use its own DRI to meet about 80% of raw material requirement for the billet production. In 1990, PTSB imported about 75% of its 800,000-tons-ferrous scrap requirement and produced 720,000 tons of steel billet. In 1993, the annual billet production capacity is expected to be raised to 1.2 Mmt from 750,000 tons in 1990.

Additionally, three other projects for expanding Malaysia's billet production capacity had been planned and approved by the Government in 1990. Antara Steel Mills Sdn. Bhd. is to build a new 500,000-mt/a billet plant in Pasir Gudang, Johor. Southern Iron and Steel Works Sdn. Bhd. is to construct a new 350,000-mt/a billet plant in Pera, Penang. Amalgamated Steel Mills Bhd. is to increase its billet plant's capacity to 500,000-mt/a from 350,000 mt/a in Klang, Selangor.

Rare Earths.—Production of crude rare earths was by Asian Rare Earth Ltd. (ARE) at Lahat, about 6 km southwest of Ipoh in Perak. According to ARE, despite construction of a long-term storage facilities in a nearby mountain cave for the low-level radioactive byproduct (thorium), a civil law suit filed by the nearby Bukit Merah residents calling for a complete plant shutdown was still pending.

In 1990, production of crude rare earths was estimated at 2,000 tons, of which about 1,800 tons was rare-earth chloride and 200 tons was middle and heavy rare-earth carbonate. The plant also produced a small quantity of tricalcium phosphate. All of the rare-earth chloride was exported to Japan, while about 60% of the rare-earth carbonate was exported to the United States and western European countries and 40% to Japan.

ARE is owned 35% by Beh Minerals Sdn. Bhd., one of the major suppliers of monazite; 35% by Mitsubishi Kasei Corp. (formerly Mitsubishi Chemical Industries Ltd.) of Japan; and 30% by local investors. Work force at the plant was about 200, of which 2 were Japanese. A sister plant, operated by Malaysia Rare Earth Corp. Sdn. Bhd. at the same site, stopped production of yttrium oxide concentrate owing to lack of xenotime in 1990.

Tin.—Malaysia's tin industry suffered another major setback in 1990 as the prices of tin on the Kuala Lumpur Tin Market (KLTM) continued the 1989 downward slide and dropped to a 4-year low of $5.60 per kg in December. According to Malaysia's tin industry sources, the low tin price in 1990 was caused by a substantial rise in the world tin surplus, a weak world demand for the metal, the disposal of the U.S. Defense Logistics Agency's stockpiled tin, and increased supply from a new tin mine in Portugal. Selling of tin smuggled out by illegal Brazilian miners via Bolivia to the world market between late 1989 and early 1990 reportedly was the main cause of the increase in the world tin surplus.

As a result of lower tin prices, Malaysia's tin production in 1990 fell below the 30,000-ton level for the third time since the October 1985 tin crisis. According to Malaysia's Department of Mines (DOM), in 1990, the monthly output of tin decreased to 1,988 tons in December from 2,958 tons in January. The total number of operating mines decreased to 141 in December from 249 in January. The total number of tin miners declined to 8,508 in December from 12,567 in January. The severity of the impact of lower tin prices on the gravel pumping sector had resulted in the closure of 85 mines and the lost of 2,671 jobs during 1990. The dredging sector, which shut down 8 dredges, also had a layoff of 794 workers in 1990. In the State of Perak, the largest tin-producing State, 68 gravel pumping mines, 8 open pit mines, and 2 dredges were shut down. The State lost 2,637 jobs in 1990.

Of the tin produced in 1990, 43% was by gravel pumping, 36% by dredging, 8% by open pits, and 13% by others. According to the Malaysian Chamber of Mines, because of increased wages and energy costs, the average production costs for the gravel pumping sector, the dredging sector, and the open pits rose to $7.10 per kg, $6.10 per kg, and $6.40 per kg, respectively, in 1990.

As a result of higher production costs, lower ore grade, and low tin prices, several major tin mining companies had diversified into other business. Others companies operating with cash-flow problems, reportedly appealed to Malaysia's Ministry of Primary Industry for a reduction in the premium for land use charged to the miners by the State government in late 1990.

MMC, the largest tin producer in Malaysia, reported a 51% drop in pretax profit for the first 6 months of 1990 to $13 million from the same period in 1989 because of the lower prices and reduced sales. In the wake of the depressed tin market, MMC acquired a 51% equity in Tepat Teknik Sdn. Bhd. (TTSB) for $1.4 million in August. TTSB is a local mechanical engineering and steel fabricating company serving the oil and gas industry. Other MMC's diversification activities in past years included marketing of palm oil and wood products, engineering consulting, diamond mining in Australia, gold exploration in Indonesia and the United States, and ilmenite exploration in Hainan, China.

To halt the downward slide of tin prices, the seven-member Association of Tin

Producing Countries (ATPC) agreed in January to cut export quotas by 5% to 84,233 tons effective March until December. To reduce further accumulation of the world tin surplus, ATPC's members agreed in November to cut the 1991 export quotas to 95,849 tons from 101,976 tons in 1990. Export quotas allocated to Malaysia were reduced to 28,556 tons in 1991 from 30,379 tons in 1990.

Production of tin metal by Datuk Keramat Smelter Bhd. and Malaysia Smelting Corp. Bhd. decreased slightly in 1990 because of a tight concentrate supply. Exports of tin metal dropped to 48,500 tons in 1990 from 49,500 tons in 1989. Export value of tin metal declined to about $305 million from $430 million in 1989 owing to lower tin prices in 1990. Exports of tin in 1990 were mainly to the Netherlands, 26%; Japan, 23%; the United States, 14%; the Republic of Korea, 8%; and Taiwan, 5%. To assist the sagging domestic tin industry, the Government announced in mid-December that the export duty on tin will be eliminated effective from January 1991.

According to DOM, domestic consumption of tin metal in 1989 was 2,359 tons, of which 44% was for production of solder, 21% for production of tinplate, 18% for production of pewter products, and 17% for chemical and other uses. Domestic demand for tin metal had grown from 1,600 tons in 1985 to 2,400 tons in 1988 and reached 2,500 tons in 1990. Because of the growing demand by the solder, tin-plate, and pewter industries, domestic consumption of tin metal was expected to reach 3,000 tons by 1991.

Perusahaan Sadur Timah Malaysia (PERSTIMA), Malaysia's sole producer of tinplate, reportedly completed the second electrolytic tinning line in November at its plant in Pasir Gudang, Johor. Production of tinplate by PERSTIMA is expected to reach 140,000 tons in 1991. Domestic demand for tinplate was about 130,000 tons and is expected to reach between 140,000 tons and 145,000 tons in 1991. Tinplate in Malaysia was consumed mainly by the canning industry.

Industrial Minerals

Barite.—Barite production rebounded from that of 1989 and reached a record high in 1990 owing to increased production from the Kuala Trengan area of Terengganu. Monthly barite production from Kuala Trengan area averaged about 2,300 tons accounting for 60% of Malaysia's total output in 1990. Most output was sold to the local oil well drilling market and the remainder was exported to Singapore and Taiwan.

Cement.—Because of strong demand by the construction industry, Malaysia's cement production continued the 1989 upward trend and reached a record of 5.8 Mmt in 1990. In 1990, the cement industry consisted of nine plants, owned and operated by eight companies. Of the nine plants, seven were in Peninsular Malaysia and two in East Malaysia. The industry's total clinker capacity was estimated at 7 Mmt/a and grinding capacity was about 8 Mmt/a. The five major cement producers in Peninsular Malaysia were Associated Pan Malaysia Cement Sdn. Bhd., which operated two plants; Cement Industries Malaysia Sdn. Bhd.; Kedah Cement Sdn. Bhd.; Perak Hanjong Simen Sdn. Bhd.; and Tasek Cement Bhd.

Kedah Cement, the second largest cement producer in Malaysia, reportedly increased its clinker capacity to 1.5 Mmt/a from 1.2 Mmt/a by installing an additional line because of strong demand in the domestic market. Kedah planned to expand its clinker capacity to 3 Mmt/a by 1992.

Fertilizer Materials.—Production of ammonia and urea was by ASEAN Bintulu Fertilizer Sdn. Bhd. (ABF). ABF, which had a work force of 459 in 1990, operated a 1,000-mt/d ammonia processing unit, a 1,500-mt/d urea processing unit, a granulator, and storage and loading facilities for ammonia and urea in Bintulu, Sarawak.

According to ABF, about 90% of the ammonia output was consumed at the plant for urea production, and the remainder was exported to neighboring countries of the Association of Southeast Asian Nations (ASEAN). At the complex, liquid ammonia was processed into urea crystals, which was then granulated into different-size granular urea for distribution. Malaysia consumed about 130,000 mt/a of urea and exported about 400,000 tons of urea to the neighboring ASEAN countries, Australia, India, Japan, the Republic of Korea, the United Sates, and western European countries. Because of increased overseas demand, ABF was under-taking an expansion program to raise its urea capacity by 20% to 595,200 mt/a by April 1991.

ABF was established as a joint-venture company of five ASEAN member countries in December 1980. The company's equity was owned 63.5% by Malaysia, 13.0% by Indonesia, 13.0% by Thailand, 9.5% by the Philippines, and 1.0% by Singapore. ABF began production of ammonia and urea in the third quarter of 1985. It exported the first cargo of ammonia to the Philippines and urea to India in October 1985.

Silica Sand.--Most silica sand was produced from the Bintulu deposit in Sarawak. A small quantity was also recovered by processing tin tailings in Perak and Selangor. According to the Geological Survey of Malaysia, during 1986-89, more than 90% of silica sand was produced by Sarawak Glass Sand Ltd. (SGS) from the Bintulu deposit, north of Bintulu near Semantan in the Baram Valley of Sarawak. Another silica sand deposit at the Kampung Gelam area near Lundu in Sarawak reportedly had been developed and is expected to start production in 1991. SGS operated a dressing plant at its Sungai plant to process crude silica sand for export to Japan. In 1990, output of silica sands rose sharply owing to increased production from four new silica sand mines in the States of Johor and Selangor.

Titanium.—Most of the ilmenite concentrate was recovered from tin tailing treatment plants operating in the States of Perak and Selangor. Ilmenite concentrate was exported to Europe, Japan, the Republic of Korea, and Taiwan. In 1989, exports of ilmenite concentrate, which were valued at $24 million, totaled 346,000 tons, of which 240,000 tons went to Japan. Exports of ilmenite in 1990 dropped substantially from those of 1989 because of reduced exports to Japan.

In September 1990, Japan suspended imports of ilmenite from Malaysia, alleging that the Malaysian ilmenite contained a high level of radioactive materials. The Malaysian Chamber of Mines (MCM), representing the Malaysian ilmenite producers, appealed to the Japan Titanium Industry Association to resume importing ilmenite from Malaysia in late 1990. According to MCM, the Malaysian ilmenite contains varying amount of thorium and uranium depending upon grade and origin, but all Malaysian ilmenite met the safety regulations of the International Atomic Energy Agency and the International Commission on Radiological Protection.[8]

In June, MMC reportedly planned to set up a joint-venture firm with Marubeni Corp. of Japan and Hainan Provincial

Metallurgical Nonferrous Metal Industry Corp. of China to mine ilmenite on Hainan Island in the South China Sea. MMC also planned to conduct joint exploration with China for ilmenite in the coastal area of Guangxi.

Construction of a new titanium dioxide pigment plant was started by Tioxide Group PLC of the United Kingdom at Telok Kalong near Kemaman in Terengganu in 1990. The $167 million titanium dioxide plant, which will use the sulfate process with an initial capacity of 50,000 mt/a, was scheduled for completion by 1991. Tioxide Group had established a local company, Tioxide (Malaysia) Sdn. Bhd., to operate the plant.[9]

Mineral Fuels

Coal.—Coal production from the Beradai deposit in the Merit-Pila area near Kapit and the Selantek deposit in the Semantan area near Kuching declined slightly from that of 1989. According to the State government of Sarawak, coal production from the two areas was exported mostly to Japan, the Republic of Korea, and Taiwan. In 1989, Sarawak exported about 102,000 tons of coal and earned about $2.6 million. Coal exports in 1990 were estimated at 100,000 tons and valued at about $2.5 million.

Natural Gas.—Natural gas production from offshore Sabah, Sarawak, and Terengganu averaged about 48.1 Mm^3/d. In 1990, more than 80% of the natural gas was produced by Sarawak Shell Bhd. (SSB) from the Central Luconia Gasfields offshore Sarawak. The remaining natural gas was produced by Sabah Shell Petroleum Co. (SSP) from the Samarang Oilfield offshore Sabah and by Esso Production Malaysia Inc. (EPMI) from the Duyong Gasfield and the Gungtong, Kepong, and Bekok Oilfields offshore Terengganu.

The natural gas produced from three Central Luconia gasfields (E11, F6, and F23) at the rate of about 38.5 Mm^3/d was delivered as feedstock to the LNG and nitrogen fertilizer plants in Bintulu, Sarawak. The natural gas produced from the Samarang Oilfield at the rate of 2 Mm^3/d was delivered as feedstock to a methanol plant and as a power source for a 79-MW powerplant and a sponge iron plant on Labuan Island off Sabah. The natural gas produced from the Duyong Gasfield and Guntong, Kepong, and Bekok Oilfields at the rate of 7.1 Mm^3/d was delivered as the power source for a 900-MW powerplant in Paka and the PTSB iron and steel complex in Telok Kalong, Terengganu, and as a feedstock to a gas processing plant and a LPG production plant in Kertih, Terengganu.

Production of LNG by Malaysia LNG Sdn. Bhd. (MLNG) rose to 6.7 Mmt from 6.6 Mmt in 1989. MLNG, which had a work force of 670 in 1990, operated three 2-Mmt/a LNG production trains (modules), four 63,000-m^3 insulated storage tanks, and port facilities in Bintulu. MLNG chartered five 130,000-m^3 French-built LNG tankers from Malaysia International Shipping Corp. to ship more than 6.5 Mmt/a of LNG to two Japanese customers, Tokyo Electric Power Co. Inc. and Tokyo Gas Co. Ltd., under a 20-year contract signed in 1983.

In August, MLNG signed another 20-year sale contract with the Fukuoka-based Saibu Gas Co. of Japan for supplying between 200,000 mt/a and 360,000 mt/a of LNG to Saibu Gas beginning in October 1993. MLNG reportedly was also negotiating with the Republic of Korea and Taiwan for LNG supply contracts. To meet the rising demand for LNG by Japan, the Republic of Korea, and Taiwan, MLNG planned to undertake a $5 million expansion project to raise its LNG production capacity from 7.5 Mmt/a in 1991 to 8.8 Mmt/a in 1995 and 12.4 Mmt/a in the year 2002. By 1997, three additional LNG trains, a second LNG jetty, the fifth insulated storage tank, and three additional LNG tankers will be built.

In June, Shell MDS Sdn. Bhd., a joint-venture firm of Shell Gas BV, Mitsubishi Corp., PETRONAS, and the Sarawak State government, reportedly had secured a $185 million, 8% fixed-rate, loan to finance partially its Middle Distillate Synthesis (MDS) gas conversion plant in Bintulu, Sarawak. Construction of the MDS plant was started in November 1989 and was scheduled for completion by the end of 1992. Total project cost was estimated at $667 million, of which 56% will be financed by loans and the remainder will be capitalized by the shareholders.

As part of the second phase Peninsular Gas Utilization (PGU-2) Project, PETRONAS awarded a contract to a consortium composed of SWES Zainal Sdn. Bhd. and Pernas Construction Sdn. Bhd. of Malaysia, Hyundai Engineering and Construction Co. of the Republic of Korea, and Sumitomo Corp. of Japan. The contract was for the expansion of the gas processing plant in Kerteh and the upgrading of export terminal facilities. When the project is completed in 1992, the Kerteh gas processing plant is expected to triple in size and draw an additional 15.5 Mm^3/d of natural gas. The processed gas will be partially delivered as feedstock to a petrochemical complex at Gebeng near Kuantan in Terengganu for production of methyl tertiary butyl ether (MTBE), propylene, and polypropylene.

In connection with the PGU-2 Project, construction of a 730-km gas pipeline by MMC Gas Sdn. Bhd. reportedly was proceeding ahead of schedule in 1990. In early 1990, EPMI reached a 20-year agreement with PETRONAS on the terms and conditions for sales of its natural gas from the Jerneh Gasfield offshore Terengganu to PETRONAS for the PGU-2 gas pipeline project. Production of natural gas from the Jerneh Gasfield is expected to begin in April 1992. In November, PETRONAS signed an agreement with the Singapore Public Utility Board for supplying 4.2 Mm^3/d of natural gas to Singapore for at least 15 years beginning in 1992.

Petroleum.—To meet increased demand for crude oil in the Asia and Pacific region, Malaysia raised its crude oil production in January by 30,000 bbl/d to 590,000 bbl/d. To assist countries facing a crude oil shortage owing to the Persian Gulf oil crisis, Malaysia boosted its crude oil production again in November by an additional 60,000 bbl/d to 650,000 bbl/d. As a result, Malaysia's crude oil output, including condensate, rose to an average of 626,400 bbl/d in 1990, compared with 588,871 bbl/d in 1989.

Production of crude oil in 1990 was from 31 oilfields with 42 offshore platforms operated by 3 foreign contractors, EPMI, SSB, and SSP. EPMI, Malaysia's largest crude oil producer, is expected to boost its production capacity to 360,000 bbl/d from 350,000 bbl/d in 1990, when the newly developed Dulang Oilfield offshore Terengganu goes on-stream in the spring of 1991.[10]

In 1990, Malaysia exported about 73% or 457,300 bbl/d of its crude oil output mainly to Singapore (29%), the Republic of Korea (18%), Japan (17%), and the United States (7%). Because of increased export volume and strengthening of the world's crude oil prices, export earnings rose 30% to $3.8 billion. Malaysia imports annually about 30,000 bbl/d of heavy crude oil to meet the requirement of the domestic refineries. However, imports of heavy crude oil had declined to about 20,000 bbl/d in 1989 because of decreased domestic requirement. In 1990, Shell Refining Co. Bhd. invested about $70 million in facilities to allow its Port Dickson refinery to use 100% of the Malaysian crude oil. Malaysia's petroleum refining industry consisted of four companies, with a total capacity of 209,500 bbl/d in 1990. In May, Shell Refining announced that it will invest additionally $259 million in the next 5 years to upgrade the hydrocracking unit of its Port Dickson refinery. Malaysia's petroleum refining capacity, by company, in 1990 is shown in table 5.

TABLE 6

MALAYSIA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Reserves
Bauxite	14,000
Clays[1]	25,600
Copper	[e]260
Gas, natural billion cubic meters	1,611
Petroleum, crude million 42-gallon barrels	2,940
Marble	68,000
Tin, in concentrate	1,100
Titanium	[e]900

[e]Estimated.
[1]Includes kaolin and ball clay.
Sources: Geological Survey of Malaysia, Malaysia Mining Corp Bhd, and PETRONAS.

In December, PETRONAS signed a letter of intent with three foreign partners for the construction of a $1.7 billion petroleum refining complex in Malacca. The petroleum refining complex will consist of a 100,000-bbl/d Sweet Train unit to process the Malaysian light crude and a 130,000-bbl/d Sour Train unit to process the Persian Gulf heavy crude. The Sweet Train unit, which will be wholly owned by PETRONAS, is scheduled to come on-stream in 1993. The Sour Train unit, which will be jointly owned by PETRONAS (45%), Caltex Trading & Transport of the United States (25%), Chinese Petroleum Corp. of Taiwan (15%), and Samsung Co. of the Republic of Korea (15%), is scheduled to come on-stream in 1995.[11]

Reserves

Malaysia is estimated to have the largest tin reserves in the world. The estimated ore reserves of ilmenite and monazite associated with tin reserves are large. Ore reserves of bauxite, copper, natural gas, petroleum, and several industrial minerals are small but considered significant in the Far East and South Asia. According to the Malaysian Government and industry sources, reserves of major mineral commodities are shown in table 6.

INFRASTRUCTURE

Malaysia's highway, railroad system, and port facilities are adequate to transport most of the nonferrous mineral products to the domestic and overseas markets. During 1990, construction work on Malaysia's 730-km natural gas pipeline system in Peninsular Malaysia was running ahead of schedule and should be completed before 1992. Work on the expansion of the natural gas processing plant and upgrading of the export terminal facilities at Kerteh began in 1990 and should be completed by 1992.

In June 1990, the Malaysian Government approved a $320 million plan to expand port facilities at Klang and Penang. About $210 million was allocated by the Government to Port Klang for construction of six general cargo and container berths, two petrochemical berths, and two dry bulk berths at Pulau Lumut to handle up to 40 mt/a of cargo. Work on Port Klang will begin in 1991 and be completed by 1995. About $110 million was allocated by the Government for construction of a second container terminal to be completed by 1994. The Government also approved a $520 million hydroelectric power project in Pergau, Kelantan. Construction of the dam and the 600-MW powerplant was scheduled to be completed in the next 5 years.

To improve the transport system in the high growth area of Klang Valley in Selangor, the Federal Government began construction of four new highways in 1990. The four new highways under construction included the South Klang Valley Expressway, Federal Route 2, the North Klang Valley Expressway, and the Shah Alam Expressway. To meet the future water requirements of the Klang Valley area, the Selangor State government awarded a $310 million water supply project to a Malaysian-Japanese consortium in 1990 to build several large reservoirs, a treatment plant, and several pumping stations.

OUTLOOK

The oil and gas industry should continue to dominate the mineral industry of Malaysia because of its contribution to the Malaysian economy. The crude petroleum production capacity should be raised to 680,000 bbl/d day when EPMI brings on-stream its newly developed Dulang Oilfield offshore Terengganu by the Spring of 1991. Production of natural gas should also be raised to more than 51 m^3/d as the result of higher demand for natural gas by the manufacturers of LNG and nitrogen fertilizer materials in the Bintulu area of Sarawak.

The tin industry is expected to remain depressed in 1991, unless the market prices of tin show significant improvement. Production of copper concentrate at the Mamut Mine in Sabah should continue for 8 or 9 more years at an annual rate of about 120,000 tons. Malaysia should emerge as an important producer of iron and steel as

TABLE 5

MALAYSIA: CRUDE PETROLEUM REFINING CAPACITY

(Barrels per day)

Company	Location	Capacity
Esso Malaysia Bhd.	Port Dickson, Negeri Sembilan	47,500
PETRONAS Penapisan Sdn. Bhd.	Kerteh, Kemaman, Terengganu	27,000
Sarawak Shell Bhd.	Luton, Sarawak	45,000
Shell Refining Co. Bhd.	Port Dickson, Negeri Sembilan	90,000
Total		209,500

Source: Oil and Gas Journal. OGJ SPECIAL, Dec. 31, 1990, p. 103.

well as petrochemical products in Southeast Asia when the 1990 investment plans are successfully implemented in the next 3 to 5 years.

Because of the extension of the 1986 guidelines for equity ownership incentives, foreign investors from Japan, the Republic of Korea, and Taiwan are expected to continue to invest in the Malaysian economy. The Ministry of Finance expects the economy to grow at a slower pace of about 8% in 1991. The public foreign debt will continue to rise because of increase borrowing from abroad for upgrading the country's major ports, Federal highways in peninsular Malaysia, and other economic development projects in various parts of the country.

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[1]U.S. Embassy, Kuala Lumpur, Malaysia. Malaysia Economic Trends Report. State Dep. Airgram A-003, SPR 004, Feb. 4, 1991, p. 2.

[2]Where appropriate, values have been converted from Malaysia ringgits(M$) to U.S. dollars at the rate of M$2.70=US$1.00 in 1990.

[3]Oil and Gas Journal. OGJ Newsletter, v. 89, No. 1, Jan. 7, 1991, p. 3.

[4]U.S. Embassy, Kuala Lumpur, Malaysia. State Dep. Telegram 10463, Dec. 14, 1990, p. 1.

[5]Malaysia Mining Corp. Bhd. Annual Report 1990, p. 26.

[6]South-East Asia Mining Letter (London). V. 2, No. 3, July 25, 1990, p. 2 and V. 2, No. 6, Sept. 28, 1990, p. 3.

[7]Metal Bulletin (London). Anshan Plans CR Mill in Malaysia. No. 7481, May 10, 1990, p. 37.

[8]South-East Asia Mining Letter (London). V. 2, No. 3, Nov. 5, 1990, p. 10.

[9]Industrial Minerals (London). Tioxide's Malaysian Plant Progress. No. 274, July 1990, p. 11.

[10]U.S. Embassy, Kuala Lumpur, Malaysia. State Dep. Airgram A-007, Dec. 17, 1990, p. 4.

[11]South-East Asia Mining Letter (London). Malaysia's 230,000 b/d Refinery Contract Signed. V. 2, No. 8/9, Dec. 14, 1990, p. 10.

OTHER SOURCES OF INFORMATION

Agencies

The Ministry of Primary Industry:

Department of Mines
11th Floor, West Block
Wisma Selangor Dredging
142 C, Jalan Ampang,
50656 Kuala Lumpur, Malaysia

Geological Survey of Malaysia
20th Floor, Tabung Haji Building
Jalan Tun Razak, P.O. Box 11110
50736 Kuala Lumpur, Malaysia

Tin Industry (Research and Development) Board
8th Floor, West Block
Wisma Selangor Dredging
142 C, Jalan Ampang, P.O. Box 12560
50782 Kuala Lumpur, Malaysia

Publications

Ministry of Primary Industries:

Department of Mines, Kuala Lumpur: Statistics on Mining Industry in Malaysia, monthly; Bulletin on Mining Statistics, Quarterly; and Bulletin of Statistics Relating to the Mining Industry of Malaysia, Annually.

Geological Survey of Malaysia: Annual Report. Tin Industry Research and Development Board: Malaysia Tin Bulletin, quarterly.

Department of Statistics, Kuala Lumpur: Statistical Bulletin, Malaysia, Monthly.
Yearbook of Statistics, Malaysia, Anually.
Statistical Bulletin, Sarawak, Annually.
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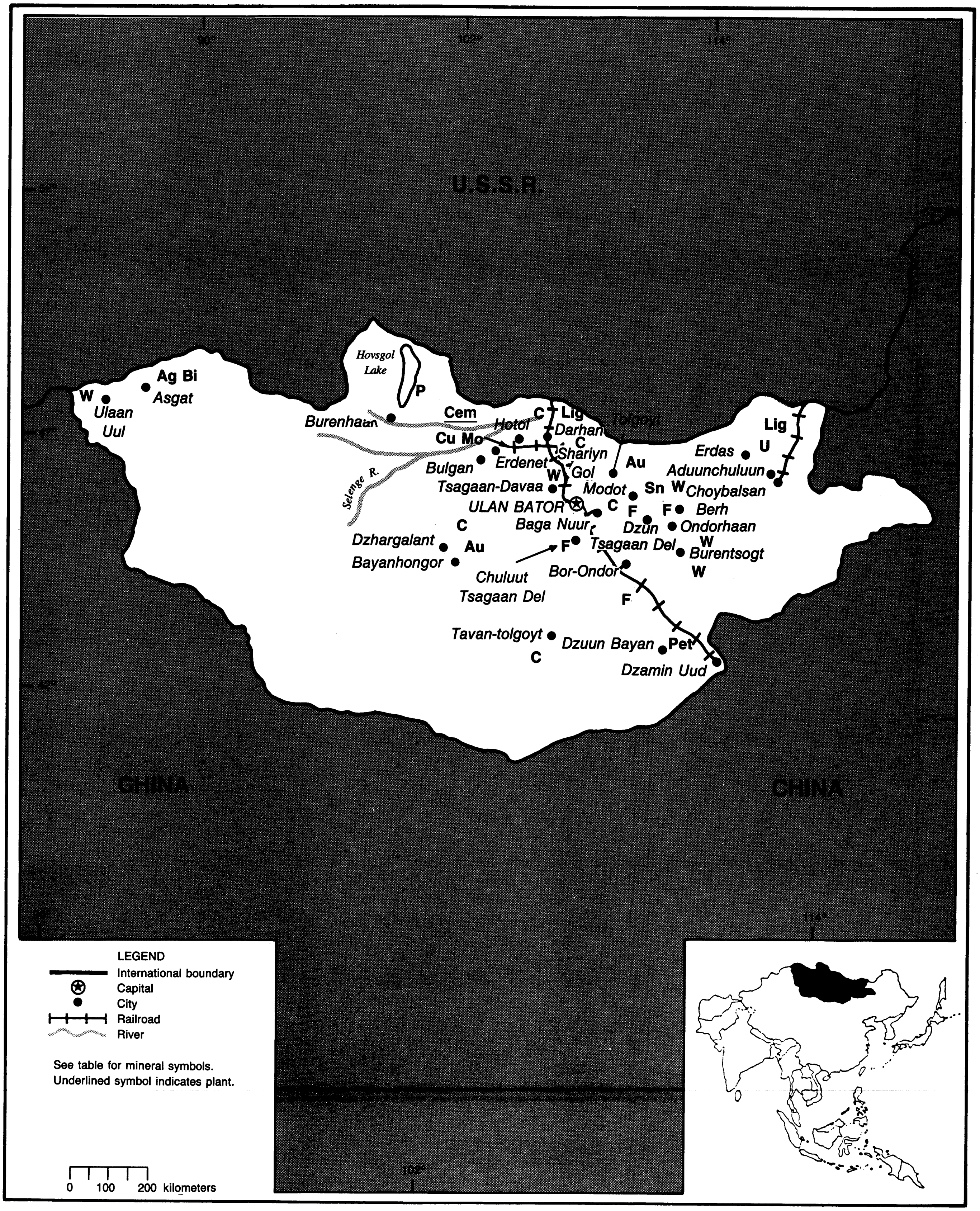
Malaysian Chamber of Mines, Kuala Lumpur: Year Book, Annually.

Malaysian Industrial Development Authority, Kuala Lumpur: Malaysia Industrial Digest, quarterly.

MONGOLIA

AREA 1,565,000 km² **POPULATION 2.2 million**



THE MINERAL INDUSTRY OF MONGOLIA

By John C. Wu

Mongolia is a mineral-rich country. According to the Mongolian authority, more than 4,000 occurrences of a wide variety of minerals had been discovered in Mongolia. Currently, coal, copper, fluorspar, and molybdenum were mined by large-scale operations, while other minerals, such as clay, gold, limestone, silver, tin, tungsten, and uranium, were mined by medium- and small-scale operations. Most mining operations were in the north-central and eastern parts of the country.

GOVERNMENT POLICIES AND PROGRAMS

In the process of transforming its centrally planned economy toward a market economy, the Laws of State Enterprise, Mineral Wealth, and Foreign Investment were passed by the Mongolian People's Great Hural in 1989. The Foreign Investment Law, which became effective on May 1, 1990, was to be of great importance to the development of the Mongolian economy. The purpose of Foreign Investment Law, embodied in 12 articles, was to establish a legal framework for foreign investment in Mongolia on the basis of equality and mutual benefit and setting up rules governing the relations arising from these activities.

Highlights of the law are summarized as follow: Investments in export-oriented production, highly advanced and scientific-intensive production, processing of natural resources, geological prospecting, and development of economic infrastructure and tourism are given high priority. Foreign investments are protected by the Government and shall not be nationalized. Establishment of a company with foreign capital participation is to be administered by the Council of Ministers of Mongolia and is to be registered with the Ministry of Finance. Companies with foreign capital may be exempt from income tax in the first 3 years of operation, from any tax in transferring its share of income abroad, and from customs duties in import goods for production as well as in its export products. Companies with foreign capital participation shall pay income tax after their first 3 years of operation, but not to exceed 40%. Companies with foreign participation in exploitation of natural resources shall pay fees for use of land, forest, water, and other natural resources and guarantee protection of the environment in its operating area.

To seek Japanese economic cooperation, the former Chairman of the Council of Ministers of Mongolia (Mongolian Premier) visited Tokyo, Japan, in February 1990. To support the improved relations between Japan and Mongolia, the Ministry of International Trade and Industry (MITI) of Japan announced in March that the Japanese company undertaking industrial projects in Mongolia and financed by Japan's Official Development Assistance Program will be covered by export insurance.

In early August, the Secretary of State of the United States made an unprecedented 5-day visit to Mongolia and signed a bilateral agreement with the Government of Mongolia for the stimulation of investments. The agreement reportedly would enable U.S. firms to invest in the Mongolia economy for the development of its natural resources and production capacity. Agreements between the two countries on trade as well as science and technology cooperative exchanges are expected to be signed in 1991.

PRODUCTION

In 1990, Mongolia was the world's third largest producer of fluorspar, accounting for about 15% of the world's total output, and was an important producer of copper, molybdenum, tin, and tungsten in the Asia and Pacific region. Because of economic reform and restructuring in the U.S.S.R., Eastern Europe, as well as in Mongolia in 1989-90, the Mongolian economy was to undergo a transformation. While the overall Mongolian economy in 1990 remained unchanged from that of 1989, the output of the mining industry fell slightly from that of 1989. However, in the coming years, the mining industry is expected to play a major role in expanding the industrial sector of the Mongolian economy with financial and technical assistance from the Western World.

TRADE

Mongolia continued to export most of its mineral products in the form of ore and concentrate to the U.S.S.R. and member-countries of the CMEA, based on joint-venture agreements or special trade agreements. According to the latest available official statistics,[1] the major exports of mineral products in 1989 were cement, 175,000 tons; coal, 776,000 tons; copper concentrate, 351,000 tons; calcium fluorite, 113,000 tons; fluorspar ore, 551,000 tons; lime, 3,600 tons; and molybdenum concentrate, 3,300 tons. Exports of other mineral products in 1989 reportedly included tin concentrate, tungsten concentrate, and rare earths.

Owing to a lack of mineral processing facilities, Mongolia relied on imports of processed mineral products mainly from the U.S.S.R. to meet its domestic demand. In 1989, the major imports of processed mineral products were refined petroleum products, ferrous and nonferrous metals, and fertilizer materials. Because of high values of these processed mineral product imports, Mongolia suffered a mineral trade deficit.

According to the Mongolian Ministry of Trade and Cooperation, Mongolia's total exports were estimated at $739 million[2] and total imports, $957 million in 1989. The U.S.S.R. remained the most important trading partner of Mongolia, accounting for 73.2% of total exports and 82.7% of total imports in 1989. Of the total merchandise trade with the U.S.S.R. in 1989, mineral products accounted for 51.3% of Mongolian exports and 32.8% of Mongolian imports.

STRUCTURE OF THE MINERAL INDUSTRY

In response to a request by the Mongolian Government, C. Itoh & Co. (C. Itoh), a leading Japanese trading firm, announced in April that it was to begin a feasibility study for construction of a 60,000-mt/a copper smelter near the Erdenet copper-molybdenum mining complex, about 350 km northwest of Ulan Bator. Furukawa Co. Ltd. of Japan reportedly was awarded the contract by C. Itoh to conduct the feasibility study in May 1990.

In June, C. Itoh and Mitsubishi Heavy Industries Ltd. had signed an agreement with the Mongolian Government through MONGOLIMPEX Foreign Trade Corp. to build a 100,000-mt/a electric steel mill in Darhan, about 250 km north of Ulan Bator. Under the agreement, Japan is to supply electrical furnaces, rolling equipment, raw materials (iron scrap), and plant designs as well as provide training of Mongolian skilled workers in Japan. Mongolia will be responsible for plant assembly and construction work. First-stage construction was scheduled for completion by 1993. The project is to be financed by a $56 million loan from the Export-Import Bank of Japan.[3]

To investigate the potential for Mongolian mineral resources for exploration and development, an eight-member Japanese mineral expedition team visited Mongolia for 2 weeks in August. According to the Metal Mining Agency of Japan (MMAJ), after visiting the Erdenet copper-molybdenum complex and four potential nonferrous mineral deposits in eastern Mongolia, Japan planned to continue negotiation with Mongolia for reaching an agreement to explore jointly for copper, lead, and zinc deposits in eastern Mongolia.

COMMODITY REVIEW

Metals

Copper and Molybdenum.—Production of copper concentrate and molybdenum concentrate by the Mongolian-Soviet Erdenet Mining and Concentrating Works at the Erdenet Mine in northern Mongolia was estimated to be more than 400,000 tons and 3,500 tons, respectively, in 1990. Mongolia continued to export more than 90% of the copper concentrate and all of the molybdenum concentrate to the U.S.S.R. in 1990. Exports of copper concentrate to Japan, according to Japanese trade statistics, were 9,162 tons in 1989 and 8,423 tons in 1990. Copper concentrate was also exported to Czechoslovakia and Finland.

According to MONGOLEXPORT Foreign Trade Corp. (MONGOLEXPORT), the Mongolian copper concentrate contains approximately between 27% and 35% of copper, plus 50 g/mt to 60 g/mt of selenium, 50 g/mt to 70 g/mt of silver, 8 g/mt to 9 g/mt of tellurium, and 0.3 g/mt to 0.5 g/mt of gold. The molybdenum concentrate contains approximately between 47% and 54% of molybdenum, plus 450 g/mt of rhenium, 90 g/mt of selenium, and 15 g/mt of tellurium. MONGOLEXPORT, a Ulan Bator-based trading company, is responsible for exporting precious metals; concentrates of copper, fluorspar, molybdenum, tungsten, and tin; as well as jewelry.

The total number of employees at the Erdenet complex had been reduced from 5,700 in 1989 to 3,800, of which about 76% was Mongols. In late 1990, Mongolian workers at the Erdenet mining and mill complex, dissatisfied with the Soviet management of the joint-venture operations, reportedly had threatened strike action and demanded that the U.S.S.R. relinquish its joint ownership in the Erdenet Copper Mining and Concentrating Works.[4]

According to a trip report published by the Geological Survey of Japan in its Chishitsu (Geological) News, the richest mineralization was the northwest ore body of the Erdenet Mine. Before mine development in 1978, the ore reserves, which included four ore bodies (north, northwest, central, and southeast), were estimated at 512 Mmt averaging 0.84% copper and 0.016% molybdenum. The average copper content of the mined ore had declined to 0.8% in 1990 from 0.86% in 1980. Copper recovery rate at the concentrator also decreased to 82% in 1990 from 85% in the early period of production. It was estimated that about 120 Mmt of ore reserves or 1 Mmt of contained copper had been mined out during the past 10 years.

TABLE 1

MONGOLIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity[3]		1986	1987	1988	1989	1990
Cement, hydraulic	thousand tons	425	541	502	513	510
Coal:						
Anthracite and bituminous	do.	497	655	692	r650	600
Lignite and brown	do.	6,567	7,110	7,914	r7,400	7,500
Total	do.	7,064	7,765	8,606	r8,050	8,100
Copper, mine output, Cu content		136,000	140,000	160,000	r135,000	135,000
Fluorspar, all grades	thousand tons	790	800	800	800	800
Gypsum	do.	r30	r30	r30	r30	30
Lime, hydrated and quicklime	do.	107	114	122	95	100
Molybdenum, mine output, Mo content		1,100	r1,400	r1,400	r1,450	1,500
Salt		16,000	16,000	16,000	16,000	17,000
Tin, mine output, Sn content		r500	r1,200	1,200	r1,300	1,200
Tungsten, mine output, W content		1,500	1,500	r1,000	r1,000	500

rRevised.
[1]Table includes data available through June 11, 1991.
[2]Statistical Yearbook of Members of the Council for Mutual Economic Assistance, Moscow, U.S.S.R. (Cement and lime, 1986-89; and coal, 1986-88).
[3]In addition to the commodities listed, gold, silver, zinc, and crude construction materials such as sand and gravel and varieties of stone such as limestone presumably are produced, but available information is inadequate to make reliable estimates of output levels.

The proven reserves and potential reserves of copper at Erdenet and the surrounding areas reportedly were estimated at 2 billion metric tons with 8 Mmt to 9 Mmt of contained copper.[5] According to a Mongolian mining official, another copper deposit had been discovered at Subarga in the Central Govi region.[6]

Gold and Silver.—Statistics on production and trade of gold and silver remained classified as state secret in Mongolia. Mongolia's gold trade with other countries is controlled by the Government-owned Mongolian State Bank, and all of the gold produced in Mongolia must be sold to the State bank. According to Mongolian and Soviet sources, the gold mining operations by joint-venture firms either with the U.S.S.R. or with Bulgaria were at Tolgoyt and Ikh-Alt in Selenge Aymag (administrative district), north-central Mongolia, and at Dzhargalant and Mukhar Ereg in Bayanhongor Aymag, southwest Mongolia. A new joint- venture operation with the Federal Republic of Germany was expected to begin in late 1990 at Boro in Tov Aymay. In north-central Mongolia, three gold mines at Sharyn Gol, Haylast, and Dazaamar reportedly were run by the Mongolian enterprise. Other important gold occurrences, which were believed to have potential for exploration and development, were at Uvur Chuluut in Bayanhongor Aymag and Tsagan-Tsakhir-Ula in Govi-Altay Aymag.

The Asgat silver deposit, which was discovered in 1988 by a joint Soviet-Mongolian geological expedition team, is about 180 km northeast of Olgiy, Bayan-Olgiy, and has potential reserves of 24.8 Mmt. According to the Mongolian Government, mineralization of silver and other associated minerals is at 3,000 to 3,800 m above sea level. The potential reserves were estimated to contain 92,900 tons of antimony, 1,356,000 tons of bismuth, 163,000 tons of copper, and 7,125 tons of silver.

Lead and Zinc.—The Yorco Mining Enterprise reportedly produced various nonferrous metals, including gold, silver, and zinc, at its processing facilities in Selenge Aymag. To attract foreign investment in the Mongolian mining industry, the Government opened four polymetallic mineral deposits for joint exploration and development with foreign partner in 1990.

According to the Mongolian Government and the Geological Survey of Japan, the Tumurtiin Ovoo deposit, which is 16 km north of Baruun-Urt in Suhbaatar Aymag, was estimated to have reserves of 7.8 Mmt containing 11.5% zinc and 0.023% cadmium. The Ulaan deposit, which is 120 km northwest of Choybalsan in Dornod Aymag, was estimated to have reserves of 37 Mmt containing 5.47% lead and zinc plus 30 g/mt to 35 g/mt of silver. The Tsav deposit, which is 130 km northeast of Choybalsan, was estimated to have reserves of 2 Mmt containing 6% lead, 5% zinc, 0.14% copper, and 220 g/mt of silver. The Mungen Ondor deposit, which is 83 km northwest of Ondorhaan in Hentiy, was estimated to have reserves of 2.8 Mmt containing 1.52% lead, 1.03% zinc, and 124 g/mt of silver.

Rare Earths.—According to the Mongolian Government and the Metal Mining Agency of Japan, two potential rare-earths deposits had been identified in southern Mongolia. The Mushgia Khudag deposit, which is 100 km northeast of Dalandzadgad in Omnogovi Aymag, was estimated to have reserves of 6.1 Mmt averaging 1.37% rare-earth oxides (REO). The Ludiin Gol deposit, which is 60 km south of Hatanbulag in Dornogovi Aymag, was estimated to have 370,000 tons averaging 3.2% REO.

Tin and Tungsten.—Production of tin decreased slightly from that of 1989, while production of tungsten dropped sharply in 1990 primarily owing to the shutdown of the Tsagaan-davaa Mine. According to the Hungarian press report, Wolframvest, a joint- venture firm of Mongolia and Hungary established in 1986 to own and operate the Tsagaan-davaa Mine, declared bankruptcy after only 1 year of operation. A sharp drop in the world market price of tungsten in mid-1990 reportedly was the main reason for the mine closure. Other tungsten mining operations, with the Soviet and member countries of CMEA, were at Burentsogt, Ikh-Khairkhan, Kobdo Gol, Kyzyl Tay, Tumentsogt, and Yugozy.

The Mongolian-owned enterprise operated a small-scale tungsten mine at Ulaan Uul in Bayang-Olgiy Aymag and was producing tungsten concentrate at the rate of 30 mt/a. According to the Mongolian Government, an important tungsten-molybdenum deposit had been identified at Ondor Tsagaan, about 80 km northwest of Ondorhaan in Hentiy Aymag. The Ondor Tsagaan deposit was estimated to have reserves of 141 Mmt containing 0.124% tungsten trioxide and 0.019% molybdenum. According to a Polish source, occurrences of wolframite (huebnerite), with considerable amounts of associated columbium oxide, had been identified at Aczit Nur, Bor Burgas, Nurin Gol, and Sagsai, all in Bayang-Olgiy Aymag of western Mongolia.

Industrial Minerals

Fluorspar.—Mongolia remained the world's third largest fluorspar producer in 1990. According to a Soviet source, Mongolia planned to produce 920,000 tons of fluorspar in 1988, of which about 450,000 tons was to be concentrated into 114,000 tons of calcium fluoride containing up to 92% CaF_2. The estimated annual output of fluorspar was at the 800,000 tons level for 1987-90. According to the International Monetary Fund (IMF),[7] the output of fluorspar in Mongolia was 543,700 tons in 1987, 522,700 tons in 1988, and 578,200 tons in 1989. However, the output of calcium fluorite was not reported for those years by the IMF.

Fluorspar was produced mainly by Mongolsovtsvetmet, a Mongolian-Soviet joint venture, and Mongol-Czechoslovakmetal, a Mongolian-Czechoslovakian joint venture. The Mongolsovtsvetmet operated underground mines at Berh and Delgerkhaan, both in Hentiy Aymag, and at Bor Ondor in Dorngovi Aymag, and open pit mines at Bor Ondor, Khar-Airage, and Orgon, all in Dorngovi Aymag and at Zuun Tsagaan Del in Henity Aymag. The Mongolsovtsvemet also operated a 118,000 mt/a calcium fluorite processing plant at Kerulen in Dorngovi Aymag. The Mongol-Czechoslovakmetal operated an open pit mine with a capacity of 45,000 mt/a at Chuluut Tsagaan Del in Tov Aymag.

Cement and Lime.—Mongolia's production capacity of cement and lime was estimated at 550,000 mt/a and 130,000 mt/a, respectively, in 1990. Production of cement and lime was at the Darhan and Hotol areas in northern Mongolia. According to the Mongolian Government, cement output increased from 502,100 tons in 1988 to 512,600 tons in 1989, of which 175,000 tons was exported. Lime production declined from 122,200 tons in 1988 to 95,000 tons in 1989, of which 3,600 tons was exported. As part of the Government's efforts to expand the mining industry, high priority was given to the development of the limestone deposits in the Tavantolgoy area, about 100 km north of Dalandzadgad in Omnogovi Aymag.

Mineral Fuels

Petroleum.—Mongolia relied on the U.S.S.R. to meet all of its refined petroleum product requirements. According to Mongol Gazry Tos, the newly established state-owned petroleum company, Mongolia planned to begin exploration for new oil wells in the Dzuunbayan Oilfield near Saynshand in Dornogovi Aymag and start crude oil production by 1993. According to Exploration Associates International of Texas Inc. (EAITI) of the United States, the early investigations by the U.S.S.R. and other members of CMEA indicated that some of the oil-rich sedimentary basin of North China extend across the border into southeast Mongolia. Oil reserves in the North China basin had been estimated at 10 billion barrels.[8]

In May, the Mongolian Ministry of Heavy Industry reached an agreement with EAITI and Western Geophysical Co. of the United States to conduct jointly a 1,500-km seismic program. According to the agreement, the seismic survey will be conducted in the eastern Govi basin area of southeastern Mongolia and was expected to begin in February 1991, pending on adequate underwriting by the interested oil companies. The project was estimated to cost $15 million and is expected to employ 20 to 30 U.S. expatriates and 100 Mongolians.[9]

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[1]The Ministry of Trade and Cooperation (Ulan Bator). Foreign Trade of Mongolia, Jan. 1990, p. 5.

[2]Where necessary, values have been converted from Mongolian tughriks (Tug) to U.S. dollars at the rates of Tug/3.03=US$1.00 in 1989 and Tug/5.63=US$1.00 in 1990.

[3]Asahi Shimbun (Tokyo). Economic Exchanges with Mongolia Examined. Feb. 28, 1990, p. 11.

[4]Sanders, A. Mongolia: Shackled to the Past. Far Eastern Econ. Rev. (Hong Kong), v. 151, No. 1, Jan. 3, 1991, p. 22.

[5]Sato, T. Journey to Mongolia. Geol. Survey of Japan (Tsukuba). Chishitsu News, No. 438, Feb. 1991, pp. 39-51.

[6]Mendoza, D. Mongolia—A New Frontier. Met. Bull. Monthly (London). Mar. 1990, p. 93.

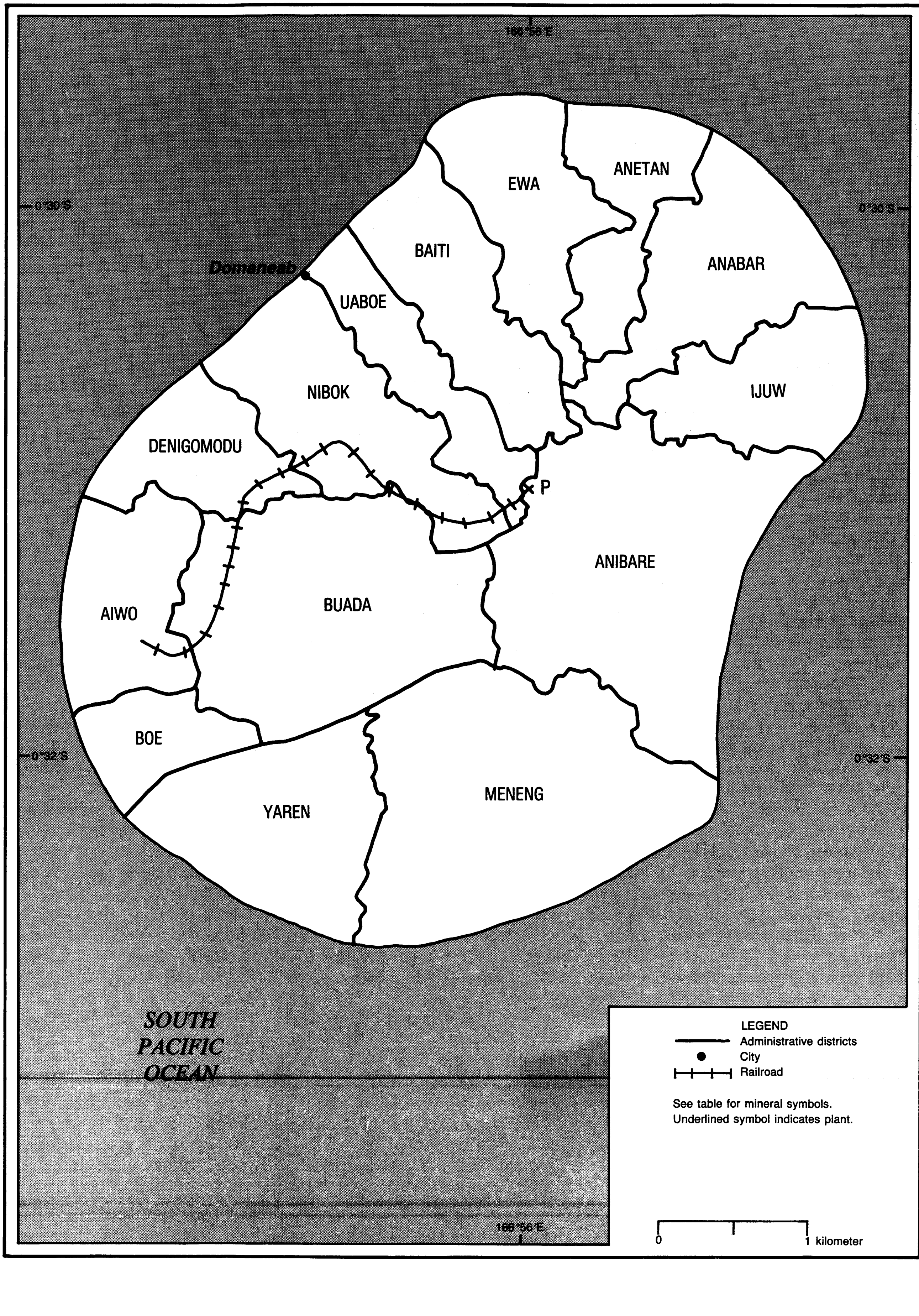
[7]Milne, E. The Mongolian People's Republic: Toward a Market Economy. International Monetary Fund (Washington, DC). Occasional Paper 79, Apr. 1991, p. 55.

[8]Binder, D. So Far From Mideast: Mongolia's Oil Intrigues Bush. New York Times (New York). Jan. 25, 1991, p. A 12.

[9]U.S. Embassy, Beijing, China: State Dep. Telegram 18410, June 14, 1990, p. 1.

NAURU

AREA 21 km² **POPULATION 9,200**



THE MINERAL INDUSTRY OF NAURU

By Travis Q. Lyday

The affluent Nauruan society, with one of the world's highest per capita incomes, continued to be based on the mining of extensive high-grade phosphate rock deposits on the central plateau of the island by the Nauru Phosphate Corp. (NPC). The country's gross domestic product varies accordingly with the amount of production and the world market price of phosphate.

GOVERNMENT POLICIES AND PROGRAMS

The Government suit seeking compensation from the former partners of the British Phosphate Commission (BPC), comprised of representatives of Australia, New Zealand, and the United Kingdom, remained before the International Court of Justice at The Hague. The claim was filed in May 1989 against Australia, which was the Administering Authority in control of the mining of Nauru's phosphate on behalf of the other partners of the BPC, for compensation during the period from 1919 until 1968 when its phosphates were sold at below market prices and for the rehabilitation of the environmental damage suffered by mining.[1] The Government, through the NPC, assumed control of the phosphate industry shortly after Nauru achieved independence in 1968. The Government's independent Commission of Inquiry in 1987 determined that Australia had the duty to pay the costs for rehabilitation of the land, about 80% of the island, worked out by phosphate mining, before independence.[2] The cost of the rehabilitation was determined by the Commission to be $180 million and called upon the three nations of the BPC each to pay one-third, or $60 million. Nauru was expected to take similar action against New Zealand and the United Kingdom.[3]

PRODUCTION

Production of phosphate in Nauru, all by the NPC, was from deposits which 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). Rock treated in the calcination plant averaged about 89% BPL (40.7% P_2O_5) and may be as high as 91% BPL (41.7% P_2O_5).

A minor amount of coral mined with the phosphate was removed by hand and used as road aggregate.

TRADE

All phosphate rock mined on Nauru was exported by NPC. Phosphate remained Nauru's sole export. Exports of phosphate rock, by destination, for 1988-90 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 rock was virtually the only natural resource of the island nation.

TABLE 1

NAURU: PRODUCTION OF MINERAL COMMODITIES[1]

(Thousand metric tons)

Commodity[2]	1986	1987	1988	1989	1990[p]
Phosphate rock	1,494	1,376	1,541	1,181	926

[p]Preliminary.
[1]Table includes data available through Aug. 2, 1991.
[2]In addition to the commodity 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	1988	1989	1990
Australia	1,253.3	822.8	593.9
Japan	—	—	—
Korea, Republic of	40.5	52.8	153.0
New Zealand	188.8	305.8	179.3
Total	[1]1,540.4	[1]1,181.3	926.2

[1]Data do not add to total shown because of independent rounding.
Source: Phosphate Rock Statistics 1991, International Fertilizer Association Ltd.

TABLE 3

NAURU: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies	Location of main facilities	Annual capacity, (thousand metric tons per year)
Phosphate rock	Nauru Phosphate Corp., 100%.	Aiwo District	1,500

Nauru's phosphate rock is mined and exported by the Government-owned NPC.

COMMODITY REVIEW

Industrial Minerals

Phosphate rock from NPC's surface mine remained the sole mineral commodity produced on Nauru, except for minor amounts of crude construction materials used for domestic purposes. Nauruan phosphate remained the highest grade of phosphate rock available in world commerce.

Production of phosphate rock in 1990 decreased 22%. The phosphate rock was mined from deposits interdigitated with evenly spaced dolomitized coral limestone pillars using mechanical extractors with clamshell buckets, leaving the coral as a "forest" of very hard rock pinnacles. The associated coral was cobbed for domestic use as road aggregate.

After overburden is removed by bulldozers, the alluvial phosphate rock is removed from around the coral pinnacles, trucked to a railhead for primary crushing, and reduced to -50 millimeters (mm). A narrow gauge railway using diesel locomotives transports the crushed material to a treatment plant where it is dried before further crushing to -12 mm and sold as run of mine product. A proportion of the fine material is upgraded by high temperature calcination to remove organic carbon and cadmium and marketed as Nauru Calcined Rock.[4]

The NPC was reportedly considering constructing a 300,000-metric-ton-per-year diammonium phosphate plant to produce superphosphate fertilizer for export.[5]

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.[6]

INFRASTRUCTURE

There are 3.9 kilometers (km) of NPC-owned railroad track, which is used to transport phosphates from the central plateau of the island to processing facilities in Aiwo 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. The merchant marine consists of four ships and includes one passenger-cargo, one cargo, and two bulk carriers. Electricity generating capacity in 1989 was reportedly 13,250 kilowatts.[7] 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.

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[1]Nauru 1990: An Environmental Challenge for Australia and the Pacific. Helen Bogdan and Associates, Melbourne, Australia, 1990, 16 pp.

[2]Pacific Islands Monthly. V. 61, No. 3, Mar. 1991, p. 19.

[3]Pacific Islands Monthly. V. 60, No. 6, June 1990, p. 25.

[4]Pacific Islands Yearbook (16th ed). Nauru. Douglas, Norman and Ngaire, editors, 1989, p. 346.

[5]Engineering and Mining Journal. V. 192, No. 1, Jan. 1991, p. 27.

[6]Page 21 of work cited in footnote 1.

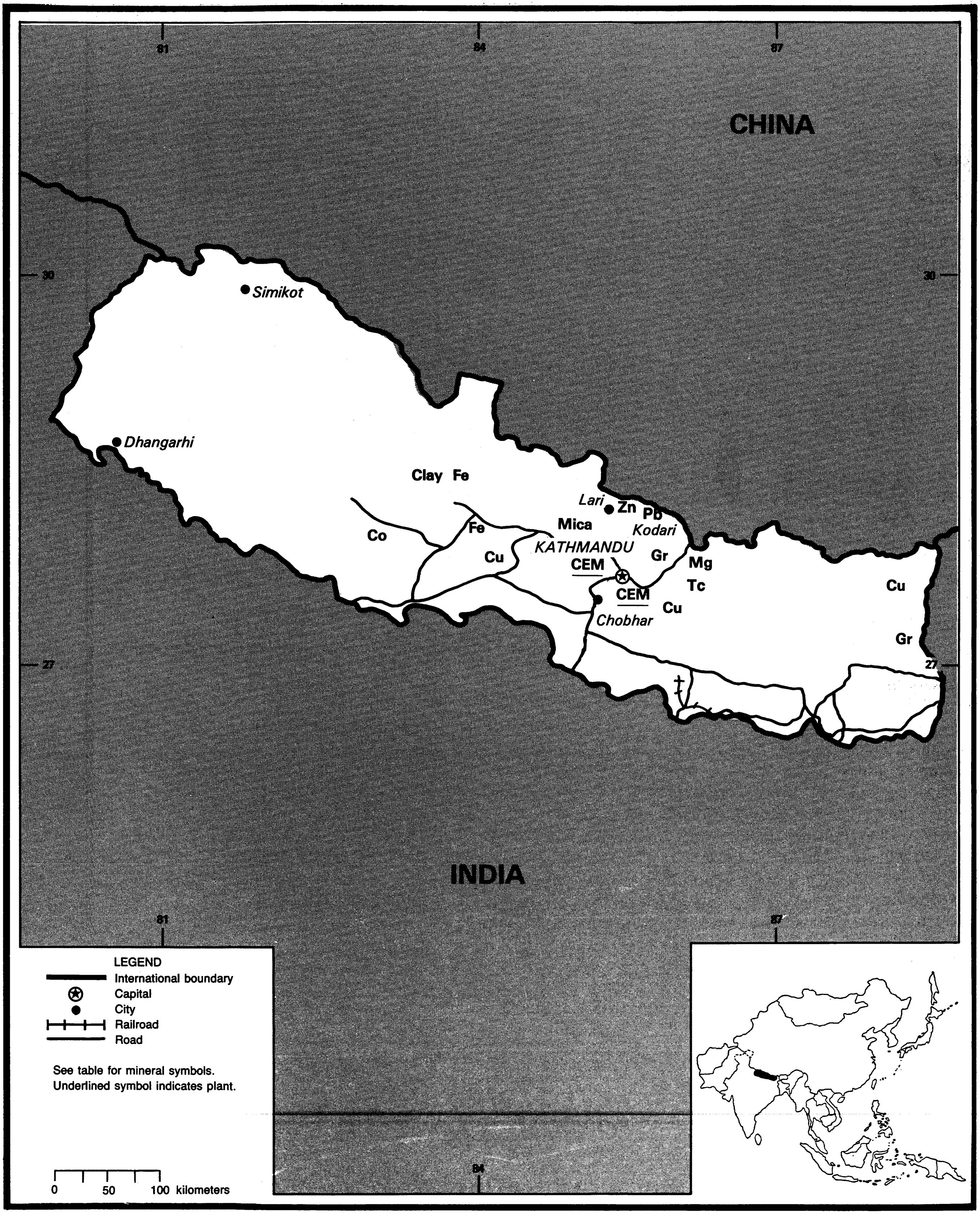
[7]U.S. Central Intelligence Agency. The World Fact Book 1990, p. 217.

OTHER SOURCES OF INFORMATION

Nauru Phosphate Corp.
Republic of Nauru
Central Pacific

NEPAL

AREA 141,800 km² **POPULATION 19.1 million**



THE MINERAL INDUSTRY OF NEPAL

By David B. Doan

Except for ornamental marble products, the mineral production of Nepal for 1990 diminished somewhat from the previous year. Reasons were largely political as unrest swept the country in February and March during violent confrontations between the people and the Government, the former charging the latter with various forms of tyranny and milking the country by plundering its natural resources. Although the struggle was initiated jointly by the Nepali Congress and the United Left Front, it turned into a broad insurrection against the existing Government in which more than 500 lives were lost, mainly from gunfire by police and army security forces. On April 16, 1990, the King capitulated by agreeing to end the panchayat system of one-party rule, at the same time yielding the army to civilian control. Limitations were placed on the Nepalese ruling monarchy in favor of a multiparty democracy, and fundamental freedoms including human rights and voting rights were stipulated in King Birendra's proclamation. It became necessary then to agree on a constitution, but infighting concerning his remaining powers by the King with the new cabinet, personified by the Prime Minister, delayed its adoption until November 9. By that time, the King was persuaded that he had indeed lost his autocratic power and he proclaimed the new constitution. Nationwide voting was then scheduled for April 1991.

The Government was too deeply involved in the constitution and the pending first nationwide election to develop any new policies with regard to the mineral industries. There was hope, however, that under the new system exploration could be speeded and augmented. To this end, a United Nations team was reported to be preparing an on-site visit to evaluate the lead-zinc prospect at Lari. It was also clear that the ongoing program to replace wood burning by electricity was essentially unaffected by Governmental changes.

Production of cement in 1990, at 107,200 tons, was down 51% from the previous year. Other production of significance to Nepal's economy included clays, down 89% at 824 tons; lignite, down 19% at 7,808 tons; salt, down 4% at 6,900 tons; and talc, down 73% at 1,798 tons. The increase in output of marble products was conspicuous, with marble chips up 1,560% at 945 tons, suggesting new popularity for the product. Production of cut marble increased 100% to 46,892 tons. The marble industry did well, but did not compensate for shrinking production in the other mineral categories.

Trade with India was restored during the year, following the dispute over new trade agreements. India had disapproved of Nepalese overtures to China concerning roadbuilding and, allegedly, weapons procurement. The result was a virtual closing of the India-Nepal border and resulting commodity shortages for the people of landlocked Nepal. With changes in India's Government, and moderation on both sides, new trade arrangements were completed.

The mineral industry of Nepal is not only small but sparsely distributed throughout the country, representing very early stages of development. Lack of power and an undeveloped road system hindered access for exploration as well as development. Historically mines have been privately owned and operated. The exception was Nepal Orind Magnesite Ltd., 50 km east of Kathmandu in the Dolakha District, currently 50% owned by the Government but not yet in production.

Little information was available on the progress of petroleum exploration in any of the 10 exploration blocks flanking the Himalayan structural front on the south side, other than a relinquished contract in May 1990, by the Shell Nepal B.V.-Triton Energy joint venture following the drilling of a dry hole.

Definitive geologic work for estimating mineral reserves has not been accomplished. The Government assumes a reserve of lead and zinc near Lari of about 2 million tons, but the basis for this estimate is not clear. Very large quantities of limestone were thought to be available for manufacture of cement, but no systematic delineation of reserves has been accomplished.

Nepal has been utilizing foreign capital, mainly as soft loans or donations, to improve infrastructure. The major beneficiary is the 6,000-km road system that has only about 2,650 km of pavement, the remainder having a gravel or earth surface. The country has 52 km of narrow-gauge railroad and five airports with paved runways. The potential for hydroelectric power development is high, but undeveloped. Kathmandu and several larger towns have electricity, but there is no national power grid.

The outlook for Nepal has improved politically, but the potential for mineral development remains untapped.

TABLE 1

NEPAL: PRODUCTION OF MINERAL COMMODITIES[1 2]

(Metric tons unless otherwise specified)

Commodity[3]	1986	1987	1988	1989	1990[p]
Beryl kilograms	(4)	(4)	400	900	[e]1,000
Cement, hydraulic	92,853	151,631	215,010	217,666	107,179
Clays for cement manufacture	6,798	[e]10,000	8,033	7,206	824
Coal: Lignite	4,536	5,081	8,311	9,639	7,808
Copper ore:					
Gross weight	[e]6	[e]6	9	20	18
Cu content	[e]2	2	3	7	6
Gem stones:[e]					
Garnet kilograms	25,000	25,000	25,000	25,000	20,000
Tourmaline do.	50	50	[5]22	20	20
Lime, agricultural	584	[e]500	21,200	40,500	[e]45,000
Magnesite, crude	63,190	38,388	45,000	27,978	[e]25,000
Salt	[e]7,000	[e]7	6	7,200	6,900

See footnotes at end of table.

TABLE 1—Continued

NEPAL: PRODUCTION OF MINERAL COMMODITIES[1 2]

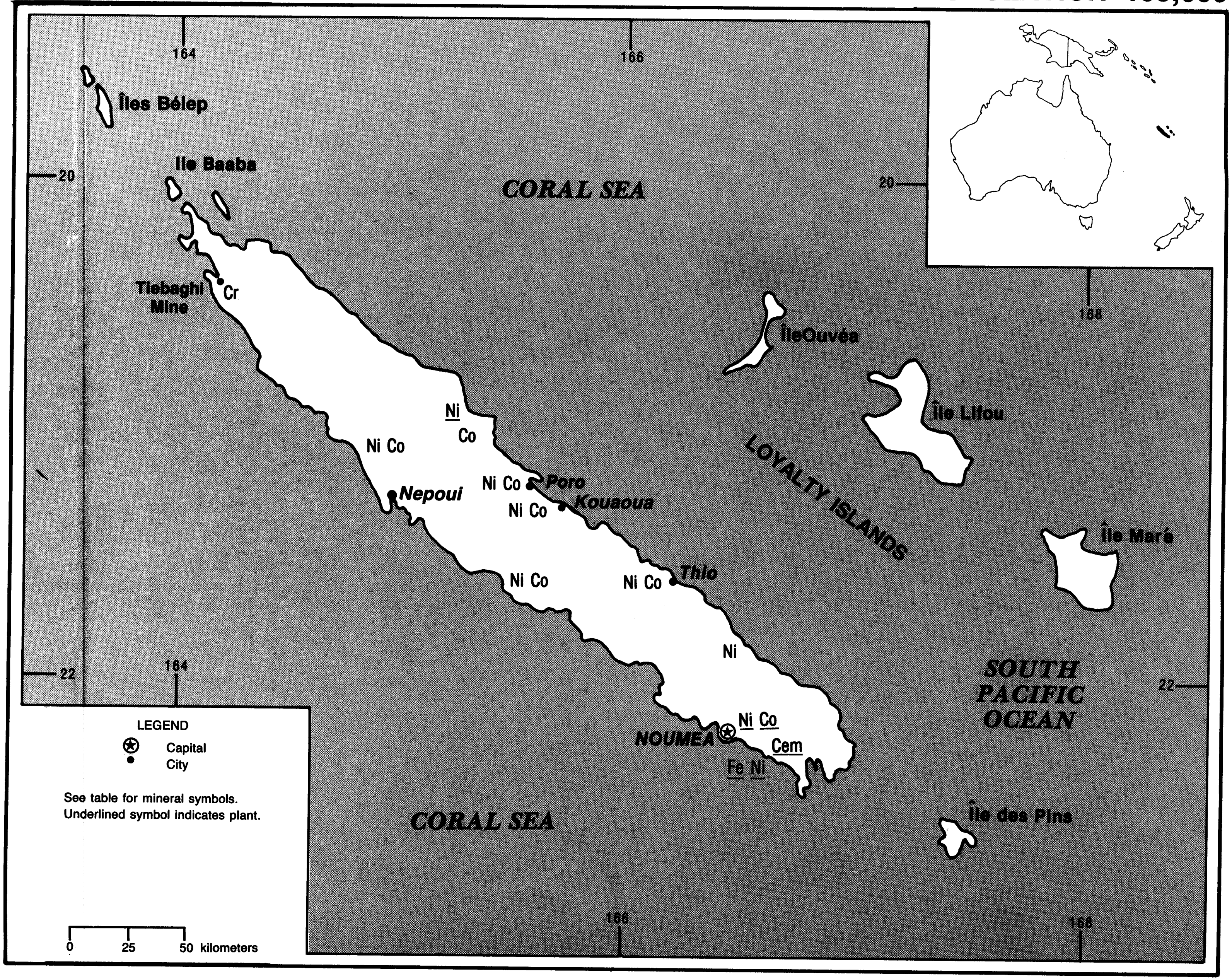
(Metric tons unless otherwise specified)

Commodity[3]		1986	1987	1988	1989	1990[p]
Stone:						
Limestone		174,798	334,270	323,584	289,743	[e]295,000
Marble:						
Chips		[e]700	11,644	1,164	57	945
Cut	square meters	10,442	15,847	15,855	23,448	46,892
Craggy	do.	3,590	6,168	6,171	68,954	5,318
Talc		8,780	[r]3,359	4,430	6,728	1,798

[e]Estimated. [p]Preliminary.
[1]Table includes data available through May 15, 1991.
[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.

NEW CALEDONIA
(France)

AREA 19,060 km² **POPULATION 153,000**



THE MINERAL INDUSTRY OF NEW CALEDONIA

By Travis Q. Lyday

The mineral industry in the French Territory of New Caledonia and Dependencies continued to be dominated by the mining of nickeliferous laterite-saprolite ore, which was used for the subsequent production of ferronickel of various grades and of nickel matte. Minor amounts of cobalt were recovered as a component of nickel matte exports from refining operations at Sandouville, near Le Havre, northern France. High-quality chromite ore was produced from ultramafic rock through July. Minor amounts of pit and quarry construction materials also were 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-metric ton-per-day capacity underground Tiebaghi Mine in the northern part of the main island of New Caledonia (La Grande Terre) until midyear when the ore was exhausted. 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]

New Caledonia remained the third largest producer of mined nickel in the world after Canada and the U.S.S.R. and was the largest producer of ferronickel, with about 40% of the world's output.[2]

TRADE

Mine output from the smaller, independently operated nickel mines was mainly for export to Australia's Yabulu nickel refinery near Townsville, Queensland, and Japan's nickel processors. Most, about 75%, of the ferronickel was shipped to consumers in Australia and all production of nickel matte was shipped to France for further processing into high-purity (99.7%) cathode nickel and nickel salts.[3]

STRUCTURE OF THE MINERAL INDUSTRY

Chromical's Tiebaghi Mine, New Caledonia's only chromite producer, was owned by Canada's Inco Metals Ltd. through its French subsidiary International Nickel France, which had a 55% controlling interest. The remaining 45% was split evenly between Sococal, a subsidiary of the Banque de Paris et des Pays-Bas, and Comines, a subsidiary of Coframines, which was a part of the French Bureau de Recherches Geologiques et Minieres (BRGM).

The nickel mines operated by Eramet-SLN (SLN), a wholly owned subsidiary of Metropolitan France's Soc. Metallurgique le Nickel, produced about 65% of the mined nickel in the territory, with the remaining 35% coming from much smaller, independently owned producers, including the Nickel Mining Corp., Noumea Nickel, the Soc. des Mines de la Toutouta, and the Soc. des Miniere du Sud Pacifique (SMSP).

COMMODITY REVIEW

Metals

Chromium.—The Tiebaghi Mine was closed permanently in July owing to the depletion of ore reserves, although it had been closed for several short periods, thought to be permanent, in the latter part of 1989 and early 1990. Chromical S.A. continued prospecting in the area in an attempt to identify additional reserves. Unsold stocks of chromite concentrate remained at the mine site because of low market prices.

Reportedly, a new company, SOMIREX, planned to construct a new chromite mine, the Alice-Louise Mine, in the southern part of La Grande Terre, which will employ about 30 people.[4]

Nickel.—SLN produced nickel ore from three mines (Kouaoua and Thio, and contractor-operated Etoil du Nord) on the east coast of La Grande Terre. SLN also produced ferronickel and nickel matte, about 7% of world production, at its Doniambo smelter at Noumea.

SLN announced early in the year that it would reduce output at the beginning of 1991 with the relining of the third of its three Demag electric furnaces at the Doniambo smelter. The relining was expected to take 5 to 6 months and would reduce monthly output at the plant from 3,900 metric tons (mt) to 2,600 mt of nickel contained in ferronickel and matte.[5]

A strike was held June 17 to July 23 by workers at SLN's Doniambo nickel smelter and its two mines in a dispute over bonus payments. On June 25, after close of the market, the company formally declared *force majeure* on all nickel shipments. Near the end of June, the workers stopped casting the smelt into an exportable form, pouring it instead into large balls that had to be recast before being exported as ingots.[6] The *force majeure* was lifted when the strike ended. Although there was no damage to the electric furnaces, which were kept running at very low levels, there were minor problems at the oxygen plant, which broke down shortly before the strike ended. Reportedly, the strike cost about $17.8 million and the loss of 4,000 mt of nickel in lost production, or the equivalent of about 1 month's production, during the 36-day period.[7]

SLN declared *force majeure* on nickel deliveries to its customers for February and March 1991 on December 21, following a fire on December 18 which destroyed electrical installations. All SLN shipments until the beginning of February were to continue as scheduled.[8] The fire, in the transformer station supplying power to the plant's third furnace, the same one that was scheduled to be relined in early 1991, destroyed two transformers and badly damaged a third.[9] The maximum loss of nickel contained in ferronickel was expected to be only about 800 mt, as power to the furnace was restored quickly with the installation of a spare transformer on December 23. This was thought initially to have saved complete destruction of the furnace itself by prevent-

TABLE 1

NEW CALEDONIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989[p]	1990[e]
Cement[e]		40,000	50,000	60,000	[2]67,232	65,000
Chromite, gross weight		72,207	61,832	70,341	60,281	[2]6,207
Cobalt, mine output:						
Co content[e 3]		5,000	5,800	6,000	6,000	6,000
Recovered[e]		700	750	800	800	800
Nickel:						
Ore:						
Gross weight	thousand tons	3,125	2,842	3,385	4,919	[2]4,400
Ni content		61,800	56,850	67,700	[r e]98,500	88,000
Metallurgical products:						
Ferronickel:						
Gross weight[e]		[2]130,500	115,600	146,300	[r]142,500	126,500
Metal content (nickel plus cobalt)		33,001	29,531	37,352	36,285	[2]32,278
Nickel matte:						
Gross weight[e]		12,260	11,300	14,300	[r]14,500	13,000
Metal content (nickel plus cobalt)		9,160	8,283	10,470	10,650	[2]9,683
Stone, sand and gravel:[e]						
Stone:						
Crude (unspecified)	cubic meters	20,000	20,000	20,000	20,000	25,000
Crushed	do.	100,000	100,000	100,000	100,000	125,000
Sand	do.	75,000	75,000	75,000	75,000	100,000
Silica (for metallurgical use)	do.	15,000	15,000	15,000	15,000	20,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Aug. 2, 1991.
[2]Reported figure.
[3]Series reflects cobalt recovery from ores and intermediate metallurgical products of nickel exported from New Caledonia to France and Japan.

TABLE 2

NEW CALEDONIA: EXPORTS OF NICKEL, BY TYPE AND DESTINATION

(Metric tons)

Type	1988	1989	1990	Destinations, 1990
Ore	1,266,830	1,821,083	1,650,474	All to Japan.
Matte	10,330	10,777	10,626	All to France.
Ferronickel, gross weight	36,819	35,294	35,215	Australia 26,920; France 8,295.

Source: Annales Des Mines (Paris), Feb. 1991.

TABLE 3

NEW CALEDONIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies	Location of main facilities	Annual capacity
Cement	S.A. Ciments de Numbo, operator and owner, 100%.	Noumea	180
Chromite, concentrate (52% Cr_2O_3)	Chromical S.A., operator. International Nickel France, 55%; Sococal, 22.5%; and Comines 22.5%.	Tiebaghi Mine	[1]85
Nickel, ore	Eramet-SLN, operator and owner, 100%.	Kouaoua Mine	1,000
Do.	do.	Thio Mine	700
Do.	Independent producers, including Soc. Metallurgique le Nickel.	Several mines on north end of island.	1,100
Ferronickel, matte	Eramet-SLN, operator and owner, 100%.	Doniambo Smelter, Noumea	[2]45

[1]Ceased operations July 1990.
[2]Contained nickel.

ing the melt in the furnace from solidifying, although more substantial damage was expected to begin early in 1991, and that lost production could be at least 3,500 mt of nickel.[10]

A controlling interest, 85%, of privately-owned nickel miner SMSP, New Caledonia's smallest nickel mining operation, was sold for $17.6 million[11] in April to a regional council of the Melanesian separatist group, Kanak National Socialist Liberation Front.[12]

Reserves

Several small-scale ore deposits have been identified in the vicinity of the Tiebaghi Mine, both to the east and to the west of the present site. Exploratory work was continuing in order to prove viable reserves.

New Caledonia's nickel reserves, estimated to be 30% of world reserves, are second only to those of Cuba.

In addition to abundant reserves of 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, 5 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 1989 was 400,000 kilowatts.[13] Generally, infrastructure for the mining of chromite and nickel ores is regarded as adequate.

OUTLOOK

Chromical S.A. appears optimistic that sufficient chromite reserves will be identified for the company to continue viable operations at the Tiebaghi Mine site.

Although SLN had planned to shut down the Doniambo smelter's third furnace, which was damaged by an electrical fire at yearend, for relining in 1991, it could not take advantage of the enforced shutdown for the relining owing to a lack of the required parts. Thus, in addition to the 5 to 6 months required to actually reline the furnace, it was anticipated that between 2 and 4 months would be required to obtain the necessary equipment for the relining. Thus, damage to the fire-affected furnace could lead to further production losses of up to 6,500 mt.[14]

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[1]Metal Bulletin (London). No. 7414, Sept. 7, 1989, p. 15.

[2]International Mining (London). V. 7, No. 1, Jan. 1990, p. 12.

[3]Metal Bulletin (London). No. 7493, June 25, 1990, p. 5.

[4]South Seas Digest (Sydney). V. 10, No. 25, Mar. 15, 1991 p. 2.

[5]Metal Bulletin (London). No. 7467, Mar. 8, 1990, p. 13.

[6]Mining Journal (London). V. 314, No. 8077, June 29, 1990, p. 515.

[7]______. V. 315, No. 8082, Aug. 3, 1990, p. 88.

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[9]______. No. 7544, Dec. 24, 1990, p. 5.

[10]______. No. 7546, Jan. 7, 1991, p. 5.

[11]Where necessary, values have been converted from the Comptoirs Francais du Pacifique Franc (CFPF), or French Pacific Franc, to U.S. dollars at the rate of CFPF102.3=US$1.00. The CFPF is linked to the French franc (F) at the rate of CFPF18.18=F1.0.

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[13]U.S. Central Intelligence Agency. The World Fact Book 1990, p. 225.

[14]Work cited in footnote 10.

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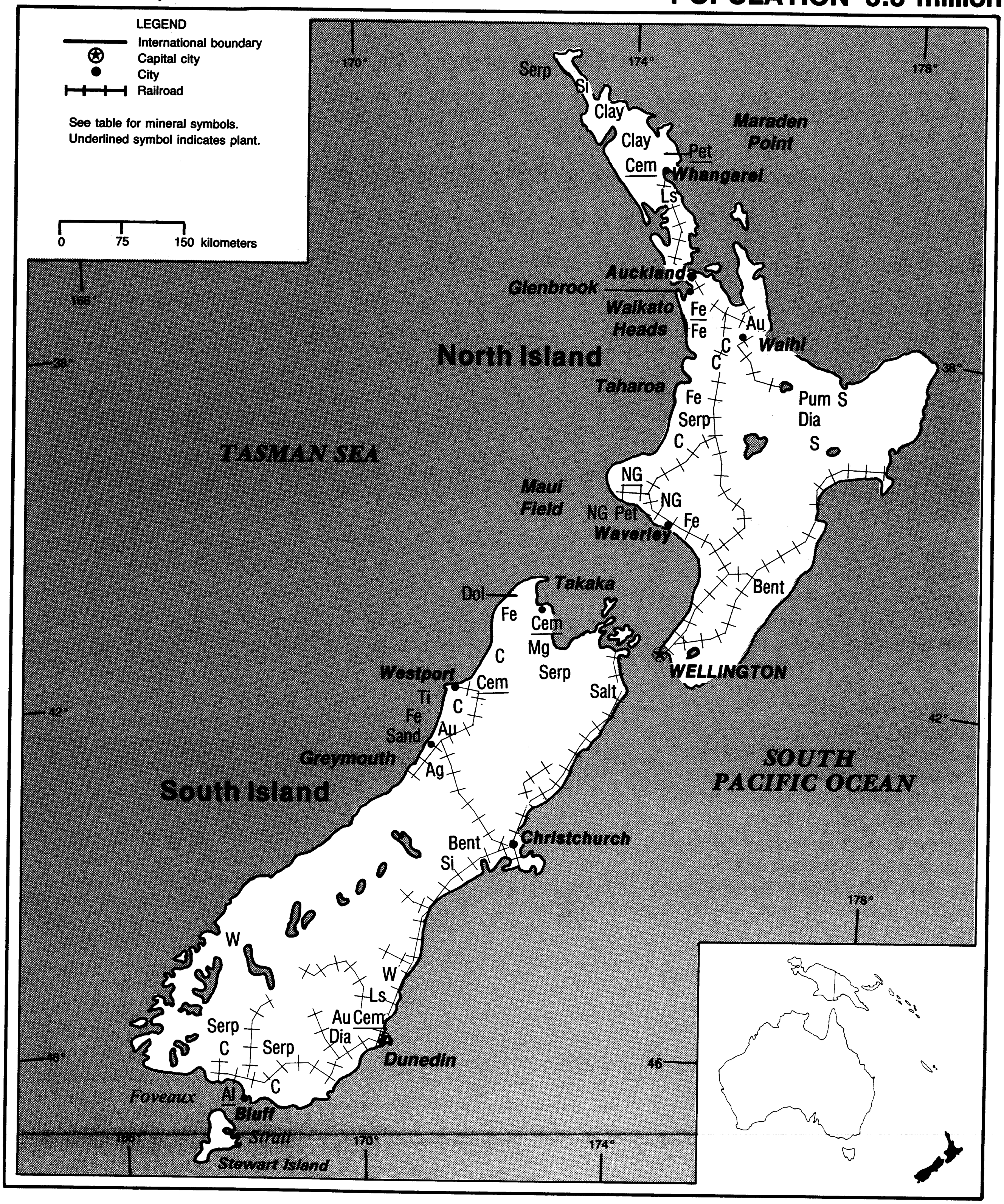
NEW ZEALAND

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 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, resulted in 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 gasfields. 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 gasfield was discovered in 1969, and production has been used primarily for electricity generation and as a premium fuel.

Today's extractive mineral industry in New Zealand constitutes only a small segment of the economy, contributing on the order of 1% to 2% to the GDP of the country. The GDP was estimated to be a little more than \$37 billion[1] in fiscal year 1990,[2] a 0.5% increase in real terms from that of the previous fiscal year. The GDP was projected to rise 1.5% in real terms in fiscal year 1991. The mineral processing sector provided an estimated 4% to 5% to the GDP, based to a significant extent on imported alumina, crude oil raw materials, and fertilizer, increasing the value of the mineral industry output to about 5% to 6% of the GDP.

PRODUCTION

Because reliable statistical information on production was unavailable for most commodities, production levels were estimated.

Mining activities in New Zealand during the year continued to be comprised of coal extraction, both by underground and open pit methods; quarrying of raw materials for use primarily in the domestic construction (clays, sand and gravel, and stone) and agricultural industries (limestone and marble); and gold and titaniferous magnetite sand (iron sand) mining. Hard-rock gold mining continued at the Martha Hill Mine at Waihi on North Island's Coromandel Peninsula and at several alluvial sites, especially on South Island. Gold mining was about to begin at Golden Cross, near Waihi, and the first gold was poured at New Zealand's second hard-rock gold mine at Macraes, South Island, during 1990. 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 mineral 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 in a privatization program through deregulation and sale of its equity to the private sector. Major facilities in private hands during 1990 included the aluminum smelter at Bluff; the gold operations at Golden Cross, Macraes, and Martha Hill; the steel plants of New Zealand Steel Ltd. and Pacific Steel Ltd.; the two cement plants at Portland and Westport; and most of the mines and quarries for industrial minerals.

COMMODITY REVIEW

Metals

Aluminum.—New Zealand Aluminium Smelters Ltd. was still investigating the possible expansion of its aluminum smelter at Bluff near Invercargill, Tiwai Point, on South Island at yearend. The planned expansion included the construction of a fourth potline that would add 100,000 to 120,000 tons of aluminum per year to the smelter's 259,000-ton-per-year capacity. The upgrading of the smelter, under consideration for several years, hinged on the successful privatization of the Maupuri hydroelectric power station operated by the state-owned Electricity Corp. of New Zealand Ltd. (ElectriCorp).[3] The Maupuri plant in the past has provided most of the power for the Tiwai Point smelter. New Zealand Aluminium was owned by Comalco NZ Ltd., a wholly owned subsidiary of Australia's Comalco Ltd., which held a 79.36% majority share, and Japan's Sumitomo Aluminium Smelting Co.

TABLE 1

NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1986	1987	1988	1989[p]	1990[e]
METALS					
Aluminum metal, smelter:					
Primary	236,332	252,000	264,398	259,671	260,000
Secondary	4,000	4,000	3,100	3,100	3,500
Total	240,332	256,000	267,498	262,800	263,500
Gold, mine output, Au content kilograms	1,265	1,148	2,404	4,963	7,500
Iron and steel:					
Iron ore, gross weight[e 2]	2,000	2,000	290	—	—
Iron sand (titaniferous magnetite):					
Gross weight thousand tons	2,580	2,290	2,351	2,367	2,400
Fe content[e] do.	1,425	1,300	1,300	1,150	1,200
Pig iron (sponge iron)[e] do.	200	200	200	200	200
Steel, crude do.	291	409	460	608	765
Lead, refinery output, secondary[e]	4,000	[3]4,000	3,600	[3]5,000	5,000
Silver, mine output, Ag content kilograms	—	—	1,845	4,837	5,000
Tungsten, mine output (scheelite):[e]					
Gross weight	(4)	10	(5)	(4)	—
W content	(4)	5	5	5	—
INDUSTRIAL MINERALS					
Cement, hydraulic thousand tons	906	880	812	729	750
Clays:					
Bentonite	3,140	—	1,255	1,342	1,500
Kaolin (pottery)	28,464	25,548	29,649	26,324	30,000
For brick and tile[e]	145,000	145,000	[3]87,892	[3]60,438	70,000
Lime[e]	160,000	160,000	150,000	100,000	100,000
Nitrogen: N content of ammonia	[e]60,000	73,000	73,000	70,000	[3]70,000
Pumice[e]	20,000	15,000	[3]25,003	25,000	25,000
Salt[e]	—	60,000	60,000	60,000	60,000
Sand and gravel:[e]					
Silica sand (glass sand)	50,000	50,000	[3]55,201	102,131	100,000
Other industrial sand	350,000	350,000	[3]330,042	316,930	315,000
For roads and ballast thousand tons	15,000	15,000	[3]12,455	12,577	13,000
For building aggregate do.	5,000	5,000	[3]5,806	5,172	5,000
Stone:[e]					
Dolomite	18,000	18,000	[3]20,461	[3]14,581	15,000
Greenstone kilograms	3,000	3,000	3,000	3,000	3,000
Limestone and marl:					
For agriculture thousand tons	1,500	1,500	[3]708	[3]983	900
For cement do.	1,500	1,500	[3]1,256	[3]1,408	1,400
For other industrial uses do.	215	215	[3]310	[3]314	300
For roads do.	350	350	[3]396	[3]377	400
Serpentine	75,000	75,000	[3]16,042	[3]21,495	20,000
Unspecified:					
Dimension	35,000	35,000	[3]17,543	[3]20,277	20,000
Rock for harbor work thousand tons	2,500	2,500	[3]1,359	[3]1,543	1,500
Sulfur[e]	1,000	[e]1,000	4,323	1,206	[3]4,000
MINERAL FUELS AND RELATED MATERIALS					
Carbon dioxide, liquefied[e]	10,000	10,000	10,000	10,000	10,000

See footnotes at end of table.

TABLE 1—Continued

NEW ZEALAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989[p]	1990[e]
MINERALS FUELS AND RELATED MATERIALS—Continued						
Coal:[e]						
Anthracite	thousand tons	(4)	(4)	(4)	(4)	(4)
Bituminous	do.	[3]679	600	[r]600	[r]763	700
Subbituminous	do.	[3]1,767	1,500	1,600	[r]1,700	1,600
Lignite	do.	[3]195	200	200	250	250
Total	do.	[3]2,641	2,300	[3]2,400	[3]2,713	2,500
Coke:[e]						
Coke oven		2,000	2,000	2,000	2,000	2,000
Gashouse		6,000	6,000	6,000	6,000	7,000
Total		8,000	8,000	8,000	8,000	9,000
Fuel briquets[e]		5,000	5,000	5,000	5,000	5,000
Gas:						
Manufactured (from gasworks)[e]—million cubic feet		356	350	350	400	400
Natural:						
Gross production	do.	191,700	189,700	[e]190,000	209,150	200,000
Marketed production	do.	164,283	[e]165,000	[e]165,000	174,480	175,000
Natural gas liquids:[e]						
Liquefied petroleum gas	thousand 42-gallon barrels	976	1,201	1,000	1,250	1,250
Natural gasoline	do.	172	157	200	[3]250	250
Total	do.	[3]1,148	1,358	1,200	1,500	1,500
Petroleum:						
Crude	do.	10,585	10,220	10,629	10,220	10,000
Refinery products:						
Gasoline	do.	13,150	11,492	[e]14,000	6,429	6,500
Distillate fuel oil	do.	4,588	7,467	[e]5,000	8,892	9,000
Residual fuel oil	do.	1,512	2,131	[e]2,000	1,863	2,000
Other	do.	679	938	[e]1,000	1,058	1,500
Refinery fuel and losses	do.	784	1,799	[e]1,000	[e]1,000	1,500
Total	do.	20,713	23,827	[e]23,000	[e]19,242	20,500

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Table includes data available through June 28, 1991.
[2]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.
[3]Reported figure.
[4]Less than 1/2 unit.
[5]Revised to zero.

TABLE 2

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
METALS					
Alkali and alkaline-earth metals	value, thousands	—	$52	—	All to Australia.
Aluminum: Metal including alloys:					
Scrap		9,371	8,582	—	Japan 5,952; Australia 1,927.
Unwrought		231,727	230,271	—	Japan 202,061; Republic of Korea 15,426.

See footnotes at end of table.

TABLE 2—Continued

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989	
			United States	Other (principal)
METALS—Continued				
Aluminum: Metal including alloys:—Continued				
Semimanufactures	10,930	13,884	379	Australia 9,311; Indonesia 642.
Chromium: Oxides and hydroxides	1	2	—	Mainly to Fiji.
Copper:				
Matte and speiss including cement copper	—	22	—	All to United Kingdom.
Metal including alloys:				
Scrap	2,906	1,987	—	Australia 585; India 436; Republic of Korea 148.
Unwrought	105	340	163	Australia 151; Philippines 13.
Semimanufactures	6,679	9,332	1,343	Australia 5,852; Singapore 412.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite thousand tons	1,464	1,441	—	Mainly to Japan.
Metal:				
Scrap	2,132	34,254	18	Republic of Korea 26,620; Thailand 2,540.
Pig iron, cast iron, related materials	[r]21	20	—	All to Papua New Guinea.
Ferroalloys:				
Ferrosilicon	106	—		
Unspecified	41	20	—	All to Australia.
Steel, primary forms	61,666	21,518	—	Philippines 19,425; Taiwan 870; Thailand 721.
Semimanufactures:				
Flat-rolled products:				
Of iron or non-alloy steel:				
Not clad, plated, coated	68,901	140,086	36,767	Japan 35,746; Thailand 31,897; Australia 16,541.
Clad, plated, coated	58,367	73,169	13,962	Australia 31,219; Canada 5,217.
Of alloy steel	168	200	58	Australia 64; Fiji 34.
Bars, rods, angles, sections	21,476	9,244	2	New Caledonia 2,127; Fiji 1,370; French Polynesia 1,185.
Rails and accessories	2	42	—	Mainly to New Caledonia.
Wire	3,559	4,378	35	Australia 2,295; Hong Kong 1,078.
Tubes, pipes, fittings	6,263	10,774	1,288	Papua New Guinea 3,267; Canada 2,574.
Lead:				
Oxides	3	—		
Metal including alloys:				
Scrap	1,563	1,213	—	Republic of Korea 500; Taiwan 344; Indonesia 241.
Unwrought and semimanufactures	82	58	—	Australia 23; Fiji 18; Singapore 10.
Mercury value, thousands	$3	$5	—	Fiji $2; Papua New Guinea $2.
Nickel: Metal including alloys:				
Scrap	509	160		Italy 43; Republic of Korea 43; United Kingdom 32.
Unwrought	14	([2])	—	NA.
Semimanufactures	280	([2])	—	NA.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$353	$148	—	All to Australia.
Silicon, high-purity	3	1	—	All 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		1988	1989	Destinations, 1989 United States	Destinations, 1989 Other (principal)
METALS—Continued					
Silver:					
Ore and concentrate	value, thousands	$113	—		
Waste and sweepings	do.	$118	—		
Metal including alloys, unwrought and partly wrought	do.	$1,469	$3,118	—	Hong Kong $1,196; Australia $946.
Tin: Metal including alloys:					
Scrap		20	—		
Semimanufactures		536	53	—	Taiwan 41; Australia 9.
Titanium: Oxides		19	11	—	Australia 6; Tonga 3.
Uranium: Oxides and other compounds,	value, thousands	—	$6	—	All to United Kingdom.
Zinc:					
Ore and concentrate		—	59	—	India 39; Japan 19.
Oxides		—	42	—	All to Australia.
Metal including alloys:					
Scrap		1,294	765	—	Taiwan 548; Australia 158.
Unwrought and semimanufactures		13	10	—	Fiji 7; Australia 1.
Other:					
Waste and scrap of precious metals, n.e.s.		$161	—		All to United Kingdom.
Ashes and residues		1,592	1,611	—	India 468; Republic of Korea 355; Japan 323.
Base metals including alloys, all forms	value, thousands	—	$86	$1	Japan $80.
Metalloids[3]		52	39	—	All to Singapore.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.[4]		190	95	—	Australia 43; Fiji 40.
Grinding and polishing wheels and stones	value, thousands	$230	$242	—	Australia $111; Papua New Guinea $63.
Dust and powder of precious and semi-precious stones including diamond	do.	$12	—		
Cement		17,426	40,454	—	Australia 27,494; Solomon Islands 3,623; Papua New Guinea 2,246.
Clays, crude		20,165	20,947	54	Japan 10,746; Taiwan 3,757; Republic of Korea 3,038.
Diamond:					
Gem, not set or strung	value, thousands	$1,032	$55	—	Fiji $54; Australia $1.
Industrial stones	do.	$8	—		
Diatomite and other infusorial earth		9	4	—	All to Fiji.
Fertilizer materials:					
Crude, n.e.s.		6,008	7,998	30	Indonesia 4,078; Japan 2,395.
Manufactured:					
Ammonia		1	1	—	All to Fiji.
Nitrogenous		76,142	65,605	—	Australia 40,801; Thailand 10,002; Japan 5,516.
Phosphatic		34	42	—	Australia 18; Cook Islands 15.
Potassic		49	39	—	Cook Islands 14; Samoa 12.
Unspecified and mixed		535	475	15	Tonga 189; Cook Islands 174.
Gypsum and plaster		8	3	—	All 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		1988	1989	Destinations, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Lime		720	3	—	All to Norfolk Islands.
Mica: Worked including agglomerated splittings	value, thousands	$9	—		
Phosphates, crude		—	2	—	All to Australia.
Pigments, mineral: Iron oxides and hydroxides, processed		1	4	—	Mainly to Fiji.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$446	$948	$54	Australia $763; Hong Kong $54.
Synthetic	do.	$11	—		
Salt and brine		2,036	2,449	1	Australia 1,586; Fiji 337; Papua New Guinea 149.
Sodium compounds, n.e.s.: Sulfate, manufactured		18	4	—	All to Tonga.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked	value, thousands	$1	$15	—	Australia $9; Samoa $4.
Worked	do.	$339	$227	—	Cook Islands $69; Samoa $59.
Dolomite, chiefly refractory-grade		22	1		
Gravel and crushed rock		494	1,140	10	Malaysia 1,002; Indonesia 46.
Limestone other than dimension		1,269	2,124	—	Fiji 1,627; French Polynesia 291.
Sand other than metal-bearing		233	273	—	Australia 246; Cook Islands 5.
Sulfur:					
Elemental: Colloidal, precipitated, sublimed		9	3	—	Mainly to Papua New Guinea.
Sulfuric acid		106	84		Fiji 34; Papua New Guinea 18.
Talc, steatite, soapstone, pyrophyllite		—	2	—	All to Fiji.
Vermiculite including perlite	value, thousands	—	$43	—	Mainly to Australia.
Other:					
Crude		219	244	—	Fiji 178; Tonga 29.
Slag and dross, not metal-bearing		40	102	—	All to Japan.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		19	86	—	Fiji 70; Vanuatu 16.
Carbon black		—	21	—	Australia 20; Fiji 1.
Coal: Bituminous		364,766	485,728	—	Japan 289,452; Australia 102,627; India 70,150.
Gas, natural: Liquefied		—	876	—	New Caledonia 874; Nauru 1.
Peat including briquets and litter		2,269	2,767	1	Australia 2,594; French Polynesia 43.
Petroleum:					
Crude	thousand 42-gallon barrels	2,600	3,831	—	All to Australia.
Refinery products:					
Liquefied petroleum gas	42-gallon barrels	6,194	107,776	—	Australia 50,564; French Polynesia 26,506; New Caledonia 23,281.
Gasoline, motor	do.	1,431,834	NA		
Mineral jelly and wax	do.	158	165	—	Australia 118; Fiji 39.
Kerosene and jet fuel	do.	435,201	NA		
Distillate fuel oil	do.	885,084	NA		
Lubricants	value, thousands	$408	NA		

See footnotes at end of table.

TABLE 2—Continued

NEW ZEALAND: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS—Continued					
Petroleum:—Continued					
Refinery products:—Continued					
Residual fuel oil	42-gallon barrrels	208,558	NA		
Bitumen and other residues	do.	48	6	—	All to Australia.
Bituminous mixtures	do.	3,969	8,739	—	Papua New Guinea 3,527; Fiji 402; Vanuatu 970.

[r]Revised. NA Not available.
[1]Table prepared by Audrey D. Wilkes.
[2]Less than 1/2 unit.
[3]Reported under SITC item number as "selenium, phosphorus, etc."
[4]Excludes unreported quantity valued at $99,000 in 1988 and $59,000 in 1989.

TABLE 3

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
METALS					
Alkali, alkaline-earth metals	value, thousands	$8	$5	$2	Australia $1; West Germany $1.
Aluminum:					
Ore and concentrate		4,350	2,288	—	Guyana 1,500; China 775.
Oxides and hydroxides		460,141	517,817	27	Australia 511,024; Japan 3,879.
Metal including alloys:					
Scrap		346	541	14	Australia 488; Cook Islands 14.
Unwrought		[2]5,562	4,776	457	Australia 3,482; Canada 363.
Semimanufactures		9,364	11,264	148	Australia 8,190; Switzerland 561.
Antimony: Metal including alloys, all forms	value, thousands	$4	$86	—	China $40; Hong Kong $24.
Chromium:					
Ore and concentrate		291	301	—	Republic of South Africa 210; Australia 84.
Oxides and hydroxides		209	147	35	West Germany 75; United Kingdom 18.
Cobalt:					
Oxides		15	19	—	United Kingdom 8; Japan 5; Finland 3.
Metal including alloys, all forms	value, thousands	$20	$50	—	United Kingdom $47.
Copper:					
Ore and concentrate		—	42	—	Netherlands 40.
Metal including alloys:					
Scrap		7	46	37	Taiwan 7.
Unwrought		4,391	5,310	3	Taiwan 3,337; Chile 806; Australia 800.
Semimanufactures		13,478	13,424	164	Australia 10,699; Taiwan 1,484.
Iron and steel:					
Iron ore and concentrate including roasted pyrite		21	36	—	Australia 34; West Germany 2.

See footnotes at end of table.

TABLE 3—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
METALS—Continued				
Iron and steel:—Continued				
Metal:				
Scrap	1,676	21	—	Australia 20; United Kingdom 1.
Pig iron, cast iron, related materials	685	694	2	Australia 375; United Kingdom 150.
Ferroalloys:				
Ferrochromium	34	82	20	Australia 14; Belgium-Luxembourg 10.
Ferromanganese	1,456	1,441	—	Japan 772; Australia 348.
Ferrosilicon	2,554	2,237	48	Philippines 667; Australia 544; Norway 553.
Ferrosilicomanganese	1,937	1,542	—	Australia 1,499; Thailand 40.
Unspecified	228	97	—	Australia 71; United Kingdom 23.
Steel, primary forms	10,283	15,656	9	Japan 15,195; Brazil 383.
Semimanufactures:				
Flat-rolled products:				
Of iron or non-alloy steel:				
Not clad, plated, coated	115,682	37,230	250	Japan 20,735; Australia 11,024.
Clad, plated, coated	63,053	68,939	1,314	Japan 29,142; Australia 27,705.
Of alloy steel	15,140	15,249	52	Japan 9,597; United Kingdom 1,757; Spain 809.
Bars, rods, angles, shapes, sections	72,897	60,619	486	Australia 35,146; Japan 11,874; Republic of Korea 6,152.
Rails and accessories	226	1,140	72	United Kingdom 614; Italy 308.
Wire	12,911	15,826	78	Republic of Korea 4,656; United Kingdom 3,747.
Tubes, pipes, fittings	25,801	21,616	764	Australia 10,824; Japan 6,279.
Lead:				
Oxides	99	78	(3)	United Kingdom 42; Australia 28.
Metal including alloys:				
Unwrought	3,395	2,999	—	Mainly from Australia.
Semimanufactures	39	116	(3)	Australia 108; Republic of Korea 6.
Magnesium: Metal including alloys, all forms	203	311	69	Norway 237.
Manganese:				
Ore and concentrate: Metallurgical-grade	76	152	—	Australia 99; Singapore 53.
Oxides	563	568	(3)	Japan 347; Australia 219.
Metal including alloys, all forms—value, thousands	$352	$467	—	Australia $456; Switzerland $6.
Mercury do.	$17	$7	—	Italy $5; Australia $1.
Molybdenum: Metal including alloys, all forms do.	$8	$10	$9	Belgium-Luxembourg $1.
Nickel: Metal including alloys:				
Scrap	3	1	—	All from Australia.
Unwrought	61	26	(3)	Norway 18; Canada 4.
Semimanufactures	92	112	59	Australia 18; Canada 11.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$129	$147	$6	Australia $44; United Kingdom $38; Hong Kong $28.
Silicon, high-purity	585	824	241	Norway 220; Australia 49.
Silver: Metal including alloys, unwrought and partly wrought value, thousands	$1,317	$2,145	$84	Australia $1,811; United Kingdom $79.
Tin: Metal including alloys:				
Unwrought	84	94	2	Malaysia 43; Australia 18.
Semimanufactures	680	169	(3)	Australia 163; Republic of Korea 5.

See footnotes at end of table.

TABLE 3—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
METALS—Continued				
Titanium:				
Ore and concentrate	(3)	2	—	All from United Kingdom.
Oxides	1,327	4,170	49	Australia 3,374; Finland 622.
Tungsten: Metal including alloys, all forms value, thousands	$21	$26	$5	Canada $14.
Uranium: Oxides and other compounds do.	—	$4	$4	
Zinc:				
Ore and concentrate	24	(3)	(3)	
Oxides	166	513	(3)	Australia 322; India 80; West Germany 60.
Metal including alloys:				
Scrap	979	—		
Unwrought	18,703	22,998	—	Australia 15,288; Canada 7,374.
Semimanufactures	483	266	3	Australia 144; United Kingdom 47.
Zirconium:				
Ore and concentrate	97	135	87	Australia 37; United Kingdom 11.
Metal including alloys, all forms value, thousands	$1	$37	$37	
Other:				
Ores and concentrates	154	181	5	Australia 171; China 5.
Waste and scrap of precious metals, n.e.s. value, thousands	$37	$10	$1	Australia $9.
Ashes and residues	32	18	—	All from Japan.
Base metals including alloys, all forms value, thousands	$13	$27	$10	Australia $7; United Kingdom $7.
Metalloids[4]	73	88	1	Philippines 60; China 2.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	304	175	54	Australia 61; Italy 37.
Artificial: Corundum	157	116	49	United Kingdom 57; Australia 6.
Grinding and polishing wheels and stones value, thousands	$2,928	$2,937	$357	Australia $548; Republic of Korea $433; Japan $314.
Dust and powder of precious and semiprecious stones including diamond do.	$164	$230	$131	Australia $50; United Kingdom $35.
Barite and witherite	2,444	1,681	111	Thailand 1,068; China 225.
Boron materials:				
Crude natural borates value, thousands	$325	$203	$2	Netherlands $190; Chile $11.
Oxides and acids	1,414	1,817	1,080	Italy 459; Chile 254.
Cement	7,102	6,527	(3)	Australia 4,204; Taiwan 1,374; Singapore 643.
Chalk	1,146	1,259	(3)	United Kingdom 922; France 153.
Clays, crude:				
Bentonite	816	894	497	Singapore 376; Australia 12.
Kaolin	9,439	11,000	4,388	Australia 6,014; United Kingdom 453.
Unspecified	7,567	4,043	2,324	Australia 1,346; United Kingdom 372.
Cryolite and chiolite	990	326	—	Mainly from Denmark.
Diamond:				
Gem, not set or strung value, thousands	$6,354	$9,036	$443	India $3,672; Australia $2,075.
Industrial stones do.	$159	$126	$53	Australia $42; Ireland $16.

See footnotes at end of table.

TABLE 3—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Diatomite and other infusorial earth	2,631	2,622	1,886	Australia 435; Philippines 178.
Feldspar	767	1,322	—	Canada 702; Norway 417; Australia 72.
Fertilizer materials:				
Crude, n.e.s.	37	18	4	United Kingdom 12.
Manufactured:				
Ammonia	3	1	(3)	Mainly from United Kingdom.
Nitrogenous	39,957	70,848	45,377	West Germany 9,410; Canada 9,229.
Phosphatic	41,002	187,976	75,746	Morocco 83,000; Egypt 14,560.
Potassic	81,010	139,623	328	Canada 133,133; U.S.S.R. 4,021.
Unspecified and mixed	42,145	30,330	1,226	Morocco 22,000; West Germany 3,420.
Fluorspar	58	301	—	China 88; Norway 80; France 40.
Graphite, natural	75	9	—	West Germany 5; United Kingdom 3.
Gypsum and plaster	122,888	79,000	15	Australia 41,691; Mexico 35,700.
Iodine including fluorine and bromine	12	10	(3)	Belgium-Luxembourg 5.
Lime	6	7	—	Australia 6.
Magnesium compounds:				
Magnesite, crude	7,482	3,689	—	China 3,602; Japan 50.
Oxides and hydroxides	6,275	6,603	121	Australia 4,037; China 2,153.
Mica:				
Crude including splittings and waste value, thousands	$184	$255	$6	Taiwan $103; China $65; Australia $47.
Worked including agglomerated splittings do.	$80	$104	$2	United Kingdom $60; Australia $15.
Nitrates, crude	68	59	5	West Germany 40; Poland 13.
Phosphates, crude	468,590	627,023	174,847	Nauru 308,586; Morocco 123,025.
Pigments, mineral: Iron oxides and hydroxides, processed	1,671	1,572	63	West Germany 1,368; United Kingdom 39.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$3,252	$3,974	$111	Australia $1,714; Thailand $1,394.
Synthetic do.	$109	$102	$1	Ireland $44; West Germany $31.
Quartz, piezoelectric units do.	—	$28	—	Japan $24; Brazil $3.
Salt and brine	90,874	65,226	4	Mexico 32,800; Australia 31,531.
Sodium compounds, n.e.s.:				
Soda ash	104	259	—	Australia 128; United Kingdom 50; Japan 42.
Sulfate	16,204	14,305	13,636	China 328; Austria 183.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	2,446	2,222	—	Republic of South Africa 673; China 613; India 292.
Worked value, thousands	$5,215	$8,586	$3	Italy $6,469; Australia $627.
Dolomite, chiefly refractory-grade	9	1,236	—	United Kingdom 1,162; West Germany 74.
Gravel and crushed rock	49	170	7	Australia 159.
Limestone other than dimension	24	—		
Quartz and quartzite	25	182	(3)	Australia 122; Netherlands 36.
Sand other than metal-bearing	761	789	155	Australia 461; Sweden 79; Japan 74.

See footnotes at end of table.

TABLE 3—Continued

NEW ZEALAND: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental:					
Crude including native and byproduct		126,843	107,209	137	Canada 106,807; Saudi Arabia 140.
Colloidal, precipitated, sublimed		65	114	1	Australia 92; Canada 20.
Sulfuric acid		34	69	22	West Germany 27; Australia 14.
Talc, steatite, soapstone, pyrophyllite		1,666	1,547	3	China 928; Australia 580.
Other:					
Crude	value, thousands	$439	$565	$31	West Germany $192; Austria $173.
Slag and dross, not metal-bearing		1,457	513	—	West Germany 380; Australia 80; United Kingdom 53.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		154	176	121	Italy 18; Trinidad and Tobago 18.
Carbon black		5,708	6,430	2,144	Australia 3,944; Japan 195.
Coal, all grades including briquets		977	629	16	United Kingdom 559; Australia 55.
Coke and semicoke		2,005	2,890	—	Australia 2,888; West Germany 2.
Gas, natural: Gaseous	value, thousands	$37	$21	$3	Australia $18.
Petroleum:					
Crude	thousand 42-gallon barrels	18,272	21,906	—	Saudi Arabia 13,658; United Arab Emirates 3,934; Indonesia 2,671.
Refinery products:					
Liquefied petroleum gas	42-gallon barrels	46	800	—	Netherlands 626; Sweden 139.
Gasoline	do.	2,137,988	NA		
Mineral jelly and wax	do.	36,139	51,305	6,690	Japan 17,802; China 15,457.
Kerosene and jet fuel	do.	160,417	NA		
Distillate fuel oil	do.	98,532	NA		
Lubricants	do.	341,677	NA		
Residual fuel oil	do.	167	NA		
Bitumen and other residues	do.	158	55	—	Australia 48; United Kingdom 6.
Bituminous mixtures	do.	1,976	1,757	418	Australia 842; United Kingdom 473.
Petroleum coke	do.	651,690	612,524	612,134	Australia 105; United Kingdom 24.

NA Not available.
[1]Table prepared by Audrey D. Wilkes.
[2]Excludes unreported quantity valued at $8,212,000.
[3]Less than 1/2 unit.
[4]Reported under SITC item number as "selenium, phosphorus, etc."

TABLE 4

NEW ZEALAND: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons per year unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Aluminum	New Zealand Aluminium Smelters Ltd., operator. Comalco NZ Ltd., 79.36%; Sumitomo Aluminium Smelting Co. Ltd., 20.64%	Bluff, Tiwai Point, South Island	259

See footnotes at end of table.

TABLE 4—Continued

NEW ZEALAND: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons per year unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Cement	Golden Bay Cement Co. Ltd., operator. Associated International Cement Ltd., 75%; and public shares, 25%	Portland plant, North Island	450
Do.	Milburn New Zealand Ltd., 100%	Westport plant, South Island	425
Coal	Coal Corp. of New Zealand Ltd. (State-owned), 100%	Waikato region, North Island	920
Gold	Macraes Mining Co. Ltd., 100%	Macraes Mine, near Dunedin, South Island	[1]2,500
Gold, silver	Cyprus Gold N.Z. Ltd., manager, 80%; and Todd Corp., 20%	Golden Cross Mine, near Waihi, North Island	[1] [2]3,425 [2] [3]8,175
Do.	Waihi Gold Mining Co. Ltd., operator. Amax Gold Mines Ltd., 28.5%; Welcome Gold Mines Ltd., 28.5%; Mineral Resources (NZ) Ltd., 28%; and Goodman Fielder Group, 15%	Martha Hill Mine, Waihi, North Island	[1]1,875 [3]5,000
Steel, crude	New Zealand Steel Ltd., manager. Helenus Corp. Ltd., owner. BHP Steel Ltd., 31%; Fisher and Paykel Industries Ltd., 25%; Steel and Tube Holdings Ltd., 25%; and Australia and New Zealand Banking Group Ltd., 19%	Glenbrook Steelworks, North Island	750
Do.	Pacific Steel Ltd., 100%.	Otahuhu Mini-steelworks, near Auckland, North Island	190
Petroleum: Natural gas, condensate	Fletcher Challenge Ltd., 100%	Maui offshore field, northwest of Waverley, North Island	[4]36
Petroleum: products	New Zealand Refining Co. Ltd., operator. Consortium of Shell Oil New Zealand Ltd; Europa Oil (NZ) Ltd.; Mobile Oil New Zealand Ltd.; Caltex Oil (NZ) Ltd.; and the State of New Zealand	Marsden Point Refinery, near Whangarei, North Island	[5]950

[1]Kilograms per year gold.
[2]Production scheduled to begin July 1991.
[3]Kilograms per year silver.
[4]Thousand cubic feet per day.
[5]Thousand 42-gallon barrels per day.

Ltd., a subsidiary of Sumitomo Chemical Co., which held the remaining 20.64%.

Discussions on privatization of the plant included a joint-venture buyout by Comalco and Sumitomo, which together would take a 25% interest, with ElectriCorp retaining a 25% interest, and the remaining 50% being floated to the public. This would ensure a continued long-term power supply to the smelter at competitive rates. Negotiations with the Government for the power-plant privatization were in obeyance at yearend.[4]

Ferronickel.—New Zealand Nickel Smelters Ltd. was pursuing financial backing to build a nickel smelter on South Island. Plans were to construct a 10,000-ton-per-year ferronickel plant, revised downward from 40,000 tons per year, using imported concentrates from New Caledonia. The ferronickel would contain about 75% iron and 25% nickel for the export market. The deep-water ports of Bluff, Dunedin, and Timaru on South Island tentatively have been announced as possible sites for the smelter because of an excess of power capacity and vast reserves of coal in the region, but strong environmental objections are anticipated.

Ferrosilicon.—Austpac Gold Exploration (N.Z.) Ltd. early in the year applied for the exploration rights of a 200-million-ton silica deposit on South Island with plans for eventually developing a 50,000-ton-per-year ferrosilicon plant to meet export demand in Asia and Europe.[5]

Gold.—Macraes Mining Co. Ltd. commenced production and poured the first bullion in November at its wholly owned Macraes Mine and treatment plant in the Otago region, 60 km north of Dunedin on South Island. The $28 million opencast mine was developed in just more than 9 months, ahead of schedule and within budget.[6] Macraes Mining bought BHP Gold Ltd.'s 70% interest in the property late in 1989 and subsequently became New Zealand's second operational lode gold miner. Output was expected to be 2,500 kg of gold in the first year, about 1,000 kg more than previously anticipated. The plant was expected to reach its full production rate of 3,100 kg/a in 1993.[7]

The Australian firm Resolute Resources, based in Perth, Australia, was planning to sell the alluvial gold operations of its subsidiary, Thames Minerals, near yearend. Thames Minerals was mining on the west coast of South Island, producing about 100 kg of gold from four plants.[8]

The Waihi Gold Co. Ltd. celebrated in midyear 1990 its second anniversary as operator of the open pit Martha Hill Mine at Waihi on the Coromandel Peninsula, North Island. During this time, Martha Hill processed about 3.5 million tons of ore and waste annually to extract about 1,900 kg of gold and 5,000 kg of silver per year. The mine at Martha Hill, originally operated during 1878-1952, produced about 155 tons of gold and 965 tons of silver. Waihi Gold is a joint venture between Amax Gold Mines Ltd., 28.5%; Welcome Gold Mines Ltd., 28.5%; Mineral Resources (NZ) Ltd., 28%; and the Goodman Fielder Group, 15%. The remaining estimated mine life was 10 to 12 years.[9]

The joint venture between Cyprus Gold N.Z. Ltd., 80%, and a subsidiary of the privately owned Todd Corp., 20%, was granted a license in May, after more than a 10-year wait, to mine its Golden Cross property near Waihi at the base of the Coromandel Peninsula, North Island.[10] The plan to mine the deposit, in an environmentally sensitive area, was given the go-ahead after the High Court rejected an appeal by an environmental organization to reverse an earlier court ruling. The mine, which will have an estimated life of 8 years, was expected to commence production in July 1991. It will be a combined open pit-underground operation producing about 3,425 kg of gold and 8,175 kg of silver per year.[11]

The partnership agreement between Heritage Mining NL, the most active explorer and largest holder of prospecting licenses in the Coromandel Peninsula of New Zealand, and Forsayth New Zealand Ltd., a wholly owned subsidiary of Australia's Forsayth NL, terminated November 20 without being renewed. Heritage Mining continued to prospect, but was seeking alternative funding to replace that provided previously by Forsayth.[12]

Iron and Steel.—In an antirecessionary move at yearend, New Zealand Steel began offering voluntary early retirement to 500 employees at its Glenbrook Steelworks, 60 km south of Auckland at Glenbrook, to reduce its work force from 2,230 to about 1,700. The company's integrated primary production was to remain at about 700,000 tons per year, almost equivalent to the mill's nominal capacity. Production of semifinished steel was to be maintained, but the output of finished products would be reduced following a sharp drop in demand in the domestic market. Production from the electric arc furnaces was also to be curtailed, depending on the price of scrap versus export prices for semifinished steels.[13]

New Zealand Steel reached full capacity operation of its semimanufacturing plant, producing 28,000 tons of slab and billet in the first 2 weeks of October following a series of equipment upgrades.[14]

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. New Zealand has 15.7 billion tons of in situ coal resources, of which 8.6 billion tons is considered recoverable by mining techniques presently employed in New Zealand.[15] Most of the lignite resources, if mined, would require large-scale mining techniques not currently used in the country.

New Zealand's reserves 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, large-scale exploration, prospecting, and development projects face a high level of public opposition because of potential environmental degradation. The estimated gold reserves in the Buller, Grey, and Hokitika River valleys on the Coromandel Peninsula are 311 tons. Additional alluvial reserves contain an estimated 93 tons of gold.[16]

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.

The communications and transportation infrastructure of New Zealand was well developed. There is 4,700 km of Government-owned railroads; 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. There are 33 principal airports with permanent-surface runways out of an aggregate of 157 serving the country. Inland waterways, of which there is about 1,600 km, are of little importance to the transportation industry. International shipping ports include Auckland, Christchurch, Dunedin, Tauranga, and Wellington.[17] Electric generating capacity in 1989 was reportedly 7.8 million kilowatts, of which about 75% was generated from hydroelectric power stations, 7% from geothermal stations, and 18% from fossil fuels (14% natural gas- and 4% coal-fired thermal plants).[18]

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

TABLE 5

NEW ZEALAND: RESERVES OF MAJOR MINERAL COMMODITIES

Commodity		Reserves
Coal:		
Bituminous	million metric tons	315
Lignite	do.	7,055
Sub-bituminous	do.	1,230
Gold, alluvial	thousand kilograms	404
Iron sands	million metric tons	850
Petroleum:		
Condensate	million 42-gallon barrels	157.2
Crude	do.	39.4
Natural gas	billion cubic feet	4,855

Source: U.S. Embassy, Canberra, Australia.

OUTLOOK

Coal production in New Zealand is expected to decrease in as much as the Government has scaled back the operations of its wholly owned coal mining corporation, Coal Corp. of New Zealand Ltd. The commercial commitment for gold mining, owing to the sustained increase in the price of gold, 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.[19] However, regulatory constraints and environmental concerns have thus far effectively limited any major expansion of the gold mining industry, as only the largest corporations with sound financial backing have the resources to sustain the long mining license application period. Mining companies, while encouraged by geological investigations, are increasingly unwilling to put up with a seemingly endless array of environmental studies, which can make the mining approval process last up to 10 years.[20]

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[1]Where necessary, values have been converted from New Zealand dollars (NZ$) to U.S. dollars at the rate of NZ$1.68=US$1.00.

[2]New Zealand's fiscal year begins on Apr. 1 and ends on Mar. 31 of the year stated.

[3]Metal Bulletin (London). No. 7463, Mar. 5, 1990, p. 11.

[4]—. No. 7511, Aug. 30, 1990, p. 9.

[5]—. No. 7458, Feb. 11, 1990, p. 11.

[6]—. No. 7536, Nov. 26, 1990, p. 12.

[7]—. No. 7561, Feb. 28, 1991, p. 10.

[8]—. No. 7529, Nov. 1, 1990, p. 9.

[9]Gold Gazette (Subiaco, Western Australia). V. 2, No. 84, Aug. 27, 1990, p. 11.

[10]Mining Engineering. V. 42, No. 9, Sept. 1990, p. 1070.

[11]Mining Journal (London). V. 315, No. 8075, June 15, 1990, p. 470.

[12]Metal Bulletin (London). No. 7538, Dec. 3, 1990, p. 17.

[13]—. No. 7542, Dec. 17, 1990, p. 25.

[14]—. No. 7531, Nov. 8, 1990, p. 45.

[15]U.S. Embassy, Canberra, Australia. State Dep. Telegram 05213, June 6, 1989, 7 pp.

[16]Work cited in footnote 15.

[17]U.S. Central Intelligence Agency. The World Fact Book 1990, pp. 226-227.

[18]Search (Carlton, Victoria). V. 22, No. 2, Mar. 1991, p. 65.

[19]California Mining Journal. V. 59, No. 7, Mar. 1990, p. 13.

[20]Work cited in footnote 15.

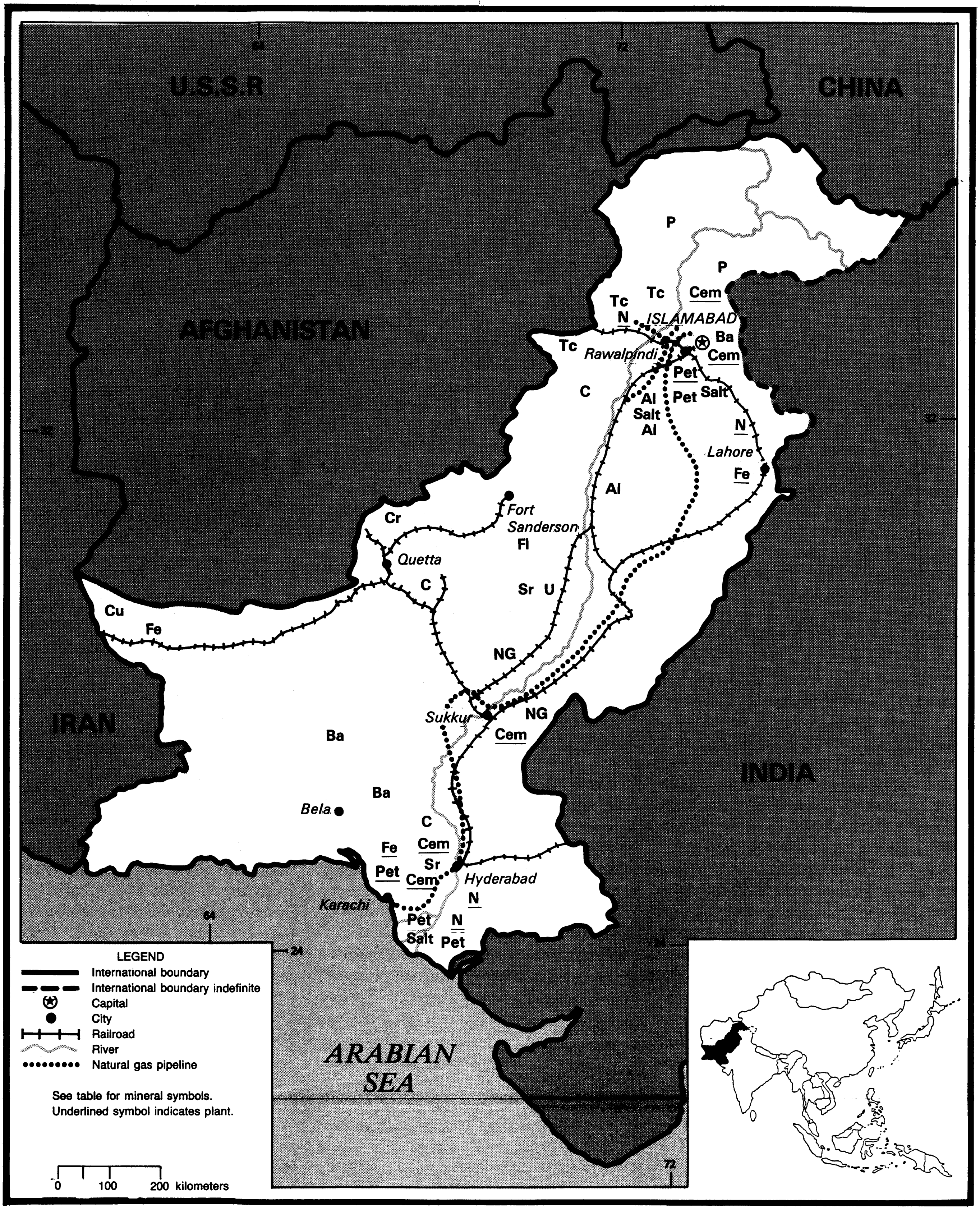
OTHER SOURCES OF INFORMATION

Ministry of Commerce
P.O. Box 1473
Wellington, New Zealand
Telephone: 04/720 030
Fax: 04/739 930

Mining & Exploration Association Inc.
P.O. Box 27314
Wellington, New Zealand
Telephone: 04/851 141
Fax: 04/851 155

PAKISTAN

AREA 803,940 km² **POPULATION 117 million**



THE MINERAL INDUSTRY OF PAKISTAN

By Chin S. Kuo

The country's fiscal problems worsened as a result of a high inflation rate, poor industrial performance, and decreased foreign aid. The Government allotted a large sum for defense by raising revenues with the help of higher prices for fertilizers and petroleum products. During the Gulf crisis, it desperately purchased finished oil products from the spot market to replace the country's main source of supply from Kuwait, which had been meeting almost all of Pakistan's energy needs. To reduce the current account deficit and stimulate expansion of the economy, the Government undertook economic reforms, including privatization of state-controlled industries and further deregulation of domestic and foreign investments. In the fertilizer industry, the Government provided new incentives, including the establishment of fertilizer plants without prior approval, a reduction of up to 50% on import duties in plant equipment, duty-free import of phosphate rock, and a fixed price for gas for a 10-year period. Any plants that were to be built in certain areas would be able to benefit from a 10-year tax-free period.

Pakistan has a wide array of mineral resources. In addition to oil and natural gas, the country has a variety of other minerals such as coal, copper, gem stones, gypsum, iron ore, marble, and phosphate rock. The Government planned a national campaign to study and exploit its mineral wealth in order to reduce costly mineral imports. The Asian Development Bank was to provide a loan of $390,000[1] to finance the 10-year project.

The country's Resource Development Corp. entered a joint venture for the $285 million Saindak Project with China Metallurgical Construction Corp. to mine, mill, and produce blister copper together with gold and silver as byproducts. Annual production of copper was to total 14,300 tons, gold 1.33 tons, and silver 2.5 tons for export to China, Japan, and Europe. However, gold output was to be retained by the Government. The project, in Baluchistan Province's Chagai district near the country's border with Iran and Afghanistan, planned to use Chinese machinery and equipment in credits of $84 million, to which repayment was to be made with copper. The first phase of the project was to develop the south ore body, which was expected to be completed by 1994. Total reserves for the south, north, and east ore bodies were estimated at 412 Mmt.

New deposits of good-quality iron ore were discovered in the Kirana Hills, near Chiniot, Punjab Province. The country's iron ore reserves were estimated at more than 430 Mmt. Pakistan Steel Co. approved eight new projects for downstream operations, two of them were to be in Lahore and the others in Karachi. The state-owned company began an expansion project to increase steel production from 1.5 Mmt/a to 3.0 Mmt/a by 1996. The U.S.S.R. agreed to provide credits of $95 million for the expansion. Currently, the plant operated at 88% capacity. Pakistan Steel also considered plans for new minimills in Chichali-Kalabagh and in Nokkundi. People's Steel Mills, a special steel producer, was restarted with Government funds of $950,000.

The Geological Survey of Pakistan discovered rich lead and zinc deposits at Duddar and Surmai, in the Bela-Khudzar area of Baluchistan Province. The Duddar deposit, 135 km northwest of Karachi, has about 660,000 tons of ore, with an average lead content of 2.99% and zinc content of 15.45%. The Surmai deposit's reserves are estimated to be 2.93 Mmt with an average combined lead and zinc content of 6.5%. Earlier, 10 Mmt of lead-zinc ore and a barite deposit were discovered at Gunga near Khudzar.

State Cement Corp. was to renovate and modernize two cement works in Punjab Province. The $96 million project financed by the World Bank was to be carried out by the Building Materials Industry Corp. of China for completion in 1992. State Cement operates 15 plants, accounting for approximately 75% of the country's total production. Seven new cement plants were expected to be in production by 1991 in the private sector, which were to increase the existing capacity by 2 Mmt/a.

The newly explored emerald occurrences at Shamozai in Swat were auctioned by the provincial government of North West Frontier. Two old emerald mines at Mingora and at Gujjar Killay were being operated by the Gemstone Corp. of Pakistan. The latter is owned 51-49 by the Federal and provincial governments. Four new granite projects were to be constructed at Tharpaker in Sind Province and were estimated to cost $31.3 million for quarries and four processing plants. Annual capacities of the plants were 20,400 m^3 of granite block and 1.07 Mm^2 of polished slabs.Pakistan met 80% of its nitrogen and 25% of phosphate fertilizer requirements through domestic production, and the shortfall was met through imports. Total fertilizer demand was estimated to be 1.9 Mmt, of which 1.435 Mmt was nitrogen, 425,000 tons phosphate, and 40,000 tons potash. The estimate represented an overall increase of 5.6% over that of the previous period. Al-Noor Fertilizer Industries planned to construct a 330,000 mt/a diammonium phosphate plant at Dhabeji near Port Qassim, 50 km north of Karachi. Part of the financing for the $167 million project was to come from the Islamic and Asian Development Banks. Work on the project was planned to begin in early 1991, with completion scheduled in 1993. Joint-venture partners were Jordan Phosphate Mines Co., Office Cheriffen des Phosphates of Morocco, and Texasgulf of the United States, each having a 10% equity stake.

Pakistan Mineral Development Corp. was mining kaolin at Nagar Parkar in Sind Province and planned to build a beneficiation plant nearby. Federal Chemicals and Ceramics Corp. operated a kaolin mine in the Shah Dheri district of Swat in North West Frontier Province. Hunza Minerals Ltd. produced kaolin from mines around Hunza in the same province and operated a beneficiation plant at Hattar in the Abbotabad district. Salt mining over a 162-km^2 area in the Salt Range was being managed by the Pakistan Mineral Development Corp., and private-sector companies were extracting salt from another 40-km^2 area.

Pakistan has about 175 Mmt of proven coal reserves. The 70-km^2 Lakhra coalfield in Sind Province was estimated to have enough bituminous reserves to sustain a production level of 900,000 mt/a for 50 years as a fuel source for a planned 300-MW powerplant. About 750,000 mt/a of lignite was to be supplied to three coal-fired powerplants of 50 MW each being installed at Khanot in Lakhra. The lignite reserves in Lakhra's southern block were estimated at 240 Mmt.

A natural gas project funded by a $30 million loan from the World Bank included construction of a gas-purification plant and expansion of its distribution system by 8.5 Mm3/d. Private- sector participation in the system was to be increased to 60% by investment in Sui Northern Gas Pipeline, Ltd.

The country planned to speed up oil exploration and increase domestic production in the face of rising demand. Amoco Corp., Exxon Corp., and Texaco Inc. of the United States signed exploration agreements with Pakistan. Other foreign companies from Austria, Ireland, and the United Kingdom also obtained exploration contracts. About 59 wells were to be drilled by private and public companies, more than one-half of these by the state-owned Oil & Gas Development Corp. New areas were to be explored in Baluchistan and Sind Provinces. Pakistan has estimated proven reserves of oil at 862 Mbbl and gas at 736 Mm^3.

Pakistan produced 60,000 bbl/d of crude oil against demand of 200,000 bbl/d, which has been rising at about 12% per year. It imported almost 70,000 bbl/d of petroleum products. The Government planned to build new oil refineries to achieve the production goal of 54,000 bbl/d. Refineries at Attock and Karachi were to be expanded to increase production in an attempt to cut costly imports. The 30,000-bbl/d refinery at Bedin was approved for construction at a cost of $92 million. A hydrocracker at Karachi was completed in 1990.

The Government launched a new policy to involve the private sector in power generation as the country was extremely short of electricity to develop an industrial economy. More than 20 local and foreign investors proposed to set up powerplants with a total output of 4,000 MW in addition to the current capacity. About 40% of Pakistan's energy requirements was met by oil, 35% by natural gas, and the rest mainly by coal. The country's power generating capability was to be increased by using large domestic coal reserves. Three coal-fired powerplants were to be built by Dongfong Electric Co. of China at a total cost of $70.5 million. In addition, the Chinese firm was to provide a credit of $65 million for equipment and machinery. Completion dates were expected to be March 1992, September 1992, and January 1993, respectively. A $1.1 billion thermal powerplant on the Hub River near Karachi was planned to generate 1,300 MW of power. Mitsui & Co. of Japan, Hawker Siddley of the United kingdom, Xenal of Saudi Arabia, and Pakistani companies were to be involved in this project.

TABLE 1

PAKISTAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
METALS						
Aluminum: Bauxite, gross weight		2,881	3,447	2,452	1,967	2,581
Antimony ore:						
Gross weight		—	45	—	51	59
Sb content[e]		—	7	—	8	9
Chromium: Chromite:						
Gross weight		8,299	10,181	3,327	27,105	18,191
Cr content[e]		2,739	3,330	1,090	8,900	6,000
Iron and steel:						
Pig iron	thousand tons	892	897	933	[e]1,000	[e]1,000
Steel, crude[e]	do.	800	1,100	1,000	1,000	1,000
Lead, refined, secondary[e]		1,000	2,000	2,000	2,000	2,500
Manganese ore:						
Gross weight		635	30	—	—	—
Mn content[e]		190	9	—	—	—
INDUSTRIAL MINERALS						
Abrasives, natural: Emery		4,972	[e]3,500	2,005	1,360	54,961
Barite		39,047	10,031	22,198	29,718	23,329
Cement, hydraulic	thousand tons	[e]6,130	6,832	7,041	[e]7,000	e/7,200
Chalk		2,192	4,292	5,035	4,165	3,175
Clays:						
Bentonite		1,282	2,537	4,880	5,466	3,235
Fire clay		87,522	122,513	124,581	130,627	81,856
Fuller's earth		15,228	17,945	12,395	15,436	16,489
Kaolin (china clay)		37,056	32,208	41,968	39,907	61,630
Other		520,000	680,661	924,237	880,382	1,012,083
Feldspar		11,575	6,675	9,026	7,703	10,249

See footnotes at end of table.

TABLE 1—Continued

PAKISTAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
INDUSTRIAL MINERALS—Continued						
Fluorspar		4,353	3,528	284	4,741	5,312
Gypsum, crude		373,000	449,013	374,258	466,969	477,671
Magnesite, crude		1,757	3,824	3,081	8,750	4,274
Nitrogen: N content of ammonia		1,154,400	1,179,000	1,173,000	[e]1,175,000	[e]1,180,000
Phosphate rock:[e]						
Gross weight		50,000	32,000	35,000	40,000	42,000
P_2O_5		16,000	10,000	11,000	[r]12,800	13,000
Pigments, mineral, natural: Ocher		608	1,792	1,040	2,394	1,382
Salt:						
Rock	thousand tons	576	268	406	721	763
Marine	do.	242	251	266	250	14
Total	do.	818	519	672	971	777
Sand and gravel:						
Gravel		—	10,750	—	—	—
Sand:						
Bajri and common		136,964	208,339	[e]210,000	[e]210,000	[e]220,000
Glass		115,000	148,783	133,991	181,187	131,042
Sodium compounds, n.e.s.:						
Caustic soda		[e]54,000	56,571	61,344	[e]60,000	[e]61,000
Soda ash, manufactured		130,894	133,133	134,106	[e]135,000	[e]135,000
Stone:						
Aragonite and marble		168,000	228,619	211,896	260,178	254,305
Dolomite		136,271	141,846	69,131	59,228	82,642
Limestone	thousand tons	6,339	7,278	6,428	7,897	7,810
Other (reported as "ordinary stone")	do.	677	551	[e]580	[e]600	[e]600
Strontium minerals: Celestite		997	1,114	488	956	1,799
Sulfur:						
Native		890	[e]1,120	690	—	175
Byproduct, all sources[e]		26,000	26,000	25,000	25,000	25,000
Total[e]		26,890	27,120	25,690	25,000	25,175
Talc and related materials: Soapstone		23,021	23,278	37,429	38,290	30,177
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades	thousand tons	2,025	2,419	3,199	2,642	2,733
Coke	do.	630	526	[e]600	[e]600	[e]620
Gas, natural:						
Gross production	million cubic feet	392,485	410,849	437,300	[e]450,000	[e]450,000
Marketed production (sales)[e]	do.	370,000	388,000	413,000	425,000	425,000
Natural gas liquids[e]	thousand 42-gallon barrels	65	70	75	75	80
Petroleum:						
Crude	do.	15,065	15,230	16,310	[e]16,500	[e]17,000
Refinery products:						
Gasoline	do.	5,865	7,012	[e]7,000	[e]7,000	[e]7,200
Jet fuel	do.	3,944	3,712	[e]3,700	[e]4,000	[e]4,000
Kerosene	do.	3,209	3,015	[e]3,000	[e]3,000	[e]3,200
Distillate fuel oil	do.	13,152	13,040	[e]13,000	[e]13,000	[e]13,200
Residual fuel oil	do.	11,382	11,635	[e]12,000	[e]12,000	[e]12,100
Lubricants	do.	980	1,005	[e]1,000	[e]1,000	[e]1,000
Other	do.	3,526	3,615	[e]4,000	[e]4,000	[e]4,100
Total	do.	42,058	43,034	[e]43,700	[e]44,000	[e]44,800

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through June 28, 1991.

TABLE 2

PAKISTAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS				
Aluminum: Metal including alloys:				
Scrap	—	52	—	Bahrain 31; Netherlands 21.
Unwrought and semimanufactures	24	39		United Arab Emirates 38; West Germany 1.
Chromium: Ore and concentrate	366,120	53,121	—	Finland 32,103; China 11,618; Yugoslavia 9,400.
Copper: Metal including alloys, scrap	([2])	2,538	—	India 857; Iran 684; Japan 307.
Iron and steel: Metal:				
Scrap	[3]350	4,701	—	Japan 3,617; India 852; United Arab Emirates 83.
Pig iron, cast iron, related materials	—	20,550	—	Bangladesh 11,000; Indonesia 9,550.
Steel, primary forms	355,930	5,236	—	All to Japan.
Semimanufactures:				
Bars, rods, angles, shapes, sections	20	188	20	Bangladesh 150; West Germany 18.
Universals, plates, sheets	270	—		
Wire	11,810	—		
Tubes, pipes, fittings	12,600	196	—	Afghanistan 183; United Arab Emirates 13.
Lead:				
Metal including alloys, scrap	170	—		
Oxides	13	—		
Nickel:				
Ore and concentrate	480	—		
Metal including alloys, scrap	—	37	—	All to Japan.
Silver: Ore and concentrate[4] kilograms	—	931	—	All to United Kingdom.
Titanium: Oxides	—	21	—	All to Oman.
Zinc: Oxides	—	2	2	
Other: Ashes and residues	—	4	—	All to Japan.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Dust and powder of precious and semiprecious stones including diamond value, thousands	—	$33	—	All to United Kingdom.
Grinding and polishing wheels and stones	8	161	—	All to Bangladesh.
Cement	—	132	—	All to Sri Lanka.
Chalk	—	15	—	All to Ghana.
Clays, crude	510	80	—	Bangladesh 60; United Arab Emirates 10.
Feldspar, fluorspar, related materials	—	21	—	All to Taiwan.
Fertilizer materials:				
Crude, n.e.s.	1,828,480	177,569	251	United Arab Emirates 177,318.
Maufactured: Phosphatic	1,050	—		
Lime	—	5,000	—	All to Singapore.
Mica: Crude including splittings and waste	1,940	12	—	All to Kuwait.
Pigments, mineral: Iron oxides and hydroxides, processed	—	2	—	All to United Arab Emirates.
Precious and semiprecious stones other than diamond: Natural value, thousands	$7,668	$7,379	$936	Hong Kong $3,178; West Germany $1,839.
Salt and brine	350,770	20,021	102	India 16,014; United Arab Emirates 2,270.
Sodium compounds, n.e.s.: Carbonate, manufactured	2,398	—		

See footnotes at end of table.

TABLE 2—Continued

PAKISTAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
INDUSTRIAL MATERIALS—Continued					
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		86,920	10,141	137	Taiwan 4,060; Japan 1,370; Italy 1,151.
Worked		—	20	—	China 13; Republic of Korea 7.
Dolomite, chiefly refractory-grade		16,960	67,920	—	All to Bangladesh.
Gravel and crushed rock		10,260	874	43	Bangladesh 831.
Sand other than metal-bearing		1,800	130	—	All to Bahrain.
Sulfur: Sulfuric acid		126	—		
Other:					
Crude		102,770	25,671	9,571	China 9,050; Japan 5,950.
Slag and dross, not metal-bearing		—	1	—	All to Bangladesh.
MINERAL FUELS AND RELATED MATERIALS					
Carbon black		1,980	801	—	India 260; Bangladesh 180; Kenya 151.
Coke and semicoke		4,000	27,500	—	All to Belgium-Luxembourg.
Petroleum:					
Crude	thousand 42-gallon barrels	1,624	1,932	—	Singapore 1,025; China 907.
Refinery products:					
Lubricants	do.	917	130	—	Mainly to India.
Residual fuel oil	do.	8,192	440	—	Yemen 147; United Arab Emirates 73.
Bitumen and other residues	do.	1,679	32	—	United Arab Emirates 29; Mauritius 3.
Bituminous mixtures	do.	41	19	—	Sudan 13; United Arab Emirates 4.

[1]Table prepared by Audrey D. Wilkes.
[2]Unreported quantity valued at $5,139,000.
[3]Unreported quantity valued at $1,678,000.
[4]May include platinum-group metals.

TABLE 3

PAKISTAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	9	17	2	China 6; West Germany 6.
Aluminum:				
Oxides and hydroxides	9,462	61,780	80	Brazil 40,012; Japan 19,580.
Metal including alloys:				
Scrap	233,960	24,830	98	Saudi Arabia 5,933; United Arab Emirates 4,476; Netherlands 3,872.
Unwrought	9,756	7,906	—	United Kingdom 2,078; Bahrain 1,875; West Germany 1,317.
Semimanufactures	7,296	8,931	106	West Germany 1,921; Venezuela 1,313; Belgium-Luxembourg 1,299.
Beryllium: Metal including alloys, all forms	413	—		
Chromium:				
Ore and concentrate	200	53	—	Netherlands 50; United Kingdom 3.
Oxides and hydroxides	128	131	2	China 75; United Kingdom 30.

See footnotes at end of table.

TABLE 3—Continued

PAKISTAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
METALS—Continued				
Cobalt: Oxides and hydroxides	2	6	(2)	Netherlands 3; China 1; United Kingdom 1.
Columbium and tantalum: Tantalum metal including alloys, all forms	920	—		
Copper: Metal including alloys:				
Scrap	290	1,917	—	Iran 1,031; Singapore 514; Afghanistan 229.
Unwrought	850	1,208	303	West Germany 579; Hong Kong 100.
Semimanufactures	10,811	10,245	248	Japan 1,742; United Kingdom 1,606; West Germany 1,515.
Iron and steel:				
Iron ore and concentrate including roasted pyrite thousand tons	15,277	1,393	—	Australia 562; India 309; Brazil 292.
Metal:				
Scrap	4,701,060	375,295	126,901	United Kingdom 82,023; United Arab Emirates 51,805; Kuwait 23,149.
Pig iron, cast iron, related materials	19,050	7,235	—	United Kingdom 3,338; Switzerland 1,304; Canada 1,012.
Ferroalloys:				
Ferromanganese	112,520	12,222	—	China 4,015; Norway 3,411; Switzerland 1,494.
Ferrosilicon	136,250	13,716	—	China 6,583; Brazil 3,421; U.S.S.R. 909.
Unspecified	13,520	1,430	23	United Kingdom 345; West Germany 314; China 265.
Steel, primary forms	458,670	57,251	6,737	Hong Kong 10,845; Argentina 10,596; Zambia 8,919.
Semimanufactures:				
Bars, rods, angles, shapes, sections	449,660	37,790	31	Japan 9,830; West Germany 9,355; Republic of Korea 5,240.
Universals, plates, sheets	3,253,030	344,189	56,139	Japan 110,608; West Germany 33,476; United Kingdom 25,975.
Hoop and strip	113,470	3,883	172	Brazil 1,413; Japan 1,008; West Germany 868.
Rails and accessories	1,590	3,488	—	France 2,000; Belgium-Luxembourg 1,000.
Wire	49,990	3,876	46	Republic of Korea 1,657; Japan 789.
Tubes, pipes, fittings	537,660	92,713	2,532	West Germany 62,218; Japan 10,500; China 6,082.
Castings and forgings, rough	24,700	588	2	Yugoslavia 172; West Germany 128; Turkey 73.
Lead:				
Ore and concentrate	1,400	353	—	All from Morocco.
Oxides	631	513	—	China 330; West Germany 143.
Metal including alloys:				
Unwrought	3,460	4,937	2	Italy 2,071; Australia 963; United Kingdom 743.
Semimanufactures	44	48	(2)	Singapore 39; China 4.
Magnesium: Metal including alloys, all forms	4	1	—	NA.
Manganese:				
Ore and concentrate	250,830	11,841	—	India 11,499; China 292.
Oxides	2,310	1,461	—	Singapore 550; China 305; Belgium-Luxembourg 269.
Mercury	58	52	—	United Kingdom 32; Italy 14.

See footnotes at end of table.

TABLE 3—Continued

PAKISTAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989 United States	Sources, 1989 Other (principal)
METALS—Continued				
Nickel:				
Matte and speiss	270	2	—	All from Canada.
Metal including alloys:				
Scrap	370	37	—	All from Japan.
Unwrought	595	564	—	Canada 338; United Kingdom 184.
Semimanufactures	177	160	2	West Germany 45; United Kingdom 44; Norway 25.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$4	$143	—	West Germany $87; Switzerland $56.
Silver:				
Ore and concentrate[3] do.	$4	$3	—	All from Singapore.
Metal including alloys, unwrought and partly wrought do.	$2	$71	—	Switzerland $50; West Germany $15.
Tin: Metal including alloys:				
Scrap	770	509	—	Kuwait 170; Yemen 138; Netherlands 106.
Unwrought	72	119	—	Malaysia 107; Singapore 9.
Semimanufactures	31	310	—	Japan 300; China 6.
Titanium: Oxides	3,610	4,105	63	West Germany 1,134; Australia 1,076; United Kingdom 945.
Tungsten: Metal including alloys, all forms	574	50	—	Switzerland 49.
Uranium and/or thorium:				
Ore and concentrate value, thousands	$19	—		
Metal including alloys, all forms do.	$5	$2	—	All from Thailand.
Zinc:				
Oxides	791	1,455	15	China 814; France 391; Singapore 81.
Metal including alloys:				
Scrap	2,780	561	—	United Kingdom 250; West Germany 206.
Unwrought	16,702	19,593	—	Republic of Korea 4,902; Australia 2,959; Spain 2,697.
Semimanufactures	64	73	—	West Germany 26; United Kingdom 25; Japan 14.
Other:				
Ores and concentrates	9,720	6,155	18	Iran 4,375; Afghanistan 1,200.
Base metals including alloys, all forms	62	131	1	Hong Kong 78; China 39.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	19,460	1,042	182	Indonesia 313; China 197; Netherlands 168.
Artificial: Corundum	32	103	—	West Germany 50; Brazil 28; France 18.
Dust and powder of precious and semi-precious stones including diamond value, thousands	$3	$27	$6	China $14; United Kingdom $5.
Grinding and polishing wheels and stones	1,060	1,074	6	China 557; West Germany 114.
Asbestos, crude	63,990	8,386	—	Canada 7,797; Singapore 299; Republic of South Africa 193.
Barite and witherite	42,780	39	17	United Arab Emirates 11; West Germany 11.
Boron materials:				
Crude natural borates	500,180	([4])	—	All from United Kingdom.
Oxides and acids	491	563	—	Italy 437; China 66; Turkey 59.

See footnotes at end of table.

TABLE 3—Continued

PAKISTAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Cement		384,980	21,509	99	United Arab Emirates 13,759; West Germany 2,053.
Chalk		67,870	5,369	6	Belgium-Luxembourg 4,328; United Kingdom 746.
Clays, crude		(5)	13,399	1,362	United Kingdom 7,608; China 1,901.
Cryolite and chiolite		110	13	—	West Germany 12; Denmark 1.
Diamond:					
Gem, not set or strung	value, thousands	$2	—		
Industrial stones	do.	—	$20	—	All from West Germany.
Diatomite and other infusorial earth		(6)	283	127	Netherlands 137; Spain 18.
Feldspar, fluorspar, related materials		35,580	82	—	China 72; United Kingdom 10.
Fertilizer materials:					
Crude, n.e.s.		—	21	—	Australia 18; West Germany 3.
Manufactured:					
Ammonia		3	19	—	United Kingdom 17; Japan 2.
Nitrogenous		222,920	27,538	—	Qatar 23,750; United Arab Emirates 3,558.
Phosphatic		7,477,400	210,468	148,890	Netherlands 36,438; France 25,140.
Unspecified and mixed		255,000	543,164	251,547	Netherlands 74,612; Saudi Arabia 62,500; Morocco 60,004.
Graphite, natural		24,020	3,638	126	China 1,854; France 812; Madagascar 255.
Gypsum and plaster		270	53	29	United Kingdom 24.
Iodine including fluorine and bromine		29	69	31	West Germany 33.
Lime		50	834	—	NA.
Magnesium compounds: Magnesite, crude including calcined		20,810	1,006	—	China 252; Japan 232; West Germany 154.
Mica:					
Crude including splittings and waste		270	8	4	United Kingdom 4.
Worked including agglomerated splittings		10	2	—	Mainly from China.
Nitrates, crude		180	1,418	—	China 1,124; Belgium-Luxembourg 189.
Phosphates, crude		2,565,570	206,564	—	Jordan 206,443.
Pigments, mineral: Iron oxides and hydroxides, processed		2,887	2,558	1	China 2,086; West Germany 375.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$786	$45	—	Thailand $43; Hong Kong $2.
Synthetic	do.	$3	$7	—	West Germany $4; Hong Kong $1; Thailand $1.
Salt and brine		680	1,960	—	West Germany 1,924; Malaysia 35.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		28	32	—	United Kingdom 20; Japan 12.
Sulfate, manufactured		7,151	6,614	6	China 5,266; Turkey 1,000.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		2,190	157	—	All from Italy.
Worked		10,460	41	—	Do.
Dolomite, chiefly refractory-grade		(7)	1,529	—	Italy 1,110; United Kingdom 341.
Gravel and crushed rock		—	2	—	All from United Kingdom.
Limestone other than dimension		270	4	—	West Germany 3; Qatar 1.

See footnotes at end of table.

TABLE 3—Continued

PAKISTAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel:—Continued				
Sand other than metal-bearing	1,650	32,358	100	West Germany 32,110; Japan 64.
Sulfur:				
Elemental:				
Crude including native and byproduct	476,670	40,701	—	Iran 20,379; Iraq 10,000; Kuwait 8,078.
Colloidal, precipitated, sublimed	1,265	465	—	Saudi Arabia 287; Japan 174.
Sulfuric acid	21	134	4	Netherlands 41; Belgium-Luxembourg 34.
Talc, steatite, soapstone, pyrophyllite	19,300	4,333	—	Nicaragua 3,154; China 1,041.
Other:				
Crude	(8)	6,827	342	Singapore 1,846; Japan 1,793; China 1,043.
Slag and dross, not metal-bearing	14,180	16,692	—	Switzerland 10,354; Yugoslavia 3,716; West Germany 2,567.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	1,050	178	53	Saudi Arabia 74; United Kingdom 46.
Carbon black	2,129	2,625	13	China 1,414; Republic of Korea 674; Singapore 190.
Coal:				
Anthracite and bituminous	8,510,050	905,232	—	Australia 662,470; Canada 242,332.
Briquets of anthracite and bituminous coal	1,050	—		
Lignite including briquets	2,790	59	13	United Kingdom 36; United Arab Emirates 10.
Petroleum:				
Crude thousand 42-gallon barrels	264,107	27,051	—	Saudi Arabia 16,200; Iran 7,701; United Arab Emirates 3,149.
Refinery products:				
Liquefied petroleum gas 42-gallon barrels	(2)	255	23	Norway 232.
Gasoline thousand 42-gallon barrels	13,211	1,439	(2)	Kuwait 1,438.
Mineral jelly and wax do.	923	80	1	China 47; Hungary 10.
Kerosene and jet fuel do.	47,758	5,066	—	All from Kuwait.
Distillate fuel oil do.	187,119	21,202	—	Kuwait 21,200.
Lubricants do.	603	78	8	Netherlands 18; West Germany 17.
Residual fuel oil do.	(9)	8,920	—	Kuwait 8,857.
Bitumen and other residues do.	(2)	—		
Bituminous mixtures do.	123	30	(2)	Mainly from United Kingdom.
Petroleum coke do.	—	(2)	—	All from United Kingdom.

NA Not available. [1]Table prepared by Audrey D. Wilkes. [2]Less than 1/2 unit. [3]May include platinum-group metals. [4]Unreported quantity valued at $26,000. [5]Unreported quantity valued at $4,826,000. [6]Unreported quantity valued at $44,000. [7]Unreported quantity valued at $571,000. [8]Unreported quantity valued at $1,118,000. [9]Unreported quantity valued at $30,521,000.

[1]Where necessary, values have been converted from Pakistani rupees (Rs) to U.S. dollars at the rate of Rs21.05=US$1.00 for 1990.

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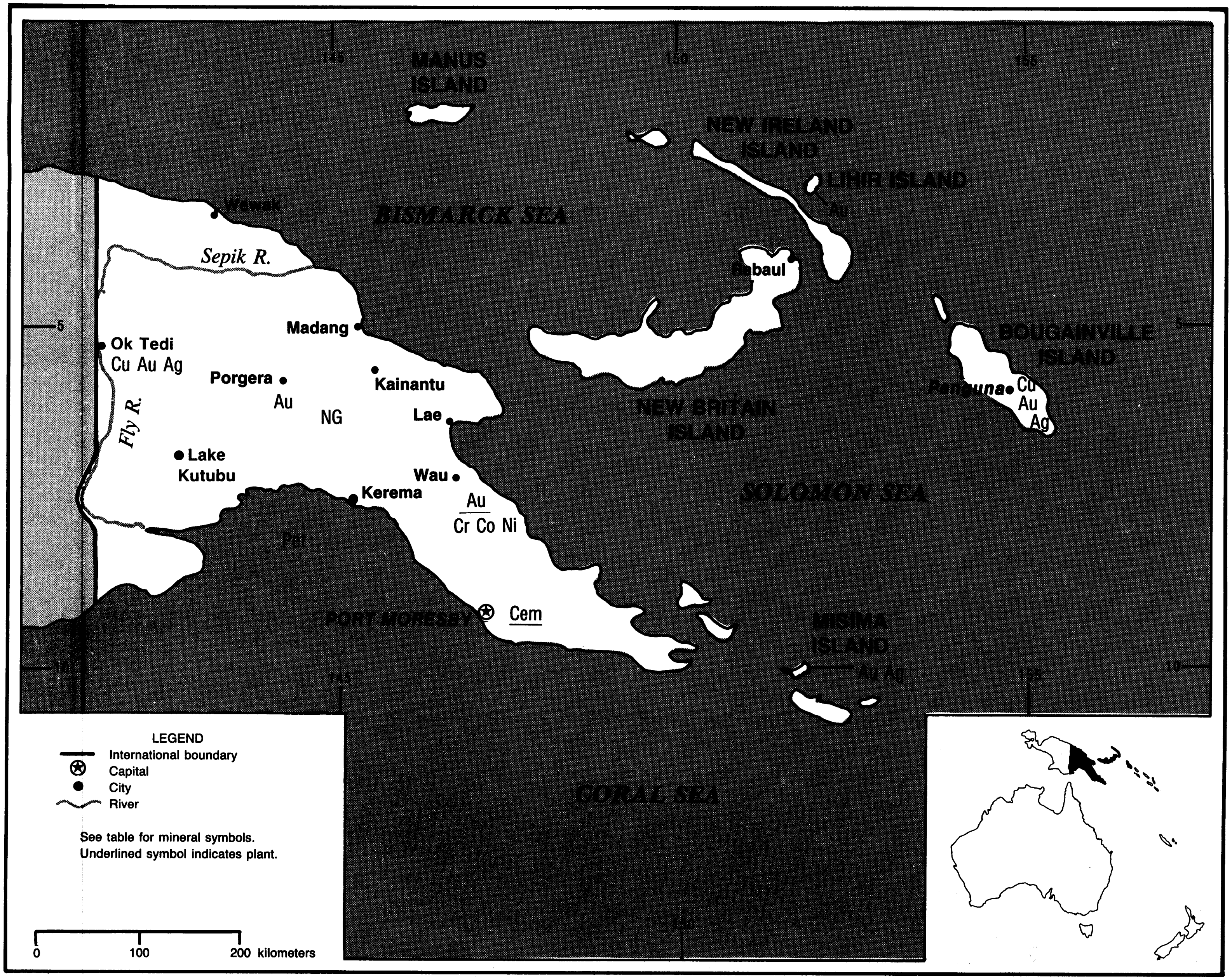
PAPUA NEW GUINEA

AREA 461,690 km² **POPULATION 3.8 million**



THE MINERAL INDUSTRY OF PAPUA NEW GUINEA

By Travis Q. Lyday

Mining in Papua New Guinea during 1990 ranged from primitive panning (remnants of Mount Kare gold rush, Southern Highlands Province) and sluicing (mopping-up operations at Wau open pit, Morobe Province) gold operations to modern mechanized copper (Ok Tedi, Western Province) and gold (Misima, Milne Bay Province) operations. Porgera also became the country's first underground mine when it commenced production in August.

GOVERNMENT POLICIES AND PROGRAMS

The Government devalued the kina by 10% on January 10 as part of a program to trim expenditures and tighten the overall budget in order to cope with the effects on the nation's economy caused by the closure of the huge Panguna Mine on Bougainville Island. Previously, the kina had been kept on par with the U.S. dollar.[1] Other steps proposed to curtail spending included a 10% cut in the country's budget, stringent restrictions on growth in commercial lending, and voluntary wage restraints.[2] The Panguna Mine averaged 180,000 mt/a of copper, about 2.5% of total world output, and provided 45% of the country's export earnings and 17% of the country's internally generated revenue during the period 1972-88, the last full year of production.[3]

The Panguna Mine was owned, operated, and managed by Australia's Bougainville Copper Ltd. (BCL), a 53.6%-owned subsidiary of Australia's CRA Ltd. The remaining BCL shares were owned by the Government, 19.1%, and public shareholders, 27.3%.[4]

PRODUCTION

Five mines operated in Papua New Guinea during 1990. One, the Wau Mine, was closed late in the year, and a new one, the Porgera Mine, was opened in August. These mines produced virtually all of the country's mineral production, excluding clays, sand and gravel, and stone for construction purposes. Another mine, the Panguna Mine on Bougainville Island, North Solomons Province, remained closed throughout the year owing to militant action by dissident landowners.

TRADE

Papua New Guinea's economy remained agrarian, relying mainly on coffee, cocoa, and copra and palm oils for export earnings. Agriculture was estimated to have accounted for more than one-third of both the GDP and foreign exchange earnings of the country. The country's mineral industry was the second most important sector of the economy, however. 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. The Porgera Mine was expected to replace Panguna's role in the national economy beginning with its first complete year of production in 1991.

Because large-scale smelting and refining did not occur in the country, although a gold buying and smelting industry that expanded into small-scale refining in 1989 served small-scale producers, virtually the entire mineral production was exported in the form of dore, bullion, and copper-gold-silver concentrates.

STRUCTURE OF THE MINERAL INDUSTRY

Papua New Guinea is a mineral-rich country with a modern mining industry. Mining is the only large-scale industry in the country, directly accounting for about 18% of the GDP.[5] In addition to several large, world-class mining operations, there are also numerous small-scale mining sites. The country has a long history of mining, beginning in 1888 with the discovery of gold on what is now Misima Island, and is a world-class producer of both copper and gold, ranking 11th in copper and 8th in gold in 1990.

At yearend, there were 152 active prospecting authorities in the country covering

TABLE 1

PAPUA NEW GUINEA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
Copper, mine output, Cu content		178,211	217,699	218,634	204,025	170,210
Gold, mine output, Au content	kilograms	35,075	33,250	38,129	27,538	31,035
Silver, mine output, Ag content	do.	55,582	61,066	70,408	93,672	[e]130,000

[e]Estimate. [p]Preliminary.

[1]Table includes data available through Aug. 2, 1991.

[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	1989	1990
Germany, Federal Republic of	67,600	30,337
Japan	114,300	77,460
Korea, Republic of	28,200	25,897
Spain	7,900	—
Unspecified	8,000	21,930
Total	226,000	155,624

Source: World Metal Statistics, June 1991.

about 20% of the land area and spending about $22 million on exploration programs; and 40 active petroleum prospecting licenses covering about 240,000 km² and spending about $225 million on work programs. There were about 40 and 17 companies exploring for minerals and petroleum, respectively, in Papua New Guinea at yearend.[6]

COMMODITY REVIEW

Metals

Copper.—The giant Panguna copper-gold mine on Bougainville Island in North Solomons Province was mothballed effective January 7 with the laying off of 2,000 of the remaining employees. This was a reversal of the previous plan's intention, which was announced on December 1, 1989, that a startup of mining would be attempted at the beginning of 1990. The mine had been on care and maintenance since mid-May 1989 because of equipment sabotage and killings by terrorist landowners. About 300 employees were retained to maintain the mine workings, provide protection for the company's assets, and sustain a nucleus for rebuilding the organization once production became feasible again. In order to finance the

TABLE 3

PAPUA NEW GUINEA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Copper, gold, silver	Ok Tedi Mining Ltd., operator. BHP Minerals Holdings Pty. Ltd., managing shareholder, 30%; Amoco Minerals (PNG) Co., 30%; State of Papua New Guinea, 20%; Metallgesellschaft AG, 7.5%; Degussa AG, 7.5%; and Deutsche Finanzierungsgesellschaft Fuer Beteiligungen in Entwicklungslaendern GmbH., (West German Development Co.), 5%	Ok Tedi Mine, Mount Fubilan, Western Province	[1]145 Cu 15 Au 30 Ag
Do.	Bougainville Copper Ltd., operator and manager. CRA Ltd., 53.6%; public shareholders, 27.3%; and State of Papua New Guinea, 19.1%	Panguna Mine, Bougainville Island, North Solomons Province	[1,2]180 Cu 10 Au
Gold	Kennecott Explorations (Australia) Ltd., 80%, and Niugini Mining Ltd., 20%	Ladolam deposit, Lihir Island, New Ireland Province	[3]25 Au
Do.	Mt. Kare Alluvial Mining Pty. Ltd., operator. CRA Minerals (PNG) Pty. Ltd., 51%; and local landowners, 49%	Mount Kare deposit, 18 kilometers southwest of Porgera, in Southern Highlands Province	[4]4.7 Au
Gold, silver	Misima Mines Pty. Ltd., operator and manager. Placer Niugini Pty. Ltd., 80%, and State of Papua New Guinea, 20%	Misima Mine, Misima Island, Milne Bay Province	12 Au 81 Ag
Do.	Placer (P.N.G.) Pty. Ltd., manager, 30%; Highlands Gold Properties Pty. Ltd., 30%; RGC (Papua New Guinea) Pty. Ltd., 30%; and State of Papua New Guinea, 10%	Porgera Mine, 130 kilometers west of Mount Hagen, in Enga Province	28 Au
Natural Gas	BP Petroleum Development Ltd., operator-manager, 95%; and Oil Search Ltd., 5%	Hides Gasfield, Southern Highlands Province	[5,6]425

See footnotes at end of table.

TABLE 3

PAPUA NEW GUINEA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Petroleum	Chevron Niugini Pty. Ltd., the operator-manager, 25%; BP Petroleum Development, 25%; Ampol Exploration Ltd., 21.23%; BHP Petroleum (PNG) Inc., 12.5%; Oil Search Ltd., 10.02%; Merlin Pacific Petroleum Co., 6.25% (State of Papua New Guinea's 22.5% share uptake will reduce holdings pro rata)	Kutubu Oilfield, Southern Highlands Province	[7][8]128

[1]Thousand metric tons.
[2]Closed since May 1989 because of civil unrest.
[3]Mining planned to start in late 1992 at the rate of 8 metric tons per year; full capacity expected to be reached in 1993.
[4]Scheduled to begin in 1991.
[5]Thousand cubic meters per day.
[6]Scheduled to begin in 1993.
[7]Thousand barrels per day.
[8]Scheduled to begin in 1992.

skeleton "maintenance" crew and the retrenchments, the two major company shareholders agreed to lend BCL $45 million for up to 2 years. CRA will provide $33.2 million and the Government $11.8 million.[7]

In February, BCL decided to close the mine and withdrew all of its company personnel from the island. Arrangements were made with local contractors on the island for minimum protection of BCL's assets, and a small managerial group was retained elsewhere in the country to facilitate the resumption of operations when it became safe to do so.[8]

The four insurers for BCL will pay $106 million in an agreement settling the court action filed by the company last year for compensation for the closure of the Panguna Mine.[9]

After three aborted attempts at talks between representatives of the Government and the dissident landowners on Bougainville Island, who had become secessionist rebels known as the Bougainville Revolutionary Army, deliberations finally began in late July in an attempt to find a satisfactory solution regarding the future of both the island and the Panguna Mine.[10] An interim accord to restore communications and essential services, which were disrupted by a Government-imposed blockade of the island, was agreed to after 1 week of negotiations. However, the main issues—the future of both the island and the mine—were deferred to a second round of talks.[11]

Landowners unhappy with the progress of negotiations concerning royalty payments and environmental issues caused a 2-day shutdown at the Ok Tedi copper-gold mine, Western Province, by blocking the access road between the township of Tabubil and the mine and its hydroelectric powerplant on January 18.[12] In early May, 1,600 mine and transport workers went on a weeklong strike over demands concerning promotions and training. Copper production of 2,000 mt/d was not affected, however.[13]

The Ok Tedi Mine is on Mount Fubilan in the Star Mountains of Western Province, 18 km from the Indonesian Province of Irian Jaya. The mine was operated by Ok Tedi Mining Ltd. Australia's BHP Minerals Holdings Pty. Ltd. was the managing shareholder with 30%. The other shareholders were Amoco Minerals (PNG) Co., a wholly owned subsidiary of Amoco Minerals Co. of the United States, 30%; the state of Papua New Guinea, 20%; Metallgesellschaft AG, 7.5%; Degussa AG, 7.5%; and the West German Development Co. (Deutsche Finanzierungsgesellschaft Fuer Beteiligungen in Entwicklungslaendern GmbH.), 5%.

Copper production in metric tons, by mine, is shown in table 4.

TABLE 4

PAPUA NEW GUINEA: PRODUCTION OF COPPER, BY MINE

(Metric tons)

Mine	1989	1990
Bougainville Mine	68,717	—
Ok Tedi Mine	135,308	170,210
Total	204,025	170,210

Gold.—At the start of the year, Highlands Gold Ltd. purchased five prospecting authorities in East New Britain Province for $6.3 million[14] from East New Britain Mining Pty. Ltd. The claims included the Wild Dog prospect where exploration has delineated a resource of 1 million tons of ore grading 6 g of gold per ton with associated copper and silver.[15]

Mining from the small-scale Mount Victor and Clarkes Ridge open pits, owned and operated by Niugini Mining Ltd., near Kainantu in Eastern Highlands Province ceased in January, and processing of stockpiled ore was completed in February.[16]

The joint-venture partners in the Porgera gold-silver project submitted a plan in March to the Government outlining a phased expansion of the project to incorporate production of 72 tons of gold from additional recoverable reserves delineated in April 1989.[17] Implementation of the plan should provide additional benefits, including increased employment, royalties, and tax revenues, aiding both the landowners and the Enga Provincial Government.[18] The mine is operated by the Porgera Joint Venture, owned by Placer (P.N.G.) Pty.

Ltd., a wholly owned subsidiary of Placer Pacific Ltd., acting as manager and holding a 30% interest; Highlands Gold Properties Pty. Ltd., a wholly owned subsidiary of Highlands Gold, 30%; RGC (Papua New Guinea) Pty. Ltd., a member of the Renison Goldfields Consolidated Ltd. group of companies, 30%; and the State of Papua New Guinea through Mineral Resources Porgera Pty. Ltd., 10%.

The revised plan recommended a three-phase program of construction after the initial development of a 1,500-mt/d underground mine to feed a 1,000-mt/d concentrator and a conventional carbon-in-pulp (CIP) extraction circuit,[19] which began in June 1989 and was completed in September 1990. Phase one included the addition of three autoclaves and an oxygen plant to boost recovery of refractory gold by pressure oxidation. The recoverable (refractory portion) gold contained in the residue from the CIP circuit was to be stored on-site in a CIP tailings storage pond until the oxidation facilities became operational, expected to be by the third quarter of 1991.[20]

Phase two, scheduled to begin near yearend 1991 with completion by the first quarter 1993, included expansion of the underground operation to 3,500 mt/d and raising the capacity of the concentrator, which will be fed by both the underground mine and the stored CIP residues, to 4,500 mt/d. Stripping of the surface mine and construction of additional infrastructure, including a 30-MW electric powerplant using natural gas from the Hides Gasfield near Tari, the Suyan township, and an airstrip at Kairik, also will begin in phase 2.[21]

Phase 3 of the plan will include the development of an open pit, providing 1,000 mt/d of ore initially but increasing to 4,500 mt/d by yearend 1993, raising the capacity of the concentrator to 8,000 mtpd, and the installation of three additional autoclaves and another oxygen plant. When the known underground reserves are exhausted, expected in 1997, production from the open pit operation will be increased to 8,000 mt/d.[22]

The phased expansion will provide some increase in gold production, from the 25-mt/a average, in the early years of operation as a consequence of the increased underground mining rate from high-grade reserves previously announced.[23]

The first stage of phase 1 development at Porgera, consisting of an underground mine and a basic concentrator for the CIP treatment process, was completed on schedule and within budget. Commissioning of the plant commenced in July, and the first shipment of gold bullion was dispatched to refiners in August.[24] The mine was officially opened in a ceremony October 20.[25] It was also announced that the mine would produce more than 28,000 kg of gold per year for the first 6 years, up from 25,000 kg/a forecast previously, placing Porgera among the top six producers in the world.[26] The mine will not be operating at full capacity until the end of 1993, however.[27]

The Government approved a special mining lease in September for the $5 million development of the Mount Kare alluvial-colluvial gold deposit, Southern Highlands Province, 18 km southwest of the Porgera Mine. The mine will be operated and managed by the Mt. Kare Alluvial Mining Co. Pty. Ltd., owned 51% by CRA Minerals (PNG) Pty. Ltd., a wholly owned CRA subsidiary, and 49% by local landowners through the Kare-Puga Development Corp.[28] Mining was expected to begin early in 1991, initially at the rate of about 700 kg of gold per year, increasing to 4,500 kg of gold per year.[29] An adjoining lease was thought to have high potential for hard-rock gold mineralization and was planned to be explored further by CRA.[30]

The partners in the Ladolam gold prospect were planning to submit their proposal for a mining license to the Government in January 1991, with mining of the oxide ore to start in late 1993 and sulfide ore to begin in the third quarter of 1994.[31] Ladolam, more commonly known as Lihir, is on the east coast of Lihir Island, which is northeast of the island of New Ireland, in the Bismarck Archipelago in New Ireland Province. Gold mineralization occurs within an elliptical volcanic crater (caldera) in four separate areas, namely, Coastal, Kapit, Lienetz, and Minifie.[32] The prospect was being developed by a joint venture comprised of Kennecott Explorations (Australia) Ltd., 80%, acting as manager, and Niugini Mining Ltd. of Australia, 20%.

Mine planning called for 3.6 Mmt of oxide ore per year to be processed during the first year of mining operations. In the second year, mining of sulfide ore was scheduled to commence at 4.1 Mmt/a, increasing to 4.8 Mmt in the fourth year. Gold production was scheduled to be 7,800 kg in the first year of production, increasing to 25,000 kg per year thereafter. Mine life was expected to be 37 years.

Financing the $1 billion mine through international lenders became more complicated in the wake of the secessionist movement and Panguna Mine closure on Bougainville Island, as well as more minor demands by landowners at other mining operations. But the partners continued to sound out bankers who will be needed to lend at least $500 million, and possibly as much as $700 million, to develop the mine to the operational stage.[33]

Gold production in kg, by mine, is shown in table 5.

TABLE 5

PAPUA NEW GUINEA: PRODUCTION OF GOLD, BY MINE

(Kilograms)

Mine	1989	1990
Bougainville Mine	6,977	—
Misima Mine	4,698	9,865
Ok Tedi Mine	15,863	[e]12,900
Porgera Mine	—	8,270
Total	27,538	[e]31,035

[e]Estimated.

Mineral Fuels

While hydrocarbon exploration in Papua New Guinea has been oriented toward finding oil, until the Iagifu Oilfield was discovered in 1986, all previous discoveries consisted of natural gas and/or natural gas liquids with no, or limited, crude oil. In 1988 and 1989, the adjacent Hedinia and Agogo Oilfields were discovered and, together, these three fields have become the country's first commercial oil discovery, renamed the Kutubu Oilfield by the project operator after a lake and town of the same name in the region. The Kutubu joint-venture project, in the PPL-100 license area, Southern Highlands Province of the Papuan Basin, was owned by Chevron Niugini Pty. Ltd., the operator-manager with a 25% equity share; BP Petroleum Development Ltd., 25%; Ampol Exploration Ltd., 21.23%; BHP Petroleum (PNG) Inc., 12.5%; Oil Search Ltd., 10.02%; and the 79.5% Japanese-owned Merlin Pacific Petroleum Co., 6.25%. The Government announced in midyear its intention of taking up its 22.5% share option, reducing the shareholdings pro rata, to become the largest single shareholder.

Chevron Niugini applied in May to the Government for a petroleum development license for the Kutubu oil export project, which was granted final approval in December. With the approval, the joint venture will own the approximately 260-km-long pipeline that will carry oil to an offshore storage and loading platform in the Gulf of Papua.[34] The planned startup rate was set at 128,000 bbl/d, although the development plan provided for daily output of up to 140,000 bbl.[35]

The Government approved in September the development of Papua New Guinea's first commercial gasfield, and construction was begun by Kinhill Engineers' Petroleum and Chemical Division. The Hides Field, Southern Highlands Province, will supply natural gas from two wells to provide power to the Porgera Mine, 70 km distant in Enga Province. Construction was expected to take 15 months. The Hides Field will provide up to 425,000 m³/d of natural gas, generating 60 MW of electrical power for the Porgera Mine.[36]

The Hides Development Project was owned by BP Petroleum Development Ltd., 95%, and Oil Search, 5%.[37] BP was also investigating the feasibility of constructing a 1,500-bbl/d microrefinery for the sale of refined product to industrial and retail users in the immediate area.[38]

Reserves

Papua New Guinea, part of the largest of the islands of Oceania, also has the greatest share of Oceania's mineral resources. However, only three major mineral commodities—copper, gold, and silver—are produced. Although there is no immediate prospect of other major commodities being produced on a large scale, subeconomic resources of chromium, cobalt, and nickel are known. Mineral sands containing magnetite and titanomagnetite occur at many locations around the coasts of Papua New Guinea. Minor quantities of platinum-group metals have been recovered from alluvial gold workings. Resources of bauxite are known on Manus Island in the Admiralty Islands and on New Ireland Island. In addition, lead, manganese, molybdenum, and zinc mineralization, as well as occurrences of industrial minerals such as limestone, phosphate guano, and phosphate rock, are widely known.[39]

Natural gas and petroleum potential is thought to be large, but sufficient proven reserves necessary for commercial production are only now being discovered.

TABLE 6

PAPUA NEW GUINEA: RESERVES OF MAJOR MINERAL COMMODITIES, BY DEPOSIT, FOR 1990

Commodity, deposit, and location	Reserves[e]
Copper	
Ok Tedi, Western Province	400 million tons ore grading 0.8% copper.
Panguna, North Solomons Province	530 million tons ore grading 0.4% copper.
Gold	
Hidden Valley, Morobe Province	60 tons recoverable gold.
Lihir (Ladolam), New Ireland Province	600 tons recoverable gold.
Misima, Milne Bay Province	77 tons recoverable gold.
Mount Kare, Enga Province	3 million cubic meters alluvium grading 5 grams gold per cubic meter.
Ok Tedi, Western Province	400 million tons ore grading 0.67 grams gold per ton.
Porgera, Enga Province	342 tons recoverable gold.
Wild Dog, New Britain Province	1 million tons ore grading 6 grams gold per ton, with associated copper and silver.
Petroleum	
Kutubu Oil Field, Southern Highlands Province	170 million barrels recoverable petroleum.
Silver	
Hidden Valley, Morobe Province	1,000 tons recoverable silver.
Misima, Milne Bay Province	1,175 tons recoverable silver.
Porgera, Enga Province	585 tons recoverable silver.

[e]Estimated.

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. The length of inland waterways totals about 10,940 km and is of little importance to the transportation industry. There are 19 principal airports with permanent-surface runways out of an aggregate of 575 in the country. International shipping ports include Lae, Madang, Port Moresby, and Rabaul. There are no railroads. Electric generating capacity in 1989 was 397,000 kilowatts.[40]

The vast majority of the in-place infrastructure in the country is concentrated in the provincial capitals.

OUTLOOK

The terrorist activity that forced the closure of the Panguna Mine in May 1989, coupled with other unrest, e.g., proliferous urban street crime, is making financiers edgy and, thus, will almost certainly make project financing for new projects, such as the Ladolam gold deposit at Lihir and the Kutubu Oilfield with its associated pipeline and marine terminal, much more difficult.

Sustained production from the huge copper and gold mines at Ok Tedi and Porgera will contribute significantly to the economy. 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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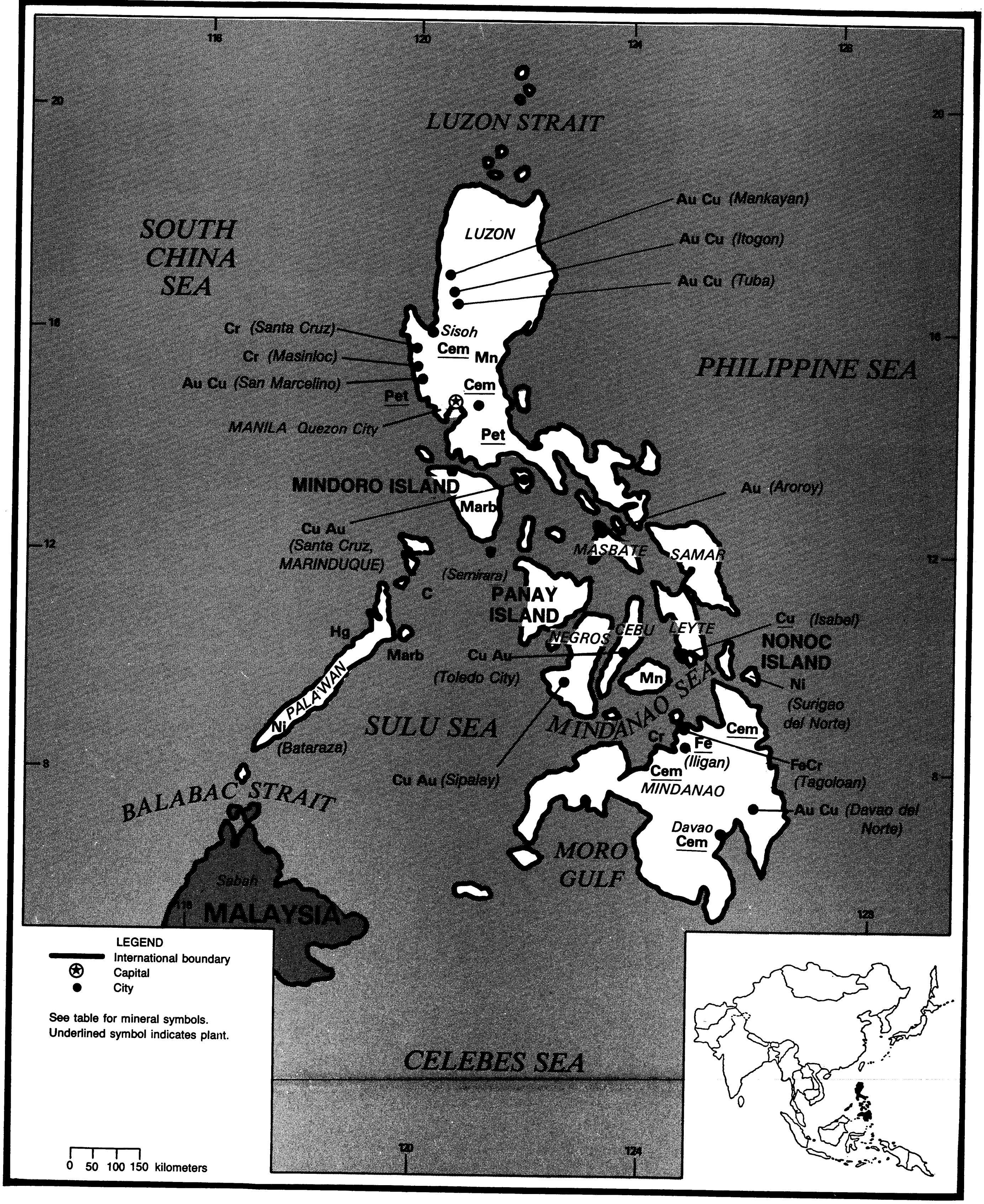
Chamber of Mines & Petroleum
P.O. Box 1032
Port Moresby, Papua New Guinea
Telephone: 212 988
Fax: 217 107

Department of Minerals and Energy
P.O. Box 352
Konedobu, Papua New Guinea
Telephone: 227 617
Fax: 213 701

PHILIPPINES

AREA 300,000 km² **POPULATION 65.7 million**



THE MINERAL INDUSTRY OF THE PHILIPPINES

By Travis Q. Lyday

The Philippines' GDP increased by 2.6% on a constant dollar basis over that of 1989 to $46.7 billion[1] in 1990, the fourth successive year of real growth. The mining and quarrying sector of the minerals industry grew by 2% during 1990, contributing 2% of the GDP. By value, copper and gold remained the country's most important mineral products. The value of cement production, petroleum refining, and other mineral commodity processing added modestly to the GDP.

The Philippines was among the top world producers of chromite, copper, and gold in 1990, ranking 9th, 11th, and 8th, respectively. It was an important regional producer of other commodities, including ferrochromium (FeCr), ferrosilicon, mined nickel, and refined copper.

GOVERNMENT POLICIES AND PROGRAMS

The proposed mining code drafted in 1988 was still pending passage before the Filipino Congress at yearend. An interim mining law[2] continued to govern mining activities within the Philippines during 1990. The interim law extended the Mineral Resources Decree of 1974 until the Congress passed the necessary laws to implement the new system of granting mining rights in the Philippines.

A bill was drafted, led by the Mines and Geosciences Bureau (MGB) and supported by industry and various mining organizations, including the Chamber of Mines of the Philippines (CMP) and the national legislature, to amend the mining code restrictions for foreign ownership in order to increase exploration and development capital. The code, which limits overseas equity in mines to 40%, was to be altered to permit 100% foreign ownership in exploration companies. Upon success in finding an ore body, the exploration company could then be able to make a profit by selling into a joint venture that abides by the constitutional provision that there must be at least a 60% domestic control of a mine. Other proposed revisions included allowance for wholly foreign-owned mine development-construction companies, ore processing facilities, and marketing organizations. There also would be a less likely possibility of expropriation, even in national emergencies, because their seizure would have to be compensated.

The Government-owned Asset Privatization Trust (APT) was tasked to privatize 19 mining firms, among other major nonperforming Filipino assets, during 1990. Three of these firms—Nonoc Mining and Industrial Corp. (NMIC), a nickel mine and refinery valued at $325 million; North Davao Mining Corp., a copper mine appraised at $305 million; and Maricalum Mining Corp., a copper mine and milling operation valued at $60 million—constituted about 80% of the total value of APT's mining portfolio for sale. Although by yearend only two minor mining assets, Sabena Mining Corp. (gold, copper, and coal) and Batong-Buhay Gold Mines (gold), actually had been sold by the APT in public biddings, negotiations were completed in October for the sale of NMIC's assets.

At the request of the Government, the Metal Mining Agency of Japan will conduct a 3-year study on mining in the Philippines beginning in 1991. The studies, with an annual budget of about $675,000,[3] will take place at nickel-chromium mines on Palawan Island in the Southern Tagalog region and at gold-copper mines on Panay Island in the Western Visayas region.[4]

PRODUCTION

The value of nonfuel production of the Philippine mining industry improved slightly in 1990 to an estimated $971 million compared with $951 million in 1989. The value of production in the metals sector increased almost 2%, from $711 million to $725 million, with the production of gold and copper contributing by far the largest share, followed by beneficiated nickel and refractory chromite ore. Industrial mineral production was $246 million, also an increase of about 2% from that of 1989.

Work stoppages occurred as a result of several strikes in the minerals industry, and the power supply to mines in northern Luzon was interrupted when a severe summer drought reduced hydroelectric power supplies. Disruptions to production included a severe earthquake on July 16 and strong typhoons in August and November that caused severe damage to machinery, equipment, and plant facilities and other infrastructure because of torrential rains and associated flooding and landslides.

TRADE

Foreign exchange earnings from exports of mineral products were $835 million in 1990, a decrease of 16% from that of the previous year's level of $995 million. Copper concentrates remained the major mineral export commodity, with 1990 foreign exchange earnings up by 11%, from $226 million to $251 million. Gold exports earned the country $270 million in 1990, a decrease of 26% from that of 1989, $363 million, due mainly to the reduced price of gold.

During 1990, exports of chromite continued to tumble, ostensibly owing to the easing of sanctions against the Republic of South Africa following significant political reforms there. However, a rise in the domestic demand for refractory-grade chromite for use in cement processing, iron and steel production, and glassmaking softened the decrease in export demand.

STRUCTURE OF THE MINERAL INDUSTRY

The Philippines has one of the oldest and most active mining industries of Southeast Asia. It has a strong, established mining

TABLE 1

PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodities[2]	1986	1987	1988	1989[p]	1990[e]
METALS					
Arsenic: White (equivalent of arsenic acid)[e]	5,000	5,000	—	—	—
Chromium: Chromite, gross weight:					
Metallurgical-grade	85,271	69,429	26,168	105,153	[3]61,792
Chemical-grade	16,109	19,899	15,211	18,424	[3]20,240
Refractory-grade	72,850	98,572	87,879	92,985	[3]101,374
Total	174,230	187,900	124,258	216,562	[3]183,406
Cobalt, mine output, Co content	92	—	—	—	—
Copper:					
Mine output, Cu content	222,644	216,145	218,089	192,991	[3]182,139
Metal:					
Smelter	124,300	124,700	[r,e]159,200	105,000	110,000
Refined	134,547	132,118	132,183	132,200	[3]125,504
Gold, mine output, Au content kilograms	40,322	32,599	30,482	29,992	[3]29,234
Iron and steel:					
Ferroalloys, electric-furnace:					
Ferrochromium	[e]55,000	—	—	[r,e]19,500	22,000
Ferrosilicon[e]	20,000	—	—	9,000	10,000
Steel, crude[e] thousand tons	250	250	[3]331	300	300
Lead: Metal, secondary refined[e]	7,000	7,000	7,000	7,200	7,000
Manganese ore and concentrate, gross weight	232	421	2,251	3,002	[3]14,583
Nickel:					
Mine output, Ni content	12,790	7,818	10,349	15,380	[3]15,818
Metal, smelter	2,076	—	—	—	—
Silver, mine output, Ag content kilograms	54,499	52,374	54,634	50,630	[3]47,518
Zinc, mine output, Zn content	1,573	1,129	1,435	1,200	53
INDUSTRIAL MINERALS					
Barite	—	—	349	348	500
Cement, hydraulic thousand tons	[r]3,547	[r]3,320	4,300	[r,e]4,000	4,000
Clays:					
Bentonite	1,800	759	2,030	5,961	[3]16,484
Red[e]	350	300	300	350	[3]140
White	16,784	[e]7,000	4,730	[e]5,000	[3]25,849
Other	366,753	406,033	860,012	[e]500,000	500,000
Feldspar	6,661	11,996	9,199	36,803	[3]46,102
Gypsum and anhydrite:					
Natural	13,080	13,233	2,250	2,000	[3]2,000
Synthetic[e]	112,000	112,000	115,000	115,000	115,000
Lime	38,110	[e]20,000	3,924	[e]4,000	[3]12,470
Magnesite	[e]650	[e]650	([4])	4,796	700
Nitrogen: N content of ammonia	([4])	—	—	—	—
Perlite[e]	3,500	[r]5,500	[r]6,900	[r]1,100	[3]3,150
Phosphate:					
Guano	3,466	[e]1,000	1,470	48,347	[3]888
Phosphate rock	1,656	[e]8,000	8,103	4,139	[3]2,963
Pyrite and pyrrhotite (including cuprous), gross weight	244,028	341,417	379,328	[e]400,000	400,000
Salt, marine	785,354	446,532	492,080	488,674	[3]490,407

See footnotes at end of table.

TABLE 1—Continued

PHILIPPINES: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodities[2]		1986	1987	1988	1989[p]	1990[e]
INDUSTRIAL MINERALS—Continued						
Sand and gravel:						
Silica sand	thousand tons	259	213	308	185	292
Other[5]	thousand cubic meters	11,525	13,943	14,842	15,140	[3]15,673
Stone:						
Dolomite		281,346	[e]360,000	585,744	[e]500,000	[3]320,424
Limestone[6]	thousand tons	4,328	4,022	4,775	3,831	[3]3,837
Marble (dimension), unfinished[e]	cubic meters	[3]7,586	5,000	5,000	5,000	[3]6,391
Volcanic cinder[e]	do.	1,000	1,000	1,500	2,000	2,000
Tuff		—	—	47,515	[e]40,000	[3]79,133
Quartz		46,972	[e]80,000	58,603	[e]60,000	60,000
Crushed, broken, other[e 7]	thousand cubic meters	[3]599	1,000	1,000	1,000	1,000
Sulfur: S content of pyrite		113,473	158,179	[e]160,000	[e]195,000	[3]134,316
Talc [e]		1,000	—	27	—	—
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades		1,128,449	1,152,342	1,335,687	1,344,676	[3]1,186,531
Petroleum:						
Crude	thousand 42-gallon barrels	2,190	1,800	2,170	1,876	[3]1,727
Refinery products:						
Liquefied petroleum gas	do.	1,868	2,297	[e]2,500	[e]2,500	[e]2,500
Gasoline	do.	9,384	11,824	[e]12,800	12,600	[3]14,261
Jet fuel	do.	2,428	4,144	[e]4,500	4,420	[3]3,421
Kerosene[e]	do.	2,700	2,500	2,500	3,415	[3]3,897
Distillate fuel oil	do.	15,681	18,404	[e]19,900	20,806	[3]23,729
Residual fuel oil	do.	17,516	20,186	[e]21,800	22,160	[3]26,428
Other:						
Naptha	do.	1,670	2,448	[e]2,600	[3]4,367	
White spirit	do.	213	248	[e]300	[e]200	
Lubricants	do.	735	763	[e]800	[3]415	[3]5,547
Asphalt	do.	255	279	[e]300	[e]300	
Refinery fuel and losses[e]	do.	2,400	2,900	3,100	[3]3,052	[3]3,071
Total	do.	54,850	65,993	[e]71,100	74,235	82,854

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through June 28, 1991.
[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]Reported figure.
[4]Revised to zero.
[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.

structure. Mining in the Philippines operated on a leasehold system until 1987, when this system was abolished in favor of a new system of joint-venture or production-sharing agreements under policies governed by interim regulations until a new mining law and enabling regulations could be passed. The proposed mining code drafted in 1988 was still pending before the Filipino Congress at yearend. The new mining code will promote the involvement of foreign investors in large-scale exploration, development, and utilization of mineral resources while retaining small-scale development by Filipinos. State control over mineral resources gives the flexibility to undertake mining as a Government activity or to enter into coproduction, joint-venture or production-sharing agreements with the domestic private sector or with corporations and associations whose capital is owned 60% by Filipinos. In addition, the code will recognize the importance of foreign investment in the Filipino minerals industry by allowing 100% foreign equity in prospecting for and processing of minerals, with a 60% Filipino-owned requirement for development and utilization.

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 the 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.—Most of the chromite mined in the Philippines is refractory-grade contained at or near the surface in low-grade lateritic deposits. The higher grade metallurgical chromite is largely podiform and also occurs near surface, extending only to shallow depth. Historically, most of the refractory-grade chromite ore has been mined from the Masinloc Mine, with metallurgical-grade ore mined from the nearby Acoje Mine at Santa Cruz. Both deposits are in Zambales Province in northern Luzon.

The Benguet Corp., the country's largest operator, produces both refractory-grade ore at Masinloc for export and metallurgical-grade ore for feed to the 60,000-mt/a FeCr plant at Tagoloan, Misamis Oriental Province, Mindanao Island, operated by Ferrochrome Philippines Inc., a subsidiary of Voest-Alpine Stahl Linz GmbH of Austria.[5] Acoje Mining Co. Inc. is the owner of the Acoje Mine at Santa Cruz and also provides feed material to Voest-Alpine under a long-term contract.

Merlin Mining NL of Australia, which owns leases producing small amounts of chromite from alluvial material surrounding the Acoje Mine as well as a laterite deposit on Dinagat Island, Surigao del Norte Province, on the northern tip of Mindanao, purchased a 24.4% interest in Acoje Mining in 1990. Merlin Mining also became the manager of the Acoje Mine. The mine originally opened in the 1930's. Mine output had been declining in recent years, with production down to about 36,000 mt/a, because of labor unrest, unpaid debts, lack of maintenance, and the selling off of equipment thought to be superfluous. Merlin Mining planned to rejuvenate the mine and restore production to about 100,000 tons of chrome concentrate per year.[6]

Copper.—The $50 million expansion project of the Philippine Associated Smelting and Refining Corp. (PASAR) was approved by the National Economic Development Authority in midyear. PASAR planned to expand production at its copper flash smelter and electrolytic refinery on the island of Leyte by 25%, which would increase output to 172,500 tons of copper cathode.[7] The expansion was scheduled to be performed under a contract by an engineering subsidiary of Finland's Outokumpu Oy. Construction was planned for completion by April 1992, with the facility to be fully operational by early 1994. 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 Mining and Development Corp., 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 principally, in decreased ranking, to Japan, Taiwan, the Republic of Korea, and the domestic market.

Marcopper Mining Corp.'s Tapian ore body at its mine in the island province of Marinduque was depleted in June. The company was looking for financial aid to restart development of the nearby San Antonio ore body, 3 km away. Previous financial difficulties early in 1989 had stopped work on developing the San Antonio unit.[8] An agreement made near yearend by Marcopper with the Government's Bureau of Inland Revenue (BIR) may have opened up the possibility of partial funding for development of the San Antonio ore body from the Asian Development Bank (ADB). After denying tax liabilities following a suspension of tax payments due to depressed world copper prices by the previous Filipino Administration, Marcopper agreed to pay $15.1 million in monthly installments to BIR over a 10-year period, beginning in 1997. The payments would be increased if the price of copper on the London Metals Exchange goes above $2.42 per kg. With this agreement, Marcopper hoped to obtain a $31 million loan from the ADB for development of the project, which was to be designed to produce 30,000 tons of copper ore per day.[9]

Atlas obtained a $30 million loan from Japan's Mitsubishi Metal Corp. Atlas planned to use the monies as partial payment in the restructuring of its foreign debts. Atlas has a 15-year contract to supply Mitsubishi with 130,000 tons of copper concentrates annually.[10]

Copper production in metric tons, by company, is shown in table 3.[11]

Ferroalloys.—Ferrochrome Philippines' FeCr plant was shut down on October 20 for the remainder of the year after its electricity supply was cut off by the local supplier, Cagayan Electric Power and Light Co. (Cepalco). Until April, Ferrochrome purchased its power from the National Power Corp. (Napocor) using a line it partly had financed. In April, the local supplier Cepalco took over the power supply from Napocor to Ferrochrome. Following an ensuing billing dispute between Cepalco and Ferrochrome, electric power to the FeCr plant was disconnected, and the plant was forced to shut down.[12]

Gold.—Operations were suspended by the Government at Benguet's Antamok open pit in March for environmental concerns relating to construction of a drainage tunnel as part of the mine's expansion and to opposition by local landowners and small-scale miners.[13] Operations were resumed at the end of June.

Production began June 5th at the Nalesbitan Mine, 40% owned and managed by Gold Fields Philippines Corp., a subsidiary of Australia's Renison Goldfields Consolidated Ltd. and the largest open pit gold mine in the country. The remaining 60% interest was held by private interests. Development of the $4.5 million mine in Camarines Norte Province, Luzon, began in April 1989 and initially was expected to produce 500 kg/a of gold and 50 kg/a of silver by heap leaching 250,000 tons of ore.[14]

Benguet, the Philippine's largest gold producer with about 5,000 kg of gold output per year, suspended operations at its Acupan Mine, Benguet Province, northern Luzon, following a devastating earthquake on July 16. The earthquake damaged a transformer and brought down powerlines, leaving the mine without electrical power, and landslides blocked access roads to the mine site. Production at the mine near Baguio resumed in early August, but at only about 50% of capacity due to flooding.[15] The Province's airfield was also damaged. Lepanto Consolidated Mining Co. Inc. and Philex Mining Corp. reported little or no damage from the earthquake to their mine sites in the area, although an electrical power failure and several casualties in the residential area of Philex's mining quarters adversely affected normal production.[16]

In August and September, two severe typhoons hit northern Luzon that caused extensive damage to all of Benguet's and Philex's mining operations in the area. All of the mines were flooded, roads and drainage facilities were blocked, and plant

TABLE 2

PHILIPPINES: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
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.	Norzagaray, Luzon	950
Chromium, in 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
Coal	Semirara Coal Corp.	Semirara Island	1,000
Copper, in concentrate	Atlas Consolidated Mining and Development Corp.	Toledo City, Cebu	[4]138
Do.	Benguet Corp.	San Marcelino, Luzon	27
Do.	Far Southeast Gold Resources Inc.	Mankayan, Luzon	[5]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
Copper, refined	Philippine Associated Smelting and Refining Corp. (PASAR)	Isabel, Leyte	138
Ferrochromium	Ferrochrome Philippines Inc.	Tagoloan, Mindanao	160
Do.	Ferro-Chemicals Inc.	Manticao, Mindanao	15
Do.	Integrated Chrome	do.	24
Gold, in concentrate	Atlas Consolidated Mining and Development Corp.	Aroroy, Masbate; Toledo City, Cebu	[6]6,220
Do.	Benguet Corp.	Itogon, Luzon; San Marcelino, Luzon	[6]9,330
Do.	do.	Antamok Mine, Northern Province, Luzon	[6 7]2,500
Do.	Far Southeast Gold Resources Inc.	Mankayan, Luzon	[6]7,775
Do.	Gold Fields Philippines Corp.	Camarines Norte, Luzon	[6]500 [8]50
Do.	Lepanto Consolidated Mining Co. Inc.	do.	[6]2,500
Do.	Philex Mining Corp.	Tuba, Luzon	[6]6,220
Iron, sinter	Philippine Sinter Corp.	Cagayan de Oro, Mindanao	[9]5,000
Nickel, in concentrate	Rio Tuba Nickel Mining Corp.	Bataraza, Palawan	10
Nickel, refined	Philnico Mining and Industrial Corp.	Nonoc Refinery, Surigao del Norte Province	[10]27 [11]4.5
Petroleum	Caltex (Philippines) Inc.	Caltex Batangas Refinery, Batangas, Luzon	[12]68
Do.	Petron Corp.	Petron Bataan Refinery, Limay, Luzon	[12]156
Do.	Pilipinas Shell Petroleum Corp.	Shell Batangas Refinery, Batangas, Luzon	[12]70
Steel	National Steel Corp.	Iligan, Mindanao	300

[1]Metallurgical grade.
[2]Chemical grade.
[3]Refractory grade.
[4]Under construction.
[5]Scheduled to increase to 172,500 tons in 1994.
[6]Kilograms gold.
[7]Scheduled to start fourth quarter 1991.
[8]Kilograms silver.
[9]Self-fluxing sinter.
[10]Nickel.
[11]Nickel and cobalt in mixed sulfides.
[12]Thousand 42-gallon barrels per day.

TABLE 3

PHILIPPINES: PRODUCTION OF COPPER, BY COMPANY

(Metric tons)

Company	1989	1990
Atlas Consolidated Mining and Development Corp.	78,911	73,923
Maricalum Mining Corp.	30,275	33,922
Marcopper Mining Corp.	22,111	18,049
Benguet Corp.	18,160	16,424
Philex Mining Corp.	19,195	15,727
Lepanto Consolidated Mining Co. Inc.	12,993	13,487
North Davao Mining Corp.	11,346	10,607
Total	192,991	182,139

Source: Chamber of Mines of the Philippines.

facilities were damaged. At yearend, both companies were still operating at well below the levels of a year earlier. And, although the loss in 1990 was considerable, the decline in output was expected to take a much bigger toll over the long term. The Acupan Mine remained partially flooded despite continuous pumping. Benguet decided on a 6-year, $4 million plan to dig a tunnel beneath the mine's lowest shaft to drain the remaining water into a nearby river.[17]

Surigao Consolidated Mining Co. was planning near yearend a heap-leaching project in Mapawa, Surigao del Norte Province, on Mindanao Island. The plant, 35 km from the company's mining site at Mainit, would extract 1,700 kg of gold during the first 5 years of operation.[18]

Canada's Galactic Resources Ltd. sold a 40% interest in Far Southeast Gold Resources Inc., a company Galactic equally owned with Lepanto, to Australia's CRA Ltd. for approximately $15 million. Galactic retained the remaining 10% of its interest in Far Southeast. Far Southeast holds the rights to mine the Far Southeast porphyry gold-copper property in Benguet Province.[19]

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 50 tons of gold valued at about $500 million in 1990. Most of this production was channeled illegally through the black market to overseas dealers, with the Central Bank of the Philippines purchasing only about 5 tons.

The illegal exporting of gold by traders was to obtain foreign currency, which was then sold to Filipinos on the black market at rates of up to 10% higher than official foreign exchange rates. In addition, the small-scale operators were limited from selling to the Central Bank because there were only two buying offices, one in Manila and the other in Davao. More importantly, traders in the black market pay cash, though their prices may be 20% to 30% below the international spot market. The Central Bank, while paying the international spot market price, takes 24 hour to pay, and then only 95% of the payment. The remaining 5% is delayed 10 working days, so purity of the gold can be determined. At yearend, the MGB was still trying to solve the problem of unauthorized gold transfers by establishing up to six additional gold-buying and gold-processing outposts throughout the country. However, it was thought that this would probably be futile unless the Central Bank offered to purchase gold in foreign currency or its black-market peso equivalent.[20]

Gold production in kg, by company, is shown in table 4.[21]

Iron and Steel.—The National Steel Corp. (NSC), wholly owned by the Government, was constructing a large expansion of its flat-rolled steel capacity, including the building of a new hot strip mill and a third tinplate line, at its Iligan, Mindanao, plant. The new capacity of hot-rolled coil and plate will be 1.1 Mmt/a. Commissioning of the $169 million plant expansion was scheduled for the final quarter of 1991. This expansion could lead to the construction, which the company was considering, of the country's first integrated steel plant to use blast furnace technology, a 2.5 Mmt/a, $1.9 billion facility, because of the substantial increase in slab feed requirements. The plant produced about one-third of the annual Philippines' requirement of billet and flat products per year, with other electric steel makers in the country and imports each providing one-third.[22]

However, the F. Jacinto Group, the forerunner of NSC, through the Iligan Integrated Steel Mills Inc., which was nationalized in 1972, formally announced plans in May to set up a 1-Mmt/a blast furnace plant costing $400 million to $450 million. The joint venture will be with China's fourth largest steelworks, China National Metallurgical Export and Import Corp.'s Shouguang Iron and Steel Div. in Xi'an, Shaanxi Province.[23] The Jacinto Group claimed to be about 2 months behind NSC in completing its feasibility study, slated for early 1991. Both NSC and Jacinto were still investigating possible plant sites, with both considering a location close to

TABLE 4

PHILIPPINES: PRODUCTION OF GOLD, BY COMPANY

(Kilograms)

Company	1989	1990
Benguet Corp. (primary and byproduct)	8,386	7,333
Atlas Consolidated Mining and Development Corp. (primary and byproduct)	4,294	4,324
Philex Mining Corp. (byproduct)	3,686	2,118
Lepanto Consolidated Mining Co. Inc. (byproduct)	2,154	1,868
Banahaw Mining and Development Corp. (primary)	620	572
United Paragon Mining Corp. (primary)	551	556
Itogon-Suyoc Mines Inc. (primary)	498	510
Marcopper Mining Corp. (byproduct)	435	454
Apex Mining Co. Inc. (primary)	377	353
Manila Mining Corp. (primary)	262	345
Surigao Consolidated Mining Co. (primary)	639	227
North Davao Mining Corp. (byproduct)	227	212
Maricalum Mining Corp. (byproduct)	236	156
Benguet Exploration Inc. (primary and byproduct)	136	16
Small-scale miners and gold panners	7,491	10,190
Total	29,992	29,234

Source: Chamber of Mines of the Philippines.

Cagayan de Oro, about 100 km from Iligan.[24]

In 1990, the Philippine Sinter Corp. (PSC), a wholly owned subsidiary of Japan's Kawasaki Steel Corp., marked the first complete year at full production capacity at its iron ore processing complex at Cagayan de Oro, Mindanao, at the annual level of 5 Mmt. This was the fourth consecutive year of increased output.

PSC was the only plant in the world at which iron ore fines originating at overseas mines were received in oceangoing carriers for processing into self-fluxing sinter, which is subsequently reshipped to overseas steelworks.

The iron ore fines feeding the sinter plant originated at Brazil's Carajas Project of Cia. Vale do Rio Doce in carriers loading at Ponta da Madeira, (40%); from Australia's Hamersley Iron Pty. Ltd. at Dampier and Mount Newman Mining Co. Pty. Ltd. at Port Hedland, 25% each; plus a small amount from Robe River Ltd. at Cape Lambert, all sourced from Western Australia's Pilbara District; and a magnetite concentrate from the Iron Ore Co. of Canada's Carol Project loading at Sept-Iles. The sinter was shipped principally to Kawasaki's Chiba and Mizushima steelworks.[25]

Nickel.—NMIC's nickel production facilities on Nonoc Island (mine) and Marinduque Island (refinery) north of Surigao City, Mindanao, in Surigao del Norte Province were sold in October by the APT to the local private-sector company Philnico Mining and Industrial Corp. (Philnico), a subsidiary of the Cabarrus Group, for $325 million. The NMIC facilities had been idle since March 1986. The sale, negotiated through most of 1990, involved a settlement of $70 million in foreign debts over 3 years, with the remainder of the purchase price, $250.2 million, paid in six monthly installments over 6 years, both beginning 1 year after the final closing date, expected to be in mid-July 1991. Included as part of the payment is the $4.8 million deposit paid by Cabarrus to the APT, which handled the sale.[26]

The mine has proven reserves of about 100 Mmt of nickel ferrous lateritic ore.[27] The refinery, the only one in the country, has a capacity of 27,000 mt/a nickel plus a further 3,200 mt/a nickel and 1,360 mt/a cobalt in the form of mixed sulfides.[28] The project will have a 6-year tax holiday, and all imports of capital equipment will be duty-free. Philnico began rehabilitating the mine complex containing ore-crushing equipment, a generator, and port facilities in August and had restored an estimated 36% of the refinery by the end of the year. Philnico planned to resume production by the end of May 1991, operating at about one-half capacity.[29]

Mineral Fuels

The Petron Bataan refinery at Limay, 40 km west of Manila and the country's largest refinery accounting for more than 50% of the country's capacity, was planning a $40 million second stage expansion program to meet a surge in fuel demand. It completed a $32 million upgrading and modernization program in March financed partly by the ADB. A second stage of the expansion program would increase capacity to meet increased home demand for diesel and liquefied natural gas at the 156,000-bbl/day facility. A World Bank loan would be used to finance a capacity expansion feasibility study. The Petron Bataan refinery was owned by Petron Corp., a wholly owned subsidiary of PNOC.[30]

The Philippines was dependent on imported oil for about 60% of its energy needs. The rise in crude oil costs resulting from the Gulf crisis increased the country's oil costs from an estimated $1.4 billion to about $1.8 billion. In September, the Government allowed price increases of 44% for fuel oil and 19% to 27% for gasoline and other products.[31] In early December, the Government again increased prices on petroleum products by an average of 45%.[32]

Reserves

Mineralization in the Philippines, although generally not rich, nonetheless is extensive. The CMP ranks the mineral reserves of the country at the top in Southeast Asia and seventh world-wide.[33] There are abundant deposits of gold, especially on eastern Mindanao and in Benquet and Camarines Norte Provinces, 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 in Surigao del Norte Province, especially on Hinatuan and Nonoc Islands, 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 on Cebu, Luzon, and Romblon; salt and asbestos on Luzon; marble on Romblon and Panay; gypsum on Luzon; sulfur on Luzon, Leyte, and Mindanao; and phosphate rock on Cebu and Bohol. Asphalt occurs on Leyte, and coal deposits are found on Cebu and Mindoro.

INFRASTRUCTURE[34]

The more than 300,000 km^2 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 in length, all on Luzon) and pipelines (about 350 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 (gravel, crushed-stone, or stabilized-soil surface), and 50,000 km unimproved earth. 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 m.

There are 237 usable airports in the country, and most are on the larger islands such as Luzon and Mindanao. Many of the smaller islands can only be reached by interisland ferries or small chartered vessels.

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 1989 was reportedly 6.7 MW, 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 kW h.

Generally, infrastructure for mineral industry operations are 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 con-

TABLE 5

PHILIPPINES: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1990[1]

(Thousand metric tons)

Commodity	Estimated Reserves
Metals	
Chromite:	27,511
Chemical	2,800
Metallurgical	15,076
Refractory	9,635
Copper	4,105,743
Gold	106,516
Iron:	474,362
Aluminum laterite	292,010
Lump ore	80,732
Magnetic sand	101,620
Lead	6,313
Manganese	1,955
Mercury	16,234
Molybdenum	30,608
Nickel	1,585,536
Zinc	6,163
Industrial Minerals	
Asbestos	24,498
Barite	163
Bauxite	82,650
Clay:	1,126,965
Bentonite	1,381
Diatomaceous earth	3,903
Dolomitic limestone	259,816
Feldspar	29,380
Guano	1,014
Gypsum	1,883
Limestone:	5,295,023
Agricultural	262,449
Magnesite	26,534
Marble	4,047,024
Perlite	18,509
Phosphate rock	2,407
Pumice and pumicite	21,878
Pyrite	991,531
Silica pebbles and/or cobbles	6,804
Silica rock form	1,207,840
Silica sand	113,717
Sulfur	44,011
Talc	503

[1]As of Dec. 31, 1988.

Source: Mines and Geosciences Bureau.

sidered to continue strong because chromium producers remained alert against overexpansion to prevent a glut in the market and because of an almost unprecedented series of production disruptions occurring in the copper sector since mid-1989. 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, ensuring strong domestic minerals demand for cement and construction materials.

The country's external debt, estimated to be $30 billion, remained at a high level in 1990. The annual debt-service ratio of goods and service exports was estimated to have increased slightly.

Inflation, estimated to be about 15% at yearend, was a major preoccupation of the Government as year-to-year increases in the consumer price index remained in the double-digit range.

[1]Converted from the Philippine peso (P) to U.S. dollars at the rate of P21.80=US$1.00 in 1989 and P24.31=US$1.00 in 1990.

[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.

[3]Converted from the Japanese yen (Y) to U.S. dollars at the rate of Y147.5=US$1.00.

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[19]American Metal Market. V. 98, No. 62, Mar. 29, 1990, p. 12.

[20]Work cited in footnote 17, pp. 80-81.

[21]Work cited in footnote 11, pp. 2-3.

[22]Metal Bulletin (London). No. 7484, May 21, 1990, pp. 21, 25.

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[33]American Metal Market. V. 98, No. 104, May 28, 1990, p. 8.

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Agencies

Chamber of Coal Mines Inc. (PHILCOAL)
RN316-A Comfoods Building
Gil Puyat Cor. Pasong Tamo
1200 Makati
Philippines

Chamber of Mines of the Philippines
504 Valoosons Realty Building
2151 Pasong Tamo
1200 Makati, Metro Manila
Philippines
Telephone: 632/817 7996
Fax: 632/817 6869

Department of Energy Resources
Visayas Avenue
Diliman, Quezon City
Philippines
Telephone: 632/964 706

Department of Environment and Natural Resources Mines and Geosciences Bureau
DMG Building, Pedro Gil
Manila, Philippines
Telephone: 632/593 136

Ministry of Energy
7901 Makati Avenue
Box 1031 MCC
Makati, Metro Manila, Philippines

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Central Bank of the Philippines, Manila:
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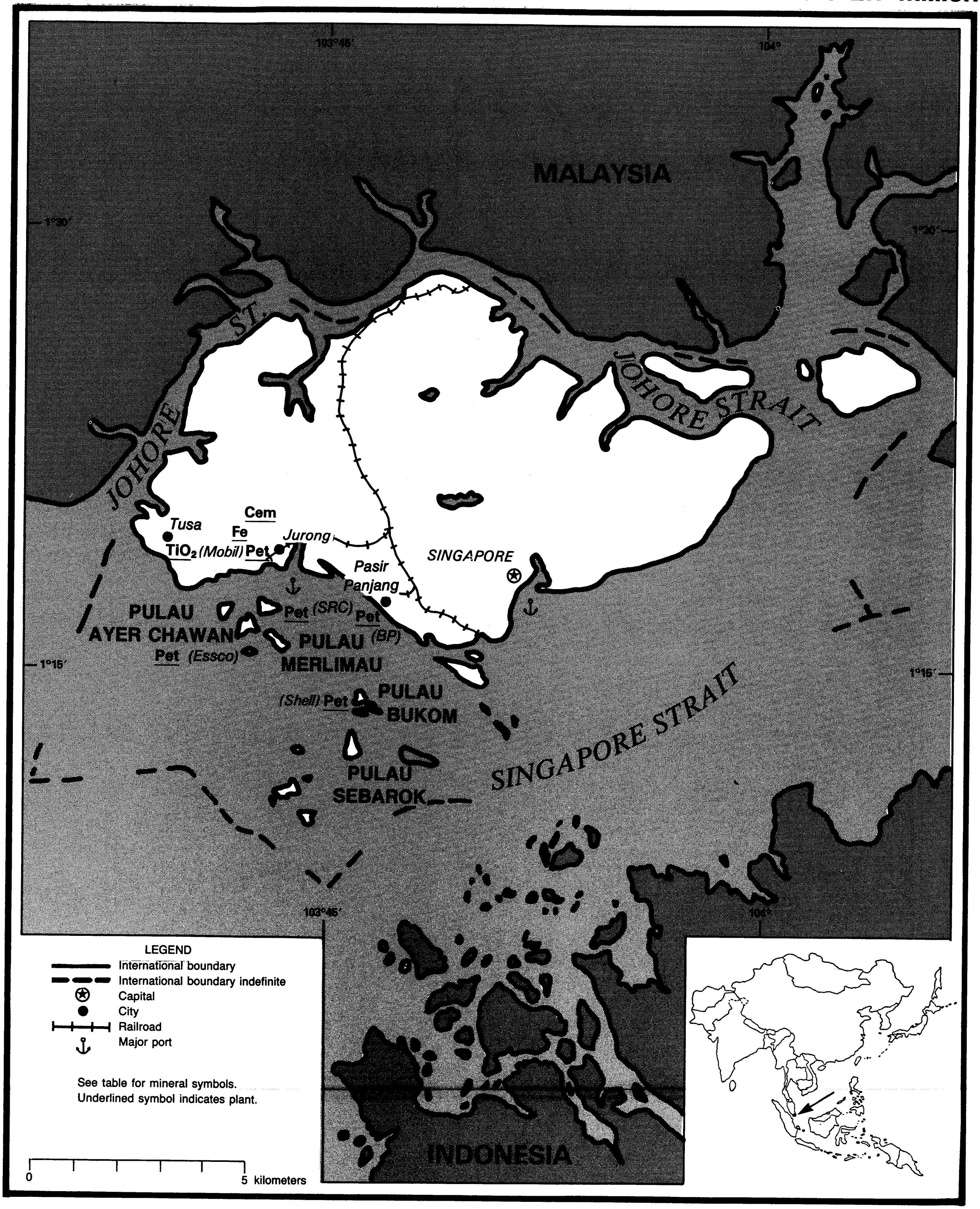
SINGAPORE

AREA 623 km² **POPULATION 2.7 million**



THE MINERAL INDUSTRY OF SINGAPORE

By John C. Wu

Singapore, an island nation of 2.7 million people with a land area of only 623 km^2, is offshore Johor Baharu of southern Peninsular Malaysia. Because of its small land area and lack of mineral resources, virtually all of its mineral requirements were met by import. However, Singapore was the world's third largest petroleum refining center following Rotterdam and Houston and the world's third largest oil market after New York and London in 1990.[1]

The mineral industry of Singapore was composed of a small quarrying sector, a small nonfuel mineral processing sector, and a large petroleum refining sector. The quarrying sector produced only broken granite for consumption by the domestic construction industry. The nonfuel mineral processing sector produced mainly cement, iron and steel, nonferrous metals, and industrial mineral products for the domestic market. The petroleum refining sector produced a wide variety of refined petroleum products for the domestic and overseas markets.

According to the Department of Statistics, Singapore's GDP at 1985 market prices grew 8.3% to $31.5 billion[2] in 1990. The output of the quarrying sector, which contributed only 0.14% to Singapore's GDP, dropped 8.9% to $45 million in 1990. The value added by the petroleum refining sector, estimated at $876 million, contributed about 2.9% to Singapore's GDP and the nonfuel mineral processing sector, estimated at $243 million, contributed about 0.8% in 1990.

Trading of crude petroleum and refined petroleum products accounted for more than 95% of total mineral trade and 17% of Singapore's total trade in 1990. Imports of mineral fuels totaled $9.6 billion and accounted for 16% of total imports. Exports of mineral fuels, totaling $9.5 billion, accounted for 18% of total exports. In 1990, the values of principal mineral commodity imports, in decreasing order, were as follows: crude petroleum, $6.9 billion; refined petroleum products, $2.7 billion; iron and steel products, $1.5 billion; and lime, cement, and construction materials, $156 million. The value of major mineral commodity exports, in decreasing order, were as follows: refined petroleum products, $7.9 billion; and manufactured fertilizer, $73 million.

Production of granite by the quarrying sector dropped considerably in 1990 owing to the closure of 8 of the 12 local quarries in March to prevent further land disturbance and to make adjacent land to the mining area available for better economic use. According to the Construction Industry Development Board, because of reduced output of granite and increased construction activity, about 20% of Singapore's 9.5 Mmt requirements for granite was met by imports from Indonesia and Malaysia.

To resolve the problems of granite shortage, the remaining four quarries, operating on Pulau Ubin, at the Mandai and Gali Batu areas, are expected to increase their output in 1991. Island Concrete, a subsidiary of the Hong Leong Group Co., which signed a joint-venture agreement with Manjung Quarry Premix of Malaysia in 1989, began production of granite in December at Lumut in Perak, Malaysia, with a monthly rate of 50,000 tons. In December, Island Concrete signed two separate agreements with three Indonesian companies to extract granite on Karimun Island of Indonesia. The two joint granite quarrying projects on Karimun Island are expected to begin operation in August 1991 at a combined monthly rate of 230,000 tons.

Production of cement was by five producers, with a work force of about 410 people, operating in the Jurong area using imported cement clinker. The value added by the cement industry was about $33 million in 1990. Imports of 1.6 Mmt cement clinker in 1990 were principally from Japan, Jordan, and Malaysia. Singapore also imported about 550,000 tons of portland cement mainly from Japan to meet the cement requirement of its construction industry in 1990.

Production of steel was by 12 producers, with a work force of about 1,750 people, operating in the Jurong industrial estate area using domestic and import iron and steel scrap. The value added by the steel industry was about $138 million in 1990. In 1990, NatSteel Ltd. (formerly National Iron and Steel Mills Ltd.) remained Singapore's leading steel producer. Malaysia, the United Kingdom, and the United States were the principal suppliers of ferrous scrap to Singapore.

In 1990, NatSteel reportedly was to invest about $22 million for upgrading its rolling mill and expand the mill's capacity by 40% to 700,000 mt/a by 1991. NatSteel had expanded its steel- related business in Malaysia through equity ownership in the Malaysian Southern Iron and Steel Works. To further expand its steel business in southeast Asia, NatSteel reportedly participated with Bangkok Steel Industry Co. Ltd. of Thailand in 1989 for building a $193 million steel mill in Thailand to produce 360,000 mt/a of steel bars and wires, beginning in 1993.

Production of nonferrous metals, including copper, lead, tin, and zinc, was by 19 producers with a work force of about 730 people using mainly scrap as raw materials imported from Japan, Malaysia, Thailand, and the United States. The value added by the nonferrous metals industry was about $36 million in 1990.

Kimetal Ltd.'s tin smelter in Singapore continued to operate despite the low price of tin in the second half of 1990. It imported about 4,200 tons of tin ore principally from Burma and Thailand as feed material for the tin smelter. The production of refined tin was estimated at about 2,500 tons in 1990. Most output of refined tin was exported to Japan and the United States.

ISK Singapore Pte. Ltd., a wholly owned subsidiary of Ishihara Sangyo Co. Ltd. of Japan, operated a 36,000-mt/a titanium dioxide pigment plant at the Tusa area, west of Jurong. The $200 million plant, which came on-stream in April 1989, reportedly was operating at full capacity in 1990. Because of increased demand in Japan, Ishihara Sangyo planned to expand its Singapore capacity by 10,000 mt/a to 46,000 mt/a in 1991. In 1990, most of the titanium dioxide pigment output was shipped to Japan, with only a small amount of the output distributed to the southeast Asian market.

Petroleum refining was by five companies with a work force of 3,200 people. Most of the petroleum refining and oil storage facilities are on small islands south of Singapore's main island. In 1990, the in-

TABLE 1

SINGAPORE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
Cement, hydraulic	thousand tons	1,805	1,527	1,595	1,706	1,852
Iron and steel: Metal: Steel, crude	do.	390	422	413	495	489
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	1,032	824	4,060	4,846	[e]5,000
Gasoline	do.	20,400	16,660	17,000	18,944	[e]24,000
Jet fuel	do.	30,664	45,400	44,000	54,100	[e]56,000
Kerosene	do.	18,430	16,275	19,375	10,933	[e]12,000
Diesel oil	do.	65,029	69,393	70,870	99,585	[e]100,000
Residual fuel oil	do.	69,197	74,475	59,940	78,321	[e]79,000
Naphtha	do.	25,449	22,950	21,250	15,961	[e]17,000
White spirit	do.	1,023	1,008	1,100	1,000	[e]1,000
Lubricants	do.	4,110	4,380	4,200	4,589	[e]5,000
Asphalt	do.	3,236	2,788	3,640	4,056	[e]4,200
Other	do.	146	182	182	7,808	[e]8,000
Total	do.	238,716	254,335	245,617	300,143	[e]311,200
Stone: Granite, broken	thousand cubic meters	5,565	7,319	6,914	7,008	6,371
Sulfur, byproduct of petroleum[e]		5,000	5,000	5,000	5,500	5,600
Tin: Metal, smelter[e]		500	1,000	1,000	3,000	2,500

[e]Estimated. [p]Preliminary.

[1]Table includes data available through June 27, 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.

TABLE 2

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	2	3	—	Mainly to Malaysia.
Aluminum:				
Ore and concentrate	73	9	NA	NA.
Oxides and hydroxides	32,174	29,300	—	Malaysia 14,568; Thailand 4,008; Republic of Korea 1,940.
Metal including alloys:				
Scrap	20,386	21,779	—	Japan 14,743; Malaysia 3,911; Taiwan 2,006.
Unwrought	106,582	65,907	14,816	Japan 13,652; Malaysia 10,829; Republic of Korea 9,348.
Semimanufactures	10,357	11,723	200	Australia 3,231; Malaysia 1,985; Hong Kong 1,126.
Cadmium: Metal including alloys, all forms	—	5	—	India 3.
Chromium:				
Ore and concentrate	4,016	633	129	Malaysia 416; Canada 59.
Oxides and hydroxides	107	62	—	Malaysia 32; North Korea 20; Thailand 7.
Cobalt:				
Oxides and hydroxides	23	17	—	Republic of Korea 7; Malaysia 4; Thailand 4.
Metal including alloys, all forms	—	16	—	North Korea 12; Malaysia 3.

See footnotes at end of table.

TABLE 2—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
METALS—Continued					
Columbium and tantalum:					
Ore and concentrate, tantalum		125	—		
Metal including alloys, all forms, tantalum	kilograms	1,615	50	NA	NA.
Copper:					
Ore and concentrate		913	65	NA	NA.
Matte and speiss including cement copper		386	298	—	China 280.
Metal including alloys:					
Scrap		37,356	40,426	95	India 14,928; Japan 10,271; Republic of Korea 8,852.
Unwrought		60,654	53,903	—	Malaysia 30,545; Taiwan 11,106; China 3,926.
Semimanufactures		12,020	24,508	41	Malaysia 8,346; India 5,640; Thailand 4,327.
Gold:					
Waste and sweepings	kilograms	2,213	1,697	282	Japan 1,170; Malaysia 241.
Metal including alloys, unwrought and partly wrought	do.	4,624	5,176	28	Malaysia 2,251; Philippines 635; India 504.
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite		39	132	NA	NA.
Metal:					
Scrap		265,389	238,193	—	Malaysia 101,566; India 42,945; Thailand 41,602.
Pig iron, cast iron, related materials		1,389	1,099	—	Malaysia 869; Thailand 110; Hong Kong 49.
Ferroalloys:					
Ferromanganese		1,670	5,610	—	Malaysia 4,950; Taiwan 500; Netherlands 100.
Ferrosilicon		715	2,589	—	Malaysia 1,584; India 549; Australia 260.
Unspecified		297	285	19	Malaysia 223; Australia 22.
Steel, primary forms		1,829	1,786	—	Australia 938; Burma 220; Malaysia 196.
Semimanufactures:					
Flat-rolled products:					
Of iron or nonalloy steel:					
Not clad, plated, coated		NA	166,817	10	Malaysia 143,743; Sri Lanka 5,059; Brunei 3,200.
Clad, plated, coated		NA	52,500	—	Malaysia 18,097; Thailand 6,795; Brunei 4,351.
Of alloy steel		NA	13,804	98	Malaysia 6,801; Philippines 839; China 804.
Bars, rods, angles, shapes, sections		291,624	294,226	45,984	Malaysia 48,687; Brunei 40,615; Thailand 37,042.
Rails and accessories		1,226	2,174	3	Malaysia 1,692; China 218; India 68.
Wire		7,726	10,262	6	Thailand 2,630; Malaysia 2,616; Repubic of Korea 474.
Tubes, pipes, fittings		125,363	139,354	26,832	Malaysia 39,643; Brunei 8,491; Australia 6,622.
Lead:					
Ore and concentrate		14	7	NA	NA.
Oxides		168	403	—	Malaysia 135; Australia 95; Thailand 88.
Metal including alloys:					
Scrap		8,131	7,535	—	Philippines 3,190; Thailand 2,297; India 1,639.
Unwrought		23,072	7,494	—	Malaysia 4,631; North Korea 1,328; Philippines 790.
Semimanufactures		777	757	—	Malaysia 510; Thailand 124; Japan 38.

See footnotes at end of table.

TABLE 2—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS—Continued				
Magnesium: Metal including alloys, all forms	61	71	—	Thailand 24; Taiwan 18; India 13.
Manganese:				
Ore and concentrate, metallurgical	15,833	9,598	—	Kenya 3,080; Philippines 2,245; Australia 1,056.
Oxides	36,956	9,352	—	Republic of Korea 3,163; Pakistan 2,115; Malaysia 1,131.
Mercury	3	6	—	North Korea 3; West Germany 1; Papua New Guinea 1.
Molybdenum: Metal including alloys, all forms	3	12	NA	NA.
Nickel:				
Ore and concentrate	22	31	—	Philippines 29.
Matte and speiss	216	1,314	—	India 1,124; Malaysia 110; Taiwan 30.
Metal including alloys:				
Scrap	97	140	31	Japan 104; Malaysia 4.
Unwrought	2,436	5,521	—	Japan 2,174; Republic of Korea 914; Belgium-Luxembourg 889.
Semimanufactures	3,165	760	—	Malaysia 503; Hong Kong 80; Taiwan 62.
Platium-group metals: Metals including alloys, unwrought and partly wrought kilograms	218	869	20	West Germany 659; Switzerland 89.
Selenium: Elemental[2]	189	541	—	Malaysia 198; India 197; China 105.
Silver:				
Ore and concentrate[3]	([4])	3	NA	NA.
Waste and sweepings[3] kilograms	3,188	4,314	121	Malaysia 1,941; United Kingdom 1,356.
Metal including alloys, unwrought and partly wrought do.	76,105	122,372	—	India 63,754; United Arab Emirates 32,357; Taiwan 8,170.
Tin:				
Ore and concentrate	7,560	3,259	191	Malaysia 1,950; Netherlands 355; Republic of Korea 325.
Ash and residue containing tin	1,463	544	—	Taiwan 433; West Germany 58; Netherlands 22.
Metal including alloys:				
Scrap	228	471	—	Malaysia 280; Taiwan 169; Belgium-Luxembourg 18.
Unwrought	27,673	27,954	6,028	Japan 10,102; Netherlands 5,319; Taiwan 1,780.
Semimanufactures	364	1,617	—	China 436; Malaysia 308; United Arab Emirates 202.
Titanium:				
Oxides	2,683	3,452	—	Malaysia 1,132; India 777; Taiwan 224.
Metal including alloys, all forms	—	32	11	Japan 7; United Kingdom 5.
Tungsten:				
Ore and concentrate	708	614	78	West Germany 266; North Korea 150; India 119.
Metal including alloys, all forms	165	119	35	Malaysia 24; Sweden 13.
Uranium and/or thorium: Ore and concentrate	1,560	609	594	NA.
Zinc:				
Ore and concentrate	20	201	—	India 198.
Oxides	1,644	1,631	—	Japan 922; Malaysia 216; India 116.
Blue powder	296	744	—	Japan 383; Malaysia 311; Thailand 27.
Metal including alloys:				
Scrap	926	2,366	—	Philippines 1,171; Taiwan 460; India 302.

See footnotes at end of table.

TABLE 2—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989	
			United States	Other (principal)
METALS—Continued				
Zinc:—Continued				
Metal including alloys:—Continued				
Unwrought	31,751	40,378	—	India 15,939; Japan 5,608; Malaysia 3,681.
Semimanufactures	431	548	—	Malaysia 217; Mauritius 131; Papua New Guinea 68.
Zirconium: Metal including alloys all forms	—	20	—	Mainly to Italy.
Other:				
Ores and concentrates	116	2,116	59	Bulgaria 550; Thailand 500; Malaysia 341.
Ashes and residues	65,064	64,598	—	Malaysia 37,024; United Arab Emirates 8,150 Brunei 7,103.
Base metals including alloys, all forms	81	863	—	India 800; Malaysia 27; Philippines 20.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	666	1,437	—	Malaysia 682; Thailand 472; Hong Kong 106.
Artificial: Corundum kilograms	22	117	—	All to Malaysia.
Dust and powder of precious and semi-precious stones including diamond value, thousands	$68	$1,268	$128	Taiwan $732; Japan $176.
Grinding and polishing wheels and stones	525	797	7	Malaysia 531; Thailand 89; Hong Kong 49.
Asbestos, crude	263	250	—	Burma 166; Malaysia 48.
Barite and witherite	17,624	8,401	—	Papua New Guinea 3,954; Philippines 1,064; Brunei 870.
Boron materials:				
Crude natural borates	19	235	—	Malaysia 181; Bangladesh 36.
Oxides and acids	284	79	—	Mainly to Malaysia.
Cement	136,126	135,805	—	Papua New Guinea 30,486; Brunei 21,643; Malaysia 19,793.
Chalk	2,892	2,197	—	Brunei 1,859; Malaysia 213; Philippines 105.
Clays, crude	29,192	33,434	—	Malaysia 10,824; Philippines 4,809; Republic of Korea 4,369.
Diamond:				
Gem, not set or strung value, thousands	$21,009	$34,661	$1,105	Belgium-Luxembourg $11,935; Hong Kong $4,583; Thailand $4,113.
Industrial stones do.	$315	$11,290	—	Thailand $9,398; Hong Kong $745. Belgium-Luxembourg $557.
Diatomite and other infusorial earth	661	543	—	Thailand 198; Malaysia 177; Papua New Guinea 57.
Feldspar, fluorspar, related materials	4,002	7,950	—	All to Malaysia.
Fertilizer materials:				
Crude, n.e.s.	33,054	23,461	—	Malaysia 22,833; Papua New Guinea 540; Brunei 53.
Manufactured:				
Ammonia	261	414	—	Malaysia 276; Maldives 48; Hong Kong 17.
Nitrogenous	21,384	18,278	—	Tanzania 8,778; Papua New Gunea 4,231 Malaysia 4,162.
Phosphatic	21,357	6,340		Malaysia 4,447; Papua New Guinea 1,273; Philippines 500.
Potassic	25,821	119,217	—	Sri Lanka 46,835; Thailand 17,827; Malaysia 14,070.

See footnotes at end of table.

TABLE 2—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials:—Continued				
Manufactured:—Continued				
Unspecified and mixed	59,838	35,329	—	Malaysia 32,755; Brunei 841; Papua New Guinea 640.
Graphite, natural	73	74	—	Malaysia 63; India 11.
Gypsum and plaster	7,279	9,215	—	Malaysia 8,070; Brunei 371; Thailand 221.
Iodine including bromine and fluorine kilograms	([4])	2,380	NA	NA.
Lime	4,392	19,274	—	Papua New Guinea 17,930; Brunei 728; Malaysia 267.
Magnesium compounds: Magnesite, crude including calcined	1,561	337	—	Malaysia 233; unspecified 103.
Mica:				
Crude including splittings and waste	377	350	—	Brunei 123; Malaysia 102; Thailand 40.
Worked including agglomerated splittings	14	46	—	Malaysia 20; Brunei 19.
Nitrates, crude	1	165	—	Philippines 64; unspecified 101.
Phosphates, crude	743	163	—	Malaysia 65; unspecified 98.
Pigments, mineral: Iron oxides and hydroxides, processed	1,102	902	—	Malaysia 726; India 104; China 46.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$17,096	$28,669	$214	Thailand $21,606; Hong Kong $3,010; Japan $1,180.
Synthetic do.	$612	$871	$166	Thailand $231; Austria $174.
Pyrite, unroasted	—	2	NA	NA.
Salt and brine	13,707	18,170	—	Malaysia 15,331; Brunei 2,102; Hong Kong 212.
Sodium compounds, n.e.s.:				
Carbonate, manufactured	8,493	NA	NA	NA.
Sulfate, manufactured	[5]11,814	11,889	—	Malaysia 9,582; Philippines 585; India 104.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	584	770	—	Malaysia 369; Thailand 121; Japan 89.
Worked	4,535	7,194	666	Malaysia 2,674; Brunei 1,002.
Dolomite, chiefly refractory-grade	810	202	NA	NA.
Gravel and crushed rock	12,484	7,579	—	Brunei 5,500; Malaysia 1,452.
Limestone other than dimension	708	187	NA	NA.
Quartz and quartzite	136	51	NA	NA.
Sand other than metal-bearing	26,273	68,872	—	Japan 49,000; Brunei 16,057; Malaysia 3,740.
Sulfur:				
Elemental:				
Crude including native and byproduct	26,925	21,342	—	Malaysia 11,292; Thailand 8,705; Philippines 460.
Colloidal, precipitated, sublimed	23,408	11,718	—	Malaysia 7,431; North Korea 2,660; Philippines 1,360.
Sulfuric acid	1,635	1,306	—	Malaysia 515; Sri Lanka 500; Brunei 129.
Talc, steatite, soapstone, pyrophyllite	2,182	1,890	—	Malaysia 920; Philippines 905.
Other:				
Crude	11,305	11,429	—	Sri Lanka 5,750; Philippines 2,013; Thailand 1,600.

See footnotes at end of table.

TABLE 2—Continued

SINGAPORE: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Other:—Continued					
Slag and dross, not metal-bearing		64,063	35,535	—	Japan 13,552; Malaysia 12,200; Philippines 6,300.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		2,586	15,381	—	Malaysia 7,465; North Korea 7,000.
Carbon:					
Carbon black		4,358	5,072	—	Australia 889; India 880; Kenya 665.
Gas carbon		—	162	—	Saudi Arabia 150.
Coal, all grades including briquets		434	322	—	Malaysia 85; Thailand 50.
Coke and semicoke		11,644	14,845	—	Malaysia 12,389; Thailand 2,173; Sri Lanka 232.
Gas, natural: Liquefied		24	29,841	—	Malaysia 21,662; Hong Kong 3,131; Taiwan 2,600.
Peat including briquets and litter		12	21	—	Hong Kong 13.
Petroleum:					
Crude	thousand 42-gallon barrels	10,778	([4])	—	All to Malaysia.
Partly refined	do.	545	1,354	980	Bahamas 265; Japan 106.
Refinery products:					
Liquefied petroleum gas	do.	3,881	3,222	—	Malaysia 2,078; Thailand 536; Hong Kong 326.
Gasoline:					
Aviation	do.	44,377	42,444	3,529	Japan 17,582; Hong Kong 8,812; Thailand 3,436.
Motor	do.	23,827	31,713	—	Malaysia 9,708; Japan 3,697; Australia 3,485.
Naphtha (including white spirits)	do.	19,212	21,302	—	Japan 15,849; Hong Kong 3,050; China 1,047.
Kerosene and jet fuel	do.	11,188	9,283	—	Japan 3,266; Hong Kong 2,073; India 919.
Mineral jelly and wax	do.	180	189	—	India 60; Taiwan 18; Madagascar 16.
Distillate fuel oil	do.	68,196	75,391	163	Thailand 28,184; Hong Kong 13,210; China 12,048.
Lubricants	do.	4,807	5,183	—	Malaysia 1,125; Thailand 970; India 550.
Residual fuel oil	do.	59,792	[6]134,170	6,404	Japan 20,954; Hong Kong 14,486; Malaysia 12,990.
Bitumen and other residues	do.	3,832	2,325	—	Malaysia 562; Australia 325; Hong Kong 221.
Bituminous mixtures	do.	14	19	—	Sudan 6; Thailand 4; Malaysia 4.
Petroleum coke	do.	2	6	—	Australia 4; Malaysia 2.

NA Not available.
[1]Table prepared by Ronald L. Hatch and Audrey D. Wilkes.
[2]Includes tellurium and phosphorus.
[3]May include other precious metals.
[4]Less than 1/2 unit.
[5]Includes hydrogen sulfate and pyrosulfate.
[6]Includes fuel oil for aircraft and ships.

TABLE 3

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989: United States	Sources, 1989: Other (principal)
METALS				
Alkali and alkaline-earth metals	30	13	5	Japan 6.
Aluminum:				
Ore and concentrate	62	111	—	United Arab Emirates 11; unspecified 100.
Oxides and hydroxides	85,995	70,188	295	Australia 68,906; Japan 438; China 256.
Metal including alloys:				
Scrap	3,101	4,452	454	Malaysia 2,793, Brunei 512; Thailand 266.
Unwrought	125,646	38,576	7,450	Australia 11,313; India 5,891; United Kingdom 4,066.
Semimanufactures	45,510	43,585	1,763	Japan 10,881; Malaysia 7,449; Taiwan 3,752.
Beryllium: Metal including alloys, all forms	5	3	—	Mainly from Japan.
Cadmium: Metal including alloys, all forms	—	21	—	Netherlands 10; Australia 8.
Chromium:				
Ore and concentrate	4,045	7,010	—	Madagascar 6,527; Mozambique 252; Japan 221.
Oxides and hydroxides	366	318	86	United Kingdom 61; Poland 54.
Cobalt:				
Oxides and hydroxides	44	21	—	Hong Kong 8; Finland 6; United Kingdom 5.
Metal including alloys, all forms	—	35	—	Zambia 13; Finland 4; Belgium-Luxembourg 3.
Columbium and tantalum: Tantalum metal including alloys, all forms	2	4	2	Japan 2.
Copper:				
Ore and concentrate	1	6	NA	NA.
Matte and speiss including cement copper	—	10	8	NA.
Metal including alloys:				
Scrap	13,367	12,646	1,177	Malaysia 3,988; Japan 2,202; Thailand 1,253.
Unwrought	90,883	55,594	3,149	Chile 19,151; Philippines 11,041; Republic of Korea 8,776.
Semimanufactures	51,294	78,385	1,145	Japan 28,240; Malaysia 21,336; Taiwan 3,688.
Gold:				
Waste and sweepings value, thousands	$3,566	$3,081	$121	Taiwan $970; Malaysia $704; Hong Kong $231.
Metal including alloys, unwrought and partly wrought kilograms	6,467	7,903	1,226	Japan 6,178; West Germany 135.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	443	1,036	—	Malaysia 907; Italy 115.
Metal:				
Scrap	182,054	196,577	26,983	Malaysia 63,537; China 16,043.
Pig iron, cast iron, related materials	119,830	182,690	82	U.S.S.R. 150,628; Iran 15,034; Malaysia 9,586.
Ferroalloys:				
Ferromanganese	1,184	3,876	—	China 2,298; Mozambique 1,260; Malaysia 71.
Ferrosilicon	4,437	11,995	77	China 6,627; Mozambique 2,720; Hong Kong 576.
Unspecified	9,890	330	46	China 61; U.S.S.R. 35; United Kingdom 35.
Steel, primary forms	172,592	260,654	70,017	Brazil 155,494; United Kingdom 704.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated thousand tons	NA	977	40	Japan 503; Republic of Korea 141; Brazil 82.
Clad, plated, coated do.	NA	190	2	Japan 114; Australia 32; Republic of Korea 14.

See footnotes at end of table.

TABLE 3—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989 United States	Sources, 1989 Other (principal)
METALS—Continued					
Iron and steel:—Continued					
Metals:—Continued					
Semimanufactured:—Continued					
Flat-rolled products:—Continued					
Of alloy steel	thousand tons	NA	79	1	Japan 47; Romania 10; West Germany 3.
Bars, rods, angles, shapes, sections	do.	173	479	3	Japan 118; Malaysia 100; United Kingdom 50.
Rails and accessories	do.	29	4	(2)	Republic of Korea 2; United Kingdom 1.
Wire	do.	55	35	(2)	China 11; Japan 8; Republic of Korea 7.
Tubes, pipes, fittings	do.	209	377	12	Japan 138; West Germany 51; Malaysia 21;
Lead:					
Ore and concentrate		—	21	—	Mainly from Morroco.
Oxides		480	458	—	Australia 224; West Germany 61; United Kingdom 55.
Metal including alloys:					
Scrap		3,913	4,387	—	Malaysia 2,759; Brunei 619; Kuwait 495.
Unwrought		26,405	12,247	1	United Kingdom 2,427; Brazil 2,354; Australia 2,337.
Semimanufactures		635	1,400	72	Australia 394; Japan 378; Taiwan 141.
Magnesium: Metal including alloys:					
Unwrought		87	91	49	Japan 22; Australia 10.
Semimanufactures		246	190	22	Japan 122; Sweden 38.
Manganese:					
Ore and concentrate		51,062	26,180	—	Gabon 26,100; Brazil 60.
Oxides		5,019	4,295	—	Japan 2,595; Brazil 900; China 479.
Mercury		56	151	4	Taiwan 124; China 9; Spain 7.
Molybdenum: Metal including alloys, all forms		7	164	(2)	Japan 163.
Nickel:					
Ore and concentrate		—	11	—	Hong Kong 10; Netherlands 1.
Matte and speiss		138	1,106	—	Canada 1,065; India 40.
Metal including alloys:					
Scrap		208	185	56	Malaysia 97; Thailand 55; Philippines 28.
Unwrought		4,041	3,355	50	U.S.S.R. 2,015; Finland 354; Canada 315.
Semimanufactures		2,531	1,000	94	Canada 243; Japan 225; Norway 170.
Platinum-group metals:					
Waste and sweepings[3]	kilograms	2,773	5,775	5	Taiwan 4,353; Malaysia 1,328.
Metals including alloys, unwrought and partly wrought	do.	890	2,115	160	Japan 739; West Germany 554; Malaysia 553.
Selenium: Elemental[4]		540	826	36	China 413; Hong Kong 159. Japan 96.
Silver:					
Ore and concentrate		2	1	NA	NA.
Metal including alloys, unwrought and partly wrought	kilograms	292,434	544,905	5,384	West Germany 110,741; Switzerland 94,108; Canada 62,381.
Tin:					
Ore and concentrate		8,846	3,831	—	China 3,193; West Germany 374; Netherlands 123.
Ash and residue containing tin		2,993	2,085	—	Thailand 1,961; Japan 81.

See footnotes at end of table.

TABLE 3—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
METALS—Continued				
Metal including alloys:				
Scrap	621	510	—	Malaysia 230; Australia 93; United Kingdom 90.
Unwrought	5,764	2,506	3	Thailand 1,215; Malaysia 774; China 200.
Semimanufactures	681	2,684	38	Japan 1,977; Hong Kong 341.
Titanium:				
Oxides	11,100	14,976	5,217	Japan 3,901; Australia 1,687.
Metal including alloys, all forms	—	154	7	China 59; Japan 36.
Tungsten:				
Ore and concentrate	764	685	—	China 276; Burma 118; Thailand 63.
Metal including alloys, all forms	130	155	90	China 52; Japan 6.
Uranium and/or thorium: Metal including alloys, all forms kilograms	50	—		
Zinc:				
Ore and concentrate	58	162	—	Australia 60; Thailand 60; Republic of Korea 40.
Oxides	1,631	2,337	74	India 743; China 623; Thailand 290.
Blue powder	2,354	2,085	524	Norway 810; United Kingdom 213.
Metal including alloys:				
Scrap	520	737	—	Malaysia 519; Canada 51; France 41.
Unwrought	45,365	52,520	168	North Korea 26,219; Australia 8,682; Republic of Korea 7,705.
Semimanufactures	590	378	7	Japan 136; Australia 54; Malaysia 50.
Other:				
Ores and concentrates	20,826	38,360	—	Japan 20,180; Australia 16,109.
Ashes and residues	327,946	243,560	—	Japan 178,867; Philippines 39,224; Australia 24,197.
Base metals including alloys, all forms	176	1,032	2	China 816; Hong Kong 57; Malaysia 52.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	1,111	2,646	428	Japan 1,646; India 273.
Artificial: Corundum	10	45	—	Italy 36; Japan 9.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$734	$861	$78	Ireland $467; U.S.S.R. $175.
Grinding and polishing wheels and stones	3,213	6,975	126	Japan 2,273; China 2,024.
Asbestos, crude	1,701	1,733	—	Italy 630; Canada 245; Botswana 166.
Barite and witherite	14,488	10,056	—	Thailand 8,432; Malaysia 1,038; Brunei 337.
Boron materials:				
Crude natural borates	27	(2)	NA	NA.
Oxides and acids	891	493	—	Italy 468; China 14.
Cement thousand tons	1,680	1,526	2	Japan 782; Malaysia 679.
Chalk	6,990	2,344	—	Malaysia 856; Australia 404; United Kingdom 158.
Clays, crude:				
Bentonite	44,902	27,750	21,701	India 3,600; China 1,521.
Fuller's earth	5,848	4,531	3,567	Japan 560; United Kingdom 327.
Unspecified	19,198	25,461	1,264	Malaysia 10,153; Australia 8,570; China 1,775.
Cryolite and chiolite	9	—		

See footnotes at end of table.

TABLE 3—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Diamond: Natural:					
Gem, not set or strung	value, thousands	$71,285	$81,823	$7,460	Israel $20,148; India $19,222; Belgium-Luxembourg $18,967.
Industrial stones	do.	$808	$4,279	$490	Israel $951; Ireland $835.
Diatomite and other infusorial earth		1,956	1,645	1,465	Philippines 94; Japan 62.
Feldspar, fluorspar, related materials		5,686	13,385	—	India 7,276; Japan 3,859; China 1,815.
Fertilizer materials:					
Crude, n.e.s.		1,708	377	—	Australia 145; Malaysia 152.
Manufactured:					
Ammonia		1,831	2,160	3	Malaysia 1,554; Netherlands 291; West Germany 158.
Nitrogenous		16,152	21,920	26	Canada 9,198; United Arab Emirates 5,000; Malaysia 4,254.
Phosphatic		8,489	1,545	100	China 1,375.
Potassic		269,480	81,604	—	Canada 58,045; West Germany 13,964; Jordan 8,024.
Unspecified and mixed		76,071	34,709	193	West Germany 23,787; France 5,006; Malaysia 2,347.
Graphite, natural		587	715	5	Japan 317; China 195; West Germany 74.
Gypsum and plaster		53,960	51,702	566	Thailand 40,456; China 4,697; United Kingdom 3,165.
Iodine including bromine and flourine		354	26	3	New Zealand 14; West Germany 5.
Lime		10,743	15,957	—	Malaysia 13,813; China 1,333; United Kingdom 393.
Magnesium compounds: Magnesite, crude including calcined		8,397	25,020	104	China 24,104; Norway 436.
Mica:					
Crude including splittings and waste		1,010	951	18	India 620; China 160.
Worked including agglomerated splittings		720	398	14	Japan 174; Taiwan 151.
Nitrates, crude		3	2,204	—	Chile 849; West Germany 624; Belgium Luxembourg 376.
Phosphates, crude		2,358	725	—	Malaysia 525; Netherlands 200.
Pigments, mineral: Iron oxides and hydroxides, processed		4,479	8,806	386	Japan 3,768; China 1,839; West Germany 1,136.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$6,427	$11,764	$1,325	Thailand $3,218; India $1,746.
Synthetic	do.	$2,187	$4,721	$261	Israel $1,363; U.S.S.R. $764; Japan $638.
Salt and brine		66,068	67,459	80	Australia 29,447; China 13,533; Israel 7,750.
Sodium compounds, n.e.s.:					
Carbonate, manufactured		3,194	—	—	NA
Sulfate, manufactured		17,565	17,289	140	China 14,238; Taiwan 1,941; United Kingdom 723.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		5,497	27,926	32	Malaysia 19,211; Republic of Korea 1,291.
Worked		50,366	57,627	3	Italy 32,757; China 10,333; Malaysia 2,846.
Dolomite, chiefly refractory-grade		254	1,223	—	Taiwan 898; France 162; Thailand 151.

See footnotes at end of table.

TABLE 3—Continued

SINGAPORE: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:—Continued					
Gravel and crushed rock		601,028	164,395	563	Malaysia 160,477; West Germany 680; Philippines 618.
Limestone other than dimension		2,526	46,262	—	Malaysia 46,058; unspecified 204.
Quartz and quartzite		1,462	298	1	Japan 10; unspecified 287.
Sand other than metal-bearing	thousand tons	1,287	943	17	Malaysia 920; United Kingdom 17.
Sulfur:					
Elemental:					
Crude including native and byproduct		308	174	—	Poland 90; China 24.
Colloidal, precipitated, sublimed		192	127	12	Poland 54; China 20; West Germany 15.
Sulfuric acid		2,484	744	113	Malaysia 291; West Germany 274.
Talc, steatite, soapstone, pyrophyllite		7,127	6,508	579	China 4,189; Norway 803.
Other:					
Crude		44,988	59,363	50	West Germany 58,569; Mozambique 342.
Slag and dross, not metal-bearing		6,990	70,435	—	Taiwan 40,624; Japan 29,632; United Kingdom 54.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		1,895	1,427	326	Republic of Korea 642; United Kingdom 171.
Carbon black		5,139	3,705	513	China 1,123; West Germany 589.
Coal, all grades including briquets		2,022	2,112	1,502	India 194; West Germany 127.
Coke and semicoke		28,521	33,008	—	Japan 22,051; Australia 9,791; China 1,048.
Peat including briquets and litter		141	115	—	NA.
Petroleum:					
Crude	thousand 42-gallon barrels	256,245	273,146	—	Saudi Arabia 102,220; United Arab Emirates 44,643; Malaysia 39,844.
Partly refined	do.	3,817	4,360	—	Malaysia 3,406; United Arab Emirates 954.
Refinery products:					
Liquefied petroleum gas	do.	55	143	—	Malaysia 100; Philippines 42.
Gasoline:					
Aviation	do.	1,104	901	—	Saudi Arabia 447; United Arab Emirates 252;
Motor	do.	14,319	24,406	567	China 8,242; Saudi Arabia 5,378; Malaysia 3,891.
Naptha (including white spirits)	do.	6,622	4,688	—	Malaysia 1,115; United Arab Emirates 821; Kuwait 728.
Kerosene and jet fuel	do.	1,241	1,644	—	Malaysia 669; Saudi Arabia 397; Kuwait 385.
Mineral jelly and wax	do.	192	193	2	China 171; Burma 5.
Distillate fuel oil	do.	13,438	12,874	224	Saudi Arabia 3,237; United Arab Emirates 2,239; Malaysia 2,201.
Lubricants	do.	1,363	1,190	61	Japan 285; Italy 261; China 162.
Residual fuel oil	do.	103,079	536	215	Malaysia 207; Kuwait 84.
Bitumen and other residues	do.	1	2	—	Hong Kong 1.
Bituminous mixtures	do.	21	12	1	Malaysia 4; United Kingdom 3; Belgium-Luxembourg 2.
Petroleum coke	do.	58	59	51	China 7.

NA Not Available.
[1]Table prepared by Ronald L. Hatch and Audrey D. Wilkes.
[2]Less than 1/2 unit.
[3]May include other precious metals.
[4]Includes tellurium and phosphorus.

dustry was operating near capacity at about 900,000 bbl/d. The value added by the petroleum refining industry was about $876 million. The industry's total output value was about $6.3 billion accounting for 16% of total output of the manufacturing sector in 1990.

The petroleum refining capacity by company in 1990 is shown in table 4.

In 1990, Singapore imported about 860,000 bbl/d of crude petroleum to feed its refineries. The major suppliers of crude petroleum were Saudi Arabia, accounting for 37% of total crude petroleum imports; United Arab Emirates, 20%; Malaysia, 13%; China, 8%; and Oman, 5%. Exports of refined petroleum products were marketed worldwide, but were mainly destined for Hong Kong, Japan, Malaysia, the Philippines, and Thailand.

Because of increased demand for high value-added refined petroleum products in the Asian market, Singapore's petroleum refining capacity had been expanded and upgraded. In 1990, Shell Eastern Petroleum, Singapore's largest refinery, completed construction of a $265 million long-residue catalytic cracker in May. Esso Singapore brought on-stream an $83 million visbreaker in April and announced in May that it planned to invest an additional $552 million to boost its refining capacity in Singapore over the next 10 years. Mobil Oil Singapore brought on-stream a $110 million medium-pressure hydrocracker.[3]

TABLE 4

SINGAPORE: PETROLEUM REFINING CAPACITY, BY COMPANY

(Barrels per day)

Company	Location	Design capacity, yearend 1990
BP Refinery Singapore Pte. Ltd.	Pasir Panjang	30,000
Esso Singapore Pte. Ltd.	Pulau Ayer Chawan	231,000
Mobil Oil Singapore Pte. Ltd.	Jurong	200,000
Shell Eastern Petroleum Ltd.	Pulau Bukom	403,000
Singapore Petroleum Co. Pte. Ltd.	Pulau Merlimau	190,000
Total		1,054,000

Source: U.S. Embassy Singapore. Singapore's Petroleum Industry: The Quiet Achiever, State Dep. Telegram 05750, June 1, 1990, pp. 2-3.

To alleviate the shortage of oil storage capacity with increased oil trading activity in Singapore, the state-owned Singapore Petroleum Co. announced in April that it planned to invest $55 million in the next 5 years to build an oil storage terminal on Pulau Sebarok, southeast of Shell's refinery on Pulau Bukom. The oil storage terminal project, to be completed by 1994, will have nine oil storage tanks with a combined capacity of 214,000 m^3 and a new jetty.

[1]The Straits Times (Singapore). Oct. 24, 1990, p. 40.

[2]Where appropriate, values have been converted from Singapore dollars (S$) to U.S. dollars (US$) at the rate of S$1.8125=US$1.00.

[3]U.S. Embassy, Singapore. State Dep. Telegram 05750, June 1, 1990, p. 1.

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8 Shenton Way #10-01, Treasury Building
Singapore 0100

Publications

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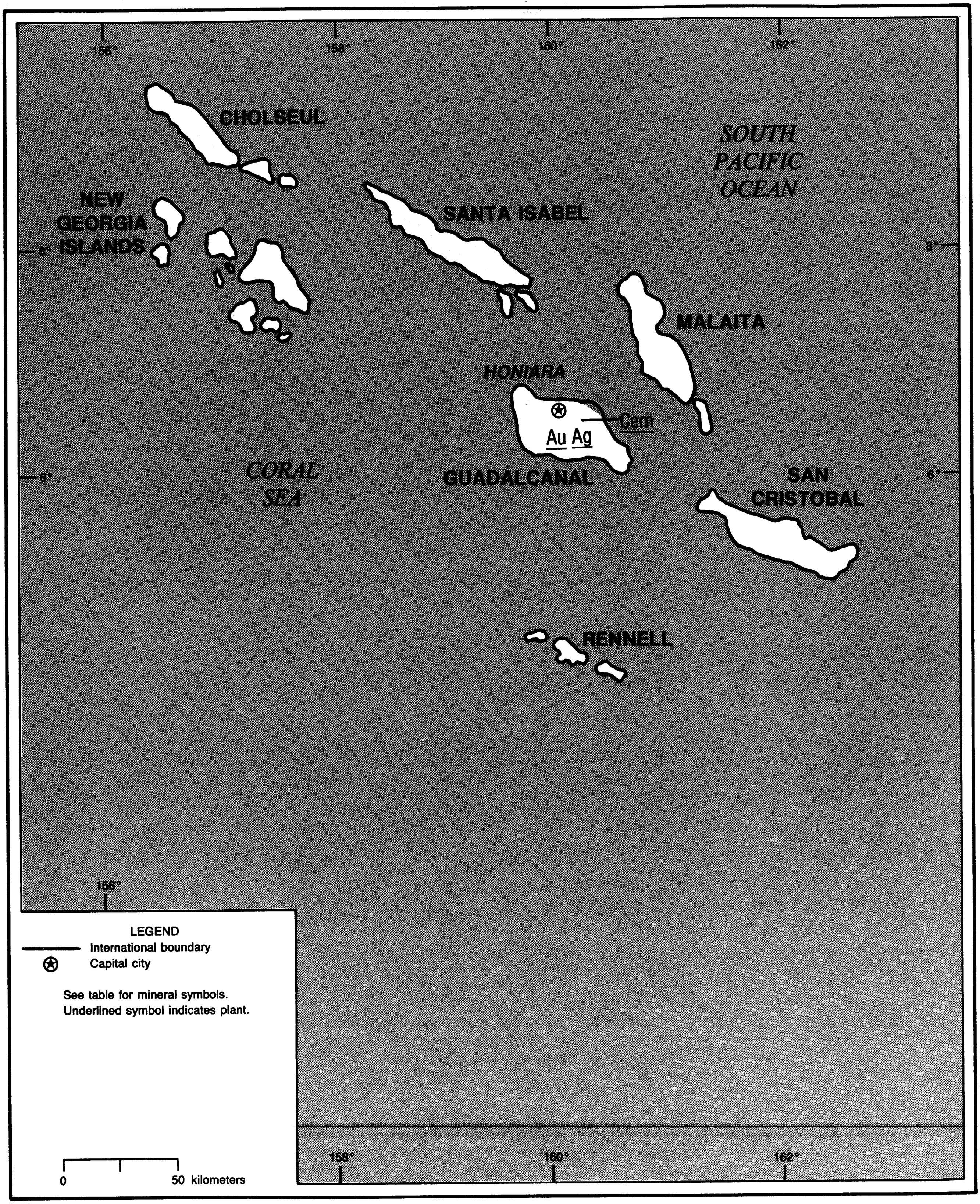
SOLOMON ISLANDS

AREA 28,450 km² **POPULATION 335,000**



THE MINERAL INDUSTRY OF THE SOLOMON ISLANDS

By Travis Q. Lyday

Mineral production in the Solomons remained restricted to minor amounts of construction materials used domestically and small quantities of alluvial gold, which was 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 kilograms (kg) 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 50:50 joint venture of Australia's Arimco NL and Cyprus Minerals Ltd. of the United States, deferred development of its planned opencut gold mine near Gold Ridge, 25 km from Honiara, pending results of feasibility studies. Arimco expected mining to begin by June 1991. Production was expected to range between 1,500 kg and 3,100 kg of gold per year and continue for 20 to 25 years.[2] Drilling established estimates of potential reserves of 5 million tons of ore with grades as high as 8.3 g of gold per ton.[3]

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 of gravel, 980 km of earth, and 800 km of private logging and plantation roads of varied construction. There are 2 permanent-surface airports, out of 29 total in the country, and 2 shipping ports, Honiara and Ringi Cove. Electric generating capacity in 1988 was reportedly 15,000 kilowatts.[4] Generally, infrastructure for mining 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]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
Gold, mine output, Au content	kilograms	98	[e]124	47	36	35
Silver, mine output, Ag content	do.	—	—	8	7	5

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Aug. 2, 1991.
[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

(Kilograms)

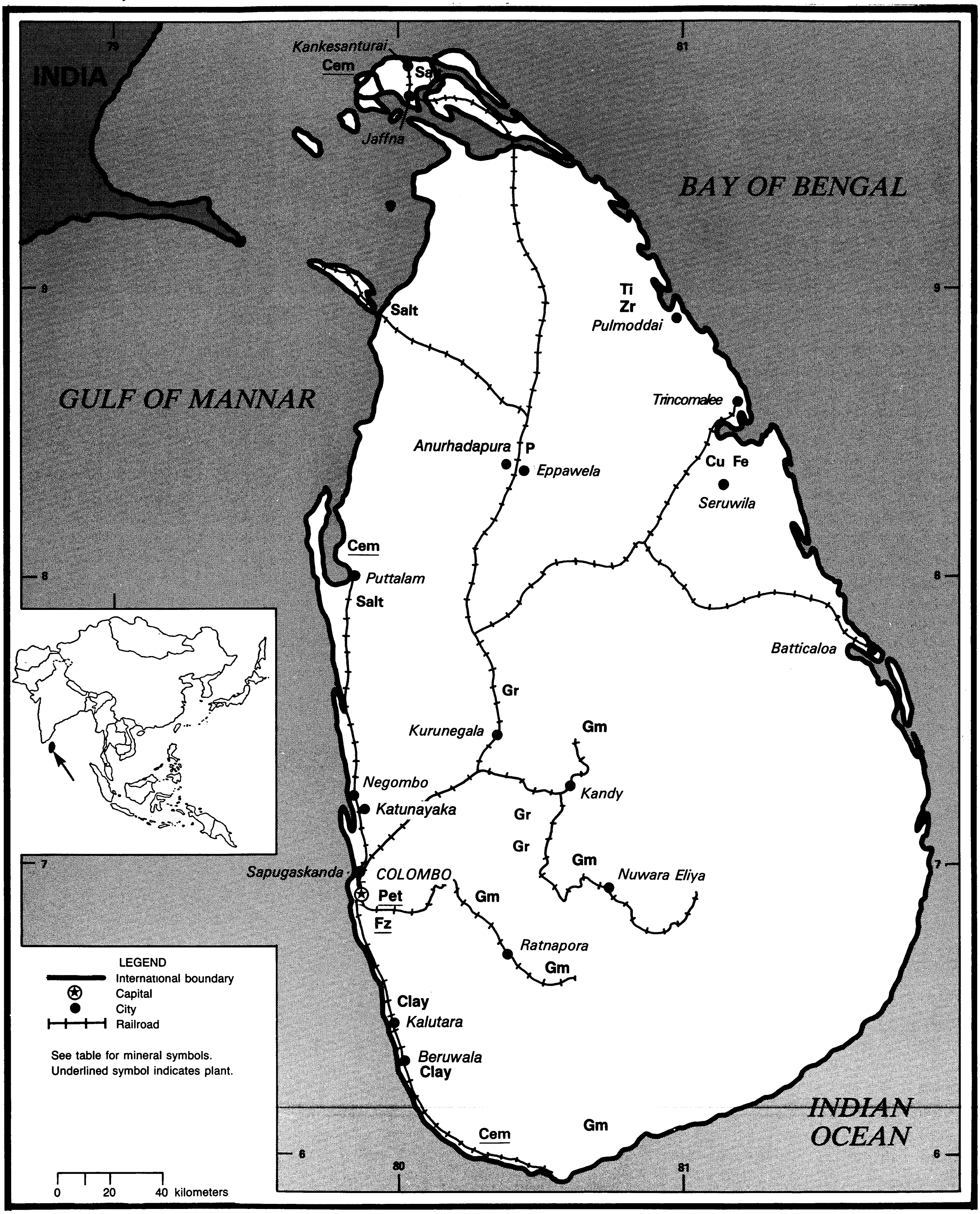
Commodity	Major operating companies	Location of main facilities	Annual capacity
Gold	Zanex Ltd, 70%; and Mavu Gold Development Ltd., 30%	Near Honiara, Guadalcanal	1,500
Do.	Arimco (Solomon Islands) Ltd., manager. Arimco NL, 50%; and Cyprus Minerals Ltd., 50%	Near Honiara, Guadalcanal	[1]1,500

[1]Mining expected to begin June 1991.

[1]Mining Annual Review. South Pacific Islands. Min. J. (London), June 1989, p. A84.
[2]South Seas Digest (Sydney). V. 10, No. 24, Mar. 1, 1991, p. 2.
[3]Metal Bulletin (London). No. 7434, Nov. 16, 1989, p. 15.
[4]U.S. Central Intelligence Agency. The World Factbook 1990, pp. 281-282.

SRI LANKA

AREA 65,600 km² **POPULATION 17.2 million**



THE MINERAL INDUSTRY OF SRI LANKA

By Pui-Kwan Tse

The mineral industry of Sri Lanka centers around harvesting gem stones and heavy-mineral sands from alluvial deposits. While a lapidary industry was being developed for international marketing of cut and polished precious and semiprecious gem stones, the ilmenite and rutile, monazite, and zircon components of mineral sands were exported without further processing. The country's economy continued to be dominated by the agricultural sector—tea, coconut, rubber, and various other associated products, and the textile sector, which accounted for 36% and 32%, respectively, of Sri Lanka's export earnings. Key economic indicators for the country were as shown in table 1, in million dollars.[1]

Despite the disruption caused by the renewed outbreak of hostilities in the northeast, the real growth in GDP was 6.2% in 1990 compared with 2.3% in 1989. Real sectoral growth in GDP was as follows, in percentage: agricultural, forestry, and fishing—8.1 (1.1% in 1989); mining and quarrying—9.1 (5.4% in 1989); manufacturing—9.4 (4.4% in 1989); construction—2.0 (0.6% in 1989); and services—4.3 (3.2% in 1989).

TABLE 1

SRI LANKA: KEY ECONOMIC INDICATORS

(Million dollars)

Economic Account	1989	1990
Domestic accounts:		
GDP at current factored costs	6,335	7,251
Fixed capital formation	1,505	1,787
International accounts:		
Exports	1,558	1,984
To the United States	400	493
Imports	2,225	2,686
From the United States	137	208
Trade balance	-167	-702
Current account balance	-307	-241
Direct investment	18	20
Foreign aid	486	553
From the United States	29	48
External debt (yearend)	5,710	5,809

As the political turmoil subsided toward midyear, the economy rebounded, reflected by a surge in trade—a 27% increase in exports as well as a 21% increase in imports. Moreover, tourism improved markedly to expand the service sector, which in turn helped contract Sri Lanka's current account balance. Inflation continued to be a major concern, running at an official rate of about 20% in 1990.

GOVERNMENT POLICIES AND PROGRAMS

Mineral production has increased in recent years, driven both by domestic consumption and by exports to earn foreign exchange credits. The Government has recognized the value of sponsored development in the form of free-trade zones. Projects in these zones, managed by the Greater Colombo Economic Commission (GCEC), permit up to 100% foreign ownership. In comparison, foreign participation in business ventures outside these zones is ordinarily limited to a minority interest.

The state has also set up specific territorial areas to enable both local and foreign investors to establish export-oriented industries; for instance, the lapidary industry. Foreign investments are guaranteed, and tax holidays of as much as 10 years are available. Dividends of nonresident shareholders are exempt from tax, and remittances are exempt from exchange controls. No import duties are charged on machinery and equipment.

The GCEC offers ombudsman-type service to foreign investors by facilitating investor relations with Government agencies, helping with labor recruitment and utility hookups, and various other business needs.

PRODUCTION

By value, Sri Lanka's mining sector centers around gem stones, principally sapphires and topaz.[2] The second most important component is heavy-mineral sands, containing titaniferrous minerals (ilmenite and rutile), zircon, and monazite (rare earths). In addition, there is small mine production of a limited array of industrial minerals, which include apatite, clays, feldspar, graphite, quartz, and salt. The value of output by the mining and quarrying sector increased by 9.1% in 1990 compared with 5.4% in 1989. Downstream production includes refinery products from imported petroleum and cement production.

TRADE

Total trade increased from $3,257 million in 1988 to $3,783 million in 1989. The value of imports continued to exceed that of exports, but the trade deficit was $644 million in 1988 compared with $667 million in 1989. The value of imports increased from $1,951 million in 1988 to $2,225 in 1989. The largest individual source for imports in 1989 was Japan, $233 million; followed by the United States, $123 million; United Kingdom, $113 million; Taiwan, $104 million; Hong Kong, $99 million; China, $92 million; Thailand, $88 million; and the Republic of Korea, $85 million. Exports increased from $1,306 million in 1988 to $1,558 million in 1989. Exports to the United States in 1989 were valued at $359 million, followed by the Federal Republic of Germany, $85 million; Japan, $80 million; United Kingdom, $77 million; Belgium, $75 million; United Arab Republic, $51 million; and Pakistan and the Netherlands, with $40 million each.

In 1990, imports were valued at $2,686 million consisting of petroleum, $359 million; textiles and apparel, $274 million; sugar, wheat, and flour, $258 million; machinery and equipment, $216 million; automotive, $108 million; chemicals, $81 million; and "other," $1,380 million. Exports in 1990, valued at $1,984 million, consisted of agricultural products (including coconut, rubber, and tin), $720 million; textile and apparel, $628 million; petroleum products, $99 million; gem stones, $73 million; and "other," $464 million.

STRUCTURE OF THE MINERAL INDUSTRY

The Government virtually owns the mining and mineral processing operations as well

TABLE 2

SRI LANKA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990[p]
Cement, hydraulic[e]	thousand tons	600	600	400	400	400
Clays:						
Ball clay		20,470	20,210	17,330	20,866	27,695
Kaolin		6,260	6,869	7,100	7,761	7,731
Brick and tile clay[e]		40,000	60,000	60,000	60,000	60,000
Clays for cement manufacture		36,322	23,277	12,487	[e]12,500	[e]12,500
Feldspar, crude and ground		7,270	7,442	6,345	6,656	9,698
Gem stones, precious and semiprecious, other than diamond	value, thousands	$23,304	$13,196	[e]$14,000	[e]$14,000	[e]$14,000
Graphite, all grades		7,453	[e]9,400	8,547	4,163	5,469
Iron and steel: Metal: Semimanufactures		10,872	33,508	[e]35,000	[e]35,000	33,422
Mica, scrap[e]		200	200	200	200	200
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	1,114	1,190	[e]2,040	3,128	5,460
Jet fuel	do.	760	552	[e]420	384	805
Kerosene	do.	1,163	1,162	[e]1,010	961	1,325
Distillate fuel oil	do.	3,111	3,819	[e]3,580	3,327	4,345
Residual fuel oil	do.	4,109	4,062	[e]2,000	—	—
Other	do.	1,793	1,628	[e]1,500	1,166	620
Refinery fuel and losses	do.	435	395	[e]440	553	630
Total	do.	12,485	12,808	[e]10,990	9,519	13,185
Phosphate rock		14,977	20,600	22,995	24,440	32,564
Rare-earth metals: Monazite concentrate, gross weight[e]		200	200	200	200	200
Salt		104,278	115,274	106,794	[e]100,000	53,031
Stone:						
Limestone	thousand tons	649	2,044	733	608	642
Quartz, massive		1,090	1,190	953	961	1,300
Titanium concentrate, gross weight:						
Ilmenite		129,907	128,500	74,305	[e]75,000	[e]75,000
Rutile		8,443	7,200	5,255	[e]5,200	5,460
Zirconium: Zircon concentrate, gross weight		[e]4,000	[e]4,000	[e]4,000	[e]4,000	19,727

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Sept. 24, 1991.
[2]In addition to the commodities 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 3

SRI LANKA: SELECTED MINERAL EXPORTS IN 1989

(Metric tons unless otherwise noted)

Commodity and Destination	Quantity	Value
Graphite:		
Australia	466	322,686
Japan	1,566	$854,224
Other	699	522,416
United Kingdom	1,000	815,467
United States	607	673,098
Total	4,338	3,217,891
Quartz:		
Japan	9,209	726,778
Other	150	13,095
Total	9,359	739,873
Dimension stone:		
Japan	2,817	336,178
Other	827	84,592
Total	3,644	420,770
Mica:		
Belgium	998	282,948
Japan	1,650	408,503
Other	43	12,716
Total	2,691	704,167
Ilmenite:		
Japan	58,300	3,128,810
Netherlands	27,000	1,590,454
United States	30,000	1,650,801
Total	115,300	6,370,065
Rutile:		
Netherlands	4,500	2,438,319
Metallic ores, unspecified:		
Japan	2	1,254
Malaysia	57	3,472
Total	59	4,726
Gem stones:		
Germany, Federal Republic of	1,874	2,540,755
Hong Kong	1,262	6,037,278
Other	1,714	31,080,077
Thailand	10,123	16,459,998
United States	2,079	5,026,086
Total	17,052	61,144,194

[1]Thousand carats.

as the related trade enterprises. The one exception is the many nonmechanized small-scale gem stone workings, which are privately owned and operated. What was probably the country's largest mineral-industry investment, the Sri Lanka State Fertilizer Manufacturing Corp., ceased operation in 1985, but the equipment is believed to be kept under maintenance and repair status. After beginning production in 1981, the plant suffered substantial annual financial losses.

Depending upon the intensity of mining activity, the mineral industry labor force consisted of 2,000 to 3,000 people out of a total national 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, particularly for salt and cement production. Gem stone and graphite mining in central Sri Lanka have been affected, as well as the recovery of mineral sands in the Pulmoddai region of the northeast coast.

COMMODITY REVIEW

Metals

Ceylon Steel Corp. has a small melting and milling operation at Ornawala. The electric furnace utilized scrap and imported ingot to provide hot metal for the mill to produce billet, wire rod, drawn wire, and sheet.

Industrial Minerals

Gem Stones.—The Government-owned State Gem Corp. (SGC) regulates the sales and trade of gem stones mined by the small,

TABLE 4

SRI LANKA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Cement	Lanka Cement Corp	Kankesanturai	1,000
		Puttalam	400
Gem stones	State Gem Corp. (sales and trade)	Colombo	NA
Graphite	State Mining and Mineral Development Corp.	Kahatagaha-Kolongaha Mines, 27 kilometers north-east of Kurunegala.	4
		Bogala Mine, 80 kilometers northeast of Colombo.	7
Petroleum, refinery products thousand 42-gallon barrels per day	Ceylon Petroleum Corp	Sapugaskanda	50
Phosphate rock	State Mining and Mineral Development Corp.	Eppawela	50
Salt	Sri Lanka National Salt Corp.	Hambantota, Elephant Pass, and Palavi	120
Steel	Ceylon Steel Corp.	Ornawala, Athurugiriya	40
Titanium, ilmenite concentrate	Ceylon Mineral Sands Corp.	Pulmoddai	150

NA Not applicable.

numerous, privately owned operations. SGC established lapidary facilities at Ratnapura and Matale for the cutting and polishing of semiprecious and precious stones, including diamonds. Moreover, the Government was to establish a Gem Trading Bank to assist in financing for the lapidary industry, the purchase, sales, import of rough stones, and export of gems.

Graphite.—The State Mining and Mineral Development Corp. operates underground mines in Kegalle and Kurunegala, producing small quantities of high-purity graphite. The corporation was seeking cooperation in the modernization of its production and processing facilities as well as the possible downstream manufacturing of graphite-base products.

TABLE 5

SRI LANKA: PRODUCTION OF GEM STONES IN 1990

(Carat)

Gem Stone	Quantity
Topaz	5,858,137
Sapphire	946,783
Garnet	48,037
Chrysoberyl	38,902
Ruby	15,889
Amethyst	6,912
Tourmaline	5,665
Aquamarine	3,798
Alexandrite	827

Phosphate.—The State Mining and Mineral Development Corp. operates an open pit mine at Eppawala. Mine production is consumed in direct fertilizer application. The corporation was seeking technical assistance to convert the mine output to monoammonium or diammonium phosphate for increased solubility.

Salt.—Sri Lanka National Salt Corp. produces solar salt from evaporation ponds at three main centers—Hambantota, Palavi, and Elephant Pass. This state monopoly was to be privatized, capacity to be expanded, and facilities to be modernized for the production of higher quality salt and iodized salt, as well as for entering the export market.

Mineral Fuels

There is no domestic production of oil in Sri Lanka. Ceylon Petroleum Corp. and Oil & Natural Gas Commission (India) agreed to conduct a feasibility study for joint exploration on Sri Lanka's side of the Palk Strait in the Gulf of Mannar. Oil was discovered on the Indian side of the strait in the early 1980's.

In 1990, Ceylon Petroleum Corp. imported 1,435,986 tons of crude oil from Iran and 355,301 tons from Malaysia for use at its refinery at Sapugaskanda. Most of the refinery output is domestically consumed. However, a portion is exported principally to Singapore and to a lesser extent, Japan, to garner foreign exchange.

Reserves

Archean rocks (from the Earth's oldest geologic era) constitutes nine-tenths of the area of the country. Geochemical remobilization during metamorphism has resulted in various mineral concentrations ranging from possible exploitation of magnetite iron ore to economic occurrences of gem stones. The extent of mineralization for many of these deposits is not yet determined. New reserves are being discovered as geologic investigations continue by Sri Lanka's Geological Survey.

One mineral commodity for which no method of reserve estimation has been devised is gem stones, which Sri Lanka has in profusion and variety. Most are precious and semiprecious colored stones mined from alluvial deposits in the hilly terrain of the southwest part of the country. Their presence in the stream beds and terraces demonstrates that in all probability more are still upstream in lode deposits more difficult to mine.

INFRASTRUCTURE

Sri Lanka has a relatively extensive network of roads and railroads capable of providing good support to mineral exploration and development. The country has about 66,200 km of highways, consisting of

TABLE 6

SRI LANKA: ESTIMATED RESERVES OF MAJOR MINERAL COMMODITIES

(Thousand metric tons unless otherwise specified)

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

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 are several thousand km of undrained tracks. Railroads include about 1,870 km of 1.676-m broad-gauge track, 102 km of this being double track.

Inland waterways comprise about 430 km navigable by shallow-draft boats. Principal seaports are Colombo and Trincomalee, with smaller ports around the periphery of the island. A seagoing ferry connects the smaller port of Talaimannar with the Indian port of Danushkodi. The country has 13 usable airports, 12 having paved runways. One airport has runways 2,440 to 3,659 m in length; seven of the others have runways 1,220 to 2,430 m long. In 1987, there was 62 km of oil pipeline for crude and refined products.

Electricity is generated by hydroelectric and thermal power/ plants, including some fired by diesel fuel. Capacity altogether is 1,300 MW, with about 4,200 MkW·h produced per year or approximately 250 kW·h per capita. New power/plants are in various stages of study and funding.

OUTLOOK

While Sri Lanka has a limited variety of known minerals, there appear to be good prospects for the discovery of other minerals. The country's dominantly Archean geology offers many possibilities depending only upon the advancement of exploration. The probabilities for discovery of petroleum offshore and onshore are not unattractive, and finds could go far toward relieving Sri Lanka's present degree of energy dependence.

Unfortunately, Sri Lanka is torn by political and ethnic insurgency to such a degree that the real concern is the country's survival in its present democratic form.

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[1]Where necessary, values have been converted from Sri Lankan rupees (SLR) to U.S. dollars at the rate SLR 40.06=US$1.00.

[2]Industrial Minerals (London). Jan. 1991, pp. 45-51.

[3]South-East Asia Mining Letter. June 30, 1990, p. 10.

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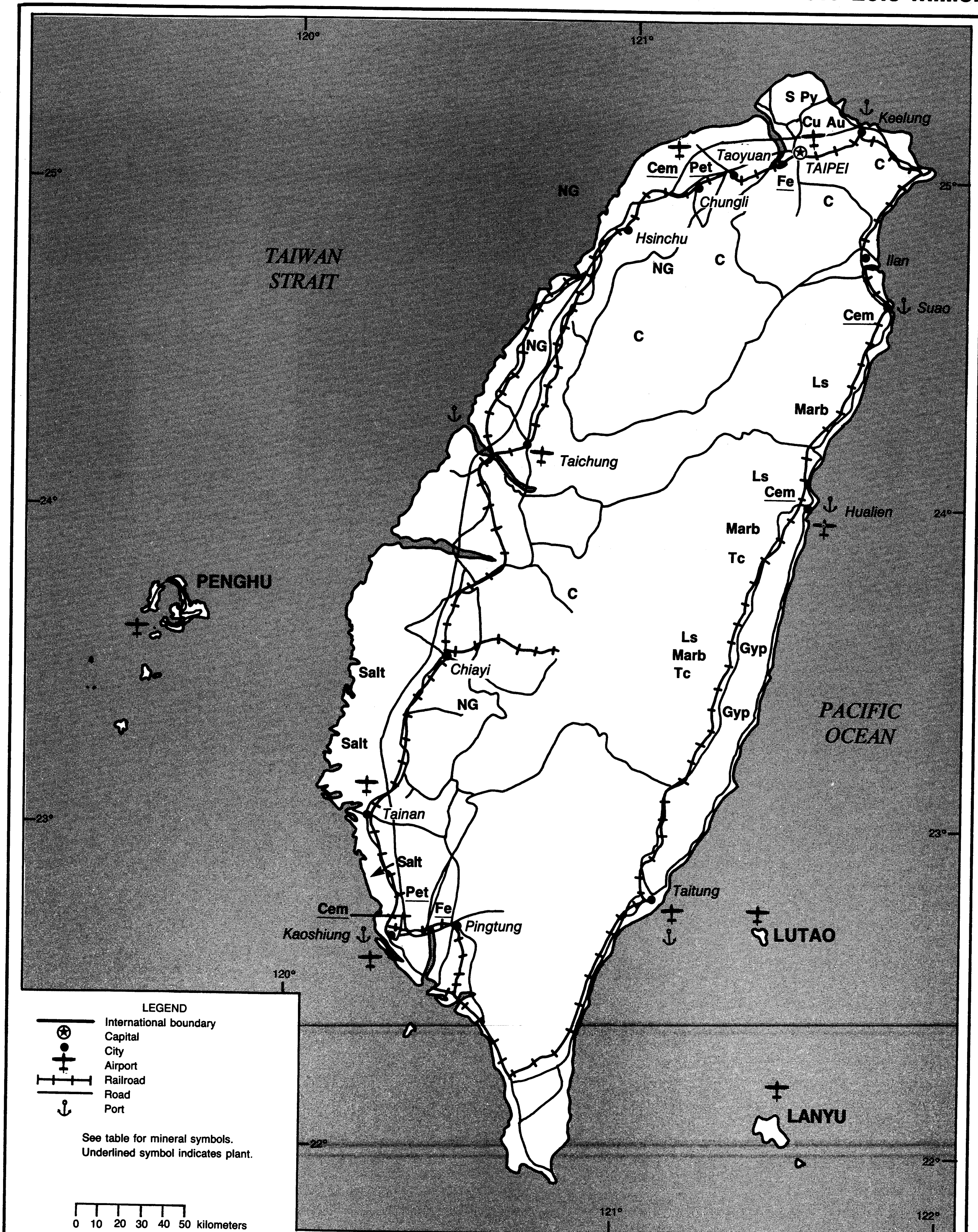
TAIWAN

AREA 35,980 km² **POPULATION 20.3 million**



THE MINERAL INDUSTRY OF TAIWAN

By Pui-Kwan Tse

After many years of effort, Taiwan was transformed from a developing country into a newly industrializing economy and became a prominent member of the world's trading community. In order to strength on its effort in international trade and financial communities, Taiwan formally submitted an application to join the General Agreement on Tariffs and Trade (GATT) on January 1, 1990, and also submitted an updated application in early 1991. In 1990, Taiwan committed $4 million to the Asian Development Fund at the Asian Development Bank meeting in New Delhi. Taiwan is also seeking to expand its role in the Pacific region and has expressed its strong desire to join the Asian Pacific Economic Cooperation and the South Pacific Forum. Taiwan has a very poor mineral resource base. Most of the raw materials and fuels that are used for industrial output are imported. However, with a highly competent work force, Taiwan became an industrialized country in the 1980's. The worldwide recession, the oil crisis triggered by Iraq's invasion of Kuwait, and the stock market price index dropping 78.6% from its peak in February 1990, caused the economy to grow only a modest 5.2% in 1990. Despite the slowdown, a 5.2% rate of growth is admirable for many industrialized countries. Taiwan's population grew from 20.1 million in 1989 to 20.3 million in 1990, and its gross national product (GNP) also increased from $150.3 billion in 1989 to $176.3 billion in 1990. With a per capita income of $7,990, an increase of 6.4% over 1989, Taiwan currently ranks 25th in the world and 2nd in Asia after Japan. Based on the assumption of an economic growth rate of 7% per year, the Government projects per capita income will reach $13,975 by 1996.

The total labor force in Taiwan was 8.3 million and the unemployment rate was 1.52%. Employment in the mining and quarrying industry only accounted for 20,000, or 0.24% of the total labor force in Taiwan, compared with 1.1 million (13.2%) for agriculture, 1.4 million (16.9%) for public administration and social services, 1.6 million (19.3%) for commerce, and 2.7 million (32.5%) for manufacture. The output value of the mining and quarrying sector was 0.41% of the gross domestic product (GNP), which is insignificant compared with other sectors. Taiwan has limited quantities of industrial minerals, mostly limestone, marble, and dolomite. Taiwan is also poor in energy supply. Domestic energy output only provided 4% of Taiwan's total energy supply. The import value of minerals accounted for 13.52% of Taiwan's total import value. Moreover, if higher oil prices were to occur, there would be a negative impact on Taiwan's economic growth in the 1990's.

Taiwan imports 100% of its aluminum, antimony, chromium, cobalt, iron ore, magnesium, manganese, molybdenum, nickel, tin, tantalum, tungsten, and zirconium. Taiwan produces small quantities of silver, copper, and gold; and 80% to 90% of these metals needed for its industry output is imported. Because of the worldwide recession, domestic demand slowed; therefore, Taiwan imported fewer industrial raw materials in 1990 compared with those of 1989.

The distribution of the GDP by sectorial input at current prices is listed in table 1. The growth rate in 1990 by kind or type of activity in terms of GDP at constant prices is shown in figure 1.

GOVERNMENT POLICIES AND PROGRAMS

Negotiations on a copyright agreement between the United States and Taiwan began in 1987. Generally, there is consensus on both sides on most issues. The remaining disputed issue was on works by Government agencies, educational institutions, judicial units, and nonprofit groups. The Taiwan Government considered such activities as "reasonable usage" of intellectual property, although the United States claims usage as a copyright infringement.

Foreign banks are not allowed to set up wholly owned subsidiaries in order to prevent them from offering the full range of trust and investment services. Moreover, foreign banks and insurance companies are restrained by quotas limiting entry into the Taiwan market. In December 1990, Taiwan's Securities and Exchange Commission (SEC) issued a complicated set of regulations for foreign institutional investors. According to the regulations, foreign entrepreneurs and entities are permitted to apply for investments ranging from $5 million to $50 million. However, under certain circumstances, the SEC may approve foreign remittances for investments for as much as $100 million. The regulations required all funds to be remitted to Taiwan within 3 months after an investment application was approved. Moreover, all principal must remain in escrow in Taiwan for at least 3 months, and capital gains on investment may be repatriated only once per year.

In 1990, the Government launched a 6-year national development plan for Taiwan. The development plan was projected to require an estimated investment totaling $476 billion to meet four key policy goals: 1. raising national income; 2. providing sufficient resources for continued industrial growth; 3. promoting the balanced development of various regions to avoid the pitfalls associated with rapid industrialization and urbanization, and population congestion; and 4. upgrading the national quality of life. The composition of Taiwan's economic structure by industrial sector is shown in table 2.

PRODUCTION

Taiwan has developed a well-diversified industrial base, consisting predominantly

TABLE 1

TAIWAN: COMPOSITION OF THE GROSS DOMESTIC PRODUCT

(Percent)

Sector	1989	1990
Agricultural production	4.89	4.27
Industrial production	43.60	42.26
Construction	4.56	4.85
Manufacturing	35.59	34.08
Other	3.45	3.33
Services	51.51	53.47
Commerce	14.62	15.29
Finance	17.90	19.32
Government	9.91	10.82
Others	9.08	8.04

of small- and medium-sized labor-intensive enterprises utilizing mainly low-technology processes but producing high-quality goods. For many years, the textile industry was the leading foreign exchange earner. Beginning in 1985, however, exports of electronic products overtook the garment industry. The manufacture of chemicals, machine tools, metals, and passenger vehicles represent output by the heavy industries sector.

The value of the output of the mining sector was only $447 million or 0.27% of the country's total industry output value in 1990. By value, natural gas continued to be the most important mine output, followed by coal and marble. The domestic production of mineral fuels provided only 3% of the country's supply of energy.

There are no mining claims in the western part of the country. In the eastern part of the country, e.g., Yilan Hsien, Hwalien Hsien, and Taitung Hsien, marble and limestone dominated the minerals output by the hard-rock mining sector. All the large minerals- and metals-producing companies in Taiwan are state-owned enterprises.

TABLE 2

TAIWAN: COMPOSITION BY INDUSTRIAL SECTOR

(Percent)

Enterprises	Composition 1991	Composition 1996	1991-96 average annual growth
Total industry	100.0	100.0	NA
Mining and quarrying	1.0	.9	4.4
Manufacturing	80.6	79.2	6.5
Capital and technology intensive	45.3	49.1	8.3
Labor intensive	35.3	30.1	4.1
Electricity, gas, and water	6.9	6.6	6.1
Construction	11.5	13.6	9.5

NA Not applicable.

TRADE

Despite a worldwide recession, Taiwan's total trade value increased to $121.93 billion, 1.2% more than that of 1989. The values of exports and imports were $67.21 billion and $54.72 billion, respectively, resulting in a trade surplus of $12.49 billion, which was the lowest surplus value in the past 5 years. The United States continued to be Taiwan's largest export destination even though the total export share fell from 36.2% ($23.9 billion) in 1989 to 32.3% ($21.71 billion) in 1990. In 1990, Hong Kong replaced Japan to become the second largest export destination, accounting for 12.8% ($8.61 billion) that included $3 billion of Taiwan-China indirect trade via Hong Kong. The largest supplier of Taiwan's imports remained Japan with 29.3% ($16.03 billion), followed by the United States, 23.0% ($12.58 billion).

Taiwan's major export revenues were from machinery equipment, 34.42% ($23.13 billion), and textiles, 15.31% ($10.29 billion) of total exports. The mineral and metals exports included base metals and their products, valued at $4.83 billion; chemical products, $1.26 billion; and mineral products, $449 million. Altogether, these commodities accounted for 10.5% of the total value of exports. Electrical machinery and equipment became Taiwan's largest import, valued at $8.92 billion, followed by machinery and mechanical equipment, $7.28 billion; base metals and their products, $5.93 billion; and chemical, $5.77 billion. Taiwan imported a total value of $4.14 billion of fuels. By sector, crude oil accounted for $3.15 billion and coal for $996 million.

The United States continued to be a major trading partner of Taiwan. However, a weak economic performance in the United States diminished U.S. purchasing power, contributing to lower imports from Taiwan in 1990. At the current trends, Taiwan will continue to expand imports and diversify its export market away from the United States to Eastern Europe, the U.S.S.R., and Southeast Asia in the 1990's.

STRUCTURE OF THE MINERAL INDUSTRY

Taiwan's industrial development has registered an impressive 12% average annual growth, but the mineral industry continued to decline. Coal, oil, and natural gas are the country's most valuable mine products. Total production only accounted for 3% of Taiwan's total energy supply. Carbonate minerals such as marble, limestone, and dolomite composed the most important nonfuel mining sector. In addition to the aggregates, clays, feldspar, salt, and talc make up the remaining mine production. In the metals production sector, the country produces copper, iron and steel, and byproducts of gold and silver with imported raw materials.

To ensure stability for the national economy, the major industrial firms, which require large capitalization in Taiwan, are Government enterprises such as China Steel Corp., Taiwan Metal Mining Corp., Taiwan Machinery Manufacturing Corp., China Shipbuilding Corp., China Petroleum Corp., Taiwan Power Co., and Taiwan Fertilizer Co. Ltd.

COMMODITY REVIEW

Metals

There were no domestic metal mining activities in Taiwan. The primary metals industry is limited to copper, iron and steel, and nickel, all of which utilize imported raw materials. Taiwan is the United States' biggest foreign market for secondary zinc, the second-largest customer for aluminum scrap, and the fifth-ranked market for recyclable copper. However, charges of massive lead poisoning of workers and contamination of the environment by a major scrap processor in the northern part of the country will likely result in the banning of imports of recyclables and will outlaw much of the country's metal reprocessing industry. The target for curtailing scrap imports will be in 1993. In 1989, the value of Taiwan's nonferrous scrap acquisition from the United States was valued at $170 million. Such a ban would hit hard at the U.S. nonferrous scrap industry.

Copper.—Taiwan's main copper smelter-refinery is operated under supervision of Taipower, at Juifang, in the northern part of the country. In 1990, Taiwan produced 16,090 tons of refined copper, down 63% from that of 1989.

Nippon Mining, a Japanese company, established a wholly owned subsidiary, NW Taiwan, to produce copper flat products at its processing plant at Taoyuan. The pro-

FIGURE 1

GROWTH RATE BY KIND OF ACTIVITY

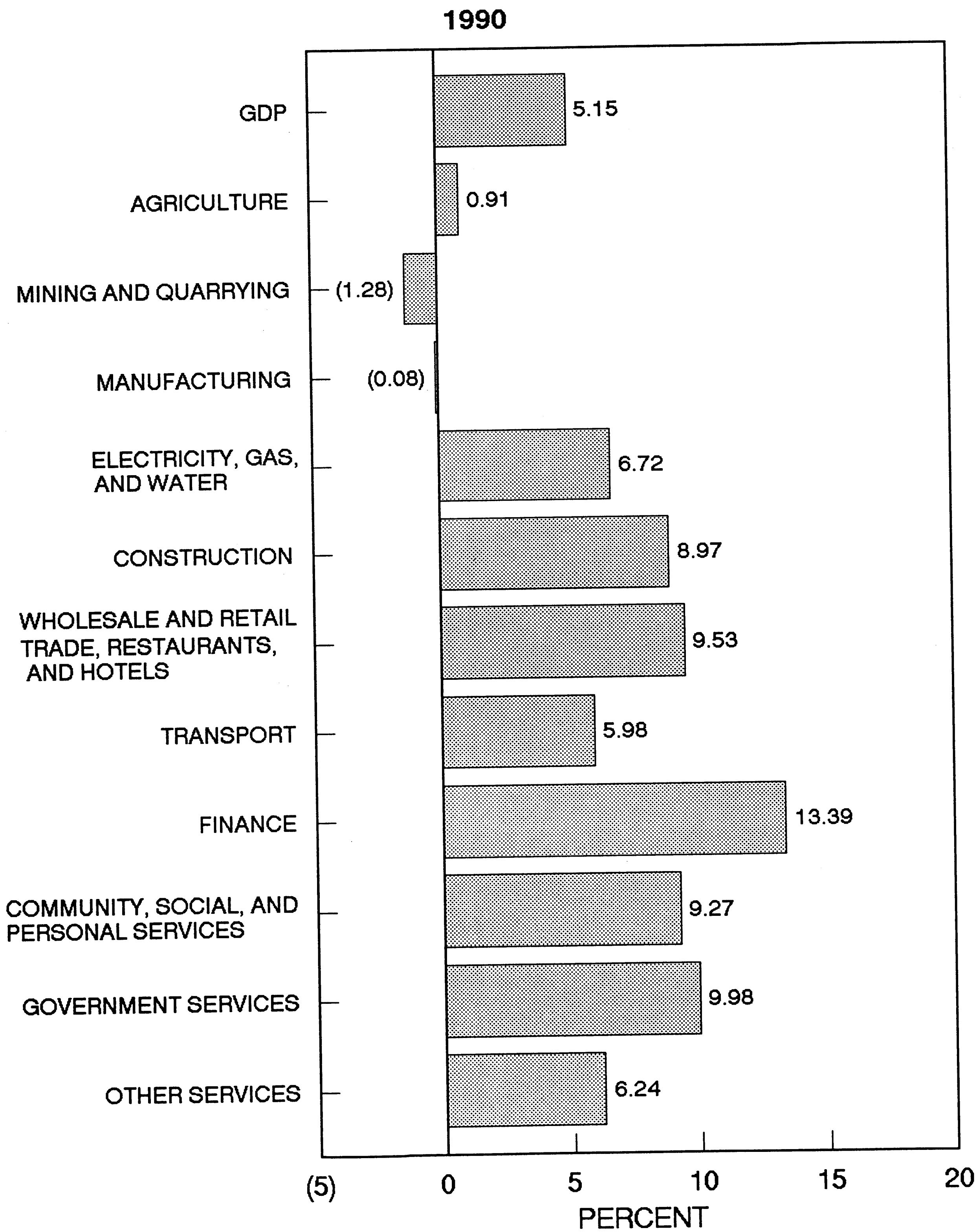


TABLE 3

TAIWAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
METALS						
Copper: Metal, refined		50,439	46,961	43,333	43,237	16,090
Gold, primary	kilograms	907	532	237	269	72
Iron and steel: Metal:						
Pig iron	thousand tons	3,740	[e]3,900	5,675	5,780	5,474
Ferroalloys:						
Ferromanganese		20,040	17,026	25,822	30,623	43,631
Ferrosiliconmanganese		20,933	18,944	30,745	25,510	20,587
Ferrosilicon		14,007	7,058	19,601	19,277	15,501
Steel, crude	thousand tons	5,679	5,949	8,313	9,047	9,554
Nickel, refined[e]		8,500	8,200	8,200	8,200	8,200
Silver, primary	kilograms	12,613	9,856	8,388	6,491	3,926
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	14,806	15,663	17,281	18,043	18,459
Clays:						
Fire clay		64,652	76,005	131,370	85,803	99,389
Kaolin		63,228	67,525	81,879	98,115	106,000
Feldspar		26,290	28,116	19,101	9,806	7,321
Gypsum: Precipitated		2,247	1,378	2,438	3,904	[e]4,945
Lime		109,690	105,005	105,701	[e]97,000	[e]100,000
Mica		774	787	4,387	4,290	[e]4,000
Nitrogen: N content of ammonia		265,248	243,275	278,410	222,197	[e]220,000
Pyrite, gross weight		10	—	—	—	—
Salt, marine		136,078	99,943	111,341	169,982	82,820
Sodium compounds, n.e.s.:						
Caustic soda		365,913	378,244	332,698	186,452	244,675
Soda ash		133,358	127,332	126,828	115,572	[e]120,000
Stone:						
Dolomite	thousand tons	258	340	448	419	339
Limestone	do.	12,462	12,407	13,653	14,069	13,924
Marble	do.	10,603	11,062	11,213	12,231	11,349
Serpentine	do.	234	253	328	469	388
Sulfur:						
S content of pyrite		5	—	—	—	—
Byproduct, all sources		62,980	89,082	86,541	76,060	95,533
Total		62,985	89,082	86,541	76,060	95,533
Talc		21,552	22,102	21,603	22,559	[e]22,123
MINERAL FUELS AND RELATED MATERIALS						
Carbon black		48,363	53,559	52,982	57,632	62,230
Coal, bituminous	thousand tons	1,725	1,499	1,225	784	480
Coke	do.	148	118	97	88	70
Gas, natural:						
Gross[e]	million cubic feet	40,000	41,000	45,000	50,000	50,000
Marketed	do.	36,111	37,325	41,087	40,642	[e]41,000
Petroleum:						
Crude	thousand 42-gallon barrels	660	934	880	850	820
Refinery products:						
Gasoline	do.	18,128	24,480	26,640	27,084	[e]28,000
Kerosene	do.	956	547	1,201	2,032	[e]2,200

See footnotes at end of table.

TABLE 3—Continued

TAIWAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Refinery products:—Continued						
Distillate fuel oil	do.	19,480	25,581	23,131	27,015	[e]628,000
Residual fuel oil	do.	53,591	51,622	60,538	71,207	[e]72,000
Lubricants fuel oil	do.	887	1,887	969	1,038	[e]1,000
Asphalt	do.	3,195	2,291	2,567	2,901	[e]3,000
Other[2]	do.	3,478	4,835	6,408	14,531	[e]16,000
Refinery fuel, losses and not reported[3]	do.	[e]25,000	21,680	11,176	8,695	[e]10,000
Total	do.	125,375	132,923	132,630	154,503	[e]160,200

[e]Estimated. [p]Prelminary.
[1]Includes data available through Mar. 15, 1991.
[2]Naphtha, solvent oil, and base oil.
[3]Includes liquefied petroleum gas and jet fuel.

TABLE 4

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
METALS					
Alkali and alkaline-earth metals		202	35	—	Indonesia 27; Japan 5.
Aluminum:					
Ore and concentrate		3	18	—	All to Republic of Korea.
Oxides and hydroxides		562	3,459	7	Philippines 1,300; Republic of Korea 1,240.
Metal including alloys:					
Scrap		5,211	4,412	16	Japan 4,342; Singapore 52.
Unwrought		34,753	30,204	4	Japan 26,992; Republic of Korea 762.
Semimanufactures		25,329	24,950	467	Hong Kong 9,644; Japan 7,541.
Antimony:					
Oxides		189	586	—	Netherlands 281; Japan 259.
Metal including alloys, all forms		5	2	(2)	Mainly to Japan.
Arsenic: Oxides and acids	kilograms	—	27	—	All to Philippines.
Beryllium: Metal including alloys, all forms	do.	[r]463	97	97	
Cadmium: Metal including alloys, all forms	do.	33,993	40,183	30,562	Japan 9,300.
Chromium:					
Ore and concentrate		—	110	—	Japan 80; Indonesia 26.
Oxides and hydroxides	kilograms	56	3,355	—	Philippines 1,930; Hong Kong 1,135.
Metal including alloys, all forms		—	22	12	Hong Kong 6.
Cobalt:					
Oxides and hydroxides	kilograms	398	23	—	Belgium-Luxembourg 20; Indonesia 3.
Metal including alloys, all forms		661	1,615	—	Netherlands 1,270; Japan 345.
Columbium and tantalum: Tantalum metal including alloys, all forms		141	30	6	Netherlands 20; West Germany 2.
Copper:					
Ore and concentrate		15	—		
Matte and speiss including cement copper		37	501	—	Hong Kong 500.

See footnotes at end of table.

TABLE 4—Continued

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
METALS—Continued				
Copper:—Continued				
Oxides and hydroxides	10	1	—	NA.
Sulfate	1,192	3,663	—	Australia 1,120; New Zealand 1,092; Saudi Arabia 185.
Metal including alloys:				
Scrap	16,396	15,665	1,069	Japan 5,804; Hong Kong 2,582.
Unwrought	2,972	2,983	861	Singapore 872; Hong Kong 328.
Semimanufactures	48,297	101,615	1,945	Japan 27,239; Hong Kong 26,573.
Gold:				
Waste and sweepings kilograms	12,339	41,621	13,292	Hong Kong 27,704; Malaysia 625.
Metal including alloys, unwrought and partly wrought do.	50	6	2	Singapore 3; Japan 1.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	472	114	—	Hong Kong 67; Japan 21; Nigeria 17.
Metal:				
Scrap	75,239	51,786	587	Japan 42,095; Thailand 3,366.
Pig iron, cast iron, related materials	3,030	4,303	92	Japan 1,315; Netherlands 1,238.
Ferroalloys:				
Ferrochromium	1,186	2,568	1,215	Japan 1,349.
Ferromanganese	1	273	—	Tanzania 203; Burundi 51.
Ferronickel	(3)	38	—	Mainly to Japan.
Ferrosilicon	318	1,694	—	Japan 1,133; Hong Kong 490.
Silicon metal	16	1	—	NA.
Unspecified	3,494	1,114	4	Indonesia 900; Hong Kong 119.
Steel, primary forms	398,420	311,145	126	Indonesia 177,210; Philippines 53,846.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	NA	842,866	39,754	Japan 505,257; Republic of Korea 73,278.
Clad, plated, coated	NA	110,826	11,568	Australia 49,150; Japan 23,524.
Of alloy steel	NA	36,828	33	Republic of Korea 31,800; Japan 2,395.
Bars, rods, angles, shapes, sections	256,625	170,615	17,684	Hong Kong 33,271; Republic of Korea 21,594.
Rails and accessories	745	884	73	Thailand 428; Japan 134.
Wire	24,241	28,855	6,820	Hong Kong 5,263.
Tubes, pipes, fittings	224,379	176,558	67,974	Japan 30,892; Saudi Arabia 18,475.
Lead:				
Ore and concentrate value, thousands	$1	—		
Oxides	404	3,969	—	Japan 3,209; Malaysia 368.
Metal including alloys:				
Scrap	11	(2)	—	All to Saudi Arabia.
Unwrought	30,879	19,305	—	Japan 8,316; Republic of Korea 6,843.
Semimanufactures	143	291	51	Singapore 137; Hong Kong 47.
Magnesium: Metal including alloys:				
Scrap	600	560	76	Japan 466; Italy 18.
Unwrought	10	6	—	Malaysia 3; Singapore 1.
Semimanufactures	10	11	7	Hong Kong 2.

See footnotes at end of table.

TABLE 4—Continued

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989	
			United States	Other (principal)
METALS—Continued				
Manganese:				
Ore and concentrate, metallurgical-grade	6	116	—	Nigeria 104; Indonesia 12.
Oxides	59	120	1	Indonesia 60; Philippines 54.
Metal including alloys, all forms	—	1	—	All to Malaysia.
Mercury	r(2)	139	—	Singapore 124; Japan 13.
Molybdenum:				
Oxides	NA	128	—	All to Netherlands.
Metal including alloys:				
Scrap kilograms	12,996	202	—	All to Singapore.
Unwrought do.	—	1,267	1,089	Indonesia 178.
Semimanufactures do.	2,589	7,036	363	Thailand 3,284; Philippines 3,058.
Nickel:				
Matte and speiss	38	2	—	All to Japan.
Oxides and hydroxides kilograms	—	160	—	
Metal including alloys:				
Scrap	3,891	3,111	39	Japan 2,345; India 291.
Unwrought	2,431	1,403	90	Japan 654; Republic of Korea 206.
Semimanufactures	84	106	14	Japan 47; Malaysia 17.
Platinum-group metals: Metals including alloys, unwrought and partly wrought kilograms	4,539	11,425	2,140	Japan 4,734; Hong Kong 1,692.
Rare-earth metals do.	—	4,478	—	Malaysia 4,041; Canada 437.
Selenium, elemental do.	70	114	—	Indonesia 100; Japan 14.
Silicon, high-purity do.	1,332	24,597	—	Hong Kong 13,363; Indonesia 4,000; Philippines 3,285.
Silver:				
Waste and sweepings[3] do.	30,473	2,215,408	1,536,645	Canada 591,254; Hong Kong 38,718.
Metal including alloys, unwrought and partly wrought do.	17,513	32,123	20,172	Canada 9,979; Hong Kong 1,115.
Tin:				
Ore and concentrate value, thousands	(2)	—		
Oxides	3	—		
Metal including alloys:				
Scrap	—	28	9	Philippines 10; Hong Kong 8.
Unwrought	203	27	1	Japan 13; United Kingdom 6.
Semimanufactures	1,070	1,255	79	Hong Kong 477; Japan 182.
Titanium:				
Ore and concentrate	—	139	—	Indonesia 80; Japan 36; Thailand 20.
Oxides	477	293	—	Hong Kong 130; Indonesia 65.
Metal including alloys, semimanufactures kilograms	3,106	57,663	552	Singapore 30,492; Japan 7,506.
Tungsten:				
Ore and concentrate	4	(2)	—	All to Japan.
Metal including alloys:				
Scrap	32	22	1	Japan 15; West Germany 4.
Unwrought	NA	15	—	All to Canada.
Semimanufactures kilograms	946	144,558	2,042	Philippines 67,114; Hong Kong 65,837.

See footnotes at end of table.

TABLE 4—Continued

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
METALS—Continued					
Uranium and thorium:					
Oxides and other compounds		147	—		
Metals including alloys, all forms		449	—		
Vanadium: Oxides		NA	320	—	All to Japan.
Zinc:					
Oxides		6,944	5,928	314	Japan 3,183; Canada 484.
Blue powder	kilograms	434	182,923	—	Japan 161,538; Republic of Korea 16,807.
Metal including alloys:					
Scrap		204	659	—	Japan 555; Netherlands 61; Hong Kong 42.
Unwrought		4,367	8,434	253	Hong Kong 6,361; Japan 580.
Semimanufactures		743	1,003	402	Republic of Korea 141; Hong Kong 137.
Zirconium:					
Ore and concentrate		—	18	—	Hong Kong 11; Thailand 5.
Oxides		—	30	—	All to Singapore.
Metal including alloys, all forms		—	95	—	Mainly to Hong Kong.
Other:					
Ores and concentrates		529	481	(2)	Japan 349; Republic of Korea 71.
Oxides and hydroxides		2,782	290	5	Japan 133.
Ashes and residues		5,786	1,358	97	Japan 1,065.
Base metals including alloys, all forms		411	288	13	Japan 71; Hong Kong 46.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		245	204	4	Indonesia 36; Japan 36.
Artificial:					
Corundum		353	19	—	Japan 18; Canada 1.
Silicon carbide		45	835	—	Indonesia 381; Japan 358; Hong Kong 66.
Dust and powder of precious and semiprecious stones including diamond		9	10	(2)	Mainly to Thailand.
Grinding and polishing wheels and stones		6,026	6,442	1,481	Thailand 1,066; Australia 721.
Asbestos, crude		(2)	(2)	—	Unspecified (2).
Boron materials:					
Crude natural borates		1	—		
Oxides and acids		11	76	—	Republic of Korea 64; Hong Kong 5; Sri Lanka 4.
Cement	thousand tons	3,581	2,203	69	Japan 1,583; Hong Kong 474.
Chalk		1,508	1,794	—	Indonesia 1,700; Hong Kong 40.
Clays, crude:					
Bentonite		11	(2)	—	All to Canada.
Fire clay		48	56	—	Hong Kong 55; Indonesia 1.
Kaolin		123	2,587	18	Philippines 1,705; Malaysia 299.
Unspecified		1,143	1,222	(2)	Philippines 476; Indonesia 245.
Cryolite and chiolite	value, thousands	$1	—		
Diamond:					
Natural:					
Gem, not set or strung	thousand carats	10,625	13,170	—	Hong Kong 13,135; Belgium-Luxembourg 30.
Industrial stones	do.	12,710	57,225	340	Thailand 29,625; Republic of Korea 11,520.

See footnotes at end of table.

TABLE 4—Continued

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Destinations, 1989	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Diamond:—Continued					
Synthetic:					
Gem, not set or strung	do.	[4]72,135	5,015	—	Thailand 3,500; Republic of Korea 1,500.
Industrial stones	do.	[4]592,095	19,990	—	Japan 16,240; Hong Kong 3,750.
Diatomite and other infusorial earth		22	156	20	Philippines 81; Hong Kong 23.
Feldspar, fluorspar, related materials		159	285	—	Indonesia 155; Philippines 122.
Fertilizer materials:					
Crude, n.e.s.		337	386	—	Japan 230; Philippines 35.
Manufactured:					
Ammonia		19	38	—	Hong Kong 29; Australia 5.
Nitrogenous		20,880	16,131	—	Fiji 5,500; Hong Kong 4,501; Philippines 4,000.
Phosphatic		6,115	6,552	—	Fiji 6,550.
Potassic		52,024	48,267	66	Japan 16,060; Hong Kong 15,680.
Unspecified and mixed		2,105	4,425	2	Japan 2,001; Hong Kong 1,486.
Graphite, natural		70	144	—	Thailand 68; Republic of Korea 50.
Gypsum and plaster		1,747	5,104	1	Indonesia 1,058; Hong Kong 1,039.
Iodine	kilograms	3,601	611	1	Thailand 540; Philippines 70.
Kyanite and related materials		—	4	—	Brazil 2; Hong Kong 2.
Lime		99	10	—	Philippines 6; Sri Lanka 3.
Magnesium compounds:					
Magnesite, crude		—	4	—	All to Malaysia.
Oxides and hydroxides		60	448	([2])	Indonesia 340; Japan 36.
Meerschaum, amber, jet		75	31	7	Indonesia 19; Mexico 2.
Mica:					
Crude including splittings and waste		183	307	—	New Zealand 259; United Kingdom 17.
Worked including agglomerated splittings		30	35	3	Japan 17; Hong Kong 8.
Phosphates, crude		NA	80	—	Philippines 60; unspecified 18.
Phosphorus, elemental		NA	208	—	Australia 205; Japan 3.
Pigments, mineral: Iron oxides and hydroxides, processed		405	9,268	7	Japan 8,868; Malaysia 221.
Precious and semiprecious stones other than diamond:					
Natural	kilograms	401,103	471,960	56,696	Thailand 123,990; Hong Kong 121,416.
Synthetic	do.	68,822	191,026	63,761	Italy 51,943; Hong Kong 29,060.
Quartz crystal, piezoelectric	do.	NA	2,300	124	Hong Kong 1,280; Switzerland 473.
Salt and brine		4,800	6,834	—	Hong Kong 6,800; Philippines 34.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		5,256	35,323	—	Hong Kong 22,515; Japan 11,002; Indonesia 1,000.
Sulfate, manufactured		20,070	30,064	—	Philippines 10,590; Republic of Korea 5,820; Indonesia 5,800.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		5,322	5,696	467	Japan 4,508.
Worked		[r]59,558	59,767	14,908	Japan 17,146; West Germany 3,350.
Dolomite, chiefly refractory-grade		241,609	213,349	—	Japan 211,500; Singapore 788.
Gravel and crushed rock		430,254	358,493	48	Japan 344,163; Philippines 324.

See footnotes at end of table.

TABLE 4—Continued

TAIWAN: EXPORTS AND REEXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Destinations, 1989: United States	Destinations, 1989: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued				
Limestone other than dimension	932	1,697	—	Indonesia 1,300; Philippines 327.
Quartz and quartzite	NA	35	—	Japan 34; Indonesia 1.
Sand other than metal-bearing	539,615	406,108	3	Japan 405,100; Hong Kong 531.
Sulfur:				
Elemental:				
Crude including native and byproduct	227	146	—	Thailand 69; Hong Kong 30; Malaysia 25.
Colloidal, precipitated, sublimed	76	9	—	Hong Kong 3; Malaysia 2.
Sulfuric acid		555	95	22 Thailand 30; Indonesia 18.
Talc, steatite, soapstone, pyrophyllite	246	290	—	Republic of Korea 200; Philippines 56.
Vermiculite	1	—		
Other:				
Crude	8,911	48,522	24	Japan 44,397; Indonesia 2,498.
Slag and dross, not metal-bearing	201,369	141,516	—	Japan 65,650; Singapore 42,729.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	(2)	61	—	All to Thailand.
Carbon:				
Carbon black	9,882	8,158	—	Indonesia 3,347; Thailand 2,762; Japan 1,006.
Gas carbon	174	120	—	Japan 56; Malaysia 30.
Coal, all grades including briquets	—	19	—	Malaysia 18; Thailand 1.
Coke and semicoke	57,531	51,246	—	Philippines 25,458; Indonesia 11,653.
Peat including briquets and litter	220	—		
Petroleum refinery products:				
Liquefied petroleum gas 42-gallon barrels	12	—		
Gasoline, motor thousand 42-gallon barrels	24	2,371	—	Mainly to unspecified countries.
Mineral jelly and wax do.	57	142	—	Republic of Korea 74; Japan 49.
Kerosene and jet fuel do.	13,342	1,362	75	Japan 76; unspecified 1,211.
Distillate fuel oil do.	8,949	3,485	—	Panama 855; Japan 691; unspecified 1,926.
Lubricants do.	980	740	7	France 207; Republic of Korea 105; unspecified 128.
Nonlubricating oils do.	117	13	—	Mainly to Republic of Korea.
Residual fuel oil do.	1,250	14,766	513	Japan 3,965; Singapore 2,220; unspecified 6,993.
Bitumen and other residues do.	NA	309	—	Indonesia 174; Hong Kong 90.
Bituminous mixtures do.	(2)	1	—	Mainly to Australia.
Petroleum coke do.	602	118	—	Mainly to Japan.

[r]Revised. NA Not Available.
[1]Table prepared by Audrey D. Wilkes.
[2]Less than 1/2 unit.
[3]Includes other precious metals.
[4]Data presented are as reported by the Inspectorate General of Customs of Taiwan; the quantity listed is believed to be material other than diamond, because of a low unit value.

cessed copper coil was imported from the parent company, Nippon Mining's Kuranmi rolling mills.

Iron and Steel.—China Steel Corp. (CSC), a state-owned enterprise, has an annual capacity of 5.6 million tons of crude steel. Facing expansion problems in Taiwan with high input cost and rising environmental regulations, CSC reached an initial overseas expansion agreement with a Malaysian partner, the Lion Group, to build a steel mill in Malaysia that would output 2.5 million tons of crude steel and 2.2 million ton of steel products annually. After the second stage completion, its annual output would reach 5 million tons. The Lion Group would hold 51% of the total investment; CSC 40%, and private Taiwan interests 9%.

Tung Mung Development Company and Krupp Stahl of Bochum, Federal Republic of Germany, had signed an agreement to build a rolled steel plant with annual output of 150,000 tons in Taiwan.

TABLE 5

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
METALS					
Alkali and alkaline-earth metals		67	43	1	Japan 31; France 11.
Aluminum:					
Ore and concentrate		39,635	31,297	63	Malaysia 28,970; Hong Kong 954.
Oxides and hydroxides		20,782	36,644	379	Japan 15,417; Australia 8,612.
Metal including alloys:					
Scrap		64,115	71,711	58,576	Australia 3,871; Canada 1,617.
Unwrought		193,405	222,824	27,973	Australia 101,638; Canada 17,140.
Semimanufactures		62,217	67,914	11,849	Japan 22,599; Spain 6,455.
Antimony:					
Oxides		1,197	987	90	France 288; Japan 229.
Metal including alloys, all forms		580	1,242	—	Thailand 374; unspecified 818.
Arsenic:					
Elemental	kilograms	NA	194	48	Japan 146.
Oxides and acids		531	185	—	France 128; Sweden 19; Belgium-Luxembourg 18.
Beryllium: Metal including alloys, all forms	kilograms	463	15	15	
Bismuth: Metal including alloys, all forms		—	20	—	Republic of Korea 4; United Kingdom 4; West Germany 3.
Cadmium:					
Oxides and hydroxides		282	274	—	Republic of Korea 175; Belgium-Luxembourg 99.
Metal including alloys, all forms	kilograms	3,600	296	293	West Germany 3.
Chromium:					
Ore and concentrate		12,238	35,709	(2)	India 9,840; unspecified 24,170.
Oxides and hydroxides		3,805	2,497	149	Japan 835; West Germany 713.
Metal including alloys, all forms		NA	60	3	United Kingdom 43; Japan 13.
Cobalt:					
Oxides and hydroxides		109	195	16	Belgium-Luxembourg 56; United Kingdom 22.
Metal including alloys, all forms		159	118	2	Zaire 35; Switzerland 22.
Columbium and tantalum: Tantalum metal including alloys, all forms		17	(2)	(2)	Japan.[2]
Copper:					
Ore and concentrate		118,023	152,261	48,145	Chile 56,661; Mexico 20,473.
Matte and speiss including cement copper		14	5	—	Hong Kong 4.
Oxides and hydroxides		112	254	7	Belgium-Luxembourg 94; Japan 90.
Sulfate		853	738	78	Japan 549; West Germany 53.
Metal including alloys:					
Scrap		30,479	30,444	12,670	Japan 5,894; Hong Kong 5,550.
Unwrought		176,689	278,666	49,997	Chile 115,126; Philippines 33,971.
Semimanufactures		73,736	64,306	3,538	Japan 40,943; Republic of Korea 5,267.
Germanium: Oxides	kilograms	NA	92	—	Mainly from West Germany.
Gold:					
Bullion	kilograms	350,984	152,419	80	Hong Kong 90,993; Switzerland 30,782.
Metal including alloys, unwrought and partly wrought	do.	11,702	4,245	2,193	Japan 992; Singapore 607.

See footnotes at end of table.

TABLE 5—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989	
			United States	Other (principal)
METALS—Continued				
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	8,477	8,371	(2)	Australia 5,194; Brazil 2,866.
Pyrite, roasted	—	8	—	All from Japan.
Metal:				
Scrap	1,255,740	1,552,971	612,088	Hong Kong 269,148; Japan 155,295.
Pig iron, cast iron, related materials	760,911	628,429	2,203	Brazil 426,813; Albania 18,481.
Ferroalloys:				
Ferrochromium	51,194	41,341	3	West Germany 123; unspecified 41,070.
Ferromanganese	23,895	18,982	—	Republic of Korea 1,600; Norway 1,477; unspecified 13,563.
Ferromolybdenum	NA	328	17	United Kingdom 71; Belgium-Luxembourg 58.
Ferronickel	NA	19	(2)	Mainly from Switzerland.
Ferrosilicomanganese	—	3,991	155	Republic of Korea 540; unspecified 3,260.
Ferrosilicon	33,591	23,556	1,316	Norway 3,310; Japan 1,853; unspecified 11,476.
Silicon metal	5,381	5,297	2	Canada 527; Norway 482; unspecified 3,562.
Unspecified	1,454	2,012	642	West Germany 432; United Kingdom 239.
Steel, primary forms	2,185,046	2,251,534	58,032	Turkey 522,002; Brazil 483,968.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated	NA	1,157,754	67,442	Japan 647,130; Canada 121,427.
Clad, plated, coated	NA	633,739	23,379	Japan 520,764; Australia 18,521.
Of alloy steel	NA	221,838	6,428	Japan 165,835; West Germany 8,133.
Bars, rods, angles, shapes, sections	1,290,461	1,374,939	2,389	Japan 463,573; Brazil 210,393.
Rails and accessories	24,371	33,065	715	Republic of Korea 8,624; Japan 7,867.
Wire	30,783	375,809	1,841	Japan 321,810; Republic of Korea 39,568.
Tubes, pipes, fittings	170,294	193,168	2,957	Japan 113,420; West Germany 19,840.
Castings and forgings, rough	7,259	NA		
Lead:				
Ore and concentrate	167	1	—	All from West Germany.
Oxides	2,451	2,040	(2)	Australia 1,097; West Germany 727.
Metal including alloys:				
Scrap	80,956	72,741	14,125	Japan 24,357; Australia 9,606.
Unwrought	18,925	26,387	3,424	Australia 11,069; Canada 2,367.
Semimanufactures	128	203	10	West Germany 86; Australia 62.
Lithium: Oxides and hydroxides kilograms	NA	11,478	10,597	Japan 863.
Magnesium: Metal including alloys:				
Scrap	24	—		
Unwrought	1,355	899	461	Norway 156; U.S.S.R. 106.
Semimanufactures	55	178	59	Japan 115.
Manganese:				
Ore and concentrate, metallurgical-grade	170,943	196,032	—	Gabon 39,721; India 21,362; Indonesia 14,409.
Oxides	2,542	2,949	(2)	India 1,370; Japan 924.
Metal including alloys, all forms	461	295	1	Brazil 200; United Kingdom 23.

See footnotes at end of table.

TABLE 5—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989	
				United States	Other (principal)
METALS—Continued					
Mercury:					
Cinnabar and vermillion		23	18	—	Hong Kong 11; unspecified 7.
Metal		18	18	9	Japan 5; Spain 3.
Molybdenum:					
Oxides	kilograms	NA	6,043	2,041	Japan 4,000.
Metal including alloys:					
Scrap		4	—		
Unwrought	kilograms	37	1,790	—	Austria 1,102; Japan 682.
Semimanufactures		123	132	81	West Germany 37.
Nickel:					
Matte and speiss		17,539	9,923	(2)	Mainly from Canada.
Oxides and hydroxides		300	335	1	Canada 241; Finland 38.
Metal including alloys:					
Scrap		155	7	3	Malaysia 4.
Unwrought		3,900	7,060	77	Canada 2,605; Belgium-Luxembourg 1,212.
Semimanufactures		812	779	81	Japan 252; United Kingdom 108.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	kilograms	1,678	3,596	467	Japan 2,770; United Kingdom 297.
Rare-earth:					
Ores and concentrates		NA	500	—	Mainly from Republic of Korea.
Oxides		NA	289	65	Japan 221; United Kingdom 3.
Metals including alloys, all forms		31	2	1	Japan 1.
Selenium, elemental		20	28	(2)	Japan 24; Australia 2.
Silicon, high-purity		85	80	12	Japan 64; West Germany 4.
Silver:					
Ore and concentrate[3]	value, thousands	\$21	\$79	\$8	Australia \$34; United Kingdom \$23.
Waste and sweepings[3]	kilograms	2,030	490	257	Hong Kong 133; Canada 100.
Metal including alloys, unwrought and partly wrought		140	129	9	Japan 35; Australia 21.
Tellurium: Elemental	kilograms	NA	404	1	Japan 300; Brazil 103.
Tin:					
Oxides		78	24	(2)	West Germany 13; United Kingdom 10.
Metal including alloys:					
Scrap		153	654	—	Singapore 428; Hong Kong 74; Japan 68.
Unwrought		5,342	4,588	4	Malaysia 2,081; Indonesia 1,676.
Semimanufactures		504	360	54	Hong Kong 176; Malaysia 50.
Titanium:					
Ore and concentrate		NA	19,096	—	Malaysia 13,851; Australia 4,974.
Oxides		16,440	19,399	2,988	Japan 7,722; West Germany 4,094.
Metal including alloys, semimanufactures		35	109	11	Japan 70.
Tungsten:					
Ore and concentrate		4,005	—		
Metal including alloys:					
Scrap		7	26	—	All from Japan.
Unwrought	kilograms	211	547	—	Belgium-Luxembourg 322; Japan 193.
Semimanufactures		89	104	30	Japan 50; Hong Kong 7.

See footnotes at end of table.

TABLE 5—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989	Sources, 1989 United States	Sources, 1989 Other (principal)
METALS—Continued				
Uranium and thorium: Oxides and other compounds	359	210	120	Japan 57; France 9.
Vanadium:				
Oxides and hydroxides	7	10	3	Japan 4.
Metal including alloys, all forms	NA	21	2	Unspecified 19.
Zinc:				
Oxides	1,170	937	43	Thailand 201; Japan 175.
Blue powder	661	509	(2)	Canada 179; West Germany 144.
Metal including alloys:				
Scrap	151,681	163,383	96,060	West Germany 11,573; Netherlands 10,622.
Unwrought	81,683	70,818	333	Australia 26,754; Canada 11,823.
Semimanufactures	909	942	26	Japan 645; West Germany 117.
Zirconium:				
Ore and concentrate	NA	26,078	1,652	Australia 16,401; Malaysia 2,636.
Oxides	432	244	69	Japan 88; United Kingdom 58.
Metal including alloys, all forms	NA	6	4	Hong Kong 2.
Other:				
Ores and concentrates	46,594	3,192	68	Australia 1,168; Brazil 1,140.
Oxides and hydroxides	1,371	813	53	Japan 644; Belgium-Luxembourg 88.
Ashes and residues	61,879	37,674	7,084	Japan 23,539; Australia 2,349.
Base metals including alloys, all forms	304	28	2	Japan 11; France 5.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	15,891	19,927	423	Indonesia 13,284; Japan 1,800.
Artificial:				
Corundum	21,832	8,441	34	Hong Kong 4,820; Japan 1,643; India 1,250.
Silicon carbide	[4]7,919	7,842	62	Hong Kong 1,582; Japan 1,413; Norway 1,402.
Dust and powder of precious and semi-precious stones including diamond kilograms	2,428	5,612	3,335	Ireland 1,059; Hong Kong 943.
Grinding and polishing wheels and stones	2,644	3,545	522	Italy 1,485; Japan 906.
Asbestos, crude	32,680	29,464	189	Canada 15,969; Greece 1,320.
Barite and witherite	1,619	1,719	(2)	Mainly from Thailand.
Boron materials:				
Crude natural borates	2,585	3,342	492	Japan 2,209; Netherlands 340.
Elemental kilograms	NA	287	253	West Germany 25.
Oxides and acids	3,116	3,672	2,639	Italy 504; Chile 438.
Bromine kilograms	80	259	—	Japan 169; West Germany 74.
Cement	183,335	412,448	13	Indonesia 356,300. Republic of Korea 17,366.
Clays, crude:				
Bentonite	23,712	26,533	22,189	Australia 1,833; Republic of Korea 820.
Fire clay	2,421	7,069	(2)	India 3,400; Hong Kong 769.
Kaolin	149,557	358,541	78,878	Hong Kong 120,564; Malaysia 48,960.
Unspecified	305,198	202,448	4,167	Hong Kong 163,374; Japan 13,952.
Cryolite and chiolite	38	116	—	Japan 93; Philippines 13.
Diamond:				
Natural:				
Gem, not set or strung thousand carats	[5]844,505	250	15	Japan 75; Hong Kong 50.

See footnotes at end of table.

TABLE 5—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989 United States	Sources, 1989 Other (principal)
METALS—Continued					
Diamond:—Continued					
Natural:—Continued					
Industrial stones	do.	265	490	5	Japan 395; West Germany 50.
Synthetic:					
Gem, not set or strung	do.	765	(6)		
Industrial stones	do.	1,250	2,100	775	Ireland 435; Israel 190.
Diatomite and other infusorial earth		7,150	11,039	6,427	Japan 3,807; West Germany 602.
Feldspar, fluorspar, related materials		338,580	499,914	519	Thailand 286,427; Hong Kong 78,304.
Fertilizer materials:					
Crude, n.e.s.		740	1,075	172	Indonesia 314; Philippines 238.
Manufactured:					
Ammonia		169,845	238,781	25	Indonesia 110,878; Saudi Arabia 98,944.
Nitrogenous		49,458	357,852	—	Chile 132,051; Saudi Arabia 119,684; Indonesia 94,156.
Phosphatic		150	209	7	Denmark 133; Japan 60.
Potassic		228,401	245,185	255	Canada 132,535; Israel 53,525.
Unspecified and mixed		15,768	19,314	6,678	Japan 6,979; West Germany 2,485.
Graphite, natural		14,890	10,106	11	Republic of Korea 5,073; India 1,734.
Gypsum and plaster		429,625	483,786	1,061	Thailand 480,886; Japan 1,452.
Iodine		28	33	—	West Germany 24; Chile 9.
Kyanite and related materials		NA	2,461	306	India 40; unspecified 2,074.
Lime		21	17	—	All from Japan.
Magnesium compounds:					
Magnesite		NA	4,491	5	Malaysia 2,200; India 1,400.
Oxides and hydroxides		66,069	51,080	1,279	Japan 14,752; India 12,990.
Meerschaum, amber, jet		5	34	—	Mainly from Philippines.
Mica:					
Crude including splittings and waste		888	992	172	Malaysia 501; India 116.
Worked including agglomerated splittings		364	359	30	Japan 170; Belgium-Luxembourg 98.
Phosphates, crude		368,630	391,353	—	Jordan 317,366; Morocco 48,818.
Phosphorus, elemental		3,415	3,039	1	U.S.S.R. 1,471; Netherlands 153.
Pigments, mineral:					
Natural, crude		606	327	—	Hong Kong 202; France 81.
Iron oxides and hydroxides, processed		34,334	35,540	443	Japan 26,736; West Germany 2,006.
Potassium salts, crude		543	22	—	All from West Germany.
Precious and semiprecious stones other than diamond:					
Natural		6,106	3,135	132	Brazil 1,733; Canada 197.
Synthetic		19	8	1	Hong Kong 4.
Pyrite, unroasted		8	27	—	Japan 26.
Salt and brine		781,925	851,667	11	Australia 851,343; Austria 180.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		108,286	96,629	82,567	Poland 5,997; Kenya 530.
Sulfate, manufactured		4,473	1,806	18	Japan 1,092; Thailand 337.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		196,098	394,458	5,452	Spain 94,033; Republic of Korea 51,268.

See footnotes at end of table.

TABLE 5—Continued

TAIWAN: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989	Sources, 1989 United States	Sources, 1989 Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel:—Continued					
Dimension stone:—Continued					
Worked		r7,195	18,580	170	Italy 9,305; Indonesia 1,940.
Dolomite, chiefly refractory-grade		2,251	3,967	—	Thailand 2,306; United Kingdom 1,812.
Gravel and crushed rock		16,750	23,700	1,083	France 9,615; Japan 4,406.
Limestone other than dimension		735,265	558,673	—	All from Japan.
Quartz and quartzite		4,837	16,260	35	Japan 13,171; Hong Kong 2,459.
Sand other than metal-bearing		38,234	66,108	1,242	Malaysia 30,004; Australia 18,331.
Sulfur:					
Elemental:					
Crude including native and byproduct		59,160	93,505	24,186	Canada 59,992.
Colloidal, precipitated, sublimed		199,815	152,578	16,095	Canada 121,952; Japan 14,333.
Dioxide		36	25	(2)	Japan 16.
Sulfuric acid		203,249	258,408	348	West Germany 237,107; Japan 20,733.
Talc, steatite, soapstone, pyrophyllite		37,337	54,693	7,391	Hong Kong 10,810; India 3,875.
Vermiculite		766	704	89	Hong Kong 201; India 108.
Other:					
Crude		142,122	140,355	1,118	Republic of Korea 121,451; Japan 6,975.
Slag and dross, not metal-bearing		28,065	38,279	63	Japan 37,987.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		129	121	106	West Germany 8; Japan 7.
Carbon:					
Carbon black		14,046	18,496	7,101	Australia 3,517; Republic of Korea 2,223.
Gas carbon		478	1,627	381	U.S.S.R. 681; West Germany 289.
Coal, all grades including briquets	thousand tons	17,888	17,067	4,136	Australia 5,920; Canada 1,051.
Coke and semicoke		207,130	155,881	(2)	Japan 132,769; Philippines 3,000.
Peat including briquets and litter		1,907	1,640	38	Netherlands 421; Finland 357.
Petroleum:					
Crude	thousand 42-gallon barrels	146,984	152,493	2,043	Saudi Arabia 64,557; Kuwait 25,305.
Refinery products:					
Liquefied petroleum gas	do.	9,829	10,262	(2)	Saudi Arabia 5,087; Qatar 2,262.
Gasoline	do.	75,478	816	519	United Arab Emirates 249.
Mineral jelly and wax	do.	296	194	26	Japan 61; Indonesia 59.
Kerosene and jet fuel	do.	NA	6,216	18	Singapore 3,966; Greece 464.
Distillate fuel oil	do.	826,140	5,373	2,868	Singapore 1,356; Kuwait 250.
Lubricants	do.	884	815	296	Japan 189; Singapore 125.
Nonlubricating oils	do.	722	311	77	Singapore 105; Japan 64.
Residual fuel oil	do.	NA	17,377	14,867	Singapore 1,741; Japan 505.
Bituminous mixtures	do.	1	(2)	(2)	Japan2.
Petroleum coke	do.	178	45	35	Japan 7; West Germany 2.

rRevised. NA Not available.
1Table prepared by Audrey D. Wilkes.
2Less than 1/2 unit.
3May include other precious metals.
4Includes boron carbide.
5Data 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.
6Unreported quantity valued at $17,300 imported mainly from United States, West Germany, and Hong Kong.
7May include Kerosene and jet fuel.
8May include residual fuel oil.

In November 1990, An Fung, a hot rolled strip mill in Kaohsiung, began trials. After the completion of initial testing, the mill would produce 2 million tons of high quality coil annually.

Taiwan's largest private steel company, the Yieh Loong Group, invested $40 million to establish a steel pipe mill in Corona, California. The mill is expected to produce 6,000 tons of steel pipe monthly in early 1992.

Titanium.—Du Pont Taiwan, a subsidiary of E.I. du Pont de Nemours & Co. Inc., had received official approval to build a titanium dioxide plant in Taiwan. The plant was estimated to cost $240 million and was expected to be completed in 1992 with an annual production of 60,000 tons. The company will invest about 20% of the initial construction cost on a pollution-control system.

Ishihara Sangyo Kaisha Taiwan, a subsidiary of Ishihara Sangyo Kaisha Ltd., Japan, had completed its expansion, adding 18,000 tons per year of rutile at its finishing plant in Kaohsiung. Raw materials will come from its Yokkaichi plant in Japan.

Mineral Fuels

The Taiwan Government plans to accelerate efforts to diversify the supply of energy resources under the 6-year plan. According to the plan for electricity development, the country would emphasize nuclear, thermal, and hydroelectric power generating. The plan is that, by 1996, the anticipated capacity of the country's power-generating system is to reach 27 million kilowatts, 10 million kilowatts more than in 1990.

After nearly 5 years of protests from the residents of Kungliao, Taipei Hsien, Taipower, with the support of the Government, announced its intent to build its fourth nuclear powerplant at Kungliao. The plant will have two light-water reactors with a total generating capacity of 2 million kilowatts. The cost of construction for the plant was $5.9 billion; initial operation was projected to begin in 1998.

In 1990, Taiwan's coal production dropped 40% to 470,000 tons compared with its production peak of 5 million ton in 1968. This was mainly attributed to the increasingly difficult mining conditions and the competition of imported coal. To ensure supplies of energy sources, the Taiwan Government has contracted joint-venture projects with other countries in exploration and exploitation of coal resources. The first shipment of coal from Kalimantan, Indonesia, under such an agreement arrived in Taiwan for test trials. In 1990, Taipower was involved in a 2-year feasibility study on the Bengalla Project on exploration of coal in New South Wales, Australia.

In 1990, Taiwan's coal imports increased 12.1% to 19.1 million tons. The major coal suppliers were Australia (35.2%), Republic of South Africa (29.8%), the United States (23.3%), and Canada (5.5%). Together these countries provided 94% of Taiwan's coal imports.

Taipower is the largest Taiwan buyer of U.S. coal. Taipower imported 3.8 million tons of U.S. coal in 1990, representing 19.8% of Taiwan's total coal imports and 40% of Taipower's coal consumption.

Taiwan's private sector indirectly imported 700,000 tons of coal from China in 1990. No major long-term coal contracts with China are expected in the near future because the Taiwan Government maintains a ban on direct trade with China. However, if Taipower gains approval to purchase Chinese coal indirectly, imports of coal from China will increase. The market share provided by U.S. companies for Taiwan's coal imports is expected to be reduced in the 1990's.

After 3 years of bitter dispute with environmentalists, China Petroleum Corp. began construction of its fifth naphtha cracker plant in Houchin, Kaohsiung Hsien, in 1990. The agreement will include a special community fund, reportedly worth $55 million, and a supervisory panel to ensure compliance with anti-pollution regulations. Construction of the plant is estimated to cost $2 billion and is expected to start production in 1994. After completion, the plant will produce $380 million of petroleum derivatives annually and will solve part of the petrochemical industries' raw materials shortage in Taiwan.

Formosa Plastics Group, Taiwan's largest petrochemical company, proposed to construct the sixth naphtha cracker plant in Ilan Hsien. Formosa Plastics claimed that the construction of the sixth naphtha cracker plant in Taiwan must be built in order to solve the raw materials shortage in order to meet the country's need for refinery products. Otherwise, the company feels that there will be no future for Taiwan's petrochemical industry and would perhaps relocate its production facilities to South Carolina, and/or Hai Tsang, Fukien, China.

Reserves

Taiwan has a very weak minerals resource base, and output is limited to carbonate minerals and fossil fuels, the value of which is significant only to the local economy.

INFRASTRUCTURE

The Taiwan Government had invested $2.40 billion to modernize its urban telecommunication service to raise the average number of residential subscribers per 100 households to 82 in the Taiwan area and to 93 in the municipality of Taipei in 1990. A 451.7-kilometers (km) north-south arterial highway from Taipei to Pingtung will be completed in June 1991 and a second 108.02 km freeway in northern Taiwan was also set for completion in 1991. The Government had planned to invest a total of $5.7 billion to develop a Mass Rapid Transit (MRT) system to ease traffic congestion in the Taipei metropolitan area. The completion of the entire construction is scheduled for 1999.

OUTLOOK

Because Taiwan lacks a strong and varied mineral resource base, the domestic mining sector will never contribute significantly to the output of downstream manufacturing. Larger wage rises in recent years and strong domestic currency have affected export competitiveness and forced business to establish operations in lower cost neighboring countries including China, Malaysia, and Thailand. The future for Taiwan-based industry seems to lie in high-technology intensive manufacturing. The Government continued to encourage foreign investments, intensified and promoted technology transfer, and implemented financial assistance to priority industries.

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[1]Where necessary, values have been converted from New Taiwan dollars (NT$) to U.S. dollars at the rate of NT$26.50=US$1.00 in 1989 and NT$27.20=US$1.00 in 1990.

OTHER SOURCES OF INFORMATION

Agencies

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15 Foochow Street,
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2 Chenkiang Street
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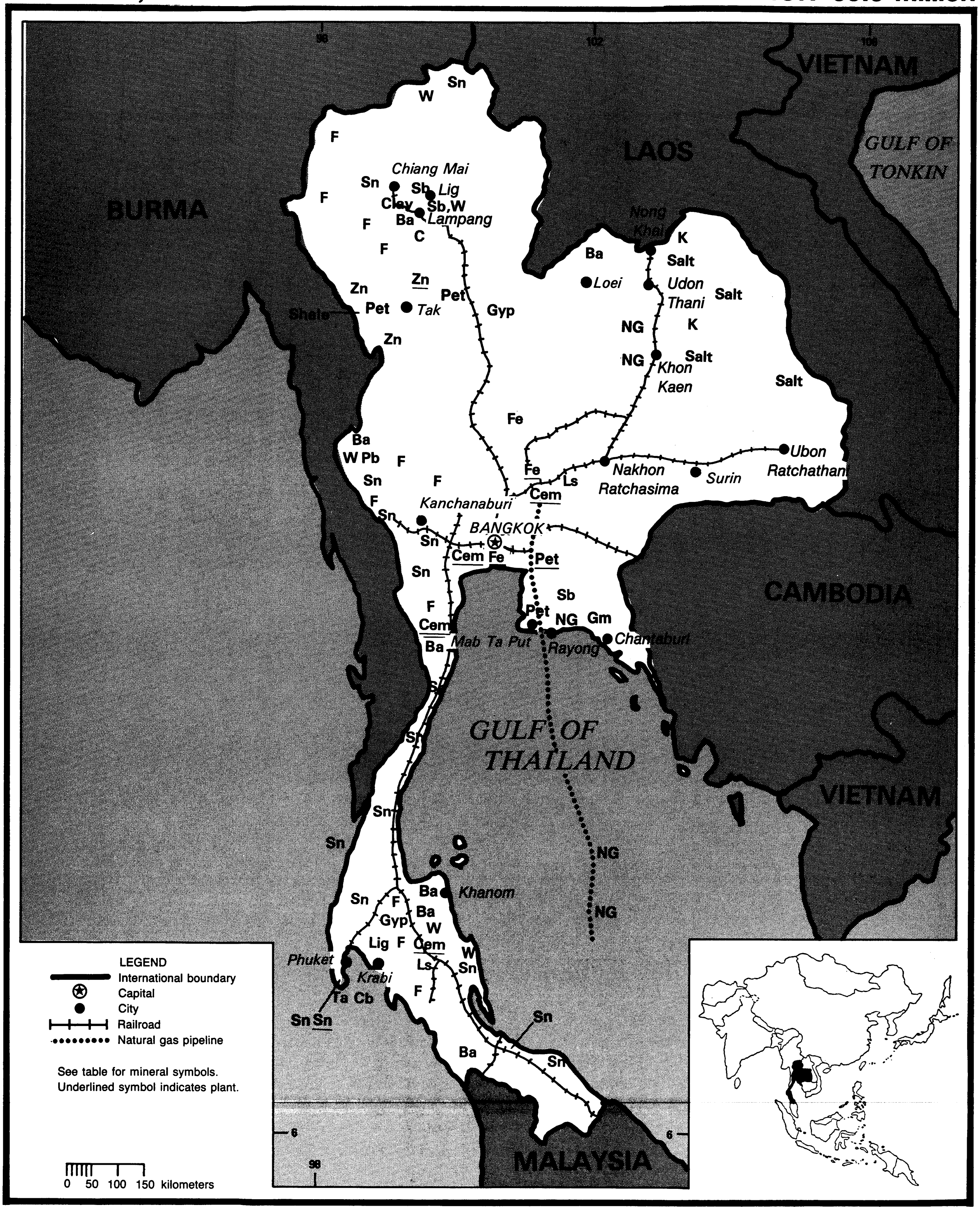
THAILAND

AREA 514,000 km² **POPULATION 55.5 million**



THE MINERAL INDUSTRY OF THAILAND

By David B. Doan

The value of mineral production in Thailand dropped 2% in 1990 to an estimated total of $677 million,[1] down from an adjusted total of $689 million in 1989. Formerly a leading economic force in Thailand, the mineral industry has been overtaken in relative importance by the steady increase of the manufacturing and service sectors combined with the effects of a general decline of mineral commodity prices in world markets.

All was not well in Thailand toward the end of 1990, as rumors grew of an impending military coup aimed at the elected Government of Prime Minister Chatichai. Political greed, in various guises, was the commonest complaint heard in the capital city of Bangkok. Otherwise, however, the economy continued to be one of the fastest growing in the world. Although the mining and agriculture sectors slowed, manufacturing and construction showed double-digit rates of growth, demand was strong, and both productive capacity and exports continued at high levels.

Consequences of this rapid growth included strong inflationary pressures as well as a lag in the development of infrastructure throughout the country. Monetary policy was tightened in the face of a 6.5% rate of inflation in 1990, largely generated by cost-push factors arising from supply shortages complicated by rising oil prices in conjunction with impending hostilities in the Persian Gulf. Fiscal policy, however, was bolstered by a solid surplus of revenues over expenditures that led to what is apparently the third budget surplus in as many years. A significant part of the surplus resulted from delays in badly needed public-sector construction projects that inevitably contributed to the problem of inadequate national infrastructure. The real problem seemed to be that the country was trying to grow faster than any orderly planning could sustain. With inflation at 6% and rising, it seemed likely that, in spite of successful fiscal policy, the next year or two would see revisions of monetary policy. The question could well boil down to a choice between higher interest rates, particularly on capital borrowing, or simply fueling the whirlwind expansion with debt and ultimate de facto devaluation of the baht. In mid-November, significantly, the bank lending rate was raised from 9.5% to 12% for the entire country.

Prime Minister Chatichai commented that Thailand had achieved a "petrochemical era," based on its large gas discoveries in the Gulf of Thailand, which in turn had given birth to an energy-intensive electronics industry that was producing major electronic components for the first time. Notably, Thailand was also in the market for about 480 new tanks for its army and a helicopter aircraft carrier for the navy, suggesting that prosperity engenders a need for protection, or at least the perception of that need.

Taking the long view, it would seem that Thailand's economy might pause to gather strength and devote more effort to infrastructure and then expand further at, or close to, the growth rates seen in the recent past. It is at least conceivable that as China prepares to aquire control of Hong Kong in 1997, much of the latter's financial activity will shift to Bangkok's markets and banking system.

GOVERNMENT POLICIES AND PROGRAMS

Following Thailand's reclassification as an Advanced Developing Country (ADC), the Government signed a memorandum of understanding with the United States Agency for International Development (USAID) on "Advancing Mutual Interests in a Rapidly Changing International Environment." USAID staff personnel will be reduced by one-half, aid for education and agriculture will be discontinued, and the USAID Office in Thailand will be dissolved and replaced by a joint U.S.-Thai Business Association. The two countries will concentrate on their mutual interests, particularly bilateral economic cooperation, and increase ways to develop Thai and U.S. private investment.

Environmental matters were beginning to influence policy at various levels. The Government decided to cease issuing permits for setting up of factories within the Bangkok Metropolitan Area, a "factory" having been defined as employing more than 100 people or prone to the generation of pollution. Similarly, in 1988, the Forestry Department had prohibited any mining activity within a number of its reserve forests. By 1990, the mining industry was complaining officially that mining exploration and new production had been brought to a standstill. In response to a determined effort by the Department of Mineral Resources, the Ministry of Agriculture was considering permitting mining activity in return for future reforestation to upgrade the environment.

PRODUCTION

In addition to the overall drop of 2% in value of mineral production, other changes took place in 1990. Lignite, worth $248 million, emerged as the country's most valuable mineral product as output rose 40% to 12 Mmt in response to accelerating demand for electricity from coal-fired powerplants. Production of zinc, the most valuable mineral product of 1989, dropped to second place with output of 404,100 tons valued at $121 million, mostly for domestic consumption. Tin, historically the country's leading mineral product, was third in value produced at 19,979 tons of concentrates worth $91 million. Meanwhile, the tin market remained relatively soft. Production of limestone increased 18% to 19.7 Mmt valued at $67 million, more than five times the amount mined 10 years before in 1980. Output of gypsum in 1990, at 1.3 Mmt was worth $61 million; that of lead amounted to 52,308 tons worth $15.3 million. Feldspar production dropped sharply to 295,398 tons valued at $8 million, down 40% from that of the previous year.

A number of other minerals were produced in greater quantity than previously, among them granite, kaolin, marble, marl, shale, and silica sand, each having a value respectively of between $5 million and $8 million. Ball clay, worth $2 million, and rock salt, worth $1 million, both represented increased output. Mined calcite, diatomite, dolomite, leucoxene, manganese ore, and phosphate rock all showed increases compared with those of 1989, but none of these was valued at more than $1 million. Gem stone discovery was more than doubled at 3.6 million carats, but no value can be assigned until after cutting and polishing.

TRADE

The total value of Thailand's mineral commodity exports in 1990 dropped about 13% to $187 million, representing a little less than 1% of the value of all exports. The most significant exports were tin, at a little more than $80 million; gypsum, at more than $52 million; and zinc, at better than $9 million. It is notable that although mineral commodities reached a peak of about 15% of total exports in the past, the present reduction is very much a result of national growth and booming exports of such items as foods, textiles, and electronics.

Tin exports were actually up from 11,130 tons in 1989 to 12,717 tons in 1990, but this was nowhere near the quota of 17,116 tons allocated to Thailand by the Association of Tin-Producing Countries (ATPC). The decline of tin prices provided lower export earnings overall in spite of the modest increase in exports at the lower prices. Gypsum shipments of 4.7 Mmt represented an increase of 7% in volume over that of 1989 but a 14% increase in value. Exports of zinc, however, at 5,840 tons, amounted to a 52% reduction in volume and a 57% decline in value.

Exports of barite grew 11% to 104,935 tons worth $5.4 million, probably reflecting increased demand for petroleum drilling muds. Although exports of feldspar decreased about 6% to 273,937 tons, the value climbed from $7.3 million to $7.6 million along with the proportion of higher-value ground feldspar. Lead exports dropped 23% to 34,379 tons worth $6 million. Finally, tungsten exports shrank 38% to 448 tons valued at $1.3 million for a mixture of 51% scheelite and 49% wolframite.

Thailand imported 600,000 tons of coal from Australia, China, and Indonesia to add to the domestic lignite production earmarked for thermal power generation. The country also imported 74 Mbbl of petroleum crude in 1989 and was thought to have brought in at least that amount in 1990. Crude imports had been up sharply in early 1990 but declined somewhat as prices rose in conjunction with Iraq's initiation of hostilities against Kuwait in August.

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 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 and collecting royalties and other taxes.

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 petroleum, zinc and some 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 minerals are distributed through many regions of the country. Principal companies and operating locations are shown in table 2.

COMMODITY REVIEW

Metals

Copper.—Padaeng Industry Co. (PDI) continued its plans to build a 120,000-mt/a copper smelter costing at least $250 million and was negotiating for a site. A new zinc smelter, its second one in Thailand, was also projected by PDI, with plans for recovery of 500,000 mt/a of sulfuric acid from the two new smelters. Although exploration for copper continued in two concession areas in northeastern Loei Province, it was widely believed that reserves amounting to between 60 and 75 Mmt of ore had been located. Rate of return on the copper-smelting operation was projected at approximately 20% per year. Observers believed that with the hoped-for success of copper smelting in Thailand, a copper fabrication industry would follow, including wire, rod, cable, and tubing to satisfy the country's steadily increasing demand.

Iron and Steel.—In what would be the country's first state-supported project, the Government has been studying the feasibility of building a 1 Mmt/a direct-reduced-iron (DRI) plant in support of Thailand's rapidly evolving steel industry. The plant would be in the vicinity of Mab Ta Put, whose conversion to deepwater port operations would be required for accommodating deep-draft ore ships bringing lump ore and direct-reduced pellets. The project would also require cheap natural gas for economic success, something of a sticking point with Thai authorities, but any DRI produced would have to compete with the world price of about $170 per ton. Gas prices approximate $4.80 per thousand British Thermal Units (BtU) in Thailand and would need to be officially discounted to $2.10 per BtU or so in order to make the entire DRI scheme viable. At present, the Government authorizes discounted gas only for the National Petrochemical Co., in which it owns a 40% share. It was not yet clear what share of the DRI project the Government would accept in return for a natural-gas discount. The DRI plant would augment the supply of imported scrap and DRI material from such sources as Sabah, Malaysia. With six new electric arc furnaces (EAF) licensed for Thailand, an onshore DRI plant would help to ensure feed at least for existing EAF consumption and output of 850,000 mt/a.

Among the new EAF projects is a joint venture between Bangkok Steel Industry, Ltd. (BSI) and Singapore's National Iron and Steel Mills, Ltd. (NISM). A 70-ton EAF and rolling mill would produce up to 360,000 mt/a of steel rebars and wire rods for regional markets, chiefly Thailand itself. Total project cost was set at $175 million, with 40% ownership by NISM, 40% by BSI, and 20% by Thai private investors. Financing was to be a combination of equity capital and bank borrowing.

Sahaviriya Steel Industry Co. (SSIC), which in 1989 won a Government tender to build the country's first strip mill, announced that the plant would produce 2

TABLE 1

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
METALS						
Antimony:						
Ore and concentrate:						
Gross weight		2,397	962	1,048	1,166	767
Sb content[e]		1,019	409	445	495	326
Metal, smelter		386	959	1,769	2,275	2,833
Chromium: Chromite, gross weight		361	5	776	416	[e]500
Columbium and tantalum ores and concentrates, gross weight:[2]						
Columbite and tantalite:						
Gross weight	kilograms	121,000	183,000	124,000	109,000	9,000
Cb content	do.	20,600	31,110	21,080	18,530	1,530
Ta content	do.	32,670	49,410	33,480	29,430	2,430
Stuverite:						
Gross weight	do.	241,000	423,000	788,000	99,000	122,000
Cb content	do.	19,400	34,003	63,343	7,958	9,807
Ta content	do.	18,800	32,912	61,310	7,703	9,492
Iron and steel:						
Iron ore:						
Gross weight		37,330	97,026	99,257	177,373	128,626
Fe content		20,532	53,364	54,591	97,555	70,744
Metal: Steel:						
Crude		463,393	534,172	552,000	689,421	684,678
Semimanufactures:						
Bars		303,652	319,835	356,000	498,986	597,899
Galvanized iron sheets		144,444	165,445	189,996	200,616	208,483
Tinplate		104,433	119,342	147,337	149,478	173,110
Lead:						
Mine output, Pb content of 42.5% concentrate		26,301	23,503	29,474	25,075	22,231
Metal: Ingot, secondary		9,122	11,366	15,614	18,711	15,861
Manganese ore:						
Chemical-grade, over 75% MnO_2		—	50	—	—	—
Battery- and chemical-grade, 75% MnO_2		4,001	5,012	3,530	3,115	2,405
Metallurgical-grade, 46% to 50% $Mn0_2$		887	4,086	4,417	7,390	14,247
Total, gross weight		4,888	9,148	7,947	11,045	16,652
Total Mn content		2,346	4,391	3,815	5,301	7,993
Rare-earth minerals:						
Monazite concentrate, gross weight		1,609	458	590	631	377
Xenotime		28	30	101	35	14
Tin:						
Mine output, Sn content		16,800	14,852	14,225	14,922	14,635
Metal, smelter, primary		19,672	15,438	14,675	14,571	15,512
Titanium:						
Ilmenite concentrate, gross weight		13,489	26,278	16,455	16,955	10,554
Leucoxene concentrate, gross weight		797	800	1,799	30	120
Rutile concentrate, gross weight		48	92	128	—	—
Tungsten concentrate:						
Mine output, gross weight		922	1,269	1,173	1,086	552
Mine output, W content		475	705	651	603	290

See footnotes at end of table.

TABLE 1—Continued

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990[p]
METALS—Continued						
Zinc:						
Mine output, gross weight		373,833	341,145	420,102	412,620	404,100
Mine output, Zn content		[r]66,000	[r]74,000	[r]81,000	91,000	81,000
Metal, smelter, primary		58,552	66,868	68,600	68,376	71,070
Zirconium concentrate, gross weight		1,705	1,532	5,098	1,496	490
INDUSTRIAL MINERALS						
Barite		142,232	33,370	40,587	76,422	139,257
Cement, hydraulic	thousand tons	[r]7,914	9,850	11,514	15,024	18,054
Clays:						
Ball clay		11,203	57,719	86,890	134,921	183,313
Kaolin, marketable:						
Beneficiated		116,037	184,179	222,964	176,281	208,029
Nonbeneficiated		16,118	22,389	46,724	152,266	139,342
Filler[3]		NA	NA	288	277	319
Diatomite		204	177	470	1,412	4,593
Feldspar		115,163	168,881	293,678	515,206	311,249
Fluorspar:						
Crude mine output:						
High-grade		156,409	102,398	76,321	98,375	94,757
Low-grade		40,715	2,514	573	[e]	—
Total		197,124	104,912	76,894	98,375	94,757
Salable product:						
Acid-grade (beneficiated low-grade)		11,500	—	—	[e]—	—
Metallurgical-grade		156,409	102,398	76,321	98,375	94,757
Total		167,909	102,398	76,321	98,375	94,757
Gem stones	thousand carats	43	37	934	[e]2,000	3,577
Gypsum		1,665,557	3,030,919	4,549,011	5,477,237	5,753,351
Phosphate rock, crude		4,940	4,502	8,348	6,584	9,547
Salt:						
Rock		2,000	3,268	5,670	15,384	119,179
Other[e]		165,000	165,000	165,000	165,000	100,000
Sand, silica		153,565	153,516	242,385	296,130	421,508
Stone:						
Calcite		230	2,170	171	2,400	40,160
Dolomite		13,771	50,767	140,455	257,576	379,548
Limestone for cement manufacture only	thousand tons	9,605	11,391	14,101	15,966	19,521
Marble		14,718	22,786	42,553	54,459	55,337
Marl for cement manufacture only	thousand tons	—	296	136	535	367
Quartz, not further described		18,068	27,459	28,449	33,850	22,074
Shale for cement manufacture only	thousand tons	1,013	1,403	2,283	2,452	2,686
Talc and related materials:						
Pyrophyllite		36,165	37,749	37,285	39,799	29,290
Talc		2,886	4,101	4,843	7,242	4,360
MINERAL FUELS AND RELATED MATERIALS						
Anthracite		2,500	8,350	15,330	8,740	20,600
Coal: Lignite	thousand tons	5,545	6,929	7,274	8,899	12,421
Natural gas (gross production)	million cubic meters	3,620	5,063	5,997	5,990	6,525

See footnotes at end of table.

TABLE 1—Continued

THAILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1986	1987	1988	1989	1990p
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum:						
Crude	thousand 42-gallon barrels	7,738	6,108	7,437	7,793	8,748
Natural gas condensate	do.	5,207	5,541	5,433	6,731	7,208
Refinery products:						
Liquefied petroleum gas	do.	1,566	e1,600	1,931	2,189	e2,300
Gasoline	do.	13,837	e13,900	15,781	16,980	e18,000
Jet fuel	do.	7,227	e7,200	8,183	10,380	e12,000
Kerosene	do.	931	e1,000	811	811	e900
Distillate fuel oil	do.	23,115	e23,200	22,021	26,493	e28,000
Residual fuel oil	do.	13,768	e13,800	15,907	21,933	e22,000
Unspecified[4]	do.	1,264	e2,000	2,447	3,000	e3,300
Total	do.	61,708	e62,700	67,081	81,786	e86,500

eEstimated. pPreliminary. rRevised. NA Not available.
[1]Includes data available through May 15, 1991.
[2]Excludes columbium- and tantalum-bearing tin slags.
[3]Kaolin for use as filler was not reported before 1988.
[4]Includes refinery fuel plus refinery gains or losses.

TABLE 2

THAILAND: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Antimony, concentrate.	Associated Minerals Co. Ltd.	Bo Thang, 130 kilometers southeast of Bangkok (temporarily inactive)	6
Do.	Parasit Mining Co.	Doi Ngoem, 100 kilometers southeast of Chiang Mai	2
Barite	American Thai Barite Co. Ltd.	Siam Mine, 200 kilometers southeast of Phuket	25
Do.	P&S Mining Co. Ltd.	Loei Mine, 10 kilometers northwest of Loei	70
Do.	STA Mining Co. Ltd.	STA Mine, 105 kilometers southeast of Chiang Mai	100
Cement	Siam Cement Co. Ltd.	Kaeng Khoi, 90 kilometers northeast of Bangkok	3,300
Do.	do.	Tambol Tabkwang, Kaeng Khoi District, 90 kilometers northeast of Bangkok	2,800
Do.	do.	Tha Luang, 90 kilometers northeast of Phuket	3,200
Do.	do.	Thung Song, 130 kilometers east of Phuket	900
Fluorspar, concentrate.	Phanom Thuan Mining Co. Ltd.	Phanom Thuan, 45 kilometers north of Kanchanaburi	60
Do.	Sk Minerals Co. Ltd.	Mine is 47 kilometers southeast of Krabi	65
Do.	Thai Fluorite Processing Co. Ltd.	Ban Lad, Phet Buri	120
Do.	United Fluorite Co. Ltd.	Salak Pra, 80 kilometers northwest of Kanchanaburi	26
Do.	Universal Mining Co. Ltd.	Mae La Luang, 120 kilometers west of Chiang Mai	35
Lead, concentrate	Kanchanaburi Exploration and Mining Co. Ltd.	Song toh, 250 kilometers northwest of Bangkok	45

See footnotes at end of table.

TABLE 2—Continued

THAILAND: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
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 kilometers north of Bangkok	220
Tantalum and columbium, in tin slag.	Thailand Smelting and Refining Co. Ltd.	Phuket	XX
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 kilometers east of Chiang Mai	.1
Do.	Siamerican Mining Enterprise Co. Ltd.	Khao Soon, 185 kilometers east of Phuket (temporarily inactive)	1.2
Do.	Sirithai Scheelite Thailand Co. Ltd.	Doi Mok, 120 kilometers northeast of Chiang Mai (temporarily inactive)	.4
Zinc:			
Ore	Padaeng Industry Co. Ltd.	Mae Sot, 64 kilometers west of Tak	350
Refined	do.	Tak	60

NA Not available. XX Not applicable.
[1]Tungsten also recovered when economical.

Mmt/a of hot coil, 1 Mmt/a of cold-rolled, and 200,000 mt/a of coated sheet steel. SSIC ended up with an overseas partner, Bruno Bolfo, the president of Duferco, a trading company. To the surprise of some, the SSIC project will not be an integrated operation with its own blast furnaces, but will instead rely on imported steel slab.

An interesting commentary on projected growth of the steel industry in Thailand was the forecast by Ganok Bhongbhibhat, Secretary-General of the Asean Iron and Steel Industry Federation, that total demand for steel scrap will rise from 897,000 tons in 1990 to 2.7 Mmt in the year 2000. Ganok noted that the 163,000 tons of scrap imported in 1990 would have to increase to 1.8 Mmt by the year 2000, suggesting a good and growing market for Thailand's current sources in the Federal Republic of Germany, Taiwan, and the United States.

Manganese.—In a bid to initiate manganese mining activity in Thailand, the Board of Investment approved certain ad hoc but unspecified incentives for the Pa Ngern Co. Ltd. to invest about $2.5 million to mine manganese deposits near Phayao, 100 km east-northeast of Chiang Mai. Pa Ngern is a new company, comprising 80% Thai and 20% Taiwanese ownership, that has been given 30 months to achieve its targeted mining and processing capacity of 15,000 mt/a for export presumably as concentrates. Purchasers were expected to be other southeast Asian countries.

Tantalum.—After overcoming a multitude of problems, Thailand Tantalum Industry Co. (TTIC) began construction of its new facility near Mab Ta Put in Rayong Province. TTIC's original plant at Phuket burned down as the result of arson committed by local residents claiming to be concerned about environmental problems. The new plant, costing $33 million, was to be leased from the Industrial Estate Authority of Thailand for 30 years plus an option for an additional 20 years. TTIC has contracted to buy Chicago-based Fansteel Inc.'s existing processing equipment for K_2TaF_7 ("K-2") and wire-drawing machinery, both of which will be moved to Thailand. A capacitor powder plant, also purchased from Fansteel, may be operated by TTIC at its U.S. site.

The TTIC plant at Mab Ta Put, with a capacity of 318,000 kg/a, would sell K-2, capacitor powder, tantalum ingots and tantalum carbides into international markets in Europe, Japan, and the United States. Most of its feed would come from tin slags, rich in tantalum, from Thailand Smelting and Refining Co. Ltd. Other raw materials were expected from China, Malaysia, and possibly other countries including Burma.

Tin.—The world tin markets were still in the doldrums throughout 1990; prices generally continued to decline, and world tin stocks showed no signs of diminishing. The industry has not recovered from the dual shocks of the shift from tin to aluminum cans in the early 1980s followed by the collapse of the tin market on the London Metal Exchange in 1985. With high-grade tin deposits and low labor costs, Thailand survived the initial slump. Over the next 5 years, however, tin prices stagnated and Thai tin mining operations gradually closed down. As of 1990, all of Phuket's 42 onshore gravel-pit mines had been shut down, and the small cutter suction dredges were nearly wiped out. The big offshore dredgers remained afloat, but the 4000-strong tin mining fleet decreased to barely 102 vessels. Many migrated to Burmese waters in a Thai-Burmese joint-venture exploration effort, but no significant success rewarded these efforts during the year. Metal content of the tin concentrates produced has ranged only between 14,000 and 15,000 tons for the past 4 years, down from a peak of 34,000 tons in

1980, and Thailand's position eroded to fifth rank worldwide behind Brazil, a pale reflection of former strength.

The Government has extended a series of tax concessions to assist tin miners through the ever-lengthening period of low prices for the metal, but tax relief alone could not combat the effect of 40,000 tons of surplus tin hanging over world markets. Meanwhile, a great many of the tin miners of Thailand who did not go to prospect in Burmese waters turned instead to the rapidly expanding tourist industry of Phuket and Krabi, where innumerable jobs were available on a wage basis.

Uranium.—Exploration for uranium has been underway in the Khorat basin of northeast Thailand for most of the decade of the 1980s. At least 4,200 m of surface drilling was accomplished in Chaiyapum, Udon Thani, Loei, and Khon Kaen Provinces. Mineralization was encountered in various forms in rocks of several ages. A purely speculative estimate, put forth by officials involved, was that uranium resources encountered thus far might range from a low of 1,000 tons to a high of 37,000 tons.

Zinc.—Exports of zinc fell prey to sharply higher domestic demand as Thailand further developed its galvanizing activities. Exports totaled 5,840 tons, a 52% decline in volume from the previous year and even a greater shrinkage from the export peak of 27,615 tons in 1986. The Thai Development Research Institute (TDRI), a prestigious private-sector think tank, predicted that domestic consumption of zinc would exceed 200,000 mt/a by the year 2000 and reach 500,000 mt/a by the year 2010 as the country developed its infrastructure and fabrication industries. Such a projection boded well for Padaeng Industry Co. (PDI), Thailand's only zinc producer at present.

PDI's earnings for 1990 were estimated to be at the $60 million level, but were expected to decrease for 1991 in light of lower prices for zinc on world markets. Price fluctuations aside, the company has been in a state of advanced planning for a $650-million expansion and diversification during the next few years. PDI would join with Metalgesellschaft AG of the Federal Republic of Germany to install a second zinc smelter larger than the first one, or 80,000 mt/a capacity versus 70,000 mt/a for the earlier one. The cost of this additional zinc smelter, $400 million, is entirely separate from that of the planned $250 million copper smelter to be situated in a different part of the country. PDI also began negotiating with Burma for zinc exploration and development rights in two unnamed areas of that country.

Industrial Minerals

Cement.—Thailand's booming cement industry had nowhere to go but up in the midst of an expanding infrastructure, and up it went, with production increasing 17% to more than 18 Mmt in 1990. Siam Cement Co. (SCC), with a 65% share of the Thai market, planned to expand the capacity of its existing production facilities and related subsidiaries by 30% to 100% between 1990 and 1993 to the tune of $1.16 billion, about $500 million to be spent for increasing cement capacity itself from 9.4 Mmt/a to 16.4 mt/a by the latter year. Although other companies were planning to increase capacity, no fears were expressed that total national cement capacity would approach glut proportions. Demand was forecast to exceed supply by 3 Mmt or more during 1990 and was rising inexorably as the country strained to add new construction in virtually all directions.

SCC's major competitor, Siam City Cement (SCTC), disclosed plans to add an extra 4.5 Mmt/a capacity by the 1992-93 period. Beyond this, Thai Petrochemical Industries Polene Co. Ltd. (TPI) based in Bangkok awarded a contract to Krupp Polysius AG of Beckum, Federal Republic of Germany, for the construction of a complete cement production system having a capacity of 7,500 mt/d of clinker. The new plant was slated to initiate production in late 1992. All in all, after construction of both new and expanded facilities, the cement capacity of Thailand was expected to increase from the current 15.6 Mmt/a to something in the range of 28 Mmt to 30 Mmt/a. It seemed clear that even if supply managed to overtake demand, there was always the greater southeast Asian market at such time as Burma, Cambodia, Laos, and even Vietnam began major expansion of infrastructure.

SCC, SCTC, and TPI lobbied strongly for the Government-controlled wholesale cement price to be increased. Thai cement was a comparatively cheap commodity at $59.50 per ton, quite a bit below international price levels. Malaysian cement was $67.00, Taiwan's $63.00, and Japanese cement was more than $80.00 per ton. In return for approving a wholesale price increase to $60.81, the Thai Government forced the three cement companies to agree to a partial easing of cement import restrictions. To alleviate local shortages and help ease overheating retail prices, the Government issued temporary import permits. The imported cement, however, had to be distributed through the existing producers' sales networks and at their expense rather than the importers'. Beyond this the producers would have to subsidize the imported cement, no small consideration in view of the price differentials noted before. The Government believed these arrangements would mitigate supply and price-inflation problems while precluding SCC, SCTC, and TPI from profiting unduly in the tight market for their products.

Fertilizer Materials.—Work continued on the development of the major potash deposit at Bamnet Narong in northeast Thailand. Officials from six Association of Southeast Asian Nations (ASEAN) approved various technical aspects of the proposed operation, under their collective 40% ownership in the joint venture with the Thai Government, which has taken the remaining 60%. Construction was scheduled to begin late in 1990, with the first shipment of muriate of potash to go out in 1995, according to present plans. Technical advisors from Germany's Kali & Salz, a major producer of fertilizer minerals, and the United Nations Department of Technical Cooperation for Development are listed as consultants to the project.

Reserves of 570 Mmt of KCl (353 Mmt K_2O) are indicated at Bamnet Narong, the deposits occurring as nearly horizontal sedimentary beds showing conspicuous lateral persistence of the potassium mineralization. Reserves had been projected to support a 30-year mine life and revenues of more than $100 million per year. The mine will comprise two vertical shafts with room-and-pillar mining methods at a depth of 180 m. Capital cost for achieving the production stage is about $289 million, about 65% of which was slated to go to surface and processing facilities.

Although marketing plans recognize ASEAN nations as the initial customers, it seemed inevitable that other countries such as China, India, Japan, and the Republic of Korea would be eager to avail themselves of the first major Asian source of supply of potash, badly needed throughout the region to support food requirements for burgeoning populations.

Gem Stones.—Thailand has become second only to India in the export of cut and polished gem stones and second only to Italy in export of jewelry settings. During the year, the country produced 3.6 million carats of gem stones, not otherwise classified, but certainly including ruby, sapphire, zircon, and probably topaz. Although diamonds are known in the Phuket area, it is not clear that any organized mining is going on. Rubies and sapphires, however, are extracted in a number of different provinces, ordinarily for processing in Bangkok. In the past year, the cutting and polishing of precious stones has spread to the hinterland as far away as Chiang Mai in search of lower costs for the highly labor-intensive work. At least 500,000 people, full-time and part-time, were employed in the industry overall.

In the past few years, a rapidly expanding diamond cutting and polishing industry, particularly of small stones yielding down to one-tenth carat, has arisen within the colored-stone industry. The diamonds were imported primarily from Australia and Belgium, and through the DeBeers Central Selling Organization. They were then processed and reexported on a scale of about 1.3 million carats in 1990, second only to India's reexport of finished diamonds, but increasing at a rate suggesting that the center of gravity of Asian gem and jewelry business is shifting toward Thailand.

Limestone.—At 19.7 Mmt production of limestone during the year increased about 18% over that of 1989 and was constrained in a continuous upward direction by the swelling domestic demand for cement in conjunction with the Thai construction boom. Exports were less than 1% of production. Based on repeated urging from the Thai Mining Industry Council, the Government finally, in the face of overwhelming demand for cement, authorized the mining of limestone from more than 1 million hectares of forest reserve. Although Thailand's reserves of limestone are about 5.5 billion tons, much of this is somewhat scattered away from supporting infrastructure or in environmentally restricted areas. In the final analysis, much of Thailand's building boom and upgrading of infrastructure depended on steady supplies of limestone for the cement industry.

Silica Sand.—In September of 1990, PPG Siam Silica Co. Ltd., a joint venture of PPG Industries in Pittsburgh, Pennsylvania, and the Mitr Phol Group started up the production of precipitated silicas. Hi-Sil 233S and Hi-Sil 255S, products developed by PPG from silica sand and soda ash, were to be used in the rubber tire and rubber sport-shoe industries. With an annual capacity of 12,000 tons, the plant in Rayong Province employed 60 people at startup but is expected to increase that number. Hi-Sil silicas are expected to be used in industrial hoses, reinforced conveyor belts, and similar mechanical rubber products as well as containers for agricultural chemicals. Possible future uses are as anticaking agents in adhesives and the fabrication of microporous membranes for heavy-duty electrical batteries.

Other Industrial Minerals.—Barite production of 139,257 tons showed an increase of 31% compared with that of the previous year, suggesting that renewed petroleum drilling operations have had an effect on demand for barite in drilling muds. Gypsum production roared upward at 5.8 Mmt, based partly on a quadrupling of domestic demand combined with firm export demand. Output of ball clay, calcite, diatomite, dolomite, kaolin, marble, marl, and shale was higher in each case than that in the previous year.

Mineral Fuels

Lignite.—A sharp increase in production of lignite broke the milder upward trend of the past 5 years. At just under 12.5 Mmt produced in 1990, output was up 28% over that of 1989 as additional quantities were needed to fuel Thailand's thermal powerplants.

Three 75-MW thermal power station was installed each year in 1977, 1978, and 1979, respectively, at Mae Moh in Lampang Province. After this, Units 4, 5, 6, and 7, each rated at 150 MW, were installed. Unit 8 and Unit 9, each rated at 300 MW, were in place by the end of 1990. Unit 10, also 300 MW, was expected to be ready in 1992, followed closely by Unit 11 in 1993. Lignite production has kept pace with the demand exerted by these powerplants as the country's requirement for electricity multiplied through the past 15 years. The Mae Moh lignite mine has become the largest opencast mine in Thailand and, after scheduled expansion of generating capability with the addition of Units 10 and 11, will be the largest in southeast Asia.

Unit 9, installed during the past year, cost more than $341 million and alone consumes 2 Mmt/a of lignite as it feeds electricity into the national power grid. In terms of economy, however, the plant will save $56 million per year in imported bunker oil.

Natural Gas.—At a total of 6,525 Mm^3 production of natural gas was up more than 8% from that of the previous year. Output of natural-gas condensates, at slightly more than 7.2 Mbbl was up about 7% from that in 1989. Several new gas wells were drilled in the Gulf of Thailand, and the production of gas continued to be primarily an offshore operation. The Government announced at a Singapore conference in September that Thailand can produce at least 17 Mm^3/d of natural gas and expects to see that volume increase to more than 31 Mm^3 by the end of the decade. Much drilling remains to be done in the offshore areas as new structures are located and tested.

The Government decided to abolish the flat royalty rate of 12.5% and shift the emphasis from gross income earned by the developer to an arrangement based more on profit and the sharing of risk and reward between the developer and the Government. Because of the higher coast of gasfield development, the Government announced an equivalent ratio of "10 million Btu's of gas to 1 bbl of oil," in allocating tax liability, a higher than true-heat-equivalent conversion based on the growing importance of gas in the country's energy consumption. A windfall profits tax, termed Special Remuneration Benefit (SRB), was to be calculated on the basis of annual revenue per m of well drilled, based on the yearly profit before taxes. Both royalty and SRB were to be tax-deductible expenses. The 50% income tax would remain in place, as would the duty-free allowance for importation of tools and equipment.

Petroleum Crude.—Output of crude increased 11% during the year to a total of 8.75 Mbbl, modest by Mideast standards but indicative of the continuous growth of production in southeast Asia. Most of the Thai crude came from onshore wells in a country that encouraged further hydrocarbon development by putting up 104 new exploration blocks for bid, 83 of them onshore and 21 offshore, covering altogether 433,000 km^2. All in all, 22 companies submitted bids on 62 of the blocks. Bidders included companies (or groups of companies) from Australia, Canada, France, the United Kingdom, Norway, Singapore, Thailand, and the United States, each company to be limited to no more than five exploration blocks. Applications were to be evaluated successively by the Department of Mineral Resources, the Ministry of Industry, and finally the Thai Cabinet, the latter to issue final approvals. The approved companies would then be granted concessions within which to begin work. It was known that competition was keen for certain of the blocks, but observers noted that in the future much of the foreign interest might well be refocused on Burma and Vietnam. Although both of these countries are highly prospective for crude and present fewer regulatory difficulties, both currently entail unsolved political problems. Vietnam is off limits to U.S. operators, and Burma's repression of human rights has deterred many international companies from doing business there. For these reasons Thailand remains the big petroleum interest in southeast Asia for the time being.

In the meantime, 15 exploratory wells were already scheduled for 1991, 9 of them offshore and 6 onshore, exclusive of the new round of bidding for concessions. About 80 development wells were also scheduled, at least 56 of them offshore in the continuing testing of the known reservoirs.

Both Caltex Oil (Thailand) and Shell Co. of Thailand were given permission by the Government to construct and expand petroleum refining facilities, both on reclaimed land in the Mab Ta Put industrial estate. Overall capacity would thus increase to 370,000 bbl/d, but existing plans were for a further increase to 600,000 bbl/d sometime in the mid-1990s. Overall, this expansion reflected the fact that Asia-Pacific demand for refined products is the fastest growing in the world.

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. 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 3

THAILAND: RESERVES OF MAJOR MINERAL

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Antimony		300
Barite		14,000
Clay, kaolin		500
Feldspar		43,000
Fluorspar		1,000
Gas, natural	billion cubic feet	6,950
Gypsum		42,300
Lead		1,500
Lignite		2,100,000
Limestone		5,500,000
Petroleum, crude	million barrels	231
Potash		570,000
Tantalum (including tantalum-bearing tin slags)		3,000
Tin		270
Tungsten		30
Zinc		3,800

routes under development in 1988. The country has 4,000 km of inland waterway, with 3,700 km of this at least 0.9 m 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 located 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 as drilling and discovery continued in the Gulf of Thailand. During 1990, the Petroleum Authority of Thailand approved the construction of a $200 million gas pipeline in the gulf, including a reported 170-km 32-inch line from Bongkot Gasfield to Erawan platform and a 161-km 24-inch line from Erawan platform to a powerplant in Khanom. Plans moved slowly for a 500-km natural gas pipeline from Martaban, in Burma, through Three Pagodas Pass on the border to Kanchanaburi, Thailand, for power generation.

One primary power utility, EGAT, serves the entire country. Energy sources include thermal plants burning lignite, natural gas, and diesel fuel; gas-turbine plants; and hydroelectric production from large dams. The national power grid has been continuously augmented to reach all parts of the country, and new generators are put on-line every year. EGAT and its supply utilities plan to test both wind-powered and minihydro energy projects.

OUTLOOK

Disregarding any possible political upheaval, Thailand is well positioned geographically, geologically, and economically for continued growth and development into a newly 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.

[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.

OTHER SOURCES OF INFORMATION

Agencies

Department of Mineral Resources
Thanon Rama 6
Phaya Thai
Bangkok 10400, Thailand

National Statistical Office
Office of the Prime Minister
Bangkok, Thailand

Mining Industry Council of Thailand
132 Sinthorn Building
Room 11, Wireless Road
Bangkok 10500, Thailand

Publications

Department of Mineral Resources, Bangkok:
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Statistical Summary of Thailand, 1986 et seq.
Statistical Yearbook of Thailand, No. 36, 1989.

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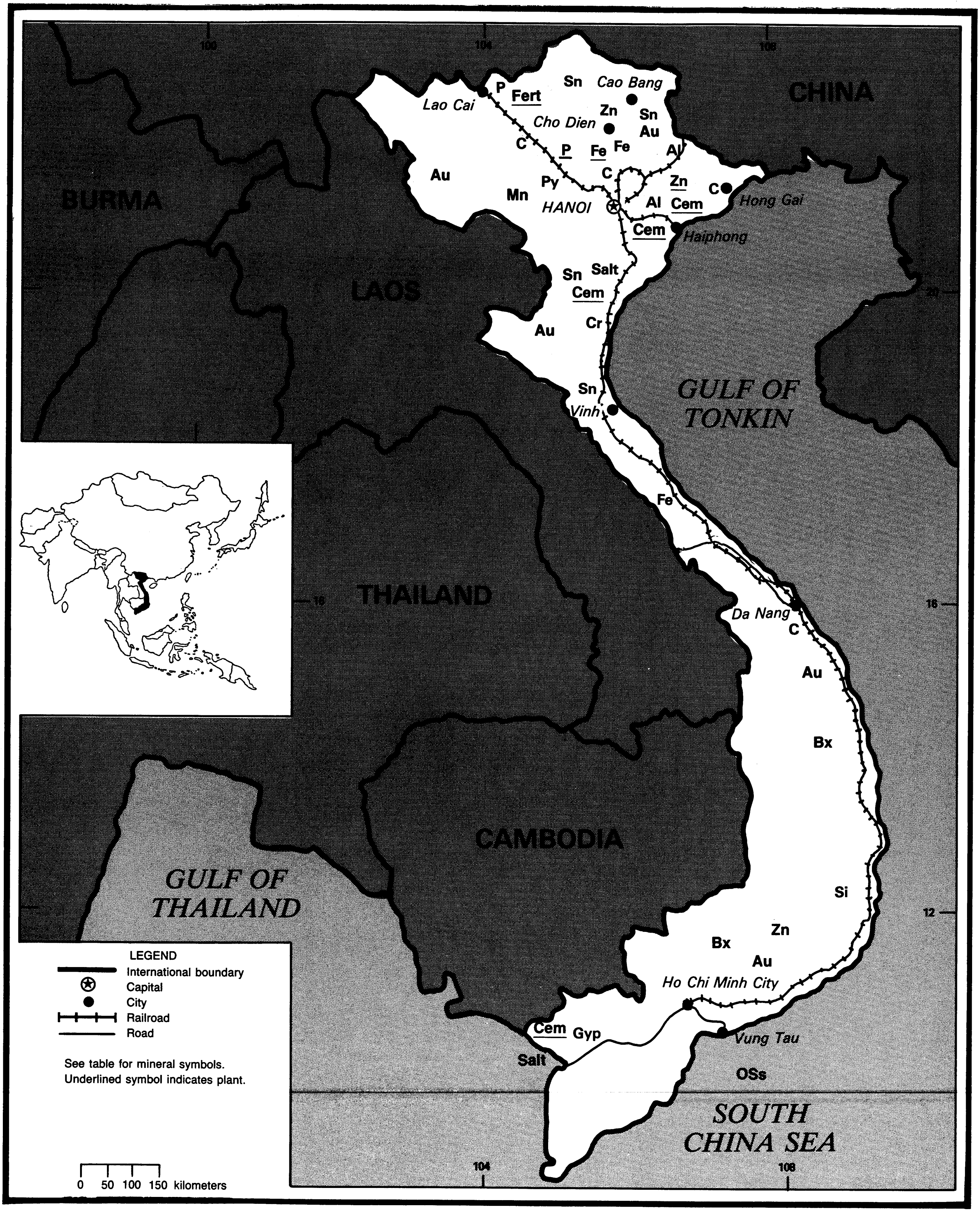
Mines and Mineral Deposits of Thailand, 1981.

VIETNAM

AREA 330,000 km² **POPULATION 68 million**



THE MINERAL INDUSTRY OF VIETNAM

By David B. Doan

Once again Vietnam's petroleum industry represented the one bright spot in an otherwise dull and nearly lifeless mineral industry. The continued development of offshore petroleum provided foreign-exchange credits in return for crude exported, one of the few dependable factors in the country's socialistic economy. Any spontaneous new ideas were metamorphosed into dialectical molds until palatable to the old guard running the country. Vietnam, however, doggedly maintained that it had no intention of deviating in theory from strictly socialist ways and means. However, the Party apparatus deteriorated as business shifted, ever so gradually, into private hands. The Government watched uncomprehendingly, not understanding that it was actually seeing capitalism in action.

Inflation was brought from 170% in 1988 to 36% in 1989 and further down to about 25% in early 1990, still not conducive to effective business but better than before. The dong (D), Vietnam's currency, was officially set at D4,000 to the U.S. dollar,[1] but the freely fluctuating black-market rate was about D4,500 to the U.S. dollar in 1989 and was thought to have improved approximately in proportion to the changes in inflation rate. By the end of 1990, however, the inflation returned with a vengeance, reaching a rate of 100% per year in late December.

The situation was exacerbated by the return of at least 170,000 workers from Eastern Europe and the U.S.S.R. Party leaders tended to blame the collapse of East European communist countries entirely on external plotting. But one retired high official admitted that Vietnam is at a dead end, with no friends in the world, and left only with the hope that the United States would lift the trade embargo so that normalization can begin.

GOVERNMENT POLICIES AND PROGRAMS

Vietnam promulgated its Law on Mineral Resources in August 1989 and then seemed to be in the throes of deciding what to do next. 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," but this did not bring in a flood of capital.

Foreign banks were allowed to apply for licenses to set up operations in Vietnam, but only under stringent rules that left many unanswered questions. Uncertainty surrounded the matter of tax rates on profits of foreign-bank branches, and there was no clear understanding of whether foreign banks could take deposits and make loans in Vietnamese currency. The type and style of banking necessary to the accomplishment of large capital projects in mining, or most other projects using international investment, could not be attracted without a greater degree of certainty as to the ground rules for financial operations.

PRODUCTION

The most important mineral commodities produced in Vietnam have been coal and petroleum, the latter gradually increasing versus the former, which has tended to stagnate. Coal production dropped from 5.5 Mmt in 1989 to a little more than 4.0 Mmt in 1990. In contrast to coal's performance, the production of petroleum crude increased from slightly more than 10.8 Mbbl in 1989 to 19.7 Mbbl in 1990, an impressive 82% rise and probably a harbinger of greater expansion to come. 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 production has lagged but that cement production has probably continued its increase.

The other fast-growing mineral industry in Vietnam, paralleling petroleum but less organized into verifiable productive operations, is the mining of gold virtually throughout the country. Unemployment is high, particularly because of demobilized military troops. These individuals, however, have boost the gold sector because they have in many instances decided to prospect for gold. The parallel with the 1870s in the western United States suggests itself, as discharged Civil War soldiers from both sides sought their fortunes in mineral prospecting. An estimated production of 1.2 tons in 1990 was worth probably $13 million to $15 million depending on world market price fluctuations. The next few years could 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 of Vietnam's GNP and the stabilization of its currency.

TRADE

Beside the necessity of burning its own coal and petroleum crude for production of power, Vietnam must export both commodities in order to survive financially in terms of its acute need for foreign-exchange credits. Demand for foreign exchange weakens the currency and fuels the inflation that had seemed to be under control midway through the year. Although trade protocols have been signed with such countries as Australia and India and discussed with Cambodia, the underlying problem is that Vietnam must have something to export on a scale sufficient to support a reasonable balance of trade.

In 1990, Vietnam earned a record 2.15 billion "rubles and dollars" from exports, up 15% from that of the previous year according to the Foreign Economic Relations Ministry.[2] 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 rough order of value, the countries main exports were rice, crude oil, frozen shrimp, coffee, and rubber.

In monetary value, the country's exports of petroleum were very likely the outstanding mineral commodity item in its trade with other countries, but it is not known what quantity was exported nor at

TABLE 1

VIETNAM: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1986	1987	1988	1989	1990
Bauxite: Gross weight		6,000	6,000	6,000	6,000	6,500
Cement, hydraulic	thousand tons	[3]1,526	[3]1,665	[3]1,954	2,000	2,500
Chromium: Chromite		4,000	4,000	4,000	3,500	3,500
Clays: Kaolin		1,000	1,000	700	750	750
Coal: Anthracite	thousand tons	[3]6,392	[3]6,839	[3]6,900	5,500	4,022
Gold	kilograms	—	500	1,000	1,200	1,200
Gypsum		25,000	25,000	25,000	25,000	25,000
Iron and steel: Metal:						
Steel, ingot	thousand tons	110	110	115	115	115
Steel, rolled	do.	50	50	50	50	50
Nitrogen: N content of ammonia		36,000	36,000	36,000	36,000	36,000
Petroleum: Crude	thousand 42-gallon barrels	200	600	5,475	10,850	19,700
Phosphate rock:						
Gross weight	thousand tons	530	300	330	500	274
P_2O_5 content	do.	175	105	115	175	96
Salt	do.	450	229	300	[r]320	340
Tin:						
Mine output, Sn content		650	680	700	850	850
Metal, smelter		620	645	600	800	800
Zinc:						
Mine output, Zn content		5,000	5,000	[r]5,500	[r]5,500	5,500
Metal, smelter, undifferentiated		4,200	4,200	4,200	4,200	4,200

[r]Revised.
[1]Table includes data available through Oct. 15, 1991.
[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 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.

what price per bbl. At an estimated price of $15 per bbl, a conservative projection would be that Vietnam exported at least $200 million worth of petroleum alone, most or all of it probably purchased by Japan. Coal exports amounted to 784,000 tons in 1990, an improvement over the 600,000 tons shipped the previous year. In contrast to the 1.3 Mmt exported in 1979, however, there was room for improvement. China and France were thought to have joined Japan as buyers, and the United Kingdom had been interested. As usual, price information has not been divulged, but earnings from coal may possibly amount to less than 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 owned and operated solely by the Government. Prior petroleum exploration and production have been joint ventures between Vietnam and the U.S.S.R. 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 1989, 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

Gold.—Gold prospects have attracted Crusader Investments Ltd., a Hong Kong mining company, to Vietnam to explore for deposits worth mining and processing by heap leaching. The company planned to spend as much as $200,000 during the first year and was negotiating a profit-sharing agreement with the Vietnam State Committee of Sciences and the Ministry of Heavy Industry. Crusader proposed to establish as many as five mines, possibly costing $10 million each, over a period of 5 years. The company was particularly interested in epithermal lode deposits and expressed reluctance to compete with local panning of placer deposits.[3]

TABLE 2

VIETNAM: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989[p]	Principal destinations, 1989
METALS				
Aluminum: Metal including alloys, all forms		35	8	All to China.
Copper: Metal including alloys, all forms		285	935	Hong Kong 810; Japan 120.
Iron and steel: Metal:				
Scrap		130,816	370,316	Japan 248,420; Indonesia 112,517; Hong Kong 9,379.
Ferroalloys		82	427	All to Japan.
Semimanufactures		69	40	All to Hong Kong.
Tin:				
Ore and concentrate		—	3,933	All to Japan.
Metal including alloys, unwrought		—	153	Japan 103; North Korea 50.
Tungsten: Ore and concentrate		—	166	All to West Germany.
INDUSTRIAL MINERALS				
Clays, crude		—	210	All to Japan.
Diamond, gem not set or strung	value, thousands	—	$542	All to Belgium-Luxembourg.
Fertilizer materials: Manufactured:				
Nitrogenous		—	20	All to Hong Kong.
Graphite, natural		50	150	All to Japan.
Gypsum and plaster		7	—	
Lime		—	79	All to Hong Kong.
Mica: Crude including splittings and waste		60	—	
Pigments, mineral: Iron oxides and hydroxides, processed		40	—	
Precious and semiprecious stones other than diamond: Natural	value, thousands	$23	$56	Japan $29; West Germany $19; France $8.
Salt and brine		—	605	All to Hong Kong.
Stone, sand and gravel:				
Dimension stone: Worked		—	83	Hong Kong 79; West Germany 2.
Sand, excluding metal-bearing		—	8,228	All to Japan.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black		—	22	All to Indonesia.
Coal: Anthracite and bituminous		95,243	236,325	China 75,125; Japan 105,817; France 43,707.
Petroleum: Crude	42-gallon barrels	3,256,618	9,779,803	All to Japan.

[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 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 1989.

TABLE 3

VIETNAM: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989[p]	Principal destinations, 1989
METALS			
Aluminum: Metal including alloys, all forms	133	64	Japan 63; Sweden 1.
Chromium: Oxides and hydroxides	40	6	All from Japan.
Cobalt: Oxides and hydroxides	2	—	
Copper: Metal including alloys, all forms	64	63	Japan 58; Sweden 5.

See footnotes at end of table.

TABLE 3—Continued

VIETNAM: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1988	1989[p]	Principal destinations, 1989
METALS—Continued			
Gold: Metal including alloys, all forms value, thousands	$403	$678	Canada $421; Japan $242; West Germany $15.
Iron and steel:			
Iron ore and concentrate: Pyrite, roasted	83,000	73,000	All from U.S.S.R.
Metal:			
Scrap	12	—	
Pig iron, cast iron, related materials	5	—	
Ferroalloys	1,531	5	All from Japan.
Steel, primary forms	99	—	
Semimanufactures:			
Bars, rods, angles, shapes, sections	705	197	All from Sweden.
Universals, plates, sheets	1,334	—	
Hoop and strip	54	—	
Wire	675	411	All from Japan.
Tubes, pipes, fittings	11,635	19,123	Spain 10,000; Japan 6,846; France 1,220.
Unspecified	432,000	NA	
Lead: Metal including alloys, all forms	20	—	
Magnesium: Metal including alloys, all forms value, thousands	—	$2	All from West Germany.
Manganese: Oxides	100	—	
Nickel: Metal including alloys, all forms	13	1	All from Sweden.
Tin: Metal including alloys, all forms	1	—	
Titanium: Oxides	180	108	Japan 83; West Germany 20.
Zinc:			
Oxides	138	—	
Metal including alloys:			
Unwrought	160	—	
Semimanufactures	([2])	—	
INDUSTRIAL MINERALS			
Abrasives, n.e.s.:			
Natural: Corundum, emery, pumice, etc.	—	21	All from Indonesia.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$25	$6	All from Belgium-Luxembourg.
Grinding and polishing wheels and stones	9	2	France 1; Sweden 1.
Cement	31,800	334,869	Indonesia 333,257; Hong Kong 900; Japan 700.
Clays, crude	500	—	
Diamond: Natural: Gem not set or strung value, thousands	$135	—	
Diatomite and other infusorial earth	70	280	All from Japan.
Feldspar, fluorspar, related materials	200	—	
Fertilizer materials: Manufactured:			
Ammonia	38	2	Do.
Nitrogenous	98,804	838,090	U.S.S.R. 621,000; Indonesia 217,090.
Phosphatic	10,500	—	
Unspecified and mixed	84,432	—	
Iodine including bromine and fluorine value, thousands	$10	—	
Mica: Worked including agglomerated splittings	([3])	1	All from Japan.

See footnotes at end of table.

TABLE 3—Continued

VIETNAM: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1988	1989^p	Principal destinations, 1989
INDUSTRIAL MINERALS—Continued				
Nitrates, crude		50	—	
Phosphorus, elemental	value, thousands	—	$5	All from Japan.
Pigments, mineral: Iron oxides and hydroxides, processed		10	42	Japan 22; France 20.
Precious and semiprecious stones other than diamond: Natural	value, thousands	—	$1	All from New Zealand.
Sodium compounds, n.e.s.: Sulfate, natural and manufactured		907	20	All from Japan.
Stone, sand and gravel:				
Dimension stone, all forms		23	10,606	Indonesia 10,576; Italy 30.
Sand excluding metal-bearing		—	200	All from China.
Sulfur:				
Elemental, all forms		50	—	
Sulfuric acid		—	17	Japan 15; France 2.
Talc, steatite, soapstone, pyrophyllite		14	3	All from Belgium-Luxembourg.
Other: Metalloids, unspecified[4]		5	—	
MINERAL FUELS AND RELATED MATERIALS				
Carbon black		56	5	All from West Germany.
Coal: Anthracite and bituminous		5,000	—	
Coke and semicoke		100	—	
Petroleum refinery products:				
Gasoline	42-gallon barrels	106	613	Netherlands 323; Belgium-Luxembourg 102; France 102.
Mineral jelly and wax	do.	16	([5])	
Distillate fuel oil	do.	—	112	All from Greece.
Lubricants	do.	14,057	9,278	Italy 8,127; Belgium-Luxembourg 98; Japan 94.
Residual fuel oil	do.	—	4,129	All from Greece.
Bituminous mixtures	do.	242	—	
Unspecified	do.	12,327,000	NA	

^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 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 1989.

[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."

[5]Unreported quantity valued at $2,000 exported by France and West Germany.

TABLE 4

VIETNAM: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

Commodity	Major operating companies	Location of main facilities	Annual capacity
Bauxite	Basic Chemical Corp.	Lo Son, believed to be in Hai Hung Province	NA
	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 Chi Minh City	1,300
Chromite	Basic Chemical Corp.	Co Dinh, 100 kiometers north of Vinh, Thanh Hoa Province	4

See footnotes at end of table.

TABLE 4—Continued

VIETNAM: STRUCTURE OF THE MINERAL INDUSTRY FOR 1990

Commodity	Major operating companies	Location of main facilities	Annual capacity
Coal, anthracite.	Ministry of Mines and Coal	Coc Sau, Deo Nai, Ha Tu, and Thong Nhat in the Hon Gai coalfield, north of Haiphong	6,000
Fertilizer:			
Apatite	General Department of Chemicals	Lao Cai, Hoang Lien Son Province, 250 km 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	Ministry of Engineering and Metals.	Cho Dien, Bach Thai Province	10
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.

Titanium.—Ilmenite mined for export will result from a joint venture negotiated between W. T. Exporters Pty. Ltd. of Australia and Vietnam's Ilmenite Mining Co. of Nghe Tinh. Ilmenite reserves of 25 Mmt have been projected in Nghe Tinh Province, about 300 km south of Hanoi, and the two parties plan to extract 25,000 mt/a in the first stage of operations. The effort will involve capital costs of $930,000 for 15 years of operation, to which the Vietnamese company will contribute approximately 30%.[4]

Industrial Minerals

Fertilizer Materials.—The shortage of nitrate fertilizers became acute in 1990 and is thought to have affected the size and vigor of the rice crop, in turn affecting rice exports and foreign exchange. Although numerical data were not available, the opinion was voiced that not 1 kg of nitrate fertilizer could be purchased in Hanoi in May 1990, although the previous year had seen a surplus. Economic difficulties with Soviet sources of supply were blamed.

In the meantime, plans were advanced for construction of a superphosphate plant in Dong Nai Province, perhaps 50 to 70 km east of Ho Chi Minh City, to have an annual capacity of 100,000 tons. Moreover, the Ho Chi Minh City Food Corp., described as Vietnam's most profitable company, negotiated a joint-venture agreement with Japan's Nissho Iwai Corp. to build a $22 million chemical fertilizer plant in a suburb of the city. Capacity was projected at 1 million to 1.5 Mmt/a, primarily for sale and use in Vietnam.[5]

Gem Stones.—The joint venture in mining of gem stones agreed to between the Vietnam General Department of Mines and Geology, the Provincial government of Hoang Lien Son, and the B. P. Co. of Thailand apparently will mine high-quality ruby rough in that province. 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 effort will concentrate on the 10 to 20-g stones similar in color and quality to the well-known Burmese and Thai ruby material. Observers said that 225 kg (1.12 million carats) of ruby rough, mined in the first 11 months of operation, might yield about 10,000 carats of top-grade faceted and polished stones.

Silica Sand.—Mining of white silica sand along the shores of Cam Ranh Bay, where reserves are thought to be at least 51 Mmt, yielded about 1 Mmt of the material, worth $1 million, which was purchased by Japan, the Philippines, and Taiwan in 1990. Other deposits of such sand are known in several places along the east coast of southern Vietnam, but have not been explored sufficiently to estimate reserves.

Mineral Fuels

Coal.—The Quang Ninh anthracite mine complex, near the Port of Hong Gai almost due east of Hanoi, was rated at an output capacity of 6 Mmt/a but the tonnage figure released for 1990 was 4,021,700 tons mined. This again reflects problems with aging or obsolescent equipment, maintenance, and spare parts. Poor motivation of workers in the midst of Vietnam's economic problems did not help, nor did the neglect of acceptable mining-engineering techniques. Coal is Vietnam's principal source of energy for production of electric power and continues to be its most significant natural resource, although petroleum utilization may overtake coal as development of offshore fields increases. At present, many of the country's powerplants are configured for the high-quality anthracite mined at Hong Gai, but the future availability of natural gas...presently flared offshore...may bring changes.

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.

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 large, representing potential wealth, but the potential value is realized only if sound engineering and design enable economic production at competitive costs.

Natural Gas.—Because no facilities have been installed for handling natural gas associated with oil production at platforms far offshore, it was reported that about 500,000 m^3 of gas were being flared into the atmosphere every day. Assuming a nominal Western market price of $1.75 per cubic foot, this loss would represent approximately $31,000 per day or better than $11 million per year.

Several 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.—Vietnam produced 19.7 Mbbl of crude in 1990 and increased the number of its offshore oil drilling rigs from 7 to 9 as 2 more rigs were moved in to drill in a scheduled 16 new holes during the year. All of this activity was accomplished by Vietsovpetro, the joint venture with the Soviet counterpart organization. Not only was the Bach Ho (White Tiger) Field being expanded through development drilling, but two other fields, Dai Hung (Big Bear) and Rong (Dragon), were being explored. These latter two fields are farther offshore and in deeper water than Bach Ho.

Aside from the effort of Vietsovpetro, other foreign companies established interests. At the end of the year, joint ventures in petroleum exploration and production had been established between Petrovietnam and the Total Co. of France; British Petroleum (BP) and Enterprise of Britain; Shell Exploration RV of the Netherlands and Belgium; Swedish Exploration Consortium AB; the Oil and Natural Gas Commission of India; Australian BHP Petroleum; Canadian Sceptre Resources; and PETROCAN, a consortium of Canadian National Oil Co. (Petro-Canada), Husky Oil of Canada, and Kuwait Foreign Petroleum Exploration Co. (KUFPEC).

Other foreign companies were negotiating. A joint seismic-exploration agreement was signed with PETROFINA Exploration of Belgium, with the proviso that this company could then select a 10,000-km^2 block for exploration drilling.

Japan, in particular, was invited by the Government to take up an interest in exploration and production, but at yearend seemed to be still studying the matter.

Bach Ho crude runs between 28^0 and 30^0 API gravity with extremely low sulfur at about 0.01%. Not having any refining facilities, Vietnam has shipped its crude to Japan and Singapore. A refinery was thought to be near completion at Phu My, about 15 km north of Vung Tau, the offshore-operations logistical base on the coast southeast of Ho Chi Minh City. Installed capacity of this refinery was to be 3 mt/a of crude or very roughly 22 Mbbl of refinery products depending upon composition. Similarly, a petrochemical complex is being built at Thanh Tuy Ha, 50 km southeast of Ho Chi Minh City, that will likewise have a 3-mt/a throughput. Upon completion of these facilities, Vietnam will have new choices in export versus domestic consumption of petroleum products.[6]

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.

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

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; and 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-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 Chi 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 Chi 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 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 kW·h 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.

OUTLOOK

Vietnam has displayed evidence of 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 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. Much would depend upon diplomatic recognition by the United States and the inception of business relationships that are now precluded.

[1]Where necessary, the Vietnamese dong (D) has been converted into U. S. dollars at the rate of D4,500=US$1.00.

[2]Hanoi Vietnam News Agency (Broadcast in English). 0616 G.m.t. May 30, 1991.

[3]American Metal Market. V. 98, No. 146, July 29, 1990, p. 6.

[4]Hanoi Vietnam News Agency (Broadcast in English). 0655 G.m.t. Sep. 29, 1990.

[5]Summary of World Broadcasts (Far East). WO156, Nov. 28, 1990, p. A/14.

[6]Hanoi Vietnam News Agency (Broadcast in English). 0720 G.m.t. May 2,1990.

OTHER SOURCES OF INFORMATION

Agencies

General Department of Chemicals
Hanoi, Vietnam
Ministry of Construction
Hanoi, Vietnam
Ministry of Engineering and Metals
Hanoi, Vietnam
Ministry of Power and Coal
Hanoi, Vietnam

MAP SYMBOLS

Commodity

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 (niobium)	Cb
Copper	Cu
Corundum	Cn
Cryolite	Cry
Diamond	Dm
Diatomite	Dia
Dolomite	DS
Emerald	Em
Emery	E
Feldspar	Feld
Ferroalloys	*FA*
Ferrochrome	*FeCr*
Ferromanganese	*FeMn*
Ferronickel	*FeNi*
Ferrosilicon	*FeSi*
Fertilizer	*Fz*
Fluorspar	F
Gallium	Ga
Garnet	Gt
Gem stones	Gm
Germanium	Ge
Gold	Au
Graphite	Gr
Ilmenite	Il
Gypsum	Gyp
Indium	In
Iron and steel	*Fe*
Iron ore	Fe
Jade	J
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
Marl	M
Mercury	Hg
Mica	M
Molybdenum	Mo
Natural gas	NG
Natural gas liquids	*NGL*
Nepheline Syenite	Neph
Nickel	Ni
Nitrates	Nit
Nitrogen (ammonia plants)	N
Ochre	Oc
Oil sands	OSs
Oil shale	OSh
Olivine	Ol
Opal	Opal
Peat	Peat
Perlite	Per
Petroleum, crude	Pet
Petroleum refinery products	*Pet*
Phosphate	P
Pig iron	*Pig*
Pigments, iron	Pigm
Platinum-group metals	PGM
Potash	K
Pozzolana	Pz
Precious and semiprecious stones	Gem
Pumice	Pum
Pyrite	Py
Pyrophyllite	Pyrp
Quartz or quartzite	Qtz
Rare earths	RE
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	Tc
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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