MINERAL INDUSTRIES OF

AFRICA

U.S.
DEPARTMENT
OF THE
INTERIOR

BUREAU
OF
MINES

1989

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

BUREAU OF MINES • T S Ary, Director

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

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Preface

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

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

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

Volume III, Area Reports: International, contains the latest available mineral data on more than 150 foreign countries and discusses the importance of minerals to the economies of these nations. The 1989 review is presented as 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 U.S.S.R., Mineral Industries of the Middle East, and Minerals in the World Economy. This year's reports incorporate location maps, industry structure tables, and an outlook section previously incorporated in our Minerals Perspectives Series quniquennial regional books, which will be 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 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 U.S. Department of State located in American Embassies worldwide. Their contributions are sincerely appreciated.

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

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

George J. Coakley
Chief, Division of International Minerals

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Vitae

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MINERAL INDUSTRIES OF

AFRICA

By Staff, Branch of Africa and Middle East

INTRODUCTION[1]

The 53 countries that constituted Africa in 1989 accounted for a significant portion of total world output of a number of mineral commodities. Among the most significant minerals to be produced in Africa were andalusite, antimony, asbestos, bauxite, chromite, coal, cobalt, copper, diamond, fluorspar, gold, lithium minerals, manganese, phosphate, platinum-group metals, and the titanium minerals—ilmenite and rutile, vanadium, vermiculite, and zircon. Despite the underdevelopment of much of Africa, mineral raw materials played a very important part of the national economies of many of its countries. In terms of percentage of export earnings, minerals accounted for more than 90% in some cases. In several countries with agrarian economies and little economic diversification such as Angola and Guinea, a single mining operation could represent an important source of foreign exchange. These latter operations tended to be the more easily mined surface deposits of diamond, gem stones, and precious metals.

Mineral commodities for which Africa had a high percentage of world output were bauxite, 16%; chromite, 44.5%; cobalt, 76.5%; copper, 13.9%; diamond, 50.7%; gold, 32.9%; manganese, 27.1%; phosphate, 22.1%; platinum-group metals, 48%; uranium, 29.2%; vanadium, 54%; and vermiculite, 41%. Several of these, chromite, cobalt, diamond, and manganese, were not produced in the United States.

The most significant mineral economies in Africa in terms of diversity and volume of output of nonfuel minerals in order of importance were the Republic of South Africa, Zaire, Zambia, Morocco, and Zimbabwe. Also important in terms of value of mineral production from several highly valued minerals or those produced in large volume, such as bauxite, diamond, gold, manganese, phosphate rock, and uranium, were Botswana, Gabon, Ghana, Guinea, Namibia, Niger, and Togo.

In terms of mineral fuels, Nigeria and Libya were the largest producers of crude petroleum, followed by Egypt and Algeria. However, the western coast of Africa remained an exploration target for additional oil and gas resources. West coast countries currently producing crude petroleum were Angola, Benin, Cameroon, Congo, Côte d'Ivoire, Gabon, and Zaire. Exploration was underway in Namibia, where gas has been discovered. Natural gas is a major export item for Algeria. The Republic of South Africa commenced development of its gas discoveries, and continued the search for additional resources. Coal was produced by only a few countries, although reserves were quite large in southern Africa. The main producers were the Republic of South Africa, which was also the world's third largest exporter of coal, Zimbabwe, and Botswana.

The Republic of South Africa had the highest value of nonfuel mineral production in Africa and ranked among the top five world producers in value of nonfuel minerals. It was among the top world producers of andalusite, chromite, diamond, fluorspar, gold, manganese, platinum-group metals, pyrophyllite, titanium, uranium, vanadium, vermiculite, and zircon.

U.S. imports in 1989 from African nations were mainly raw materials. In the case of mineral commodities, 10 countries were considered to be major import sources. Among these were Gabon for manganese; Guinea for bauxite; Liberia for iron ore; Madagascar for graphite; Morocco for barite; Namibia for quartz crystal; the Republic of South Africa for andalusite, antimony, asbestos, chromite, diamond, fluorspar, gem stones, manganese, platinum-group metals, pyrophyllite, vanadium, and vermiculite; Zaire for cobalt, copper, and diamond; Zambia for cobalt; and Zimbabwe for chromium and lithium. U.S. exports to Africa were mainly food, equipment and machinery, computers, and aircraft.

The total land area of Africa is about 3.2 times that of the United States. Exclusive of the mineral commodities mentioned above for which there was no U.S. production or which were unique to Africa in terms of dominating world markets, U.S. production of most mineral commodities exceeded that for all of Africa. Although Africa has been a source of minerals for centuries, large areas are under thick vegetative or sand and unconsolidated alluvium cover, which impede exploration. Other large areas are subject to internal strife or legislation prohibitive to risk investment, which have set back the pace of mineral industry development and even exploration.

The population of Africa is about 660 million compared to 250.4 million for the United States. However, Africa's labor force is only 187.8 million or about 50% larger than 123.9 million for the United States and consists for the most part of unskilled or semiskilled labor. Lack of skilled labor remains a significant factor in the slow pace of mineral project development throughout much of Africa. The combined gross domestic product (GDP) of the countries of Africa is estimated at about $386 billion and is vastly outweighed by the $5,233 billion gross national product of the United States. African countries have some of the lowest per capita GDP in the world and vary from about $110 for Mozambique to $3,720 for the island nation of Seychelles. Average per capita GDP for the region is $585. All tons are metric in this report unless otherwise specified.

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[1]George A. Morgan, Chief, Branch of Africa and Middle East, Division of International Minerals.

SELECTED GENERAL SOURCES OF REGIONAL INFORMATION

Africa Economic Digest London.

British Sulphur Corp. Ltd., London:
Nitrogen, bimonthly.
Phosphorus and Potassium, bimonthly.
Sulphur, bimonthly.

Bureau de Recherches Geologiques et Minieres, Paris.
Engineering News, Johannesburg.

Institution of Mining and Metallurgy, London: Transactions, monthly.
Bulletin.

International Lead and Zinc Study Group, London.

International Monetary Fund, Washington, DC: International Financial Statistics, monthly and annual yearbook.

McGraw-Hill, Inc., New York: Engineering and Mining Journal, monthly.

Mining, Financial Mail Survey, Johannesburg.

Mining Journal Ltd., London:
Mining Magazine, monthly.
Mining Journal, weekly.
Mining Annual Review, July.

Penn Well Publishing Co., Tulsa, Oklahoma: International Petroleum Encyclopedia.

Society of Economic Geologists, University of Texas, El Paso, Texas: Economic Geology (and Bulletin), bimonthly.

Standard Bank, Johannesburg, South Africa: Standard Bank Review, monthly.

United Nations Statistical Office, New York: U.N. trade statistics.

U.S. Central Intelligence Agency: World Factbook, annual.

U.S. Department of Commerce:
Bureau of the Census: trade statistics.
International Trade Administration: Foreign Economic Trends and Their Implications for the U.S., International Marketing Information Series.

U.S. Department of Energy.

U.S. Department of Interior, Bureau of Mines:
Mineral Commodity Summaries.
Minerals Yearbook, v. I, Metals and Minerals; v. III, Area Reports: International.
Minerals Facts and Problems.
Information Circular 8610; Summary of Mining and Petroleum Laws of the World (in five parts), part 4, Africa.

U.S. Joint Publications Research Service, Arlington, Virginia: Foreign Broadcast Information Service Regional Publications, weekly.

World Bank, Washington, DC: Bank news releases.

World Bureau of Metal Statistics, London: World Metal Statistics, monthly.

TABLE 1

AFRICA: PRODUCTION OF SELECTED MINERALS COMMODITIES, 1989

(Thousand metric tons unless otherwise specified)

	Aluminum	Cement	Chromite	Cobalt, mine (tons)	Copper, mine	Diamond (thousand carats)	Gold (kilograms)	Iron ore	Lead, mine	Manganese	Petroleum crude (thousand barrels)	Phosphate	Steel, raw	Uranium (tons)	Zinc, mine
Algeria	—	[e]6,500	—	—	—	—	—	[e]2,700	[e]3	—	253,675	[e]1,225	[e]1,400	—	[e]12
Angola	—	[e]1,000	—	—	—	1,245	—	—	—	—	[e]167,000	—	[e]10	—	—
Benin	—	[e]500	—	—	—	—	—	—	—	—	[e]1,700	—	—	—	—
Botswana	—	—	—	215	27	15,252	[e]66	—	—	—	—	—	—	—	—
Burkina Faso	—	—	—	—	—	—	[e]3,760	—	—	—	—	—	—	—	—
Burundi	—	—	—	—	—	—	18	—	—	—	—	[e]3	—	—	—
Cameroon	92	[e]580	—	—	—	—	[e]8	—	—	—	59	—	—	—	—
Central African Republic	—	—	—	—	—	415	328	—	—	—	—	—	—	—	—
Congo	—	[e]77	—	—	1	—	4	—	[e]1	—	55,000	—	—	—	[e]1
Côte d'Ivoire	—	[e]700	—	—	—	12	13	—	—	—	730	—	—	—	—
Egypt	180	9,507	—	—	—	—	—	2,562	—	—	310,980	1,347	1,400	—	—
Ethiopia	—	[e]250	—	—	—	—	745	—	—	—	—	—	—	—	—
Gabon	—	115	—	—	—	1	81	—	—	2,592	80,000	—	—	1,047	—
Ghana	169	565	—	—	—	494	13,358	—	—	279	—	—	18	—	—
Guinea	—	—	—	—	—	148	2,050	—	—	—	—	—	—	—	—
Kenya	—	1,216	—	—	—	—	15	—	—	—	—	—	—	—	—
Liberia	—	85	—	—	—	155	734	[e]11,700	—	—	—	—	—	—	—
Libya	—	[e]2,700	—	—	—	—	—	—	—	—	412,450	—	[e]10	—	—
Madagascar	—	[e]35	63	—	—	—	45	—	—	—	—	—	—	—	—
Malwai	—	[e]70	—	—	—	—	—	—	—	—	—	—	—	—	—
Mali	—	[e]2	—	—	—	—	3,000	—	—	—	—	[e]10	—	—	—
Mauritania	—	90	—	—	—	—	—	11,138	—	—	—	—	—	—	—
Morocco	—	[e]4,200	—	121	—	—	—	176	67	32	[e]260	18,067	7	—	19

See footnotes at end of table.

TABLE 1—Continued

AFRICA: PRODUCTION OF SELECTED MINERALS COMMODITIES, 1989

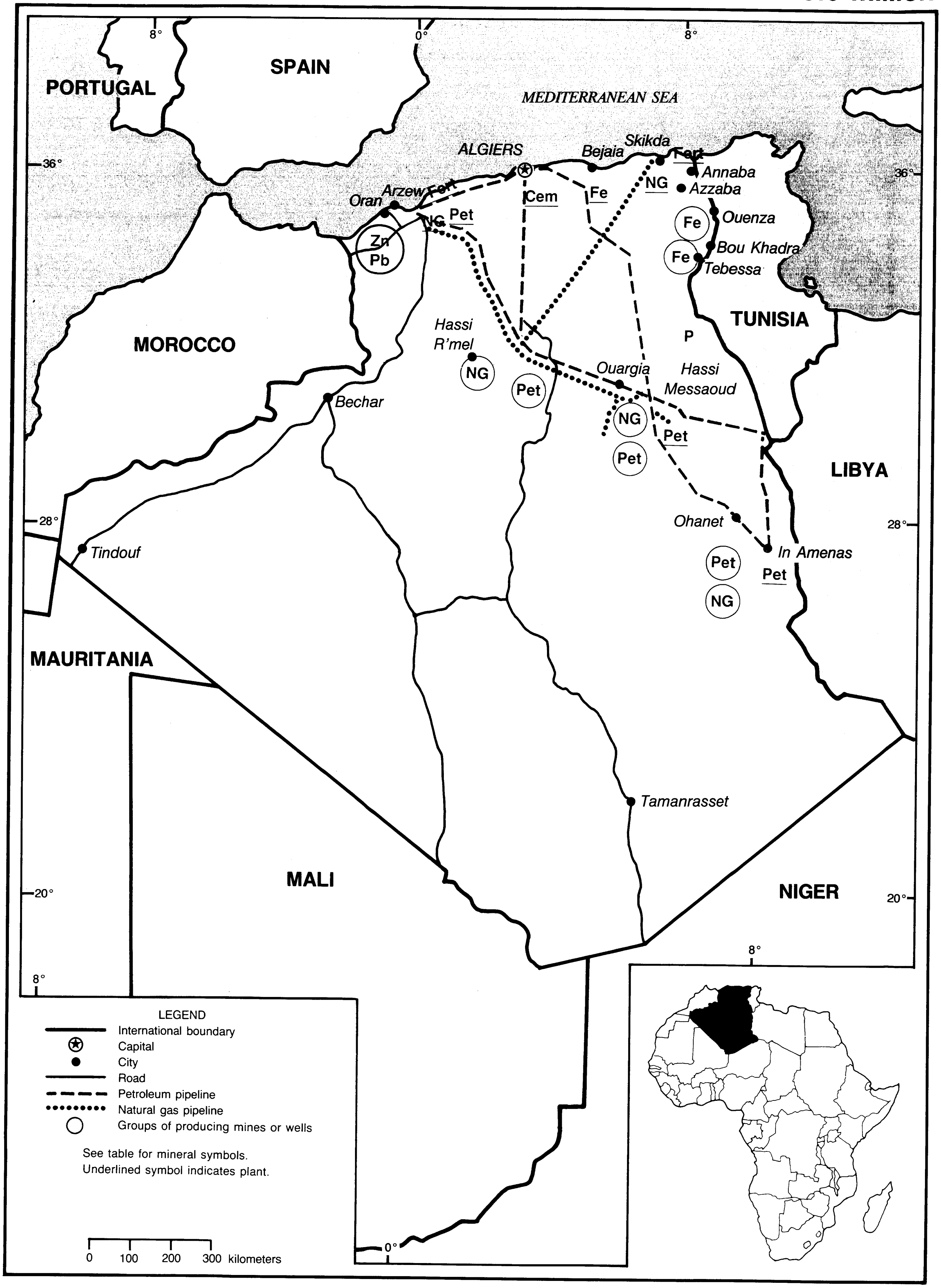
(Thousand metric tons unless otherwise specified)

	Aluminum	Cement	Chromite	Cobalt, mine (tons)	Copper, mine	Diamond (thousand carats)	Gold (kilograms)	Iron ore	Lead, mine	Manganese	Petroleum crude (thousand barrels)	Phosphate	Steel, raw	Uranium, (tons)	Zinc, mine
Mozambique	—	[e]80	—	—	88	—	—	—	—	—	—	—	—	—	—
Namibia	—	—	—	—	27	927	336	—	24	—	—	—	—	[e]4,100	42
Niger	—	27	—	—	—	—	—	—	—	—	—	—	—	3,013	—
Nigeria	—	3,500	—	—	—	—	—	[e]300	—	—	626,489	—	[e]200	—	—
Rwanda	—	[e]70	—	—	—	—	[e]10	—	—	—	—	—	—	—	—
Senegal	—	380	—	—	—	—	—	—	—	—	13	2,388	—	—	—
Sierra Leone	—	—	—	—	—	129	226	—	—	—	—	—	—	—	—
Somalia	—	[e]100	—	—	—	—	—	—	—	—	—	—	—	—	—
South Africa, Republic of	170	[e]8,700	4,575	[e]730	197	9,116	605,452	29,958	90	3,623	—	2,900	[e]8,900	3,456	90
Sudan	—	[e]150	25	—	—	—	650	—	—	—	—	—	—	—	—
Swaziland	—	—	—	—	—	55	—	—	—	—	—	—	—	—	—
Tanzania	—	540	—	—	—	[e]150	116	—	—	—	—	5	—	—	—
Togo	—	439	—	—	—	—	—	—	—	—	—	[e]3,500	—	—	—
Tunisia	—	3,228	—	—	—	—	—	280	3	—	37,595	6,610	[e]180	—	9
Uganda	—	14	—	—	—	—	—	—	—	—	([1])	—	—	—	—
Zaire	—	[e]470	—	[e]25,000	475	20,000	[e]2,032	—	—	—	9,779	—	—	—	[e]75
Zambia	—	386	—	[e]7,000	400	—	[e]225	([1])	[e]10	([1])	—	—	—	—	[e]25
Zimbabwe	—	719	627	90	16	—	16,003	1,143	—	—	—	134	650	—	—
Total Africa	611	46,995	5,290	33,156	1,231	48,099	649,194	59,957	198	6,526	1,955,730	36,189	12,768	11,616	273
Share of world total, percent	3.4	4.2	44.5	76.5	13.9	50.7	32.9	6.5	5.8	27.1	9	22.1	1.6	29.2	3.8
United States	4,030	71,700	—	—	1,498	—	265,500	59,000	419	—	2,778,745	49,817	88,810	6,210	288

[e]Estimated.
[1]Less than 1/2 unit.

ALGERIA

AREA 2,381,740 km² **POPULATION 25.6 million**



THE MINERAL INDUSTRY OF

ALGERIA

By Bernadette Michalski

Algeria's mineral industry included a diverse but modest production of metals; however, hydrocarbons remained by far the leading mineral sector, accounting for about 95% of total export earnings in 1989.[1] Reduced production from Algeria's depleting oilfields made investments in hydrocarbon exploration, production, and processing imperative. The Government launched an aggressive policy to develop and market hydrocarbons, particularly natural gas. Included in the Government's priority list was the development of the Haoud el Hamra Gasfield, the expansion of the infrastructure for natural gas exports, and the negotiation of long-term natural gas export contracts.

GOVERNMENT POLICIES AND PROGRAMS

The national 5-year plan covering 1990–94 emphasizes international cooperation in energy development and the removal of limitations on foreign equity. Within the timeframe of the national 5-year plan, the Oil Law of August 1986 was to be amended to remove the stipulation that the Government's hydrocarbon agency, Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures (SONATRACH), was to hold a 51% interest in all associations with foreign partners.

In February 1989, Algeria became a member of the newly formed Maghreb Union, which created an alliance of complimentary economies of Libya, Mauritania, Morocco, and Tunisia. It was believed that the Maghreb Union would afford the opportunity to negotiate on a common front with the European Community. About two-thirds of all the trade of the combined Maghreb Union nations is conducted with the European Community.

PRODUCTION

Algeria led the members of the Organization of Petroleum Exporting Countries (OPEC) cartel in natural gas production and exports and ranked sixth among the world's producers. Although petroleum production remains significant, the nation's more mature wells required gas reinjection to maintain pressures.

A variety of nonhydrocarbon minerals were produced in minor amounts, but only iron ore, mercury, and phosphate rock are produced on a significantly larger scale. The entire output of iron ore was consumed by the national iron and steel industry. Mercury was produced entirely for export, and production remained dependent on the price of this commodity in the world market. Phosphate rock production, essentially an export commodity, was reported at 350,000 tons of calcined phosphate and 900,000 tons of screened phosphate.

The decline in lead and zinc production was attributed to the temporary closure of the Kherzet Youcef Mine while shaft deepening operations were being carried out in 1989.

TRADE

Algeria's dwindling oil reserves prompted the Government to focus on marketing natural gas, condensates, and refined products. Total export earnings were estimated at $10 billion in 1989 with hydrocarbons contributing about $9.5 billion. This represented an increase of 25% over the total hydrocarbon revenues of 1988. The revenue improvement was partially attributable to a recovery in crude oil prices. The average spot price for Algerian Saharan Blend crude oil was $18.20 per barrel in 1989 compared with $15.15 per barrel in 1988. Increased revenues were additionally supported by the increase in natural gas exports. Algeria's adoption of a more flexible price

TABLE 1

ALGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[p]
METALS						
Cadmium, refined		128	124	102	55	46
Iron and steel:						
Iron ore, gross weight	thousand tons	3,776	3,360	3,380	3,118	2,700
Metal:						
Pig iron	do.	1,462	1,246	1,478	[e]1,700	1,700
Steel, crude	do.	1,245	1,120	1,378	1,400	1,400

See footnotes at end of table.

TABLE 1—Continued

ALGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[p]
METALS—Continued						
Lead, concentrate, Pb content[e]		3,800	3,600	3,600	3,500	3,200
Mercury	kilograms	92,900	758,400	758,400	690,000	586,000
Silver[e]	do.	3,700	3,700	3,700	3,000	3,000
Zinc:						
Concentrate, Zn content		13,500	16,500	13,000	12,000	11,600
Metal, smelter output		35,700	29,000	19,000	37,500	28,000
INDUSTRIAL MINERALS						
Barite, crude		60,000	60,000	45,000	43,000	45,000
Cement, hydraulic[e]	thousand tons	[3]6,096	[3]6,460	6,500	6,500	6,500
Clays:						
Bentonite		32,000	32,300	24,600	25,000	25,000
Fuller's earth[e]		3,500	3,500	3,500	3,500	3,500
Kaolin		13,000	14,200	16,000	17,800	18,000
Diatomite		2,600	4,000	3,300	[e]4,000	4,000
Gypsum[e 4]	thousand tons	250	275	275	275	275
Lime, hydraulic[e]		40,000	40,000	40,000	40,000	40,000
Nitrogen: N content of ammonia[e]		150,000	150,000	150,000	150,000	150,000
Phosphate rock	thousand tons	1,207	1,203	1,073	1,332	1,225
Salt	do.	168	190	233	237	240
Sodium compounds: Caustic soda[e]		700	700	700	700	700
Strontium minerals: Celestite, gross weight[e]		5,400	5,400	5,400	5,400	5,400
Sulfur, elemental[e]		20,000	20,000	20,000	20,000	20,000
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross	million cubic meters	100,320	97,300	110,910	109,903	[3]108,000
Dry[5]	do.	38,510	46,968	43,180	44,900	44,000
Natural gas plant liquids	thousand 42-gallon barrels	33,100	40,550	45,750	54,000	54,000
Petroleum:						
Crude	do.	234,095	248,675	239,200	236,800	[3]253,675
Condensate from oil and gas fields	do.	150,000	160,000	170,000	175,000	170,000
Refinery products:						
Gasoline	thousand 42-gallon barrels	15,300	14,600	15,700	16,000	16,000
Kersosene and jet fuel[e]	do.	5,100	5,100	5,475	5,500	5,500
Distillate fuel oil	do.	59,500	51,500	54,400	55,500	55,500
Residual fuel oil[e]	do.	42,700	40,000	40,500	41,200	43,000
Lubricants	do.	700	700	700	700	700
Other[e]	do.	[3]40,900	45,200	43,425	47,100	47,300
Total	do.	164,200	157,100	160,200	166,000	168,000

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Sept. 30, 1990.
[2]In addition to the commodities listed, secondary aluminum, secondary lead, and secondary copper may be produced in small quantities and crude construction materials presumably are produced for local consumption, but output is not reported, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.
[4]Includes approximately 50,000 tons of plaster each year.
[5]Excludes gas used in reinjection, flaring, venting, transmission losses, and natural gas liquids extraction.

system that linked the price of natural gas to the price of crude oil improved market accessibility. Total export volumes of natural gas increased by 10% over those of the previous year, attaining nearly 30 billion cubic meters in 1989. More than 17 billion cubic meters was exported as liquefied natural gas, and a total of nearly 13 billion cubic meters of natural gas was exported by pipeline to Italy and Tunisia. The bulk of natural gas exports were delivered to Western Europe. The largest consumer was Italy, which imported 11.4 billion cubic meters, followed by France at 9 billion cubic meters. Both Distrigas Corp. and Panhandle Eastern Corp. of the United States resumed deliveries of liquefied natural gas from Algeria. Deliveries in 1989 totaled 1,430 million cubic meters and 70 million cubic meters, respectfully. Revenues from natural gas exports are expected to increase appreciably as traditional and new export markets respond to Algeria's introduction of a realistic market-based pricing formula.

STRUCTURE OF THE MINERAL INDUSTRY

The Algerian Government controls all mining and mineral processing industries; however, the insistence on SONATRACH'S majority participation in all

TABLE 2

ALGERIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS				
Aluminum: Metal including alloys:				
Scrap	177	404	—	France 382; Italy 22.
Unwrought	—	185	—	All to Italy.
Copper: Metal including alloys:				
Scrap	1,760	6,158	—	Italy 2,738; France 1,693; Netherlands 1,000.
Unwrought	—	287	—	West Germany 155; France 132.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	60,591	20,585	—	Albania 16,105; Kampuchea 4,479.
Metal:				
Scrap	150,637	142,267	—	Spain 59,134; Italy 58,959.
Pig iron, cast iron, related materials	72,656	120,230	—	Italy 54,898; U.S.S.R. 35,591; Indonesia 17,205.
Steel, primary forms	73,241	156,596	—	Thailand 72,111; Italy 47,782; Tunisia 7,915.
Semimanufactures:				
Bars, rods, angles, shapes, sections	1,979	—		
Universals, plates, sheets	35,391	70,756	6,874	Thailand 14,757; Italy 11,312; United Kingdom 8,645.
Tubes, pipes, fittings	14,649	14,406	5,849	Libya 2,437; Belgium-Luxembourg 2,263; United Arab Emirates 2,031.
Lead:				
Ore and concentrate	3,471	5,303	—	Bulgaria 3,860; Morocco 1,443.
Oxides	—	1	—	All to Italy.
Metal including alloys, scrap	2,000	38	—	All to France.
Magnesium: Metal including alloys, scrap	2	6	—	Do.
Mercury	608	528	—	Netherlands 224; East Germany 112; West Germany 48.
Nickel: Metal including alloys, scrap	1	—		
Zinc: Metal including alloys:				
Scrap	656	—		
Unwrought	3,236	20,676	2,000	U.S.S.R. 4,788; Hungary 4,296; Netherlands 4,081.
Other:				
Ashes and residues	942	685	—	All to France.
Base metals including alloys, all forms	224	—		

See footnotes at end of table.

TABLE 2—Continued

ALGERIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones value, thousands	$1	$3	—	All to U.S.S.R.
Barite and witherite	1,000	17,500	—	U.S.S.R. 16,400; Albania 1,000.
Cement	150	3,599	—	Liberia 2,400; Spain 1,199.
Clays, crude	5,495	8,236	—	Iraq 5,925; Tunisia 2,040.
Diatomite and other infusorial earth	380	968	—	Tunisia 568; Iraq 400.
Feldspar, fluorspar, related materials	—	50	—	All to Tunisia.
Fertilizer materials: Manufactured				
Ammonia	63,101	79,766	7,988	Switzerland 30,406; Spain 23,801; Tunisia 7,608.
Nitrogenous	83,366	83,889	—	France 49,642; Egypt 9,805; Syria 6,560.
Graphite, natural	67	—		
Phosphates, crude	855,520	744,177	—	Romania 183,429; Austria 165,337; Turkey 66,263.
Salt and brine	4,942	9,202	—	Iraq 4,702; Mali 2,500; Benin 2,000.
Stone, sand and gravel: Dimension stone:				
Crude and partly worked	—	98	—	All to Italy.
Worked	6	20	—	All to Saudi Arabia.
Other: Slag and dross, not metal-bearing	—	2,617	—	All to France.
MINERAL FUELS AND RELATED MATERIALS				
Coke and semicoke	36,219	19,691	—	All to Tunisia.
Gas, natural:				
Gaseous million cubic meters	11,325	12,200	—	Italy 11,470; France 10,685; Belgium-Luxembourg 3,635.
Liquefied	13,595	17,200	480	Do.
Petroleum:				
Crude thousand 42-gallon barrels	183,996	196,315	48,426	Italy 26,462; France 21,674; West Germany 20,832.
Refinery products:				
Liquefied petroleum gas do.	27,945	44,800	9,524	NA.
Gasoline, motor do.	30,132	34,166	1,194	Netherlands 14,614; France 9,230.
Kerosene and jet fuel do.	1,715	743	155	Netherlands 298; Italy 147.
Distillate fuel oil do.	29,778	34,910	677	Netherlands 12,629; Japan 8,189; France 6,078.
Lubricants do.	10	2	—	Mainly to Belgium-Luxembourg.
Residual fuel oil do.	32,577	36,692	33,599	Francew 3,075.

NA Not available.
[1]Table prepared by Virginia A. Woodson.

hydrocarbon production contracts may no longer be pursued. Legislation liberalizing foreign equity participation was anticipated in the 1990–94 plan.

The Government has enacted legislation permitting multiple labor unions and a more flexible framework for managers to hire and fire employees and establish procedures for resolving labor disputes.

COMMODITY REVIEW

Metals

Aluminum.—The construction of a 220,000-ton-per-year capacity aluminum smelter in western Algeria was under consideration. The proposed $1 billion aluminum smelter would be a joint venture between the International Development Corp. of Dubai and Algeria. Production agreements and raw materials supply for the smelter would be guaranteed by the Switzerland firm of ABB Asea Brown Boveri.

Iron and Steel.—Raw steel output, reported at 1.4 MMmt tons annually, was

TABLE 3

ALGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS				
Alkali and alkaline-earth metals	27	5	—	West Germany 3; France 2.
Aluminum:	177	404	—	France 382; Italy 22.
Ore and concentrate	—	37	—	Mainly from France.
Oxides and hydroxides	187	253	—	West Germany 249.
Metal including alloys:				
Scrap	20	—	—	Italy 2,738; France 1,693; Netherlands 1,000.
Unwrought	7,665	7,946	—	West Germany 5,192; Netherlands 1,457.
Semimanufactures	13,812	10,228	4	Italy 4,196; France 2,301; Egypt 964.
Chromium: Oxides and hydroxides	44	111	—	U.S.S.R. 52; Netherlands 48; France 9.
Cobalt: Oxides and hydroxides value, thousands	$29	$4	—	Belgium-Luxembourg $2; Netherlands $2.
Copper:				
Matte and speiss including cement copper	—	1	—	All from United Kingdom.
Metal including alloys:				
Unwrought	418	298	—	France 142; West Germany 99; Italy 56.
Semimanufactures	24,496	22,258	3	Turkey 9,796; Belgium-Luxembourg 3,721; Spain 1,918.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	387	2,061	—	Netherlands 2,050; Canada 11.
Metal:				
Scrap	3	180	—	All from Italy.
Pig iron, cast iron, related materials	10,472	17,252	—	West Germany 7,180; Italy 4,709; Canada 3,216.
Ferroalloys:				
Ferromanganese	2,170	7,322	—	France 4,017; Spain 1,928; Norway 1,280.
Ferrosilicon	NA	5,687	—	Norway 5,239; France 165.
Unspecified	3,458	729	—	France 241; Brazil 200; United Kingdom 130.
Steel, primary forms	22,014	6,888	—	France 4,922; Italy 1,396.
Semimanufactures:				
Bars, rods, angles, shapes, sections	662,162	680,179	([2])	Austria 157,972; Turkey 128,630; Spain 61,536.
Universals, plates, sheets	76,917	87,219	—	West Germany 46,937; France 20,014; Belgium-Luxembourg 12,380.
Hoop and strip	6,856	7,115	1	France 4,376; West Germany 1,533; Italy 633.
Rails and accessories	24,745	5,545	—	France 3,875; United Kingdom 707; Austria 396.
Wire	33,914	27,246	—	Italy 6,746; Belgium-Luxembourg 6,110; Portugal 5,611.
Tubes, pipes, fittings	66,331	64,259	174	West Germany 17,381; France 13,888; Switzerland 10,719.
Lead:				
Ore and concentrate	6	—	—	Liberia 2,400; Spain 1,199.
Oxides	2,481	3,225	—	Italy 2,575; China 575.
Metal including alloys:				
Unwrought	16,214	10,350	—	West Germany 2,832; Italy 2,216; Belgium-Luxembourg
Semimanufactures	55	34	—	France 31; West Germany 2.
Magnesium: Metal including alloys:				
Unwrought	14	—		
Semimanufactures	21	—		

See footnotes at end of table.

TABLE 3—Continued

ALGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Manganese:				
Ore and concentrate, metallurgical-grade value, thousands	—	$2	—	All from France.
Oxides	1,799	1,260	—	Japan 750; West Germany 460.
Mercury value, thousands	$3	$11	—	West Germany $9; Switzerland $1.
Molybdenum: Metal including alloys, all forms do.	$32	—		
Nickel:				
Matte and speiss	3	8	—	All from West Germany.
Metal including alloys:				
Unwrought	1	1	—	All from France.
Semimanufactures	266	91	—	Spain 29; West Germany 24; France 17.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$24	$24	—	Switzerland $22.
Silver: Metal including alloys, unwrought and partly wrought do.	$2,025	$2,027	—	Belgium-Luxembourg $1,228; Austria $650; West Germany $86.
Tin: Metal including alloys:				
Unwrought	310	537	—	Malaysia 310; Brazil 100.
Semimanufactures	55	114	(2)	Italy 42; China 33; Belgium-Luxembourg 26.
Titanium: Oxides	9,791	7,517	—	West Germany 3,500; Belgium-Luxembourg 2,201; Australia 1,199.
Tungsten: Metal including alloys, scrap value, thousands	—	$3	—	All from Canada.
Zinc:				
Ore and concentrate	100,820	32,598	—	Peru 22,724; Canada 5,199; Sweden 4,675.
Oxides	578	345	—	Netherlands 121; Italy 80; China 70.
Metal including alloys, semimanufactures	587	384	—	Belgium-Luxembourg 321; Italy 62.
Other:				
Ores and concentrates	—	30	—	All from France.
Oxides and hydroxides	341	—		
Base metals including alloys, all forms	156	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	29,217	10,047	—	Greece 9,795; Italy 219.
Artificial: Corundum	382	374	—	Austria 175; Italy 140; France 42.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$68	—		
Grinding and polishing wheels and stones	218	205	—	Italy 129; France 41; Austria 21.
Asbestos, crude	18,260	17,047	(2)	Canada 12,938; Republic of South Africa 3,894.
Boron materials: Oxides and acids	36	207	—	Italy 115; Belgium-Luxembourg 55; Turkey 21.
Cement thousand tons	1,663	1,019	—	Tunisia 453; Greece 302; Spain 166.
Chalk	35,069	30,267	—	France 16,043; Spain 13,724.
Clays, crude	13,713	12,392	—	United Kingdom 9,509; France 2,193.
Cryolite and chiolite	(3)	42	—	Italy 20; Denmark 13.
Diamond, natural:				
Gem, not or strung value, thousands	—	$4	—	All from West Germany.

See footnotes at end of table.

TABLE 3—Continued

ALGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued				
Diamond, natural—Continued				
Industrial stones value, thousands	$247	$305	—	Zaire $210; France $58.
Diatomite and other infusorial earth	54	233	—	Spain 200; West Germany 25.
Feldspar, fluorspar, related materials	1,653	4,485	—	Turkey 2,285; Norway 750; West Germany 600.
Fertilizer materials:				
Crude, n.e.s. value, thousands	$1	—		
Manufactured:				
Ammonia	2	3	—	Austria 2.
Nitrogenous	18,227	19,968	—	West Germany 8,850; France 6,070; Spain 3,897.
Phosphatic	172,239	23,625	—	Turkey 21,611; Belgium-Luxembourg 2,000.
Potassic	102,681	99,155	4	Belgium-Luxembourg 39,962; West Germany 22,260; Spain 19,755.
Unspecified and mixed	53,790	17,570	—	Greece 16,642.
Graphite, natural	25	77	—	West Germany 73; Austria 4.
Magnesium compounds, unspecified	1,229	868	—	Austria 721; China 50.
Mica:				
Crude including splittings and waste	88	122	—	All from France.
Worked including agglomerated splittings	1	—		
Phosphates, crude value, thousands	—	$8	—	All from France.
Pigments, mineral: Iron oxides and hydroxides, processed	3,084	2,183	—	China 1,326; Belgium-Luxembourg 420.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	—	$9	$2	West Germany $7.
Synthetic do.	$2	$171	—	All from Switzerland.
Pyrite, unroasted	35	4	—	All from West Germany.
Salt and brine	283	57	—	West Germany 44; France 12.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	32,178	34,930	—	Italy 18,003; France 11,796.
Sulfate, manufactured	15,069	33,516	—	Italy 9,499; Libya 8,917; Belgium-Luxembourg 8,636.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	50	34	—	All from France.
Worked	1	—		
Dolomite, chiefly refractory-grade	510	2,207	—	Albania 1,000; France 500; Spain 478.
Gravel and crushed rock	103,010	43,905	—	Italy 38,168; Greece 5,426.
Quartz and quartzite	18	1	—	Mainly from West Germany.
Sand other than metal-bearing	33	5,914	—	Belgium-Luxembourg 5,003; West Germany 900.
Sulfur:				
Elemental:				
Crude including native and byproduct	126,888	80,020	—	France 75,020; Spain 5,000.
Colloidal, precipitated, sublimed value, thousands	$1,238	$1	—	All from France.
Sulfuric acid	2,317	71	([2])	Netherlands 60; France 9.
Talc, steatite, soapstone, pyrophyllite	957	1,835	—	Spain 1,519; France 315.
Other: Crude	40	428	—	Turkey 400; France 25.

See footnotes at end of table.

TABLE 3—Continued

ALGERIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988	
				United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		—	1,000	—	All from France.
Carbon black		2,226	3,334	—	West Germany 1,732; France 557; Spain 477.
Coal:					
Anthracite and bituminous	thousand tons	1,371	1,305	727	Australia 400; Poland 150.
Briquets of anthracite and bituminous coal		59	43	—	All from France.
Coke and semicoke		53,000	9,768	—	All from Yugoslavia.
Peat including briquets and litter	value, thousands	$130	—		
Petroleum refinery products:					
Liquefied petroleum gas	42-gallon barrels	35	—		
Gasoline, motor	do.	([4])	4,148	—	France 2,584; Belgium-Luxembourg 1,292.
Mineral jelly and wax	do.	32,834	166,065	—	Spain 83,997; West Germany 81,533.
Kerosene and jet fuel	do.	([2])	91,132	—	Italy 78,074; Belgium-Luxembourg 12,284.
Lubricants	do.	294,861	635,467	70	Spain 526,071; Belgium-Luxembourg 38,563.
Bitumen and other residues	do.	415,801	310,672	—	Spain 195,465; Austria 92,167.
Bituminous mixtures	do.	95,269	50,407	545	France 29,258; Austria 19,986.

NA Not available.
[1]Table prepared by Virginia A. Woodson.
[2]Less than 1/2 unit.
[3]Unreported quantity valued at $10,000.
[4]Unreported quantity valued at $222,000.

TABLE 4

ALGERIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodities	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Cement	Enterprise des Ciments et Derives de L'Est (Government, 100%)	Setif, near Bejaia Batna, 60 kilometers south of Skikda Constantine, west of Skikda	1,000,000. 1,000,000. 1,000,000.
Do.	Enterprise des Ciments et Derives de L'Quest (Government, 100%)	3 plants at Oran	2,900,000.
Do.	Cimenterie de Oued Sly (Government, 100%)	El-Asnam, 80 kilometers west of Algiers Djelfa	2,000,000. 500,000.
Do.	Entreprise des Ciments et Derives du Centre (Government, 100%)	Blida, 5 kilometers southwest of Algiers Bouira, near Algiers Algiers	1,000,000. 1,000,000. 500,000.
Fertilizer	Entreprise Nationale des Engrais (Asmidal) (Government, 100%)	Arzew	495,000 ammonium nitrate. 660,000 ammonia. 132,000 urea. 395,000 nitric acid.
Do.	do.	Annaba	330,000 ammonium nitrate. 330,000 ammonia. 254,000 nitric acid. 495,000 sulfuric acid. 165,000 phosphoric acid. 550,000 compound fertilizers.
Iron ore	Entreprise Nationale de Fer et de Phosphates (Government, 100%)	Ouenza and Bou Khadra	4,000,000.

See footnotes at end of table.

TABLE 4—Continued

ALGERIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodities	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Mercury	Entreprise Nationale des Nonferreux et Substances Utiles (Government, 100%)	Azzaba	4,000.[2]
Natural gas	Societe Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures (Government, 100%)	Hassi R'Mel and Hassi Messaoud natural gas gathering center	112,000.[3]
		Liquefaction plants at Arzew	22,900.[3]
		Liquefaction plant at Skikda	7,900.[3]
Natural gas liquids	do.	Hassi R'Mel	200.[4]
Petroleum:			
Crude	do.	Hassi-Messaoud and others (El Borma, Al Agreb, Amassak, Tabankort, Nezla North, Haoud Berkaoui, Zemlet Ennous, Zarzaitine, Rhourde El Baguel, Edjeleh, Tin-Fouye and others)	1,200,000.[5]
Do.	Total, Compagnie Francaise des Petroles (French Government, 34.1%; Abu Dhabi Investment Authority, 8.4%; Caisse des Depots et Consignations, 5.2%; other diverse shareholders, 52.3%).	Mereksen	5,500.[5]
Refinery products	Enterprise Nationale de Raffinage des Produits Petroliers (Government, 100%).	Refinery at Skikda	323,000.[5]
		Refinery at Arzew	60,000.[5]
		Refinery at El Harrach, near Algiers	58,000.[5]
		Refinery at Hassi Messaoud	23,700.[5]
		Refinery at In Amenas	6,500.[5]
Iron and steel	Entreprise Nationale de Siderurgie (Government, 100%).	El Hadjar, near Bejaia	1,500,000.

[1]Metric tons per year unless otherwise specified.
[2]Kilograms per year.
[3]Million cubic meters per year.
[4]Million barrels per year.
[5]Barrels per day.

produced at the Entreprise Nationale de Siderurgie's El Hadjar steel complex, the nation's sole steelworks. Blast furnace modernization requiring a 3-month shutdown was scheduled for mid-1990.

Site preparation for the 2-million-ton-per-year capacity Bellara steel complex, east of Algiers, was completed by Algerian firms. Bids for the complex were invited in three lots: direct-reduction process plant, scrap yard, and harbor installations; electric arc furnace with continuous casting, water-treatment plant, and electrical distribution network; and maintenance shop, stockyard, and repair area. No contracts had been made for the $3 billion complex as of mid-1990.

Iron Ore.—The bulk of Algeria's iron ore output was extracted from the mine at Ouenza. Mining operations were spread over 17 square kilometers (km^2) with the main seam 2 kilometers (km) long and 500 meters wide. Production totaled 2.7 MMmt of hematite ranging from 53% to 60% iron content. Removal of 5.6 million tons of overburden was required.

Iron ore was also mined at Bou Khadra and shipped with Ouenza ore by rail to the El Hadjar processing plant, near Bejaia, a distance of 170 km. Both mines are operated by Entreprise Nationale de Fer et de Phosphates.

Mercury.—Algeria was a significant world producer of mercury, supplying about 10% of the world's total output. Entreprise Nationale des Nonferreux et Substances Utiles reported the average production cost of mercury in Algeria at $300 per flask. The price of mercury on the New York market in 1989 ranged from $285 to $300 per flask.

Industrial Minerals

Cement.—Société Nationale des Matriaux de Construction controls the production of all construction materials, including cement, bricks, and concrete forms. Four regional enterprises control cement production and produce about 6.5 MMmt annually. However, cement shortages continued.

Phosphate Rock.—Production was derived from the Djebel Onk openpit mine 330 km south of Annaba and 22 km from the Tunisian border. Operated by Entreprise Nationale de Fer et de Phosphates, the deposit site covers 2,100 km^2 and produced 1.2 MMmt of processed phosphate. To produce this amount, the mine handles nearly 3 MMmt of overburden and nearly 3 MMmt of phosphate-bearing material. The latter is processed by either wet or dry methods. Water is supplied to the plant at a rate of 300 cubic meters per hour through a 90-km-long pipeline. Both mine and plant were in virtually continuous operation. About one-third of the output was utilized at the

Annaba fertilizer complex, and the remainder was exported principally to Romania, France, and Spain.

Mineral Fuels

Natural Gas.—Gross production of natural gas was 108 billion cubic meters, about 5% was flared, and nearly 50% was reinjected to maintain petroleum reservoir pressure. Liquefaction of natural gas for the export market averages about 90,000 cubic meters per day. The gas liquefaction complexes, three at Arzew and one at Skikda, are operating well below the design capacity because of disrepair and lack of funds for replacement parts. Contractors for the overhauling and upgrading projects at the complexes were Bechtel Corp. and M W Kellogg Co. of the United States and Sofregas of France.

Petroleum.—Exploration.—Exploration agreements based on the amended 1986 Hydrocarbons Code have been finalized with Azienda Generali Italiana Petroli S.p.A. (AGIP), Compania Espanola de Petroleos (Cepsa), the Broken Hill Pty. Ltd. (BHP), Anadarco Petroleum Corp. of the United States, and an international consortium. The consortium is headed by Total CFP, which holds 55% interest, with Repsol Exploration holding 25%, and the Kuwait Foreign Petroleum Exploration Co. holding 20%. Agreement terms included a 50-50 split in development costs. Production is to be shared on a 35-65 basis in SONATRACH'S favor for production up to 15,000 barrels per day (bbl/d). SONATRACH's share rises to 87.5 for production in excess of 75,000 bbl/d.

AGIP activity was centered in block 403 about 725 km south of the Mediterranean coast and 208 km west of Tunisia. Development work on AGIP's Rom discovery includes construction of a pipeline from the field to the coast. Production startup was expected by late 1990 and was expected to reach an optimum production level of 30,000 bbl/d.

BHP conducted exploration in the Rhourde-el-Lough and Sif Fatima blocks of the Ghadones Basin. SONATRACH'S exploration in the Erg region resulted in a discovery at Rhourde-El-Rouni east of Hassi Messaoud.

Anadarco Petroleum Corp.'s exploration and production-sharing agreement covers 7,300 km^2 near the Tunisian border.

Production.—Crude oil production averaged 710,000 bbl/d, an increase of 6.5% over 1988 levels, well below the 667,000-bbl/d quota assigned by OPEC. Most of the production was derived from Hassi Messaoud-Haoud el Hamra Fields in the Sahara, the Zarzaitine-Edjeleh Field near Ohanet, and In Amenas near the Libyan border. Field condensate production, excluded from OPEC quotas, averaged 470,000 bbl/d.

Refining.—SONATRACH operated four refineries with a combined distillation capacity of 465,000 bbl/d and a catalytic reforming capacity of 56,000-bbl/d. Refined product output averaged more than 460,000 bbl/d.

Reserves

Hydrocarbon reserves as reported by the Energy Ministry in January 1989 totaled 3.25 trillion cubic meters of natural gas. Unassociated natural gas accounted for 85% of these reserves. Petroleum reserves were reported at 9.24 billion barrels of light, low-sulfur crudes.

Iron ore reserves were reported at 35 MMmt averaging 53% Fe; however, an estimated 970 MMmt of 53% Fe content ore was identified at the undeveloped Gara Djebilit deposit.

INFRASTRUCTURE

Natural gas was pumped from Hassi R'Mel by pipeline to the Mediterranean ports of Arzew and Skikda. Nine lines carried dry gas. Four lines carried condensates and LPG. A gasline network totaling 1,500 km transported natural gas from Alrar, Rhourde Nouss, and Gassi Touil to Hassi Messaoud and Hassi R'Mel.

The delivery of Algerian natural gas to Libya and Tunisia was facilitated by a protocol signed in March 1988 creating the Société Transmaghrebine de Gas Natural. The firm is responsible for the construction and operation of a 415-km natural gas pipeline from the junction of the Transmed pipeline from Oued-Saf-Saf at the Algerian-Tunisian border to Zuwara, on the Libyan coast. The proposed pipeline linking Algeria to Spain via Morocco and the Straits of Gibraltar was nearer to realization with the signing of an agreement providing for the construction of the 2,000 km-long Algerian-Moroccan portion scheduled for completion in 1995.

OUTLOOK

The Government took signifiant steps towards economic reform in 1989 by granting managerial autonomy to many state-owned industries. Import monopolies were disbanded by liberalizing foreign currency allocation procedures for imports.

The nation's financial situation remained heavily dependent on movements in oil prices. The impact of the Gulf crisis on oil prices should increase export earnings and possibly push the balance of payments current account into a small surplus.

According to the Algerian Ministry of Mines, by 1994, exports of natural gas are expected to exceed 57 billion cubic meters, nearly doubling the 1989 level.

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[1]Where necessary, values have been converted from Algerian dinars (DA) to U.S. dollars at the rate of AD7.6086 = US$1.00.

OTHER SOURCES OF INFORMATION

Ministry of Mines
80 Avenue Ahmed Ghermoul
Algiers
Algeria

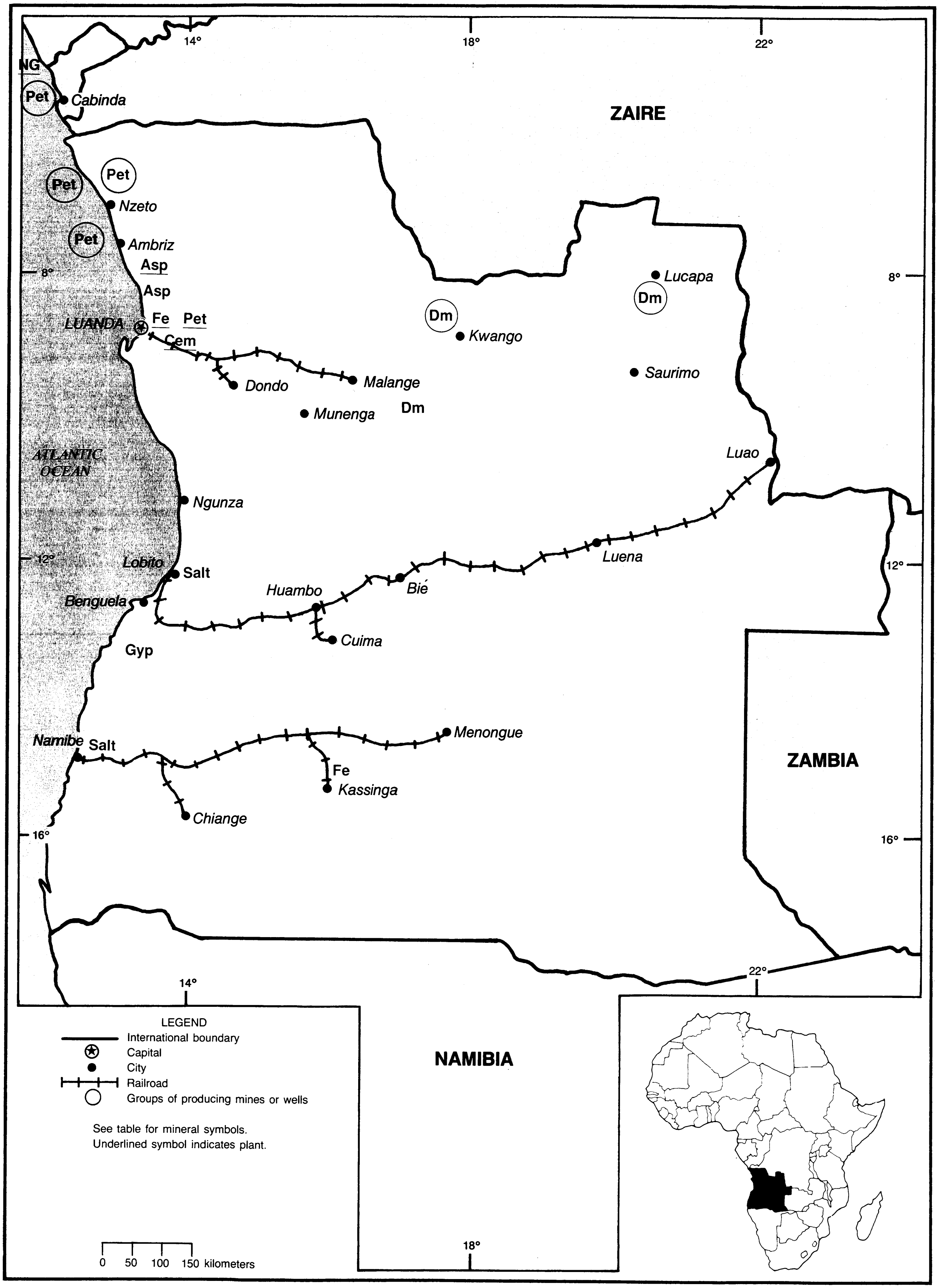
Ministry of Industry
Le Colise Rue Ahmed-Bey de Constantine
Algiers
Algeria

Société Nationale des Matriaux de Construction
90 Rue Didouche Mourad
Algiers
Algeria

Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures
10 Rue du Sahara, Hydra
Algiers
Algeria

ANGOLA

AREA 1,246,700 km² **POPULATION 8.5 million**



THE MINERAL INDUSTRY OF

ANGOLA

By Audie L. King

In 1989, the petroleum industry continued to dominate the Angolan economy. Crude oil production accounted for more than 50% of the country's gross national product (GNP) and about 95% of Government revenues. Crude oil production rose by less than 1% over the previous year's levels after having increased by about 27% between 1987 and 1988. The Government, in an effort to prop up prices, entered into an agreement with five other independent oil-producing nations to reduce its output. Production decreased by about 100,000 barrels during the first half of the year. This was a major departure from the Government's past policies that called for the production of as much petroleum as possible to support its war efforts. Military expenditures have accounted for about 40% of Government spending.

Diamonds continued to be the only major mineral commodity mined in the country. Diamond mining accounted for nearly 5% of the GNP. Estimated production increased for the seventh consecutive year to more than 1.2 million carats. This was still less than one-half of the production level achieved before the civil war began in 1975. Empressa Nacional dos Diamantes Endiama, the state diamond mining company, set the stage for further production increases by agreeing to reenter De Beers' diamond cartel in return for development work on the nation's large, diamond-rich, kimberlite deposits.

Although Angola had a large and diversified mineral resource potential, war continued to hamper the mineral industry's expansion. In December 1989, fighting intensified, resulting in further damage to the nation's battered infrastructure.

GOVERNMENT POLICIES AND PROGRAMS

In preparation for membership in the International Monetary Fund and the World Bank, the Government had begun to liberalize its economic policies and move to a more market oriented economy. Part of this reform affected the mining laws that had been in effect since 1979. Although the Government continued to consider all mineral resources to be property of the state, new laws allowed foreign companies to participate in exploration. The provision in the law requiring foreign companies to accept 51% Government ownership had also been removed from the laws. This effectively allowed the mining industry to enjoy the same freedom of operations that the highly successful petroleum industry had enjoyed for many years. To oversee the changes in the mining laws, a temporary commission was formed that would oversee the formation of a new Ministry of Mines. Since Independence, the Geological Survey Department and the National Department of mines, which controls the state mining companies, had been under the Ministry of Industry.

Other reforms would free price controls that had caused the cost of goods on the parallel market to be more than 60 times that of regulated prices. The banking industry would be revamped to encourage foreign investment, make international business transactions easier, and to lessen the importance of foreign currency in Angola's domestic economy. The country's finance minister hoped that foreign investment would increase in the mineral industry, as well as in fishing, agriculture, and transportation.

PRODUCTION

Despite the continuation of the war, the production of most mineral commodities was estimated to have increased during 1989. Petroleum production was up for the seventh straight year. It, however, increased by less than 1% in 1989 compared with more than a 25% increase in 1988. Angola was one of six non-OPEC oil-producing nations that agreed to reduce its output by about 5% during the first half of 1989 to prop up world prices.

Diamond production increased sharply for the third consecutive year. UNITA accounted for part of the production increase. It operated three barges on the Kwanza River near Kwango and produced 45,000 carats during the year, which it reportedly sold to De Beers under contract.

The iron ore mine at Kassinga, which closed in 1973, was being maintained in preparation for reopening when the market improves and the link to the Benguela railway is restored.

Clay, granite, marble, and quartz were reported to be mined at a number of localities throughout the country, but information on production and mine locations is sparse and unreliable.

TRADE

Petroleum products accounted for more than 90% of Angola's export earnings. Diamond exports accounted for most of the rest of the country's exports. Angola also exported minor quantities of coffee and timber. About 90% of exports was taken by the United States, nearly all of which was petroleum. Other recipients of Angolan exports included, in approximate order of importance, Brazil, Spain, Portugal, and the United Kingdom.

Angola's principle imports were food, clothing, instruments and optical goods, paper, unspecified minerals, chemicals, plastics, metals, and electrical and transport equipment. Excluding military sales, the main suppliers were, in approximate order of importance: the U.S.S.R., Portugal, France, the United States, and Brazil.

STRUCTURE OF THE MINERAL INDUSTRY

Despite the fact that the Angolan economy was dominated by state enterprises, foreign private industry played a key role in the Angolan petroleum industry. These

TABLE 1

ANGOLA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
Asphalt and bitumen, natural	metric tons	[r]8,000	[r]10,000	11,000	13,000	13,000
Cement, hydraulic[e]	thousand metric tons	350	350	350	1,000	1,000
Diamond:[3]						
Gem[e]	thousand carats	464	240	675	950	1,167
Industrial[e]	do.	250	10	75	50	78
Total	do.	714	250	750	1,000	1,245
Gas, natural: Gross[e]	million cubic meters	[r 4]3,441	[r 4]3,917	4,780	6,297	6,353
Gypsum[e]	metric tons	20,000	20,000	20,000	57,000	57,000
Iron and steel:[e]						
Iron ore	do.	—	—	—	([5])	—
Steel, crude[e]	do.	10,000	10,000	10,000	10,000	10,000
Natural gas plant liquids, propane and butane	thousand 42-gallon barrels	2,630	2,320	2,900	2,900	3,310
Petroleum:						
Crude	do.	89,060	102,930	131,190	165,000	167,000
Refinery products	do.	[r]7,655	[r]9,855	9,490	9,450	9,480
Salt[e]	metric tons	[r]50,000	[r]55,000	60,000	70,000	70,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Jan. 22, 1991.
[2]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and broken stone) presumably is produced for local consumption, but information is inadequate to make reliable estimates of output levels.
[3]Does not include smuggled artisanal production.
[4]Reported figure.
[5]Revised to zero.

private oil companies operated on the basis of joint ventures or production-sharing agreements with Sonangol, the state run oil company.

Diamonds were mined by Endiama, which like the petroleum companies, was considered an Enclave enterprise. Enclave enterprises were free from most Government oversight and regulation.

All other minerals were mined or processed by Government enterprises. State companies were formed that were responsible for mineral deposits that were not being mined but were potentially valuable. For example, Fosfang was accountable for a large phosphate deposit in northwestern Angola. Ferrangol, another state company, intended to bring the Cassala-Kitunga iron ore mine near Kassinga into operation.

COMMODITY REVIEW

Industrial Minerals

In 1989, Angola was the fifth largest diamond producer among the world's market economies after Australia, Zaire, Botswana, and the Republic of South Africa. Estimated production increased to 1.2 million carats in 1989, up from about 1 million carats in 1988. The civil war still caused Angola to produce well below the its potential. Before the war, the country was producing nearly 2.5 million carats. Endiama was the only legal mining company. The state company had full rights to mining and marketing diamonds in Angola. Endiama's main source for diamonds was in the Kwango area where it had a mining contract with Rio Tinto Zinc RTZ. At the end of 1989, another contract was announced with the Portuguese state company, Sociedade Portuguesa de Empreendimentos SPE, to mine alluvial deposits in the Lucapa area. Under a 2-year contract, SPE would also explore a 700-square-kilometer area. It was hoped that at the end of the 2-year contract SPE and Endiama would form a joint venture for the further exploration of diamonds in Angola.

The diamond mining areas were not well protected, and the transport routes were dangerous. Key supplies of fuel and equipment had to be flown in. Working conditions remained hard with little food or other consumer goods. Theft, smuggling, and illicit digging continued to be a problem, and it was estimated that more than $50 million was smuggled over the Zaire border to the buying offices in Tshikapa or through Lisbon.

Endiama and De Beers agreed to reestablish their relationship. About 80% of the world's diamonds were sorted and sold by De Beers Central Selling Organization (CSO), which had sales of about $4.1 billion in 1989. Angola was the only major diamond-producing country to independently market its diamond production. Angola had been marketing its diamond output independently since 1985, when De Beers pulled out of the country because of the civil war. Endiama had maintained a system of marketing that entailed monthly and bimonthly tenders in Luanda, where a group of 14 invited dealers competed for the production output. Some of the dealers had contracts that extended through 1989. From early 1990, however, Angola expected to market a significant portion of its output through CSO. When output increases, it is expected to move toward an exclusive marketing arrangement. De Beers would begin to market diamonds mined in the Kwango region, which amounted to about 75% of the country's output of 1.2

TABLE 2

ANGOLA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity
Cement	Empresa de Cimento de Angola (Cimangola) (Government, 100%)	Luanda	e 1 1
Diamond	Empresa Nacional dos Diamantes (Endiama) (Government, 100%)	Luanda Norte Province, Kuango and Lucapa areas	e 2 1
Petroleum, crude	Cabinda Concession (Chevron-operator, United States, 39.2%; Sociedade Nacional de Combustiveis (Sonangol), Angola, 51%; Agip S.p.A., Italy, 9.8%)	Offshore Cabinda	e 3 75
Do.	Block 2 Concession (Texaco-operator, United States, 20%; Sonangol, Angola, 25%; Total CFP, France, 27.5%; Petrobras, Brazil, 27.5%)	Offshore Zaire Province between the Zairian border and Nzeto	e 3 15
Do.	Block 3 Concession (Societe National ELF Aquitaine (ELF)-operator, France, 50%; Mitsubishi, Japan, 25%; Agip S.p.A., Italy, 15%; INA-Naftaplin, Yugoslavia, 5%; Naftagas, Yugoslavia, 5%)	30 kilometers off the coast, near Nzeto	e 3 45
Do.	Block B Concession (Petrofina S.A. (Fina)-operator, Belgium, 49%; Sonangol, Angola, 51%; Texaco, United States, 16.4%)	Onshore, about 50 kilometers south of the Zairian border, near the coast	e 3 15
Petroleum, refined	Fina Petroleos de Angola (FPA) (Petrofina S.A. (Fina), Belgium, 40%; Government, 60%)	Luanda	3 12
Iron and steel	Sidewrurgia Nacional (Government, 100%)	do.	4 30,000

e Estimated.
1 Million metric tons per year.
2 Million carats per year.
3 Million barrels per year.
4 Million tons per year.

million carats in 1989. De Beers would also supply Endiama with a $50 million loan to increase production in the Kwango area and an additional $50 million during the next 5 years to develop other deposits. It was also anticipated that De Beers would develop the very large kimberlites in the Lucapa area. At least five diamond pipes were to be explored in the Lucapa area. Three pipes, including the largest one called Catoca, were among the largest kimberlite pipes in the world. Detailed discussions and technical studies were underway, and the overall cost to develop the deposit was not known. Production was not expected to start until the mid-1990's, but the declaration of intent opened up the prospect of Angola becoming one of the world's top producers in value and volume terms. Revenue from diamond production could reach $500 million to $1 billion per year after the kimberlite pipes were developed. In return for its help in exploiting this potential, De Beers expected to resume its role of marketing Angolan diamond production and thus increase its control over the world market. It was also reported that Endiama was negotiating with the U.S.S.R. for the bulk sampling of the Catoca deposit near Lucapa. Catoca was the most promising of the undeveloped kimberlite deposits.

UNITA reported diamond sales of 45,000 carats in 1989, earning $14 million. UNITA hoped to triple production in 1990. Alluvial mining occurred at several locations along the Kwanza River. About 33% of the production was of industrial quality and 67% was of gem quality. The production was sold to De Beers under an agreement signed in 1988.

The Angolan Government ask Endiama to present an emergency plan to safeguard the diamond mines along the Kwango River in northeastern Angola that were threatened by continuing heavy rains.

Mineral Fuels

Angola trimmed production by 5% during the second quarter of 1989. Angola was one of six independent oil producers that agreed to reduce production to stabilize world prices. It stepped up production slightly during the second half of 1989 to a yearend total of about 167 million barrels of crude oil. This was less than a 1% increase over 1988 production levels.

Texaco made a discovery at the Tamboril-1 well, 4 kilometers (km) south of the Sulele Field and some 28 Km offshore in Block 2. The field tested at 6,100 barrels per day. It also struck oil at the Bagre-1 well 7 miles offshore in Block 2. It flowed at more than 13,488 barrels per day. Oil was also found at the Cobo-1 well in Block 3, 9 km southeast of the Pacassa well, about 60 km offshore near Nezeto. It flowed 28,000 barrels per day.

Of Angola's 14 demarcated offshore blocks, 3 were in production: the Cabinda Concession and blocks 2 and 3. Three of the other blocks, designated 1,4, and 5, were being explored. Blocks 6, 7, and 8 were allocated to foreign investors after a promotional meeting held by the Government in mid-1989. Sonangol was expected to offer the five southern blocks, designated 9 through 13, under a similar production-sharing agreement used off Cabinda and the other blocks. The foreign investors would assume the risks of exploration for a share of the profits if the block was commercially successful. Blocks 9 through 13 extend south from

Ngunza to the border with Namibia. Interest in the area was high because of similarities between the geology of the area to that of the oil-rich Campos Basin in Brazil. Negotiations were also underway for the north and central onshore areas in Cabinda. Chevron Co.'s predecessor, Gulf Oil Corp., made many oil and gas finds in the same area before Angola's independence in 1975, when the civil war forced it to relinquish its concession. Block 6 was awarded to a group formed by Conoco Inc., 60%; Union Oil Co. of California, 25%; and Cie Française des Pétroles (Total), 15%. In 1989, Elf Aquitaine Ltd. (Elf) invited Petrobrás Internacional SA to take a 7% share in Block 7. Elf is the major shareholder in the operation with 45%. Norsk Hydro AS has 13%, Mitsubishi Petroleum Development Co. Ltd., 10%; OMV AG, 10%; British Gas Corp., 7.5%; and Enterprise Oil plc., 7.5%. Block 8 went to a group comprising Total, 40%; Petrofina SA, 40%; and British National Oil Co., 20%.

Reserves

Despite increased oil production throughout the 1980's, Angola had been able to maintain a reserves to production ratio that would indicate reserves of about 2 billion barrels. Proven natural gas reserves were reported to be 2,100 billion cubic feet. It was estimated, however, that resources exceeded 5,000 billion cubic feet.

According to Government estimates, Angola had proven diamond reserves of about 82 million carats in deposits grading a minimum of 0.6 carats per cubic meter. About 50 million carats of these diamonds occurred in kimberlites that had not yet been commercially mined. Estimates of the inferred reserve base were about 350 million carats.

The Kassinga iron ore deposit, which was mined from 1968 to 1973, had 100 million tons of proven reserves that graded more than 63% iron. An additional 1 billion tons of ore that graded between 35% and 63% iron was indicated. Ferrangol also claimed to have extensive iron deposits 70 km northeast of Dondo in Kwanza North Province. Ferrangol also had a potentially commercial manganese deposit about 150 km east of Dondo.

Reserves of about 10 million tons of commercial-grade phosphate ore had been proven at Kindonacaxa near Nzeto in Zaire Province. A 15,000-ton-per-year pilot plant that had operated in 1981 showed that the crushed phosphates produced were suitable for domestic consumption. The possibility of using the ore to produce phosphoric acid in the future was still being investigated by the Angolan phosphate company (Fosfang). The deposit had not yet been mined because of war related transport difficulties. There were also large phosphate deposits in Cabinda Province at Mongo-Tando, about 45 km north of Cabinda.

Resources were known to exist for asphaltic coal, barite, bauxite, beryllium, copper, gold, granite, gypsum, kaolin, lead, marble, mica, quartz, rare earths, talc, tungsten, uranium, and zinc.

INFRASTRUCTURE

The basic infrastructure in Angola was developed before independence in 1975. It consisted of a northern, central, and southern rail-port system with a feeder road network. The rail system consisted of 2,879 km of 1.067-meter gauge and 310 km of 0.600-meter gauge tracks. Most of the route was damaged in the past 15 years of civil war, and the undamaged sections were too dangerous to use extensively. Trains that did run routinely pushed a ballast car in front to absorb the blast of explosives that were often placed on the tracks. Most of the railroads' physical assets had fallen into disrepair or had been destroyed by rebel attacks. Overall freight shipments had fallen to a small fraction of what they were before independence. The flow of goods had also reversed, with imports dominating the freight business.

Belgian engineers were planning to reopen the Benguela railroad that was once the main transport system for central Africa. The project would cost $572 million and would be completed by the late 1990's. Survey work involving the entire 1,350 km of track was to have begun at yearend 1989 but was believed to be interrupted by further military action. The port city of Lobito at the end of the railway would become the primary terminal for regional trade. This project is especially important to Zaire, a leading producer of copper and cobalt. It once transported one-half of its trade on the Benguela line. The Southern African Development Coordination Conference and a group of Western and Arab donors decided to proceed with the reopening of the Benguela. They pledged $93.8 million to proceed with most of the initial stages of the project. Under the plan, the railroad, which was 90% owned by a London-based subsidiary of the Belgian conglomerate Societe Generale de Belgique and 10% owned by the Angolan Government, would change ownership to allow for easier financing. The Angolan Government would operate the physical assets while the rest of the company would be owned by the Governments of Angola, Zaire, and Zambia. Eventually Societe Generale's stake would be reduced to about 20%.

Angola had about 73,828 km of roads, 8,577 of which was paved. The road system however has not been maintained since independence and was in severe need of repair. It was estimated that more than 200 bridges and 5,400 km of paved roads needed rehabilitation or reconstruction.

Air transport, which was considerably safer than any type of ground transportation, had grown consistently since 1975.

The total installed capacity of Angola's electrical supply system was about 463 megawatts in 1987, the last date that these data were available. Of this total, only 59% was available because much of the system had fallen into disrepair since 1974 when Angola's power generation peaked at 1,029 gigawatt hours. Following independence the nation's demand for power fell dramatically and has since recovered to about 750 gigawatt hours. In 1986, Angola generated 754 gigawatt hours of electricity, 97.6% of which was from hydroelectric plants.

Work on the 520 megawatt Capanda hydroelectric project continued in spite of the fact that the country's present power-generating capacity far outstripped its projected demand. Brazil's Construtora Norbeto Odebrecht was the main contractor for the Capanda scheme. The company was the lead partner in Consortio Capanda, a joint venture also including Technopromoexport of the U.S.S.R. and Furnas Centrais Electricas (FCE) of Brazil. Odebrecht was responsible for 70% of the project work, including technology transfer and civil engineering. Technopromoexport was handling the survey work and mechanical engineering, including the supply and installation of four 133-megawatt turbines. FCE was providing training and technical assistance for the scheme. Work at the dam site 148 km southeast of Luanda began in December 1986. It was still on schedule for the first turbine to open in December 1992. The remaining three turbines would be on-line by 1994. The Kwanza River was diverted through a 320-meter-long relief tunnel early in 1989, and excavators in the dry bed had already removed all of the earth and most of the rock scheduled to be moved. Work on the dam wall started in October 1989. Completion was due in January 1991 with a final height of 110 meters and a width of 1,120 meters. There were 2,500 workers on site of whom 2,050 were Angolan. Original plans foresaw only 20% of the staff being native workers. Brazilian staff made up most of the foreign workers.

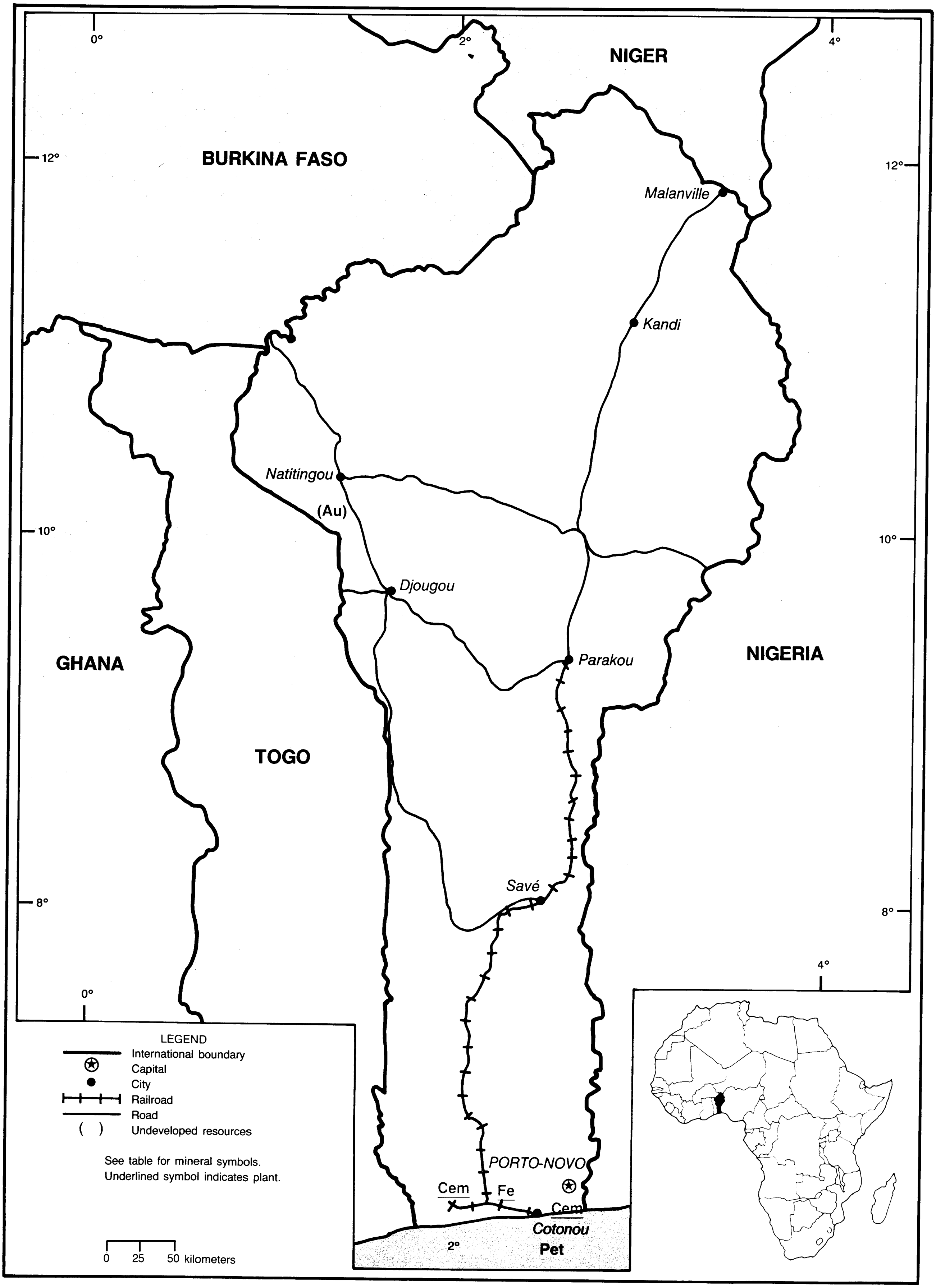
OUTLOOK

The economy will continue to be heavily dependent on the price of crude oil for the foreseeable future. When peace finally comes, Angola will be able to divert its crude oil earnings from the military into the nation's economy. It should then be able to repair its crumbling infrastructure and attract foreign investment. The stagnating minerals industry can be expected to revive once transportation and security problems are resolved. Within a few years iron ore, phosphate rock, and gold could be added to Angola's list of exports commodities. Exploration rights for the higher risk onshore oil concessions will also be awarded.

Recent changes in the Angolan Government's attitude toward a free market economy and a multiparty political system may help stabilize the economy.

BENIN

AREA 112,620 km² **POPULATION 4.7 million**



THE MINERAL INDUSTRY OF

BENIN

By Hendrik G. van Oss

The mineral industry of Benin consisted of production of crude petroleum, cement, iron and steel semimanufactures, and salt. Unspecified quantities of stone and sand and gravel were also produced for local construction purposes. The country was heavily dependent on imports of petroleum refined products and manufactured goods. Government revenues were primarily from import duties on goods transiting Benin for reexport to neighboring countries, particularly Nigeria. In 1988, the latest year for which data are available, this was 53% of all taxes collected.

GOVERNMENT POLICIES AND PROGRAMS

The Government had a number of privatization schemes underway, covering mainly agricultural, transportation, and commercial enterprises, but also enterprises such as the cement industry. It was revising the investment code, which currently includes tax breaks and repatriation of profits for foreign investors. Benin lifted unspecified controls on several agricultural commodities. Price controls and import restrictions on selected goods were also being removed.

Benin is a member of the West African Monetary Union and, as such, shares a common central bank, the Banque Centrale des Etats de l'Afrique de l'Ouest, with six other countries. The country's currency convertibility is guaranteed by France.

PRODUCTION

Benin's principal mineral production in 1989 was crude petroleum, output of which was about 4,500 barrels per day produced from a single offshore oilfield about 15 kilometers south of Cotonou. The potential for further discoveries and increased production exists owing to agreements signed with several foreign oil companies.

Output of cement was reported to be below capacity owing to financial difficulties. Both imported clinker and domestically produced limestone are used for cement production.

The country's fledgling iron and steel semimanufactures plant was proving to be economic, with nearly all output exported to Nigeria.

TRADE

Total exports were estimated at $250.3 million in 1989, and total imports were $441.5 million.[1] Trade with the United States totaled $17.6 million in exports and $7.1 million in imports. Exports in 1987, the latest year for which detailed statistics were available, were mainly to the Federal Republic of Germany, France, and other European countries. The major import sources were France, Thailand, Japan, the Netherlands, and India. The main export items were crude petroleum, cotton, and palm oil. The major import items were refined petroleum products, construction materials, and machine parts.

STRUCTURE OF THE MINERAL INDUSTRY

The Office Béninois des Mines (OBEMINES), under the Ministry of Industry, Mines, and Energy, was the Government agency responsible for developing the mineral resources of the country. Nearly all industry and commerce has been under state control for years. Recently, the Government began to relinquish control of various establishments and sectors. Most significantly, several major international petroleum companies have exploration and production-sharing agreements with Benin. The Government maintains ownership of petroleum resources, with the producer gaining a contractually agreed portion of sales.

The Government continued to be involved with the country's cement industry through its joint venture with the Government of Nigeria in the Société des Ciments d'Onigbolo. A new iron and steel minimill was successfully commissioned in 1989 with a capacity of about 11,000 metric tons per year (mt/y) of semimanufactures.

COMMODITY REVIEW

Metals

Gold.—OBEMINES, with the assistance of the U.S.S.R., reportedly has identified gold reserves in several small deposits totaling nearly 2 tons. Of this total, the Perma deposit had about 450 kilograms of gold in alluvium and about 810 kilograms in hard rock. No information was available on actual or planned production.

TABLE 1

BENIN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1985	1986	1987	1988[p]	1989[p]
Cement, hydraulic[e]	300,000	300,000	300,000	500,000	500,000
Petroleum, crude thousand 42-gallon barrels	2,900	2,800	[e]1,940	[e]1,800	[e]1,700
Salt, marine[e]	100	100	100	100	100

[e]Estimated. [p]Preliminary.
[1]Includes data available through Oct. 31, 1990.
[2]In addition to the commodities listed, unreported quantities of stone and sand and gravel are believed to be produced, but information is inadequate to estimate output levels.

Iron and Steel.—The Société Béninoise de Siderurgie (SBS) inaugurated a $5.2 million iron and steel mill to produce reinforcing bars, wire, and galvanized sheathing for roofing. Two production lines with capacities of 7,000 mt/yr and 4,000 mt/yr, respectively, were on-stream, and a third line of 3,000 mt/yr was due on-stream at yearend 1990. The mill uses scrap input.

Mineral Fuels

Ashland Oil Co. of the United States has operated the offshore Sèmè oilfield under a full service contract for the Government since 1987. Output has been as high as 10,000 barrels per day (bbl/d), but is currently about 4,500 bbl/d. No oil or gasdiscoveries have been made since the discovery of the Sèmè field in 1968. However, in 1989, the Government awarded the remaining offshore region to International Petroleum Ltd. of Canada. An unspecified company reportedly successfully bid for onshore drilling rights, but has yet to commence actual drilling.

RESERVES

With commencement of an additional production well, reserves of crude petroleum from the Sèmè oilfield were reported to be 100 million barrels.

INFRASTRUCTURE

Benin's transportation infrastructure is not well developed. Although Benin's 580 kilometers of railroad, all 1-meter gauge, transect the most populous area of the country, much of the land remains unserviced by railroad. Benin has about 5,000 kilometers of roads, of which only about 18% are paved. In 1989, about 150 million kilowatt hours of electricity was imported from Ghana; this represented about 85% of the Benin's total usage. The recently commissioned Togo-Benin Nangbeto hydroelectric plant, and several diesel-powered electric plants dependent on imported fuel, supplied the remainder.

The port of Cotonou, the main transport hub of the country, is operated by the Government. It has one 1,320-meter wharf, and one 500-meter wharf, the latter for tankers.

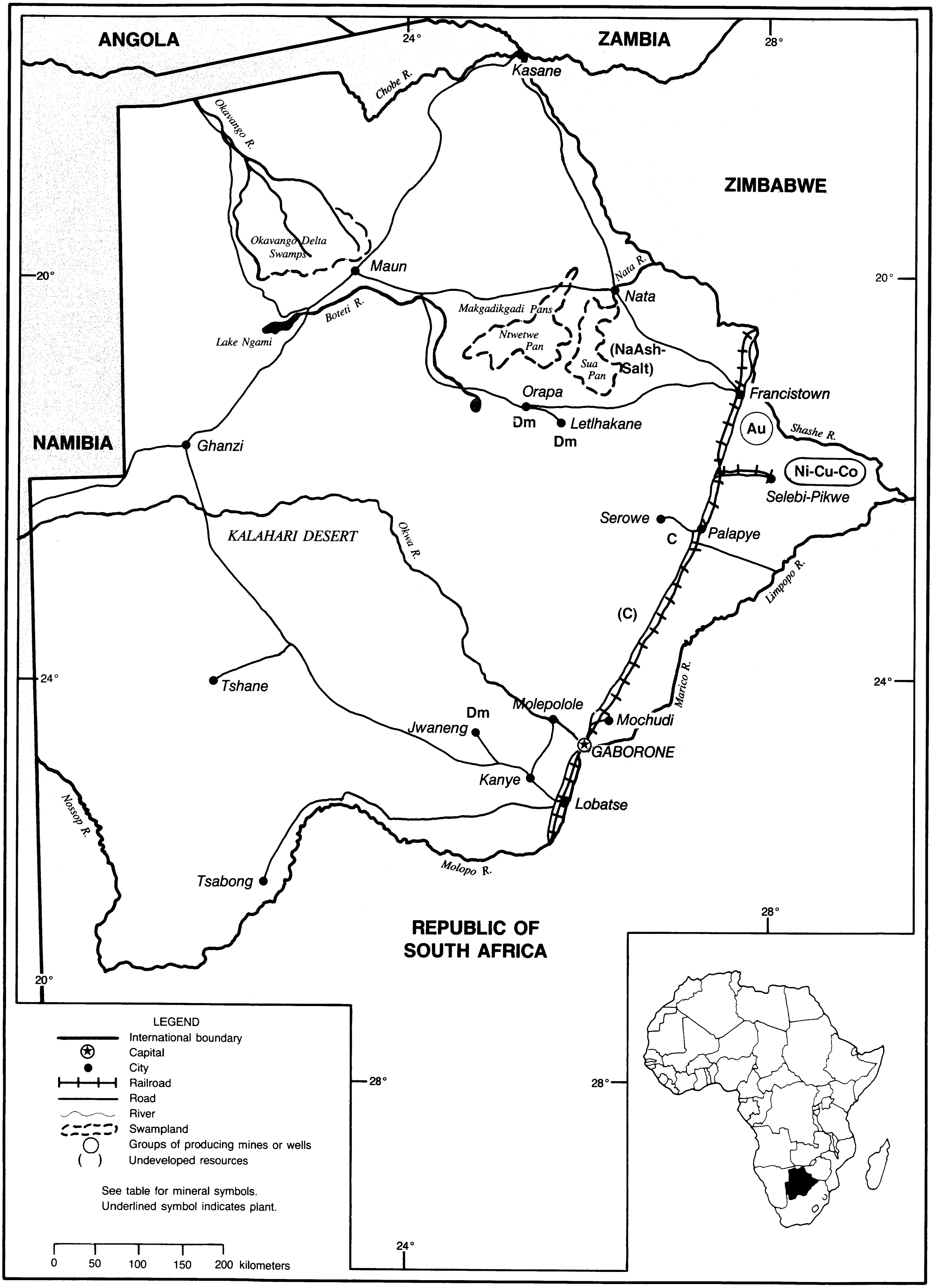
OUTLOOK

The Government's objective to privatize the country's numerous state-owned enterprises should help improve the efficiency of several production and service companies. Foreign donor assistance will still be necessary to service the heavy external debt the country incurred from its investments in the cement and petroleum sectors. Commencement of small-scale mining and industrial projects, such as gold production at Perma, could improve investor confidence in other projects.

[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF319=US$1.00.

BOTSWANA

AREA 600,370 km² **POPULATION 1.2 million**



THE MINERAL INDUSTRY OF

BOTSWANA

By Lloyd E. Antonides and Bernadette Michalski

Minerals, particularly diamonds and to a lesser extent, gold, nonferrous base metals, coal and crushed stone provided the basis for a healthy economy in 1989, as had been the case for more than one decade. Revenues generated by the mineral industry were the major factor in sustaining a favorable budget and trade position as well as supporting a 13% annual growth rate in the gross domestic product from 1980 to 1988 and a 9% growth rate in 1989.

The total value of mineral production rose from $1.18 billion in 1988 to $1.51 billion in 1989.[1] A 15.5% increase in diamond prices in March 1989 and an improved pula to dollar exchange rate were significant factors in establishing the increase.

The nation leads the world in the value of diamond production and was the third largest producer by volume. Total employment in the formal sector was estimated at 150,000 workers, which reportedly included 20,000 to 25,000 working in the mining industry of the Republic of South Africa. The overall labor force employed in domestic mining increased from 10,180 in 1988 to 12,712 in 1989. Botswana's diamond mining operations accounted for 6,112 while the mining and smelting of nickel-copper-cobalt ores employed 4,929.

Although trade and balance of payment surpluses remain favorable, Government officials expressed concern that expenditures were increasing at a rate that would overtake revenue in a few years. The Government encouraged private enterprise, as well as diversification away from heavy reliance on mining, especially diamonds. The production of diamonds accounted for 63% of Government revenues in 1989. At the same time, official statements and actions clearly indicated that the Government wanted to continue to attract more and wider investments in capital-intensive mining projects, especially where it added to the infrastructure.

Although the overall value of mineral production increased by 28% over that of 1988, the production of cobalt, copper, and nickel smelter products decreased in volume during 1989, according to statistics released by the Government. The decline in nonferrous base metal production was attributed to technical problems experienced at the smelter and lower ore grades. Diamonds, which constituted more than 82% of overall mineral production by value experienced only a marginal increase in volume but a 68% increase in value over that of 1988. Gold production tripled, and output was valued at $894,000 compared with $280,000 in 1988.

Sales of gem and near-gem diamonds were reported at 12,230,651 carats, and industrial diamond sales were reported at 4,036,423 carats in 1989. Government statistics reflect that about 90% of total exports, by value, went to European nations other than the United Kingdom. Although diamond shipments to jewelry centers presumably accounted for most of this, 75% of the nickel-copper-cobalt smelter matte was sold to refineries in Norway and the balance to refineries in Zimbabwe. The Republic of South Africa continued to be the major trading partner through which at least 80% of Botswana's imports and nearly all exports were shipped.

Botswana RST Ltd.(BRST) increased nickel-copper-cobalt ore output by more than 8,000 tons in 1989 as compared with 1988, and smelted it to produce granulated nickel-copper-cobalt matte. However, metal content of matte declined by

TABLE 1

BOTSWANA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[p]
Coal, not further described		437,053	499,373	579,409	612,873	633,045
Cobalt: Co content of smelter product[2]		222	163	181	291	215
Copper:						
Mine output, Cu content of ore milled[e 3]		27,274	27,499	27,888	27,303	27,353
Cu content of smelter product		21,692	21,336	18,933	24,428	21,709
Diamond:						
Gem and near gem[e]	thousand carats	6,318	9,590	9,368	10,660	10,676
Industrial stones[e]	do.	6,317	3,500	3,840	4,569	4,576
Total	do.	12,635	13,090	13,208	15,229	15,252
Gem stones, semiprecious, rough[4]	kilograms	14,310	4,900	40,103	38,600	146,000
Gold[e 5]	do.	12	25	31	21	66
Lime		2,600	225	325	226	—
Nickel:						
Mine output, Ni content of ore milled[e 3]		26,300	25,558	25,920	25,971	23,684
Smelter product, gross weight		51,507	47,930	43,238	57,530	49,754
Ni content of smelter product[2]		19,565	18,974	16,528	22,539	19,759
Sand and gravel	cubic meters	102,524	129,181	122,203	179,936	147,300
Stone, crushed, not further described	do.	132,966	177,792	225,362	337,677	458,900

[e]Estimated. [p]Preliminary.
[1]Table includes data available through July 1, 1990.
[2]Figures also used for recoverable mine output in world production tables appearing in V. 1 of the Minerals Yearbook.
[3]Calculated from reported tonnage and head grade of ore milled.
[4]Principally pink carnelians and agates.
[5]Includes minor amounts of silver.

17% from 1988 levels when stockpiled ore was also smelted into matte. Further decline in metal production was anticipated in 1990 with nickel dropping to about 17,500 tons due to reduced ore grade and copper to below 20,000 tons. The decline would have been more precipitous without the completion of the Selebi Phase One extension expected to start production in April 1990. Ore production from the project was expected to average 550 tons per day for 1990, rising to 1,500 tons per day by 1991.

Increased gold production in 1989 reflected the opening of the Map Nora Mine of Shashe Mines (Pty.) Ltd., 8 kilometers (km) south of Francistown, in the Tati gold field in northeastern Botswana. Planned ore output was 6,600 tons per month; however, production was below planned levels due to metallurgical difficulties.

Prospecting for platinum-group metals (PGM) continued in the Molopo Farms Complex. A joint-venture exploration agreement between Molopo Corp. of Australia and Inco Co. of Canada was signed at yearend 1989 under which Inco would advance $1 million for up to 6,900 meters of percussion and diamond drilling to test previously identified PGM targets. Inco may spend a further $1.24 million in the second 12 months of the agreement. After the completion of the second phase, Inco will earn 50% interest in the project and will have the right to assume management of the project.

During the year, 12 quarries for crushed stone and 3 sand pits were in operation for the construction industry.

Production of diamonds once again attained record levels both in volume and in value. Output was obtained from three open pit mines operated by Debswana. The Orapa Mine treated 7,338,000 tons of ore yielding 6,063,000 carats. The Letlhakane Mine treated 2,996,000 tons of ore, yielding 774,000 carats, and the Jwaneng Mine treated 5,828,000 tons of ore, yielding 8,415,000 carats. Construction was on schedule at the Jwaneng recrush plant for a planned completion date in the spring of 1990. The plant should contribute an additional 30% to the mine's output by treating lower grade ore and tailings to permit extracting mostly smaller diamonds that were not otherwise economically recoverable.

The Government of Botswana was considering awarding licenses to Debswana and Lazare-Kaplan of New York to permit the opening of diamond-cutting factories in Botswana.

In 1989, development work in the Sua Pan deposit commenced under a mining lease issued to Soda Ash Botswana (Pty.) Ltd. It was owned 52% by a South African consortium effectively led by AECI Ltd., and 48% by a consortium headed by the Government of Botswana. The commissioning of the plant was expected during the first quarter of 1991. Annual production of 300,000 tons of soda ash and up to 650,000 tons of salt was scheduled within 2 years after startup. Sodium sulfate and potash particularly were mentioned as potential byproducts. Markets in southern Africa, mostly in the Republic of South Africa, were expected to absorb most of the production. The processing facilities were to be based on Kerr-McGee Ltd.'s technology used in California, United States, for brines having the same chemistry.

The Morupule Coal Mine, about 250 km north-northeast of Gaborone and 15 km west of Palapye, continued to expand production to meet increased power demand. Identified coal resources in Botswana were 40 billion tons. About 3.5 billion tons had been reported as economically recoverable.

The search continued into Botswana's oil and gas potential, which generally was considered to be in the western Kalahari. Aerial surveys apparently continued to justify further exploration. Early in 1989, Petro Canada International Assistance Corp. confirmed it would drill a hole up to 4,000 meters deep, presumably to obtain stratigraphic information.

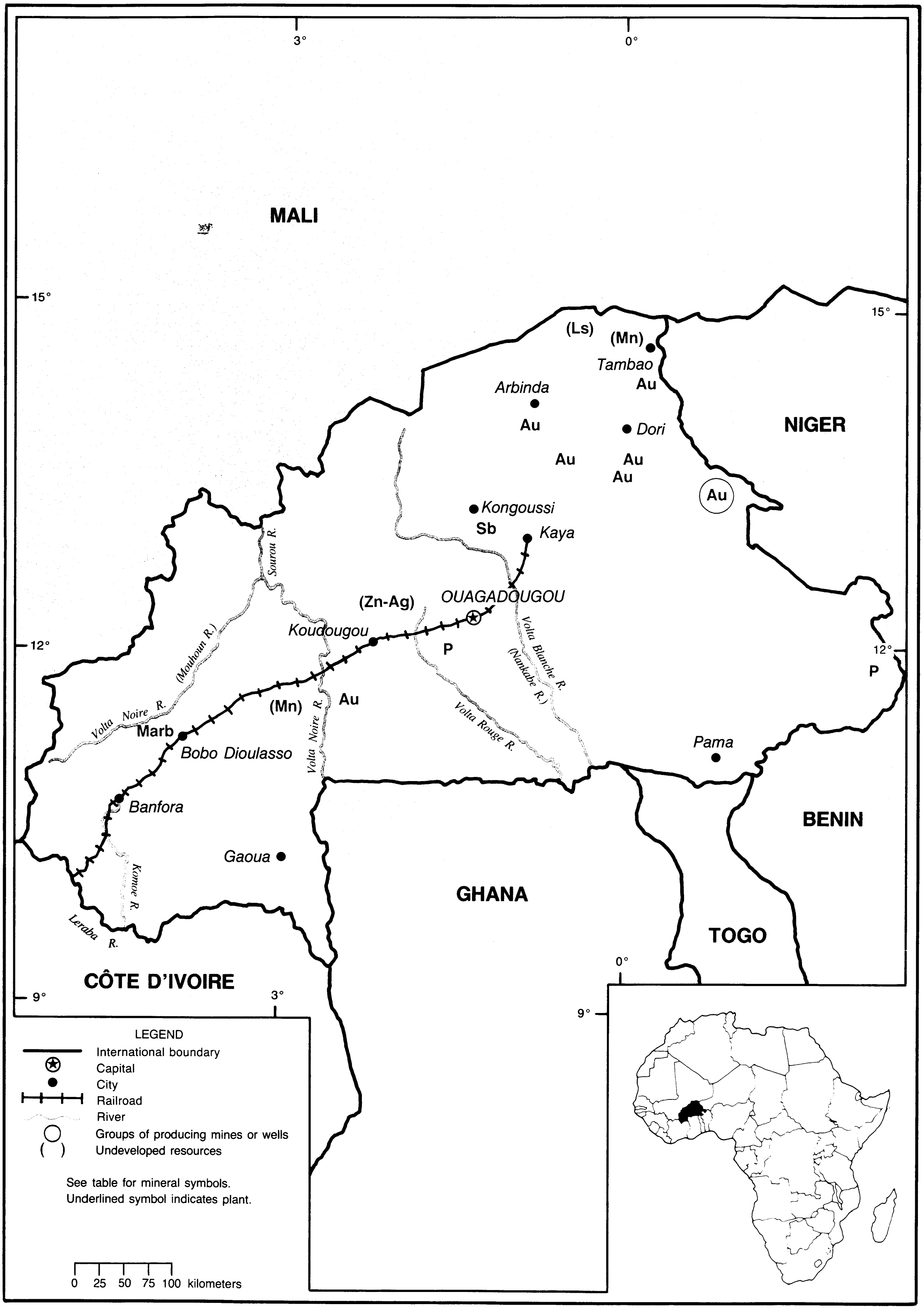
Budget allocation in 1990-91 allotted $150 million for road building and maintenance. A priority was given to the northwest to counterbalance previous concentration on the southeast. Most of the existing infrastructure was near the eastern border in a 100-km-wide by 650-km-long strip along the railroad from Zimbabwe to the Republic of South Africa. The construction of the Sua Pan rail line was begun in October, and the 175-km line was expected to be operational by April 1991. It will be used to transport soda ash and salt from the Sua Pan plant, and coal from the Morupule colliery. The mining industry absorbed 70% of the country's total electricity, 865 gigawatt hours, generated in 1989.

Prospects for the mining industry were good as more foreign interests sought to establish projects in Botswana. The country's positive growth rate, built on the mining industry, was expected to continue.

[1] Values converted from Botswana Pula (P) to U.S. dollars at the rate of P1.8734=US$1.00 for 1990, P2.0125=US$1.00 for 1989 and P1.8159=US$1.00 for 1988.

BURKINA FASO

AREA 274,200 km² **POPULATION 9.1 million**



THE MINERAL INDUSTRY OF

BURKINA FASO

By Hendrik G. van Oss

Mining makes up only a small portion of the overall economy of Burkina Faso, which is dominated by agriculture, but it is a major component of the country's trade. The gross domestic product (GDP) of Burkina Faso in 1989 was estimated to be about $1.75 billion,[1] of which the mining sector, overwhelmingly dominated by the production of gold, contributed only about 1.5% based on official data. However, it is estimated that the majority of Burkina Faso's gold production was smuggled out of the country, estimates of which imply that the true mineral component of the GDP in 1989 was closer to 5%. This further implies that gold was the country's largest export, accounting for almost one-third of total exports.

The geology of Burkina Faso is dominated by Precambrian rocks, which cover about 90% of the country. The majority of the Precambrian rocks are lower Proterozoic granitoids with subordinate migmatitic gneisses. The Precambrian terrane is cut by a large number of north-northeast to northeast-trending greenstone belts and shear zones containing volcanosedimentary rocks of the Birimian Series. These greenstone belts host the majority of the country's mineral occurrences, notably gold, zinc, manganese, copper, nickel, and antimony. By far the most important mineral deposit is that of the Poura gold mine, operated by Société de Recherches et d'Exploitation Minières du Burkina (SOREMIB), 150 kilometers (km) southwest of Ouagadougou. There is artisanal placer and lode gold production from the same area, but most of the artisanal production comes from the northeast and north-central part of the country.

A belt of upper Proterozoic and Paleozoic sedimentary rocks covers the westernmost part of the country; these host small bauxite deposits and, near some diabase intrusives, some deposits of marble, one of which is being exploited. In the extreme southeast part of the country, near the Benin border, are sedimentary rocks that host a number of phosphate deposits, including the Kodjari deposit, which is being mined on a very small scale.

GOVERNMENT POLICIES AND PROGRAMS

The relative role of mining in the Burkina Faso economy has increased, both because of a higher level of gold production and because prolonged drought conditions have adversely affected the otherwise dominant agricultural sector. The Government is actively encouraging foreign investment in the formal mining sector and is seeking to introduce more efficient extraction technology to the major centers of artisanal gold production. Although the Government recognizes that the country's greatest potential to attract investment is in gold, agreements have been pursued toward the development of other mineral resources. A notable outcome of this policy was the September 1989 agreement with Boliden International Mining (Boliden) of Sweden to conduct a detailed feasibility study of the Perkoa zinc-silver deposit. Against the advice of a number of international financial agencies, the Government has continued to work on developing a rail line to Tamba. Successful completion of this line might allow the development of the large manganese ore deposit near Tambao and of limestone deposits nearby. The Government has traditionally taken a significant level of equity participation in mining and exploration projects; the degree of participation is negotiable and has declined in recent years.

Evaluation of the country's mineral resources has been a major component of the 1986-90 Five-Year Plan. Work toward this end, commonly with foreign assistance, has been carried out by the Bureau des Mines et de la Géologie du Burkina (BUMIGEB).

The basic mining laws of Burkina Faso are set out in the 1965 Mining Code (Law No. 9-65), as supplemented by various mining regulations, such as Ordinance No. 76-010 of June 22, 1976, and Decree No. 77-012 of January 15, 1977. Per regulations issued at yearend 1984, the state controls all gold exports; since 1987 these have been through the state agency Comptoir Burkinabè pour les Métaux Précieux (CBMP). The CBMP pays the formal gold-mining sector, currently represented by only one operation, 97.4% of the world gold price. However, purchases from artisanal miners are at a much lower price; the difference is used by the CBMP to pay the mining taxes, smelting and refining charges, insurance, and export taxes. This price policy has reportedly resulted in the majority of the artisanal gold production being smuggled out of the country.

The 1984 Investment Code (Ordinance No. 84-0151/PRES/CNR of July 7, 1984) was a major revision of its 1978 predecessor and is currently being considered for revision to further promote investment in the country. Despite provisions in the code and other laws for certain tax holidays and exemptions, the Government imposes a 4% tax, described as a processing fee, on virtually all imports regardless of tax exemptions.

PRODUCTION

Official mineral production data for Burkina Faso are only available for gold, and even these do not account for the significant level of smuggled production. Reported gold production in 1989 decreased almost 44% to 2,172 kilograms (kg) of bullion or doré. The decrease was owing to technical problems at the Poura Mine, the country's single largest gold producer, and to the continued lack of production from three small semi-industrial operations. The artisanal component of the country's reported gold output was 1,208 kg, almost unchanged from 1988, and consequently the estimate of smuggled production, included in table 1, has not been changed. Burkina Faso has had, beginning in 1980, a small, erratic output of antimony from one operation, but data on its output are unavailable.

TRADE

Gold was the only mineral commodity exported from Burkina Faso in 1989. Official exports of gold in 1989 were worth about $24 million, about 9% of total exports. Gold was officially the second largest export item after cotton, exports of which were worth $67 million. The official exports of gold do not account for the majority of the artisanal gold production, which is smuggled out of the country. Estimates of the value of this smuggled production vary widely; the estimated smuggled production incorporated into table 1 would be worth approximately $72 million. If this estimate is correct, total gold exports in 1989 from Burkina Faso were worth about $96 million or 29% of the country's total exports. The economic impact of the smuggled trade, while significant, is partly mitigated by the practice of selling to middlemen, who pay perhaps 70% of the world price for the gold. Most of the smuggling is reportedly by way of Togo.

Mineral commodity imports were estimated to have totaled about $100 million in 1989 or about 16% of the country's total imports. Petroleum products imports in 1989 were about 1.5 million barrels, worth an estimated $80 million. The other major mineral commodity import was cement, worth about $19 million. The petroleum products imports are transshipped through Côte d'Ivoire and Togo; much of the imported cement is of Togolese manufacture.

France continued to be Burkina Faso's largest trading partner, taking about 30% of Burkinabè exports and providing about 23% of the country's imports. Within Africa, the country's largest trade was with Côte d'Ivoire. Overall trade with the United States was negligible in 1989.

STRUCTURE OF THE MINERAL INDUSTRY

The Poura Mine was the only formal gold mine in operation in 1989. The mine was operated by SOREMIB, a joint venture of the Government, 60%; the Islamic Development Bank, 20%; and Compagnie Française des Mines (COFRAMINES) of France, 20%. Three semi-industrial operations, which were joint state and foreign efforts to improve artisanal gold output, and which had registered a small output in 1987, were closed in 1988 and 1989 for technical reasons. A small phosphate mine was in operation in southeast Burkina Faso, as was a small marble quarry about 25 km northwest of Bobo Dioulasso.

In 1989, about 1,000 persons were permanently employed in the mining sector. In addition, as in previous years, several thousand Burkinabè were engaged in artisanal gold mining. The artisanal activity is, however, seasonal as the Government closes the gold fields during the growing season to encourage farming.

TABLE 1

BURKINA FASO: PRODUCTION OF MINERAL COMMODITIES[1]

(metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Gold[e]	kilograms	1,555	1,866	[r] [3]7,000	[r] [3]9,300	[3]7,600
Phosphate rock[e]	thousand tons	3	3	3	3	3
Pumice and related volcanic materials[e]		10,000	10,000	10,000	10,000	10,000
Salt		6,500	6,500	6,500	6,500	6,500
Stone: Marble[e]	do.	100	100	100	100	100

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Oct. 15, 1990.
[2]In addition to the commodities listed, Burkina Faso produced clay, and sand and gravel for local constructional uses. Information is inadequate to make reliable estimates of output levels.
[3]Estimate based on reported formal and legal artisanal production, and estimated smuggled artisanal output. Approximately 75% of artisanal production is believed to be smuggled out of the country. Original data are for doré or bullion and have been adjusted for this table assuming a gold content of 90%.

COMMODITY REVIEW

Metals

Gold.—The Poura gold mine was the largest single gold producer in Burkina Faso in 1989. The deposit was first mined in the late 1800's, but mining on an industrial scale did not begin until 1939 and continued until 1966. Production records prior to 1960 are unavailable, but production from 1960 to 1966 reportedly totaled 5.62 tons of gold. Mining resumed in 1984, with production increasing yearly until 1988, when a cave-in of the declines interrupted operations toward yearend. Mining was halted until July 1989, when the sinking of a new decline and other repairs were completed; the severe decrease in production in 1989 reflected this interruption. COFRAMINES had managed the mine since its startup in 1984; in 1989, the management contract was transferred to MINOREX of Canada.

The Government-owned semi-industrial gold operations begun in 1986 at Guiro and Bayildiaga, about 35 km southwest of Dori, and in 1987 at Sebba, about 75 km southeast of Dori, shut down at yearend 1987 for technical reasons. The gold exploitation at Sebba was as a joint venture with the Government of North Korea, which operated the project. Total production from these operations was only 18.5 kg of doré.

Several international groups were exploring for gold in Burkina Faso in 1989. Most of this work was in the north-central and northeast part of the country.

Zinc.—An agreement was signed in September 1989 between the Government and Boliden for the company to commence detailed feasibility studies of the Perkoa zinc-silver deposit, about 110 km west of Ouagadougou. The deposit was discovered in 1982 by BUMIGEB and the United Nations Development Program and was the first massive sulfide zinc deposit to be discovered in West Africa. The deposit was initially drilled by Penarroya of Spain, who outlined the current, published reserves. The deposit was brought to the attention of Boliden in 1988, and an initial agreement to study the deposit was signed with the Government toward the end of that year. Boliden believes that the deposit has the potential to produce about 130,000 tons per year of concentrate, grading 55% zinc and about 170 grams of silver per ton. Unlike many mineral deposits in Burkina Faso, the Perkoa deposit is favorably located in terms of infrastructure, being only about 30 km from the Abidjan to Ouagadougou railroad.

Reserves

Burkina Faso's gold reserves are not well known but are potentially large. The Poura Mine is believed to have remaining reserves of about 8,000 kg of gold in ore grading about 11 grams of gold per ton. This is based on various reported estimates of original reserves of between 20,000 kg and 30,000 and a known production of about 15.3 tons. Elsewhere there are a number of known occurrences of both lode and placer gold deposits. Some of these are of high grade, but reserves data are not available. Many of the deposits, currently worked by artisanal miners, are believed to have insufficient reserves to warrant formal exploitation.

The Perkoa zinc-silver massive sulfide deposit has estimated reserves, according to the Government, of 4.5 million metric tons (MMmt) grading 17.43% zinc and 50 to 60 grams of silver per ton. These reserves are to a depth of 400 meters; the deposit is claimed to be open at depth. Detailed production feasibility studies commenced in early 1990.

The Tambao manganese deposit has an exploitable resource of 15.5 MMmt grading 51% manganese, according to BUMIGEB. There is also a resource, amounting to about 13 MMmt, of lower grade manganese carbonate material. The economics of this deposit hinge on the construction of 250 km of track from Kaya, financing for which has not been secured as yet. The Kiéré deposit, 100 km northeast of Bobo Dioulasso and only 10 km south of the railroad, contains a resource of 500,000 tons grading 42% manganese. Approximately 40 km to the west of Tambao, at Tin Hrassane, is a large limestone deposit, which BUMIGEB claims could support a cement plant of 150,000-ton-per-year capacity. Reserves have been put in excess of 63 MMmt.

According to BUMIGEB, the Kodjari phosphate deposit, presently being exploited on a small scale, contains reserves of 80 MMmt grading between 18% and 33% P_2O_5. The Arli phosphate deposit, 50 km southwest of Kodjari, contains a resource of 2.8 MMmt grading 29% P_2O_5.

INFRASTRUCTURE

The transportation infrastructure of Burkina Faso is underdeveloped. The country has 617 km of single-track, 1-meter-gauge railroad, which links Ouagadougou to Abidjan in Côte d'Ivoire, and which, in 1989, was extended another 100 km to Kaya. Until 1989, the railroad was run jointly with Côte d'Ivoire, but because of severe financial losses, operations were split up during the year. The railroad carries mixed freight and passengers and is a major trade route for Burkina Faso. The Government hopes to extend the railroad an additional 250 km to Tambao in the northeast corner of the country. It is hoped that this extension, together with needed rehabilitation of the existing track, will allow the development of the Tambao manganese deposit. Completion of the railroad might also allow the construction of a cement plant based on a large limestone deposit found 40 km to the west of Tambao. The financing for this railroad extension was uncertain.

Burkina Faso has about 16,500 km of roads, of which about 1,500 km are paved. The electrical generating capacity of the country is 121 megawatts (MW), all in thermal plants. In April 1989, the $90 million Kompienga Dam was inaugurated on the Kompienga River near Pama. The installed capacity will be 14 MW, which is 14% of the country's current needs. The reservoir is expected to be filled within 3 years. Work was ongoing on Bagre Dam, on the Nankabe (Volta Blanche) River about 30 km northeast of Ouagadougou. This dam will have a hydroelectric capacity of 7.5 MW. A 60-MW hydroelectric dam is planned for the Mouhoun (Volta Noire) River near the Ghanaian border. These dams will greatly reduce the country's dependence on thermal power generation and hence will allow a major reduction in fuel imports.

OUTLOOK

Gold will continue to dominate the mineral economy of Burkina Faso for the foreseeable future. Given the number of known gold occurrences and the geologic similarity of the country to its gold-rich neighbors Ghana and Mali, the potential for additional gold discoveries and the development of new mines is high. The artisanal component of gold production will continue to be significant because the expected exhaustion of some of the more easily accessed surface deposits will likely be offset by the current Government program of introducing more efficient methods and equipment for mining and gold recovery.

Given a favorable outcome of the feasibility studies of the Perkoa deposit, the country can expect to have a significant production of zinc and silver by about 1995. The development of the Tambao manganese deposit and the nearby Tin Hrassane limestone deposit hinge on the completion of the railroad from Kaya and the upgrading of the existing rail system to handle heavy ore freight. This undertaking will be very expensive, and given the lack of support from the international financial agencies, the prospects for this project are uncertain. The lack of infrastructure and unstable world commodity prices will hinder the development of most of the country's other mineral resources.

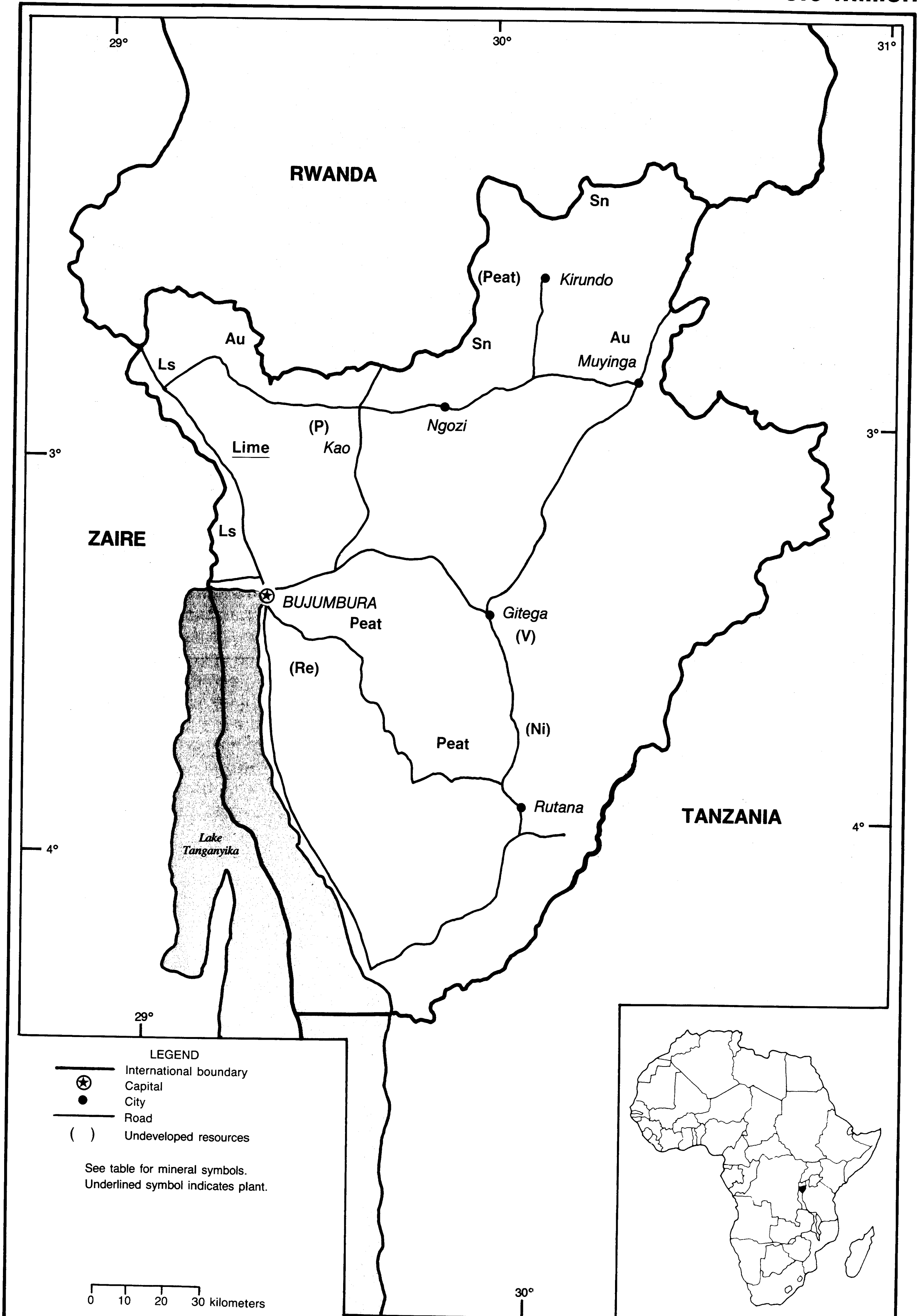
[1]Where necessary, values for Burkina Faso have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF319=US$1.00.

OTHER SOURCE OF INFORMATION

Bureau des Mines et de la Géologie du Burkina (BUMIGEB)
01 B.P. 601
Ouagadougou 01
Burkina Faso

BURUNDI

AREA 27,830 km² **POPULATION 5.6 million**



THE MINERAL INDUSTRY OF

BURUNDI

By Lloyd E. Antonides

The mineral potential of Maryland-size Burundi, which lies across the crest of the Nile and Zaire rivers watersheds, continued to be far more significant than actual production. Within the French-speaking country, one of the world's poorest in per capita income, mineral production has always played a minor role in the economy, apparently never contributing more than a small fraction of 1% to the gross domestic product (GDP). In 1989, the GDP was estimated to be on the order of $1 billion.[1]

In addition to lime, clays, and various crude construction materials, minerals reportedly produced at various times have included gold and tin, starting in the 1920's; tungsten, rare earths, and probably columbium-tantalum, starting in the 1950's; and peat, starting in the 1970's. In recent years, nickel, phosphate, and vanadium deposits, often with associated precious and other valuable minerals, attracted some attention, as have oil and gas possibilities. However, lack of infrastructure, especially reasonable-cost transportation, was cited as a major obstacle to development. Availability of water and hydroelectric power were favorable factors, and the latter had potential for major expansion.

Agriculture, primarily coffee, remained the economic base and almost sole source of foreign exchange. In 1989, according to International Monetary Fund (IMF) data, coffee prices and export volume dropped, and the value of total exports fell 40% in dollar equivalents to about $78 million. Imports were down 10% in dollars to $187 million, and the consumer price inflation downtrend reversed, rising to almost 12%. There were indications that the GDP barely grew in current or constant national currrency and probably fell when converted to equivalent current U.S. dollars. An annual Government deficit was again reported, and an official currency devaluation was announced.

The dense, mostly rural population with a 3.6% growth rate maintained relentless pressure on the economy. AIDS was reported to be a very serious concern. Maintaining intertribal peace remained a major political and social issue.

Destructive rains early in the year, especially along northern Lake Tanganyika, destroyed or damaged buildings, roads, and communications; disrupted the food supply; and required emergency Government expenditure. Japanese aid was promised to assist the Government, and for road maintenance elsewhere. Belgian, United States, and French grants and loans were announced for other specific projects and for the economic reform program implemented in 1985.

GOVERNMENT POLICIES AND PROGRAMS

Burundi's 1967 Investment Code and 1986 Investment Law provided tax and other benefits for domestic and foreign private investors. Additional privileges were available if the venture had priority status as being important to the economic development of the country. The 1976 Mining and Petroleum Code was also designed to be attractive to investors.

However, in 1979, the Government suspended mining, at least for export trade, claiming a need to map and assess the country's mineral potential. According to the press, such a program was conducted, into at least the last half of the 1980's, with assistance from several European countries and the United Nations (U.N.). The program appeared to have had some positive results.

In 1983, the ban on gold was relaxed, and in the following years, the Government sought ways to gain the benefits that would result from increased mineral production and especially foreign investment in mining.

During 1989, nickel, phosphate, cement, and other mineral projects continued to be promoted internationally, and the Ministry of Energy and Mines was encouraging and advising small-scale domestic mining activities. Additionally, presumably with Government sponsorship, primary and alluvial gold occurrences in the northwest and northeast, as well as sulfide ore traces and kaolin in the north-central region, were being investigated. Late in the year, the Ministry also obtained an African Development Fund grant for the foreign exchange portion of a 1990 final feasibility study on development of a phosphate mine.

At a November national conference on diversifying and increasing exports, greater mineral production on both artisanal and larger scales was one of the three major goals stated by the Government. Earlier World Bank funding and Belgian loans were given to support a Government program aimed at stimulating private enterprise. The United States and Burundi were negotiating a bilateral investment treaty to establish specific standards for investment in Burundi, although there was already an Overseas Private Investment Corp. insurance program agreement in effect.

PRODUCTION

The most significant change in mineral production for 1989 was the addition of tin mineral output, which actually recommenced in 1987.

TABLE 1

BURUNDI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
Clays: Kaolin		4,360	5,113	5,290	4,021	4,305
Gold	kilograms	26	31	26	14	18
Lime		1,100	160	137	96	202
Peat		10,313	12,455	17,000	17,589	14,200
Tin, mine output (60% SnO_2)		—	—	5	50	106

[p] Preliminary.
[1] Includes data available through July 1, 1990.
[2] In addition to commodities listed, various crude construction materials (clays, sand and gravel, stone, et al.) presumably are produced, but information is inadequate for making reliable estimates of output levels.

TRADE

Mineral export value, principally of gold and tin, as usual was minuscule in comparison to mineral import value. Petroleum products, cement and steel, and fertilizer were major mineral imports.

STRUCTURE OF THE MINERAL INDUSTRY

The Government apparently has been the principal participant in mineral activity for many years. At least one-half dozen donor countries and agencies, especially the U.N. Development Program, also were involved at various times during the past 20 years. During the past 10 years, several large international firms investigated some of the nickel, phosphate, and vanadium deposits as well as the oil-gas possibilities, but none took a substantial investment position.

Mineral exploitation was limited mostly to efforts of individuals or small groups of artisans who sold their product to export traders. However, the Government reportedly was involved in lime and possibly clay production through an entity referred to as the Burundi National Lime and Cement Making Co. The Government also was associated with peat operations, especially recent mechanization, through a National Peat Office (Onatour) reportedly set up in 1977.

In 1974, the apparently only two domestic mining companies, at least one of which was referred to as Belgian, were reportedly merged into an enterprise referred to as Sobumines, with 49% Government ownership. Although there was no further mention of its activities, at the time the component companies were identified as producers of rare earths, tin, and other minerals.

The Amoco Burundi Petroleum Corp. was identified as a subsidiary of Amoco International Oil Co. and the entity that acquired an oil concession in 1985 and proceeded with exploration. In early spring 1989, the formation of Burundi Mining Corp. (Buminco), owned 25% by the Government and 75% by Mannai group of Qatar, was announced. Among its stated functions were overseeing and regulating existing mining operations, gold in particular, and, especially, increasing safety. Many of the artisan miners were reported in 1989 to be agricultural workers doing off-season work in shallow opencast excavations.

COMMODITY REVIEW

Metals

In April 1989, casualties were suffered when a mine collapsed in the gold district around Muyinga in the northeast. Heavy rains and unskilled farmer-miners were mentioned as causes.

Buminco reportedly started gold exploitation in early spring. This was probably in the northeast, where the company was also reported to be conducting a survey. The U.N. also was surveying the deposits in the northwest.

Industrial Minerals

A Government tender was in process for a 10-month final feasibility study on mining and processing facilities to produce single superphosphate. The deposit was at Matongo, about 75 kilometers (km) by main paved road north of Bujumbura and convenient to water and electric power. Reportedly, bids were due in January 1990. The African Development Fund granted the roughly 75% foreign exchange portion of the $1.5 million study.

Reports indicated the phosphate (apatite)-carbonatite deposit was discovered by aerial geophysics in 1971, apparently during a U.N. sponsored program. It was explored on a preliminary basis in the late 1970's also by the U.N., and studied on a preliminary feasibility basis in the early 1980's by British Sulfur Corp. Ltd., with a further market study in the mid-1980's by Louis Berger International. Pilot plant test work on bulk samples was being done in the fall of 1989 by the International Fertilizer Development Center in the United States.

The British Sulfur study was quoted as giving an estimate of 17.3 million tons proven and probable rock averaging more than 11% phosphorous pentoxide (P_2O_5), which could be beneficiated to 32% to 35% P_2O_5. The market studies reportedly indicated that a small export market in neighboring countries could be expected and that plant capacity of 30,000 tons per year of single superphosphate was justified.

Mineral Fuels

An oil exploration-exploitation coordination agreement between Zaire and Burundi was announced in January. Work reported completed by Amoco around the north end of Lake Tanganyika included geophysical work in 1985 and at least two exploratory dry holes in 1987. Additional work planned for 1988 apparently remained suspended in 1989.

Reserves

Burundi's mineral resources do not appear to be of world importance, but they could be important to the country's future economy. The Musongati nickel laterite deposit was reputed to be the largest in Africa and the Mukanda vanadium to be as rich as any in the Republic of South Africa. The Matongo phosphate offered a boon to agriculture.

Information on quantity and grade of some deposits was reported in various publications and usually referred to results of various donor country and U.N. Development Program projects. Pending review of original sources, the accuracy and precise definition of the data were not known, and the following is only indicative of the size and quality of some mineralization that has been of interest:

Nickel.—Reported were 29 million tons averaging 1.6% nickel (Ni) to 72 million tons averaging more than 1% Ni at Musongati, about 90 km southeast of Bujumbura—laterite with cobalt, copper, and platinum group metals.

Phosphate.—Reported were 17.3 million tons averaging more than 11% P_2O_5 at Matongo, about 45 km north of Bujumbura—apatite associated with carbonatite.

Peat.—Considered currently exploitable were 3.4 million tons, mostly in valley bogs about 25 to 50 km southeast of Bujumbura, to 200 million tons with residual moisture of 30% throughout the country. However, in marshes along the river border 90 to 140 km northeast of Bujumbura residual moisture was 85%.

Rare-Earth Metals.—Reported were 5,400 tons of unspecified grade at Gakara, about 25 km southeast of Bujumbura—bastnasite with high europium and cerium, in quartz veins in schist.

Vanadium.—Reported were 5.5 million tons averaging 1.5% vanadium to 17.2 million tons averaging more than 0.6% at Mukanda, about 75 km east of Bujumbara—primary and oxidized minerals with iron and titanium.

INFRASTRUCTURE

An extensive network of roads existed in Burundi, but only a few main ones were paved. Over the years, a steady program of upgrading has been aided by many grants and loans from outside the country. Belgium, Japan, and the African Development Fund were mentioned by the press as sources in 1989. Roads were considered to be very good north from Bujumbura into Zaire or into Rwanda and on to Uganda, fairly good east and south to the Tanzanian border, but beyond, to the nearest railheads, not very satisfactory for commercial traffic.

Lake Tanganyika between Bujumbura and railheads at Kigoma (Tanzania) about 175 km south and Kalemi (Zaire) about 300 km south, as well as the road head at Mpulungy (Zambia) about 525 km south, provided important routes for commerce.

Further availability of hydroelectric power was aided by French loans and a grant for distribution powerlines and transformers.

OUTLOOK

In the short term, no major change in the mineral industry was expected, especially since even medium-size ventures normally come into production only several years after commitment. Although smaller scale operations could materialize more quickly, the lack of trained mining personnel and the problems of transportation were significant limitations.

[1]Where necessary, values have been converted from Burundi francs (BF) to U.S. dollars at the rate of BF158.67 = US$1.00 in 1989 and BF140.40 = US$1.00 in 1988.

OTHER SOURCES OF INFORMATION

Agencies

Department of Geology and Mines
Ministry of Energy and Mines,
Republic of Burundi
B.P. 745, Bujumbura, Burundi
Telephone: 257-22278; Telex: 5182 BDR; Fax: 257-22337

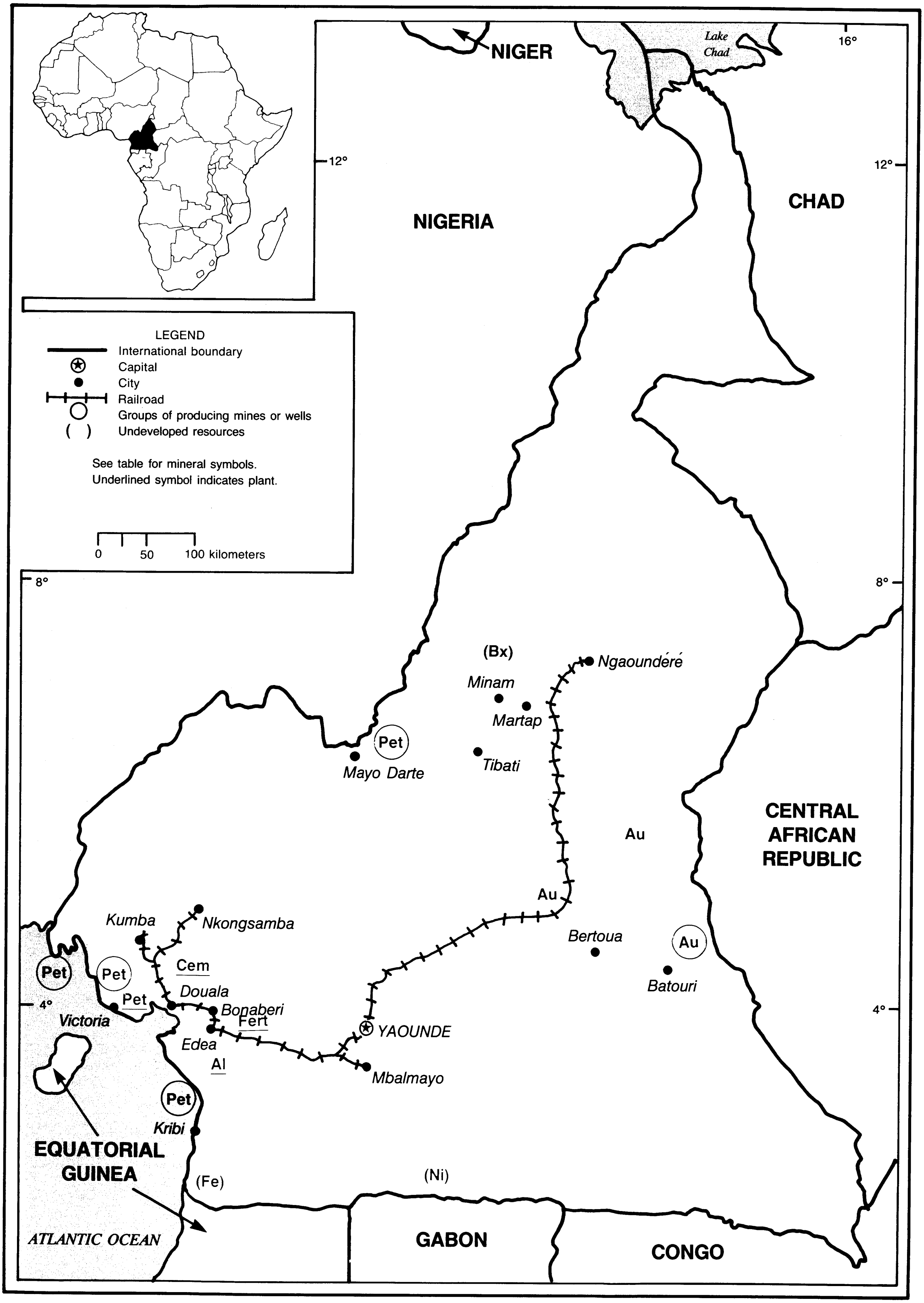
Department of Technical Cooperation for Development
Natural Resources and Energy Division, United Nations
1 UN Plaza, New York, NY 10017
Telephone 212-963-8764

Publications

Atlas du Burundi, Universite de Bordeaux, 1979, 96 pp.

CAMEROON

AREA 475,440 km² **POPULATION 11 million**



THE MINERAL INDUSTRY OF

CAMEROON

By Thomas P. Dolley

Cameroon's mineral industry was based mainly on production of aluminum metal, cement, and crude petroleum. Petroleum production continued to decline in 1989. World oil prices rose to approximately $20 per barrel by yearend 1989 and $36 per barrel in 1990, but Cameroon was unable to earn additional revenue owing to reduced output. Additionally, high taxation by the Government has not encouraged petroleum exploration. Crude petroleum, cocoa, and coffee were the chief export commodities of Cameroon.

The gross domestic product (GDP) for Cameroon has deteriorated during the past several years. The GDP for 1989 was estimated at $11.2 billion,[1] down approximately $700 million from that of 1988. Declining petroleum production and ongoing economic restructuring have hampered economic growth. Additionally, foreign debt for 1989–90 was estimated at $6.6 billion.

GOVERNMENT POLICIES AND PROGRAMS

Government reforms instituted to stimulate Cameroon's sagging economy have yet to achieve meaningful results. These reforms include decontrolling prices on certain goods, reforming or eliminating inefficient parastatal enterprises, and revising the banking sector.

The mineral policy and legislation of Cameroon is based on the Mining Code, law 64-LF-3 of April 6, 1964, and Decree 64-DF-163 of May 26, 1964. Other pertinent legislation is the Mining Taxation Code, law 64-LF-13 of November 18, 1968, and the decree regulating oil companies, law 82-20 of November 26, 1982. Foreign operators desired an overhaul of the petroleum taxation and production-sharing arrangements. A provision for reimbursement of expenses associated with prospecting and drilling also was of concern. The petroleum sector awaited a revision of the hydrocarbons code, which currently provides production-sharing guidelines of 30% of output to the foreign operator and 70% of output to Cameroon's Société Nationale des Hydrocarbures (SNH).

PRODUCTION

Production of mineral commodities in Cameroon is not significant when compared with the global mineral industry. Hydrocarbon production, Cameroon's chief mineral commodity, has been declining steadily since 1987. Aluminum production from the plant at Edea increased owing to rising global market prices. Tin has been mined in modest amounts since 1933. Additionally, limestone is quarried for use in the cement industry.

Cameroon hosts a variety of mineral deposits, but few have been commercially exploited. The development of a viable mineral industry in Cameroon is difficult owing to inadequate transportation infrastructure and lack of electrical power and financial investment.

TRADE

Crude oil accounts for approximately 50% of Cameroon's exports and most of the nation's foreign exchange. The balance of Cameroon's exports are dominated by agricultural products, such as cocoa and coffee. Total exports for 1989 were estimated at $1.9 billion.

STRUCTURE OF THE MINERAL INDUSTRY

Although the Government is actively involved in the mining sector, its equity in a mineral project generally does not exceed 33%. Foreign operators in Cameroon's mineral industry are usually involved in joint ventures with the Government. The Government's dominant parastatal in the mineral industry is Société National d'Investissement (SNI).

SNH was the state-owned company involved in hydrocarbon exploitation. Compagnie Camerounaise de l'Aluminium (ALUCAM) and the Société Nationale Raffinage (SONARA) are the state-owned companies that manage the aluminum smelter and oil refining facilities, respectively.

COMMODITY REVIEW

Metals

Aluminum.—Increasing world aluminum prices during the last several years have helped to stimulate production of aluminum at the smelter at Edea, east of Douala. The smelter operated at close to its 85,000-metric-ton-per-year capacity, utilizing alumina from Guinea. The smelter's capacity is expected to double in the 1990's.

France's Bureau de Recherches Géologiques et Minières (BRGM), contracted by the Société des Bauxites du Caméroun (Sebacam), surveyed the bauxite deposits of Minim-Martap in the 1960's. Reserve estimates were 1 billion tons of ore grading 43% alumina and 3.4% silica.

Tin.—Tin has been mined from the cassiterite deposits of Mayo Darle, near the Nigerian border, since 1933. Though production is small, concentrates won from the deposits grade from 70% to 74% tin metal. The cassiterite deposits are found near the contact of an acidic basal granite and an overlying gneissoid granite. The gneissoid granite has been intruded by dikes of volcanic rhyolites and trachytes. The latter rock units are suspected to be the source of the tin-bearing hydrothermal solutions. The cassiterite is found as eluvial deposits on the hills surrounding the area. Additionally, cassiterite is found in the quartz porphyry bedrock of the area at the contacts with the rhyolite dikes. By the beginning of 1989, France's BRGM had pulled out of a planned joint venture

TABLE 1

CAMEROON: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Aluminum metal, primary	metric tons	90,296	83,810	79,008	86,513	[3]91,716
Cement, hydraulic	do.	748,858	783,368	[3]718,869	584,523	580,000
Gold, mine output, Au content	kilograms	8	8	[e]8	[e]8	8
Petroleum, crude[e]	thousand 42-gallon barrels	49,000	53,000	63,500	62,780	[3]58,648
Pozzolana	metric tons	105,634	168,425	128,574	130,490	130,000
Stone:						
Limestone	do.	96,961	78,260	42,443	57,369	57,000
Marble	do.	1,432	331	209	[e]200	200
Tin ore and concentrate:						
Gross weight	kilograms	13,000	[e]13,000	7,685	4,894	4,800
Sn content[e]	do.	[3]10,000	9,300	5,533	3,400	3,400

[e]Estimated. [p]Preliminary.
[1]Includes data available through Dec. 1, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, stone, and sand and gravel) presumably are produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

TABLE 2

CAMEROON: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Aluminum	La Compagnie Camerounaise de l'Aluminium Pechiney-Ugine (Pechiney, France, 58%; Government, 42%)	Edea, south of Douala	85,000.
Cement	Société des Cimenteries du Cameroun (Government, 100%)	Bonaberi and Figuil	900,000. 100,000.
Fertilizer	Société Camerounaise des Engraise (Government, 100%)	Bonaberi	160[2] ammonium. 100[2] sulfate. 180[2] sulfuric acid.
Gold	Artisanal workings	Batouri	NA.
Petroleum:			
Crude	(Société Nationale de Hydrocarbures, 60%; Elf, France, 40%)	Rio Del Rey Oilfields (offshore and North of Victoria)	172,000.[3]
Refined	(Société Nationale Raffinage and Hydrocarbures, 66%; Total-Cie., France, 10%; Elf, France, 8%; Mobil and Shell, United States, 8% each)	Limbe	43,020.[3]
Tin	Artisanal workings	Mayo Darle	NA.

NA Not available.
[1]Metric tons per year unless otherwise specified.
[2]Metric tons per day.
[3]Barrels per day.

with the Government to further develop the tin resource.

Mineral Fuels

Exploratory drilling activity decreased in 1989 from the previous year owing in large part to low global oil prices and lack of cost incentives to attract foreign operators. Only one well was completed, Ankodat Marine-2, by France's Société National Elf Aquitaine (Elf). The well was plugged and abandoned after reaching a total depth of 2,012 meters. Work in this concession, near the Nigerian border, reportedly was discontinued owing to uncertainty of the official offshore border between Cameroon and Nigeria. Elf conducted development work at two other wells but dropped its 703-square-kilometer (km^2) offshore Oceanic I exploration permit in the Douala Basin.

Geophysical activity in the form of seismic surveying declined in 1989. Elf completed 296 kilometers (km) of offshore seismic work in 1989, compared with 6,656 km in 1988. Total onshore and offshore acreage held under license in Cameroon declined in 1989 from 14,146 km^2 the previous year. Onshore licensed acreage was 8,765 km^2, and offshore acreage was 4,402 km^2. On May 23, 1990, Elf and Pecten International of the United States signed a 5-year agreement to proceed with new oil and gas exploration. Pecten International is a subsidiary of Shell Petroleum of the United States. The agreement was to be ratified by the Government in late 1990 with Pecten International planning for new exploration work to begin by November 1990. Currently, Pecten International operates the offshore Mokoko-Abana oilfield and is an equity partner with Elf and its other offshore field production.

Reserves

Bauxite reserves at Minim-Martap had been estimated at 1 billion tons by BRGM and Sebacam. A variety of minerals occurs in Cameroon, but with the exception of tin and limestone, few have been commercially exploited.

INFRASTRUCTURE

Electrical generation capacity is approximately 752 thousand kilowatts. Railroads total 1,003 km of track, of which 858 km is 1-meter gauge track with the remainder being 0.6-meter gauge track. Highways total approximately 65,000 km, 50% of which is unpaved. The major seaport is at Douala.

OUTLOOK

Government authorities have conceded that without additional commercial hydrocarbon discoveries, Cameroon's petroleum reserves will be exhausted by the end of the century. Output of crude petroleum will probably continue to decline in the short term, reducing available revenue to the Government. Further foreign venture capital for petroleum exploration in Cameroon may be contingent on revisions in the tax code. Poor infrastructure and marginal ore grades may continue to hamper development of known mineral deposits.

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[1]Where necessary, values have been converted from Communauté Financiere Africaine francs (CFAF) to U.S. dollars at the rate of CFAF319.01 = US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

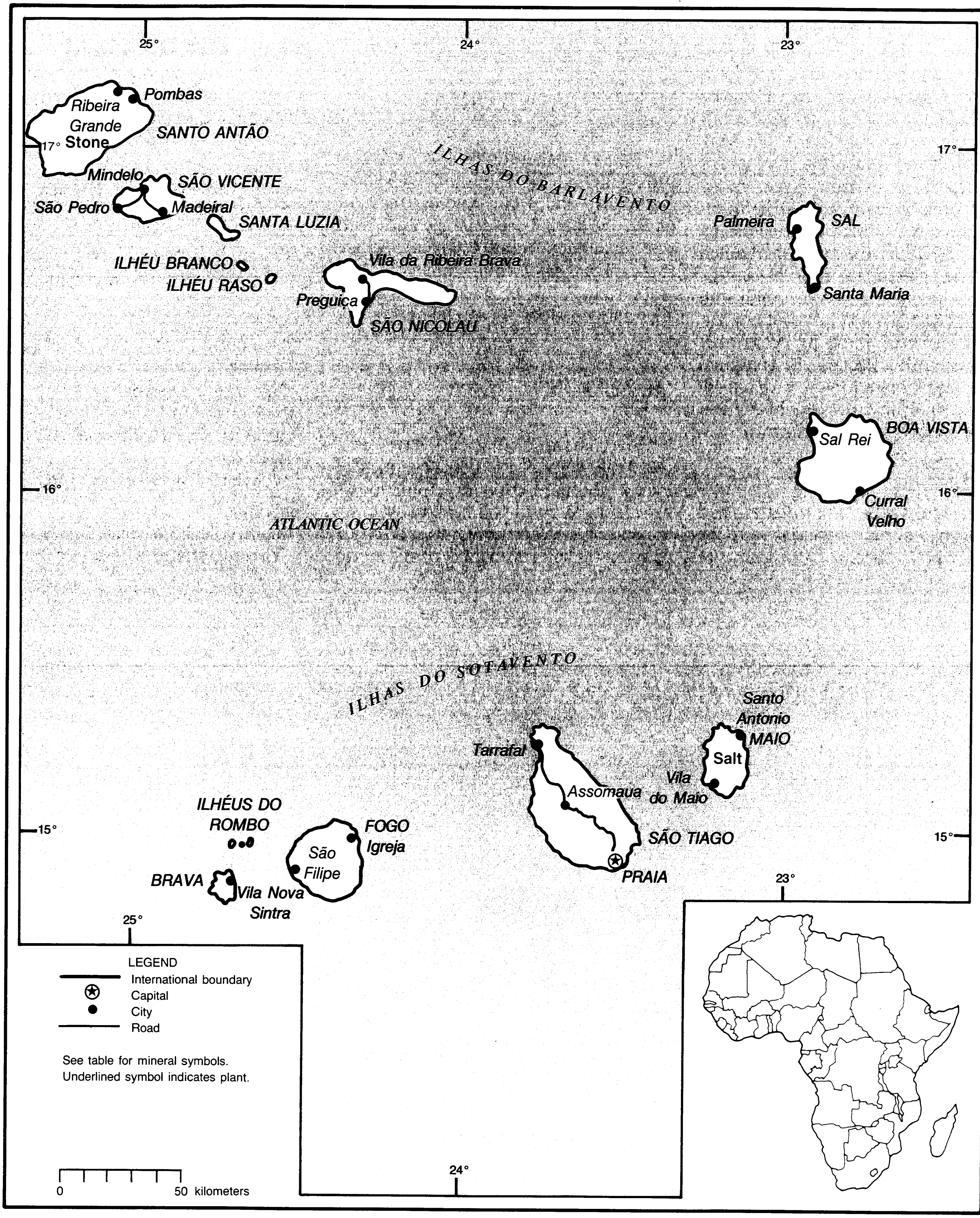
Department of Mines and Geology
B.O. 70
Yaounde, Cameroon
Director of Mineral Resources
Ministry of Commerce and Development
B.P. 1004
Yaounde, Cameroon

Publication

Ministry De L'Economie Et Du Plan, Yaounde: Bulletin Mensuel De Statistique.

CAPE VERDE

AREA 4,030 km² **POPULATION 365,000**



THE MINERAL INDUSTRY OF

CAPE VERDE

By Audie L. King

Mining was a very small contributor to the Cape Verdian economy, which was concentrated in the services and the agricultural sectors. Cape Verde produced minor quantities of salt and pozzuolana. Cement, gypsum, kaolin, limestone, ornamental building stone, and pumice have been either mined or identified as possible resources.

Salt was produced on the island of Maio. The Islands of Sal and Boa Vista have reportedly produced salt in previous years. Pozzuolana, a volcanic rock used as a cement substitute, was mined on Santo Antão Island. A plan initiated in 1984 to produce 64,000 tons per year of cement on Maio Island was suspended by the Government in 1988 when it was decided that domestic demands could be met more cheaply through imports.

Economic growth had been impressive during the 1980's. Real gross domestic product had increased at an average rate of 6% per year between 1980 and 1986. This strong economic performance is partially due to the Government's sound economic policies, but the country remains strongly dependent on foreign aid and emigrant remittances.

GOVERNMENT POLICIES AND PROGRAMS

Cape Verde's Second National Development Plan (1986–90) seeks to improve the country's balance of trade. In 1987, the latest year for which such data are available, Cape Verde had a trade deficit of $126.7 million ($134.6 million in imports and 7.9 million dollars in exports).[1] The Government has begun to realign the economy to deal with the country's high levels of unemployment and its shortage of natural resources. New economic policies emphasize labor intensive activities in the manufacturing sector, such as the transformation of imported raw materials, and the service sector, such as tourism.

The Third Party Congress, held in November 1988, approved a number of policies focusing on ways to utilize Cape Verde's strategic geographical position to promote exports and economic growth. The development of the Country's tourist, fishing, and offshore banking concerns were dealt with specifically.

In December 1988, the Cape Verdian constitution was amended to provide for private banking and insurance companies.

In May 1989, a duty-free warehousing system was established under which most goods could be stored for up to 4 years without the payment of duties. These new warehousing laws would facilitate the importation of raw, semifinished, or finished materials that would be used in Cape Verde's export industries.

PRODUCTION

Small quantities of salt and pozzuolana were mined for domestic consumption. The mining industry employed an estimated 170 people in 1989, of which 50 worked in the salt industry and 120 in the extraction of naturally occurring building materials. Salt production had decreased markedly since 1985 owing apparently to technical problems. During the same period of time, high demand from the construction industry had caused pozzuolana production to more than double.

TRADE

In 1988, the latest year data were available, Cape Verdian salt exports were $48,600, and salt imports were $65,300. In 1980, Cape Verde was a net exporter of salt, exporting $372,500 with no reported salt imports. All pozzuolana continued to be mined for domestic use.

STRUCTURE OF THE MINERAL INDUSTRY

All Cape Verdian mining companies were privately owned. The Cape Verdian Government had exhibited a positive attitude toward foreign investment. Laws enacted in recent years should make it easier for foreign companies such as Salins du Cap Vert, a French-owned salt producer, to operate profitably.

TABLE 1

CAPE VERDE: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Salt	metric tons	6,163	4,855	[r] [e]5,000	[r] [e]3,000	3,000
Pozzuolana	do.	23,000	33,000	43,000	53,000	53,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Sept. 4, 1990.
[2]In addition to commodities listed, small quantities of limestone, clay, gypsum, pumice, and ornamental building stone may have been produced, but output was not reported, and available information is inadequate to make reliable estimates of output levels.

TABLE 2

CAPE VERDE: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[e 1]
Salt	Salins du Cap Vert (Private; French, 100%)	Maio Island	45
	Companhia de Fomento	Maio Island	45
Pozzuolana	Four small, private companies	Santo Antão Island	53

[e] Estimated.
[1] Thousand metric tons per year.

COMMODITY REVIEW

Industrial Minerals

Salt.—Two extraction plants were reportedly in operation on Maio Island. The operating companies were Saline du Cap Vert, a private French company, and Companhia de Formento, which was recently shut down owing to operational difficulties. In the past, salt was also produced on Sal and Boa Vista Islands. Marine salt extraction, which accounted for only 0.6% of Cape Verde's total production, had recently received attention from the Government. The salt industry, along with other marine resources such as shipping and fishing, was singled out for future development in Cape Verde's most recent National Development Plan. Nevertheless, production had fallen sharply during the past 12 years, from 31,000 tons in 1977 to only 3,000 tons in 1989.

Pozzuolana.—Together with its value added cement products, pozzuolana or volcanic trass accounted for 88% of the value of all minerals produced for construction purposes. The industrial minerals industry had quadrupled from 1980 to 1985 and has since been growing at 10% per year. Pozzuolana was mined from four mines on Santo Antão Island.

INFRASTRUCTURE

The island's main ports were at Mindelo on the island of São Vicente and at Praia on São Tiago Island. There were smaller ports on many of the other islands. The ports collectively handled 394,000 tons of freight in 1986, the latest year for which such statistics were available.

The Amilcar Cabral international airport on Sal Island, which had a capacity of 1 million passengers per year, was being enlarged in 1988, even though air traffic had decreased in recent years. Because of its strategic location, the airport was used for refueling airliners from the Republic of South Africa, Portugal, the U.S.S.R., Cuba, Guinea Bissau, and Angola. Smaller airports were on most other islands.

There were 2,250 kilometers of roads in 1981, the last year that such data were available, of which 660 kilometer was paved.

The availability of water was the major concern in a country that had suffered devastating droughts and famines every 20 to 30 years throughout its history. The most recent drought started in 1968 and lasted 10 years.

Only international aid and the importation of nearly all of the islands' food requirements have averted disaster. Past droughts have wiped out 15% to 40% of the population. Rainfall finally broke the latest drought in 1978, but has been erratic during most of the 1980's. In 1984, heavy rainfall caused catastrophic floods. Recent programs included reforestation, the building of rainwater dikes, water well drilling, and irrigation to reduce some of Cape Verde's weather-related problems.

OUTLOOK

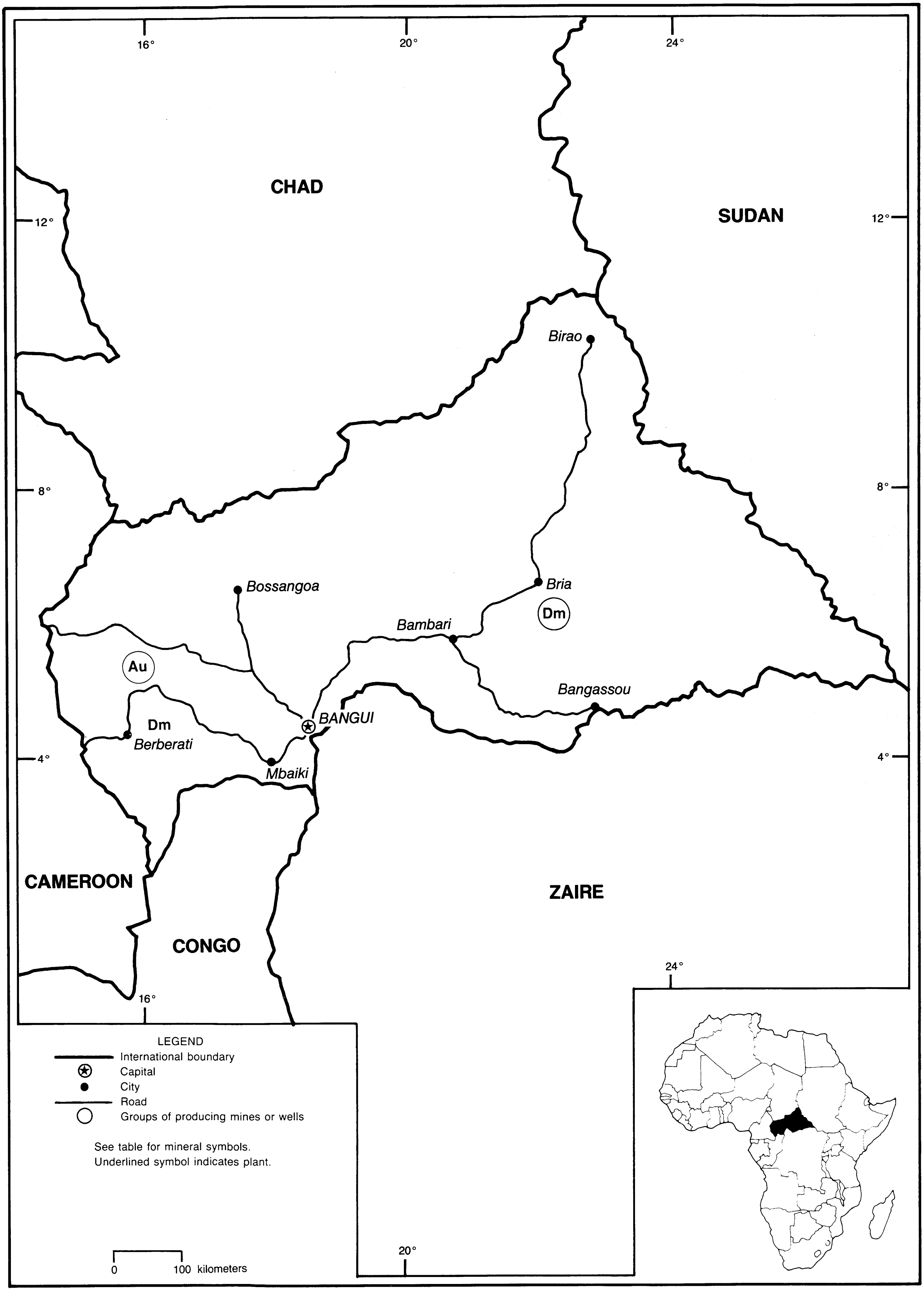
A downturn in the world's economy would be detrimental to the Cape Verdian pozzuolana industry. Because most of the materials extracted in Cape Verde are for local consumption in the construction industry, the future of its mineral industry is tied to the islands' economy, which in turn is dependent on foreign aid and emigrant remittances.

Cape Verde's salt industry produced only 3% of its capacity in 1988. Salt output should increase as problems that have beset the industry for the past few years are resolved.

[1] Where necessary, values have been converted from Cape Verdian escudos (CVEsc) to U.S. dollars at the rate of 72CVEsc = US$1.00.

CENTRAL AFRICAN REPUBLIC

AREA 622,980 km² **POPULATION 2.8 million**



THE MINERAL INDUSTRY OF THE

CENTRAL AFRICAN REPUBLIC

By Thomas P. Dolley

The landlocked Central African Republic's mining industry continued to be based on diamond production. The country remained underdeveloped and undermonetized in 1989. With a population estimated at 2.8 million people, it remained heavily dependent on foreign aid and entered a third phase of a Structural Adjustment Program (SAP) in June 1990. The SAP, initiated in 1986, was continued by the Government in cooperation with the International Monetary Fund and the World Bank. The goal of the SAP is to establish sustainable economic growth and invigorate the potential for trade. The country's landlocked condition has complicated trade activity owing to higher transport costs. Other than streamlining the civil sector of the nation, the SAP has had limited success in improving economic conditions. External debt at yearend 1989 was $660 million.[1] The gross domestic product (GDP) for 1989 was approximately $1 billion.

France supplied approximately 60% of the country's imports. An additional 14% of imports was supplied by other members of the European Community. Fluctuation of global prices for some of the Central African Republic's most important exports exacerbated problems such as constant budget deficits and increased foreign debt. Major nonmineral export commodities of the Central African Republic are coffee, cotton, livestock, timber, and tobacco.

Mining legislation was based on the Mining Code, Law No. 61/208 of April 11, 1961. This law was subsequently modified in 1979 with 12 additional annexes attached, the latest in 1984. These annexes provide guidelines for the ownership, exploitation, possession, and marketing of gold and raw diamonds. Hydrocarbon legislation was based on the Petroleum Code, Ordinance No. 73/016 of February 10, 1973.

Agriculture is the dominant industry, accounting for 40% of the GDP. Mining activity accounts for only 4% to 5% of the GDP. Alluvial diamonds of gem quality along with gold were the primary minerals exploited. Official Government statistics indicate that total revenue generated for gem-quality diamonds was approximately $66.3 million, with industrial diamonds generating $3.6 million. Revenue generated from gold was approximately $3.3 million. However, a large proportion of diamond and gold activity is clandestine and unreported. Clandestine production of these mineral commodities could represent more than one-half of total production.

Since 1987, Osborne & Chappel Goldfields (OCG) of Malaysia, in a joint venture with Belgium's Société d'Enterprise et de Investissements (Sibeka), conducted geophysical surveys and drilling in the western part of the country along the Mambere River. Targets for the investigation included diamonds and other heavy minerals. However, no significant deposits were discovered along the 20-kilometer section of river, and OCG and Sibeka withdrew from the project in 1989.

An estimated 80% of the country's energy needs were supplied by wood. Petroleum products were the most significant imports. A consortium of foreign operators, headed by Esso Exploration and Production Central Africa and the Royal Dutch/Shell Group, relinquished their petroleum exploration tracts in 1988.

A positive near-term outlook for the country is predicated on the development of an adequate transportation and marketing infrastructure, coupled with the attainment of a technically skilled work force, both of which do not currently exist. The Government sought foreign investment and expertise, but will remain heavily dependent on loans from the international community.

[1]Where necessary, values have been converted from Communauté Financiere Africaine francs (CFAF) to U.S. dollars at the rate of CFAF319.01 = US$1.00.

TABLE 1

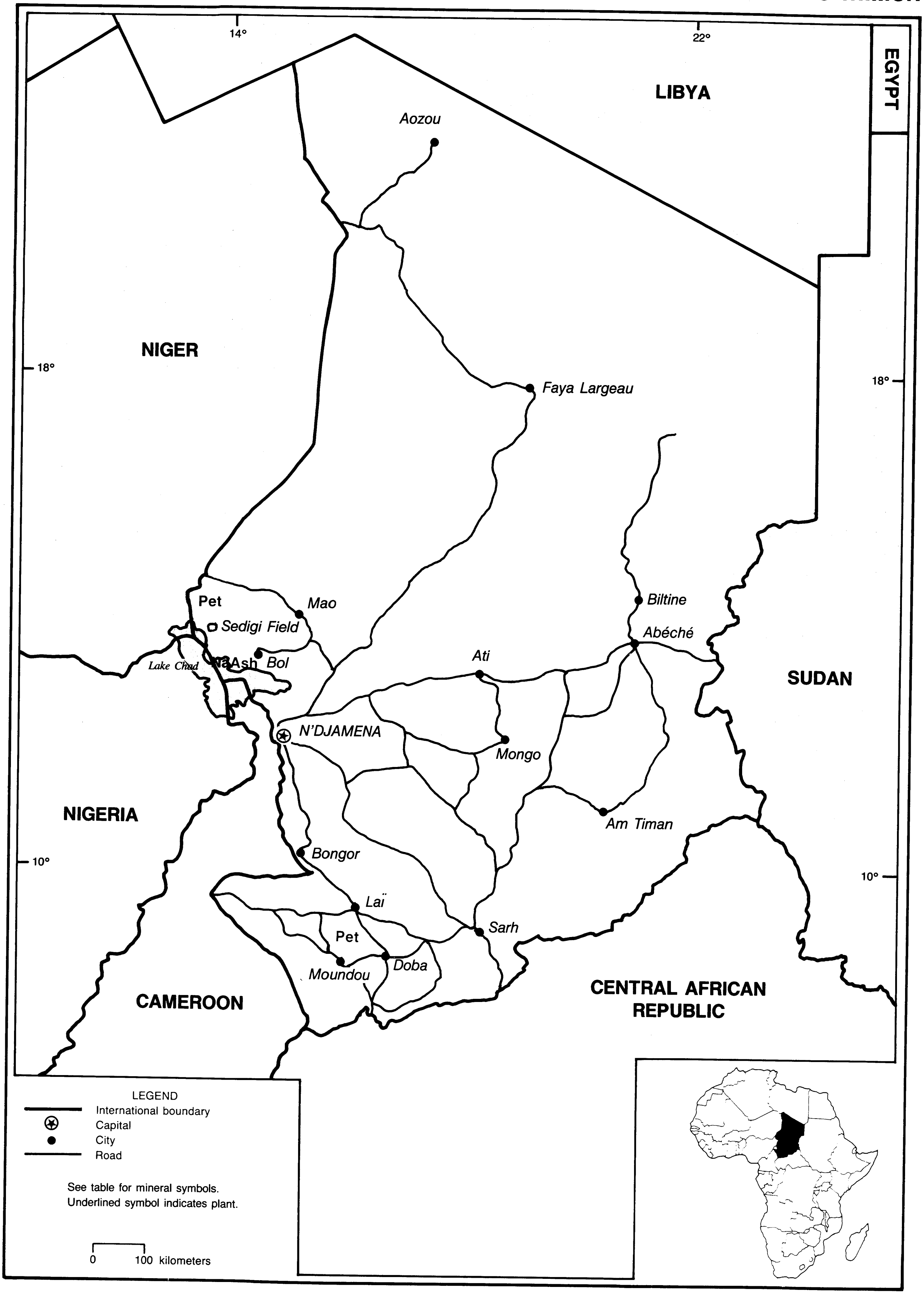
CENTRAL AFRICAN REPUBLIC: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
Diamond:						
Gem	carats	189,545	258,701	303,769	284,130	334,396
Industrial	do.	87,452	98,677	108,455	59,278	80,806
Total	do.	276,997	357,378	412,224	343,408	415,202
Gold	kilograms	188	219	223	381	328

[p]Preliminary.
[1]Includes data available through Apr. 14, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, gravel, sand, and stone) presumably are produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.

CHAD

AREA 1,284,000 km² **POPULATION 5 million**



THE MINERAL INDUSTRY OF

CHAD

By Thomas P. Dolley

The landlocked nation of Chad, nearly twice the size of the State of Texas, had no significant mineral industry in 1989, a problem exacerbated by limited energy resources. Most of the daily energy needs in Chad continued to be generated from traditional fuels such as wood and charcoal. Chad's economic condition has remained essentially unchanged throughout the decade of the 1980's. With a population totaling about 5 million people, Chad remained one of the poorest countries in the world. The gross domestic product for 1989 was estimated at approximately $993 million,[1] with a per capita income of about $170. External debt at yearend 1989 amounted to $360 million. Chad remained highly dependent on foreign aid. Civil war, conflict with neighboring Libya, drought, and food shortages have also combined to thwart the development of a viable mineral industry in Chad. Additionally, Chad did not possess a railway system or river port facilities to assist mining industry development.

Civil unrest continued in the country in 1989 and into late 1990. A territorial dispute between Chad and Libya over the reportedly mineral-rich Aouzou strip in northern Chad remained unresolved in 1989 and early 1990. The dispute would probably be submitted in 1990 to the International Court of Justice for adjudication.

GOVERNMENT POLICIES AND PROGRAMS

The Government's mineral policy centers on the exploration and development of domestic hydrocarbons, with a causative effect of lessened woodfuel usage and curtailed deforestation. Mining legislation in Chad was based on Mining Code No. 7/PC/TP/MH of January 18, 1962, and Petroleum Code No. 7/PC/TP/MH of February 3, 1962. In early 1989, the Ministry of Mines, Petroleum and Energy stated that the mining and petroleum codes remained in effect, but that the Government recognized the need to revise the regulations. A committee was to be formed to review and modify the 1962 regulations with a revised code to be released in 1990 or 1991.

PRODUCTION

Owing to frequent civil war, regional strife, poor infrastructure, drought, and famine, Chad had virtually no mineral industry. Production of mineral fuels was nonexistent. Historically, Chad has produced an average of 4,000 to 5,000 tons per year of trona, or hydrous sodium carbonate, from the Lake Chad region since the 1970's. Production of trona in Chad is not significant on a global scale.

TRADE

Export revenues totaled about $145 million in 1989, with cotton accounting for $68 million of this export total. Importation costs for 1989 were $234 million, of which petroleum imports represented a major percentage.

Petroleum products consumed in Chad are exclusively imported from Nigeria and Cameroon. Owing to the fact that there are no railway or pipeline facilities, importation of petroleum is by trucks, which are privately owned and operated. Entry of these trucks into Chad is uncontrolled, and substantial smuggling of fuel and petroleum products occurs across the border of Nigeria. Additionally, petroleum prices are high, owing to the 1,400 kilometers (km) of difficult inland roadways that must be traversed by the trucks. Lowered international oil prices in the late 1980's have not benefitted Chad. Distribution of the majority of petroleum products is through Shell Oil Corp. and Mobil Oil Corp. of the United States and Total of France. An officially reported total of 418,719 barrels of petroleum products was imported by Chad in 1989. These products were comprised of jet fuel, gasoline, distillate fuel oil, kerosene, lubricants, and natural asphalt. Fuel shortages occurred in Chad during March 1989 owing to fire damage, maintainence, and unspecified problems at three Nigerian refineries during the year.

STRUCTURE OF THE MINERAL INDUSTRY

The Government's principal mineral agency was the Ministry of Mines, Petroleum and Energy in N'Djamena. Petroleum exploration was initiated in 1970 by a consortium of oil companies headed by the Continental Oil Co. (CONOCO) of the United States and augmented by Exxon Corp., Chevron U.S.A. Inc., and Shell Oil Co. of the United States. CONOCO later transferred its holdings to Esso Chad, a consortium of Shell, Chevron, and Exxon of the United States. The Société d'Etude et d'Exploitation de la Raffinerie du Tchad (SEERAT) is a Chadian parastatal, which is owned 51% by the Government with the remaining 49% of the shares owned by Shell, Esso, and Chevron. Future petroleum refining development in Chad will be SEERAT's prime responsibility. Trona production in Chad was privately managed.

COMMODITY REVIEW

Mineral Fuels

Commercial hydrocarbon production does not exist in Chad. However, crude oil was discovered in Chad in 1974 at Sedigi, north of Lake Chad, approximately 300 km from the capital city N'Djamena. Sedimentary rock covers approximately 70% of Chadian territory. Structural and sedimentary geology was first studied during field work conducted in the 1960's.

In 1989, exploration acreage that was held under license by foreign petroleum operators totaled 355,716 square kilometers. Geophysical exploration in Chad for 1989 featured the acquisition of 1,418 km of seismic profiles by Esso on its Chari, South Chari, and Lake Chad blocks. Additionally, a petroleum structure nearby the Sedigi Fields, containing crude oil similar to that found at Sedigi, could be utilized after the proposed production at the latter declines.

SEERAT will build, own, and operate a proposed pipeline and refinery in the future. Further development of the project will depend on World Bank funding in the form of a Petroleum and Power Engineering Credit valued at $11 million.

Reserves

A variety of minerals have been reported to occur in Chad; however, official Government reserve figures have not been reported. Trona resources constitute a significant mineral commodity obtained from Lake Chad.

INFRASTRUCTURE

Diesel generators produce all electrical power utilized in Chad using imported diesel fuel. Total installed generating capacity amounted to 29.2 megawatts. Chad possessed no railroad or river port facilities. Roadways totaled 31,322 km, only 32 km of which were bituminous material and the remainder gravel or unimproved.

OUTLOOK

The decimation of forest and woodfuel resources for energy use by 99% of Chadian households is expected to continue. Compounding this problem with frequent droughts and delayed development of domestic hydrocarbon potential could create a serious energy imbalance in Chad. There appears little prospect for foreign loans to Chad for mining and infrastructure development.

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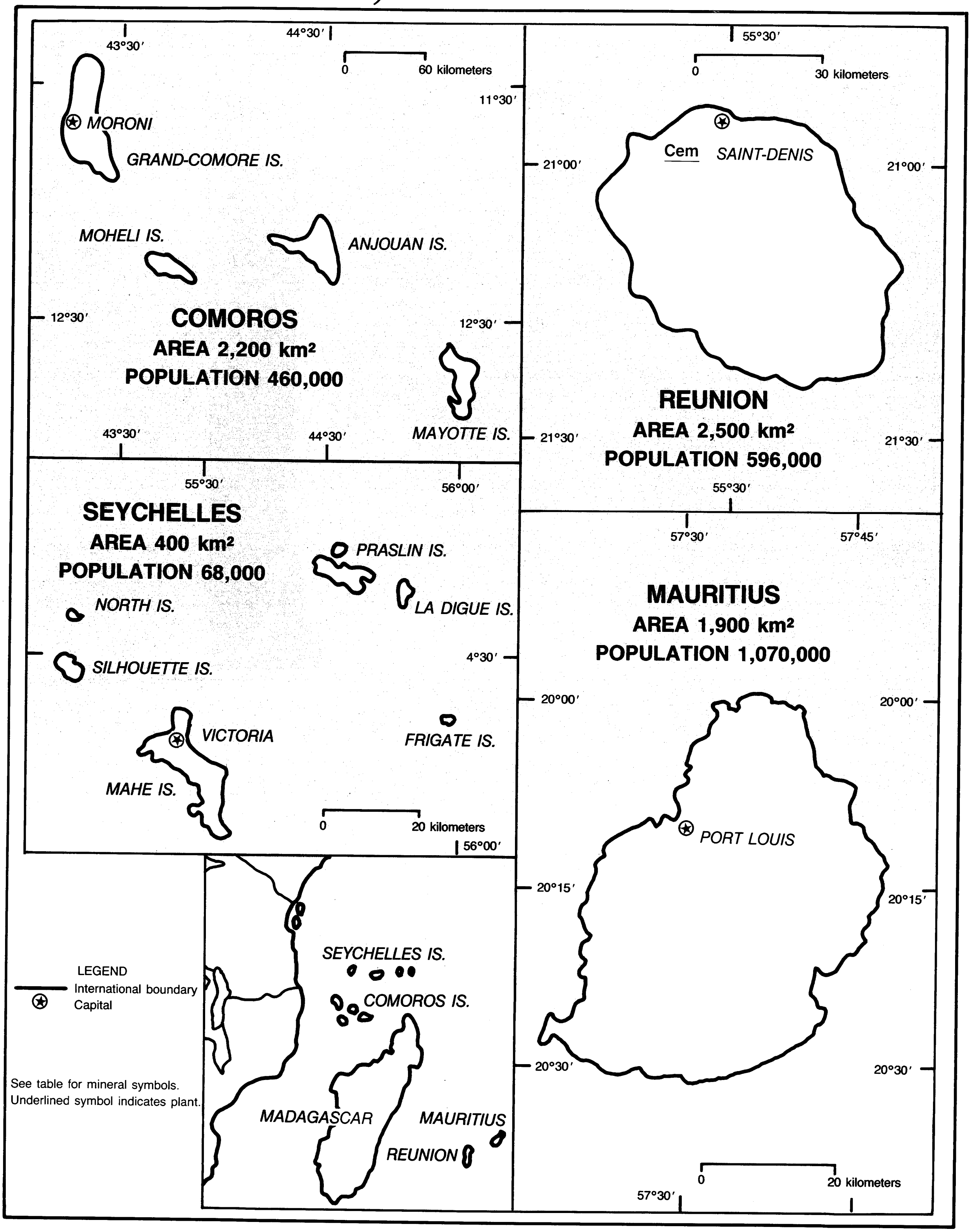
[1] Where necessary, values have been converted from Communauté Financíere Africaine francs (CFAF) to U.S. dollars at the rate of CFAF319.01 = US$1.00.

ISLANDS OF COMOROS, MAURITIUS, REUNION, AND SEYCHELLES



THE MINERAL INDUSTRIES OF

COMOROS, MAURITIUS, REUNION, AND SEYCHELLES

By Audie King and Lloyd E. Antonides

COMOROS

Comoros, a three island nation between Madagascar and Mozambique, had production of only common building materials, such as sand and rock. New home construction technology, based on research conducted by the Council for Scientific and Industrial Research of the Republic of South Africa, was being implemented. The method utilizes abundant local sources of lava and volcanic ash in a cementation process, both for structural support and for plastering. The method obviates the use of coral for lime production and can be undertaken by unskilled labor.

The gross domestic product was estimated at $207 million in 1988, the latest year for which data are available. Agriculture, including fishing and forestry, and tourism, are the most important industries. Cash crops for export include cloves, perfume essences, and copra. Comoros is the major source for essence of ylang-ylang, which is used in perfumes, and the second largest producer of vanilla. France is the major trading partner; U.S. trade with Comoros is insignificant. Electricité et Eaux des Comoros had responsibility for both power generation and delivery. Total generating capacity was 16 megawatts (MW), all based on diesel fuel, except for 1 MW from hydroelectric power. The country's future concern is preservation of its relatively fragile environment as it copes with population growth and minimizing erosion from deforestation and other industrial activities.

MAURITIUS

The mineral industry of Mauritius, an island nation off the western coast of Madagascar, consisted essentially of lime, rock production, and salt in 1989. About 300,000 metric tons per year (mt/yr) of coral sand and 2,000 mt/yr of coral were produced, mainly for construction purposes. The economy was dominated by sugar production for export; however, significant diversification has occurred with the creation of export-oriented textile businesses. Successful agriculture and textile sectors, coupled with tourism, have resulted in nearly full employment for the country's work force.

Exports were $1.042 billion and imports were $1.3 billion in 1988. Exports of textiles and clothing were $454 million, and exports of sugar were $334 million. Mineral exports were as follows: diamonds, $22 million; fertilizers, 8,811 tons; and iron and steel scrap, 4,845 tons. The major portion of the country's exports, in order of importance, were to the United Kingdom, France, and the United States. France, the United States, and the Republic of South Africa were major sources of imports. Total U.S. exports to Mauritius were $136 million, and total imports from Mauritius were $151 million.

The principal mineral commodities imported by Mauritius as sea cargo in 1988 were as follows: cement, 346,948 tons; coal, 34,009 tons; fertilizer, 42,342 tons; liquefied petroleum gas, 161,600 barrels; and other petroleum products, 3 million barrels. Other general imports were as follows: clays, 5,541 tons; iron and steel ingots, 25,403 tons; and iron and steel semimanufactures, 67,484 tons.

Electric power generating capacity, which is under the control of the Central Electricity Board, was 233 MW. Projects underway for increasing such capacity included the Bocage-Guibes Dam and hydroelectric project, valued at $35 million, and expansion of existing thermal generating capacity, valued at $24 million. Industrial activity was halted for 2 days in March owing to a strike by electrical workers. The sugar industry supplies much of its own elec-

TABLE 1

MAURITIUS: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1985	1986	1987	1988[p]	1989[p]
Lime[e]	7,000	7,000	7,000	7,000	7,000
Salt[e]	6,000	6,000	6,000	6,000	6,000
Stone: Basalt, not further described[e]	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000

[e] Estimated. [p] Preliminary.
[1] Includes data available through Nov. 2, 1990.
[2] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

trical power, some of it through the consumption of bagasse.

Mauritius looked forward to a $121 million development plan for 1990–93, $60 million of which was to be donated by foreign Governments primarily for training skilled workers. It was recommended that, for environmental reasons, mining of coral sand and coral be terminated to prevent damage to the nation's lagoons. The mining and crushing of local basalt was to replace the loss of the coral.

REUNION

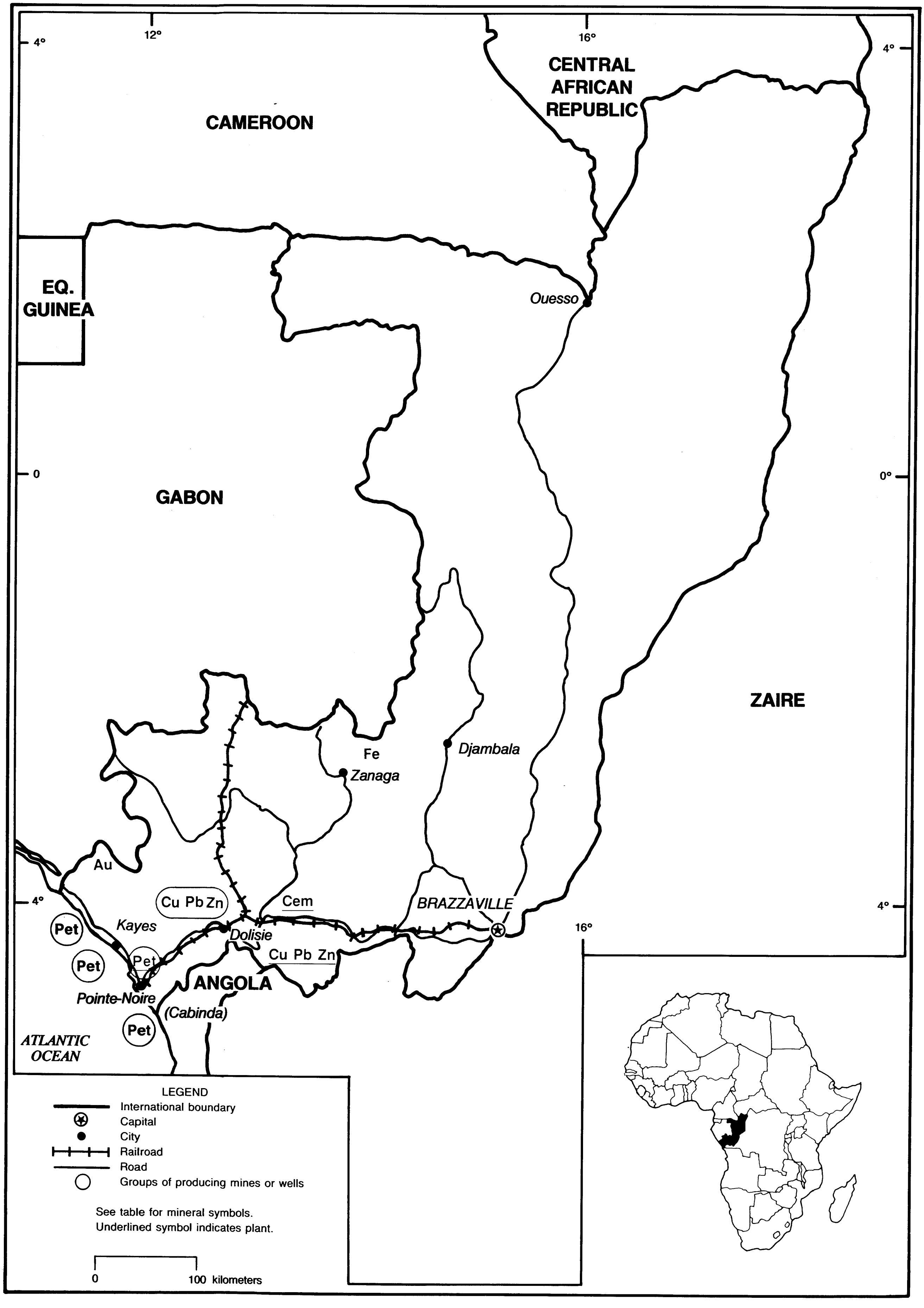
The mineral sector of Reunion was relegated to production and consumption of local deposits of rock and coral. A clinker grinding plant with 200,000-mt/yr capacity, supplied from imported materials, is near Saint-Denis. Most of the economy is agriculture based, with tourism increasing in importance. The principal export products are sugar and spices; imports were mainly manufactured goods, food, and equipment. Total electric generating capacity was 245 MW.

SEYCHELLES

The only mineral production of significance was the collection of guano for use as phosphate fertilizer, annual output of which was estimated at 4,500 tons for 1985–89. Enterprise Oil Corp. of the United Kingdom completed seismic studies for determining the presence of potential reservoir traps for crude petroleum in the Seychelles. The company planned to commence drilling in 1990 with an expenditure of about $30 million. The Seychelles National Oil Co. was also attempting to interest other companies in exploring for oil in the Seychelles. Farming, fishing, and tourism were the main sectors of the economy. Total electric generating capacity was 25 MW. Limited land area and increasing population and dependency on tourism have sparked concern for the concurrent environmental degradation.

CONGO

AREA 342,000 km² **POPULATION 2.2 million**



THE MINERAL INDUSTRY OF

CONGO

By Thomas P. Dolley

The People's Republic of the Congo remained a major petroleum producer in sub-Saharan Africa in 1989. Indeed, the mainstay of the Congolese economy was the production of crude oil. Crude oil production in 1989 increased by more than 10% compared with the previous year. Of the total Congolese production, 70% is exported to the United States, amounting to an estimated $400 million in revenue.[1] Petroleum acreage under license by yearend 1989 equaled 14,735 square kilometers, a slight increase over that of 1988. Offshore permits accounted for 58% of the total acreage. However, the Congolese nonfuel minerals sector remained underexploited in 1989.

Mining legislation in the Congo is based on Law 29-62 of June 1962. The law has been amended several times, most recently with Decree No. 86/814 of June 11, 1986. In general, mining is carried out by the state or through joint-venture agreements. The population in the Congo was approximately 2.2 million with a per capita income of $1,000. External debt for the Congo was estimated at $4 billion by yearend 1989, with the Government seeking U.S. supported negotiations with the International Monetary Fund and World Bank for rescheduling of the debt.

Hydro-Congo is the state-owned petroleum company that employed 1,483 people in 1989. The Government announced the restructuring of Hydro-Congo, which included the eventual privatization of a majority of the company's sectors, from transport facilities and refining to retail outlets. Restructuring of the company could halve the number employed by 1990. Foreign petroleum producers were involved in equity partnerships with Hydro-Congo, either as joint ventures in exploration or in production-sharing agreements.

Société Nationale Elf Aquitaine (Elf) of France, operating through its subsidiary Elf-Congo, was the primary petroleum producer and accounted for 80% of total production within the Congo. Elf-Congo produced 35 million barrels of Congo's total crude oil production in 1989. Practically 100% of this production is exported to the United States. Production of crude oil from the Congo represented 19% of Elf's global production total. Elf has been active in the Congo since 1968 and has extended its contract until the year 2005. The other producer, accounting for 20% of total crude oil output, was Italy's Azienda Generali Italiana Petroli S.p.A. (Agip). Agip's offshore Hinda Marine-1 wildcat well had an oil and gas discovery in 1989.

By yearend 1989 and early 1990, U.S. companies were making a new presence in petroleum exploration and development in the Congo. On February 1, 1990, Atlantic Richfield Co. (Arco), Apache Oil, and Citizens Energy Corp. of the United States signed an oil exploration agreement with Hydro-Congo. The signing followed more than 1 year of negotiations and covered exploration and production rights on the Marine 8 Field offshore of Pointe-Noire. The tract was reported to cover 980 square kilometers. Arco was designated as the operator of the field. Equity partnership in the permit was 50% by Hydro-Congo, 26.79% by Arco, 21.21% by Apache Oil, and 3% by Citizens Energy Corp. The foreign companies will pay exploration and start-up costs.

Amoco of the United States was to start production in 1990 at the Yomba-Masseko-Youbi petroleum field, approximately 40 kilometers (km) offshore of the

TABLE 1

CONGO: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic	metric tons	57,700	[e]58,000	[e]76,000	77,000	77,000
Copper, mine output, Cu content	do.	253	[e]250	726	726	1,000
Gas, natural:[e]						
Gross	million cubic feet	13,000	13,000	13,000	13,000	13,000
Marketed	do.	350	350	350	350	350
Gold, mine output, Au content[e]	kilograms	16	5	4	4	4
Lead, mine output, Pb content	metric tons	1,460	[e]1,400	[e]1,400	1,750	1,000
Lime[e]	do.	[3]7,000	7,000	7,000	7,000	7,000
Petroleum, crude	thousand 42-gallon barrels	43,564	43,435	44,895	[4]49,275	[4]55,000
Zinc, mine output, Zn content[e]	metric tons	2,336	2,300	2,300	1,750	1,000

[e]Estimated. [p]Preliminary.
[1]Includes data available through Dec. 31, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, gravel, sand, and stone) presumably are produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.
[3]Includes imported clinker.
[4]Reported figure.

Congo. The field development was to include 2 platforms and 22 wells. Equity ownership in the venture was Amoco at 50%, Hydro-Congo at 42.75% and a consortium of Kuwait and Saudi Arabia at 6.25%. Financing for the project came from several international banks. Amoco was marketing and distributing refined petroleum products as a share of the Congolese domestic market.

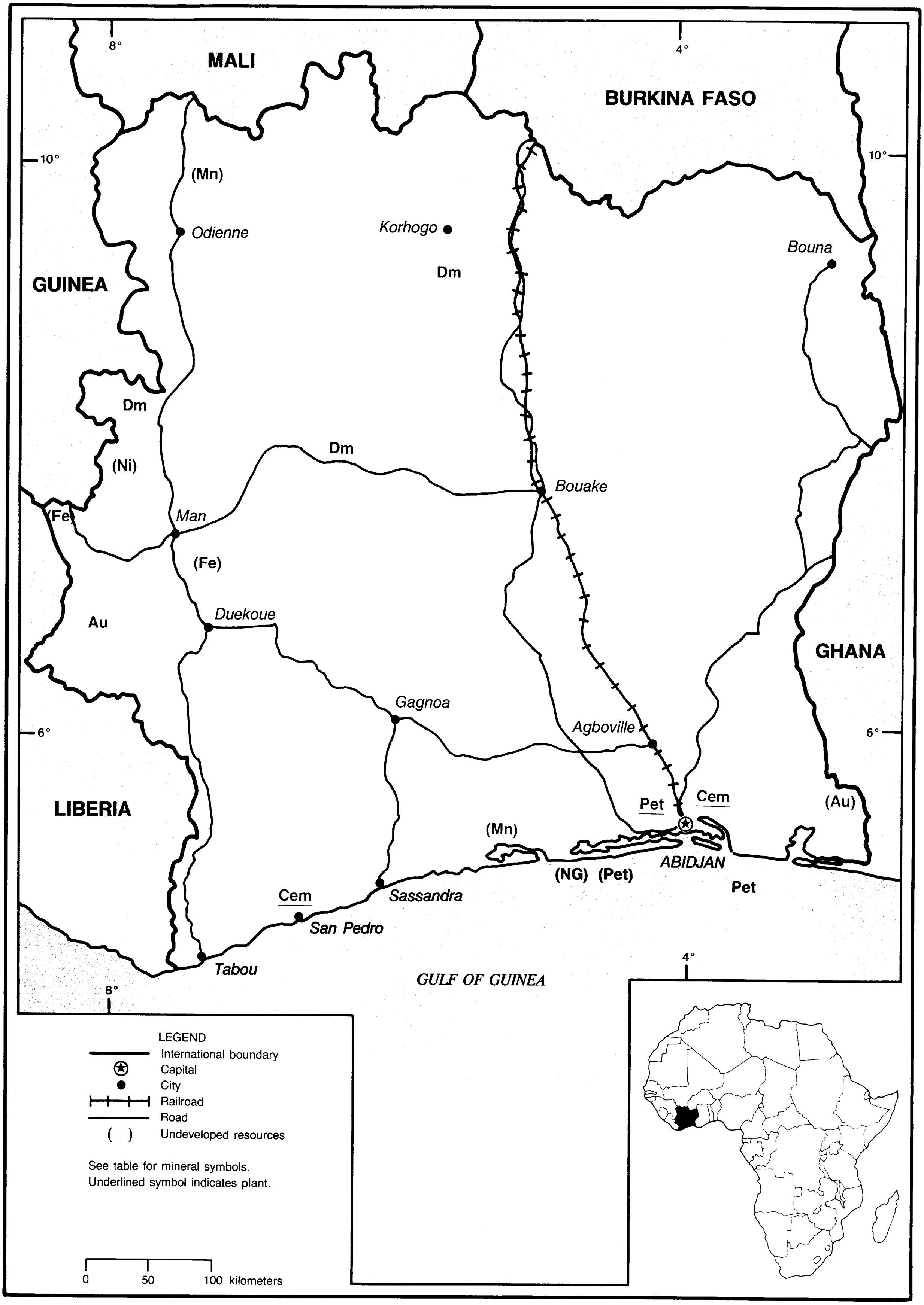
Following a 5-year hiatus, the state-owned Société Congolaise de Recherche et d'Exploitation Minières (Socorem) was scheduled to resume mining operations in 1990 at two base metal deposits in the M'Fouati region, 290 kilometers southwest of Brazzaville. The two deposits, Djenguile and Yanga-Koubenza, were to produce copper, lead, and zinc. A beneficiation plant built by the U.S.S.R. with an annual capacity of 6,000 tons of lead already existed in the region. The U.S.S.R. was the only international mining partner with the Government. Socorem reported that negotiations were proceeding with unnamed U.S. companies to study possible exploitation of diamonds and gold in the Congo.

The near-term outlook for petroleum development looks favorable for the Congo, especially owing to renewed U.S. involvement. However, being dependent on a single commodity such as crude oil leaves the Congo economically vulnerable to the fluctuations in the worldwide petroleum market. Thus, foreign aid will remain necessary in the Congo for the future. Full exploitation of the nonfuel minerals sector awaited improved global market conditions and infrastructure development in the Congo.

[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF319.01 = US$1.00.

CÔTE D'IVOIRE

AREA 324,460 km² **POPULATION 12.5 million**



THE MINERAL INDUSTRY OF

CÔTE D'IVOIRE

By Hendrik G. van Oss

The production of mineral commodities played but a negligible role in the economy of Côte d'Ivoire, accounting for less than 5% of the country's 1989 gross domestic product of about $9.5 billion.[1] As in years past, the Ivoirian economy was dominated by the production of agricultural products, most notably cocoa, coffee, and timber. In 1989, the economy continued to be severely affected by low world cocoa and coffee prices.

The mineral economy was dominated by the production of petroleum, which experienced a severe decline in 1989 owing to the late 1988 shutdown of the larger of the country's two producing oilfields. Two oil refineries operated during the year, largely on imported input, but their output was inadequate to meet domestic demand. Côte d'Ivoire produced a small quantity of gold and diamonds during the year, all from artisanal operations. The country's cement production was well below capacity and was entirely dependent on imported clinker.

Despite the lackluster performance of the mineral industry in 1989, it was anticipated that the mineral sector's contribution to the Ivoirian economy would significantly increase in the near future. A new gold mine commenced production in 1990, and a second deposit was in an advanced stage of exploration and was expected to be in production within a year or two. At least two major international mineral exploration companies were involved in reconnaissance-level gold exploration elsewhere in the country. Another company completed feasibility studies of a nickel laterite deposit. A new legal framework for hydrocarbon exploration was attracting foreign interest in oil exploration and in the development of a known significant natural gas reserve.

Much of the current interest in mineral exploration in Côte d'Ivoire stems from the country's geologic similarity to its neighbors, some of which have enjoyed a significant increase in mineral production in recent years. Another attractive feature is the fact that relatively little mineral exploration has occurred in the past, largely owing to a past lack of Government interest in promoting such activity.

Virtually all of Côte d'Ivoire is made up of Precambrian rocks, including a number of northeast-trending belts containing volcanosedimentary rocks of the Birimian series. These greenstone belts contain a number of gold deposits; indeed, some are extensions of belts that have been the source of significant gold production in Ghana and Mali. The extension of the Ghanaian Bibiani belt into the southeast corner of Côte d'Ivoire hosts several gold deposits that will likely be brought into production within 3 years. The Ity Gold Mine, brought into production in 1990, is a peculiar laterite gold deposit that is developed over similar rocks, but which happen to be unmineralized. Placer gold occurrences, most derived from Birimian lode occurrences, are widespread. Birimian and other Precambrian rocks also host a number of manganese ore deposits and iron formations; one of the manganese deposits was mined in the past. A number of nickeliferous ultramafic rock occurrences are known in western Côte d'Ivoire; some of these, and their derived laterites, are cobalt-bearing, with cobalt concentrations in excess of 500 parts per million having been recorded. Diamond-bearing kimberlites have been found in north-central Côte d'Ivoire; some of these have been mined, as have several placer deposits derived from these kimberlites and from sources outside the country.

A thin strip of Tertiary clastic sedimentary rocks exists along part of the country's Atlantic coast. These rocks are the onshore extension of a more significant offshore sedimentary basin. Structural and lithologic traps within this offshore basin host Côte d'Ivoire's modest known oil and natural gas reserves and hold promise of additional discoveries.

GOVERNMENT POLICIES AND PROGRAMS

Despite early enthusiasm for the potential role of the petroleum industry, the Government's economic policies have long-reflected the dominance of cocoa, coffee, and other agricultural production in the economy of Côte d'Ivoire. However, recent economic hardship resulting from several years of depressed world prices for these agricultural products have forced a reassessment of the Government's policies. The growth of the mining and mineral exploration sector, particularly in gold, in such neighboring countries as Ghana and Mali has not gone unnoticed, nor has the fact that Côte d'Ivoire is geologically similar to these countries. Consequently, foreign investment in the mining and mineral exploration sector has been encouraged, and the budgets of relevant Government agencies, such as the Ministry of Mines, left intact.

The Government has traditionally taken an equity interest in mineral exploitation, either through the Société Nationale d'Opérations Pétrolières de la Côte d'Ivoire (PETROCI), or through the Société d'Etat pour le Développement Minier de la Côte d'Ivoire (SODEMI), for fuel and nonfuel minerals, respectively. These parastatals are also involved in mineral exploration, commonly in cooperation with foreign entities. Notable in this respect is SODEMI's long relationship with France's Bureau de Recherches Géologiques et Minières (BRGM). The degree of state equity-participation in new ventures has decreased in recent years; however, the Government strongly encourages foreign investors to take Ivoirian partners.

The basic mining law of Côte d'Ivoire is the Mining Code (Law No. 64-249) of July 3, 1964. Petroleum exploration and production is governed by the Petroleum Code (Law No. 70-849) of August 3, 1970, as modified by Ordinance No. 75-04 of January 3, 1975, and by Decrees No. 82-949 of October 18, 1982, and No. 83-1008 of September 14, 1983. A new contractual framework for oil and gas exploration was drafted during 1989 and was released in June 1990 as part of a new exploration promotion program. A major feature of this law is the limitation of Government participation in new petroleum ventures, thus removing a significant risk element that was present in the old legislation. A number of the tenets of the 1959 Investment Code were revised under Law No. 84-1230 of November 8, 1984.

PRODUCTION

In recent years, the mineral economy of Côte d'Ivoire has been dominated by the production of petroleum, albeit in modest quantities. With the closure of the Espoir offshore oilfield toward yearend 1988, brought on by severely declining reserves, the country's oil production fell almost 85% to only about 2,000 barrels per day in 1989.

Reported gold and diamond production increased slightly. Production in 1989 was entirely by artisanal miners and may not include both domestic and imported material smuggled out of the country. The reported production is probably an underestimate of true Ivoirian output; however, the degree of underestimation may not be great because the high wage structure of the country would make artisanal mining a relatively unattractive vocation. The Ity gold mine began operations in 1990 and was expected to pour its first gold toward yearend.

Cement production was estimated to be essentially unchanged and continued to be well below output capacity.

TRADE

Côte d'Ivoire's trade is dominated by the export of agricultural products, the import of petroleum products, and the transshipment of goods for some of the country's landlocked neighbors. Exports increased slightly in 1989 to about $2.7 billion, of which $1.3 billion was from sales of cocoa, coffee, and timber. Petroleum product exports were worth about $265 million.

Total imports in 1989 declined more than 30% to about $1.5 billion, of which about 20% was petroleum and petroleum products. About one-third of these petroleum and petroleum product imports were destined for reexport, either directly or after refining in Côte d'Ivoire. All of the country's cement production was from imported clinker and gypsum. France accounted for about one-third of Côte d'Ivoire's total imports. About 75% of the country's petroleum imports, worth about $250 million, were from Nigeria.

STRUCTURE OF THE MINERAL INDUSTRY

Petroleum was produced in 1989 from one offshore field, operated by international companies. Refined petroleum products were produced by two refineries in Abidjan, largely using imported crude oil. One formal gold mine commenced operations in 1990. Gold was also produced by artisanal miners, as were diamonds. Côte d'Ivoire's cement plants are entirely dependent on imported clinker and have operated well below capacity for several years. The Government holds a significant equity interest in almost all of the mineral commodity companies.

The Ivoirian labor force in 1989 was estimated to number about 5.7 million workers, of whom more than 85% were involved in agriculture. Employment in the minerals industry is insignificant, numbering about 1,500 in the petroleum

TABLE 1

CÔTE D'IVOIRE: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Cement[3]	thousand metric tons	679	776	653	700	700
Diamond[e 4]	carats	20,000	13,600	21,000	11,157	[5]11,689
Gold[4]	kilograms	—	5	7	6	[5]13
Petroleum:						
Crude	thousand 42-gallon barrels	[6]8,060	[6]6,600	[6]6,200	4,721	[7]730
Refinery products:[e]						
Motor gasoline	do.	2,190	2,190	2,555	2,562	2,562
Kerosene and jet fuel	do.	3,285	3,285	3,285	3,294	3,294
Distillate fuel oil	do.	3,650	3,650	3,650	3,660	3,660
Residual fuel oil	do.	3,650	3,650	3,650	3,660	3,660
Liquefied petroleum gas	do.	350	350	350	350	350
Other	do.	365	365	365	366	366
Total	do.	13,490	13,490	13,855	13,892	13,892

[e]Estimated. [p]Preliminary.
[1]Includes data available through Sept. 28, 1990.
[2]In addition to the commodities listed, Côte d'Ivoire produces clay, stone, and sand and gravel for local construction purposes. Information is inadequate to make reliable estimates of output levels.
[3]Output based entirely on imported clinker.
[4]Does not include artisanal production smuggled out of the country.
[5]Reported figure.
[6]Data are for fiscal year ending July 30.
[7]Production from the Bélier Field only. Espoir Field shut down Oct. 26, 1988.

TABLE 2

CÔTE D'IVOIRE: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major producing companies (ownership)	Location	Capacity[1]
Cement	Société des Ciments d'Abidjan (Government, 40%; Omnium Tropical of Côte d'Ivoire, 24%; SCOA, 12%; Socafracim, 9%; Ciments Vicat of France, 12%; Ciments Lafarge of France, 3%)	Clinker-grinding plant at Abidjan	600,000.[e]
Do.	Société Ivoirienne de Ciments et Matériaux (Ciments d'Origny of France, 80%; private Ivoirian shares, 20%)	do.	750,000.[e]
Do.	Société des Ciments du Sud Ouest (main owners are Government and Société Tropical)	Clinker-grinding plant at San Pedro	300,000.[e]
Gold	Société des Mines d'Ity (SODEMI,[2] 60%; Coframines of France, 40%)	Open pit mine, 90 kilometers southwest of Man	650.[3 4]
Petroleum[5]	Esso consortium (Esso Group, 63.75%; Shell, 21.25%; PETROCI,[6] 15%)	Bélier offshore field, 32 kilometers southeast of Abidjan	2,000.[7]
Petroleum products	Société Ivoirienne de Raffinage (SIR) (PETROCI, 47.27%; others,[8] 52.73%).	Petroleum refinery in Abidjan	Crude oil input: 59,000.[7]
Do.	Société Multinationale de Bitumes (PETROCI, 95.76%; Royal Dutch Shell, 2.88%; others 1.36%).[9]	do.	Crude oil input: 10,000.[7] Output: 5,000[7] asphalt.

[e]Estimated.
[1]Metric tons per year unless otherwise specified.
[2]SODEMI is an acronym for state-owned Société pour le Développement Minier de la Côte d'Ivoire.
[3]Kilograms gold per year.
[4]Mining commenced in 1990. First gold pour anticipated in December 1990. Reported grade is 7 grams per ton.
[5]The Espoir offshore field, operated by Phillips Petroleum Company Ivory Coast, was shut down in late 1988.
[6]PETROCI is an acronym for State-owned Société Nationale d'Opérations Pétrolières de la Côte d'Ivoire.
[7]42-gallon barrels per day.
[8]The other owners in SIR are Shell, 10.29%; BP, 10.10%; TOTAL, 10.10%; Mobil, 8.00%; Elf, 5.00%; Texaco, 3.70%; Esso Africa, 0.15%; and the Government of Burkina Faso, 5.39%.
[9]PETROCI holding is direct, 91.94%; and through its 50% holding of Shell Côte d'Ivoire, 2.88%; and its holding in SIR, 0.94%. The other owners consist of the non-PETROCI owners of SIR, 1.06%; and private Ivoirians, 0.3%.

production and refining companies and perhaps 1,000 others in the cement and construction materials sector. Estimates of the number of artisanal gold and diamond miners are not available, but the number in 1989 probably did not exceed 1,000 persons.

COMMODITY REVIEW

Metals

Gold.—A favorable production decision was made by Société des Mines d'Ity to develop the Ity gold deposit in the Toulepleu greenstone belt southwest of Man. The deposit was discovered in 1957 and has been the subject of intermittent exploration, including several feasibility studies, since that time. Site preparation was underway in early 1990. A cyanide plant adequate for a 700- to 800-ton-per-day heap-leach operation, was being constructed for the mine by Kappes, Cassiday and Associates of the United States and was scheduled to be shipped at the end of September 1990. Gold production was expected by yearend. The open pit mine's reserves are in gold-bearing laterite. A 7-year mine life was planned, with an average annual gold output of 650 kilograms. An underlying columnar clay-altered zone also contains gold, but metallurgical problems with this material have, to date, prevented it from being added to the reserves.

In January 1989, Marshall Minerals Corp. of Canada purchased control of Eden Roc Mineral Corp.'s gold concession in the Afema shear zone in southeast Côte d'Ivoire. From 1985-87, Eden Roc drill-outlined probable reserves on the property, but was unable to further test the property in 1988 because of financial problems. Marshall conducted further drilling during 1989 and early 1990 to prove the reserves delineated by Eden Roc and, earlier, by the BRGM. The concession has several potential ore bodies, the best of which appears to be the Asupiri-1 zone, which is reported to contain a high-grade core exceeding 1 million metric tons (MMmt) grading about 8 grams (g) of gold per ton. Nearby, along strike of the mineralized shear zone, is the Anuiri deposit, which is reported to contain reserves exceeding 700,000 metric tons (mt), grading 3.7 g of gold per ton. The ore deposit contains both lateritic (oxide) and sulfide ore reserves. An 800-ton-per-day mill was envisioned, and construction was expected to begin in 1990. Toward this end, a new development agreement was signed with SODEMI, with the operating company to be called Société des Mines d'Afema, owned 90% by Eden Roc and 10% by SODEMI. As exploration to date has been conducted over only about 6 kilometers (km) of the 35-km portion of the shear zone controlled by the company, it was predicted that additional reserves would be discovered with further exploration of the concession.

Nickel.—A feasibility study was completed by Trillion Resources of Canada on the company's 3,600-square-kilometer concession containing the Sipilou nickel laterite deposit near the Guinea border about 70 km northwest of Man. The basis of this study was drill reserves delineated by other companies in the early 1980's. These amounted to 54 MMmt grading 1.9% nickel.

Mineral Fuels

Declining reserves and increased difficulty in maintaining output led to the closure of the Espoir offshore field toward the end of 1988. As a result, oil production in 1989 was entirely from the Bélier offshore field, 32 km southeast of Abidjan. Reserves in this field too were declining severely, and it was considered possible that Bélier would be shut down by the end of 1990. As part of a new drive to promote oil exploration, the Government in early June 1990 invited international oil companies to tender bids for 11 offshore blocks.

Development of the country's natural gas resources is considered an important step in reducing the country's fuel imports. Apart from using natural gas in the country's thermal powerplants, the Government wants to encourage its use as a substitute for woodfuel for domestic use. The Government invited proposals from international companies to develop the Foxtrot offshore gasfield, 80 km southwest of Abidjan, which was discovered by Phillips Petroleum in 1981. It was reported that several companies had responded favorably.

Reserves

Côte d'Ivoire has had production of gold, diamonds, manganese, and petroleum, and has significant undeveloped resources of other minerals, most notably iron and nickel. Very little interest has been shown in most of Côte d'Ivoire's other mineral resources, largely because of the lack of infrastructure and low or unstable world prices. Information is scanty on most of these deposits; the most useful single reference on the subject was published by SODEMI in 1975.[2]

The gold reserves of Côte d'Ivoire are potentially significant, given the geologic similarity of the country with its gold-rich neighbors and the widespread, if modest, production of gold by artisanal miners. To date, reserves have been delineated for only two minable deposits; this tally will likely increase as further exploration is done.

Reserves for the Ity Mine, reported by SODEMI, are 715,000 mt of laterite ore grading 7 g of gold per ton. In addition, there is a resource of almost 1.5 MMmt grading 9 g of gold per ton within a columnar clay zone beneath the laterite. There are, however, metallurgical problems with this clay material, and testing is underway to find an economic means of extracting the gold from it.

Total reserves in the Afema shear zone are not yet known, but early work on several deposits within the zone by the BRGM and, in 1987, by Eden Roc, delineated about 2.3 MMmt grading in excess of 6.2 g of gold per ton. In 1989, drilling in the Afema zone by Marshall Minerals Corp. confirmed reserves on two of the deposits of at least 700,000 mt grading 3.7 g of gold per ton. Exploration of these deposits continued in 1990, and it was expected that the reserves would be increased, especially as new areas of the concession were evaluated.

There has been widespread production of diamonds from alluvial and kimberlite deposits; most of the production has been from the Séguéla and Tortiya camps about 400 km northwest of Abidjan. According to SODEMI, original reserves at these two camps totaled about 9 million carats. Although remaining reserves at these camps have been inadequate to sustain formal production in recent years, it is possible that significant resources may remain there and elsewhere in the country.

The Mokta manganese deposit, 150 km west of Abidjan, was mined from 1960 to 1970 and produced about 1.36 MMmt of manganese ore grading between 45% and 52% manganese. Remaining reserves probably do not exceed 300,000 tons. The Ziémougoula deposit, near the Malian border about 620 km northwest of Abidjan, is reported by SODEMI to have a drill-indicated resource of 1.2 MMmt grading 47% manganese. At Korhogo, about 570 km northwest of Abidjan, there are low-grade manganese resources totaling 1.5 MMmt grading between 20% and 35% manganese. Lack of railing infrastructure makes these deposits uneconomic.

According to SODEMI, total nickel resources at Sipilou, 70 km northwest of Man, are from 200 to 250 MMmt grading 1.3% nickel in laterite, plus 80 to 100 MMt of peridotite grading 1.7% nickel. Within the laterite resource is a higher grade inventory of about 54 MMmt grading 1.9% nickel; this was the subject of a feasibility study in 1989, the outcome of which had not been announced as of yearend. Additional nickel resources totaling 46 MMmt grading between 1.3% and 2% nickel have been described by SODEMI for three deposits about 30 km east of Sipilou.

A number of iron ore deposits are known to exist in western Côte d'Ivoire, the most important of which are the Mount Klahoyo deposit 20 km southeast of Man, and the Nimba deposit 90 km west of Man near the Liberian and Guinea borders. The deposit at Mount Klahoyo contains a resource in excess of 300 MMmt of iron ore grading between 35% and 40% iron. This deposit was seriously evaluated during the 1970's by a consortium of international steel companies in terms of developing pelletizing and shipping facilities at the port of San Pedro. However, the project was eventually rejected as uneconomic given the cost of constructing the necessary infrastructure, including a railroad and powerplant, and the poor world market for pellets. The Nimba deposit contains a resource of several billion tons of iron ore grading about 46% iron and is an extension of higher grade deposits of the same name in Liberia (now exhausted) and Guinea. At one time, there were plans to link the remaining low-grade Nimba deposits in Liberia and the higher grade deposits across the border in Guinea to the concentrating plant at the Bong Mine in Liberia. Had this occurred, the low-grade Nimba material in Côte d'Ivoire might have been exploited by a short rail linkup to this infrastructure. However, current world iron ore market conditions do not justify the cost of the Bong Mine linkup, and consequently, the Côte d'Ivoire iron ore deposits cannot be considered economic.

Total petroleum resources of Côte d'Ivoire have been estimated to be about 100 million barrels (MMbbl). It has been estimated that the Espoir Field, which shut down toward yearend 1988 after producing about 31 MMbbl, could produce another 40 MMbbl if secondary recovery methods were used. However, this may not take into account the geological complexity of the field. Original reserves of the Bélier Field were put at 70 MMbbl, of which almost 18 MMbbl had been produced by yearend 1989. Oil production has decreased significantly, and it is believed that without secondary recovery methods being used, remaining recoverable reserves are very limited. The Government estimates that gas reserves in Côte d'Ivoire amount to about 3,500 billion cubic feet. Many of the gasfields are small. About 940 billion cubic feet are in the Foxtrot Field, which is considered the most promising gasfield in the country.

INFRASTRUCTURE

In 1989, Côte d'Ivoire had 657 km of railroad, all 1-meter gauge, extending from Abidjan to the Burkina Faso border, and thence to Ouagadougou and Kaya in that country. Until mid-1989, the railroad was run by Regie des Chemins de Fer Abidjan-Niger (RAN), a joint venture between the two Governments. The joint venture was not profitable, and at the time of the company's closure in 1989, RAN was reported to be in excess of $170 million in arrears. RAN was replaced in Côte d'Ivoire by the parastatal Société Ivoirienne des Chemins de Fer, but this company, as of April 1990, was reported to be in severe financial difficulties also.

Côte d'Ivoire has about 50,000 km of roads, of which only about 8% are paved.

There are two major ports in Côte d'Ivoire: Abidjan (and the adjacent Bouet) and San Pedro. Abidjan is a deep water port and is a major container-shipping facility. Traffic in 1989 was 10 MMmt, of which 6.2 MMmt were imports. Petroleum accounted for about 51% of the total traffic, and most petroleum shipments utilized the Bouet mooring facility, which can handle tankers of 250,000 deadweight tons. Abidjan also has clinker-unloading conveyors that, in 1989, handled an estimated 600,000 tons of combined clinker and gypsum imports. The Port of San Pedro was built in 1971, largely to handle lumber exports. Total exports through San Pedro in 1989 were an estimated 860,000 tons, and imports are estimated to have been about 170,000 tons. Imports included an estimated 120,000 tons of clinker and 12,000 tons of gypsum.

Côte d'Ivoire's total installed electrical energy capacity was about 1,100 megawatts in 1989, of which about 75% was hydroelectric. About two-thirds of the hydroelectric capacity was considered to be dependable under current drought conditions. Production of electricity was 2,440 million kilowatt hours in 1989, of which about 60% was from hydroelectric plants. This hydroelectric power output was only about one-fifth of the estimated hydroelectric potential of the country. In 1984, the country's grid was connected to Ghana's Volta River Authority (VRA) grid for the exchange of surplus energy and for emergency support.

OUTLOOK

The new promotional program for petroleum and natural gas exploration, together with a generally favorable investment climate, will likely result in an increased level of exploration for hydrocarbons in the near term. Côte d'Ivoire's oil and gas potential is, however, considered only modest. It is unlikely, therefore, that future production of hydrocarbons will become a major factor in the Ivoirian economy except as a partial replacement for current fuel imports.

Côte d'Ivoire has the geologic potential to become a significant West African producer of gold, although the annual output will probably not exceed 2,000 kilograms for the next 5 years. Gold will continue to be the principal nonfuel mineral commodity of interest to overseas investors. There is also potential for an increased output of alluvial diamonds.

The development of most of Côte d'Ivoire's other mineral resources, notably nickel and iron ore, will continue to be hampered by the lack of infrastructure and by volatile world commodity prices.

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[1] Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate CFAF319=US$1.00.

[2] Peron, C., 1975, Atlas des Indices Mineraux de la Côte d'Ivoire au 1/4,000,000 (Atlas of Mineral Occurrences in Côte d'Ivoire at a scale of 1:4,000,000): SODEMI, Abidjan.

OTHER SOURCES OF INFORMATION

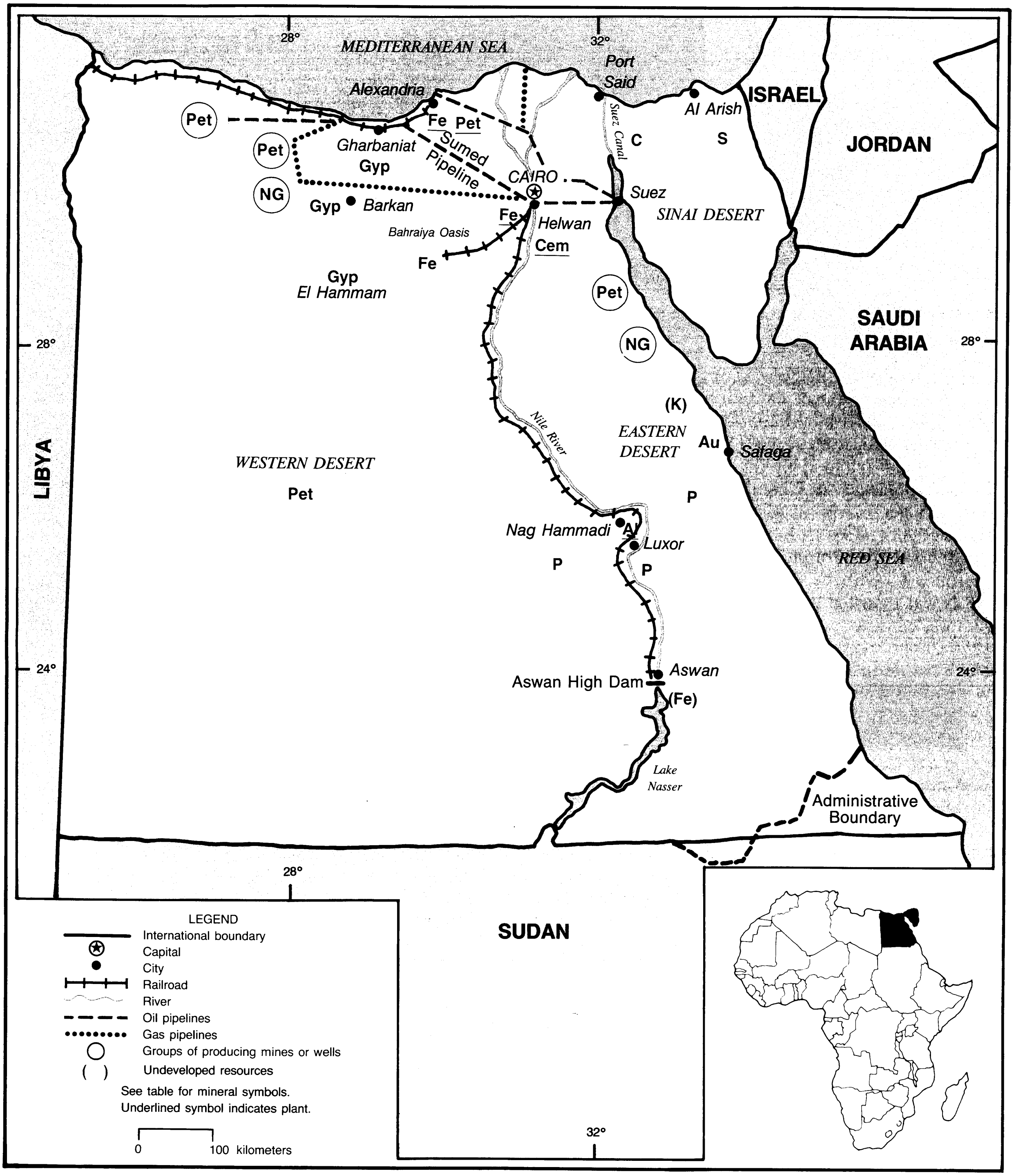
Direction de la Géologie
Ministère des Mines
B.P. V28
Abidjan, Côte d'Ivoire

Société Nationale d'Opérations Pétrolières de la Côte d'Ivoire (PETROCI)
B.P. V194
Abidjan 12, Côte d'Ivoire

Société pour le Développement Minier de la Côte d'Ivoire (SODEMI)
01 B.P. 2816
Abidjan 01, Côte d'Ivoire

EGYPT

AREA 1,001,450 km² **POPULATION 54.7 million**



THE MINERAL INDUSTRY OF

EGYPT

By Thomas P. Dolley

Petroleum remained the only major mineral resource that was heavily exploited in Egypt in 1989. Total petroleum production increased marginally from approximately 309 million barrels in 1988 to about 311 million barrels in 1989. Most of the other nonpetroleum minerals exploited were primarily for domestic consumption. The petroleum industry of Egypt accounted for 14% of the gross domestic product, estimated at approximately $23 billion.[1]

Egypt closed the decade of the 1980's with a stagnant economy and growing inflation. In the 1970's, high world oil prices stimulated increased oil production and foreign investment. Lowered world oil prices and declining balance of payments were featured in the mid-1980's to late 1980's and contributed to the current economic situation. With an external debt estimated at $54 billion, Egypt was one of the highest debtor nations in the world. In March 1990, the International Monetary Fund (IMF) and the World Bank were unclear as to standby credit and structural adjustment loans for Egypt. Still pending were agreements by the Government to implement devaluation of the commercial bank exchange rate, the raising of interest rates, and the privitization of certain public-sector corporations.

In the late 1980's, the base metal industry in Egypt became one of the most important domestic industries, chiefly because of its criticality to the exploitation of mineral resources for local consumption.

GOVERNMENT POLICIES AND PROGRAMS

Mining legislation dated back to the Mining and Petroleum Code, Law No. 66 of 1953, and Mining Code Law No. 86 of 1956. As of July 1990, a newly drafted Egyptian Mining Law that will replace the existing law was being held up in the Egyptian Cabinet until provisions in the draft law were settled. The Egyptian General Petroleum Corp. (EGPC) was created under Law No. 20 of 1976. This updated petroleum policy called for all oil exploration permits to be awarded as production-sharing agreements and conversion of all joint ventures into production-sharing agreements. Additionally, a recent natural gas clause should allow foreign concessionaires to share directly in the profits from gas production.

In 1987, new mineral exploitation was to be directed from the Ministry of Industry to the Ministry of Petroleum. The latter organization was renamed the Ministry of Petroleum and Mineral Wealth. All mineral-based public-sector companies will operate under the Ministry of Industry.

Egypt was not a member of the Organization of Petroleum Exporting Countries. Thus, a Government commission sets the price per barrel of crude oil exports on the 1st and 15th of each month. The price set usually paralleled the world petroleum price. Because of the high-sulfur content of Egyptian crudes, the price tended to be somewhat lower than the comparable world petroleum price. Preceding August 14, 1989, the Government converted all petroleum revenues into Egyptian pounds at an artificial Government exchange rate of £E0.70 = US$1.00.

Excess cost recovery on petroleum exports for the Government during fiscal year 1988-89 amounted to $98.4 million. Under an oil production contract, any excess cost recovery represented the reimbursement of a foreign operator to the Government of the difference between the maximum amount the operator was allowed to recover and the amount the operator initially did recover against expenses. This formula also included the amount of expenses the foreign operator recovered under any given period.

The Government operated a multiple exchange rate system, introduced in May 1987, which was frequently modified. The official purpose of the exchange rate system was to direct foreign exchange to priority public uses. This legislation had an opposite effect, encouraging Egyptian citizens to hoard foreign exchange, causing the resultant capital loss of the Egyptian pound. Thus, Egyptian investments abroad exceed currency held in domestic bank deposits. The IMF advised the Government during the year on curtailing the system of multiple exchange rates.

During the year, the Government sought to counteract the effects of spiraling inflation. The Government recognized the need for a more liberal currency exchange rate and for making the exchange rate more market oriented. Previously, in May 1987, the Government enacted a reform of rules governing the commercial bank exchange rate. To date, these reforms had been ineffective, and no new legislation had been enacted.

PRODUCTION

Production of crude petroleum increased marginally in 1989 to an average of 852,000 barrels per day (bbl/d) from the 1988 average of 848,000 bbl/d. Natural gas and liquefied petroleum gas (LPG) production also increased.

Dominant mineral exports included phosphates, kaolin, gypsum, sand for glass, handmade porcelain, and finished glass products. Additionally, Egypt was the largest Arab producer of refractories, with production at 250,000 tons per year.

TABLE 1

EGYPT: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	1987	1988[p]	1989[e]
METALS					
Aluminum metal	208,587	175,000	178,850	173,460	[2]179,500
Copper, refined, secondary[e]	2,600	2,500	2,500	[2]4,000	[2]3,600
Iron and steel:					
Iron ore and concentrate thousand tons	87	2,135	1,700	2,000	[2]2,562
Pig iron do.	225	121	46	132	132
Crude steel do.	533	281	347	347	[2]1,400
Semimanufactures do.	500	NA	NA	NA	NA
Ferroalloys: Ferrosilicon	[e]7,500	7,221	7,702	7,806	7,800
INDUSTRIAL MINERALS					
Asbestos	229	476	209	166	[2]312
Barite	4,426	3,385	4,116	5,651	[2]7,295
Cement: Hydraulic thousand tons	5,749	7,612	8,746	9,787	[2]9,507
Clays:					
Bentonite	3,000	5,126	3,827	3,166	[2]3,512
Fire clay	250,000	364,300	148,727	150,000	[2]250,000
Kaolin	108,378	127,784	125,256	[e] [r]124,000	[2]121,515
Feldspar, crude	19,073	19,287	15,963	6,131	[2]27,731
Fluorspar	85	80	776	1,849	[2]1,721
Gypsum and anhydrite, crude	841,467	905,688	1,088,472	1,100,000	[2]1,309,426
Lime[e]	97,000	95,000	95,000	95,000	95,000
Nitrogen: Ammonia, N content thousand tons	684	680	788	485	480
Phosphate: Phosphate rock do.	1,074	1,271	1,167	1,146	[2]1,347
Salt, marine do.	1,061	976	1,012	922	[2]1,162
Sodium compounds:					
Soda ash	49,108	[e]50,000	[e]45,000	47,711	47,000
Sodium sulfate	66,830	18,940	42,484	[e]42,000	[2]45,677
Stone, sand and gravel:					
Basalt thousand cubic meters	720	899	1,044	1,050	[2]873
Dolomite[e] thousand tons	500	500	500	500	500
Granite, dimension cubic meters	4,000	2,938	2,000	[e] [r]12,000	[2]21,487
Gravel thousand cubic meters	10,736	11,214	11,200	[e]11,000	[2]11,527
Limestone and other calcareous, n.e.s. do.	12,059	13,476	14,785	[e]15,000	[2]16,347
Marble blocks (including alabaster) cubic meters	43,312	40,000	27,814	13,000	[2]27,857
Quartz	7,500	NA	NA	NA	NA
Sand including glass sand thousand cubic meters	12,677	13,122	246	55	[2]11,645
Sandstone do.	486	475	417	[e]400	[2]316
Sulfur:					
Elemental, byproduct[e]	3,000	7,300	7,600	7,600	7,600
Sulfuric acid	46,452	55,000	[e] [r]57,000	31,274	31,000
Talc, steatite, soapstone, pyrophyllite	7,700	8,800	[e]7,500	7,268	[2]7,146
Vermiculite	488	495	[e]500	236	[2]272
MINERAL FUELS AND RELATED MATERIALS					
Coke: Oven and beehive thousand tons	895	908	[e]900	936	930
Gas, natural:					
Gross production million cubic feet	172,000	180,000	195,200	195,000	[2]226,000
Marketed do.	134,000	155,000	155,000	155,000	155,000

See footnotes at end of table.

TABLE 1—Continued

EGYPT: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum and refinery products:						
Crude	thousand 42-gallon barrels	319,000	296,745	327,040	309,520	[2]310,980
Refinery products:						
Liquefied petroleum gas	do.	2,000	5,000	[e]5,000	[e]5,000	5,000
Gasoline and naphtha	do.	25,000	27,000	[e]27,000	[e]27,000	27,000
Kerosene and jet fuel	do.	20,000	20,000	[e]20,000	[e]20,000	20,000
Distillate fuel oil	do.	25,000	30,000	[e]30,000	[e]30,000	30,000
Lubricants	do.	1,000	1,000	[e]1,000	[e]1,000	1,000
Residual fuel oil	do.	65,000	60,000	[e]60,000	[e]60,000	60,000
Asphalt	do.	2,500	2,000	[e]2,000	[e]2,000	2,000
Unspecified	do.	1,000	4,500	[e]4,500	[e]4,500	4,500
Refinery fuel and losses	do.	6,500	6,500	[e]6,500	[e]6,500	6,500
Total	do.	148,000	156,000	[e]156,000	[e]156,000	156,000

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through May 25, 1990.
[2]Reported figure.

TRADE

Egypt's trade deficit reached a record $7.5 billion in the fiscal year July 1, 1988, to June 30, 1989. The deficit increased by approximately $1 billion from the previous year. This trade imbalance was mainly the result of a decrease in exports precipitated by a drop in oil prices. Additionally, Egypt imported approximately 60% of its food at a yearly cost of $4 billion. Revenue from Egypt's three primary exports, petroleum, cotton, and textiles, deteoriated. Income from Suez Canal traffic, tourism, and remittances from Egyptians working abroad were not sufficient to offset the trade deficit. The current account balance soared from minus $554 million in 1988 to minus $1.4 billion in 1989, equal to more than 4% of the gross national product.

Total petroleum exported in 1989 was approximately 53.2 million barrels or nearly 66% of Egypt's exports. One-half of these petroleum exports were vended to Italy, and approximately 6% to 7% were imported by the United States. Egyptian petroleum exports included naphtha, fuel oil, and slack wax. Petroleum product imports included diesel fuel, LPG, and aviation fuel. Additionally, anticipating the continual flux of the world petroleum market price, the Government boosted pipeline transit fees for the Suez Mediterranean pipeline. On January 1, 1990, the fee rose 25%, from $0.28 a barrel to $0.36 a barrel.

STRUCTURE OF THE MINERAL INDUSTRY

Virtually all mining and mineral processing in Egypt was carried out by Government-owned mining companies. Egypt's Mining and Refractories Corp. was the parastatal under the Ministry of Industry that controlled the mining and refractories industries. Iron and steel production, with oil production and refining, was based on production-sharing agreements. The Government generally held a 50%-equity ownership in these production-sharing agreements.

COMMODITY REVIEW

Metals

Aluminum.—In January 1990, the Gulf Development Fund and the Development Fund of Abu Dhabi agreed to help fund an integrated plant for rolling aluminum. Egypt's first industrial project of this type, the production capacity of 60,000 tons per year would be totally for export. Funding would amount to $100 million.

Gold.—The United Kingdom's Minex, a subsidiary of Greenwich Resources, determined during the year that under the terms of the Egyptian Concession Agreement signed in 1985, the exploitation of gold deposits discovered in the Eastern Desert between the port of Safaga and Marsa Alam would not be commercially viable. With a capital investment of $4 million in this foreign venture, Minex was expecting to renegotiate improved terms with Egypt before the concession expiration date of March 1, 1990. Continuation of the project awaited further capital investment.

Iron and Steel—Production of iron ore rose to approximately 2.5 million tons, with the ore mined at the sedimentary deposits in the Bahraiya Oasis of the Western Desert.

Notwithstanding economic restrictions, shortage of raw materials, and a depressed local demand for steel, the Government continued its policy of

TABLE 2

EGYPT: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988 United States	Destinations, 1988 Other (principal)
METALS				
Alkali and alkaline-earth metals	—	20	—	All to Greece.
Aluminum: Metal including alloys:				
Scrap	—	300	—	All to Japan.
Unwrought	—	1	—	All to Iraq.
Semimanufactures	107,307	121,513	976	Netherlands 52,651; Italy 35,737; Jordan 5,291.
Copper: Metal including alloys:				
Scrap	—	857	—	All to Italy.
Unwrought	1,138	—		
Semimanufactures	383	302	—	Italy 300.
Iron and steel: Metal:				
Scrap	547	1,392	—	Netherlands 709; Italy 643.
Pig iron, cast iron, related materials	—	3	—	All to West Germany.
Ferroalloys:				
Ferromanganese	—	10	—	All to Saudi Arabia.
Ferrosilicon	—	15,170	1,495	Japan 8,808; Turkey 2,065.
Unspecified	8,853	—		
Steel, primary forms	26,390	43,101	4,959	Italy 25,140; Netherlands 5,030.
Semimanufactures:				
Bars, rods, angles, shapes, sections	144	17,632	10,134	West Germany 2,619; Belgium-Luxembourg 2,442.
Universals, plates, sheets	13,254	32,648	10,499	Italy 7,018; United Kingdom 4,902.
Hoop and strip	4,912	523	—	Turkey 281; Zimbabwe 242.
Wire	13	23,914	21	West Germany 17,520; Belgium-Luxembourg 3,709.
Tubes, pipes, fittings	598	4,348	2,835	Albania 1,100.
Castings and forgings, rough	116	390	—	Kuwait 223; Netherlands 98.
Lead:				
Oxides	—	49	—	All to Sudan.
Metal including alloys: Semimanufactures	—	34	—	All to United Kingdom.
Manganese: Ore and concentrate, metallurgical-grade	—	1	—	All to Saudi Arabia.
Nickel: Metal including alloys, scrap	17	—		
Zinc:				
Oxides value, thousands	$1	—		
Metal including alloys:				
Unwrought	200	6	—	All to Sudan.
Semimanufactures	404	—		
Other: Ashes and residues	699	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones	3	18	—	Saudi Arabia 10; unspecified 8.
Cement	2,000	9,986	—	Sudan 9,736.
Clays, crude	31,317	5,785	—	All to Oman.
Fertilizer materials: Manufactured:				
Nitrogenous	5,362	13,757	—	Jordan 8,547; Greece 3,710.
Phosphatic	—	4,000	—	All to Czechoslovakia.
Unspecified and mixed	20	3,711	—	Jordan 1,506; Sudan 1,500.

See footnote at end of table.

TABLE 2—Continued

EGYPT: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988 United States	Destinations, 1988 Other (principal)
INDUSTRIAL MINERALS—Continued					
Lime		—	80	—	All to Kuwait.
Phosphates, crude		68,650	122,254	—	Romania 35,975; Indonesia 24,512; Albania 21,760.
Pigments, mineral: Iron oxides and hydroxides, processed		256	51	—	Sudan 30; Greece 21.
Salt and brine		180,276	122,017	—	Italy 95,777; Cameroon 11,550.
Sodium compounds, n.e.s.: Soda ash, manufactured		1,550	—		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		([2])	2,945	—	West Germany 1,588; Italy 1,314.
Worked		915	372	—	West Germany 362.
Gravel and crushed rock		([3])	2,011	—	Israel 1,647; unspecified 360.
Sand other than metal-bearing		4,937	24,284	—	Oman 14,057; Saudi Arabia 6,200; Kuwait 3,639.
Sulfur: Sulfuric acid		100	—		
Talc, steatite, soapstone, pyrophyllite		345	528	—	East Germany 272; West Germany 232.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		30	60	—	All to Sudan.
Carbon black		—	1	—	All to Saudi Arabia.
Coal: Anthracite and bituminous		9	—		
Coke and semicoke		63,635	72,544	—	Romania 35,265; Tunisia 18,909; Switzerland 16,500.
Petroleum:					
Crude	thousand 42-gallon barrels	72,166	51,022	8,706	Israel 15,624; Singapore 7,927.
Refinery products:					
Liquefied petroleum gas	do.	124	49	—	All to Yemen (Sanaa).
Gasoline	do.	88	200	—	Italy 52; West Germany 47; Algeria 17.
Mineral jelly and wax	do.	146	342	13	West Germany 280; Italy 39.
Kerosene and jet fuel	do.	5,566	10,706	390	France 6,353; Italy 2,180.
Distillate fuel oil	do.	925	1,077	—	Mainly to bunkers.
Lubricants	do.	—	12,068	—	Greece 11,690.
Residual fuel oil	do.	11,066	13,377	—	Italy 4,166; France 1,826; bunkers 6,671.
Bitumen and other residues	do.	12	215	—	Italy 182; Greece 30.
Bituminous mixtures	do.	—	([4])	—	All to Sudan.
Petroleum coke	value, thousands	—	$17,354	—	Italy $6,917; France $4,232.

[1] Table prepared by Virginia A. Woodson.
[2] Unreported quantity valued at $175,000.
[3] Unreported quantity valued at $148,000.
[4] Less than 1/2 unit.

increasing self-sufficiency in steel production and the lowering of steel imports. Investment by the Government in new steel-producing capacity was directed primarily at older, state-owned mills that were underutilized. Production of steel for 1989 rose to 1.4 million tons owing primarily to the output of the Alexandria National Iron & Steel plant (ANSDK). This facility represented the newest and most efficient steel plant in the Middle East. ANSDK produced 932,000 tons in 1989, and its Midrex sponge iron module was operating at 133% of normal capacity. Sufficient profits and further investment in new equipment might be unattainable for ANSDK given its 10% ownership by Japanese steel companies Kobe Steel Ltd., Toyo Menka, and NKK Corp. and annual debt repayments of $72 million to the World Bank and Japan's Overseas Economic Co-operation Fund. Additionally, ANSDK received Government sanction to sell 60% of its products in U.S. dollars because sales in foreign currency were deemed essential for the com-

TABLE 3

EGYPT: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS				
Alkali and alkaline-earth metals	1	—		
Aluminum:				
Ore and concentrate	—	2	2	
Oxides and hydroxides	1,659	554	52	West Germany 240; Brazil 208.
Metal including alloys:				
Unwrought	—	1	—	All from Yugoslavia.
Semimanufactures	2,704	2,089	34	West Germany 394; France 198; Switzerland 160.
Chromium: Oxides and hydroxides	10	111	—	Poland 66; China 27.
Cobalt: Oxides and hydroxides	1	—		
Columbium and tantalum: Metal including alloys, all forms, tantalum	8	—		
Copper:				
Matte and speiss including cement copper	40	998	—	Switzerland 500; United Kingdom 498.
Metal including alloys:				
Scrap	11	11	—	NA.
Unwrought	5	5	—	All from United Kingdom.
Semimanufactures	11,755	14,853	309	Turkey 4,599; Greece 2,921; Belgium-Luxembourg 1,208.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	538,931	826,602	—	Brazil 613,123; Sweden 239,711.
Pyrite, roasted	—	4	—	Albania 2; Malawi 1.
Metal:				
Scrap	1,992	11,772	—	NA.
Pig iron, cast iron, related materials	983	61,818	—	Canada 17,010; Poland 13,674; U.S.S.R. 11,841.
Ferroalloys:				
Ferromanganese	16,415	11,770	—	Switzerland 5,372; France 5,015.
Ferrosilicon	—	162	—	Belgium-Luxembourg 104; West Germany 58.
Unspecified	64	333	—	United Kingdom 201; Italy 41; Spain 36.
Steel, primary forms	(2)	66,394	—	Bulgaria 11,373; West Germany 11,203; Switzerland 7,656.
Semimanufactures:				
Bars, rods, angles, shapes, sections	824,333	752,613	3,430	Romania 256,465; Yugoslavia 202,704; Czechoslovakia 96,422.
Universals, plates, sheets	195,857	256,437	38,650	West Germany 31,369; France 28,997; United Kingdom 18,564.
Hoop and strip	965	1,717	2	West Germany 625; Yugoslavia 423; Netherlands 204.
Rails and accessories	15,012	5,815	—	West Germany 2,338; India 1,116; Switzerland 1,065.
Wire	18,112	22,319	7	Hungary 6,201; China 3,025; Poland 2,802.
Tubes, pipes, fittings	(3)	96,260	4,530	Japan 34,558; Brazil 12,523; West Germany 10,795.
Castings and forgings, rough	22,643	35,720	7,427	Romania 11,657; Italy 3,265.

See footnotes at end of table.

TABLE 3—Continued

EGYPT: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Lead:				
Oxides	1,790	1,564	—	Bulgaria 787; West Germany 325; East Germany 224.
Metal including alloys:				
Scrap	561	3,013	—	Sudan 1,858; United Kingdom 1,006.
Unwrought	15,807	16,058	—	United Kingdom 6,742; Italy 2,857; Morocco 2,851.
Semimanufactures	71	69	—	Netherlands 52; Italy 7.
Magnesium: Metal including alloys:				
Scrap value, thousands	$7	—		
Unwrought	50	42	—	Yugoslavia 38.
Semimanufactures	4	—		
Manganese:				
Ore and concentrate, metallurgical-grade	408	408	—	Mainly from Belgium-Luxembourg.
Oxides	505	24	—	Belgium-Luxembourg 20; Bulgaria 4.
Mercury	18	16	—	Mainly from West Germany.
Molybdenum: Metal including alloys, unwrought[4]	([5])	13	—	All from United Kingdom.
Nickel:				
Matte and speiss	40	19	—	Canada 10; United Kingdom 5.
Metal including alloys:				
Scrap	21	—		
Unwrought	56	6	—	All from Belgium-Luxembourg.
Semimanufactures	110	64	—	Switzerland 42; France 10.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$354	$17	—	United Kingdom $15; Switzerland $2.
Silver: Metal including alloys, unwrought and partly wrought do.	$1,677	$2,627	—	Switzerland $1,984; West Germany $398.
Tin: Metal including alloys:				
Scrap	4	—		
Unwrought	186	297	—	Malaysia 100; United Kingdom 77; Belgium-Luxembourg 60.
Semimanufactures	24	46	1	West Germany 24; Singapore 13.
Titanium: Oxides	1,085	2,296	58	West Germany 1,357; Finland 268; France 267.
Tungsten: Metal including alloys, all forms	9	—		
Zinc:				
Oxides	295	998	52	France 851; United Kingdom 62.
Metal including alloys:				
Scrap	—	209	—	Switzerland 199.
Unwrought	7,158	10,432	—	Zaire 7,025; France 3,020.
Semimanufactures	19	12	—	Hong Kong 9; Austria 2.
Other:				
Oxides and hydroxides	2,189	125	—	West Germany 57; Austria 33; United Kingdom 20.
Base metals including alloys, all forms	1,781	142	([6])	Belgium-Luxembourg 90; United Kingdom 50.

See footnotes at end of table.

TABLE 3—Continued

EGYPT: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	434	184	—	Greece 163; Italy 10.
Artificial: Corundum	52	62	—	West Germany 61.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$17	—		
Grinding and polishing wheels and stones	3,170	2,376	21	Italy 1,132; Yugoslavia 444; West Germany 230.
Asbestos, crude	9,300	12,230	302	Canada 3,392; Cyprus 1,476; Zimbabwe 1,1404.
Boron materials: Oxides and acids	352	297	—	Italy 194; Turkey 100.
Cement thousand tons	3,823	2,373	—	Romania 1,444; Greece 490.
Chalk	427	48	1	France 46.
Clays, crude	31,317	34,353	278	United Kingdom 26,878; Turkey 1,304; Japan 1,167.
Cryolite and chiolite	11	72	—	All from West Germany.
Diamond: Industrial stones value, thousands	—	$107	—	All from Italy.
Diatomite and other infusorial earth	747	—		
Feldspar, fluorspar, related materials	9,079	15,345	—	Turkey 13,000; Poland 1,700.
Fertilizer materials:				
Crude, n.e.s.	—	1	1	
Manufactured:				
Ammonia	141	111	—	Poland 100; United Kingdom 11.
Nitrogenous	122,165	438,261	6	U.S.S.R. 150,840; Romania 119,333; France 43,945.
Phosphatic	—	9,428	39	U.S.S.R. 8,389; Republic of Korea 1,000.
Potassic	31,713	14,977	—	All from Switzerland.
Unspecified and mixed	756	651	97	United Kingdom 234; Netherlands 158.
Graphite, natural	1,365	859	—	China 492; France 320.
Magnesium compounds, unspecified	8,484	34,312	8	Turkey 10,428; North Korea 7,141; Greece 5,483.
Mica:				
Crude including splittings and waste	14	95	—	Mainly from India.
Worked including agglomerated splittings	3	—		
Pigments, mineral: Iron oxides and hydroxides, processed	5,324	3,771	6	Hong Kong 1,546; China 1,455; India 347.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$12	$43	—	Pakistan $16; Hong Kong $6; other Asia $17.
Synthetic do.	$97	$883	$285	Pakistan $406; Hong Kong $131.
Pyrite, unroasted	4	—		
Salt and brine	812	137	—	West Germany 130; Netherlands 7.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	8,556	—		
Sulfate, manufactured	48,140	—		
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	(7)	707	—	Jordan 695.
Worked	698	1,542	8	Italy 589; Greece 463; Spain 211.

See footnotes at end of table.

TABLE 3—Continued

EGYPT: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel—Continued				
Dolomite, chiefly refractory-grade	241	39	—	All from Norway.
Gravel and crushed rock	1,521	518	14	Italy 381; France 73.
Quartz and quartzite	435	174	—	Netherlands 50; Turkey 50; Sweden 43.
Sand other than metal-bearing	487	562	13	Belgium-Luxembourg 349; Japan 190.
Sulfur:				
Elemental:				
Crude including native and byproduct	110,312	164,873	—	Iraq 124,927; Romania 39,910.
Colloidal, precipitated, sublimed	38	481	—	West Germany 280; India 201.
Sulfuric acid	4	219	2	West Germany 214.
Talc, steatite, soapstone, pyrophyllite	1,570	1,617	24	Finland 1,050; Italy 240.
Other: Crude	731	1,451	—	Cyprus 450; Sudan 361; Italy 360.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	4,490	6,652	8	France 2,365; Netherlands 1,858; West Germany 1,390.
Coal:				
Anthracite and bituminous thousand tons	1,310	1,142	301	U.S.S.R. 472; Australia 275.
Lignite including briquets	1	—		
Unspecified	—	10	—	Netherlands 9; Albania 1.
Coke and semicoke	42	—		
Peat including briquets and litter	618	700	—	Finland 215; West Germany 163; Netherlands 147.
Petroleum, refinery products:				
Liquefied petroleum gas thousand 42-gallon barrels	1,774	348	—	Greece 167; Italy 94; France 60.
Gasoline do.	—	(6)	—	Mainly from Greece.
Mineral jelly and wax do.	2	14	(6)	West Germany 8; United Kingdom 5.
Kerosene and jet fuel do.	147	765	1	Italy 284; Saudi Arabia 125; Greece 106.
Distillate fuel oil do.	4,106	4,449	—	Kuwait 1,395; Israel 1,085; Singapore 1,074.
Lubricants do.	295	241	77	United Kingdom 38; France 28.
Bitumen and other residues do.	(6)	—		
Bituminous mixtures do.	1	1	—	Mainly from Belgium-Luxembourg.

NA Not available.
[1] Table prepared by Virginia A. Woodson.
[2] Unreported quantity valued at $25,513,000.
[3] Unreported quantity valued at $115,437,000.
[4] May include scrap.
[5] Unreported quantity valued at $46,000.
[6] Less than 1/2 unit.
[7] Unreported quantity valued at $1,697,000.

pany's profitability.

Egyptian domestic consumption of steel was down during the past several years because of the depressed construction sector. Consumption of raw steel dropped from 2.9 million tons in 1986 to 1.8 million tons in 1989. Additionally, the industry suffered from a lack of essential scrap metal, forcing ANSDK to import approximately 200,000 tons in 1990, mostly from the United Kingdom and the United States.

The Egyptian Iron and Steel Co. at Helwan modernized in 1989. Plans were to quadruple annual billet production to 600,000 tons. Egypt's Metallurgical Industries Corp. (Micor) commissioned a feasibility study for the construction of a plant for production of high-quality, specialty, and engineering steels. Production would supply machinemaking, automobile assembly, and defense industries. Funding would probably come from Bahrain, Kuwait, and Qatar.

Depending on terms of a forthcoming IMF agreement and its concomitant austerity measures and on the Government's planned upgrades of the steel industry, Egypt could move from import steel dependence to domestic overcapacity.

Industrial Minerals

Gypsum.—Quarried for the cement and building stone industry, the Gharbaniat, El Hammam, and Barkan gypsum deposits are within the Western Desert. The Egyptian Geological Survey and Mining Authority (EGSMA) had estimated gypsum reserves in these areas at 10 million tons. The Barkan and Gharbaniat sites experienced intermittant flooding by ground water, which disrupted quarrying operations.

Nitrogen.—In March 1990, the Kuwaiti-based Arab Fund for Economic and Social Development approved a $27.3 million loan to partly finance a planned ammonium nitrate plant to be located in Suez. The client was the parastatal Societe d'Engrais & d'Industries Chimiques, which planned to modernize its Suez plant. Three international companies submitted bids in late 1988. They were Japan's Chiyoda Chemical Engineering & Construction Co. and two Federal Republic of Germany firms, Didier Engineering and Uhde. The plant was to process ammonia from a 1,000-ton-per-day unit to be built by France's Technip. The ammonium nitrate will be produced at a rate of 1,000-tons-per-day from the ammonia produced by the French unit.

Phosphate Rock.—Phosphate rock continued to be the major nonfuel mineral product of Egypt. Production was principally from the East and West Sebaiya mines on the Nile River, south of Luxor. Additional production came from mining activity adjacent to the Red Sea port of Safaga. The phosphate rock produced had an average grade of approximately 25% P_2O_5. Egypt's only phosphoric acid plant was at Abu Zaabal, north of Cairo.

Potash.—During 1989, a revenue sharing contract was signed between the U.S. subsidiary of Australia's Broken Hill Pty. Ltd. Co. (BHP Utah Minerals International) and EGSMA. The agreement concerned exploration and development of potash resources in the Sinai along the Gulf of Suez. The total area of exploration would be approximately 14,800 square kilometers (km^2). Pending ratification by the Government, this agreement could lead to a $500 million investment to develop the potash.

Sulfur.—Freeport Egyptian Sulfur Co., a wholly owned subsidiary of Freeport-McMoRan Inc., continued drilling operations in the North Sinai Desert of Egypt in early 1989. The drilling operations were near the No. 1 Diqla discovery well at Al Arish on the Mediterranean Sea. Fifty-eight wells had been drilled with further drilling scheduled. Activities outlined a geologic resource of approximately 20.3 million tons of sulfur. If developed, the sulfur will be mined utilizing the Frasch process. The Frasch process typically involved injecting hot water into the upper cap rock sections of salt domes. Thus, the solid sulfur contained in the upper cap rock is melted and returned to the surface in liquid form.

For further development of the Sinai concession to commence, continued drilling will be necessary to gain data on the nature of the deposit and determine what percentage of the sulfur was recoverable from the deposit. Freeport-McMoRan must inform the Government by March 1991 as to whether they will take the deposit from an exploratory to a production phase. Additionally, financing and the access to and cost of fuel to heat the water utilized in the Frasch process would be other factors to consider before full development. Freeport-McMoRan Inc. intended to turn the concession over to another subsidiary, Freeport-McMoRan Resource Partners.

Mineral Fuels

Coal.—Plans for the reopening and

TABLE 4

EGYPT: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Aluminum	Aluminum Co. of Egypt (Government, 100%)	Nag Hammadi	170.[2]
Cement	Helwan Portland Cement Co. (Government, 100%)	Helwan	1.4.
Do.	Tourah Portland Cement Co. (Government, 100%)	Tourah	1.4.
Fertilizers	Societe d'Engrais and d' Industries Chimiques (Government, 100%)	Talkha Abu Qir	1.37 nitrogen. 900[2] nitrogen.
Iron	Egyptian Iron and Steel Co. (Government, 100%)	Helwan, plant	1.5.
Petroleum, crude	Egyptian General Petroleum Corp. (Government, 100%), Amoco Egypt Oil Co.	El Morgan, Suez Gulf July, Suez Gulf Ramadan, Suez Gulf	115.[3] 140.[3] 101.[3]
Petroleum, refining	Suez Oil Processing Co. (Government, 100%)	Mostorod	78.[3]
Do.	Alexandria Petroleum Co. (Government, 100%)	Alexandria	64.[3]

[1] Million metric tons per year unless otherwise specified.
[2] Thousand metric tons per year.
[3] Thousand barrels per day.

rehabilitation of the Maghara coal mine continued during the year by Egypt's Sinai Coal Co. in conjunction with the United Kingdom's British Mining Consultants and Babcock Contractors Ltd. following the approval of a financial grant from the United Kingdom's Overseas Development Administration. In the Sinai Desert, the mine represented the only domestic source of coal in Egypt. Jurassic in age, the deposit was originally developed in the 1960's, but the Maghara Mine was closed in 1967 during the Arab-Israeli conflict. Warfare destroyed mining equipment, and the entrances to the mine were blocked. Redevelopment plans for the mine include two longwall faces with production to commence in 3 years and an output of 750,000 tons per year in 5 years.

Egypt's El Nasr Coke & Chemical awarded two 3-year contracts for the importation of coal with the Pittston and Mapco coal companies of the United States. Both awards were approved by the U.S. Agency for International Development. Pittston was to supply 400,000 tons of coal; Mapco was to supply 135,000 tons of coal for 1990. Import tonnage for 1991 was to increase by 185,000 tons. El Nasr's total coal requirement for 1990 was 1,585,000 tons, 500,000 tons of which was to come from the U.S.S.R.

Natural Gas and Petroleum.—Egypt was essentially self-sufficient in fossil fuels and had a surplus of crude oil for export. These exports provide an important source for hard currency earnings.

Producing oil wells in the Miocene sediments of the Gulf of Suez region provided for approximatley 93% of total Egyptian oil production. Reduction in oil production from the Gulf of Suez was primarily because of declining reserves. Four onshore oil and gas concessions were awarded for the Gulf of Suez by EGPC. The concessions, pending approval by the Government, were awarded to Canada's Gulf Canada Corp.; Marinex Petroleum, a United Kingdom subsidiary of Canada's Can-West Holdings; Deminex of the Federal Republic of Germany; and the United States' Exxon Corp. During 1989, Amoco of the United States, in cooperation with EGPC, announced a crude oil discovery in the Gulf of Suez. The discovery was made in the Middle Miocene Upper Rudeis formation of the North October Field. A well at this concession had tested at a flow rate of 20,000 bbl/d.

Italy's Azienda Generali Italiana Petroli S.p.A. (Agip) and Amoco of the United States had been granted three concessions for deepwater exploration of oil and gas off the eastern Nile River Delta coast. Amoco received one 785 km^2 concession; Agip received two concessions of 1,400 km^2 and 2,000 km^2, which were to be operated by Agip's Cairo subsidiary, International Egyptian Oil Co. Both of these companies produce the bulk of Egypt's oil and gas under production-sharing agreements. The concession agreement was made with EGPC in early 1990. Only three blocks out of the six blocks tendered by EGPC in 1989 were accepted. Other foreign operators did not bid for the concessions because of what they perceived as EGPC's lack of incentives to explore in inherently high-cost deepwater areas.

Natural gasfield development remained a priority for Egypt, with the Netherlands Royal Dutch/Shell being a major player in the Western Desert. Total output for natural gas was planned to reach 1.5 billion cubic feet a day by the mid-1990's. At least 60% of total natural gas output in Egypt was currently utilized for electrical generation.

Reserves

The economic mineral resources of Egypt had been examined and utilized for thousands of years. During the decade of the 1980's, a total of 1,218 producing oil wells were developed. Production from the Gulf of Suez probably peaked in 1985–86 and should continue to decline into the 1990's. Recent petroleum discoveries were apparently not sufficient enough to offset the loss of production from declining reserves, which could be depleted in 10 years.

Gold and copper deposits exist in Egypt, but were not of sufficient grade to be economically viable. Much of Egypt remained geologically unexplored in detail.

Natural gas reserves were thought to be high, but outstrip the demands of the local market and will not be exploited for export until an improvement in the market.

INFRASTRUCTURE

For 1990, Egypt's Suez Canal Authority commissioned an 18-month, $2 million feasibility study into deepening and widening the Suez Canal. The action was taken in anticipation of a more vigorous petroleum market for the 1990's. If the dredging and widening were to take place, the canal could accomodate fully laden supertankers with a deadweight tonnage of up to 270,000 tons with the deepening of the draught to approximately 20 meters. Currently, the canal can handle vessels up to a deadweight tonnage of 150,000 tons. At present, dredging activities should increase deadweight tonnage up to 180,000 tons. The study was contracted to the Dutch Nedeco consortium and funded by the Kuwaiti-based Arab Fund for Economic and Social Development.

Rehabilitation plans were announced in May 1990 for the Aswan No. 1 hydroelectric powerplant, which has had a 30-year operational life. The $117 million scheme was being appraised by the Federal Republic of Germany's Kreditanstalt fuer Wiederaufbau (KfW). The plan called for replacement of generators and turbines. Current output at the plant was 240 megawatts (MW), with output ranging in the past from 100 MW to 350 MW.

Construction of new electrical generation capacity received additional stimulus during the year. Egypt's diminished hydroelectrical capacity became a concern in 1987–88 because of lowered riverflow in the Nile. A heavy Nile flood in 1989 eased concerns, but construction still continues for 3,100 MW of additional electrical generation capacity to be fueled by natural gas and petroleum. Completion was slated for 1994 and should increase installed capacity by 33%.

In early 1990, the Egyptian Atomic Energy Authority, in cooperation with the International Atomic Energy Agency in Vienna, completed renovations on the Inshas nuclear reactor, which had been inoperative for 10 years. Primarily for research, the reactor will serve industrial needs, such as the production of iodine-131 for medical purposes. Renovations at the reactor included control, measuring and alarm systems, and radioactive monitoring. Control and safety systems made by the U.S.S.R. were replaced by Western equipment. The Government reported that another reactor was under construction and that the Inshas nuclear reactor should serve in the interim.

OUTLOOK

Future mineral industry development within Egypt would probably be directed toward domestic utilization as opposed to exporting mineral commodities because of the growing population and industrial demands being placed on the nation. Additionally, the Government was attempting to grapple with environmental pollution resulting from mining and hydrocarbon drilling activities. Since the construction of the Aswan High Dam, silt impoundment behind the dam led to increased crop yield, but also caused waterlogging of the soil and increased salinization. Downstream of the dam, the abscence of the 60 to 180 million tons of silt deposited annually by the Nile River must be compensated by the application of 13,000 tons of calcium nitrate fertilizer per year. Lack of silt deposition had also caused net erosion of the Nile River Delta. Parenthetically, despite greater public awareness of the problems of pollution, the Government agency responsible for such activities, the Egyptian Environmental Affairs Agency, lacked the funds, technical staff, and organizational structure to enforce existing environmental legislation.

[1] Where necessary, values have been converted from Egyptian pounds (£E) to U.S. dollars at a rate of £E2.52 = US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

Egyptian Geological Survey and Mining Authority
Salah Salem Road
Abbassiya, Cairo

Egyptian General Petroleum Corp.
Osman Abdul Hadiz St.
Box 2130
Nasr City, Cairo

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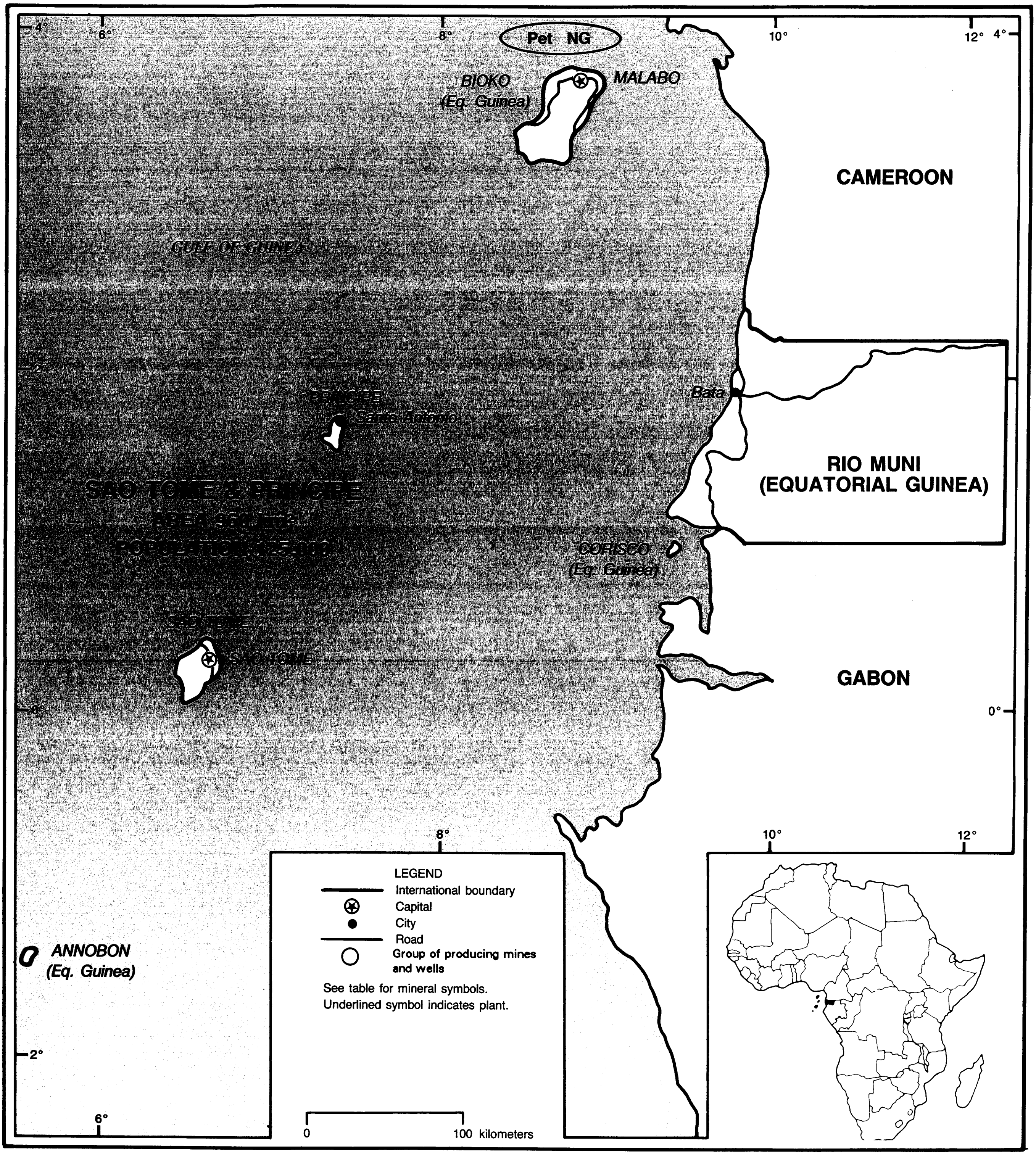
EQUATORIAL GUINEA

AREA 28,050 km² **POPULATION 370,000**



THE MINERAL INDUSTRIES OF

EQUATORIAL GUINEA AND SAO TOMÉ E PRINCIPE

By Thomas P. Dolley

EQUATORIAL GUINEA

The Republic of Equatorial Guinea is a west-central African nation composed of volcanic islands and territory in mainland Africa. The population was estimated at 370,000 people. The nation had no significant mineral activity in 1989 and early 1990. Agriculture, forestry, and fishing account for approximately 60% of the gross national product and almost all exports.[1] The International Monetary Fund (IMF) failed to grant new loans, under a structural adjustment program, to the nation in late 1989 because of concern about state expenditures. Additionally, by yearend 1989, the Government accepted the renunciation of a contract by the Spanish/Equatorial Guinea Oil Co. (GEPSA) concerning development of the Alba natural gas condensate field. GEPSA had equity ownership of 50% by Repsol of Spain and 50% by the Government of Equatorial Guinea.

Petroleum exploitation in Equatorial Guinea was controlled by the Hydrocarbons Law (Model of Agreement), Section II, Paragraph 2.8 (E). The law stipulates the method of cancelation of an agreement when a specific contractor does not start production of a hydrocarbon field within the specified period of time.

The Alba Field was discovered by Repsol in 1984. The field is 36 kilometers offshore, north of the island of Bioko, and had a lateral extent of 60 kilometers in water 70 meters deep. Repsol felt that the project was too small to merit further involvement. In April 1990, a 5-year contract was signed between the Government and three U.S. companies to continue development of the field. The Government retained all rights to the concession with equity stakes by Walter International at 25%, McMoRan International at 50%, and Samedan Oil Co. at 25%. The arrangement involved a complicated production-sharing agreement covering approximately 200,000 hectares. If oil was developed, the contract would extend to 30 years, and if natural gas was developed, the contract would extend to 60 years. Walter International planned to drill two wells at the Alba Field, construct a pipeline to shore, and begin constructing a processing plant for recovery of liquids with full production to commence by mid-1991. Additionally, France's Société d'Urbanisme pour l'Afrique, a subsidiary of Bouygues, was to set up a joint venture in 1990 with the Government to produce and market electricity on the island of Bioko. Controversy surrounding the shipment and processing of toxic wastes from the United States in Equatorial Guinea were refuted by both Governments in 1990.

SAO TOMÉ E PRINCIPE

Sao Tomé e Principe is a dual island nation south of Nigeria and west of Gabon on the Equator in the North Atlantic Ocean with a population estimated at 125,000. The small republic had export earnings amounting to $11 million in 1989, with an external debt accounting for 80% of that figure.[2]

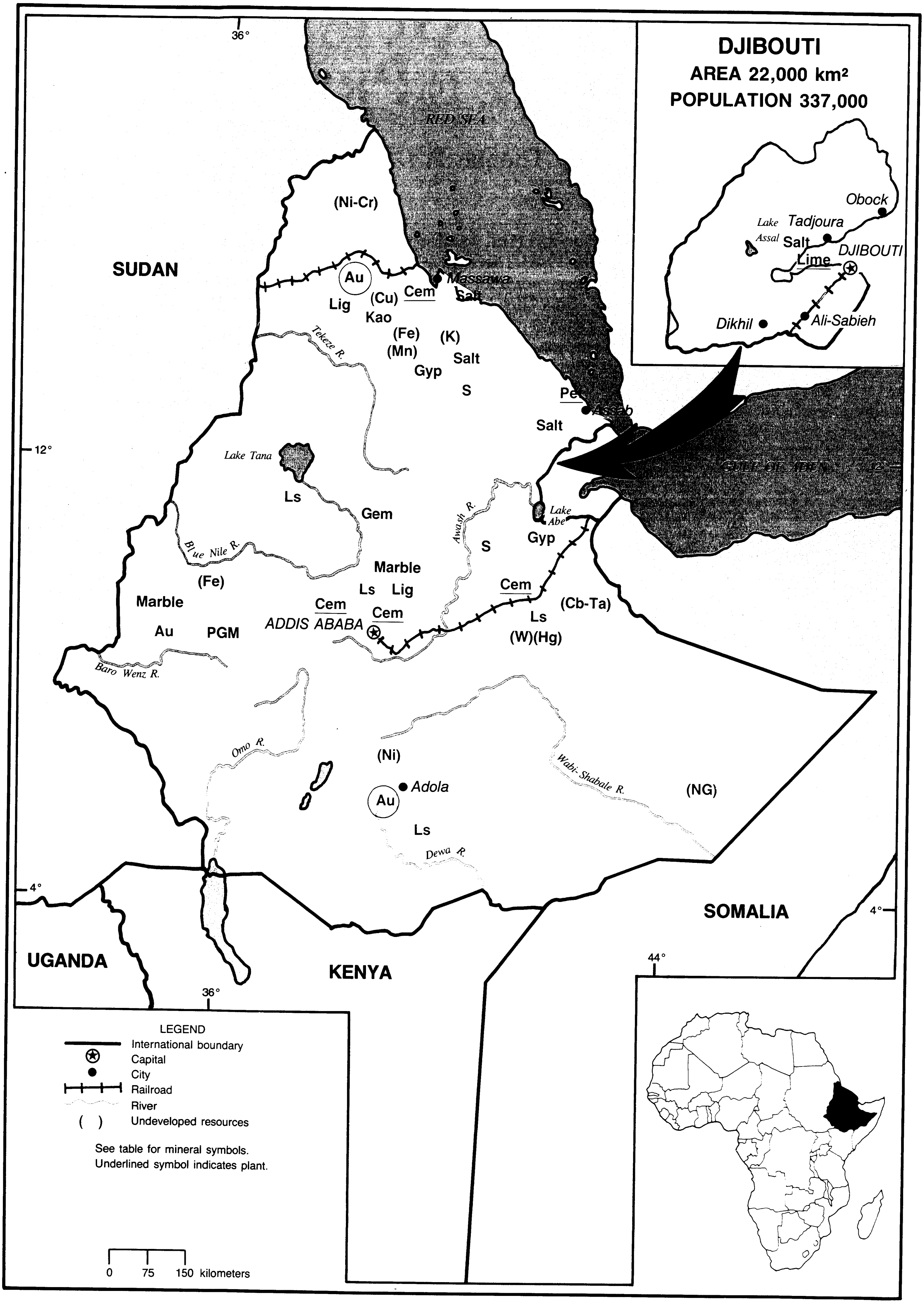
The country had no significant mineral industry. Some small clay and stone open pit operations were utilized for local construction needs. The legal system of Sao Tomé was based on the Portuguese legal system and customary law. Decree Law 30-80 of July 1980 does not relate to mining investment specifically. However, it stipulates the conditions for foreign investment. Recently, seismic surveys in the Gulf of Guinea had indicated the presence of a layer of salt offshore of mainland Africa, which could extend as far west as Sao Tomé. The possibility of hydrocarbon-bearing strata could attract future seismic surveying in and around the small republic.

[1] Where necessary, values have been converted from Communauté Financiere Africaine francs (CFAF) to U.S. dollars at the rate of CFAF325.31 = US$1.00.

[2] Where necessary, values have been converted from Sao Toméan dobras (STD) to U.S. dollars at the rate of STD122.48 = US$1.00.

ETHIOPIA AND DJIBOUTI

AREA 1,221,900 km² **POPULATION 51.7 million**



THE MINERAL INDUSTRIES OF

ETHIOPIA AND DJIBOUTI

By Lloyd E. Antonides

Minerals continued to account for only about 1% of Ethiopia's economy as measured by the gross domestic product (GDP) which was estimated to be about 6 billion[1] in 1989. However, a wide variety of minerals were known to occur in deposits of potentially economic size and grade. The Government was planning to introduce new incentives to attract foreign as well as domestic investment. Government companies still dominated the industry, however, but sizeable production came only from artisans and small cooperatives.

Construction materials were the most significant mineral commodities produced on a volume basis. Although cement production data is not available from official sources, it is estimated to be one of the major commodities of the country. A new 300,000-ton per-year capacity plant was under construction near Muger, north of Addis Ababa, where a similar plant opened in 1984—both with assistance of Cuban expatriates. Marble and other dimension stone products were also growing in output, especially for export, from central and western parts of the country. A new cutting and polishing plant was being built in Awash east of Addis Ababa.

Production of gold came from north, west, and especially south-central areas—mostly from artisans or cooperative operations. A new Government-owned mine, Lega Dembi, was near completion in the south-central Adola districts. Starting as an open pit, it was

TABLE 1

ETHIOPIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic[e]		250,000	[r]270,000	[r]325,000	[r]406,000	400,000
Clays: Kaolin (china clay)		75	90	2,500	750	[3]400
Diatomite		150	137	40	20	20
Gold: Mine output, Au content[e]	kilograms	470	923	642	728	[3]745
Gypsum and anhydrite, crude		700	850	1,400	1,900	[3]2,100
Lime		[e]2,100	2,200	2,300	3,000	[3]145
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	58	69	75	56	[3]74
Gasoline	do.	852	913	1,059	865	[3]1,060
Jet fuel	do.	403	418	421	382	485
Kerosene	do.	22	64	106	95	100
Distillate fuel oil	do.	2,149	1,484	1,612	1,294	[3]1,534
Residual fuel oil	do.	1,365	2,051	2,269	2,056	[3]2,412
Other including refinery fuel and losses	do.	660	526	550	340	[3]50
Total	do.	[r]5,509	5,525	6,092	5,088	[3]5,715
Platinum: Mine output, pt content	grams	1,700	2,400	1,040	1,485	1,500
Pumice	cubic meters	15,000	35,481	26,042	143,442	[3]23,000
Salt:[e]						
Rock		15,000	15,000	15,000	15,000	10,000
Marine		120,000	120,000	120,000	120,000	100,000
Stone, sand and gravel:						
Dimension stone		300	460	557	600	600
Limestone[e]		100	100	75	145	150
Sand	do.	530	540	680	990	[3]775
Other[e]	do.	1,100	1,030	1,150	1,320	[3]4,900

[e]Estimated. [p]Prelimary. [r]Revised.
[1]Data are for fiscal year ending July 6 of the year listed. Includes data available through July 1, 1990.
[2]In addition to commodities listed, various crude construction materials (clays, sand and gravel, stone, etc.) presumably are produced but information is inadequate for making reliable estimates of output levels.
[3]Reported figure.

planned eventually to go underground. A 3,000-ton-per-year ore input cyanide-leaching plant was being built.

Salt was also a major commodity. Both rock salt from the Danahil Depression south of Massawa and sea salt from solar evaporation ponds near Massawa and Assab were the principal operations.

The Government continued to promote the country's oil potential with missions to North American companies, and it also commissioned a study on small-scale utilization of natural gas. The Assab oil refinery was also planned to be rehabilitated.

Among minerals promoted during 1989 that were not previously considered to have much potential were: cesium, columbium and tantalum for which a pilot processing plant was announced; and soda ash. Bentonite and diatomite were also cited.

The outlook for a growing mineral industry appeared to be good, but the timing and extent depended on resolution of the political situation and ongoing insurrections.

DJIBOUTI

Mineral production remained an insignificant component of Djibouti's economy, which approached a GDP of $400 million[2] in 1989. Small but unspecified quantities of minerals were reported to be produced: solar-evaporated sea salt near Tadjoura by a local entrepreneur, calcium lime just west of Djibouti city by a private operator, and construction sand and gravel and stone near sites of road and other construction prospects. A potential for gypsum and perlite production was also reported, and mineral water bottling was cited as a noteworthy industry. A proposed 60,000-ton-per-year cement plant based on limestone near Ali Sabieh was studied in the early 1980's using donor funds reportedly from Iraq and Austria, but implementation was never reported.

French-funded investigations of the geothermal potential west of Lake Assal, which commenced in the late 1970's, led to further studies and test drilling through 1988. The total cost for the studies, including funds from other donors, was about $20 million. In mid-1989, the International Development Association approved more than $9 million to fund development of geothermal energy for electric power generation. The oil potential of the country is still unknown. In 1988, Chevron Corp. unsuccessfully offered to spend several million dollars and use equipment being removed from Somalia to explore the southern half of Djibouti in return for the rights to negotiate a concession. However, the Government opted for a proposal from a Middle Eastern group that apparently failed to materialize through the end of 1989.

The Massachusetts-size, officially French-speaking country's economy was based on its strategic location on the west side of the strait between the Red Sea and Indian Ocean, across from the Republic of Yemen. Its port provided general transhipment and resupply facilities and also was the railhead for shipments to and from Addis Ababa and other Ethiopian cities. More than 70% of the GDP was attributed to services involving maritime, railroad, and related financial-commercial activities. The country also offered a free trade zone and welcomed private investment with favorable laws. In spite of arid and mostly nonproductive soil, agriculture, especially animal husbandry, accounted for almost 30% of the GDP. The work force included a sizable expatriate component but unemployment was more than 50%. The nation was heavily dependent on foreign aid to balance its payments and for development projects. Little change in the economy or mineral industry was expected in the near future.

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[1]Where necessary, values have been converted from Ethiopia birr (EB) to U.S. dollars at the rate of EB2.070=US$1.00 in 1989.

[2]Where necessary, values have been converted from Djibouti francs (DF) to U.S. dollars at the rate of DF177.72=US$1.00 in 1989.

OTHER SOURCES OF INFORMATION

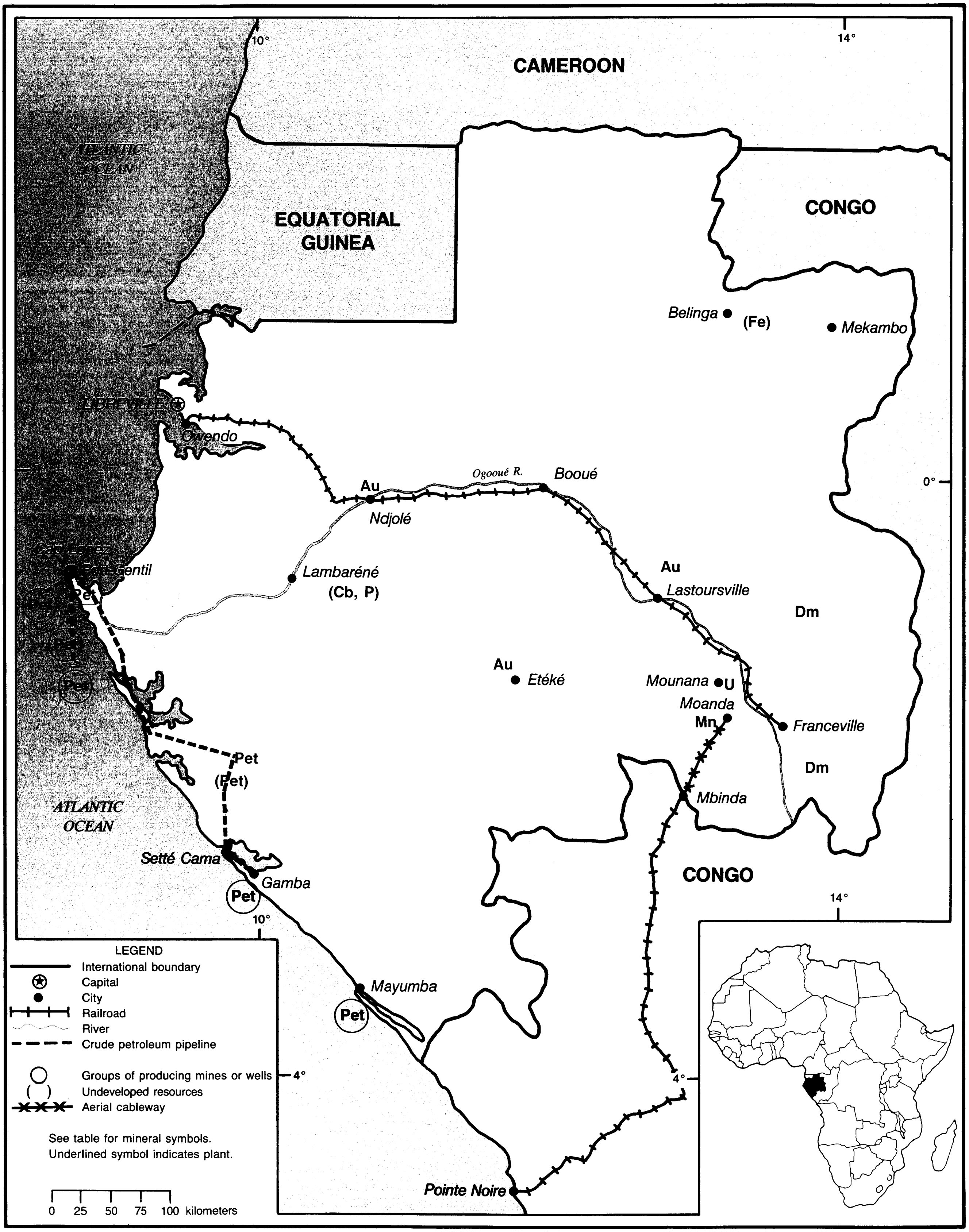
Agencies

Ethiopia
Ministry of Mines and Energy
P.O. Box 486
Addis Ababa, Ethiopia
Telephone: 15 74 13 Telex: 21448

Djibouti
Ministry of Industry & Industrial Development
P.O. Box 175
Djibouti, Djibouti
Telephone: 253–350340

GABON

AREA 267,670 km² | **POPULATION 1.06 million**



THE MINERAL INDUSTRY OF

GABON

By Hendrik G. van Oss

Gabon's economy is dominated by the production of mineral commodities and timber. Mineral production accounted for about 43% of Gabon's estimated 1989 gross domestic product (GDP) of $3.5 billion[1] and about 79% of the country's total exports. The mining industry is dominated by the production of oil, manganese, and uranium, of which oil is by far the most important. Oil exports made up about 87% of total mineral exports. Because of Gabon's low population, its per capita GDP was the highest in sub-Saharan Africa.

Gabon is the smallest oil producer in the Organization of Petroleum Exporting Countries (OPEC) and the sixth largest oil producer in Africa. It is the fourth largest producer of manganese ore in the world, but is the largest producer of battery-grade manganese ore. The manganese ore mine at Moanda is the largest single manganese ore mine in the world. Gabon is a significant world producer of uranium.

In terms of geology, the eastern two-thirds of Gabon is dominated by lower Precambrian granitic rocks. Numerous vein and placer gold occurrences are known within this terrane, but total production, virtually all by artisanal miners, has been small. In the northeast part of the country, west of Mekambo, there is a roughly east-west belt of folded Precambrian phyllites and gneisses in which there are large itabirite iron deposits. One of these, Belinga, has been considered for exploitation, but the project is not currently economically feasible because of a lack of infrastructure. The Proterozoic Francevillean Series, dominated by clastic sedimentary rocks, forms a roughly east-west belt extending some 225 kilometers (km) from the center of the country almost to the Congolese border. About 50 km northwest of Franceville, these rocks host large, very high-grade manganese and uranium deposits; these have been exploited since the early 1960's. One of the uranium deposits, Oklo near Mounana, is notable for being the site of the world's only known natural nuclear chain reaction. As a result of this reaction, which took place in the Precambrian, some of the richest zones within the deposit, exceeding 40% uranium in places, are not considered ore because the uranium therein is depleted in the fissionable isotope U^{235}.

A major northwest-southeast sedimentary basin is present along the Atlantic coast and extends offshore at least as far as Sao Tomé, 250 km to the northwest of Cap Lopez. The Cretaceous sedimentary rocks within this basin are the source of Gabon's oil production, which commenced in 1956. Favorable trapping structures include faults related to the opening up of the Atlantic Ocean, and salt diapirs. Recent advances in seismic data interpretation has allowed the reevaluation of the potential for structural traps beneath the widespread evaporite formation within the Cretaceous sequence. Drilling of an onshore target beneath this salt formation led to the discovery in 1985 of the Rabi-Kounga Field, Gabon's largest, about 100 km north of Gamba, and the subsequent rejuvenation of interest in oil exploration in Gabon.

Since 1980, a major mineral exploration program has been carried out, largely by France's Bureau de Recherches Géologiques et Minières, along a 130,000 square-kilometer swath surrounding the Trans-Gabon Railroad. Although a number of small gold and base metals deposits have been discovered as a result of this program, the most significant discovery was that, in 1987, of the Mabounié carbonatite, 40 km east-southeast of Lambaréné. The weathered residuum above the carbonatite contains a large resource of columbium and phosphates; despite initial optimism, the deposit has yet to be demonstrated as economic.

GOVERNMENT POLICIES AND PROGRAMS

The Government views minerals as being the key to Gabon's future economic development, and development of the country's mineral resources is thus encouraged. In contrast with many other African countries, the development potential of Gabon's agricultural sector is small, largely owing to the low population density and the attraction of high wages in other sectors of the economy.

The Government has traditionally taken significant equity ownership in mineral companies, either directly or through buy-ins. In recent years, in part because of pressure from international lending agencies, the Government has relaxed this policy with respect to new ventures. It is now possible to form a company in Gabon having no direct Government participation.

The Government has invested in overseas mineral concerns, especially where doing so would benefit Gabon's mineral industry. The most notable example of this is the Government's 30% share of Société de Ferromanganèse de Paris-Outreau, the large French ferromanganese producer.

The basic mining law of Gabon is the 1962 Mining and Petroleum Code—Law 15/62, as modified in 1968 by Law 16/68, and in 1970 by Decree No. 981. The mining fiscal regime is now governed by Ordinance No. 38/79/PR. Petroleum exploration and exploitation was further regulated in 1974 by Law 14/74 and re-regulated in 1982 by Law 14/82. A useful summary of the non-oil mining laws is contained within a recent Government publication on gold in Gabon.[2]

The principal investment law is the 1961 Investment Act 5/561 as modified in 1967 by Ordinance 21/67.

Most of the major services in Gabon, such as the railroads, power generation, water, and port operations, are run by parastatal agencies, most of which, however, have significant but not majority ownership participation by the major industrial companies.

PRODUCTION

Gabon's oil production in 1989 was at its highest level in many years and was well in excess of the country's OPEC quota. The increase was because of output from the Rabi-Kounga Field, which commenced production in January. Production in 1990 was expected to exceed 100 million barrels. A virtual cessation of oil production for a short period in May 1990 as a result of civil disturbances was not expected to significantly hurt output for the year. The country's only oil refinery continued to operate well below its capacity of 8 to 9 million barrels per year.

Manganese ore production increased significantly to a record level. The increase was in part made possible by the completion, late in 1988, of the ore port of Owendo, which provides the mine with a second export route for its product.

Uranium production fell slightly, and it was expected that production would continue to decrease because of declining grades and continued low world uranium prices. The uranium is exported through Owendo.

Reported gold production fell significantly. Virtually all of the country's gold production is from artisanal operations, and because most of this is smuggled out of the country, the true output is unknown. Likewise, most of Gabon's modest diamond production is smuggled out of the country.

TRADE

Gabon's total exports are estimated to have amounted to about $1.9 billion in 1989, of which an estimated $1.5 billion was from mineral commodities. Oil export revenues increased dramatically to approximately $1.3 billion, largely owing to oil production from the new Rabi-Kounga Field. Manganese revenues are estimated to have increased about 18% to about $140 million, largely owing to an increase in production and exports. Uranium export revenues declined slightly, largely

TABLE 1

GABON: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic[3]	metric tons	244,768	210,858	140,196	132,038	[4]115,442
Clinker	do.	221,610	202,198	106,000	104,000	[4]113,000
Diamond, gem and industrial[e]	carats	550	500	500	500	500
Gas, natural:						
Gross	million cubic meters	[e]2,100	1,994	1,770	1,904	2,100
Marketed[e]	do.	113	85	113	127	127
Gold, mine output, Au content[5]	kilograms	50	62	79	138	[4]81
Manganese:						
Metallurgical grade ore, gross weight (50% to 53% Mn)	metric tons	2,281,000	2,440,000	2,216,039	2,186,158	[4]2,500,800
Pellets, battery- and chemical-grade, gross weight (82% to 85% MnO_2)	do.	59,000	70,000	187,135	67,977	[4]91,607
Total	do.	2,340,000	2,510,000	2,403,174	2,254,135	[4]2,592,407
Petroleum:						
Crude	thousand 42-gallon barrels	62,307	60,000	56,243	57,895	80,000
Refinery products:						
Gasoline	do.	523	480	447	459	460
Jet fuel and kerosene	do.	776	530	485	499	500
Distillate fuel oil	do.	1,690	1,380	1,121	1,153	1,200
Residual fuel oil	do.	2,912	1,130	1,100	1,080	1,100
Other[e]	do.	135	100	100	100	100
Refinery fuel and losses[e]	do.	200	130	150	150	150
Total[e]	do.	6,236	3,750	3,403	3,441	[4]3,510
Uranium oxide (U_3O_8), content of concentrate	metric tons	1,105	1,059	934	1,094	[4]1,047

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Aug. 23, 1990.
[2] In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) is also produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.
[3] Includes cement produced from imported clinker.
[4] Reported figure.
[5] Gold production figures likely do not include production smuggled out of the country, for which there are no reliable data.

as a result of reduced output. Gabon's largest non-mineral export was wood, for which exports are estimated to have remained relatively unchanged at about $180 million.

France continued to be Gabon's most important trading partner, taking about one-third of Gabon's exports, including oil worth about $400 million. France buys virtually all of Gabon's uranium output and a significant proportion of its manganese production, largely for conversion to ferromanganese. France supplied about 50% of Gabon's $760 million in imports in 1989, mostly consumer goods, machinery, and food products. Gabon's exports to the United States were worth about $210 million and were mostly oil and manganese ore.

STRUCTURE OF THE MINERAL INDUSTRY

Gabon's oil production is from only four producing companies, of which one accounted for about 48% of the total output as an operator, but approximately 67% of the total output as owner. The Government had equity participation in most of the country's oil production ranging from 25% to 36.25%.

Gabon had one manganese mine and two uranium mines in operation during the year. One company produced clinker and cement. The Government was a significant owner of all of these. The country's diamond and most of its gold production is by artisanal miners.

Gabon's total salaried labor force is estimated to number about 120,000, of which about one-third is in the industrial and commercial sectors. The mineral industries employ about 9,000 workers, of which about 5,000 are employed in the petroleum sector. In addition, mineral-related employment in the transportation sector numbers several thousand. Gabon's low population has necessitated the extensive employment of expatriate labor, including

TABLE 2

GABON: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Cement	Société des Ciments du Gabon (Government, 90.54%; ELF-Gabon, 9.44%; other, 0.01%)	Clinker plant at N'Toum, 40 kilometers east of Libreville	350,000[2] clinker.
Do.	do.	Clinker-grinding plant at Owendo	270,000[2] cement.
Do.	do.	Clinker-grinding plant at Franceville	130,000[2] cement.
Manganese	Compagnie Minière de l'Ogooué (Government, 29.23%; Compagnie Française de Mines, 17.60%; USX (United States), 15.10%; others,[4] 38.7%)	Open pit mine at Moanda	2.7.[3]
Petroleum, crude	ELF-Gabon (Société Nationale ELF Aquitaine of France, 75%; Government, 25%)	Mandji on and offshore field near Port Gentil	108,000.
Do.	Shell Gabon[5] (Royal Dutch-Shell, 75%; Government, 25%)	Lucina Marine offshore field, 15 kilometers south of Mayumba	11,000.
Do.	do.	Gamba-Ivinga Field, onshore at Gamba	12,000.
Do.	do.	Rabi-Kounga Field, 100 kilometers north if Gamba	135,000.
Do.	AMOCO	Oguendjo offshore field, 85 kilometers southeast of Port Gentil	17,000.
Do.	British Gas Corp. United Kingdom	Obando, Octopus, and Pelican offshore fields, 60 kilometers southwest of Port Gentil	14,000.
Petroleum products	Compagnie Gabon-ELF de Raffinage[6] (ELF-Gabon, 70%; Government, 30%)	Refinery at Port Gentil	24,000.
Uranium	Compagnie des Mines d'Uranium de Franceville (Compagnie de Mokta of France, 38.98%; Government, 24.75%; Compagnie des Matières Nucléaires of France, 18.81%; Uranium Péchiney, 10.62%; others, 6.84%)	Two mines near Mounana	1,200[2] (uranium oxide).

[1] Barrels per day unless otherwise specified.
[2] Metric tons per year.
[3] Million metric tons per year.
[4] The other equity shareholders in COMILOG are: Maaldrift B.V. of the Netherlands: 10.73%; Société Auxiliare du Manganèse de Franceville (SAMAF) of France: 10.01%; COMIREG of France: 10.01%; Elkem AS of Norway: 5.70%; Société de Ferromanganèse de Paris-Outreau: 1.00%; private Gabonese nationals: 0.62%.
[5] Shell Gabon is in joint venture with the ELF group in Gabon. Production from the most important field, Rabi-Kounga, will be shared (42.5% each), with the Government holding 15%.
[6] In 1983-1984, Gabon's other refinery, operated by Société Gabonaise de Raffinage (a joint venture between the Government, ELF-Gabon, TOTAL of France and others) was linked with Compagnie Gabonaise-ELF de Raffinage to form a single refinery complex at Port Gentil.

workers from neighboring countries. Wages in Gabon are very high by African standards.

COMMODITY REVIEW

Metals

Compagnie Minière de l'Ogooué (COMILOG) experienced both record ore production and its first full year of ore shipments via the Trans-Gabon Railroad to the minerals port of Owendo. The ore port was inaugurated at yearend 1988, and will allow either the shipment of the company's entire ore production through Owendo, or the company to double its output if the traditional route through the Congo is also fully utilized. For the near future, it is planned to ship 49% of the first 2.4 million metric tons (MMmt) per year of production through the Congo, and the remainder through Owendo. In 1989, COMILOG shipped 2,467,307 metric tons (mt) of manganese ore, of which 2,397,800 mt was metallurgical grade ore, and 69,507 mt was battery grade ore.

In addition to ore, COMILOG produces a large quantity of unsalable manganese oxide fines. It is estimated that stockpiles of this material at Moanda may amount to as much as 12 MMmt. The Government was looking at ways to build a ferromanganese plant to process the fines, but it was recognized that the energy requirements of conventional ferromanganese technology would make such a project uneconomic under current market conditions.

Mineral Fuels

Gabon produces oil from almost 500 wells, located in 6 oilfield complexes, most of which are offshore. Gabon's apparent production of crude oil in 1989 was the country's highest in more than a decade and a major increase over the output of 1988. The increase was entirely the result of the coming on-stream in January of the massive Rabi-Kounga onshore field. Production from the Rabi-Kounga Field was well in excess of original plans, averaging about 65,000 barrels per day (bbl/d) for much of the year, but achieving 120,000 bbl/d toward yearend, about 6 months ahead of schedule. Accordingly, it was announced by the operator, Shell-Gabon, that the field's target rate for 1990 had been increased to 135,000 bbl/d. A 135-km pipeline from the field to Gamba was completed in 1988, and a 235-km line to Port Gentil was completed in early 1989.

Gabon's other fields averaged a total of about 160,000 bbl/d, of which about two-thirds was from the Mandji Field complex operated by ELF-Gabon near Port Gentil.

Discovery of the Rabi-Kounga Field has renewed interest in oil exploration in Gabon, especially onshore. About a dozen companies were conducting oil exploration, both onshore and offshore, in 1989. Approximately 65% of Gabon's oil acreage, much of it presently controlled by Elf-Gabon, will open for bid in 1991; it is anticipated that record bid prices will be realized for these concessions. Several onshore and offshore discoveries were announced in 1989 and in early 1990.

During a brief period in May 1990, rioting in Port Gentil forced the evacuation of expatriate oil workers, particularly those working for Shell and ELF-Gabon. Oil production was cut from 270,000 bbl/d to just 20,000 bbl/d —the minimum needed to prevent paraffin buildup in the pipes. By the end of the month, production had been largely restored.

Reserves

Gabon's manganese oxide ore reserves in the Moanda area are very large, amounting to in excess of 200 million tons grading about 48% manganese according to COMILOG. About 25% of these reserves are in the immediate area of the existing mine. The Moanda area also has a large inventory of manganese carbonate, although no plans exist to mine this material.

Gabon's oil resources are large but are not well defined. The recently discovered Rabi-Kounga Field and its satellite deposits are widely reported to contain approximately 1 to 1.2 billion barrels of oil, with about 480 million barrels recoverable. Further exploration is expected to increase the reserves of this field. The other producing fields and new offshore discoveries are believed to have total reserves of about 700 million barrels. The Rabi-Kounga discovery has generated a great deal of interest in onshore exploration, and it is expected that present and future offshore and onshore exploration will significantly increase the country's known reserves.

Reserves of natural gas are likewise significant, being in excess of 16 billion cubic meters, but again are poorly known. Very little of the country's gas production is marketed.

Uranium reserves are only well defined for the Mounana area, where total reserves in 1982 were given by the Government as about 33,000 tons of uranium metal, adequate for about 25 years of production at then-current levels. The total reserves in 1982 were distributed among four deposits: Boyindzi, 3,000 tons; Oklo, 15,000 tons; Okélobondo, 5,000 tons; and Mikoulougou, 10,000 tons. Production subsequent to 1982 has all been from the Oklo and Boyindzi deposits and has amounted to about 8,400 tons of uranium metal. The 1982 reserves were based on more favorable economic conditions than are current. Recoverable reserves as of yearend 1989 amounted to about 13,000 to 16,000 tons of uranium metal. Gabon has very high uranium production costs, but has traditionally received long-term contract prices for its uranium output. Given continued low world prices, it is uncertain how long Gabon will be able to maintain its current level of production and sales.

Gabon has numerous deposits of iron ore, the most significant of which are in the northeast part of the country. The largest and best known of these is the Belinga deposit, 100 km west-northwest of Mekambo. According to the Government,[3] the resource at Belinga amounts to 566 MMmt grading 64.24% iron, 2.18% silica, and 0.122% phosphorus. Of this amount, approximately 345 MMmt is low phosphorus (0.07%) material. The Boka Boka deposit, 40 km southwest of Mekambo, has a resource of 194 MMmt grading 62.5% iron, 3.57% silica, and 0.106% phosphorus. The Batouala deposit, 70 km southwest of Mekambo, has a resource of about 100 MMmt grading 65.7% iron. Of these deposits, only the Belinga deposit has been seriously considered for mining. However, exploitation of the Belinga deposit would require the construction of a 235-km extension of the Trans-Gabon Railway from Booué to the deposit, and the construction of suitable shiploading and storage facilities at the port of Owendo. This construction, and hence the exploitation of the Belinga deposit, is considered uneconomic under current market conditions.

The Mabounié carbonatite, located 40 km east-southeast of Lambaréné, has a columbium resource, according to the Government,[4] of 15 million tons grading 2% columbium oxide (Cb_2O_5), or 42 million tons grading 1.78% Cb_2O_5. It also contains a phosphate resource of about 85 million tons grading 24% P_2O_5, and some rare earths. Tests in 1987 and 1988 showed that the columbium resource was likely uneconomic, except possibly as a byproduct of phosphate mining, and the economics of mining the phosphate resource had yet to be demonstrated as of yearend 1989.

Gold occurrences are widespread, and diamonds are found in southeast Gabon. However, the reserves of gold and diamonds are not known with any certainty.

INFRASTRUCTURE

Gabon's transport infrastructure is still underdeveloped. The only railroad in Gabon is the Trans-Gabon Railroad, which runs 669 km from Owendo to Franceville. The first segment, comprising the 183 km from Owendo to Ndjolé, was operational at yearend 1978, and the 156 km segment on to Booué was inaugurated in early 1983. The final segment to Franceville was inaugurated at yearend 1986. A short spur to the manganese mine at Moanda was completed shortly thereafter. The track is 1.437-meter gauge. Plans to build a 235-km extension northeast from Booué to the Belinga iron deposit are on indefinite hold owing to unfavorable world market conditions for iron ore. The Trans-Gabon railroad hauls general freight, lumber, passengers, and, especially, manganese ore. Shipment of the latter commenced in December 1988, following the completion of the ore shiploading facilities at the port of Owendo. Manganese ore railing capacity is at least 3 MMmt/yr, utilizing trains of 70 to 96 railcars hauling 6,000 to 8,000 tons per trip. The railroad is also now used to export the country's uranium production. In addition, in 1988, the railroad carried 580,000 tons of lumber, 80,500 tons of clinker, 20,000 tons of fuel, about 150,000 tons of general freight, and about 250,000 passengers. Overall responsibility for running the railroad is with the Office de Chemin de Fer Transgabonais (OCTRA).

Prior to the completion of the ore port at Owendo, Gabon's manganese ore production was shipped via a 76-km aerial cableway to Mbinda in the Congo, and thence by 296 km of railroad to the Congolese port of Pointe Noire. This route also has a capacity of about 3 MMmt/yr, and still carries about half of Gabon's manganese production. Similarly, Gabonese uranium (yellowcake) was trucked to Mbinda for railing to Pointe Noire.

Gabon has about 7,500 km of roads, of which only about 10% are paved, including city streets. Most of the roads are in poor condition; in 1989, Gabon secured a $30 million loan for a 3-year road rehabilitation project. Gabon has about 1,600 km of navigable waterways, the most important of which is the 310-km stretch of the Ogooué River from Port Gentil to Ndjolé. Gabon has a well-developed civilian aviation system, that includes international airports at Libreville, Port Gentil, and Franceville; about 60 other public airports; and at least 50 private landing strips.

Gabon has a sophisticated satellite telecommunications network and a good electrical grid. Electricity production in 1988, the last year for which data are available, was 906,428,000 kWh. Total installed generating capacity is about 310,000 kW. Of this capacity, 166,000 kW is installed in the country's three hydroelectric plants. These plants are the Kinguélé (72 MW capacity) and Tchimbélé (57 MW capacity) stations on the Mbéi River about 110 km east of Libreville, and the Poubara station (37 MW capacity) on the Ogooué River about 40 km south of Franceville. Both the manganese and uranium mines utilize power from the Poubara station. The bulk of the remainder of Gabon's electrical capacity is supplied by 24 thermal power stations. There is a modest generation of electricity using solar cells; much of the country's telecommunication system is so powered.

The mineral storage and shiploading facilities at the port of Owendo were inaugurated at yearend 1988 after 16 months of construction. The $50 million project was a compromise from earlier plans to build a manganese and iron ore shipping facility. The original plan would have involved a 7.5-km conveyor jetty out to waters of 21 meters (m) depth dredgable to 27 m. This depth would have allowed the loading of 250,000 deadweight tons (dwt) ore carriers, but was deemed too expensive given the poor world market for iron ore, and the expense involved in putting the Belinga iron deposit into production. An intermediate plan, which involved dredging an 18-m channel at Owendo to allow 150,000 dwt ships, was also abandoned after it was determined that it would be too expensive to keep the channel open. Owing to oil revenue shortfalls in 1986, continued low world iron prices, and the completion of the Trans-Gabon Railroad to Franceville, it was decided to build a much smaller ore port, to handle manganese ore only.

The mineral port at Owendo can handle ships of up to 42,000 dwt, drawing 11 m. As the water depth is only 11 m, ships come in and leave at high tide (12.5 m depth). Ore is loaded by a 900-m conveyor at a maximum rate of 3,000 tons per hr. There is storage at the port for about 700,000 tons of ore. The old port of Owendo is for general cargo, containers, and petroleum products, and can handle about 55,000 tons per year. General port affairs are handled by the parastatal Offices des Ports et Rades; however, the mineral port is run by Société du Port Minéralier d'Owendo, of which COMILOG is the majority owner.

Gabon's petroleum infrastructure consists of 643 km of crude oil pipeline, 14 km of refined products pipeline, several oil shipping facilities, and one refinery complex. The bulk of Gabon's petroleum production is shipped from the terminal at Cap Lopez, about 10 km northwest of Port Gentil. Tankers of up to 250,000 tons can be handled. Port Gentil handles much of Gabon's international trade in general cargo and lumber. It is also the site of the country's only oil refining facilities. The oil terminal at Cap Lopez is fed by numerous pipelines leading to the surrounding offshore oil wells, some as far away as 110 km, and a new 238-km pipeline leading to the onshore Rabi-Kounga Field. Some of the offshore wells have their own tanker-loading facilities. The oil terminal at Gamba can load tankers up to 140,000 dwt by means of a 6.3-km pipeline to an offshore floating station. Gamba services the nearby oilfields, but also is connected to the Rabi-Kounga Field by means of a new 135 km pipeline. The offshore oil terminal at Lucina can load tankers of up to 165,000 dwt, and the nearby Mayumba offshore terminal can handle ships up to 70,000 dwt.

OUTLOOK

As a result of production from the Rabi-Kounga Field, Gabon's economy will continue to be dominated by petroleum well into the next century. Although production from several of the currently producing offshore fields is declining, recent offshore discoveries should maintain the offshore share of production at current levels for at least a decade. The potential for the discovery of new fields, both offshore and onshore, is high. It is expected that there will be very lively interest in bidding for the large petroleum acreage that will open in 1991.

Manganese will continue to dominate the non-oil mineral sector. With the completion of the internal export infrastructure for manganese, Gabon has the potential capacity to double its current output of ore should market conditions so dictate. Its manganese ore is high-grade by world standards and should continue to enjoy a healthy demand. The economics of installing a ferromanganese plant to utilize the currently unsalable washed fines output of the mine hinges on the development of a less energy intensive conversion technology than is currently in use elsewhere in the world.

Continued low world uranium prices augur poorly for the health of Gabon's uranium sector. It is likely that Gabonese output will either decline significantly in the near future, or will realize lower revenues as the country's traditional customers turn to cheaper sources of uranium.

Although Gabon has good geologic potential for the discovery of deposits of other minerals, especially gold, expansion of this sector of the mining industry will be somewhat hampered by high costs, especially wages; the lack of infrastructure; and the physical difficulty of working in heavily forested country.

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[1] Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate CFAF319 = US$1.00.

[2] Ministère des Mines, de l'Industrie et de la Consommation-Direction Générale des Mines et de la Géologie: L'Or au Gabon (Gold in Gabon), 1988, pp. 33-38.

[3] Ministère des Mines. Direction des Mines, République Gabonaise, 1971, Plan Minéral; Partie Principale, pp. 111-114.

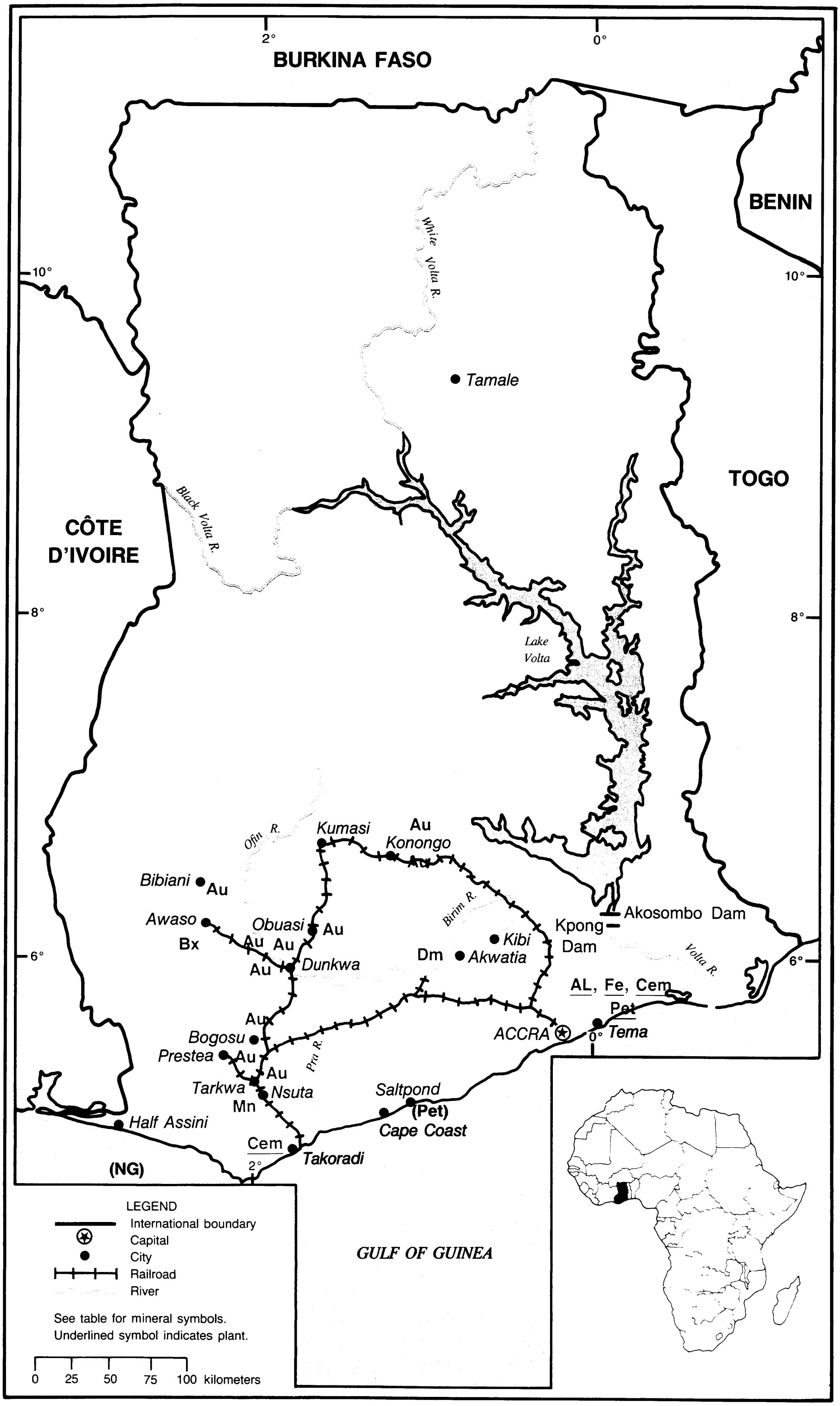
[4] République Gabonaise. Direction Générale des Mines et de la Géologie. Le Gisement de Mabounié (The Mabounié Mineral Deposit), 1989, 31 pp.

OTHER SOURCES OF INFORMATION

Ministère des Mines, de l'Industrie et de la Consommation:
Direction Générale des Mines et de la Géologie, Libreville.

GHANA

AREA 238,540 km² **POPULATION 14.8 million**



THE MINERAL INDUSTRY OF

GHANA

By Hendrik G. van Oss

Mining has played an important role in the economy of Ghana throughout the country's history and remains the major factor in the country's industrial sector. The country's mineral economy is dominated by the production of gold, a commodity that has been produced in the region since well before the first arrival of Europeans in the 15th century. Ghana has significant resources of other mineral commodities, notably diamonds, manganese ore, and bauxite. In the 1930's, Ghana was the second largest producer of diamonds in the world, and, in 1960, it was the sixth largest producer of manganese ore.

Exports of primary mineral commodities in 1989 accounted for about 4% of Ghana's estimated gross domestic product of $5.2 billion,[1] but almost 25% of the country's total exports of about $800 million. In this respect, mineral exports were second only to cocoa and cocoa products; but, whereas low world prices since 1986 have significantly reduced the earnings from cocoa exports, mineral exports have remained healthy. Apart from the production of primary mineral commodities, Ghana is an important aluminum producer, utilizing about 60% of the hydroelectric potential of the world's largest reservoir to smelt imported alumina on a tolling basis. The mining and aluminum industries are large employers of Ghanaian labor and are major users of the country's railing and shiploading infrastructure.

In 1989, the formal mining sector consisted of several gold mines, one large diamond mine, one bauxite mine, and one manganese ore mine. There was also artisanal production of gold and diamonds. Several international companies were involved in gold exploration during the year, and favorable production decisions were made for three advanced gold projects; these were scheduled to come into operation in 1990.

The Ghanaian Government in recent years has enacted laws aimed at promoting mineral exploration and mining. In addition, it has sought international help in conducting regional mapping and exploration programs. These programs have concentrated on the southwest and south-central parts of the country, from whence virtually all of the country's mineral output has come.

In terms of economic importance, Ghana's geology is dominantly that of a series of steeply dipping, isoclinally folded, northeast-trending lower Proterozoic greenstone belts made up of volcanic and sedimentary rocks of the Birimian Series. Some of the Birimian belts contain major northeast-trending shear zones, and these commonly host quartz veins. Most of Ghana's gold deposits have developed in these veins or in areas of strong sulfide (pyrite and arsenopyrite) mineralization in the shear zones. By far the dominant locus of gold mineralization has been the shear zone and vein system that hosts the Ashanti, Prestea, Bogosu, and Southern Cross Mines, as well as many others now closed.

The Birimian belts can have the gross form of synclinoria, some of which are cored by clastic rocks of the Tarkwaian Series. The Tarkwaian Series exposed to the east of the zone hosting the Ashanti and other gold mines contains gold-bearing conglomerates very similar to the banket conglomerates of the Witwatersrand gold field in the Republic of South Africa. In 1989, there was one mine exploiting Tarkwaian conglomerate gold ore; a second operation commenced mining in 1990. Alluvial diamonds eroded from the Birimian Series and gold from both the Birimian and Tarkwaian Series form widespread placer deposits that are exploited by both formal and artisanal placer operations. The Nsuta Mine exploits manganese ore developed in Birimian Series rocks. Deep weathering of alumina-rich Birimian rocks has produced a number of bauxite deposits, including that exploited by the Awaso Mine.

Proterozoic granites intrude much of the Birimian, especially in the south-central and northwest parts of the country. The southeast corner of the country, along the coast and Togo border, is dominantly made up of lower Precambrian Dahomeyan gneisses and schists. These were long thought to represent basement to the Birimian but are now generally regarded as migmatites derived from Birimian protoliths. The central and eastern one-third of the country is covered by horizontally bedded clastic sedimentary rocks of the upper Proterozoic to lower Paleozoic Voltaian System. These non-Birimian rocks are locally important as sources of industrial and construction rocks and minerals.

Artisanal mining of gold in Ghana, from both placer and lode deposits, has occurred for thousands of years. Gold mining by Europeans started in the 1620's, but the major gold boom in Ghana started in the 1880's. The Ashanti Mine was discovered in 1895 and has produced almost 622,000 kilograms (kg) of gold since that time from ore having an average gold grade of about 20 grams per metric ton (g/mt). Ghana's formal sector gold production in the 20th century has been quite variable, reaching highs of 12,773 kg in 1914, 17,371 kg in 1942, and 28,470 kg in 1960—the highest recorded production to date. Production after 1960 largely declined until 1983 (8,585 kg), but since then it has steadily increased. The number of active gold mines declined precipitously after World War II, but because the surviving gold mines (including four of the five operating in 1989) were all relatively large, they were able to maintain a large output until about 1960. Then output began to decline owing to a combination of rising costs, a fixed gold price, deteriorating equipment, burdensome governmental regulations, and declining ore grades. State Gold Mining Corp. (SGMC) was formed in 1961 to take over all the gold mines except the Ashanti Mine and the Konongo Mine; the latter was taken over in 1965.

Alluvial diamonds were discovered in Ghana in 1919 and were exploited by a number of companies, only one of which was still in operation in 1989. Consolidated African Selection Trust began mining the Akwatia deposits in 1924 and continued mining until 1982, when the

Government assumed total ownership of the property through the new operating company, Ghana Consolidated Diamonds (GCD). Total formal-sector diamond production in Ghana peaked in the 1970's, when production exceeded 2.5 million carats. There has been a severe decline in diamond production since that time.

The Nsuta high-grade manganese ore deposit was discovered in 1914 and has been mined since 1916. In 1975, the state-owned Ghana National Manganese Corp. (GNMC) assumed ownership of the property and has operated it since. The Nsuta Mine has been the only significant producer of manganese ore in Ghana, although there has been some small production, on a sporadic basis, of low-grade material from other deposits.

Bauxite was also discovered in 1914. The Awaso deposit, currently being mined by Ghana Bauxite Co. Ltd (GBC), was discovered in 1921. Mining commenced in 1940. The Awaso Mine has been the only bauxite mine in Ghana, although several other bauxite deposits are known and have been explored. The Government is seeking investors to develop some of these deposits, ideally to provide input to an integrated aluminum industry. The idea of damming the Volta River for power was first mentioned in 1904, and the use of such a facility to power an aluminum plant was first proposed in 1915. In 1959, a feasibility study was conducted by Kaiser Engineers of the United States, which concluded that a project to construct a dam at Akosombo to power an aluminum plant to be built at Tema was economically sound. Kaiser Engineers was awarded the engineering and management contract for the project in 1961. The dam and power station were completed in 1965. The aluminum smelter, the first in Africa, was completed in 1966, and the first potlines were put into operation in 1967. The smelter is run as a tolling operation and to date has used only imported alumina.

GOVERNMENT POLICIES AND PROGRAMS

Minerals have traditionally played a major role in the Ghanaian economy, and the Government recognizes that their continued exploitation is vital to the future health of the economy. If revenues from the export of agricultural products continue to decline because of low world prices, or, as in the case of the timber industry, are increasingly restricted for environmental reasons, mineral export revenues will increase in importance. Consequently, the Government is encouraging investment in the mining sector.

The growth of the minerals industry is an integral part of the continuing Economic Recovery Program, launched in 1983. This program is an attempt to overcome the effects of a period of inefficient management of state-owned companies, overly tight restrictions on the availability of foreign exchange, and unrealistic investment laws. These past policies had led to a major deterioration of the country's mines and transport infrastructure and an unfavorable climate for foreign investment in Ghana. In addition, low wages and a general decline in the economy had led to the emigration of a large number of skilled Ghanaian nationals. The Economic Recovery Program has sought to reverse the deterioration of the economy through a combination of improved investment laws, a relaxation of foreign exchange restrictions, and the privatization of the large state-owned industrial sector.

From 1900 until 1986, at least 75 mining and related investment laws were enacted. Although the Minerals Act of 1962 became the major mining law, many of the others had to be dealt with by the existing mining companies and by companies wishing to invest in the mining sector. In early 1980, a Committee on Gold Mining was appointed to review the Ghanaian mining industry and to recommend a solution to the severe decline in that sector of the economy. The committee's yearend 1980 report[2] identified the morass of mining-related laws as being a significant contributor to the decline and recommended enacting new investment and mining legislation to supersede the old laws. The Minerals and Mining Law, 1986 (PNDCL 153), which now governs mining and mineral exploration in Ghana, was a direct outcome of the 1980 report.

Another recommendation of the 1980 report was the rehabilitation of the gold mines. In 1984, rehabilitation work began at the Ashanti Mine, and in 1985, a similar program started for the SGMC mines. The goal of these programs is to increase the production of the mines through a combination of purchasing new equipment, repairing old shafts and mine workings, improving mine safety, rehabilitating the mills, and improving mine management and cost accounting. Loans for the rehabilitation programs have been secured, by and large, from international lending agencies such as the World Bank. The relaxation of the country's foreign exchange laws has allowed the mines to purchase much needed new equipment and supplies. Partly as a condition for the loans, but also in accord with its new privatization policies, the Government agreed to seek foreign investors in the wholly state-owned companies GCD; SGMC subsidiaries Dunkwa Goldfields Ltd., Prestea Goldfields Ltd., and Tarkwa Goldfields Ltd.; and in most of the Ghana Industrial Holdings Co. (GIHOC) subsidiaries, including Steelworks Co. The Government has also obtained loans to rehabilitate the country's railroad and shiploading infrastructure, particularly that serving the mining industry.

The Minerals and Mining Law, 1986, is based on the state's ownership of all minerals in Ghana. Under the law, the Government is entitled to 10% equity participation in all mining ventures and has the option to purchase an additional 20%. The law applies equally to foreign and Ghanaian nationals, with the exception that certain small-scale mining activities and the mining of certain commodities such as sand and gravel are reserved to Ghanaians. Licenses are required for all exploration and mining, and the law sets forth the conditions under which such licenses are issued, renewed, or canceled. The taxation regime, including provisions for tax holidays and depreciation, is specified in the law, with reference to existing laws where retained. The law specifies that Ghanaian nationals are to be trained to replace expatriates wherever possible and that preference is to be given to Ghanaian sources for supplies. Furthermore, the law recognizes the importance of protecting the environment.

Other related and applicable laws include the Additional Profits Tax Law, 1985 (PNDCL 122); the Minerals Commission Law, 1986 (PNDCL 154); and the Minerals (Royalties) Regulations, 1987 (LI 1349). The basic investment codes of Ghana are those of 1981 (Act 437) and 1985 (PNDCL 116). The Petroleum (Exploration and Production) Law, 1984

(PNDCL 84) controls petroleum-related activities. The importation, transportation, and transfer of mercury is governed by the Mercury Law, 1989 (PNDCL 217). Regulation of artisanal gold mining was set forth in the Small-Scale Gold Mining Law, 1989 (PNDCL 218). The Precious Minerals Marketing Corporation Law, 1989 (PNDCL 219) set up the Precious Minerals Marketing Corp. (PMMC) to promote the development of small-scale gold and diamond mining in Ghana and to provide a purchase mechanism for the output of such mining.

The Ministry of Lands and Natural Resources (MLNR) has authority over all aspects of the Ghanaian mineral economy and is the entity that grants mineral exploration and mining leases. Under the MLNR, the Minerals Commission has overall responsibility for recommending mineral policy, promoting mineral development, advising the Government on minerals matters, and serving as a liaison between industry and the Government.

Geologic studies of Ghana are conducted by the Geological Survey Department; the Lands Commission maintains records of exploration licenses and mining leases; and the Mines Department has authority in mine safety matters. All mine accidents and other safety problems must be reported to the Ghana Chamber of Mines; the Chamber also provides information on Ghana's mining laws and negotiates with the mine labor unions on behalf of its member companies. All of the mining companies operating in 1989 were members of the Chamber of Mines. The Ministry of Fuel and Power formulates Ghanaian energy policy and issues licenses for petroleum and natural gas exploration in and offshore Ghana.

PRODUCTION

The production of most mineral commodities increased in 1989, with output of aluminum, bauxite, cement, gold, and silver reaching their highest levels in the decade.

Ghana was the third largest producer of gold in Africa after the Republic of South Africa and Zimbabwe. Ghana's increased gold output was largely a result of the effects of ongoing expansion and rehabilitation of the Ashanti Mine, by far the country's largest gold mine. The first full year of operation for the Southern Cross Mine was 1989; it was Ghana's first heap-leach operation.

Production from Ghana's only formal diamond mine, Akwatia, declined 40% to 134,030 carats as a result of continuing equipment deterioration.

Sales to the Government, through the newly formed PMMC, of artisanally mined gold and diamonds were significantly higher than in previous years and were believed to presage a major decrease in the amount of smuggling of these commodities. Miner confidence in the PMMC pricing system improved during the year, and, toward yearend, sales of diamonds to the PMMC were believed to account for the majority of the ongoing production heretofore smuggled out of Ghana. Despite this trend, an unknown but believed significant quantity of gold and diamonds was smuggled out of the country during the year.

Production of manganese ore and bauxite increased, the latter especially so, largely in response to ongoing improvements to the country's railing and shiploading infrastructure.

The production of finished cement benefited from the increased availability of foreign exchange, which allowed an increase in the level of imports of clinker. Steel production rose significantly owing to the startup of a new, private steel mill.

TRADE

Despite an increased level of most mineral exports, the total value of Ghanaian exports declined to about $800 million, largely because of low world prices for cocoa and cocoa products, which remain the country's main export items. World gold prices in 1989 averaged 12% lower than in 1988, and this largely offset the significant 1989 increase in Ghana's official gold production with the result that gold export sales increased only very slightly to $165.6 million. Gold sales represented about 85% of the country's total official primary mineral exports. However, gold smuggled out of the country was estimated to be worth an additional $20 to $25 million. Official diamond exports were worth about $3.5 million; it is believed that smuggled diamond production was worth an additional $4 to $6 million. Manganese ore exports increased 54% to 285,369 tons, worth about $11.7 million. Bauxite exports increased 25% and were worth $9.1 million. Including the estimated value added component of Ghana's aluminum production, mineral commodities accounted for almost one-third of the total value of the country's official exports. Timber exports were worth in excess of $100 million, and exports of electricity were worth about $75 million.

The level of imports rose slightly to about $1.2 billion. The increase was largely made possible by an increased level of foreign aid to Ghana and by the general ease of access to foreign exchange enjoyed since the relaxation of fiscal controls early in 1988 and in early 1989. As in 1988, the dominant import commodity was crude oil, imports of which amounted to 22,000 barrels per day, worth $148.3 million in 1988, the latest year for which data were available.

In 1989, Ghana's biggest trading partner continued to be the United Kingdom, which supplied about 24% of Ghana's imports and took 16.5% of its exports. The United States was Ghana's second most important trading partner, taking about 23% of Ghana's exports and supplying about 12.5% of its imports. Other important trading partners for Ghana were the Federal Republic of Germany, Japan, Spain, Romania, and Nigeria. Aluminum from the Volta Aluminum Co. (VALCO) reduction plant was sold mainly to the United States. Ghana's bauxite exports were to the United Kingdom. Manganese exports were mainly to Japan, Spain, Romania, and Norway. Ghanaian gold was toll refined in Switzerland before being sold on the world market, and Ghana's diamonds were sold in Belgium. Nigeria was the source of Ghana's crude oil imports.

STRUCTURE OF THE MINERAL INDUSTRY

The mineral industry of Ghana is dominated in value by the production of gold. In 1989, gold was produced by five formal mines, of which three were lode operations and one was a placer mine. One of the lode mines, a world-class operation, accounted for almost 80% of the country's total formal gold output. There was also artisanal production of gold, largely from placer deposits.

TABLE 1

GHANA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Aluminum:						
Bauxite:						
Gross weight	metric tons	[r]169,475	[r]204,047	196,255	284,500	[3]347,065
Sales	do.	169,500	226,461	229,415	299,939	[3]374,646
Metal, smelter, primary	do.	48,550	124,570	150,316	161,392	[3]168,581
Cement, hydraulic[4]	thousand metric tons	363	219	[3]274	[3]477	[3]565
Diamond:						
Gem[e]	thousand carats	60	[r] [3]88	65	155	124
Industrial[e]	do.	572	[r] [3]498	400	465	370
Total	do.	632	[r]586	465	[5]620	[5]494
Gold	kilograms	9,322	8,931	10,201	11,601	[3]13,358
Iron and steel: Steel, crude[e]	metric tons	5,400	5,000	[r]7,500	6,500	17,500
Manganese:						
Ore and concentrate,[6] gross weight	do.	[r]318,665	[r]304,351	274,451	259,614	[3]279,210
Mn content[e]	do.	[r]118,000	[r]110,000	[r]98,000	[r]97,000	110,000
Petroleum:						
Crude[e]	thousand 42-gallon barrels	100	—	—	—	—
Refinery products:[e]						
Gasoline	do.	[r]1,460	[r]1,825	[r]1,825	[r]1,825	1,825
Jet fuel	do.	[r]365	[r]365	[r]365	[r]365	365
Kerosene	do.	[r]1,095	[r]730	[r]1,095	[r]1,095	1,095
Distillate fuel oil	do.	[r]1,095	[r]1,460	[r]2,190	[r]2,190	2,190
Residual fuel oil	do.	[r]2,190	[r]2,190	[r]1,825	[r]1,825	1,825
Other	do.	[r]1,460	[r]365	[r]365	[r]365	365
Refinery fuel and losses	do.	[r]365	[r]365	[r]365	[r]365	365
Total	do.	[r]8,030	[r]7,300	[r]8,030	[r]8,030	8,030
Salt[e]	metric tons	50,000	50,000	50,000	50,000	50,000
Silver, Ag content[e] of gold ore	kilograms	467	447	510	580	668

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through July 15, 1990.
[2]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) are produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.
[4]All from imported clinker.
[5]Production includes that of Akwatia Mine (1988—225,000 carats; 1989—134,030 carats), Precious Minerals Marketing Board purchases of artisanal production (1988—34,231 carats; 1989—151,606 carats), and estimates of smuggled artisanal production.
[6]Manganese ore production for 1985-88 is processed ore output reported by Nsuta Mine. Production for 1989 is the reported mine production minus carbox fines, which were unsalable.

Diamonds are produced by one formal mine and by artisanal miners. In 1989, for the first time, a significant proportion of the artisanal production was sold to the Government.

Ghana has one bauxite mine and one manganese ore mine. Two cement clinker-grinding plants were in operation in 1989, as were three small steel mills, one of which commenced operations during the year. Ghana has one small oil refinery using imported crude oil and one aluminum smelter using imported alumina.

In 1989, Ghana's labor force comprised about 5.6 million workers. Almost 19% of the workers were in industry and about 55% were in agriculture. The formal mining sector employed about 25,000 workers, about 20,000 of whom worked for gold-mining companies. These numbers included workers directly employed in the mining and ore milling operations and in company-owned shiploading facilities, farms, lumber mills, and other captive service industries. It is estimated that an additional 150,000 persons were directly dependent on the wages earned in the formal mining sector. The mining companies have been the source of most of the educational and health care facilities for the mining towns and surrounding areas. The livelihood of a significant proportion of the employees of Ghana Railway Corp. was tied to the railing of bauxite and manganese ore and of mining equipment and supplies. Approximately 30,000 Ghanaians worked at least part time as "galamsey" or artisanal miners; this estimate may include workers

TABLE 2

GHANA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity
Aluminum	Volta Aluminum Co. Ltd. (VALCO) (Kaiser Aluminum & Chemical Corp., 90%; Reynolds Metals Corp.,10%)	Aluminum smelter at Tema	200,000.[1]
Bauxite	Ghana Bauxite Co. Ltd. (Government, 55%; British Alcan Chemicals Ltd. of the United Kingdom, 45%)	Bauxite mine at Awaso	500,000.[1]
Cement	Ghana Cement Works Ltd. (Government, 75.5%; Scancem International ANS of Norway, 24.5%)	Clinker grinding plants at Takoradi and Tema	700,000.[1]
Diamond	Ghana Consolidated Diamonds Ltd. (Government, 100%)	Placer mine at Akwatia	250,000.[e 2]
Gold	Ashanti Goldfields Corp. (Ghana) Ltd. (Government, 55%; Lonrho Plc of the United Kingdom, 45%)	Underground and surface mine at Obuasi	12,500.[3]
Do.	Southern Cross Mining Ltd. (North Queensland Co. of Australia, 70%; Government, 30%)	Open pit mine at Obenemase, near Konongo	1,250.[3]
Do.	State Gold Mining Corp. (Government, 100%)	5 gold dredges near Dunkwa	315.[3]
Do.	do.	Underground mine at Prestea	800.[3]
Do.	do.	Underground mine at Tarkwa	800.[3]
Manganese	Ghana National Manganese Corp. (Government, 100%)	Open pit mine at Nsuta	350,000.[1]
Steel	Steelworks Co. subsidiary of Ghana Industrial Holdings Co. (Government, 100%)	Steel mill at Tema	2,500[1] rebar.
Do.	Wahome Steel Ltd. (private Taiwanese investors, 95%; Ghanaian investor, 5%)	do.	18,000[1] rod, rebar, and wire.
Petroleum products	Ghanaian-Italian Petroleum Co. (Government, 100%)	Refinery at Tema	26,600.[4]

[1]Metric tons per year.
[2]Carats per year.
[3]Kilograms per year.
[4]Thousand 42-gallon barrels per day.

from the formal mining sector who engaged in artisanal mining on weekends and holidays.

COMMODITY REVIEW

Metals

Aluminum and Bauxite.—The VALCO reduction plant increased output slightly in 1989 but still operated below the operational capacity of 180,000 metric tons per year (mt/yr) based on the use of 4½ of the plant's five potlines. VALCO uses imported alumina; in 1989, this was from Jamaica.

GBC continued to increase its production and exports of bauxite from the Awaso Mine. The company had plans to increase exports to 500,000 mt/yr within a few years and ultimately planned to produce at a rate of 1 million metric tons (MMmt) per year. Production and export increases, the latter in part from stockpiles, have been made possible by significant, ongoing improvements to the railroad and to the company's shiploading facilities at Takoradi. At Takoradi, GBC was involved with a total rehabilitation project that was to include a new jetty and offshore loading facility, as well as a new conveyor system. Financing for the project has been secured from the Commonwealth Development Corp.

Gold.—Ghana's official gold production was the highest since 1977, largely the result of the ongoing rehabilitation and expansion project at the Ashanti Mine and the 1988 startup of the Southern Cross Mine. There was also production from the three mines run by SGMC. In addition, a significant but undocumented amount of gold was produced by artisanal miners. Traditionally, most of this gold, estimated to amount to about 1,900 kg annually, has been smuggled out of the country, largely to Togo and Côte d'Ivoire. In an effort to encourage both artisanal production of gold and its legal sale to the Government, a licensing system for small-time miners was set up in 1989, and a pricing formula, averaging 93% of the world price, was enacted by the PMMC. The PMMC purchased 288.4 kg of gold in 1989; this modest response to the new purchasing program reflected, in the main, an inefficient network of buyers.

Favorable production decisions were made during the year for two open pit gold projects (Bogosu and Teberebie), for the Kwabeng placer project, and for a pilot placer mine on the Koshea concession. Construction work commenced at both open pit projects in 1989, and both were expected to come into production in 1990. The placer projects were expected to be in operation by yearend 1990. A production decision was expected by yearend 1990 for another open pit gold project. In addition, there were a number of less-advanced exploration programs ongoing during the year. These developments were all an outcome of the favorable legal and financial conditions set forth in the 1986 Minerals and Mining Law. Another encouraging factor has been the successful application of heap leaching by the Southern Cross Mine and at Ashanti Mine; Ghana has many gold deposits that may be amenable to this gold extraction method. Ghana's formal sector gold output was anticipated to be about 16,500 kg in 1990.

Almost 79% of Ghana's gold production came from the Ashanti Mine. Production in 1989 was 10,488 kg, an 8% increase from that of 1988 and a 21% increase from that of 1987. The $156 million expansion and rehabilitation program for the mine, which began in 1984, was ongoing during the year. This program has the goal of increasing the mine's output to about 12,500 kg by 1990 and about 17,500 kg by 1995. This is to be achieved largely by developing relatively shallow quartz and sulfide ores toward the south end of the mine, a large sulfide ore body at moderate to deep levels in the central part of the mine, and deep mixed ores toward the north end. In addition, surface ore bodies to the south of the underground workings are to be developed. The southern and central underground ore bodies are being developed by two new shafts. The 2,600-foot George Cappendell shaft was inaugurated in 1988 on the southern ore body; construction of the George Cappendell sub-vertical, which will effectively double the depth of the shaft, was ongoing during 1989. This shaft system is largely to provide access and ventilation for this region of the mine; most of the ore from it will be hoisted by the new Kwesi Mensah shaft to the north via mile-long conveyor belts to be installed on levels 20, 23, and 26. Sinking of the Kwesi Mensah shaft continued during the year and was expected to reach the design depth of 5,200 feet in 1991. The Kwesi Mensah shaft will also hoist ore from the central ore body. However, much of the deep ore below the Kwesi Mensah shaft will be transported by a deep conveyor system north to the Adansi shaft, which was being deepened to 7,000 feet for the purpose. The Kwesi Mensah shaft will provide fast access and much needed ventilation for the central portion of the mine, but mining below 5,000 feet will still require refrigeration.

The rehabilitation program has also made possible the purchase of five raise borers as well as other machinery for the underground operation. In addition, the treatment plant for the underground ore was being upgraded, and a tailings treatment plant had been installed. Throughput for the latter is from a reserve of about 13 MMmt of old mine tailings; these have an average gold grade of about 3 g/t. In 1989, the mine was recovering about 60 kg of gold per month from the tailings plant.

Some surface ore was mined during the year from three small open pits to the south of the George Cappendell shaft. The high-grade portion of the ore was sent to the main mill; the remainder was stockpiled until the completion of the company's new heap-leach facilities. The open pits, and several others to follow, are part of the Sansu Project, which is designed to increase the output of the Ashanti Mine by about 5,600 kg of gold annually, and which involves three main construction efforts. An oxide ore plant will treat about 1.2 MMmt per year of open pit material by conventional milling and cyanidization methods. A heap-leach plant will treat about 450,000 mt/yr of low-grade surface ores. Finally, the existing tailings treatment plant will be expanded to increase throughput by 720,000 mt/yr. In early 1990, the company signed a $60 million loan package, coordinated through the International Finance Corp. (IFC), to finance the bulk of the $93 million Sansu Project. The project was expected to be in production in 1991, with full production slated for 1994. At that time, total Ashanti Mine output is predicted to be about 17,500 kg of gold per year, of which the Sansu open pit ore will contribute about 28%, the underground ore 60%, and the tailings 12%. Although the new Sansu treatment facilities will be constructed with strict environmental protection provisions, the Project's financial package will also make possible the installation of sorely needed arsenic and sulfur oxide emissions removal equipment at the existing roasting plant.

Reserves at the Ashanti Mine are large and are likely to be significantly increased through the company's ongoing underground and surface exploration program. At yearend, the underground reserves (all categories) were about 8 MMmt grading about 16 g/mt. The Sansu reserves were almost 20 MMmt grading 4.7 g/mt.

SGMC operated the Prestea and Tarkwa underground mines and the Dunkwa gold dredging operation. Rehabilitation work continued at the mines, with the goal of raising total SGMC production to about 4,000 kg by the early 1990's. By midyear, the Government had secured loan agreements from the World Bank, the European Investment Bank, and Caisse Centrale of France for about one-half of the $105 million needed for phase II of the rehabilitation project. The remainder was being sought from the African Development Bank, which was expected to approve the loan in February 1990. Phase II will mainly affect the Prestea and Tarkwa Mines and will involve major rehabilitation of the underground workings, including repairs to the main shafts, replacement of the winders, dewatering of workings, and the purchase of mining machinery. The mills at both mines are to be rehabilitated, especially the Prestea mill. Security at both mines is to be improved. The reserves at both mines are limited, and the rehabilitation program will also provide money for drilling to expand the reserves. Phase I of the rehabilitation program also involved repairs and rehabilitation of surface and underground facilities, but had as an additional goal the modernization of the inventory and cost accounting systems used at the mines.

Despite the rehabilitation work from phase I of the program, total gold production by SGMC in 1989 was 1456.52 kg, a decrease of about 7% from that of 1988. The major contributor to this overall decline was the disappointing performance of the Prestea Mine, which produced only 603.1 kg in 1989—a 17.4% decrease. Rehabilitation work to date at Prestea has allowed a general increase in the mill throughput since 1984. However, the operation has suffered from declining grades over the same period. In 1989, mill throughput fell 7% to about 180,000 tons; recovery grade was only about 3.35 g/mt, which was only 78% of the head grade. The proportion of quartz vein ore mined decreased, which put an increased burden on the Prestea mill's sulfide ore-roasting circuit. In 1989, about 43% of the total gold in the throughput was in the sulfide ore. Much of this ore was wet and had a high graphite content. The graphite tended to clog the mill's filter presses, already in poor condition, with the result that inadequate drying of the sulfide concentrate was being achieved prior to roasting. This in turn led to the roasters being unable to prepare the sulfide adequately for cyanide leaching. Approximately 52% of the gold in the sulfide ore was not being recovered. In contrast, the mill's gravity circuit was relatively efficient.

Total gold ore reserves of the Prestea Mine at yearend 1988 were given by the company as 7.162 MMmt grading 7.88 g/mt. Proven reserves were 2.18 MMmt grading 7.69 g/mt. However, the proven reserves included about 442,000 tons grading 10.33 g/mt in pillars and 1.06 MMmt grading 7.86 g/mt that, for other technical reasons, were not available for mining. The proven reserves available for mining and not in pillars were about 682,000 tons grading 5.7 g/mt. This grade is about 25% above 1989 mill head grades and suggested dilution problems in the mining.

In 1989, the Tarkwa Mine recovered 638.5 kg from about 119,000 tons of ore milled. This performance was about as targeted and represented a very slight increase in gold output. Mill throughput was about 84% of capacity. In contrast to Prestea, the Tarkwa ore requires only a gravity and cyanide circuit, and mill recoveries are high (about 96% in 1989). The goal of the rehabilitation project is to increase mill throughput and head grades; the latter have fallen 25% since 1986.

Total ore reserves of the Tarkwa Mine at yearend 1988 were given by the company as about 6.1 MMmt grading 6.8 g/mt. Of this inventory, about 665,000 tons grading 8.1 g/mt were considered to be proven reserves, of which about 495,000 tons grading 8 g/mt was available for mining.

Gold production from the five dredges operated by Dunkwa Goldfields Ltd. increased very slightly to 215 kg. The operation continued to have major equipment problems. Total ore reserves for Dunkwa, as given by SGMC, exceed 200 million cubic meters grading 0.15 gram of gold per cubic meter.

The Southern Cross Mine had its first full calendar year of operation in 1989. The mine opened in May 1988 and was the first new gold mine to be opened in Ghana in more than 40 years. The mine is an open pit, heap-leach operation at Obenemase, 7 kilometers (km) northeast of Konongo. The mine produced 1,071 kg of gold in 1989, all from oxide ore.

Proven gold ore reserves as of April 30, 1989, for the currently mined A-Pit were given by the company as 650,00 tons of oxide ore grading 5.28 g/mt and 234,000 tons of sulfide ore grading 11.68 g/mt. Probable reserves were 170,000 tons of sulfide ore grading 9.6 g/mt. A neighboring ore body ("B-Pit"), as yet unmined, had proven plus probable gold ore reserves of 200,000 tons grading 1.34 g/mt. The A-pit reserves were open to the east. The company had identified almost 700,000 tons of probable gold ore reserves grading 2.93 to 4.31 g/mt at the Kwakawkaw prospects nearby and was continuing its drilling of these and other prospects during the year. Apart from the lode reserves, the Southern Cross concession contains gold ore reserves in tailings of about 1.8 MMmt grading almost 1 g/mt.

Ore reserve delineation drilling continued at the Bogosu Project, operated by Canadian Bogosu Resources Ltd. (CBR), and a favorable production decision was made in August. At yearend 1989, CBR was a joint venture between Sikaman Gold Resources Ltd. of Canada, 14%; Billiton BV of the Netherlands, 62.5%; the IFC, 13.5%; and the Government, 10%. At yearend 1988, Sikaman and Billiton each had 40.5% of the project, and the IFC had 9%. Early in 1989, Billiton agreed to increase its stake to 65.5%, with Sikaman retaining a repurchase option for 11.5% to be exercised by October 1990. In mid-1989, the IFC agreed to purchase an additional 4.5% of the project. The Bogosu Mine will involve several open pits, and, initially, will exploit the remaining oxide ore left by Marlu Gold Mining Areas Ltd. when it shut down its open pit and limited underground operation in 1955. After the oxide ore is exhausted, the Bogosu Mine will exploit sulfide ores. Total open pit proven and probable ore reserves as of November 30, 1989, were given by Sikaman as about 12 MMmt grading 3.53 g/mt. About 375,000 tons of this is oxide gold ore grading about 3 g/mt. Mining and stockpiling of oxide ore commenced in May 1990, and the oxide plant was expected to be commissioned in the third quarter of 1990. The oxide ore will be treated in a carbon-in-leach circuit. The sulfide ore will be run through a conventional flotation circuit followed by calcination in a two-stage fluidized bed roaster. About 250,000 tons, all oxide ore, will be processed in 1990 to yield about 715 kg of gold. In 1991, the remaining 125,000 tons of oxide ore and about 825,000 tons of sulfide ore will be processed to yield about 4,730 kg of gold. Subsequent production will be sulfide ore, at a rate of 900,000 mt/yr, yielding about 3,580 kg of gold annually.

In 1989, Sikaman amalgamated with Shefford Resources Ltd. and so acquired Roan Selection Trust Overseas (Luxembourg), which held an 85% interest in two gold placer properties near Kwabeng, about 16 km north of Kibi. Subsequently, Sikaman sold 60% of its interests in the placers to ITM International of Luxembourg. Feasibility studies of the placers by Minproc Engineers of Australia were completed in mid-1989. Proven reserves were given by Sikaman as 7,791,000 million cubic meters grading 0.57 gram of gold per cubic meter, and probable reserves were 2.4 million cubic meters grading 0.45 gram of gold per cubic meter. Based on these reserves, a decision was made in February 1990 to develop the property. Production was expected to commence in October 1990 at a mining rate of about 1 million cubic meters per year.

In April 1989, Pioneer Group Inc. of the United States increased its interest in Teberebie Goldfields Ltd. to 90% by buying out the 27% interest of Glencar Explorations (UK) PLC for $4.6 million. The Government held the remaining 10%. A decision was made to develop the property, an open pit operation exploiting Tarkwaian conglomerate ore about 5 km southwest of Tarkwa. Stripping and heap-leach pad construction started in the third quarter of 1989, and actual mining commenced in early June 1990. The first gold was expected to be poured in August 1990. Full-scale mining at a rate of about 2.1 MMmt per year was expected to be reached by the first quarter of 1991, at which time the gold yield, at 75% recovery, was expected to be 3,110 kg per year. Proven gold ore reserves, as given by Pioneer, are 25 MMmt and probable reserves are 11 MMmt, all grading about 2 g/mt.

Exploration continued at the Iduapriem

Project, owned by Ghana Australian Goldfields Ltd., a joint venture among Australian companies Golden Shamrock Mines, 51%; and Titan Resources NL, 12%; the IFC, 20%; the Government, 10%; and private Ghanaian and British investors, 7%. Golden Shamrock had an option to purchase Titan Resource's interest in the project. Iduapriem is 11 km southwest of Tarkwa and, like Teberebie, will be an open pit operation exploiting Tarkwaian conglomerate ore. A carbon-in-leach circuit will be used. Phase I and early phase II drilling was completed early in 1990 and reportedly confirmed minable gold ore reserves of 4.1 MMmt grading 2.65 g/mt, and probable reserves of 1.5 MMmt grading 1.1 g/mt. Further drilling was planned in early to mid-1990 to increase these reserves. If this drilling confirms anticipated additional reserves of about 6 MMmt grading about 2 g/mt, the company was planning to start mine construction in the third quarter, with first gold production expected in early 1991.

In mid-1989, Dana Exploration PLC of Ireland announced that it would start trial gold dredging on the Koshea concession near Asamang. The operation will exploit gold-bearing gravels near the junction of the Ofin and Pra Rivers, about 30 km south-southeast of Dunkwa. Announced reserves were only 1.32 million cubic meters grading 0.47 gram of gold per cubic meter, but total reserves were expected to be much larger.

In August 1989, Sikaman announced that the Government had assigned the rights to the old Abosso Mine to a joint venture made up of Canadian companies Sikaman, Lyco Resources, and Ranger Exploration. Each of these companies held a 30% interest, while the Government retained 10%. The underground Abosso Mine is 10 km northeast of Tarkwa and, like other idle mines in the area, exploited gold-bearing Tarkwaian conglomerates. The Abosso Mine produced about 87,000 kg of gold during the period 1897 to 1956, when the mine closed because of a prolonged labor dispute. Proven gold reserves at the time of the mine's closure were said to be 424,000 tons of ore grading 9.1 g/mt and probable reserves were 1.9 MMmt grading 7.8 g/mt. Initial feasibility studies by Sikaman were started in October 1990 and concentrated on defining the tailings reserves at the mine. Sikaman confirmed earlier estimates of 4 MMmt of tailings grading 1 g/mt and demonstrated that regrinding the tailings would permit a 70% to 80% gold recovery using cyanide leaching. A full feasibility study of the tailings reserves was expected to be completed by July 1990. The open pit potential of the concession will also be evaluated.

Cluff Resources of the United Kingdom announced encouraging results of its exploration program in the Bokitsi Mine area, 15 km west of Dunkwa. A 54-hole drilling program was completed late in 1989 and delineated inferred resources of 2.56 MMmt of oxide gold ore grading 2.4 g/mt. The company was planning further drilling and a prefeasibility study of the open pit oxide resources in 1990.

Iron and Steel.—In May, Wahome Steel Ltd. commenced trial operations of its rolling mill at Tema and, at yearend, brought on-stream a 10-ton electric arc furnace purchased from Taiwan with the aid of a loan from the IFC. The company will produce rebar, wire, and wire rod. The plant will have an output capacity of 30,000 mt/yr, although full production levels are expected to be 25,000 mt/yr. The arc furnace will produce billet from remelted scrap purchased from various Ghanaian sources. The output will supply the local construction industry and is expected to meet the 75% of demand that is met by imports. The company's production in 1989 was estimated to be about 10,000 tons; full production levels are expected to be reached by 1991.

The state-owned Steelworks Co., part of GIHOC, operated a small steel mill in Tema. Installed capacity is reported to be 12,000 mt/yr of rods and bars, but because of deteriorating equipment, 1989 output capacity was only about 21% of this amount. This mill is one of the many GIHOC companies being put up for sale by the Government.

Manganese.—Manganese production from GNMC's Nsuta Mine increased significantly in 1989, largely in response to improved railing schedules. About 131,000 tons of the 1989 production was oxide ore, with the remainder being carbonate and carbox (mixed carbonate and oxide) ore. Production was expected to increase slightly in 1990, with carbonate and carbox ores making up most of the increase. The $18 million calcining plant completed in 1982 remained uncommissioned at yearend, although the Government was studying the feasibility of putting it into operation to realize higher prices for the mine's carbonate ores. In 1989, the carbonate ore production was exported to Japan.

GNMC was exploring for additional reserves during the year, particularly of carbonate ore at depth between the old oxide ore bodies. In addition, exploration for oxide and carbonate ore was ongoing in an area 1 to 4 km to the south and southeast of the existing pit area.

Industrial Minerals

Production of diamond from the Akwatia Mine fell dramatically in 1989. The high-grade terrace gravel deposits on which the existing mill was based were all but exhausted during the year. The focus of mining, as in the previous 2 years, was on the Birim River gravel deposits delineated during the early 1980's by the United Nations (U.N.). These grade about 1.1 carats per cubic meter—mostly very small, high-quality stones that are considered industrials only because of their size. The mining and milling operations continued to suffer from severe deterioration of equipment and a lack of spare parts, largely a legacy of earlier tight foreign exchange restrictions. Much of the original and replacement equipment has been cannibalized to keep a few pieces running. Further, the existing mill was not well suited to handling the Birim River gravels. As a result, gravel mining and throughput in 1989 was only about one-third that necessary for the operation to be profitable. While the mill was centered on the high-terrace gravels, the Birim River gravel deposits are 10 to 30 km away, and their exploitation involves lengthy and expensive haulage. Because of the poor condition and inconvenient location of the existing mill, the company felt that it should be abandoned in favor of several small semimobile plants that would be located on the Birim gravels. These plants would process about 1 million cubic meters of gravel annually to produce about 1.1 million carats per year. A feasibility study of this plan was completed in September 1989 and concluded that the project was viable given the U.N.-delineated reserves, which were adequate for 15 years of production. In addition, GCD had realistic expectations of increasing these reserves. The Government was seeking equity investment and other financing for the semimobile plant project through its plan, announced early in 1990, to privatize GCD.

Apart from the Akwatia Mine, there has traditionally been significant artisanal production of diamonds from placer deposits. Despite Government efforts to purchase this production, before 1989, most of it was being smuggled out of the country, largely to Togo. The Government estimated that this smuggling involved 30,000 to 50,000 carats per month. Sales to the Government through the Diamond Marketing Corp. (DMC) in 1988 were only about 34,000 carats. In 1989, the PMMC was set up to replace the DMC in an effort to improve the level of diamond purchases. The response was initially disappointing; purchases during the first 6 months of 1989 totaled only about 36,000 carats. However, as confidence in the PMMC pricing system improved, more diamonds were brought in. Purchases during the second half of the year totaled almost 118,000 carats.

Mineral Fuels

Atlantic Richfield Co. (ARCO), operating on behalf of Royal Dutch/Shell Group and Unocal Corp., started a program to drill three offshore wells in the Tano Basin, south of Half Assini. Their first well was to test the structure between the North and South Tano discoveries made by Phillips Petroleum in 1978. The other two wells were to test shallower targets. No results had been announced as of yearend. ARCO had an option to drill a well in the North Tano Concession to obtain an interest from Ghana National Petroleum Corp. (GNPC).

Amoco Ghana Petroleum Co. spudded an offshore well at yearend on its new concession just to the southeast of Accra. Amoco had acquired its new block in exchange for relinquishing its exploration concession offshore near Togolese waters. The new Amoco block includes a target revealed by a 1987 seismic survey of the Accra and Saltpond basins by Japan National Oil Co., the results of which were made public in May.

GNPC was planning a drilling program in the South Tano Basin, about 32 km offshore, with the aim of proving sufficient natural gas reserves there to justify a minimum flow of 1.4 million cubic meters per day to a new thermal power station at Half Assini. The power station was planned by the Volta River Authority to come on-stream in 1993. Natural gas was discovered in the South Tano Basin in 1984 by Petro-Canada International Assistance Corp. GNPC also planned to drill a wildcat to test a seismic target just north of the old Saltpond offshore field. In June, GNPC signed an agreement with Nigerian National Petroleum Corp. to conduct a 4-month, $2.5 million seismic survey of the onshore Tano Basin at Half Assini.

Reserves

GBC claims that it has 30 years of bauxite reserves in the present ore body being exploited at the Awaso Mine and reserves in other ore bodies nearby adequate to support a total mine life of 100 years. Mining plans call for an increase in output to 500,000 mt/yr, to be doubled eventually. As reported in detail by the director of the Ghana Geological Survey Department,[3] Ghana has significant undeveloped bauxite resources, most notably the unmined portions of the Sefi-Bekwai deposits of the Awaso area, the Aya-Nyinahin deposits about 60 km west of Kumasi, and those in the Atewa Range near Kibi. These have been extensively drill sampled. GBC likely has access to most of the Sefi-Bekwai deposits. The Aya-Nyinahin drill-delineated bauxite inventory totals 278 MMmt grading 48.9% to 51% alumina and 2.8% to 4.4% silica. The Kibi area bauxite resource totals 120 MMmt grading 40.8% to 45.7% alumina and 1.8% to 3.9% silica.

Proven and probable gold reserves of the country's five operating gold mines and of the operations scheduled to come into production in 1990 total about 515,000 kg, of which about 52% are reserves at the Ashanti Mine. Ghana's total gold resources are undoubtedly much larger than this, based on the known extent of host rocks, the widespread artisanal production of gold, and the encouraging results of a number of recent exploration programs. In addition, there are a large number of closed old mines, many of which shut down without having depleted their gold inventories and which have not yet been evaluated under a modern economic scenario.

Although several manganese deposits are known in Ghana, the only significant known reserves are at the Nsuta Mine. Current ore reserves at the Nsuta Mine have not been published, although it is believed that the mine has reserves of oxide ore sufficient for about 10 more years of production at 1989 levels. Direct shipping carbonate ore reserves, calculated in 1964 by the Ghana Geological Survey Department,[4] were listed as about 17 MMmt grading 31% manganese. Remaining reserves of carbonate ore are likely adequate for 50 to 60 years of production at current levels. The 1964 reserve calculation also listed about 11 MMmt of carbonate ore grading 20% manganese; this resource was not economic under 1989 market conditions.

Ghana's diamond resources are large, based on known reserves at the Akwatia Mine and the widespread artisanal production of diamonds. The low- and high-terrace gravel deposits that have accounted for almost all of the Akwatia Mine's historic output are now virtually exhausted. The bulk of current production, and the future production from the mine, will be from gravels along the Birim River. The proven reserves in these gravels were delineated by the U.N. during a drilling program from 1980 to 1983; according to GCD, the reserves amount to about 15 million cubic meters grading about 1.1 carats per cubic meter. However, because of access difficulties in marshy areas, the U.N. drilling program was restricted to only about one-half of the area of interest. It appears likely that GCD's current drilling in the marshy areas will greatly increase the total reserves.

Ghana's oil and gas resources are not well known, although there have been numerous drilling programs both onshore and offshore. To date, Ghana's only oil production has been from the offshore Saltpond Field, which produced approximately 3.8 million barrels of oil during about a 7-year period ending in 1985. The field was shut down in 1985 because of low pressures and other production difficulties. The field's original reserves, as indicated by the Government,[5] were approximately 8.9 million barrels. Indications are that there are economic resources of natural gas offshore, but these have not yet been proved.

INFRASTRUCTURE

Ghana's road, railing, and electric power infrastructure is concentrated in the south and southwestern part of the country. This is largely an outcome of these regions having the bulk of the country's population and resources.

In 1989, Ghana had about 32,000 km of roads, of which about 6,000 km were paved. Many of the paved roads was in very poor condition. The major rivers and Lake Volta provide about 1,400 km of navigable waterways. Ghana has 953 km of 1.067-meter-gauge railroad forming a triangular network linking the ports of Takoradi and Tema with Accra and Kumasi. There is an important branch line to the Awaso Mine. Because of severe deterioration of the rail lines in the early 1980's, Ghana has embarked on a major railroad rehabilitation project. Priority has been given to the western line, which is the export route for the country's manganese ore and bauxite production and serves the major gold-producing area. As of yearend 1989, significant improvements had been made to the western line; however, the eastern and southern lines remained in very poor condition, and the entire system suffered from a shortage of railing stock. All railing was by the Ghana Railway Corp., which reported transporting 761,000 tons of freight in 1989, the largest tonnage railed in a decade. About 78% of this was ore. The company expected to rail a total of 805,000 tons of freight in 1990.

Ghana's major ports are Takoradi and Tema, each of which can handle ships up to about 30,000 deadweight tons. All of the country's manganese ore and bauxite shipments are from Takoradi. Ore shiploading capacity at Takoradi was being renovated by GNMC and GBC. Ore-loading capacity in 1989 was estimated to be about 350,000 mt/yr for manganese ore and about 400,000 mt/yr for bauxite. However, the bauxite loading facilities were being expanded to handle a near-term shipping goal of 500,000 mt/yr and a long-term export goal of 1 MMmt per year. VALCO has its own berth at Tema for offloading alumina and other inputs to its reduction plant and for loading aluminum ingot. The facility can offload alumina at a rate of 500 tons per hour and has storage facilities for 75,000 tons of alumina and 22,500 tons of coke.

In 1989, in common with many countries in Africa, the dominant energy source in Ghana was fuelwood, which accounted for about 70% of the country's total energy use. Electrical generating capacity was reported to be 1,185 kilowatts (kW), of which 1,072 kW was from hydropower, largely generated by the Akosombo Dam (912 kW) and the Kpong Dam. Approximately 60% of Ghana's electrical output is consumed by VALCO. Excess from the remainder is sold to Togo and Benin. Ghana's domestic grid is being rehabilitated and expanded. The grid was extended to the northern part of the country in 1989. Although the mines all are connected to the national grid, most have backup oil- or wood-fired generators.

OUTLOOK

Ghana's export economy will continue to be dominated by the export of cocoa and minerals. Gold will remain by far the most important primary mineral export. The expansion plans at the Ashanti and SGMC mines, plus the coming on-stream in 1990 of two major new gold mines, should ensure that Ghana's annual gold output reaches about 31.1 tons or 1 million troy ounces by about 1995. The potential for the discovery of new gold deposits is high, and the investment climate is favorable for the rapid evaluation and development of new discoveries.

If the Akwatia Mine is able to enact its expansion and rehabilitation plans, Ghana's diamond output will likely increase significantly in the near-term. Because of declining reserves, it is unlikely that Ghana will be able to increase its output of manganese ore significantly. Ghana has the potential to increase its exports of bauxite, both through the expansion of output from the Awaso Mine and by the development of new deposits. Ghana's extensive undeveloped bauxite resources are of only modest grade and have high silica contents, and future world market demand for this bauxite is uncertain. In addition, the country's railing and shiploading infrastructure is inadequate for exporting this material. The development of an integrated aluminum industry is subject to railing and power constraints that make questionable the economics of such a project under 1989 market conditions.

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[1]Where necessary, values have been converted from Ghanaian cedis (C) to U.S. dollars at a rate of C270 = US$1.00.

[2]Quashie, L. A. K., et al. Report of the Committee for Increased Gold Output in Ghana, United Nations document DP/UN/GHA-78-003, 1980, 78 pp.

[3]Kesse, G. O., The Mineral and Rock Resources of Ghana. Rotterdam, A. A. Balkema, 1985, 610 pp.

[4]Work cited in footnote 3.

[5]Work cited in footnote 3.

OTHER SOURCES OF PUBLICATIONS

Geological Survey Department
P.O. Box M. 80
Accra, Ghana

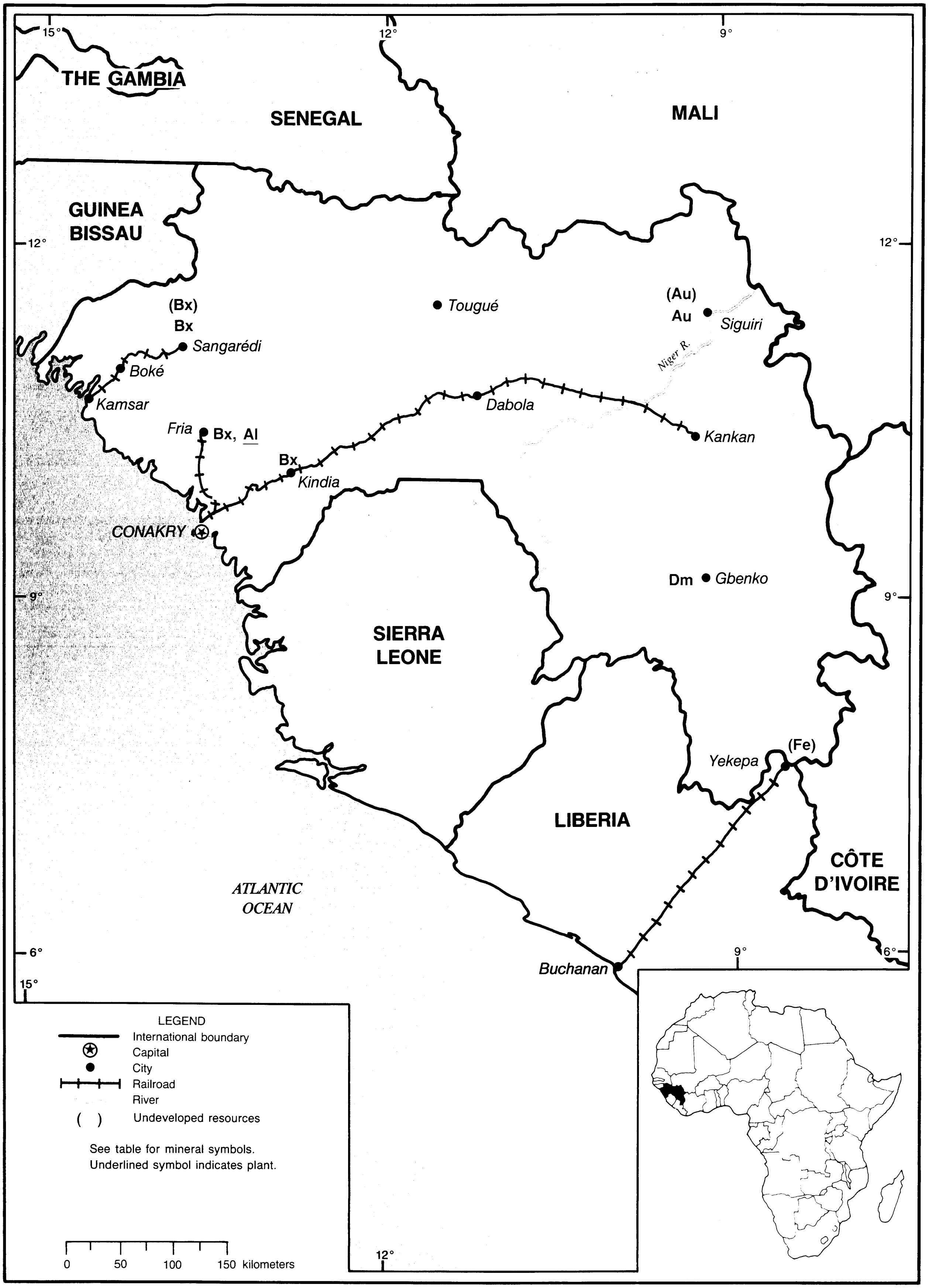
Minerals Commission
P.O. Box M. 248
Accra, Ghana

The Ghana Chamber of Mines
P.O. Box 991
Accra, Ghana

Precious Minerals Marketing Corporation
P.O. Box M. 108
Accra, Ghana

GUINEA

AREA 245,860 km² **POPULATION 7.1 million**



THE MINERAL INDUSTRY OF

GUINEA

By Hendrik G. van Oss

Guinea's economy has traditionally been one of the most heavily minerals dominated in the world. The export of mineral commodities in 1989 accounted for almost 30% of the country's estimated gross domestic product (GDP) of $2.5 billion[1] and about 93% of total exports. In 1989, Guinea was the second largest producer of bauxite in the world, and the minerals economy was dominated by the production of this commodity. Bauxite once accounted for more than 90% of total exports and 95% of total mineral exports. In recent years, however, the minerals economy has diversified with the startup of diamond and gold mines in the country. Consequently, in 1989, estimated bauxite revenues accounted for about 55% of total mineral exports. Undocumented production and trade in diamonds and gold may have amounted to about $40 million in 1989, or an additional 6% of mineral revenues. These revenues, although small compared to the overall GDP, have had a disproportionately significant impact on the country's largely underdeveloped rural economy.

Three bauxite mines, one alumina smelter, one diamond mine, and one gold mine were in production during 1989. The Government was actively negotiating with the U.S.S.R. toward the development of an aluminum complex near Dian Dian northeast of Boké, near the Guinea Bissau border. The complex was to consist of a new bauxite mine, a 150,000-metric-ton-per-year (mt/yr) alumina plant, a 600,000-mt/yr aluminum smelter, and a large hydroelectric plant. There was, however, some dispute over this project with the country's largest bauxite company, Compagnie des Bauxites de Guinée (CBG), because the project was to use CBG's railroad and shiploading infrastructure and was on land to which CBG reportedly had right of first refusal. The cost of the project was estimated to be at least $2 billion. Feasibility studies for the project were to be completed in 1991. Under an agreement signed in 1988, the U.S.S.R. was engaged in a general minerals exploration program over a 45,000-square-kilometer (km^2) area in central Guinea. About 20% of this area was explored during 1989.

The Government was engaged throughout 1989 in negotiations to bring into production the large high-grade iron ore deposit in the Nimba Mountains in southeast Guinea. The project, known as MIFERGUI-Nimba, hinged on linking the deposit with existing iron ore transportation infrastructure in Liberia because the 17 kilometers (km) of new track required would be far less costly than building the necessary infrastructure to allow shipping the ore out through a Guinean port. Realization of the project depended on halting the deterioration of the Liberian infrastructure and attracting the necessary financing for the new mine, both of which were in jeopardy as a result of insurgent activities in Liberia.

Guinea is largely underlain by granites and gneisses, dominantly of Archean age. In much of the western one-third of the country, these basement rocks are overlain by Paleozoic clastic sedimentary rocks, which have been intruded in many places by Mesozoic diabase and ultramafic sills. Deep and prolonged weathering of the sediments and the mafic intrusives has led to the formation of the extensive bauxite deposits that dominate the Guinean economy. In southeast Guinea, within the Archean granite-gneiss terrane, are northeast to north-trending Archean greenstone belts containing iron formations, including those in the Nimba Mountains. Numerous placer deposits are known in gravels derived from gold-bearing quartz veins and shear zones within the Precambrian rocks, particularly those in the Siguiri area near the Mali border. Diamondiferous kimberlites of Mesozoic age have intruded the Precambrian terrane in southeast Guinea; these have eroded to form placer diamond deposits.

Extensive bauxite deposits were recognized in Guinea in the early 1900's, but exploration of the deposits did not commence until the 1920's. Most of the major bauxite exploration has taken place since about 1950. The first bauxite deposit to be mined was Iles de Los near Conakry, which was mined from 1952 to 1962. Its bauxite was developed over a nepheline syenite. The Fria deposit was explored in the mid-1950's, and the mine was inaugurated in 1960. The huge Sangarédi deposit, and other deposits nearby, were explored during the same period. The Sangarédi Mine opened in 1973. The Kindia Mine opened in 1974.

The Aredor Mine opened in 1984, exploiting diamond placers that are derived from kimberlites very close by. However, placer production of diamonds, albeit on an erratic basis, had occurred in the region since the discovery of diamonds in Guinea in 1933. This production included that from several small companies as well as that of artisanal miners. Gold production has been widespread for decades, although significant exploration, mostly for placer deposits, has largely been since 1970. The Koron Mine opened in 1988.

GOVERNMENT POLICIES AND PROGRAMS

In recognition of mining's dominant role in the Guinean economy, official Government policy is to encourage mineral exploration and exploitation. The Government is particularly anxious to encourage the exploration of nontraditional minerals, such as uranium and iron. This notwithstanding, the Government has expended great effort in promoting the further development of the country's bauxite resources and is especially interested in expanding the value added of that commodity.

The Government has traditionally taken at least 49% ownership of all mining operations. This has, at times, led to certain administrative difficulties and a disappointing flow of revenues to the Government. Consequently, the Government is exploring financial alternatives to high-equity participation in mining ventures.

The Mining Code of 1986, as amended by a series of Orders (Nos. 10236-10245) issued October 22, 1988, is the basic mining law of Guinea. The existing bauxite, gold, and diamond companies operate, however, under agreements that predate the Mining Code, and it is recognized that the Code is likely to be only a partial basis to the negotiation of agreements for new mining ventures. Tax holidays and other financial matters related to new mining ventures are regulated by the Investment Code of January 3, 1987.

In cooperation with international financial institutions, the Government has, in recent years, undertaken a program of privatization of the once dominant state-owned industrial sector. Foreign companies having operations in Guinea are encouraged to keep their expatriate staffs to a minimum and to train Guineans to replace as many of the expatriates as possible.

In common with other countries in the region, and in partial response to the concerns of the international lending institutions, the Government of Guinea has become increasingly attentive to environmental issues. The country is a major regional watershed, being the source of, among others, the Niger and Gambia Rivers, and issues of water supply and quality have become topics of both domestic and international concern. This has already affected ongoing mining operations and projects as well as plans for new hydroelectric schemes. Deforestation, both as a result of the mining and lumber industries and as a consequence of traditional slash and burn farming, is of major concern, and, in 1989, the Government suspended all cutting permits and enacted a ban on timber exports. International aid for reforestation programs was being actively sought.

PRODUCTION

In 1989, Guinea was the second largest producer of bauxite in the world. Bauxite production was from three operations: the Sangarédi Mine, operated by CBG; the Kindia Mine, operated by Office des Bauxites de Kindia (OBK); and the Fria Mine, operated by the FRIALCO consortium. By far the largest of these was the Sangarédi Mine, for which reported production in 1989 was 11.235 million metric tons (MMmt) (dry weight). All three mines increased their production during the year.

The Fria Mine's bauxite output is all used by the company's alumina plant, the only one in the country. Alumina production increased significantly, largely due to the beneficial effects of a European-financed rehabilitation program begun during the year.

In 1989, Guinea had one formal diamond mine and one gold mine. Both were placer operations. Reported gold production from the Koron Mine increased significantly as the mine experienced its first full year of production, albeit with technical difficulties. Production from the Aredor diamond mine increased slightly owing to an increase in grade. In addition to the reported production of gold and diamonds, there was production of these commodities by artisanal miners. Legal artisanal gold sales to the Government are estimated to have amounted to about 1 ton. The Government was the only legal buyer of gold, and because of poor prices offered for artisanal production and the Government's reluctance to buy small quantities of gold, much of Guinea's artisanal production was smuggled out of the country. The amount of smuggled gold production is unknown, but is estimated to be about 2 mt/yr. Some of this may represent material smuggled through Guinea from neighboring countries. Similarly, Guinea's artisanal diamond production is smuggled out of the country. There are no official estimates of this production; however, the diamond market in Antwerp, Belgium, reported sales of Guinean diamonds in 1989 of 218,000 carats, which suggests an artisanal production to that market of about 55,000 carats after the Aredor Mine's sales are subtracted.

TRADE

The value of Guinea's official mineral exports in 1989 is estimated to be about $720 million. As in previous years, Guinea's mineral trade was dominated by exports of bauxite, the value of which in 1989 is estimated to be about $400 million. Alumina exports increased significantly and yielded revenues of $234 million. Diamond sales revenues increased 23% to $56.17 million because of a 38% increase in the number of diamonds sold to 163,186 carats rather than to a large increase in production. Sales revenues were adversely affected by a 10.5% decrease in the average diamond sales price, a result of lower world prices and the production of smaller stones. Gold revenues are estimated to have been about $27 million, of which about $15 million was from the Koron Mine's production, with the remainder being from Government purchases of artisanal production. The gold and diamond revenue figures do not, however, reflect the value of smuggled artisanal production. The value of this smuggled production is unknown. Assuming a smuggled trade of 2 tons of gold and 50,000 to 60,000 carats of diamonds, and prices for the latter equivalent to those received by Aredor, the value of the smuggled gold can be estimated to be about $25 million and that of the diamonds about $15 million. This would reflect final sales prices, not income to the artisanal miners.

Total imports by the mining sector were $590 million in 1988, the last year for which data were available. About 50% of this involved imports of supplies and equipment by the bauxite and alumina sector. Guinea imported an estimated 2.9 billion barrels of petroleum products, a modest decrease from revised estimated 1988 imports of 3 million barrels. The decrease in part reflected an almost 40% decline in gasoline imports to about 408,000 barrels resulting from a decline in illegal reexports of this fuel. As a result of the startup of a local cement plant late in 1988 and a 40% surtax on cement imports imposed

TABLE 1

GUINEA: PRODUCTION OF MINERAL COMMODITIES

Commodity[1] [2]		1985	1986	1987	1988[p]	1989[e]
Aluminum:						
Bauxite:						
Mine production:						
Wet basis	thousand metric tons	13,100	14,423	14,600	16,868	[3] 17,767
Dry basis	do.	11,790	13,300	13,500	15,619	16,520
Shipments (dry basis):						
Metallurgical-grade bauxite	do.	11,084	11,469	11,500	13,500	[4] 15,600
Calcined bauxite	do.	100	122	138	264	200
Alumina, calcined:						
Production	do.	572	556	543	590	[3] 617
Shipments	do.	572	556	543	590	[3] 621
Diamond:[5]						
Gem	thousand carats	123	190	163	136	[3] 138
Industrial	do.	9	14	12	10	[3] 10
Total	do.	132	204	175	146	[3] 148
Gold[e] [5]	kilograms	—	—	—	[6] 1,300	[6] 2,050

[e] Estimated. [p] Preliminary.
[1] In addition to the commodities listed, modest quantities of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[2] Includes data available through June 11, 1990.
[3] Reported figure.
[4] Reported bauxite exports through November 1989 were 14,459,000 metric tons, including 11,586,200 metric tons dried to about 3% moisture (considered dry) from the Sangarédi Mine, and 2,873,200 metric tons containing about 10% moisture from the Kindia Mine, which converts to about 2,700,000 metric tons at 3% moisture. This yields total 11-month exports (dry) of about 14.3 million metric tons, or a projected 15.6 million metric tons for the year.
[5] Figures do not include undocumented artisanal production believed smuggled out of the country.
[6] Figure includes 320 kilograms (1988) and 1,059 kilograms (1989) reported mine production. Remainder represents reported approximate sales to Government of artisanal production.

since November 1988, clinker imports increased by 55% to about 120 MMmt, and cement imports declined about 75% to about 24 MMmt.

STRUCTURE OF THE MINERAL INDUSTRY

The mineral industry was dominated by the production of bauxite by three companies, one of which was entirely state-owned. There was one diamond mine and one gold mine in operation in 1989. In addition, there was widespread artisanal production of both commodities, for which official estimates were not available.

Guinea's labor force is estimated to number about 2.6 million workers, an estimated 20% of whom are in industry. Guinea's formal mining industry employs about 8,200 workers. About 75% of these are in the bauxite and alumina sector. As a result of the Government's policy of encouraging the training of Guinean staff to replace expatriates, the latter make up only about 5% of the mining labor force. It is believed that perhaps 100,000 Guineans are dependent on the wages earned in the formal mining sector. In addition, because of the enclave nature of mining in Guinea, a significant proportion of the country's social services, such as electricity, potable water, schools, hospitals, and road repairs, are provided by the mining sector.

Guinea has a significant informal or artisanal mining sector. In recent years, the Government has taken steps to protect holders of major diamond and gold placer mining concessions by banning artisanal mining in those areas. This has greatly reduced, but not eliminated, artisanal mining in such areas, but has not affected other parts of the country. Current estimates of the total number of full-time artisanal miners in Guinea vary widely, but the number is likely to be at least 15,000 to 20,000.

COMMODITY REVIEW

Metals

Aluminum.—The capacity upgrade of the Friguia alumina refinery commenced in 1989. This 3-year program, made possible in part by a $38.5 million European Community Mining Aid program (SYSMIN) loan awarded in 1988, is to restore the refinery's capacity to 700,000 mt/yr. Early benefits of the program were a $7 per ton reduction of costs in 1989 to $171 per ton and improved labor relations resulting from a new incentive pay program. Both production and shipment of alumina increased, despite a number of train derailments. In 1989, Norsk Hydro Aluminium of Norway acquired 20% of the FRIALCO consortium, which owns 51% of Friguia (see table 2).

CBG's bauxite production from the Sangarédi Mine was 11.235 MMmt (dry weight), essentially unchanged from 1988. A number of derailments plagued ore deliveries to the port of Kamsar, and, as a result, the company was forced to draw down heavily on its ore stockpiles at the port to meet shipping contracts. The company finalized plans in 1989 for bringing the nearby Bidi-Koum deposit on-stream in 1992. Bidi-Koum will be worked simultaneously with Sangarédi, which will delay the exhaustion of the latter's high-grade (about 62% alumina) ore. The Bidi-Koum ore averages about 55% alumina and has a higher iron and titanium content than the ore at Sangarédi.

Gold.—Aurifère de Guinée (AUG) experienced its first full year of production at the Koron Mine near Siguiri, although the 1,208 kilogram output from the placer mine was about 40% below that expected. Production during the year was at a reduced level for about 8 months because the company had to overcome recovery and environmental problems associated with the high clay content of the gravels. The clay forced the company to use trucks rather than conveyor belts for gravel haulage, and clay discharge into the water was degrading the quality of the Niger River, leading to complaints of adverse impacts to farming and fishing downstream. The company built a large water impoundment to retard clay discharge, pending the completion of a flocculation system. Gold production increased significantly during the last quarter of 1989, and AUG anticipated that production in 1990 would approach the design capacity of about 2 tons.

Iron Ore.—Negotiations were ongoing throughout 1989 among the interested parties in the MIFERGUI-Nimba project to bring matters to a stage where financing for the estimated $200 million project could be sought. The project involves the exploitation of the high-grade Pierre Richaud iron ore deposit in the Nimba Mountains of southeast Guinea. The ore is of interest mainly to the European market as an alternative ore source to Brazil and Australia. The economics of the project hinge on being able to avoid the costly construction of a railroad to Conakry and appropriate shiploading facilities at that port. Instead, the ore is to be exported through Liberia, by the expedient of building 17 km of new track to the existing railroad connecting the almost exhausted Liberian iron ore deposits at Yekepa with the ore port of Buchanan.

The original MIFERGUI-Nimba consortium was composed of 11 partners, including the Governments of Guinea and Liberia; the Liberian-American-Swedish Minerals Co. (LAMCO), which partly owned and operated the Liberian ore shipping infrastructure; and France's Bureau de Recherches Géologiques et Minières (BRGM). One major problem with the project was the unwieldy nature of the consortium. This problem was solved toward mid-1989 by a negotiated agreement between the parties to transfer their mining rights to a new offshore company to be formed. Complicating this was the cessation of LAMCO's operations in Liberia in October 1989, followed by the termination of the LAMCO concession by the Liberian Government. Although mining at Yekepa was quickly resumed under the management of a new entity called the African Mining Consortium Ltd. (AMCL), the crucial Liberian railing and port infrastructure was now entirely owned by the Liberian Govern-

TABLE 2

GUINEA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Bauxite and alumina	Compagnie des Bauxites de Guinée (HALCO Mining Inc.,[2] 51%; Government, 49%)	Sangarédi Mine, about 242 kilometers north of Conakry. Drying and shiploading facilities are at Kamsar, 160 kilometers northwest of Conakry	11.2 bauxite.
Do.	Société d'Economie Mixte Friguia (FRIALCO Holding Co.,[3] 51%; Government, 49%)	Fria Mine and Kimbo alumina plant are at Fria, 75 kilometers north of Conakry	2.5 bauxite. 0.650 alumina.
Do.	Offices des Bauxites de Kindia (Government, 100%)	Kindia Mine (Debele deposit) at Kindia, about 110 kilometers northeast of Conakry	3 bauxite.
Diamonds	Société Mixte Aredor Guinée S.A.[4] (Government, 50%; Aredor Holdings Ltd., 50%)	Aredor placer mine and mill are at Gbenko, 475 kilometers east of Conakry	200.[5]
Gold	Aurifère de Guinée[6] (Chevaning Mining and Exploration Co.[8] of the United States, 51%; Government, 49%)	Koron placer mine near Siguiri, about 540 kilometers northeast of Conakry	2,000.[7]

[1] Million metric tons per year unless otherwise specified.
[2] HALCO is a consortium of Aluminum Co. of America, 27%; ALCAN Aluminium Ltd (Canada), 27%; Pechiney (France), 10%; Vereinigte Aluminium-Werke A.G. (Federal Republic Germany), 10%; Commonwealth Aluminium Co. (Australia), 8%; Aluminia Italia S.p.A. (Italy), 6%; Billiton International Metals B.V. (Netherlands), 6%; Reynolds Metals Co. (United States), 6%.
[3] FRIALCO is a consortium of Noranda Minerals Inc. (Canada), 30%; Pechiney (France), 30%; British ALCAN Aluminium, 20%; and Norsk Hydro Aluminium (Norway), 20%.
[4] "Aredor" is an acronym for Association pour la Recherche et l'Exploitation du Diamants et de l'Or. Aredor Holdings Ltd. is a consortium of Australian companies Bridge Oil Ltd., 79.2%; and Bankers Trust Australia (U.K.) Ltd., 3.52%; Industrial Diamond Co. (Holdings) Ltd. (United Kingdom), 6%; and the International Finance Corporation, 11.28%.
[5] Approximate thousand carats per year from about 1.3 million cubic meters per year of gravel.
[6] Formally called Société Aurifère de Guinée.
[7] Approximate kilograms per year of gold from about 1 million cubic meters per year of gravel.
[8] Company is a joint venture of Union Miniere S.A. (Belgium), 50.1%; and Pancontinental Mining Ltd. (Australia), 49.9%.

ment, through the Liberian Mining Corp. (LIMINCO). Thus, AMCL brought no property rights to the MIFERGUI negotiations.

In December 1989, a protocol was signed among the two Governments, AMCL, and the BRGM setting up Nimba Corp. (NIMCO), registered in Jersey, to bring the MIFERGUI-Nimba project to fruition. The capital in NIMCO was to be held by three classes (A, B, C) of shareholders. MIFERGUI-Nimba formed class A and brought the mining rights to the deposit. The class B partner was LIMINCO, which brought the Liberian infrastructure. The class C partners were initially to be the BRGM and AMCL, which were to provide some cash and the operating, shipping, and marketing expertise, and which were to bring in new investment partners. Several European, and possibly American, steel corporations were believed to be interested in investing in NIMCO. At yearend, it was not known who would be the mining operator for the project and whether or not the operator would be an equity shareholder in NIMCO.

Another problem with the MIFERGUI-Nimba project was the rapid deterioration of the LAMCO/LIMINCO transportation infrastructure. A major overhaul to this infrastructure would be required in order to handle the 6- to 9-million-ton-per-year output from MIFERGUI. Financing for such an overhaul hinged both on the successful negotiations and financing of the MIFERGUI-Nimba project proper and on the operation of an interim or bridging project in Liberia to keep the infrastructure from deteriorating further from lack of use. High-grade reserves remaining at Yekepa were alone inadequate to support mining operations for the 3-year period required to construct the MIFERGUI-Nimba mine and infrastructure. Instead, the bridging project, which was commenced by AMCL toward yearend, was based on blending the remaining high-grade reserves at Yekepa with a larger quantity of lower grade, higher phosphorus material found nearby. Reserves of high-grade ore were considered adequate for an acceptable blend for about 3 years. Purchasers of this marginal product were largely those interested in securing long-term purchase contracts for the high-grade MIFERGUI ore.

Despite the optimism early in 1990 over the smooth startup of the AMCL bridging project and the successful formation of NIMCO, it was recognized that either significant delays to MIFERGUI-Nimba startup beyond the life of the AMCL operation or failure of the bridging operation to maintain the infrastructure would pose grave risk to the entire MIFERGUI project. Of great concern was the insurgency in Liberia, begun in December 1989, which halted the bridging operation in May 1990.

Industrial Minerals

The Aredor placer mine near Gbenko produced 147,704 carats from 1.22 million cubic meters of gravel in 1989. This slight increase in production was the result of a modest increase in grade. Sales revenues increased more than 23% to $56.16 million, but the average price received declined $33 to $282 per carat, not counting stones of more than 100 carats mass, or $345 per carat counting the large stones. The price decline reflected a decline of the average stone size recovered to 0.77 carat, compared with 0.80 carat in 1988, and a notable decline in the number of stones recovered that exceeded 20 carats. The Aredor Mine is notable for its very high proportion of gem-quality diamonds (93%) and the production of the occasional large stone of extraordinary quality. In 1988, a 181.7-carat stone was found that sold for the record price of $8.6 million. In 1989, a 256-carat stone was found that later sold for $10.036 million.

The Aredor Mine has very high mining costs, and despite the increase in revenues in 1989, the company recorded a loss for the year. Mining conditions are difficult, and the diamond distribution is erratic. Because mining has taken place ever farther downstream from the source kimberlites, there has been a decrease in the number of large stones, which fetch higher prices per carat. One positive development in 1989 was that the company obtained two lease extensions, totaling 813 km^2, on the northeast side of the existing mining concession. Because this new ground is closer to the source kimberlites, it is expected that an increase in average stone size will be realized from these areas. Exploration in the lease extensions commenced in 1989, and a significant proportion of the mining was expected to be from these areas in 1990 and 1991.

Star Diamond Co. (United Kingdom) was conducting a feasibility study on its deposit in southeast Guinea, but the company was experiencing difficulties in its negotiations with the Government over a mining agreement.

Reserves

Guinea's bauxite resources are known to be very large. Estimates of the total bauxite resources vary, but are on the order of 6 billion tons. According to HALCO Mining Inc., proven reserves at Sangarédi in 1985 stood at about 75 MMmt grading about 62% alumina. CBG's proven reserves at Bidi-Koum were about 20 MMmt grading about 55% alumina. There are large additional resources of lower grade material in the area. OBK's reserves at the Debelé deposit are reported by the company to be about 28 MMmt grading about 45% to 46% alumina. Friguia's reserves (all classes) are reported by the company to exceed 200 MMmt grading at least 40% alumina. There are other explored bauxite deposits in Guinea. These include the Ayé-Koyé deposit 30 km northwest of Sangarédi, which has resources of about 195 MMmt grading about 50% alumina; the Dabola deposit with a resource of about 450 MMmt grading 42% alumina; and the Tougué deposit, which is believed to contain a resource in excess of 1 billion tons, grading about 41% alumina. The Dabola deposit is near the Conakry-Kankan railroad, but this line is not in condition to handle ore shipments.

No official estimates exist for Guinea's total diamond or gold reserves, although they are both believed to be significant. According to Bridge Oil Ltd., Aredor's alluvial diamond reserves at yearend 1989 were 809,992 carats, but the company expected to increase these reserves upon exploration of their new leases adjoining the original concession.

AUG's reserves at the Koron placer gold mine were originally reported by the company to be some 9 million cubic meters containing about 18 tons of gold. AUG has discovered additional gold resources nearby at Didi and Nankoba containing an estimated 11 to 12 tons of gold in gravel grading about 1.3 grams per cubic meter.

The total iron ore reserves at Mount Nimba depend on the mining scenario envisioned. The reserves on which the

MIFERGUI project is currently based are those from the 1977 Kaiser Engineers and Constructors Inc. feasibility study of the Pierre Richaud deposit and amount to 315 MMmt grading 66.5% iron. There are additional lower grade iron ore resources in the region and elsewhere in Guinea, but these are currently uneconomic.

INFRASTRUCTURE

Guinea's transportation infrastructure is considered to be underdeveloped, being barely adequate for its existing mining operations and inadequate for new projects. In 1989, Guinea had 1,046 km of railroads. The mining railroads consisted of a 135-km standard (1.435 meter) gauge line linking the Sangarédi Mine with the Port of Kamsar, a 104-km standard gauge line linking the Kindia Mine with Conakry, and a 145-km 1-meter gauge line linking the Fria Mine with Conakry. These railroads are considered to be in adequate condition for the present ore and equipment railing demands; however, there have been problems with train derailments in recent years. In addition to the mine railroads, there is a 662 km 1-meter gauge line linking Conakry with Kankan, completed in 1914, that has been in very poor condition, but which is undergoing rehabilitation with French assistance.

In 1989, Guinea had about 30,000 km of roads, of which only about 4% was paved. The country has about 1,300 km of rivers navigable by small boats.

Guinea has two mining ports: Kamsar and Conakry. Kamsar serves the Sangarédi Mine and can handle ships up to 62,000 deadweight tons (dwt). It has ore train unloading facilities adequate for about 37,000 tons per day of bauxite ore, storage capacity for about 700,000 tons of wet bauxite, drying facilities for the ore, and covered storage for the dried ore of 130,000 tons capacity. Shiploading capacity is about 34,000 tons per day. Conakry serves the Fria and Kindia Mines and is also the country's main general cargo port. It is poorly dredged and can only handle ships up to 36,000 dwt. Storage facilities for the Kindia Mine bauxite shipments are minimal as shiploading capacity of 15,000 tons per day, 360,000 tons per month in 12 ships, is adequate to handle the arriving ore. The port's storage capacity for the Fria plant's alumina output is 71,000 tons, and shiploading capacity is about 60,000 tons per month at two berths capable of handling ships of 24,000 dwt.

In 1987, the last year for which complete data were available, Guinea's electrical generating capacity was 176,000 kilowatts (kw), of which 47 kw was from hydroelectric plants and 129 kw was from thermal plants. The latter used imported fuel. Except for OBK, which in part used hydropower, the mining sector relied on self-operated thermal plants. These accounted for almost 80% of the country's total thermal powerplant output.

OUTLOOK

Because of Guinea's immense reserves of bauxite, the country should be a major producer of this commodity for the foreseeable future. It is likely that output levels will be increased, largely through opening new deposits. The Government has plans to increase the country's alumina output and to construct an aluminum smelter. Both of these projects would be very expensive and would require a major hydroelectric project. However, existing and projected market conditions do not bode well for the fruition of these plans.

Guinea's significant gold and diamond resources undoubtedly could sustain production above current levels. Several companies are already engaged in exploration for these commodities, and this activity is likely to increase, especially if the Government takes further measures to encourage foreign investment in Guinea.

Assuming a rapid restoration of political stability in Liberia, it is likely that the MIFERGUI-Nimba project will come to fruition. Exploitation of lower grade iron ore reserves in the Nimba Mountains or elsewhere in Guinea will depend on much stronger future market conditions for iron ore than currently exist.

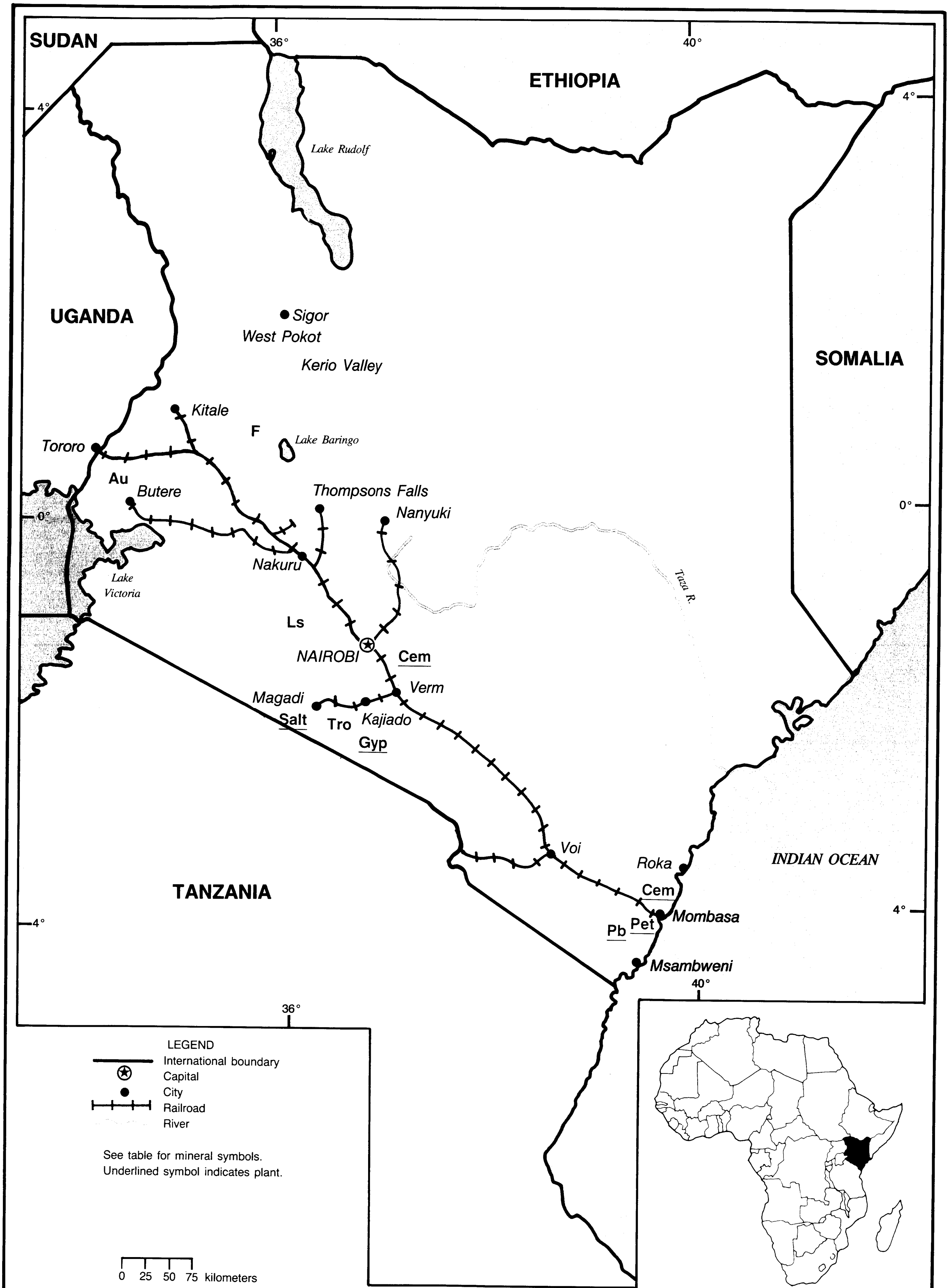
[1] Where necessary, values have been converted from Guinean francs (GF) to U.S. dollars at the rate of GF573 = US$1.00, which was the exchange rate for March 1989. As the GF floats against the US$, it is likely that the average exchange rate in 1989 was approximately GF600 = US$1.00.

OTHER SOURCES OF INFORMATION

Ministry of Natural Resources and the Environment
Conakry, Guinea

KENYA

AREA 582,650 km² **POPULATION 24.6 million**



THE MINERAL INDUSTRY OF

KENYA

By David Izon

The mineral industry of Kenya has not been a significant factor in the economy of Africa or the world. Although Kenya was considered only moderately endowed with mineral resources, it was the most industrialized country in eastern Africa. The formal industrial sector, both public and private, was relatively small, however, accounting for 13% of gross domestic product (GDP) in 1989. Mineral export earnings accounted for about 17% of total earnings but less than 1% of the GDP. The production of three industrial mineral commodities, cement, fluorspar, and soda ash, accounted for about 70% of the total value of Kenya's mineral output. Soda ash was one of the more important mineral foreign exchange earners. Kenya exported most of its minerals to the United Kingdom, Europe, and neighboring African countries. U.S. companies had no significant investments in the country's mineral industry.

The Government endeavored to promote exports, particularly nontraditional exports, by liberalizing import licensing and reducing import duties on raw materials, intermediate goods, and spare parts. There were no significant changes in investment patterns in the country in 1989. The industrial sector employed 182,300 people in 1989, of which about 3,400 were in the mineral industry.

GOVERNMENT POLICIES AND PROGRAMS

Kenya actively encouraged foreign investment in the oil and mineral sectors. In 1989, the Government announced new measures to simplify the tariff structure, liberalize interest rates, decontrol prices, and improve access to capital. The Government also embarked on programs aimed at reducing total dependence on imports for the country's energy needs. Major technical cooperative agreements were signed, one between Kenya and Japan and one with Bureau de Recherches Geologiques et Minieres (BRGM) of France, to conduct a 3-year mineral exploration program in the coastal sedimentary basin and Kerio Valley regions, respectively. The Olkaria geothermal power project was also being developed jointly by Finland and Kenya.

The new 5-year development plan (1989–93) envisaged an annual 5.4 % real growth in GDP. The Government was determined to achieve this goal by exercising measures to contain inflation. The new policy allowed investors to deduct all foreign exchange losses on their investments. This was intended to promote and emphasize the role of private enterprise in the industry and commerce.

PRODUCTION

In general, mineral production remained relatively stable except for fluorspar. Fluorspar output increased owing to higher demand.

TABLE 1

KENYA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
Barite		255	420	50	48	210
Carbon dioxide gas, natural		3,151	4,093	4,386	5,182	5,231
Cement, hydraulic	thousand tons	847	1,312	1,321	1,239	1,216
Clays, kaolin		320	2,000	40	42	—
Diatomite		3,082	1,450	616	712	783
Feldspar		692	—	—	—	1,112
Fluorspar (acid grade)		58,174	50,851	60,190	99,000	95,181
Gem stones, precious and semiprecious:						
Amethyst	kilograms	10	([3])	([3])	([3])	([3])
Aquamarine	do.	7	([3])	([3])	97	99
Garnet	do.	87	44	408	835	127
Cordierite (iolite)[e]	do.	[4]24	20	20	20	10

See footnotes at end of table.

TABLE 1—Continued

KENYA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
Gen stones, precious and semiprecioua—Continued						
Ruby	kilograms	92	66	70	1,420	36
Sapphire	do.	(3)	100	222	1,390	37
Tourmaline	do.	31	5	11	23	1
Gold, mine output, Au content	do.	13	73	278	17	15
Gypsum and anhydrite		74,078	11,060	38,819	37,965	36,478
Lead:						
Mine output, Pb content		e550	e550	545	562	—
Metal:e						
Smelter		1,000	2,000	2,000	2,000	1,000
Refined		1,000	2,000	2,000	2,000	1,000
Iron and steel: Steel, crude		(5)	(5)	(5)	(5)	—
Kyanite		(5)	(5)	(5)	(5)	—
Lime		27,860	12,300	26,482	27,326	32,167
Magnesium compounds: Magnesite		e300,000	e300,000	—	—	—
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	253	303	304	e300	320
Gasoline	do.	2,722	2,832	2,869	e3,000	3,087
Jet fuel and kerosene	do.	2,775	3,095	3,261	e3,400	3,587
Distillate fuel oil	do.	3,719	3,916	4,333	e4,300	4,190
Residual fuel oil	do.	4,310	4,234	4,178	e4,200	4,201
Other[6]	do.	687	721	844	e800	766
Total including refinery fuel and losses	do.	14,466	15,101	15,789	e16,000	16,151
Phosphatic materials: Guano		6	—	—	—	—
Salt: Crude, rock		66,330	e91,000	72,000	94,682	103,220
Sodium compounds, n.e.s.:						
Soda ash, natural		227,760	237,650	228,650	220,000	240,880
Soda, crushed, raw		5,441	5,882	1,557	—	—
Stone, sand and gravel:						
Calcareous:						
Coral[7]	thousand tons	58	175	1,331	1,352	1,427
Limestone[8]	do.	1,333	2,069	400	416	16
Sand, industrial (glass)		100	255	r e3,000	r e7,000	10,841
Shale		750,000	e750,000	142,428	r e130,000	118,459
Vermiculite		1,515	2,544	3,887	3,707	2,436
Wollastonite		—	298	—	—	142

eEstimated. pPreliminary. rRevised.
1Includes data available through July 1, 1990.
2In addition to the commodities listed, various crude construction materials (other clays, sand and gravel, and stone) not presented in this table presumably are produced, but quantity is not reported, and available information is inadequate to make reliable estimates of output levels.
3Less than 1/2 unit.
4Reported figure.
5Revised to zero.
6Includes refinery fuel and losses through 1985. Starting in 1986, refinery fuel and losses are included in output of individual products, but totaled as follows, in thousand barrels: 1985—500; 1986—525; 1987—625; 1988—625 (estimated); and 1989—625 (estimated).
7Probably all for cement manufacture.
8Probably mostly for cement manufacture.

TRADE

Kenya's main trading partners were the United Kingdom, Europe, and neighboring African countries. The country expended about 30% of its export earnings on importation of oil for its Mombasa refinery operations. Imports from the United States were mainly iron and steel, phosphate rock, and processed nonferrous minerals. Statistics indicated that Kenya did not normally export its minerals to the United States.

STRUCTURE OF THE MINERAL INDUSTRY

At yearend 1989, the Government owned at least 51% of all mining companies, including the cement plants and oil refinery. Five major industrial mineral companies in Kenya were Bamburi Portland Cement Co., East African Portland Cement Co., Kenya Fluorspar Co., Athi River Mining Ltd., and Magadi Soda Co.

COMMODITY REVIEW

Metals

There were widespread small-scale mining activities for gold and other metallic minerals in Kenya. Significant amounts have not been found, and few foreign companies were prospecting for gold and other minerals. BRGM of France was awarded a 3-year contract by Kenya's Ministry of Environment and Natural Resources to explore for copper, gold, lead, and zinc in the Kerio Valley in northwest Kenya. Other companies involved in gold exploration included Kenor of Norway, San Martin of Switzerland, and Migori Gold of Kenya. San Martin of Switzerland conducted underground operations on quartz reefs in the Lake Victoria Basin while Kenor explored concessions in the north of the country and in the Nyanza greenstone belt bordering Lake Victoria.

Industrial Minerals

Mining operations were largely confined to industrial minerals—fluorspar, limestone (for cement), and soda ash. A wide range of other industrial minerals were produced on a small scale. These included barite, diatomite, feldspar, graphite, clay gypsum, marble, dimension stone, talc, vermiculite, and wollastonite. Silica sand was also mined at Msambweni and Roka on Kenya's southern and northern coasts, respectively, and shipped for bottle glass manufacture in Nairobi by Central Glass Industries.

Cement.—Cement was produced by two major companies in Kenya, Bamburi Portland Cement Co. and East-African Portland Cement Co. A third cement plant was proposed to be built at West Pokot in the Rift Valley Province and was to have a capacity of 0.3 million tons per year. Output would be intended mainly for export to neighboring Uganda.

Fluorspar.—Production remained relatively high in 1989. The main producing company was the Kenya Fluorspar Co. Its operations benefited recently from the development of an economically feasible process for reducing phosphorous impurities in the concentrates.

Soda Ash.—The Magadi Soda Co. continued to increase production at its mining and processing complex southeast of Nairobi. The Magadi operation is also Kenya's largest source of crude salt with a yearly production close to 40,000 tons.

Mineral Fuels

Dependence on imported oil has been a major cost item in the national budget of Kenya. Ongoing exploration work has not found any commercially exploitable deposits of oil. Five foreign companies were drilling wells in northern and eastern Kenya to test viability for commercial operations in 1989. Drilling work has also been extended to cover exploration blocks in the Rift Valley and Nyanza Basins in western Kenya. The renewed interest in exploration was due to new scientific information received from the Kenya National Oil Corp. and Ministry of Energy and Mines.

Reserves

There were no officially reported reserves data.

TABLE 2

KENYA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Cement	The East African Portland Cement Co. (Government, Blue Circle Industries PLC; Cementral Holding AG)	Athi 30 kilometers southeast of Nairobi	350
Do.	Bamburi Portland Cement Co. Ltd. (Cementral AG; Blue Circle Industries)	Mombasa	1,156
Fluorspar	Kenya Fluorspar Co. Ltd. (Government, 100%)	Kitale	120
Gypsum and anhydrite	Athi Rivers Mining Ltd. (East African Portland Cement Co.)	Senya, Kajiado	2
Soda ash	Magadi Soda Co. Plc (Imperial Chemical Industries PLC, United Kingdom)	Magadi, Kajiodo	300
Salt	Magadi Soda Co. PLC (Imperial Chemical Industries PLC, United Kingdom)	do.	55
Petroleum refinery	Kenya Petroleum Refineries (Government, 87.25%; Royal Dutch/Shell Group of companies, 12.75%)	Mombasa	[2]95

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

INFRASTRUCTURE

Mineral commodities were transported on the country's only railway system, which roughly parallels Kenya's southern border. The railroad enters the country near Tororo, Uganda, passes through Nairobi, and terminates at the port city of Mombasa, connecting key mining cities and districts along the way. Transportation of petroleum products from Mombasa to Nairobi was primarily by pipeline. The Government of Kenya planned to extend the Mombasa-Nairobi pipeline to western Kenya to reduce road and rail transportation. Principal airports are at Mombasa and Nairobi. The main seaport is at Mombasa. A contract to improve telecommunications was signed between Kenya and the United Kingdom's GEC Plessey Telecommunications. Thirty five percent of the project cost will be met by the United Kingdom. World Bank and British Rail have agreed to assist Kenya in building a 240-kilometer railway from Kampi Ya Moto, 24 kilometers northwest of Nakuru, to Sigor, 217 kilometers northwest of Nakuru.

OUTLOOK

Kenya has had sufficient investment for several development projects that will continue into the future. In the energy sector, France will provide $26 million for an electrical power station and another $2.6 million to finance feasibility studies on several other projects. Development of an industrial center in the Kerio Valley after the completion of the Turkwell Valley hydroelectric scheme will increase the labor force in the mineral industries. Successful completion of the proposed railway system will ease transportation problems for the industrial sector and allow for further expansions. Oil and gas exploration is a priority and is expected to continue. Government policies that are directed toward projects that will improve mineral production, increase foreign earnings, and reduce the deficit are also expected to continue.

OTHER SOURCES OF INFORMATION

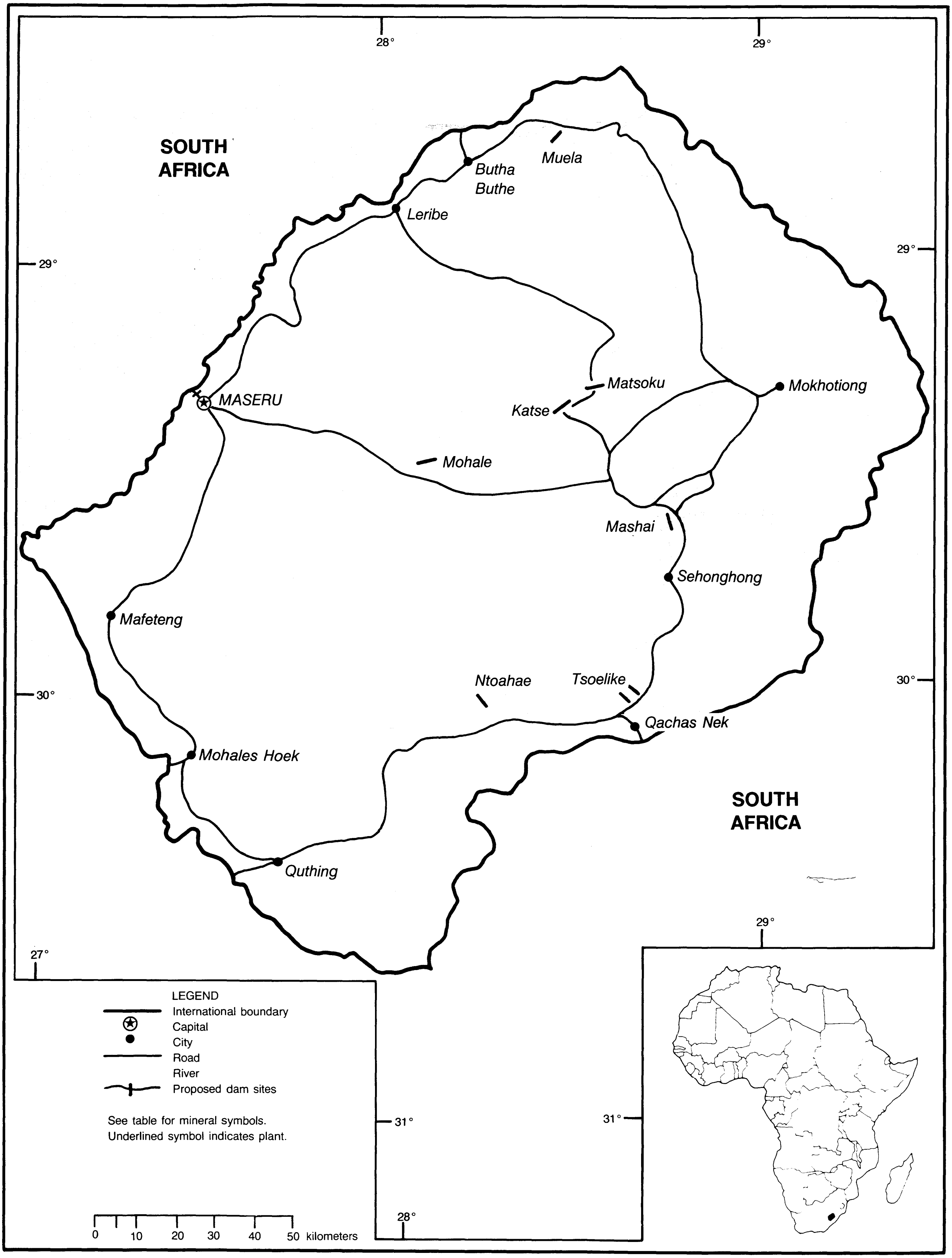
Agencies

Permanent Secretary
Ministry of Energy and Mines
P.O. Box 30582
Nairobi, Kenya

Mines and Geological Department
Ministry of Environment and
Natural Resources
Kencom House, Moi Avenue
P. O. Box 30126
Nairobi, Kenya

LESOTHO

AREA 30,000 km² **POPULATION 1.7 million**



THE MINERAL INDUSTRY OF

LESOTHO

By Audie L. King

Since 1982, when declining reserves and a recession in the world diamond market caused De Beers to close the only active diamond mine in Lesotho, mining has constituted a minor part of the country's economy. Except for minor amounts of sand and gravel and other materials for the local construction industry that accounted for less than 1% of the gross domestic product (GDP), no minerals were mined in 1989.[1] It is still believed that Lesotho has good gem-quality diamond reserves. Coal, limestone, phosphate, and uranium deposits have also been identified and may be exploited in the future.

Lesotho's economy continued to expand for the fourth consecutive year. The GDP's real growth was greater than 5% in 1989 despite a return to drought conditions that hampered growth in the early part of the 1980's. This growth can be attributed to recent policy changes that have stimulated foreign investment in an industrial sector that is dominated by textiles, light manufactures, and construction. The manufacturing sector has grown by 12% per year for the past 5 years and now composes 10.2% of the economy. The economy may also be reaping the initial benefits of the giant Lesotho Highlands Water Project (LHWP) that is in the beginning stages of construction and promises to greatly improve economic conditions for the next 50 years. The project will involve the construction of six major dams, two hydroelectric power stations, three pumping stations, and a total of 225 kilometers (km) of water transfer tunnels. When completed, the LHWP will improve Lesotho's trade deficit by selling a large portion of Lesotho's water resources to the Republic of South Africa. The construction project already employed 2,000 local workers and will hopefully relieve some of the serious unemployment problems that Lesotho is facing. Unemployment was estimated at between 35% and 50% of the population. This high unemployment rate had made it necessary for many of the country's young men to leave Lesotho to find work in the Republic of South Africa's coal and gold mines.

GOVERNMENT POLICIES AND PROGRAMS

The Government of Lesotho recognized the considerable benefits that its export trade had derived from recent policy changes that promote foreign private investment. Recent modifications to the governmental structure demonstrated the Government's commitment to promote its free market export-orientated economy and reverse growing unemployment trends. These structural adjustments include the establishment of an export finance facility, a trade promotion unit, and the expansion of the role of the Lesotho National Development Organization to include concessionary financing. Lesotho had reduced Government spending and had limited nonproductive or consumptive loans. The Lesotho National Development Corp. (LNDC) was established to make investment by foreign companies and entrepreneurs an easy one step operation. The Government's investment package included a tax-free holiday for up to 15 years, free access to foreign exchange, and the option to repatriate investment capital and a portion of earnings. The Government would offer concessional loans, grants for training the country's large labor pool, and security for investments through membership in the Multilateral Investment Guarantee Agency.

In 1988, after a decade of steadily weakening trade balances, the Government started a 3-year program of economic reform backed by the International Monetary Fund (IMF). The IMF had recently approved a $4 million loan, the third in the 3-year structural-adjustment facility program. After a slow start, Lesotho's economic performance was better in some areas than the IMF expected. The target for GDP growth was 4%, and the economy had actually grown by 9.4% in the 1988-89 fiscal year. A renewal of drought conditions that caused the slow growth years in the early 1980's slowed the growth to 5.5% real growth in GDP for the 1989-90 fiscal year. Inflation in 1989-90 was 14.9% compared with a forecast rate of 16%. The external account deficit fell to 3.9% in the current year from 6.3% the previous year, and the overall budget deficit was down to 3.3% from 9.7% in the previous year. An IMF report covering the first year of the program stated that the Government had failed to meet any of the IMF's goals dealing with Government wages, current expenditure, domestic credit, nonconcessional external borrowing, and most problematic of all, the budget deficit. The budget deficit increased from 11% to 17% of the GDP in 1988. This increase came at a time when Government receipts from taxes were also increasing. Government wage increases were targeted to be 23%, but actual raises were 40% in 1988. The 1989-90 Government budget was announced to be a moderate $232 million. Emphasis was on restraining spending and maximizing revenues. A Government spokesman said that the country's financial constraints were because of dependence on remittances from residents that worked in the Republic of South Africa and limited natural resources. Gross investment as a share of the GDP was targeted at 56.3% and savings as 54.3% of the GDP. These high savings and investment figures reflected the anticipated fund transfers to Lesotho associated with the LHWP.

PRODUCTION

Production was limited to small amounts of sand and gravel and clay used for the domestic construction industry. According to Government figures, the total value of minerals produced in the country was less than 0.1% of the GDP. However, the LHWP was expected to greatly increase consumption of basic building materials.

TRADE

Lesotho remained highly dependent on trade with the Republic of South Africa, though it had recently made some progress in expanding its markets into Europe and the United States. In 1988, the last year that such data were available, the United States accounted for only 1% of Lesotho's $425 million worth of total imports. Its principle imports included petroleum products, building materials, clothing, motor vehicles, machinery, pharmaceuticals, and corn and other food products. The percentage of exports going to the United States had increased from 5% of Lesotho's total exports in 1985 to 25% in 1988. Its main exports were baskets, cattle, hides, mohair, vegetables, wheat, and wool. Lesotho exports cotton apparel, rugs, textiles, and tapestry to the United States.

After having stagnated during the early 1980's, overall exports grew by 287% from 1984 to 1988, the last year that these data were available. This growth trend was expected to continue. The Basotho Loti had declined in value in relation to hard currencies in recent years because its value was tied to the South African Rand, making Basotho products cheaper in much of the world markets.

Some manufacturing firms that had been producing banned or boycotted South African goods had relocated in Lesotho because of the added access they have to European and North American markets. In the past 3 years, 20 companies had relocated to Lesotho primarily to take advantage of the country's preferential access to world markets. These access advantages include negotiated duty-free markets in the European Community as a signatory to the Lome Convention and duty-free trade with the other members of the Southern African Customs Union, as well as counterseasonality with Europe and the United States. Lesotho also has trade advantages with the United State under the general system of preference and most-favored-nation status. Currently these firms are allowed to label imported materials as "made in Lesotho" if they achieve 25% value added within the country as required by international regulations.

An American company announced plans to manufacture tiles in Lesotho for the South Africa Customs Union countries of Botswana, Lesotho, the Republic of South Africa, and Swaziland. These markets were finding it hard to import goods from abroad because their currencies were tied to the South African Rand, which had consistently decreased in value. The LNDC was also promoting economically viable import-substituting industries such as tile and brickmaking. Despite this increase in exports, the trade deficit was $471 million in 1989.

STRUCTURE OF THE MINERAL INDUSTRY

Since the closing of the Letseng-La-Terai diamond mine operated by De Beers in 1982, small deposits of crushed stone and other crude building materials had been worked by private individuals. Laws requiring that all mining operations be licenced by the Government had been stringently enforced in recent years.

COMMODITY REVIEW

It was thought that Lesotho still had good gem-quality diamond reserves even though the Letseng-La-Terai diamond mine was closed in 1982 after only 7 years of operation owing to diminishing ore grades and a recession in the diamond market. Lesotho had abundant stone for use in the construction industry. Deposits of coal, limestone, phosphates, and uranium had been identified, but their economic viability had not yet been assessed.

INFRASTRUCTURE

A poorly developed infrastructure had slowed Lesotho's economic development by not allowing a cohesive internal market to develop. Modern road construction in the country's mountainous terrain had proved too expensive for local developers. In recent years, with the help of foreign aid, a road system that would open up the country's interior to development had begun to take shape. A paved perimeter road was recently completed with the help of U.S. construction firms and U.S. Government funds. Six hundred and fifty kilometers of new or improved roads into the interior will be built in conjunction with the LHWP. There were 508 km of paved roads and more than 2,500 km of improved-earth or gravel roads. There was a major airport at Maseru and smaller airports at most of the country's other major cities.

The LHWP is a massive infrastructural project that will take 30 years to complete. The project will supply the water-starved areas around Johannesburg and Pretoria with surplus water from Lesotho's Maluti Mountains. A hydroelectric plant will also be built. The scheme will make Lesotho self-sufficient in the generation of electricity and will provide royalties from the export of water. Financing was already secure for the initial planning and infrastructural phases. It was provided by the World Bank, the European Community, the European Investment Bank, and various bilateral sources, including France, Germany, the United Kingdom, and the United States.

The water transfer portion of the project will consist of five dams that will capture a major portion of Lesotho's unused water resources and reverse the southerly direction of their flow. Through a complex system of underground tunnels, up to 70 cubic meters per second of water will be channeled into the Republic of South Africa's Ash River, where it will be captured by the Vaal Dam, 70 km south of Johannesburg.

Plans also called for the construction of a hydropower plant that is expected to be a huge benefit for Lesotho. It imports 80% of its energy needs from the Republic of South Africa at a cost of about $7.8 million per year. A smaller dam, the 55-meter-high Muela Dam, will form the tail pond of the hydroelectric power station. The power scheme will go to tender in 1992. When the Muela powerplant 45 km north of Katse is completed, it will generate 260 gigawatt hours per year of power. This is enough power to make Lesotho virtually self-sufficient in electric power. The LHDA stated that without the water transfer project, Lesotho would be unable to build its own hydropower generation scheme.

Lesotho will earn between $20 and $40 million per year in royalties for the transfer of water to the Republic of South Africa when the project is completed. This could amount to as much as 6% of the country's GDP. Projected earning will be indexed for inflation and will not be affected by cost overrun from the construction phase of the project. The project will be supervised by the LHDA. However, under a treaty signed with the Republic of South Africa in 1986, that country will assume full responsibility for the costs and debt service for any part of the project dealing with water transfer. Lesotho will be fully responsible for the portion of the project dealing with the power generation plant.

Ita, a South African construction company, and Dumez, a French company, were cutting a $63 million road from the Republic of South African border to the site of the first dam to be built at Katse. At Katse, engineers were completing site preparation for the construction of a 180-meter-high, 500-meter-wide concrete dam that will have a capacity of 1,950 million liters of water and will be the largest dam in sub-Saharan Africa. It was scheduled to begin construction in January 1991 and was expected to begin filling in September 1994. The first water is to be delivered to the Republic of South Africa in August 1996. Contracts for the construction of the Katse Dam, a 48-km transfer tunnel and a 37-km delivery tunnel, all of which was estimated to be worth $590 million, will be awarded in 1990. The second part of phase 1 will involve the construction of the Mohale Dam and a delivery tunnel. In phase 2, the Mashai Dam will be built, and a second transfer tunnel will be built. In phase 3, the Tsoelike Dam will be constructed, and the Ntoahoe Dam in the 4th phase. The dams range in height from 126 meters to 180 meters and have a total storage capacity of 6.5 billion cubic meters.

More than one-half of Lesotho's active male labor force works in the Republic of South Africa. According to Government figures, 125,000 Basotho migrant workers were employed in South African mines in 1989. Of this total, about 101,000 worked in gold mines and about 6,000 in coal mines. It was estimated that 50,000 more Basotho citizens were working in the Republic of South Africa in nonmining jobs, bringing the total number of migrant workers to 175,000. Approximately 1,000 new jobs were created in Lesotho each year; however, about 10,000 people came into the job market. A Basotho miner could earn 8 to 10 times as much working in the South African mines as working in rural agriculture at home. In 1989, 60% of the Lesotho's families owed their support to South African wages, which in 1989 were estimated to be more than $300 million. These wages were the principal way that the Government financed its large trade deficit, which was estimated to be $381 million in 1989. The Government used migrate workers' wages to finance development by requiring that 60% of the total wage sum be deposited with the Government until each worker's contract was completed.

OUTLOOK

The LHWP, high in the Maluti Mountains, will change the economic face of Lesotho for the next 50 years. Besides the obvious economic gains derived from water transfer royalties and the reduction of the trade deficit by reducing energy imports, many positive secondary benefits will be realized. The major infrastructural projects will open up the interior to tourism, fishing, and modern agriculture. The power generation spinoff of the water transfer project will help Lesotho's balance of payments and encourage light industry.

If Lesotho's positive investment climate persists, along with its preferential access to world markets, the future introduction of cheap "home grown" electrical power could be extremely significant to the manufacturing sector. Once a sizable number of manufacturing firms are established, they should become self-propagating.

Lesotho will continue to depend heavily on the wages of its citizens derived in the Rupublic of South Africa. The importance of South African jobs may diminish somewhat, however, as new jobs open up in the manufacturing sector and in other sectors affected by the LHWP. The importance of jobs created by the construction of the project, which will continue for the next 30 years, should not be overlooked. The estimated 6,500 construction workers that the project will employ once it is in full swing, however, is small compared to the secondary jobs that will likely be generated.

There may be an increase in the quantity of building materials, such as sand and gravel, produced in Lesotho. Besides the possibility that local materials will be used in the construction of roads and dams in conjunction with the LHWP, the demand for raw materials in tile and brick manufacturing and for other construction purposes will likely increase.

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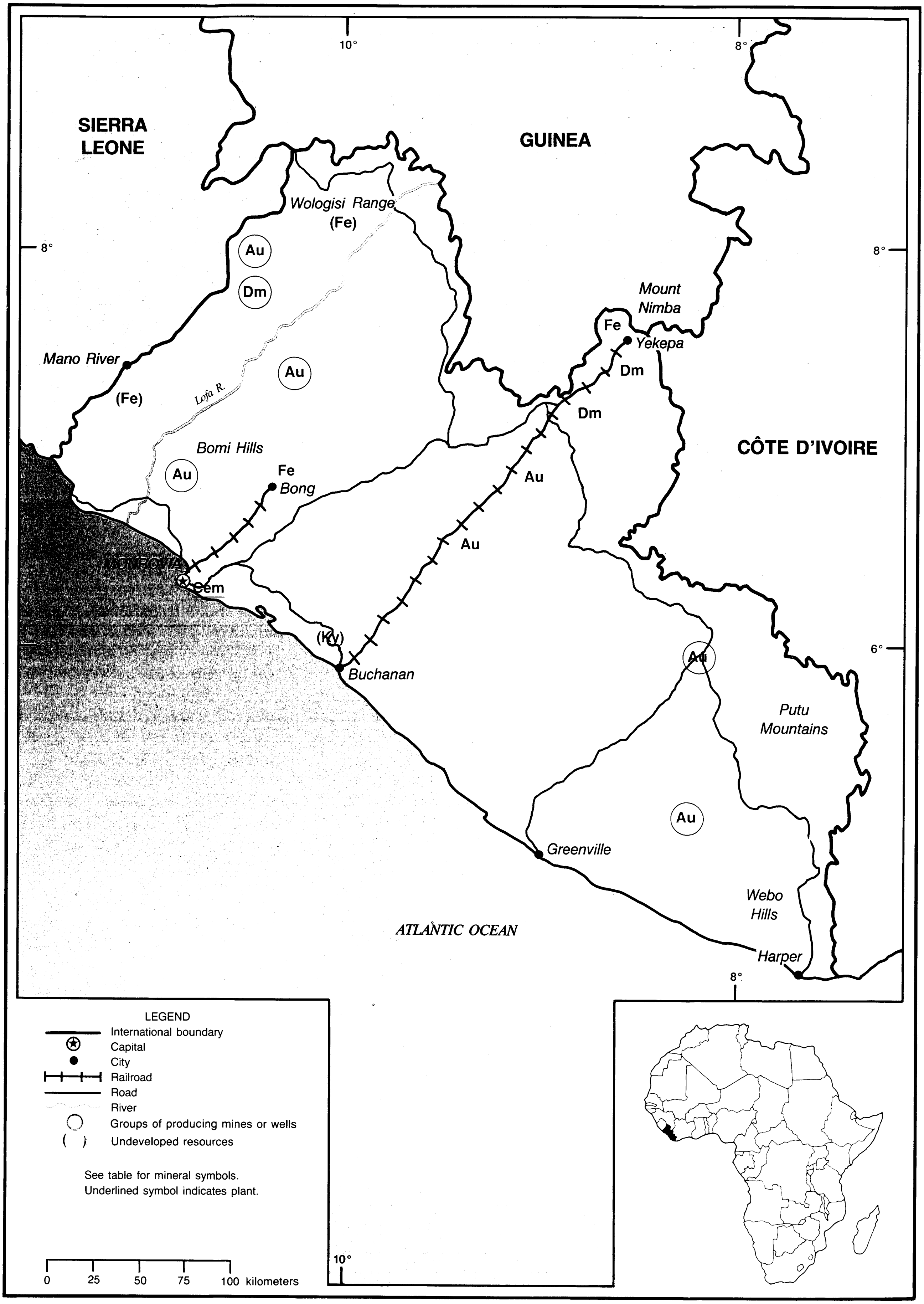
[1]Where necessary, values have been converted from Basotho Maloti (M) to U.S. dollars at the rate of M2.55 = US$1.00.

LIBERIA

AREA 111,370 km² **POPULATION 2.6 million**



THE MINERAL INDUSTRY OF

LIBERIA

By Hendrik G. van Oss

Liberia is a heavily-forested, well-mineralized country whose economy is dominated by the export of mineral commodities, timber, and rubber, and by revenues from license fees from the world's largest merchant fleet. In 1989, about 22% of the country's reported gross domestic product (GDP) of about $1 billion[1] was contributed by mining, mostly of iron ore. However, it was believed that unrecorded production of gold and diamonds, smuggled out of the country, may be worth as much as or more than the iron ore production. Thus, the true GDP may be on the order of $1.2 billion with the mineral component amounting to 35%.

Two iron ore mines, operated by Bong Mining Co. (BMC) and the LAMCO Joint Venture (LJV), were in production during the year. A major development during the year was the cessation of the LJV operations in October, largely because of the near exhaustion of the high-grade reserves, at which point complete ownership was assumed by the Government. A new consortium was formed to resume and maintain operations so as to keep operational the railing and shiploading infrastructure for the mine. This infrastructure was key to the development of the MIFERGUI-Nimba high-grade iron ore body in Guinea, just across the border from Yekepa. The economics of the MIFERGUI-Nimba project hinge on connecting the deposit to the LJV infrastructure by the construction of 17 kilometers (km) of new track, as opposed to a much lengthier route out through Guinea.

Western Mining Corp. of Australia was negotiating exploration and mining rights on a major concession covering about 18,000 square kilometers in western and northern Liberia. The concession was granted in mid-March 1990. However, a separate agreement, granting Western Mining certain exemptions to the country's foreign exchange surrender laws, was still under negotiation.

Liberia's geology is dominated by a complex of Archean migmatitic and granulitic gneissic rocks. These contain several northeast-trending narrow zones containing iron formations. In the southeast third of the country there are northeast-trending Proterozoic belts containing volcanosedimentary rocks, similar to those of the Birimian series found to the east in Côte d'Ivoire.

The best known Liberian ore deposits are the iron deposits found scattered throughout the country. Iron mining commenced in 1951 with the Liberian Mining Co. operation in the Bomi Hills the mine closed in 1977. The National Iron Ore Co. (NIOC) commenced mining of iron ore at Mano River in 1958. This operation closed in 1985. High-grade iron deposits near Yekepa in the Nimba Range were put into production in 1963 by LJV. LJV was owned jointly by the Government, through its parastatal Liberian Mining Corp. (LIMINCO), and by Liberian American-Swedish Minerals Co. (LAMCO), a joint venture largely of the Government and Gränges AB & Co. of Sweden. BMC commenced mining low-grade iron ore in the Bong Range in 1965. Other low- grade iron ore deposits are known, such as those that exist in the Putu Mountains and the Wologisi Range, but are currently considered to be uneconomic.

Kimberlites are known to exist near the Sierra Leone border, but have never been proven economic. Alluvial diamonds, however, are known from many parts of the country, particularly along the Lofa River and its tributaries in western Liberia. Gold is likewise widespread in alluvial deposits. Exploitation of gold and diamonds is common, but to date has been confined to small placer operations.

Silica sand deposits are found along the coast between Monrovia and Buchanan and small quantities have been mined in recent years. Liberia is known to have significant deposits of kyanite near Buchanan and of barite about 50 km northeast of Monrovia. Neither has been exploited. Heavy mineral sands have been found along the coast in the eastern half of the country, but likewise have never been exploited. Occurrences of nickel, chromium, and uranium mineralization are known, but are not considered economic.

GOVERNMENT POLICIES AND PROGRAMS

The Liberian Government recognized the dominance of mining in the country's economy and had a policy of welcoming new investment in the mining sector. The Government was particularly interested in encouraging the development of formal mining for gold and diamonds because the country's resources of these were considered to be significant and because it was believed that most of the current production was being smuggled out of the country. The value of this smuggled production was estimated to be similar to the value of the country's iron exports, and, hence, the loss of tax revenues from this production was of concern to the Government.

In recent years, mining companies seeking to do business with the Government have negotiated individual agreements, which have, however, been based on older mining and investment codes. The basic mining code of Liberia was contained in the Revenue and Finance Laws of 1956, Titles 24 and 35, Liberian Code of Laws. This was amended and supplemented by the Diamond Industry Act of 1958, which regulated diamond operations and which was revised in 1979 to include provisions for mining gold and for allowing foreign participation in joint ventures in alluvial mining. Petroleum exploration in Liberia is governed by the Petroleum Code and Model Agreement of March 1982. The 1966 Investment Incentive Code, as amended in 1973, and which was followed by the Investment Incentive Code of 1975, provided new industries with certain exemptions from customs duties and various taxes and provided for 100% repatriation of profits and freedom from foreign exchange restrictions. The investment codes were further amended by the 1982 Decree Amending the Investment Incentive Code of March 6, 1973.

Owing to cash-flow shortages and the erosion of confidence in the Liberian dollar, the Government in 1986 decreed that 25% of all foreign exchange earnings from exports be surrendered to the Government in exchange for Liberian dollars at parity with the U.S. dollar. This surrender requirement has been of concern to such establishments as the iron mining companies, which have subsequently negotiated agreements for partial exceptions to the decree. In March 1989, further cash-flow problems led the Government to cancel these agreements for the iron ore and rubber companies.

Although the Liberia Petroleum Refining Co. (LPRC) has traditionally been the major importer of petroleum products, the iron ore and rubber companies have had licenses to import such products to meet their own needs. In early 1989, LPRC signed an agreement with the Liberia National Petroleum Corp. (LPNC), whereby the LPNC was to be the sole buyer for the country and LPRC the sole distributor. This change has proved cumbersome and has met with resistance from the iron ore and rubber producers.

PRODUCTION

The reported production of all mineral commodities, except silica sand, fell in 1989. In the case of cement, it is believed that the shortage of foreign exchange adversely affected the importation of clinker and reduced the number of construction starts. Reported diamond and gold production, all from artisanal workings, was based on tax revenues and was generally believed to be an underestimate of true Liberian output. The production was believed to include a portion of the production from neighboring countries smuggled into Liberia. It is likely that continued erosion of confidence in the Liberian dollar led to an increase in the smuggled component of Liberian production and possibly to the rerouting of some of the smuggled production from other countries in the region.

Iron ore was produced by BMC and by LJV and its successor Iron Mining Co. of Liberia (LIMCO). BMC's production of slightly more than 7 million metric tons (MMmt) was essentially unchanged from that in 1988. Production by LJV was at full capacity until the closure of the mine at Yekepa at the end of July; production for the year was about 4.4 MMmt. LIMCO was formed to resume production at Yekepa, and about 300,000 tons was mined toward yearend. Mine production and ore railings were halted in mid-May 1990 because of insurgent activities in the region.

TRADE

Liberia's official trade in mineral commodities was dominated by exports of iron ore, worth $208 million in 1988, the latest year for which data are available. This was almost as much as the value of rubber and timber combined. Overall, trade with the United States accounted for 25% of Liberia's exports in 1988 and about 19% of the country's imports.

Iron ore exports accounted for about 47% of the country's total reported exports in 1988, the latest year available, and are believed to have held a similar position in 1989. Officially recorded exports of diamonds and gold were about $9 million and $7 million, respectively, in 1989, but it was recognized that the smuggled trade in these commodities was probably much larger, perhaps in excess of $200 million.

Liberia's iron ore exports in 1989 declined 7% to about 12.747 MMmt. BMC suffered a 3% decline to 6.977 MMmt, largely because of a decline in sales to Italy. LAMCO's exports fell by more than 11% to 5.77 MMmt, largely as a result of the company ceasing shipments at the end of October.

The Federal Republic of Germany's imports of iron ore from Liberia were

TABLE 1

LIBERIA: PRODUCTION OF MINERAL COMMODITIES

Commodity[1]		1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic	metric tons	95,000	[r]95,845	105,374	105,800	[2]85,300
Diamond:[3]						
Gem	thousand carats	66,394	63,322	112,113	[e]66,812	61,822
Industrial	do.	71,927	188,830	182,921	[e]100,218	92,732
Total	do.	138,321	252,152	295,034	167,030	[2]154,554
Gold[4]	kilograms	152	625	467	677	[3]734
Iron ore	thousand metric tons	15,318	15,295	13,742	12,767	11,700
Silica sand[e]	metric tons	5,000	5,000	5,000	6,600	10,000

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

[1] In addition to the commodities listed, Liberia produced a variety of crude construction materials (clays, stone, sand and gravel), but available information is inadequate to make reliable estimates of output levels. Table includes data available through May 21, 1990.

[2] Reported figure.

[3] Data do not include smuggled production.

[4] Data are based on tax revenues for exports and may include gold produced outside of Liberia. Data do not include unrecorded gold production smuggled out of Liberia.

slightly higher in 1989 and accounted for about 45% of Liberia's iron ore exports. Italy accounted for 23% of Liberia's iron ore exports. Iron ore exports to the United States increased 56% to 200,000 tons. France imported almost 1 million tons of iron ore from Liberia, an 18% increase. Exports to Belgium were 910,000 tons, a 35% decline.

Exports of Liberian iron ore to Eastern Europe declined significantly: exports of ore to Romania fell almost 53% to 534,000 tons, exports to Yugoslavia fell 69% to 59,000 tons, and exports to the German Democratic Republic fell to zero.

Since the 1982 closure of Liberia's only oil refinery, the country has had to import all of its petroleum products. Imports of fuel and other petroleum products were estimated to amount to about $70 million in 1989, or about one-fifth of the country's total imports.

STRUCTURE OF THE MINERAL INDUSTRY

The formal mineral industry was dominated by the production of iron ore by two companies in which the Government held major interest. Diamond and gold production was all from artisanal placer operations, the total number and true output of which were unknown.

The Liberian work force was estimated to amount to 700,000 persons actually employed, of which 570,000 were engaged in subsistence agriculture and 27,800 were in industry. About 72% of the industrial work force was in mining; however, an estimated 15,000 of these workers were artisanal miners. The iron ore industry employed about 3,000, a one-third decline from levels in 1985.

COMMODITY REVIEW

Metals

Early in 1989, to meet certain cash-flow shortages, the Government canceled the exceptions to the 25% foreign exchange surrender law negotiated with LJV and BMC. Initially, both companies refused to pay, whereupon, in mid-March, the Government embargoed iron ore shipments from both companies. Because of this, LJV declared force majeure. Following negotiations, both companies agreed to new foreign exchange payments to the Government, and both companies had resumed shipments by March 25.

The short-lived shipping embargo was an additional factor in the worsening relations between LAMCO and the Government. Although these relations had deteriorated over several years, they had taken a major downturn when LAMCO announced in 1988 that it was advancing by 6 months the shutdown of its Nimba Mine at Yekepa to mid-1989. LAMCO claimed that its high-grade reserves had been depleted faster than expected and that it was not economic under current economic conditions to mine its low-grade, high-phosphorus, reserves, such as those at Mount Tokadeh, about 20 km southwest of Yekepa. Further, the company was faced with rapidly deteriorating conditions of its railroad to Buchanan and felt that the remaining ore reserves did not justify the resources necessary to rehabilitate the line. The company was also discouraged by the lack of progress with the negotiations between the Guinean and Liberian Governments over the MIFERGUI-Nimba project. In August, LAMCO announced that mining at Yekepa had ceased July 29 and that its shipments from stockpiles at the mine and Buchanan would be completed by about November.

During the year, LAMCO was involved in negotiations with the Government concerning LAMCO's possible role in both the bridging operation to MIFERGUI-Nimba and in operating the new Guinean mine once it became

TABLE 2

LIBERIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity
Cement	Liberia Cement Corp. (Scancem, Norway, 67.7%; Government, 36.25%)	Bushrod Island, off Monrovia	[1] 200,000
Diamonds	Artisanal production	Placer operations throughout country, especially near Lofa River	[2] NA
Gold	Artisanal production	Placer operations throughout country	[2] NA
Iron ore	Bong Mining Co. (Exploration und Bergbau GmbH, Federal Republic of Germany (FRG), as manager for 3 companies (all FRG): Thyssen Stahl AG, 21.4%; Hoesch Stahl AG, 8.05%; Krupp Stahl AG, 4.3%; Finsider International S.S. of Italy, 16.25%; Government, 50%)	Mine and pelletizing plant in Bong Range, 80 kilometers north-northeast of Monrovia	[3] 7.3
Do.	Iron Mining Co. of Liberia (Government, 100%)[4]	Yekepa, Nimba Mountains, 250 kilometers northeast of Buchanan	[3] 4.2

NA Not available

[1] Metric tons per year.

[2] Diamond and gold artisanal production capacity is unknown because of varying number of workers and smuggling of both local and foreign production.

[3] Million metric tons per year.

[4] From its startup, the mine was operated by the LAMCO Joint Venture (LJV) until it ceased mining on July 29, 1989, and shipping in October 1989. LJV was 62.5% owned by the Government of Liberia and 37.5% by Liberian Iron Ore Ltd., controlled by Gränges AB & Co. of Sweden.

operational. It was known that both LAMCO's iron ore customers in Europe and the Guinean Government viewed LAMCO's participation with favor. However, this view was not shared by the Government of Liberia, and following the cessation of mining at the end of July, the Government announced that it was terminating LAMCO's mining concession and that the mine and reserves, as well as the railroad and loading facilities at Buchanan, were reverting to the Government. Further, the Government announced that it had approved an agreement between LIMINCO and the African Mining Consortium Ltd. (AMCL) for the immediate resumption of mining at Yekepa and the management of the bridging operation.

AMCL is a consortium of financial, marketing, and shipping concerns led by M. A. Hanna Mining Co. of the United States, which will provide technical services. Both LIMINCO and AMCL set up operating subsidiaries. LIMINCO's subsidiary was Nimba Mining Co. (NIMBACO) and has a supervisory role. AMCL's operating subsidiary was LIMCO. AMCL rehired most of the workers laid off by LAMCO after it closed the mine. The agreement between AMCL and the Government is for a 15-month bridging project, although it was felt that the company would be called upon to extend this to 3 years. In either case, the bridging project would ship a blend of the remaining high-grade ore at the Nimba Mine with abundant low-grade ore from Mount Tokadeh. A problem with extending the project to 3 years was that it would likely necessitate a major midstream overhaul of the railroad, which would require additional financing.

The choice of AMCL to manage the bridging project led to further difficulties in the MIFERGUI-Nimba negotiations between the Governments of Liberia and Guinea. The latter had not had prior knowledge of the appointment and worried that AMCL would have difficulty marketing the bridging project's output. This ore was considered to be of marginal quality. AMCL expressed confidence that markets would be secured, especially among those LAMCO customers desiring secure purchasing contracts for the eventual MIFERGUI-Nimba production. In addition, AMCL was looking at markets in the United States and in Asia. The latter, it was recognized, might require deepening the bedrock Port of Buchanan to allow the loading of larger ships, a prospect considered to be prohibitively expensive.

Operations at Yekepa resumed shortly after the appointment of AMCL, and production in December was believed to be about 300,000 tons. Shipments of ore from Buchanan resumed in late January 1990 and included material remaining in the LAMCO stockpile as well as newly mined ore. In early May 1990, ore railings and, subsequently, mining, were halted because of insurgent activities centered in the region. The outcome of the insurgency was of major concern to the backers of the MIFERGUI-Nimba and bridging projects.

Reserves

Gold and diamond reserves are not known quantitatively, although artisanal placer production is widespread and reserves are believed to be significant. BMC has reported that its reserves of soft ore will be exhausted by 1995. However, BMC has reserves of hard ore, for which the company modified its plant in 1985 and which will form the bulk of its future production. Information provided to the U.S. Embassy by BMC in 1989 indicated that the company had reserves adequate for operations at current levels until the year 2006.[2] This would imply about 265 MMmt of ore grading about 36% iron.

According to Gränges, LIMCO inherited remaining high-grade reserves at Yekepa of approximately 2 MMmt. This, however, was material in the pit walls and floor and is relatively expensive to mine. The bridging operation involves blending this ore with lower grade ore at Mount Tokadeh, reserves of which are claimed by AMCL to be adequate for a 3-year bridging operation extracting about 4 MMmt per year of blended ore. In addition, LAMCO had an inventory in the Yekepa area of several hundred million tons of lower grade material. The actual reserves of this low-grade material were dependent on the realization of schemes either to blend the low-grade ore with high-grade Guinean ore, or to concentrate or pelletize the material at BMC's facilities. The first scheme was considered unlikely because of a lack of market demand for the product. The second was considered uneconomic because of the need to build a railroad to the BMC facilities. Consequently, this low-grade inventory cannot be considered to be reserves under current economic conditions.

INFRASTRUCTURE

Liberia had two railroads operating during the year. BMC owned and operated a 78-km standard-gauge track connecting the iron mine at Bong with the iron shipping terminal at Monrovia. Railing capacity was about 7.5 MMmt per year. LJV, and late in the year, LIMCO, operated a 267-km standard-gauge track connecting the Nimba iron mine at Yekepa to the loading facilities at the Port of Buchanan. When inaugurated in 1963, the track had a railing capacity of about 14 MMmt per year; in recent years it had deteriorated because of lack of maintenance, and the capacity during 1989 was only about 50% of the original. It was widely believed that the continued utility of the track beyond about mid-1991 would require a major rehabilitation program. The 148-km narrow-gauge railroad connecting Monrovia with the NIOC mine near Mano River near the Sierra Leone border has been inoperational since shortly after the mine's closure in early 1985.

The major mineral industry ports of Liberia were Monrovia, Buchanan, and Harper, of which the first two handle the country's mineral exports. Monrovia has an ore stocking capacity of approximately 800,000 tons of iron ore concentrate and 500,000 tons of pellets, and a shiploading capacity of 84,000 tons per day. The harbor has a depth of 13.71 meters with a soft bottom and can accommodate ore carriers of 120,000 deadweight tons (dwt). Buchanan port has a depth of 12.8 meters and has a bedrock bottom. The port has an ore stockyard of approximately 2.1 MMmt capacity and is equipped with a 6,000-ton-per-hour shiploader. The port can handle ships up to 80,000 dwt, or 120,000 dwt if shortloaded to 80,000 tons. The Port of Harper is used by Mobil to import petroleum products.

Liberia's National Port Authority (NPA) is charged with operating the major ports. To improve the efficiency of the operations at Monrovia, the Government, in 1988, signed a 3-year contract with Hamburg Port Consultants (HPC) of the Federal Republic of Germany to operate and develop the port at Monrovia. In September 1989, following prolonged disputes with the NPA, HPC terminated its management agreement and left the country. Following the cessation of LAMCO's operations, NPA assumed total control of the Port of Buchanan.

Liberia has about 10,000 km of roads, of which about 8% are paved.

OUTLOOK

Iron mining will continue to play a significant, if diminished, role in the Liberian economy, at least for the next decade. A major factor in the iron mining sector in Liberia will be the success of the MIFERGUI-Nimba project in Guinea, which is to use the Liberian railing and shipping infrastructure developed by LAMCO. Failure or significant delay in the development of MIFERGUI-Nimba will adversely affect the market for the marginal product of the bridging operation at Yekepa, the success of which is necessary for the rehabilitation of the rail line. The continued progress of these iron ore projects is crucially dependent upon the outcome of the insurgency that halted the bridging project in May 1990.

Given a stable political and investment environment and very strong markets in the future for iron ore, there is potential to utilize the bulk of the low-grade ores near Yekepa and some of the similar deposits elsewhere in Liberia by linking them by rail to the concentrating and pelletizing facilities at Bong. However, this will require the construction of new railroads, which cannot be justified under current economic conditions.

The potential for an increased output of gold and diamonds is considered good, especially if the exploration efforts of Western Mining are successful and if additional foreign companies start exploration programs in Liberia.

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[1] Where necessary, values have been converted from Liberian dollars (L$) to U.S. dollars. The L$ is at official parity with the U.S. dollar. However, many unofficial transactions utilize a parallel currency market where the L$ trades at a discount. The exchange rate in the parallel market was quite variable, but at yearend 1989 was approximately L$2.50 = U.S.$1.00.

[2] U.S. Embassy, Monrovia, Liberia. SPR 4532: Iron Ore: Foreign Trade, 1988. Dep. of State Telegram Monrovia 02998; Mar. 23, 1989, 2 pp.

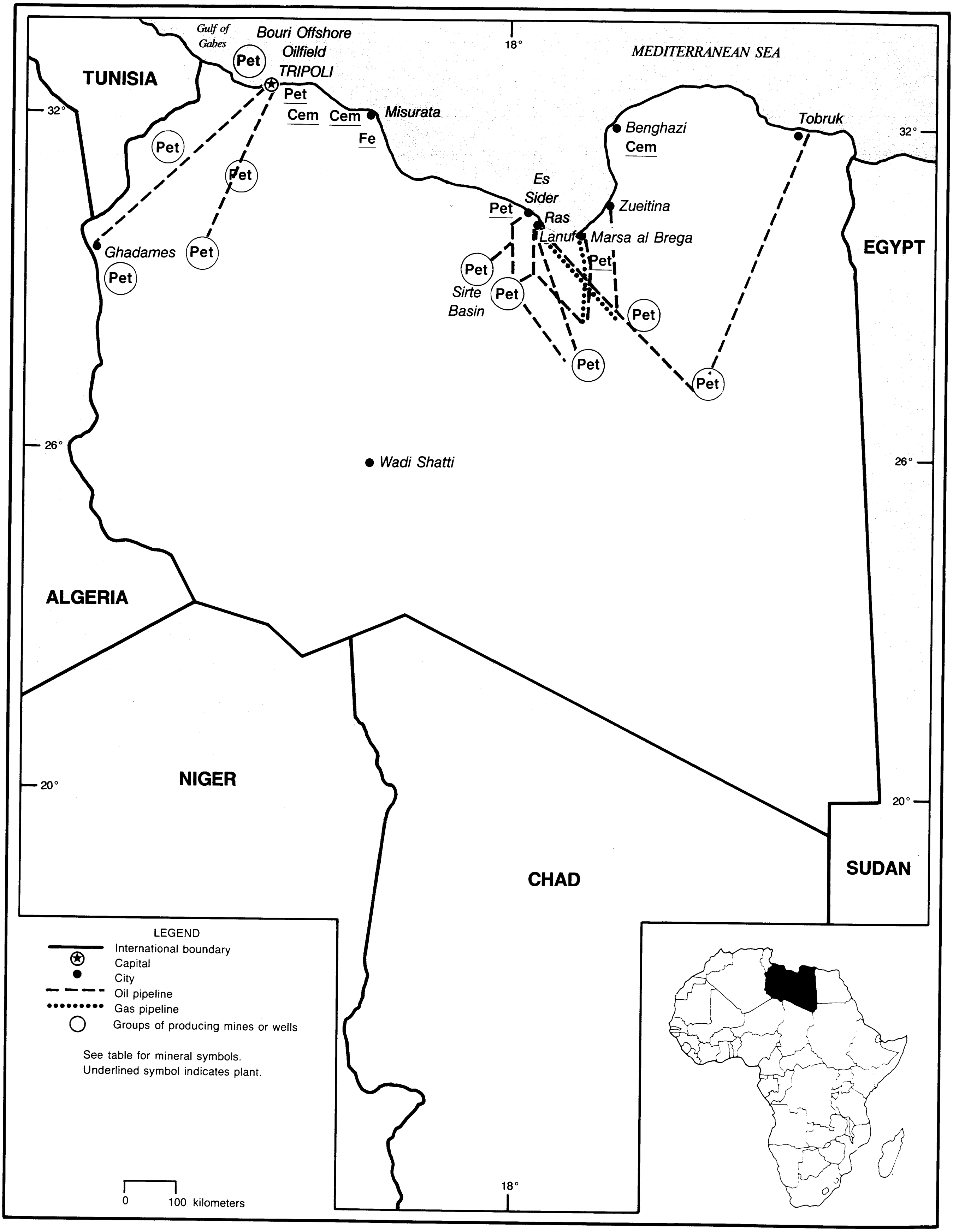
OTHER SOURCES OF INFORMATION

Liberian Geological Survey, Ministry of Lands, Mines and Energy
P.O. Box 9024
Monrovia, Liberia

Liberian Bureau of Mines, Ministry of Lands, Mines and Energy
P.O. Box 9024
Monrovia, Liberia

LIBYA

AREA 1,759,540 km² **POPULATION 4.0 million**



THE MINERAL INDUSTRY OF

LIBYA

By Thomas P. Dolley

Petroleum production continued to dominate Libya's mineral industry in 1989 and early 1990. During this period, an increase in petroleum production coupled with a rise in world oil prices improved that section of the Libyan economy.

Forecasts indicate that Libya's current account deficit had moderated in 1989, compared to a deficit that spiralled to \$1.8 billion[1] in 1988. Additionally, the gross domestic product declined by approximately 4% in 1989. Libya had the highest per capita income of any African country.

Average crude oil production for 1989 increased over the 1988 figure to approximately 1,130,000 barrels per day (bbl/d). The volume of crude petroleum production rose by approximately 10% to 412,450,000 barrels. Libya maintained a second place standing in crude petroleum production among African nations in 1989, behind Nigeria in the first place position. Increased international interest in petroleum exploration highlighted mineral industry developments in Libya for 1989.

Globally, the petrochemicals market soared in 1988 and early 1989 after 2 years of increased demand. Despite a slowing of this market since early 1989, Libya continued an investment strategy aimed at the production of downstream and value-added petroleum products and petrochemicals.

GOVERNMENT POLICIES AND PROGRAMS

During the year, the Government maintained its rapprochement policy towards other north African countries. This conciliatory outlook was aimed at uniting north Africa into a more closely knit confederation of states, called the Great Maghreb, for the purposes of trade and economic cooperation. Additionally, by forging better ties with nations already favored by Western trading partners, Libya could consolidate its position with these same Western clients. Borders had been opened and a peace plan signed with Chad, in September 1989, to resolve a 16-year conflict with that nation. The sovereignty of the supposedly mineral-rich Aouzou strip in northern Chad was submitted to arbitration by the International Court of Justice in The Hague.

In the petroleum sector, the Government added more flexibility to production sharing agreements during recent negotiations with foreign operators in order to attract continued investment.

Investment in petrochemicals was conceived by the Government to better exploit Libya's main petroleum export market in Europe, especially in light of the anticipated demand among European Community (EC) members after 1992.

The United States first imposed trade sanctions on Libya in 1986, and they have been renewed annually up to and including 1990. The sanctions included the banning of U.S. exports to Libya and prohibition of lines of credit. Five U.S. oil companies had been affected by the sanctions: W. R. Grace & Co., Conoco, Marathon Oil Co., Amerada Hess, and Occidental Petroleum Corp. These companies had a total of \$2 billion worth of assets in Libya. Further operations by these companies in Libya would be contingent on improved relations between the United States and Libya. It was thought that the Government wanted the U.S. companies back in operation in Libya, particularly due to Libya's growth in petroleum marketing outlets in Europe. The Government of Libya had stated that the companies would not be permitted to return until the United States lifts restrictions on American citizens working in Libya and on sales of Libyan petroleum to the United States.

PRODUCTION

Petroleum production and exploration remained the mainstay of the Libyan mineral sector during the year. Hydrocarbon production accounted for approximately one-half of the gross national product. A petroleum production capacity test was conducted by Libya in the first quarter of 1990, according to the Secretariat of Petroleum. Production was estimated at 1.65 million bbl/d, an increase of 400,000 bbl/d over 1989 figures. It is believed that the Government was conducting the test to convince the Organization of Petroleum Exporting Countries (OPEC) to raise Libya's production quota which had been previously set at 1.233 million bbl/d. Libyan authorities claim that any excess production at this time would be placed in storage and that a modest investment by the Government could enable production to be raised to 2 million bbl/d. The bulk of Libyan crude oil production came from onshore fields located primarily in the Sirte Basin in the north-central part of the country.

Azienda Generali Italiana Petroli S.p.A. (AGIP) of Italy was the sole operator of the Bouri offshore oilfield, located 125 kilometers northwest of Tripoli near the maritime demarcation with Tunisia. The Bouri offshore oilfield was inaugurated in 1988 and since that time 25 wells had been drilled and production increased to 53,000 bbl/d.

Two offshore platforms were being utilized at Bouri; the 67,000 metric ton DP-4 platform there is one of the largest and heaviest offshore structures in the world. The DP-3 platform weighed 35,000 metric tons. It is believed that development of the field included a drilling plan to increase to 50 wells, with recoverable reserves estimated at 670 million barrels.

TRADE

Hydrocarbons account for virtually all export revenues in Libya. In early 1989, Libya supplanted the United Kingdom as West Germany's major supplier of hydrocarbons. Additionally, Libya became Turkey's largest petroleum supplier after Iraq. In September 1989, Turkey agreed to increase crude oil imports from Libya to approximately 21 million barrels for 1990. Previously, in 1987, Libyan

TABLE 1

LIBYA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic	thousand metric tons	[e]6,500	2,077	2,700	[e]2,700	2,700
Gas, natural:[e]						
Gross	million cubic feet	[r]423,000	[r]455,000	[r]424,000	[3]420,000	420,000
Marketed[4]	do.	[r]200,000	[r]240,000	[r]202,000	[3]194,200	194,200
Gypsum[e]	thousand metric tons	180	180	180	180	180
Iron and steel: Crude steel[e]	do.	10	10	10	10	10
Lime[e]	do.	260	260	260	260	260
Nitrogen: N content of ammonia	do.	411	[r]352	[e]350	[e]350	350
Petroleum:						
Crude	thousand 42-gallon barrels	392,375	389,090	367,555	374,125	[3]412,450
Refinery products:						
Gasoline	do.	5,475	5,110	7,000	[e]7,000	7,000
Kerosene and jet fuel	do.	5,840	6,935	11,000	[e]11,000	11,000
Distillate fuel oil	do.	10,585	17,885	15,000	[e]15,000	15,000
Residual fuel oil	do.	18,615	20,805	15,000	[e]15,000	15,000
Other	do.	5,840	3,285	1,000	[e]1,000	1,000
Refinery fuel and losses	do.	1,825	2,190	2,000	[e]2,000	2,000
Total	do.	48,180	56,210	51,000	51,000	51,000
Salt	thousand metric tons	12	12	12	12	12
Sulfur, byproduct of petroleum and natural gas[e]	do.	14	14	14	14	14

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through June 12, 1990.
[2]In addition to the commodities listed, a variety of construction materials (sand and gravel, crushed stone, brick, and tile) was produced, but available information was inadequate to make reliable estimates of output levels. Natural gas liquids were also produced but were blended with crude petroleum and were reported as part of that total.
[3]Reported figure.
[4]Excludes gas reinjected into reservoirs.

crude oil exports to Turkey amounted to approximately 14 million barrels; but, in 1988, they fell to 2.1 million barrels because of problems concerning delayed payments to Turkish contractors for work performed in Libya.

Trade was nonexistant between the United States and Libya during the year. Prior to 1986, trade between the countries was significant. Libyan export revenues to the United States amounted to $800 million dollars in 1981.

At yearend 1989, the signing of a letter of understanding between Libya and Iran was expected to increase trade between these nations in 1990 to $100 million. Under the agreement, Libya would export polyvinyl chloride, iron, and caustic soda and import automobiles, textiles, combine harvesters, and minerals.

STRUCTURE OF THE MINERAL INDUSTRY

In general, petroleum exploration and production-sharing, along with any proposed mining activities, were based on Fiscal Provisions, Revenue and Financial Law of July 1, 1977. This legislation was amended in 1980 with new production-sharing patterns based on the following criteria: 85% to 15% in the Government's favor for top hydrocarbon prospects, 81% to 19% for medium oil prospects, and 75% to 25% for less significant oil prospects. In the past 2 to 3 years, more flexibility had been introduced to these production sharing patterns to attract more investment following the departure of some foreign operators. Libya continued to rely on foreign expertise and technical personnel to develop its petroleum and mineral industry.

Libya's National Oil Corp. (NOC) was the parastatal created by the Government in 1970 to oversee petroleum and natural gas exploration, production, and marketing through its 11 wholly owned subsidiaries. AGIP was the only significant foreign producer.

Both the iron and steel industry and the cement industry in Libya were controlled by parastatals that had 100% Government ownership.

COMMODITY REVIEW

Metals

The Misurata steel complex was commissioned after years of delay. Full commercial production was not to begin before 1990. Principal contractor for the project was Voest Alpine of Austria. According to plant officials, the Misurata steel complex was scheduled to produce 700,000 tons of finished steel in 1990 and 250,000 tons of flat products. By April 1990, steel output was running at 1,000 tons per day. Additionally, feasibility studies were being conducted on the production of galvanized sheet steel at the complex. The Government expected sheet output from the plant to achieve 140,000 tons in 1990, with an objective of Libyan self-sufficiency in steel products for the first time. However, steel sales in Libya would probably be heavily subsidized.

TABLE 2

LIBYA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Cement	Libyan Cement Company (100% Government ownership)	Hawari, near Benghazi	1.5
Do.	National Cement and Building Materials Co. (100% Government ownership)	El Margueb and Lebda	1.4
Do.	El Fataiah Cement (100% Government ownership)	Derna	1
Iron and steel, crude	Misurata Iron and Steel Complex (100% Government ownership)	Misurata	1.1
Petroleum, crude	Libyan National Oil Corporation (NOC) (100% Government ownership)	Mainly Sirte Basin	[2]1.8
Do.	Agip-North Africa Middle East (85% NOC, 15% Azienda Generali Italiana Petroli (Agip), Italy)	Bouri offshore oilfield, Bu Attifel onshore oilfield, Rimal Katib onshore oilfield	[3]53,000 [3]137,000 [3]6,400
Do.	Elf Aquitaine-Libya (85% NOC, 15% Société National Elf Aquitaine, France)	El-Meheiriga onshore oilfield	[3]829
Petroleum, refining	Azzawiya Oil Refining Company (100% Government ownership)	Azzawiya	[3]120,000
Do.	Ras Lanuf Oil and Gas Processing Company (100% Government ownership)	Ras Lanuf	[3]201,000
Do.	Sirte Oil Company (100% Government ownership)	Marsa al-Brega	[3]8,400

[1]Million tons per year unless otherwise specified.
[2]Million barrels per day.
[3]Barrels per day.

Exportable steel for 1990 could reach 150,000 tons, according to authorities at the complex. Previously, Libya imported all of its iron and steel requirements, primarily from the Federal Republic of Germany.

Misurata's dual direct reduction modules were built by Japan's Kobe Steel Ltd. and were supplied with locally produced natural gas. A 700,000 pellet iron ore contract for 1990 was to be supplied by Brazil's mining firm Cia. Vale do Rio Doce, and 10% of the furnace feed would be supplied by scrap iron and steel.

The Government estimated that total funding spent on the Misurata steel complex over the past decade was approximately $6 billion, with an additional $510 million allocated for the project in March 1990.

The Misurata complex suffered from a shortage of skilled workers. The People's Republic of China reportedly had 400 personnel on site, including managers and engineers. Additionally, Egypt announced preparations to send 285 technical personnel to the Misurata complex.

Industrial Minerals

West German contractor Uhde signed an estimated $45 million contract in early 1989 with the Libyan state-owned National Petrochemical Co. to repair an ammonia plant at the Marsa al-Brega fertilizer complex. The ammonia plant was damaged by a gas explosion in April 1988, which cut production by 31% for the year. Uhde was responsible for the original design, construction, and commissioning of the plant in 1978. Additional installations were constructed by Uhde at the site in 1981. The new contract also calls for upgrading ammonia production capacity 20% to 400,000 metric tons per year (mt/yr.).

The Marsa al-Brega fertilizer complex was comprised of two ammonia plants and two urea plants. Both ammonia plants had a combined production capacity of 660,000 mt/yr. Nominal urea production was also curtailed in 1988 by approximately 35% as a result of the gas explosion. Annual combined urea production capacity was 907,500 mt/yr.

Despite delays, Uhde claimed that repairs and upgrades at the Marsa al-Brega complex will be completed by the second half of 1990. Uhde claimed that delays were also caused by difficulties in obtaining export licenses from the Government of the Federal Republic of Germany for equipment to be utilized at the fertilizer complex because of problems surrounding another West German company, Imhausen Chemie, related to equipment supplied to an alleged chemical weapons plant at Rabta.

Mineral Fuels

Natural Gas.—In addition to a policy directed at attracting foreign investors into oil exploration and production, Libya sought to revive its sagging international natural gas trade. Emphasis had been placed on discoveries of nonassociated natural gas fields. In 1989, Libya's offshore Bouri oilfield had large volumes of associated natural gas flared during the petroleum production cycle, hampering any increased oil production from the field. Additionally, significant volumes of nonassociated gas had been discovered during exploration near the Bouri oilfield. Depending on market availability, Libya hoped to exploit these resources.

Spain's state-owned Enagas had called to renew its contract for importation of 760,000 tons of liquefied natural gas (LNG) a year, providing that certain problems with the LNG were solved. Imports of Libyan LNG had marketing problems in the past due to the LNG containing liquefied petroleum gas (LPG). To offset this problem, Libya planned to build a gas separation plant at the Marsa al-Brega terminal.

During 1989, LNG commerce with Italy, supplied by a liquefaction plant at Marsa al-Brega, Libya, had been phased out.

Petrochemicals.—The Ras Lanuf petrochemical complex functioned at approximately 90% of capacity in 1989 and was operated by the Yugoslavian company Hemijska Industria Pancevo. Three first-phase units at the complex had designed production capacities as follows: ethylene unit at 330,000 mt/yr.; propylene unit at 171,000 mt/yr., and a butene unit at 135,000 mt/yr. Petrochemical production for 1989 from these units was 300,711 tons of ethylene, 168,107 tons of propylene, and 117,556 tons of butene. All of these petrochemical amounts rose significantly compared to the previous year.

Petroleum—**Exploration.**—The Ghadames basin, located in western Libya, and the Sirte basin, located in north-central Libya, were both targets for exploration agreements during the year. The Sirte basin trends in a northwest-southeast direction and was uplifted and faulted in Silurian time, followed by a period of subsidence in Cretaceous and Tertiary time.

INA-Naftaplin (INA) of Yugoslavia signed an exploration and production sharing agreement with the NOC in June 1989. Five areas in the Sirte basin covering 1,279 square kilometers were to be explored under the terms of the agreement. At yearend, INA signed an agreement with the Libyan NOC to explore for oil in the western offshore area. This agreement was part of a third round of production-sharing and exploration accords and called for INA to perform seismic surveys utilizing their own seismic survey ship and drilling platforms. Initially the sole operator, INA hoped to attract other foreign partners to take a 50% share of the project. The agreement came in the wake of controversy surrounding INA's curtailment of Libyan crude purchases at Yugoslavian refineries because of the price of the oil. Typically, INA accepted the Libyan crude under a barter trade agreement in payment for work performed by Yugoslavian firms in Libya. The crude price was usually fixed in advance.

In August 1989, the NOC signed exploration and production sharing agreements covering four tracts in the Sirte basin and one tract in the Ghadames basin. The tracts covered a total area of approximately 21,108 square kilometers. Foreign companies involved in the agreements were OMV Exploration & Production Ltd. of Austria, the parastatal Braspetro of Brazil, and Husky Oil International Inc. of Canada. Husky Oil expected to begin exploratory drilling in 1991 under the agreements, pending approval by the Libyan Government. Husky Oil was to pay $35 million of $100 million in exploration costs.

Additionally, Fina Exploration Libya, a wholly owned subsidiary of Belgium's Petrofina, signed an exploration and production sharing agreement with Libya's NOC on February 25, 1990. Ratification of the agreement was forthcoming by the Libyan authorities. The contract covered three areas totaling 15,736 square kilometers in the Sirte basin. The agreement stipulated a minimum exploration commitment over 6 years comprising 8,500 kilometers of seismic surveys and the drilling of 12 exploratory wells.

Plans moved forward during the year to explore the Gulf of Gabes, offshore Tunisia, between both nations. The Libyan-Tunisian Exploration Co., capitalized at $5 million, was responsible for surveying, exploration, and development of the 3,000 square kilometer 7 November oilfield. This concession was located between Libya's offshore Bouri Field and Tunisia's Ashtart Field. Revenue from the Bouri Field would be set aside for additional joint-venture projects. AGIP, the Bouri operator, and Elf Aquitaine Tunisie, the Ashtart Field operator, were being considered for development contractors. Additionally, negotiations between the Egyptian General Petroleum Corp. and the NOC were held in late 1989, to discuss utilizing Egyptian expertise in Libyan gas and oil exploration.

Spain solidified its role in petroleum activities in Libya during 1989. At yearend, a protocol was initialed among two Spanish state petroleum concerns, Enagas and Repsol, and Libya's NOC. In general, the agreements called for increased cooperation among the petroleum firms in the refining and petrochemical sectors.

Refining.—Libya's domestic throughput petroleum refining capacity was approximately 380,000 bbl/d., with the greatest amount of processing at the Ras Lanuf facility. The 220,000 bbl/d. unit was currently running at one-half capacity. Domestic consumption was between 90,000 and 100,000 bbl/d.

Compagnia Tecnica Internazionale Progetti (CTIP) of Italy was awarded a contract by NOC in late 1989 for design consultation work on expansion of the Tobruk oil refinery. The construction contract for the project was awarded to Yugoslavia's Energoinvest. The project aimed at doubling the refinery's throughput capacity of 20,000 bbl/d. Additionally, CTIP won a design consultancy services contract in July 1989 for building a 20,000 bbl/d hydroskimming plant and a LPG unit at Sebha. The plant was conceived to refine crude oil from nearby fields and provide adjacent localities with petrol and diesel products. CTIP also was awarded a $14.3 million subcontract to supply engineering material and equipment for a gas pipeline to connect 103A gasfield to the plant compressor station near Marsa al-Brega. The laying of the 78-kilometer pipeline will be completed by a subsidiary of the main client in the project, Libya's Sirte Oil Co.

Tamoil Italia, an Italian petroleum refiner, had more than 80% Libyan equity ownership. In late 1989, Tamoil Italia purchased a 50% share of the Italian oil distributor, Bortollotti, thus increasing Libyan petroleum distribution markets in Italy.

Reserves

Libya's petroleum industry parastatal, the NOC, stated in early 1990 that a study on proven oil reserves in Libya resulted in a doubling of prior estimates. The study estimated proven oil reserves at 45 to 50 billion barrels and natural gas reserves at 43 trillion cubic feet. Libya possessed other industrial mineral resources including gypsum, magnetite, phosphate rock, potash, sodium chloride, and sulfur, for which reserves have not been officially reported. These resources remained largely untapped due to high costs for development given current global markets.

INFRASTRUCTURE

Transportation of petroleum and natural gas was primarily through a network of pipelines from wellhead to processing and shipping points that were located primarily on the Mediterranean coast.

The Government continued its policy of prioritizing the budget for Libya's largest infrastructure project, the Great Manmade River (GMR), during 1989 and early 1990. Estimated cost of the entire five phases of the GMR was $27 billion. A major part of the financing of the project was to come from foreign exchange generated from petroleum revenues.

Dong Ah Construction Co. of South Korea was awarded the GMR Phase 2 contract on February 4, 1990. The contract was valued at $5.5 billion dollars. Dong Ah Construction Co., principal contractor for GMR Phase 1, was to undertake all tasks during the project, with the exception of the engineering subcontract. This was to be awarded to an unnamed European firm. GMR Phase 1 was to be completed by 1991. GMR Phase 2 called for the construction of a 1,100-kilometer waterway, designed to convey 2 million cubic meters of water a day from the Fezzan artesian fields in the south of Tripoli to northwestern coastal regions. GMR Phase 2 was to be completed by 1998.

OUTLOOK

Government reserve figures indicate that Libyan crude oil and natural gas production will continue well into the 21st Century. Due to low sulfur content, Libyan light crudes should realize increased demand by environmentally concerned Western nations in the 1990's. This was exemplified in 1989 and early 1990 by increased purchases of crude oil, petrochemicals, and refined products by Italy, Libya's biggest trading partner. Italy's state-owned electrical utility, Ente Nazionale per l'Energia Elettrica, decided to burn low-sulfur fuel oils. Libyan crude oil was characteristically lighter than Iranian and Iraqi counterpart crude oils. Libyan crude petroleum had an extremely low sulfur content, from .2% to .6%, considered ideal for environmentally concerned users. Natural gas consumption in Europe, predicted to rise in coming years, would enable Libya to exploit its predominantly untapped reserves.

[1]Where necessary, values have been converted from Libyan dinars (LD) to U.S. dollars at the rate of LD0.33424 = US$1.00.

OTHER SOURCES OF INFORMATION

Agency

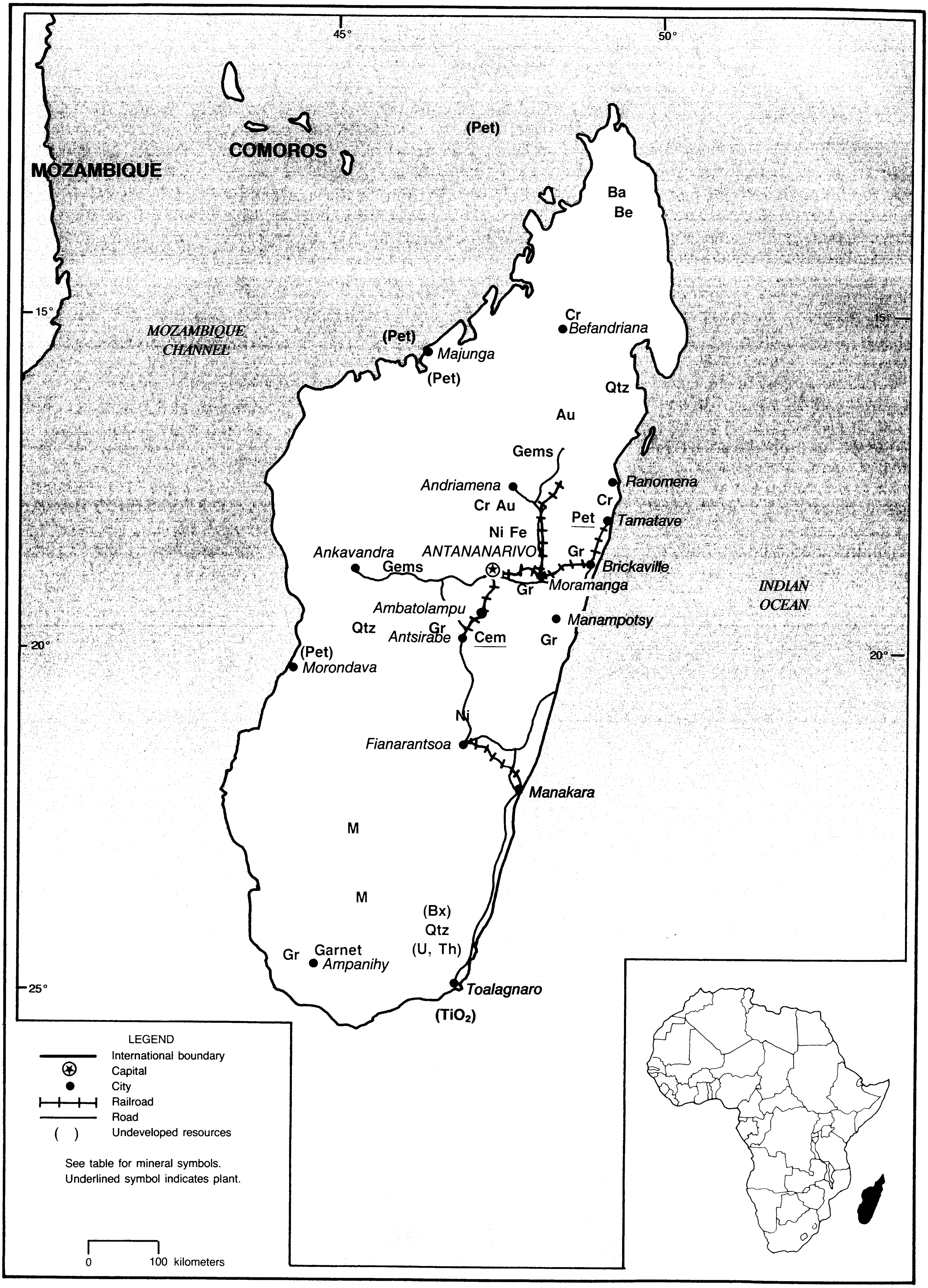
Secretariat of Petroleum Sadoon Sweheli Street Tripoli, Libya

Publication

M. J. Salem and M. T. Busrewil, eds., Al-Fateh University, Tripoli, Socialist People's Libyan Arab Jamahiriya, Academic Press, 1980: The Geology of Libya, vols. I, II, III.

MADAGASCAR

AREA 581,540 km² **POPULATION 11,800,524**



THE MINERAL INDUSTRY OF

MADAGASCAR

By Thomas P. Dolley

Chromite and graphite remained the two dominant mineral commodities produced in Madagascar. This reflected a continuation of a historical trend in Malagasy mineral production that can be traced back to the mid-1970's. However, mineral production in Madagascar showed mixed results in 1989. Chromite production declined moderately in 1989, with flake graphite showing a modest increase. Madagascar remained an important producer of graphite. Although production was small by world standards, the graphite produced was a high-quality crystalline flake product. Quartz production stagnated, the exception being some types of ornamental quartz and piezoelectric quartz. Production of various precious and semiprecious stones was also mixed.

Within the past 2 years, chromite production in Madagascar has declined to 50% of the nation's average production figures for the 1970's. Historically, production averaged approximately 150,000 tons per year in the 1970's. Chromite production in Madagascar, though within the top 10 world producers, still remained modest when compared with the top producing nations. Production of chromite came principally from an open pit mining operation in Andriamena, operated by the Malagasy parastatal Société Kraomita Malagasy. Recent declining production can be partially attributed to softened world markets and technical and financial problems within Kraomita. Additionally, the world's major steel and ferroalloy manufacturers generally prefer processed ferrochrome rather than chromite ore and concentrates. Madagascar has unsuccessfully attempted to attract foreign investors in a ferrochrome operation.

Madagascar, the fourth largest island in the world, remained one of the least monetized developing countries in 1989. With a population estimated at more than 11.8 million and a per capita income of $158,[1] Madagascar lacked economic solvency. Per capita income has declined since the mid-1980's with increasing population. Estimated external public debt for 1989 was $3.6 billion.

GOVERNMENT POLICIES AND PROGRAMS

The Government nationalized all mineral resources, with the exception of graphite and mica, in 1975. However, private foreign mining interests are active in the country, and participation by foreign mineral producers and developers is encouraged by the Government. The bulk of Madagascar's mining legislation was based on the Mining Code, Ordinance 62-103 of October 1, 1962. The Investment Code, Law #85-001 of 1985, has drawn mixed results from foreign investors since its inception. A new mining code was being drafted between the Government and the Federation of Mine Associations (FEDMINES).

The Petroleum Code, Law #80-001 of June 6, 1980, provided for two different types of production-sharing contracts. The first type of contract covered equity ventures between foreign oil operators and the Government's Office Militaire National pour les Industries Strategiques (OMNIS). The Government maintained 51% ownership, and cost and production sharing was financed by income tax payments and royalties based on achieved rates of return. The second type of contract was a risk service contract in which the foreign oil company assumed all exploration and exploitation costs. Such costs would be repaid through a royalty on production of 10% to 20% for a crude oil discovery and 5% to 20% for a natural gas discovery.

The Government lifted official price controls on gold in October 1989 under Decree No. 89132. The Government planned to make a further announcement that would permit private operators to mine gold in Madagascar.

The Government has attempted to provide a stable environment for foreign investment since 1975. In early 1990, diplomatic relations between Madagascar and the Republic of South Africa were renewed. The United States provides both economic and military aid to Madagascar.

The Government continued to seek multilateral and bilateral interest to aid in controlling the degradation of the environment during the past few years. Uncontrolled slash and burn cultivation, overgrazing, and massive erosion threaten Madagascar's agricultural and hydroelectric potential.

PRODUCTION

Production of mineral commodities was mixed during the year. Production of the country's four main mineral commodities, chromite, graphite, quartz, and mica, remained essentially stable. Development of a large ilmenite sand deposit in southern Madagascar was delayed owing to inadequate infrastructure. Precious and semiprecious stones were primarily from artisanal mining and sold to foreign buyers for export. The Government levies a 12% tariff on foreign exporters of these stones.

TRADE

Chromite, graphite, quartz, and mica are the four primary minerals exported by Madagascar. Export destinations for chromite were dominated

TABLE 1

MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES[1]

(Kilograms unless otherwise specified)

Commodity[2]		1985	1986[e]	1987	1988[p]	1989[p]
METALS						
Beryllium: Beryl in quartz concentrates, industrial and ornamental		50	50	[3]35	3	154
Chromium: Chromite concentrate, gross weight	metric tons	127,415	[3]82,910	106,600	64,177	62,540
Gold, mine output, Au content[e]		4	4	[3]40	90	45
Rare-earth minerals: Bastnasite[e]		9,000	10,000	10,000	10,000	10,000
INDUSTRIAL MINERALS						
Abrasives, natural: (industrial only)[e]		10,000	10,000	10,000	10,000	10,000
Cement, hydraulic[e]	metric tons	35,000	35,000	35,000	35,000	35,000
Clay, kaolin	do.	6,367	6,000	1,427	365	1,315
Feldspar[e]		[3]5,195	5,000	5,000	5,000	5,000
Gem stones:						
Amazonite		5,519	5,500	3,783	525	23,885
Amethyst:						
Gem		11	10	[3]11	1,700	3
Geodes[e]		[3]8,550	9,000	9,000	9,000	9,000
Citrine		372	400	[3]6	112	754
Cordierite		762	800	387	886	4,051
Garnet		1,201	1,500	1,500	6	23
Tourmaline		2,000	2,000	2,000	2,367	[e]2,300
Graphite, all grades	metric tons	13,971	[3]16,187	13,169	14,106	15,863
Mica, phlogopite:						
Block	do.	25	100	25	5	7
Scrap	do.	500	1,300	300	605	899
Splittings and sheet	do.	64	194	77	8	162
Total	do.	589	[3]1,594	402	618	1,068
Ornamental stones:						
Agate		8,042	8,000	14,034	13,886	9,005
Apatite		3,500	3,500	1,948	2,090	9,016
Aragonite	metric tons	991	1,000	500	[e]500	2,187
Calcite	do.	1,160	1,000	2,934	1,243	1,373
Celestine		29,974	30,000	4,365	34,511	28,398
Jasper		16,300	16,000	19,730	21,030	30,137
Labradorite		14,821	15,000	24,320	27,748	23,015
Other gem and ornamental[e]	metric tons	200	250	250	250	[e]250
Quartz:						
Crystal		32,500	32,500	32,500	22,136	40,875
Geodes		3,000	3,000	[e]3,000	2,700	[e]2,700
Hematoid		15,000	15,000	6,825	9,089	5,795
Piezoelectric		150	150	[e]150	153	163
Rose quartz		10,500	50,000	77,980	360,290	64,384
Smelting[e]		[3]1,334,000	1,000,000	1,000,000	1,000,000	1,000,000
Other ornamental		6,500	6,500	4,925	[e]5,000	6,578
Tourmaline		1,100	1,000	276	520	3,237
Salt, marine[e]	metric tons	30,000	30,000	30,000	30,000	30,000
Stone:						
Calcite, industrial[e]	do.	2,000	2,000	2,000	2,000	2,000
Dimension, marble, other[e]	do.	3,000	3,000	3,000	3,000	3,000
Marble, cipoline	do.	35	110	5	4	5

See footnotes at end of table.

TABLE 1—Continued

MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES[1]

(Kilograms unless otherwise specified)

Commodity[2]		1985	1986[e]	1987	1988[p]	1989[p]
MINERAL FUELS AND RELATED MATERIALS						
Petroleum refinery products:[e]						
Gasoline	metric tons	[3]454	[3]128	[3]425	451	[e]460
Kerosene and jet fuel	do.	[3]304	[3]116	[3]287	303	[e]310
Distillate fuel oil	thousand 42-gallon barrels	[3]598	[3]216	[3]560	664	[e]670
Residual fuel oil	do.	[3]729	[3]986	[3]813	979	[e]980
Other	do.	[3]30	[3]19	[3]48	96	[e]100
Total	do.	[3]2,115	[3]1,465	[3]2,133	2,493	[e]2,520

[e] Estimated. [p] Preliminary.
[1] Table includes data available through Nov. 8, 1990.
[2] In addition to the commodities listed, modest quantitites of unlisted varieties of crude construction materials (clays, sand and gravel, stone) presumably are produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.
[3] Reported figure.

by India and China. Other exported minerals are gold, beryl, monazite, and precious and semiprecious stones. Agriculture generates 80% of all export earnings, with the mining sector contributing only 3% of export revenue.

Total revenue from mineral exports in 1989 was approximately $28.7 million. Export tonnages of the major mineral commodities produced in 1989 were as follows: chromite, 134,338 tons; graphite, 15,221 tons; quartz, 585 tons; and mica, 357 tons.

STRUCTURE OF THE MINERAL INDUSTRY

The chromite industry is controlled by the parastatal Société Kraomita Malagasy. Graphite and mica production is owned and operated by foreign entities, but the Government exerts control of these operations in the form of taxes, royalties, and official approval of all foreign exchange transactions. OMNIS is primarily involved in research, joint ventures, and promotion of Madagascar's mineral potential.

Mining accounts for a small portion of the approximately 16% of the gross domestic product (GDP) contributed by industry, and employs less than 5% of the labor force. Artisanal mining of precious and semiprecious stones remains a significant part of production; however, black-market operations and smuggling prevents accurate governmental reporting.

COMMODITY REVIEW

Metals

Chromite.—Chromite deposits within Madagascar are in the northern part of the country, above the geologic delimiter separating younger Proterozoic rocks in the south from the older Archean rocks in the north. The three main districts where chromite is found are Andriamena, Ranomena, and Befandriana. Chromite ore grades in the three areas range from 31.4% to 45.0% Cr_2O_3, with Andriamena the main area mined. Chromite ore is normally found within calc-ferromagnesian rocks of the Andriamena complex, which is centrally located within four large synclinorial ranges. These ranges are separated and delineated by granitic migmatites, derived from shield rocks with an age of 3.2 billion years. The Andriamena complex of rocks is comprised of basal, stratiform, silicoaluminous rocks and an upper formation comprised of mafic to ultramafic eruptive rocks. This upper formation is where the chromite ore is generally confined, within either stratified lopoliths containing rocks ranging from anorthosites to peridotites, or as single small lenses or bands of chromite. Chromite reserve estimates for the Andriamena complex are 7.4 million tons. The Andriamena complex is comparable in geological setting with the Bushveld complex of the Republic of South Africa and the Stillwater complex of the State of Montana in that they are all of similar geologic age and contain important accumulations of chromite and platinum within norite and bronzite igneous rocks. Additionally, both Andriamena and the Bushveld contain traces of graphite.[2]

Decreased stainless steel production in 1989 and early 1990, exacerbated by declining global ferrochromium prices and the need for modernization of Madagascar's mining sector, have led to lowered chromite production in recent years in Madagascar. In an attempt to forestall the chromite decline, France granted a loan for approximately $995,000 to Kraomita for the modernization of Madagascar's chromite mining and treatment plant. Additionally, the French agency Bureau de Recherches Géologiques et Minières (BRGM) signed an agreement with OMNIS for the exploration, exploitation, and marketing of chromite, platinum-group metals, and associated sulfides from the Andriamena district.

Gold.—Madagascar contains some scattered gold deposits and a large black market for the mining and sale of gold. The Government officially reports only a few kilograms of production annually. However, production is not significant on a global scale. Total actual production could be 135 kilograms annu-

TABLE 2

MADAGASCAR: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity (metric tons per year unless otherwise specified)
Chromite	Kraomita Malagasy (Government, 100%)	Andriamena	175.[1]
Graphite	Etablissements Gallois (private—French, 100%)	Artsurakambo Mine, Brickaville Marovintsy Mine, Vatomandry	4,800. 3,600.
Do.	Societe Miniere de la Grande Ile (Societe Participation Industrielle et Miniere, France, 100%)	Ambatomitamba Mine, Tamatave	6,000.
Do.	Etablissement Izouard (private—French, 100%)	Faliarno Mine, Moramanga	2,000.
Mica	Societe des Mines d'Ampandrandava (Societe Participation Industrielle et Miniere, France, 100%)	Ampandrandava Mine and Sakamasy Mine	600 phlogopite. 600 phlogopite.

[1] Million metric tons per year.

ally, two to three times the official number owing to smuggled gold. On October 10, 1989, the Government lifted official price controls on gold. This action opened the way for private gold mining to resume in Madagascar after a hiatus of 14 years. France had given the Government a grant of $1 million for gold exploration.

Titanium.—The Canadian firm QIT-Fer et Titane Inc., a subsidiary of RTZ's BP Minerals and OMNIS, had formed a joint-venture company, QIT-Madagascar Minerals, to exploit the ilmenite sands near Toalagnaro (formerly Fort Dauphin). The Madagascar scheme was owned 49% by QIT and 51% by OMNIS. The resource is high grade at 60% TiO_2. Though QIT plans to follow through with development of the project, by late 1989 the project was indefinitely postponed. The main reason for postponement was a lack of adequate electricity required for the mining project. As of October 1990, OMNIS was still considering the mining and export of the TiO_2 sands of Toalagnaro. An environmental assessment was underway, but the total mineral project cost still had to be determined. The purpose of the assessment was to help determine project design. Consultants are providing technical assistance to OMNIS. Actual production may not take place until 1994.

Industrial Minerals

Graphite.—Madagascar remained an important producer of high-quality flake graphite throughout the 1980's. Production tonnage was small to modest by world standards. Geologically, Precambrian sediments within the Manampotsy, Ambatolampy, and Ampanihy mining districts were subjected to metamorphism, which brought about the formation of the graphite. The Manampotsy and Ambatolampy districts are on the eastern slope of the central highlands of Madagascar and have been subjected to intense weathering. These two areas have accounted for virtually all of the past production of flake graphite in Madagascar. Expensive processing, poor concentrate grades, and lack of adequate infrastructure have hindered the development of the hardrock graphite deposits of the Ampanihy mining district located in southern Madagascar.

Mineral Fuels

Petroleum.—Domestic sources of hydrocarbons remained an elusive solution for Madagascar's increasing energy consumption. No drilling activity had been reported in 1989 and 1990. The last activity reported was the January 1988 announcement by Petro-Canada International Assistance Corp. of a discovery of natural gas and condensate at the wildcat West Manambolo-1 well from two sand reservoirs of Cretaceous age. New tracts were open for exploration in 1989 and 1990. Acreage under license for exploration practically doubled in 1989 to 83,423 square kilometers (km^2). Shell Oil increased its holdings to 55,475 km^2 with the addition of three new onshore tracts, the Karoo Corridor, Majunga North, and the Majunga Central. Amoco reduced its onshore coverage from approximately 36,000 km^2 to about 28,000 km^2. Onshore exploration geophysics totaled 615 kilometers (km) of seismics for 1989. Shell Oil completed 500 km of this total, with 4,500 km left to be completed in its seismic program on the Majunga tracts.

Broken Hill Petroleum of Australia signed an 8-year exploration agreement with OMNIS in February 1990. Exploration will be carried out over a 25,000 km^2 concession, offshore of the northwest coast of Madagascar. The initial 3 years of the 8-year program were for data acquisition, processing, and geological interpretation of 5,000 line km of seismic surveys. One wildcat oil well is planned to be drilled.

Reserves

The Government stated that Madagascar has significant deposits of chromite, ilmenite, coal, bauxite, iron ore, and bastnasite. Graphite deposits and pegmatite deposits and minerals typical of these deposits have been historically exploited.

INFRASTRUCTURE

Electrical production capacity in 1989 was 119,000 kilowatts. Railroads totaled 1,020 km of 1-meter gauge track. The road system totaled 40,000 km, including about 4,700 km of paved roads and 800 km of crushed stone, gravel, or stabilized earth roads, with the remainder improved or unimproved earth. Irrigation infrastructure remained one of the most developed in Africa.

OUTLOOK

The decade of the 1990's should be critical for Madagascar because representatives for either conservation or development will attempt to direct national policy. There are indications that previous environmental problems must be addressed before new lenders will participate in new mining development projects.

Poor transportation and electrical power infrastructure will continue to prevent major mineral development in the short term.

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[1] Where necessary, values have been converted from Madagascar francs (FMG) to U.S. dollars at the rate of FMG1,603.5 = US$1.00.

[2] Biemesderfer, G. K., Chromite and Other Strategic Minerals in the Republic of Madagascar, U.S. Trade and Development Program, Order No. TDP-86-PG-03, Washington, DC 20523, Sept. 1986, 31 pages.

OTHER SOURCES OF INFORMATION

Agencies

Direction des Mines et de l'Energie
Ministere de l'Industrie et du Commerce
Ambohiday, 101 Antananarivo

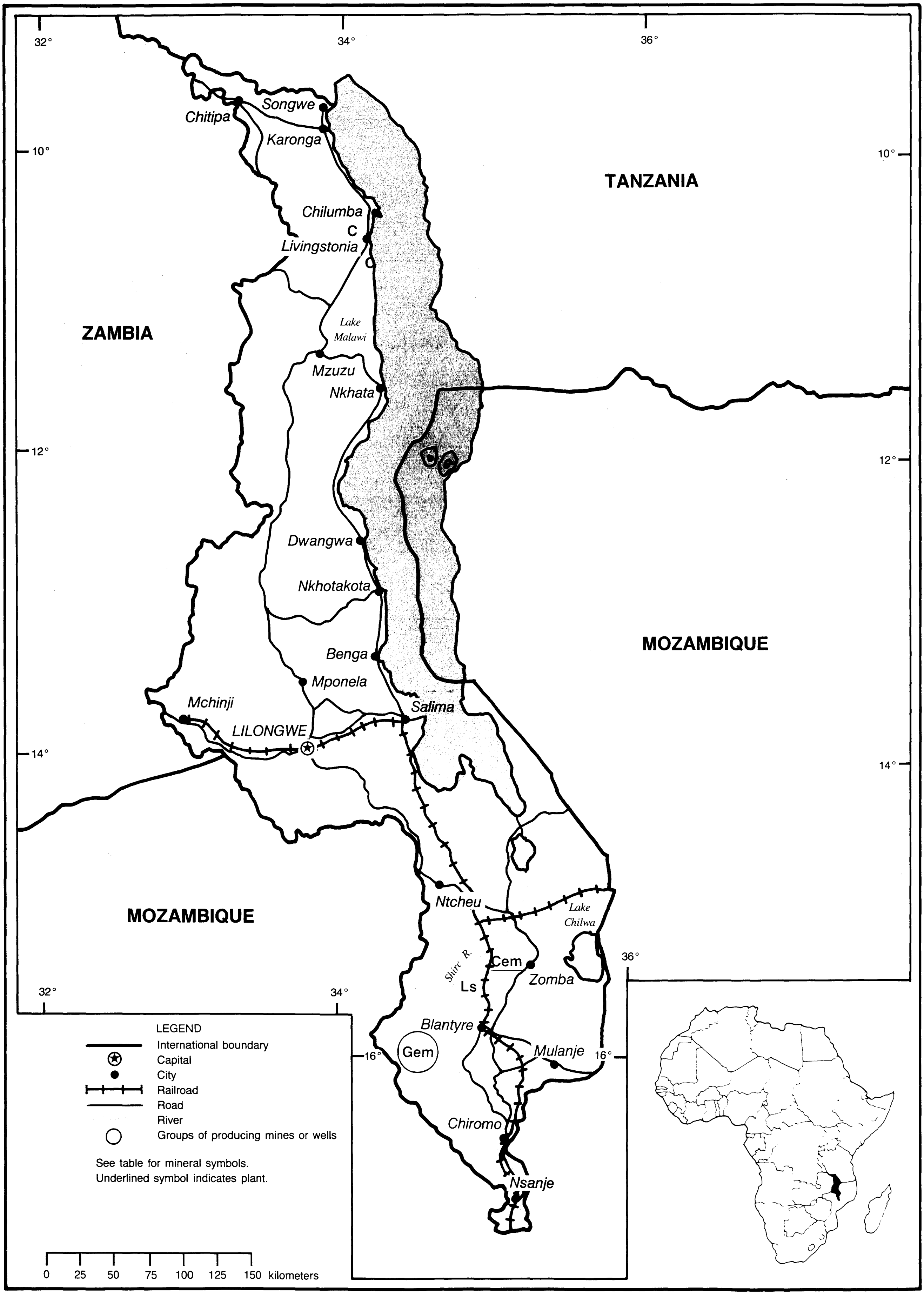
Office Militaire National pour les Industries Strategiques
(OMNIS)
21 Lalana Razanakombana
B.P. 1 bis, 101 Antananarivo

Publication

Ministere des Finances et du Plan, Direction de L'Institut National de la Statistique et de la Recherche Economique, B.P. 485, Antananarivo: Bulletin Mensual de Statistique (bimonthly).

MALAWI

AREA 119,000 km² **POPULATION 9.2 million**



THE MINERAL INDUSTRY OF

MALAWI

By Audie L. King

Mining, mainly in support of the construction industry, remained a relatively insignificant part of Malawi's economy. It accounted for less than 1% of Malawi's gross domestic product (GDP) in 1989. Although a wide variety of mineral deposits have been discovered in Malawi, only limestone for cement production and crushed stone; coal, which is also used for cement production; and minor quantities of gem stones are being mined at the present time.[1]

Malawi's economy grew by a real 4% to 5% in 1989. This was the second consecutive year of economic growth following several years of poor performance. The turnaround in Malawi's economic fortunes can be attributed to better crops following the 1987 drought and to recent adjustments made to the Government's policies on trade and industrial development.

Agriculture, mostly of a subsistence nature, was the most important sector of the economy, accounting for 37% of the GDP and more than 75% of employment.

GOVERNMENT POLICIES AND PROGRAMS

The Malawian Government has drafted a new investment code with tax and duty incentives to encourage foreign investment in manufacturing. Royalties, dividends, profits, loan capital, and a portion of personal earnings may be repatriated without restriction, though such actions must be reported. There were no laws mandating the reinvestment of any portion of profits in Malawi. Since the new code was implemented in March of 1988, the real GDP had grown by 4% per year.

The Government drafted a 500-page document entitled "National Energy Plan." It expressed concerns over widespread deforestation and the fear of being cutoff from its energy source.

PRODUCTION

Malawi's economy has emerged from a crisis in the early 1980's that adversely affected the mining industry. Business confidence was strong, and the economy grew slightly faster than the population growth in 1989. Government spending was under control, and inflation was less than 10% for 1989.

TRADE

Malawi's exports consisted mostly of tea, tobacco, and other primary commodities. A very small quantity of gem stones was the country's only mineral export. Imports consisted mostly of fuel, fertilizer, chemicals, and machinery.

In 1987, the last year for which such data were available, Malawi's total exports were $278.4 million, of which 23% went to the United Kingdom, 11% to the Republic of South Africa, 11% to the United States, 10% to the Netherlands, 9% to West Germany, and 9% to Japan. Malawi's imports were $177.5 million, of which 35% came from the Republic of South Africa, 20% from the United Kingdom, 6% from Japan, 5% from West Germany, and 3% from the United States.

STRUCTURE OF THE MINERAL INDUSTRY

The Mining Investment and Development Corp. (Midcor) was formed in 1985 with a priority of developing coal mines. It presently operates the Kaziwiziwi Mine in the northern district of Livinstonia that produced 18,256 tons in 1987 and 35,296 tons of coal in 1988, the latest year for which production data were available. Midcor hopes to increase production to 50,000 tons per year, but known reserves will be exhausted in 3 to 5 years. The Kaziwiziwi coal mine employed an average of 264 people in 1988. The Mchenga Mine, operated by Midcor since April 1988, produced 4,071 tons of coal in 1988 and employed 53 people.

The Portland Cement Co. has mined limestone at Changalumi, near Zomba, in southern Malawi since 1960. It produced 65,597 tons and employed 706 people in 1988, the latest date that such data were available. In 1987, it produced 72,834 tons.

The Gem Co. of Malawi produced 285.1 grams of ruby and 811 grams of

TABLE 1

MALAWI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic		61,654	69,471	72,831	65,597	70,000
Coal		4,000	10,708	18,256	39,376	40,000
Stone: Limestone for cement		[e]100,000	103,037	107,040	105,000	105,000
Gem stones: Ruby and sapphire[e]	grams	1,000	1,000	1,000	[3]1,096	1,000

[e]Estimated. [p]Preliminary.
[1]Includes data available through Oct. 23, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

sapphire from the Chimwadzulu Mine in 1988. The mine employed about 65 people.

COMMODITY REVIEW

Metals

A uranium mine was being developed at Kayelekera in northern Malawi, west of the town of Karonga, by the British Central Electricity Board (CEGB). CEGB had invested $2.8 million in exploration and estimated that $18 million more would need to be spent to get the mine on-line. Once operational, it was estimated that 2,000 to 4,000 tons of uranium ore would be processed into yellowcake per year on site. Environmental impact on the water supply still needed to be investigated.

Industrial Minerals

Cement.—The cement plant at Changalume was being renovated in 1989 to overcome production bottlenecks that have caused production to fall in the past few years.

The Mines Department, in cooperation with the Intermediate Technology Group (Itdg) of the United Kingdom, tested a new simple vertical shaft kiln at Balaka, near Zomba.

Gem Stones.—One hundred and sixteen nonexclusive prospecting licenses were issued for semiprecious stones in 1988, the latest date that such data were available. One hundred and five were issued in 1987. The Malawi Export Promotion Council conducted a gem stone production and marketing survey during the year with the view to promote the industry.

Gypsum.—The Department of Mines started a pilot gypsum mine at Mponela. The product was reported to be good enough in quality to be used in small-scale industries.

Lime.— Midcor was to receive a mining licence from the Government to produce lime and aggregate from a proposed 2.75-square-kilometer quarry in Bwanje Valley in Ntcheu District. The project was expected to cost $1.7 million, and construction was expected to be completed in 1991. The Government was expected to take 40% equity in the project. The market was estimated to be 15,000 tons per year, but initial production was expected to be 6,000 tons, of which 4,000 tons would be lime and 2,000 tons would be aggregate. Lime is presently imported from Zambia and the Republic of South Africa for use in water treatment, construction, and sugar manufacturing. The new Malowa Hill quarry should be able to meet domestic demands.

Mineral Fuels

Coal.—Exploration and drilling continued at the Mwabvi coalfield in the Nsanje District. Drilling was locally funded and was a followup to the French funded preliminary exploration program that was undertaken jointly by the Bureau de Recherches Geologiques et Minieres (BGMR) of France and the Geological Survey Department (GSD) of Malawi. Owing to the strategic nature of the coal deposit it was expected that further French-funded exploration would be conducted by BGMR. Plans were for the Canadian engineering firm, Bullock Engineering Corp., to supervise the project. The GSD would monitor the progress of the project for the Government.

Geologic mapping was completed in the coal-bearing North Karroo Sedimentary Basin, southwest of Karonga. These maps will serve as a basis for future exploration programs that were as yet unplanned.

Petroleum.—The Government had indicated that it would like to resume talks with Mobil Oil Corp. on exploration for oil on Lake Malawi and in the lower Shire Valley. Negotiations fell through on the issue in 1988 owing to low petroleum prices.

Reserves

The limestone deposit at Changalumi in southern Malawi was estimated to contain 100 million tons of material that was suitable for cement production.

The Kaziwiziwi coal deposit in northern Malawi had minable reserves that were estimated to be 150,000 tons. At present production rates, this deposit will be exhausted in 5 or 6 years. The Nkana Field, a larger deposit of poorer quality coal on the Tanzanian border, is reported to contain between 1.7 and 14 million tons of coal in a seam that is about 1 meter thick. The reserve potential of the Longwe and Mwabi coal deposits in the lower Shire Valley north of Chiromo are currently being investigated.

Malawi also contained significant deposits of other minerals that had not yet been exploited. An apatite deposit at Tundulu at the southern end of Lake Chilwa contained 1.25 million tons of rock that averaged 15% P_2O_5. The Kangankunde carbonatite complex, about 75 kilometers (km) north-northwest of Blantyre, was reported to contain 11 million tons of material that ran 8.4% $SrCO_3$ and 1.9% rare-earth oxides. A 28.8-million-ton bauxite deposit occurs on the Mulanje syenogranitic massif, 25 km northeast of Mulanje. The bauxite averaged 4 to 5 meters in thickness and covered 5.2 square kilometers. China clay, corundum, dimension stone, graphite, silicon sand, uranium, and vermiculite deposits had also been investigated but not yet exploited. Exploration for chromite, gold, gypsum, petroleum, rutile, and salt has been conducted in recent years.

INFRASTRUCTURE

Malawi was almost totally dependent on South African transport routes for its export trade. More than 80% of all export goods was shipped via road and rail to the Port of Durban, more than 3,500 km away. Most of the remaining exports were shipped to Dar es Salaam, Tanzania. The traditional export routes to Beira and Nacala in Mozambique had been virtually closed since 1985. These transportation difficulties had made Malawi's external transportation routes one of the most expensive in the world. It was ranked the second most expensive by the African Development Bank (ADB). It was estimated that Malawi lost more than $100 million in 1989 owing to higher transportation costs, equivalent to 34% of the country's total export earnings. In an effort to lower transportation costs, a permanent road link with Tanzania was being established with the help of foreign aid from many countries, including the United States. Repairs were also being made on the rail link to Nacala. Under an agreement with Mozambique, Malawi consented to provide military protection from the border to Malema, Mozambique, when the Nacala line is opened.

Domestic trucking capacity was insufficient to meet demands. Critical distribution needs such as the transport of crops and the timely distribution of fertilizer were not met. The domestic rail system also experienced difficulties caused by the shortage of spare parts and railroad cars.

Kier International, part of the United Kingdoms's Beazer National Construction Co., began repairs on a 80-km road linking Lilongwe and Salima. The project will take 30 months. Bids were being evaluated on the renovation of 130 km of Route S53 between Dwangwa and Nkhata.

Import and export traffic increased by 42% to 960 thousand tons. This was owing mainly to increased imports of maize to feed an estimated 800,000 refugees from Mozambique. The Durban Port continued to handle the largest share of trade; however, trade through the port at Dar es Salaam increased by 77.5% in 1989. The importance of the northern route was expected to increase in 1991 when most of the facilities on the Northern Corridor are completed. Exports through Mozambique remained very small.

There was 2,662 km of paved roads, 334 km of gravel roads, and 9,219 km of dirt roads in 1988, the last year that such data were available. There were major airports at Lilongwe, Chileka (near Blantyre), Mzuzu, and Karonga and smaller airports at many other cities throughout the country.

In 1987, the last year such information was available, the Government reported that an average of 296 people were employed in the mining sector. This was less than 1% of the total of 407,393, which consisted of 316,359 in the private sector and 91,034 in the Government.

OUTLOOK

For the present, the health of Malawi's mineral industry, which was almost exclusively involved in supplying raw materials to the domestic construction industry, is dependent on the expansion of the country's economy. The long-term future of the mineral industry looks bright. A wide range of undeveloped mineral deposits have been discovered in recent years, and the Government seems willing to cooperate with foreign agencies that have been offering technical and financial support in the areas of exploration and mineral processing. Development of new mines and process plants will diversify and expand the overall economy, but the mining sector will probably not become a major contributor to the nation's GDP.

Malawi's economy will continue to be dependent on foreign aid and on the agricultural sector, which is vulnerable to fluctuations in world commodity prices, insect infestations, and adverse weather conditions. The country's resolve in improving its internal and external infrastructural problems will in large measure determine its future economic expansion. Easing of political tensions in Mozambique and the subsequent reopening of Malawi's traditional trade routes would be highly beneficial to the country's external finances. Stability in the region would stimulate growth in all sectors of the economy, including the energy and mining sector. The high military cost of maintaining the newly reopened rail link through Mozambique to Nacala will not substantially lower the cost of transportation of the country's exports and imports. The expected completion, in the next few years, of improvements to the transportation link to Dar-es-Salaam will give Malawi the added security of an alternative to the costly South African Port of Durban.

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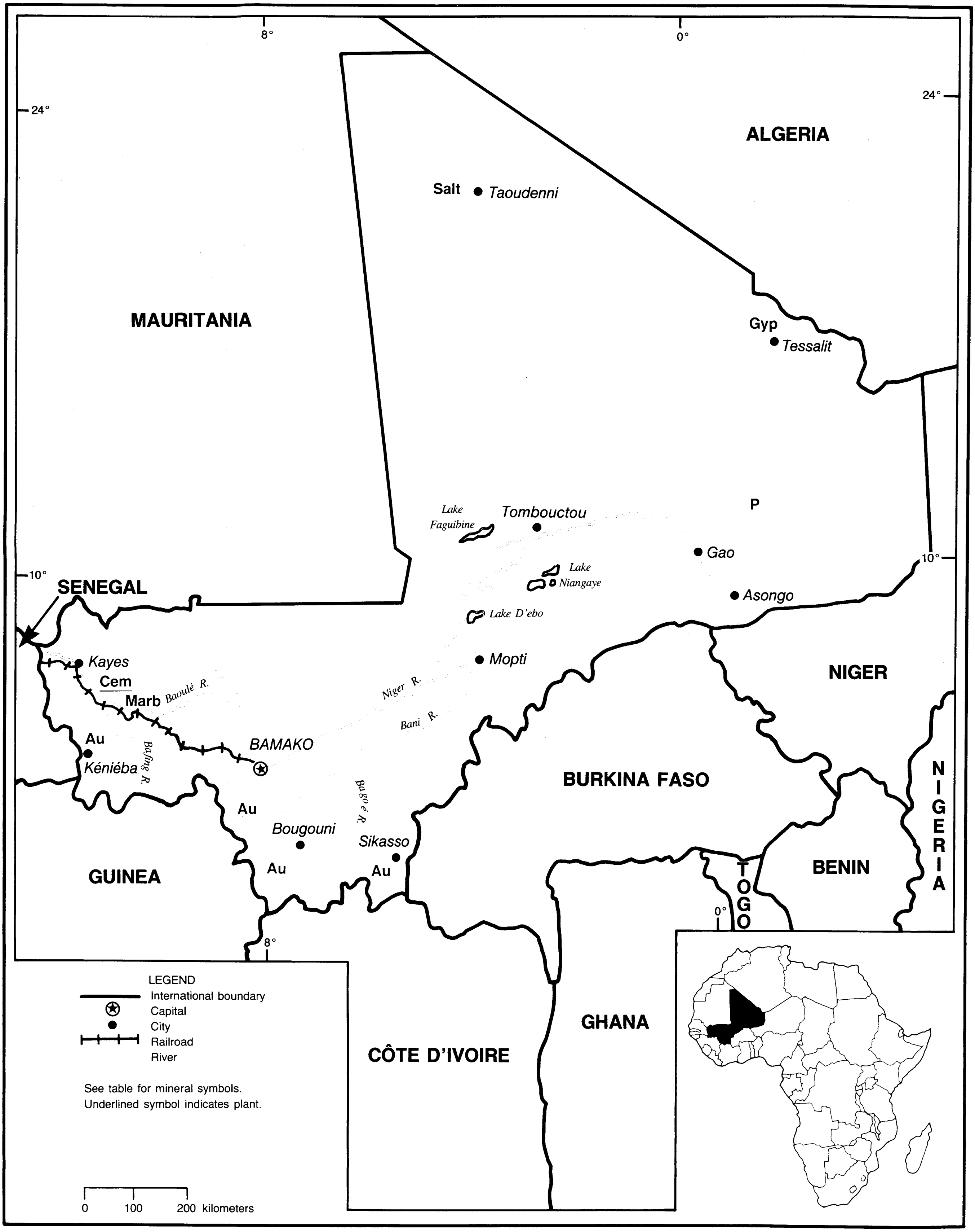
[1]Where necessary, values have been converted from Malawian kwacha (MK) to U.S. dollars at the rate of MK2.63 = US$1.00

MALI

AREA 1,241,232 km² **POPULATION 8.1 million**



THE MINERAL INDUSTRY OF

MALI

By Hendrik G. van Oss

The mineral economy of Mali in 1989 was dominated by the production of gold, although small quantities of construction materials, gypsum, marble, phosphate, and salt were also produced. The mining sector accounted for about 2% of the country's gross domestic product (GDP), or about $40 million;[1] gold made up almost 93% of this. Despite its modest contribution to the GDP, mining made an important contribution to the country's foreign exchange; gold accounted for 14% of Mali's total exports and was the third largest export after cotton and livestock.

Mali's gold production was from two formal mines, one of which began production in January 1990, and from small-scale semi-industrial and artisanal operations. In terms of value, output of other mineral commodities was insignificant compared to gold.

Mali has a wide variety of mineral deposits; most of these are uneconomic because of a lack of infrastructure. The best English reference on Mali's geology and mineral resources was published as a joint project of the Government and the United Nations Development Program (UNDP).[2]

The geology of Mali is dominated by Precambrian rocks in the southwestern and central parts of the country, and Paleozoic to Cenozoic rocks over the remainder. By far the most important rocks economically are a number of north-to-northeast-trending belts of Proterozoic granitic rocks and greenstones, the latter belonging to the Birimian Series, which occur in the west and southwest, especially near Kéniéba, Bougouni, and Sikasso. The Birimian rocks in these areas, in common with similar rocks in Burkina Faso, Côte d'Ivoire, Ghana, Guinea, and Senegal, have gold deposits. Most of these are associated with shear zone-related iron sulfide-rich rocks, including quartz veins. Near Kéniéba, the Precambrian terrane also hosts diamond-bearing kimberlites; these have proven not to be of economic grade. Iron ore deposits are also known in this area, as are large, but low-grade, bauxite deposits. South-southeast of Gao, a relatively small area of Birimian rocks host a large but presently uneconomic manganese deposit.

In northeast Mali, overlapping into Algeria, Precambrian granitic and volcanic rocks are exposed in the Adrar des Iforas. A wide variety of minerals have been found in this region, including copper, gold, tin, uranium, and zinc. The remoteness of the area has made exploration very difficult and would make economic exploitation of most of the deposits prohibitively expensive.

The Paleozoic and younger sedimentary rocks, particularly in northern and eastern Mali, host a number of industrial mineral deposits, some of which are exploited on a small scale. Limestone deposits in western Mali are also exploited to a limited degree.

GOVERNMENT POLICIES AND PROGRAMS

The mining sector, particularly gold, is viewed by the Government as having the greatest growth potential of any sector of the Malian economy, especially in terms of generating foreign exchange. The Government encourages foreign private investment in this sector, and, in an effort to encourage such investment, has sought to improve the availability and quality of information about the country's geology and mineral resources. One manifestation of this has been the cooperation with the UNDP, which has had a decade-long program of resource evaluation in Mali, including regional systematic geochemical sampling. One successful outcome of this program was the discovery of the gold anomaly that was later developed into the Syama Mine. As part of the UNDP program in Mali, a modern exploration facility has been set up and staffed in Bamako, consisting of a modern assay laboratory, and exploration equipment, including four-wheel drive vehicles and drill rigs. This facility is available to the international mining community, both for work in Mali and elsewhere in West Africa.

The basic mining law of Mali is the Mining Code, Ordinance No. 34/CMLN of September 3, 1970, as modified by Decree No. 112/PG of September 3, 1970, and by Order No. 65/MDITP, January 28, 1971. Later modifications include that of Article 48 of the Mining Code by Law No. 81-80/An-RM of July 13, 1981, and of Article 8 of the Mining Code by Ordinance No. 90-07/P-RM of April 13, 1990. This last ordinance formalized the artisanal mining sector. In 1989, the Government was investigating how to improve the mining code to attract more foreign investment in the country. It was believed a new code, perhaps incorporating provisions of recently negotiated mining agreements, would be drafted within 1 or 2 years.

Petroleum exploration and exploitation are regulated by Decree No. 30 of May 23, 1969, and by Decree No. 21, April 20, 1970. The current Investment Code is Law No. 86-39/An-RM of March 8, 1986; this replaced and abrogated the 1976 Investment Code.

Mining is regulated by the Direction Nationale de Géologie et des Mines, which is part of the Ministry of Industry, Hydraulics and Energy.

PRODUCTION

Production of most mineral commodities was essentially unchanged in 1989 except for gold, output of which increased modestly. Almost 90% of the gold output was from artisanal and a few small, semi-industrial operations. The largest single gold producer in 1989, as in previous years, was the Kalana Mine, output from which fell 17% to about 400 kilograms (kg), two-thirds of that expected. Malian gold production was expected to increase by about 70% in 1990 because of the startup in January 1990 of production from the Syama Mine.

TRADE

Mali's mineral commodity trade

TABLE 1

MALI: PRODUCTION OF MINERAL COMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic		19,005	20,000	22,000	25,000	20,000
Gold: Mine output, Au content[e] [3]	kilograms	[r]600	[r]725	[r]950	2,650	[4]3,000
Phosphate rock[e]		[4]7,047	[4]3,452	[4]8,092	10,000	10,000
Salt[e]		4,500	4,500	4,500	4,500	[4]5,000
Stone: Marble		769	750	200	155	155
Gypsum[e]		300	300	600	720	700
Silver[e] [5]	kilograms	34	31	34	50	24

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

[1]Includes data available through Oct. 24, 1990.

[2]In addition to the commodities listed, Mali produced clay, stone, sand and gravel for local construction purposes, but information is inadequate to make reliable estimates of output levels.

[3]Includes estimate (Government estimate 1988 and 1989) of artisanal production and may include some gold smuggled into Mali. The Kalana Mine accounted for about 60% of total output in 1985; 30% in 1986; 35% in 1987; 18% in 1988; and 13% in 1989.

[4]Reported figure.

[5]Estimated output from Kalana Mine only.

consisted mainly of exports of gold, and imports of petroleum products, cement, and fertilizers. Mali's international trade is by rail to the port facilities at Dakar, Senegal; and by truck to Abidjan, Côte d'Ivoire; Lomé, Togo; and Cotonou, Benin.

Mali's gold exports in 1989 were worth about $37 million or about 14% of the country's total exports. Gold was the third largest export commodity behind cotton and livestock, exports of which were worth about $95 million and $75 million, respectively. Despite a higher level of output, the value of the gold exports remained essentially unchanged from 1988 because of lower world gold prices in 1989.

Mali was entirely dependent on imports for the country's petroleum products needs. In 1988, the latest year for which data are available, these imports amounted to about 1.1 million barrels, worth about $60 million, or about 12% of total imports. Cement imports were worth about $3.5 million, and fertilizer imports were worth about $3 million.

Most of Mali's mineral commodity imports are transshipments through Côte d'Ivoire and Senegal, although a significant proportion of petroleum product imports are also trucked in from Togo and Benin. There was no significant trade in mineral products between the United States and Mali.

STRUCTURE OF THE MINERAL INDUSTRY

Mali's formal mining sector was dominated by gold production from one mine in 1989 and two in 1990. In addition, there was production of gold by small, semi-industrial operations and by artisanal miners. Gypsum, marble, phosphate, and salt were produced in limited quantities by one mine each. In addition, there were a number of small operations producing construction materials such as sand and gravel and stone.

Only about 1% of Mali's total labor force of approximately 2.6 million is in industry. The formal mining industry employs approximately 1,000 persons, of whom about 400 are employed by the gold mines. The number of artisanal miners, many of whom work only part-time, is not known, but is estimated to be in the range of 6,000 to 8,000 persons.

COMMODITY REVIEW

Metals

In March 1989, the Government concluded an agreement with BHP-Utah International Inc. for the development of the Syama gold deposit, about 75 kilometers (km) southwest of Sikasso. The deposit was expressed by one of the gold anomalies discovered by the UNDP during a 1983–85 program of exploration of the Bagoé River region. BHP-Utah International was granted a concession to the area in early 1987, and subsequent exploration led to a favorable production decision at the end of January 1989. The deposit consists of open pit minable reserves of oxide ore and underlying sulfide ore, as well as deeper sulfide reserves that would require underground mining. The oxide reserves were sufficient for a 3-year operation, using a carbon-in-leach circuit to treat 2,000 tons per day. Planned gold output was about 2,200 kg per year, contained in doré. Geotechnical and additional reserve-delineation drilling was done in 1989. Site preparation and mill construction were underway by September, and mining commenced toward yearend. The first doré was poured in mid-January 1990, and the mine was formally inaugurated April 19, 1990.

A production decision for the development of the sulfide reserves at Syama was expected toward yearend 1990. Initial mining of the sulfide reserves would be by deepening the existing oxide ore pit, with subsequent mining taking place underground. It was expected that a roasting circuit would be needed to process the sulfide ore, which is highly refractory. Apart from the capital costs involved in installing a roaster, a significant factor in

TABLE 2

MALI: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location	Capacity[1]
Cement	Société des Ciments du Mali (majority Government-owned)	Cement plant at Diamou, about 50 kilometers southeast of Kayes	50,000.[e]
Gold	Société de Gestion et d'Exploitation des Mines d'Or de Kalana (Government, 100%)	Kalana underground mine, 110 kilometers southwest of Bougouni	600.[2]
Do.	Société des Mines de Syama (BHP-Utah International Inc. of the United States, 65%; Government, 35%[3])	Open pit gold mine at Syama, 75 kilometers southwest of Sikasso	2,240[2] gold.
Gypsum	Plâtre de Tessalit, (Government,[5] 100%)	Gypsum mine near Tessalit, 450 kilometers north of Gao	1,000.[e]
Marble	Marbre de Sélinkégni[5] (Government, 100%)	Marble quarry at Sélinkégni, 80 kilometers southeast of Kayes	200.[e]
Phosphate	Phosphates du Telemsi (Government,[5] 100%)	Tamaguilelt Mine, 205 kilometers north of Ansongo	25,000.[e]
Salt	Sel gemme de Taoudénit (Government,[5] 100%)	Taoudénit salt mine, near Taoudenni	6,000.[e]

[e]Estimated.
[1]Metric tons per year unless otherwise specified.
[2]Kilograms per year from 2,000 tons per day of ore.
[3]Assumes that the Government fully exercises its option to increase its holdings from its initial 15%.
[4]Operated by Société Nationale de Recherches et d'Exploitation des Ressources Miniéres du Mali (SONAREM).
[5]Beginning in 1990, the Sélinkégni marble deposit will be mined by Mali Marbre, a joint venture of Belgian company Institut Nationale Belge des Industries Extractives and Torrence Ltd. of the United Kingdom, combined 51%; SONAREM, 20%; and miscellaneous Malian nationals, 29%. Capacity is to be increased to 5,000 tons per year.

the development decision was expected to be the high cost of fuel in Mali.

In June 1989, Sikaman Gold Resources Ltd. of Canada completed the first phase of an exploration program on a gold property near Kéniéba. The property was a sublease of a portion of a large concession held by Victory Exploration Corp., a subsidiary of Bermuda-registered Trans-African Mining Ltd. Work on the property, including shallow drilling, identified a gold-mineralized quartz vein system that was tracable for about 5 km along strike. Sikaman reported gold grades of 2 to 4 grams (g) per ton over widths of 4 to 8 meters within this zone. Additional exploration work was planned for 1990.

Reserves

Mali is a well-mineralized country,[2] although mineral exploration and development have been hindered by the lack of infrastructure, which alone renders most of the deposits uneconomic. Reserves have been delineated only for certain gold deposits, and a few deposits of industrial and construction minerals. In addition, resources have been delineated for bauxite, iron, and manganese.

Total gold reserves are not well known, having only been delineated for a few deposits. It is likely that additional reserves will be discovered. According to BHP-Utah International, the proven oxide ore reserves at the Syama Mine at yearend 1989 were 2.1 million metric tons (MMmt) grading 3.7 g of gold per ton. These reserves were sufficient for a 3-year open pit operation. There is, in addition, a modest amount of oxide ore in some small satellite deposits. Below the oxide ore, there are reserves of open pit minable mixed oxide-sulfide and sulfide ore of 2.5 MMmt grading 5.5 g of gold per ton. Indicated deep sulfide ore reserves, which would require underground mining, are 4.5 Mmmt grading 7.2 g of gold per ton.

Published reserves at the Kalana Mine at yearend 1984, when mining commenced, were approximately 1 MMmt grading 36 g of gold per ton. The ore consists of a number of largely sub-parallel quartz veins that have proven to have more variable grades than originally indicated. Gold output, totaling about 1,800 kg from the mine's startup at yearend 1984 through yearend 1989, has been much less than expected. Reserves are presently estimated by the company to be about 1.7 MMmt grading 15 g of gold per ton. The Kalana concession is believed to have potential for additional reserves, but these have not yet been well-delineated.

The only other gold deposits for which reserves are reasonably well known are the Loulo deposits, numbered 0 to 3, about 30 km northwest of Kéniéba. According to the Government, these contain a total resource of about 6.4 MMmt grading 4.38 g of gold per ton. The largest of the deposits is Loulo 0, which has about one-third of the total inventory. In late 1988, the Société Minière de Loulo, a joint venture between the Government, 51%; and COFRAMINES of France, 49%; was formed to exploit the property. The economic viability of the deposit had not been demonstrated as of yearend 1989.

Mali's phosphate resources are in the southeast part of the country, and have been delineated only for the Tamaguilelt deposit, which is being mined. According to the Government, reserves of this deposit total about 10 MMmt grading 31.4% P_2O_5. The potential of this region for additional reserves is high; reportedly, the phosphate-bearing formation can be traced for more than 400 km along strike.

Mali has large deposits of limestone and dolomite, some of which are suitable for cement and others which are suitable for ornamental stone (marble). Most of the deposits are uneconomical because of a lack of transport infrastructure or local markets. The cement plant at Diamou exploits the Gangontéry I deposit. At the time the cement plant started production in 1969, the deposit had reserves of about 7 million tons of limestone; about 500,000 tons have been mined to date. There is an additional deposit nearby, reportedly of somewhat lower quality, that has proven plus probable reserves totaling almost 60 MMmt. The Sélinkégni marble deposit has approximately 10.5 MMmt of reserves suitable for marble aggregate and tile, or for lime manufacturing.

The In Kereit gypsum deposit near Tessalit is being exploited on a small scale. According to Société Nationale de Recherches et d'Exploitation des Ressources Minièrees du Mali (SONAREM), the reserves of this deposit are approximately 370,000 tons. At Taoudénni, about 35 MMmt of gypsum have been delineated in evaporite beds. This area is being exploited for salt, reserves of which are estimated to total 53 MMmt.

Mali has a number of iron ore deposits, most of which are in western Mali and most of which are low grade. The best known of these is the Balé deposit, 200 km west-northwest of Bamako, just north of the Guinea border. According to SONAREM, the Balé deposit has a resource of 146 MMmt grading 50% to 60% iron, within a larger inventory of lower grade material.

The Ansongo manganese deposit, about 20 km southeast of Ansongo, contains a resource of about 3 MMmt grading in excess of 40% manganese, and 4.5 MMmt grading 30% to 40% manganese. Exploitation of this deposit will only be conceivable at such time as the Tambao deposit, 120 km to the southwest in Burkina Faso, becomes economic. A railroad to Tambao, from Kaya in Burkina Faso, is being planned by the Government of that country.

Western Mali contains a number of low- to medium-grade bauxite deposits. Tonnages range from 10 to 580 MMmt, and grades typically are in the range 20% to 48% alumina. None of these is currently economic, especially in light of higher grade deposits in Guinea.

No reserves of energy minerals have been established, although occurences of uranium mineralization, oil shale, and lignite are known.

INFRASTRUCTURE

In common with much of West Africa, Mali's transportation infrastructure is underdeveloped. The country's only railroad consists of a 642-km segment of the 1,286 km, 1-meter gauge line connecting Bamako with Dakar, Senegal. The line carried almost 45 million tons in 1988, the latest year for which data are available. Railroad service is subject to frequent and lengthy interruptions during the rainy season. Mali had 15,700 km of highways in 1989, of which about 11% were paved.

Mali's electrical generating capacity was 92 megawatts (MW) in 1989; the country's three hydroelectric plants accounted for 57 MW. The Sélingué plant, at 45 MW, is the largest plant, but commonly produces below capacity owing to drought-induced low water levels in its reservoir and an incomplete powerline network. The rest of Mali's electricity is generated by thermal plants. Mali's electricity production was 165 million kilowatt hours in 1989. The Mantantali Dam, about 250 km west of Bamako, was completed in 1988 and is to have a plant of 91-MW capacity. Mali is to receive about 50% of the output, with the rest going to Senegal and Mauritania. Owing to a dispute among these countries over routing of the transmission lines, installation of the generating equipment has been indefinitely delayed.

Both the Kalana and Syama mines had their own diesel generators; fuel for these was a major component of mining costs at both mines. Work was in progress to link the Kalana Mine to the Sélingué power grid.

OUTLOOK

Mali's mineral industry will continue to be dominated by the production of gold. The potential for the discovery and development of additional gold deposits is high. Limited local markets and a general lack of infrastructure will continue to hamper the development of the country's known resources of other minerals, except on a very modest scale.

[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF319=US$1.00.

[2]Direction Nationale de la Géologie et des Mines, 1987, Mineral Resources of Mali: United Nations UNDP/DTCD MLI/85/007 Project, 64 pp.

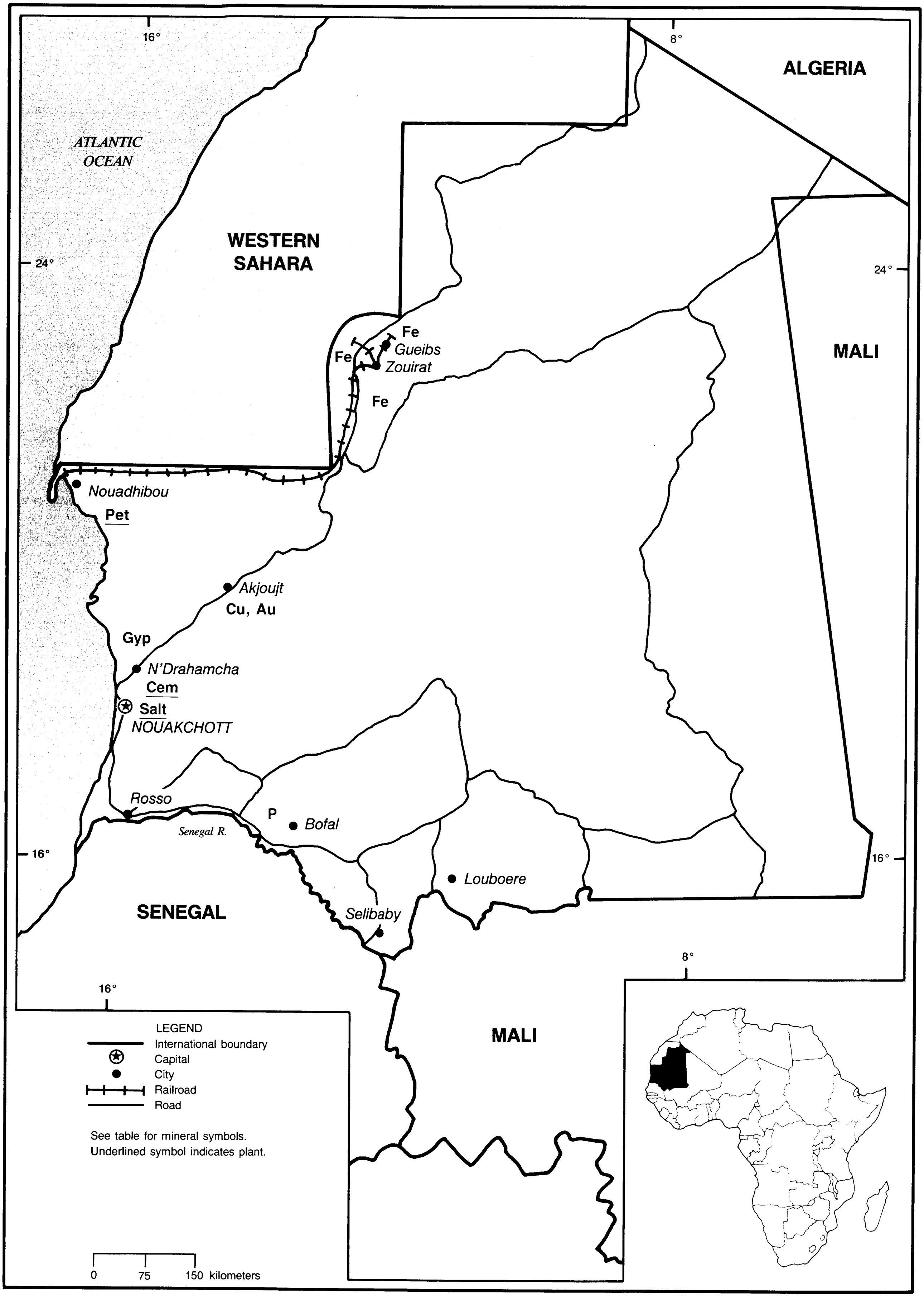
OTHER SOURCES OF INFORMATION

Direction Nationale de la Géologie et des Mines
B.P. 223
Bamako, République du Mali

Société Nationale de Recherches et d'Exploitation des Ressources Minières du Mali
B.P. 2
Kati, République du Mali

MAURITANIA

AREA 1,030,700 km² **POPULATION 1.9 million**



THE MINERAL INDUSTRY OF

MAURITANIA

By Bernadette Michalski

Mauritania has a resource-based economy sustained jointly by the fishing industry and the mining of iron ore. Each industry accounts for more than one-third to just under one-half of the nation's foreign exchange earnings, with the lead position fluctuating from year to year with variations in the world market price for iron ore. Interest has been shown in resuming copper mining operations near Akjoujt. This deposit was mined between 1970 and 1978, but actual reopening was postponed from a targeted 1989 startup date owing to contract negotiations.

Mauritania's external debt service obligations substantially exceeded payment ability. Public and private investment programs focused on fisheries, iron ore mining, intensified hydrocarbon exploration, and infrastructure development. The latter concentrated on more effective use of existing assets.

GOVERNMENT POLICIES AND PROGRAMS

The Government's new economic plan covering the period between 1989 and 1991 projected a growth rate of 3.5% annually by essentially continuing the program started in 1985, which helped to revitalize the economy.

To encourage exploration and development, a new petroleum code was adopted on November 11, 1988, updating and consolidating existing legislation. Included in the code was a guarantee that foreign companies holding a contract for hydrocarbon exploration and production may repatriate capital, dividends, and interests without the imposition of taxes on transferred funds.

PRODUCTION

Iron ore, produced solely by Société Nationale Industrielle et Minière (SNIM), continued to be Mauritania's principal mineral commodity with 1989 output reported at 12.11 million metric tons (MMmt) compared with 9.52 MMmt in 1988. Anticipated 1990 production was estimated by SNIM at 13 MMmt tons.

Output of refined petroleum products averaged more than 4,000 barrels per day, most of which was distillate fuel oil.

Evaporated salt is derived from the coastal lagoons north of Nouakchott, principally for the fishery industry. However, the level of output has not been reported, and the estimate of 5,500 tons annually merely represents a plausible level.

TRADE

Mauritania's mineral export commodities are iron ore and small quantities of gypsum and plaster products. Com-

TABLE 1

MAURITANIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
Cement[3]		—	—	80,000	90,000	90,000
Gypsum		5,470	18,060	19,402	20,000	[e]18,000
Iron and steel:						
Iron ore:[4]						
Gross weight	thousand tons	9,333	8,929	9,000	10,004	11,138
Iron content[e]	do	5,600	5,840	5,850	6,500	7,150
Metal: Semimanufactures		4,481	5,512	5,465	NA	NA
Petroleum refinery products	thousand 42-gallon barrels	—	—	300	2,000	1,515
Salt[e]		5,500	5,500	5,500	5,500	5,500

[e] Estimated. [p] Preliminary. NA Not available.
[1] Table includes data available through Sept. 1, 1990.
[2] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3] From imported clinker.
[4] Data represent reported gross weight of iron ore exports. Iron content is estimated to be 65%.

bined, these commodities accounted for more than one-third of all export earnings reported at $424 million in 1988. Iron ore exports in 1988 were reported at just over 10 MMmt, consisting of 8.75 MMmt of fines and 1.26 MMmt of lump ore, valued at $144 million.[1] In 1989, iron ore exports exceeded 11.1 MMmt, consisting of 9.68 MMmt of fines and 1.46 MMmt of lump ore, valued at about $190 million. The bulk of export shipments were to the steel mills of the European Community. France received 2.9 MMmt, and Belgium 2.6 MMmt, while Italy and the United Kingdom received 2.1 and 1.3 MMmt, respectively.

Mauritania enjoyed a number of advantages over most iron ore exporters, including the proximity of the Western European markets and the capacity to accommodate ships of 120,000 to 150,000 deadweight tons. Western Europe was the destination of 90% of exported fines and all lump ore from Mauritania between 1986 and the first half of 1990. During this period, other destinations included the United States and Japan.

Mauritania's expenditures on fuel and energy imports in 1988 were reported at $25 million, compared with $33 million in 1987 before operations at the country's sole refinery recommenced. Product imports in 1989 were 1.13 million barrels and accounted for 43% of consumption in that year; the remainder was supplied from the refining of imported crude oil.

COMMODITY REVIEW

Metals

Copper.—Production at the Akjoujt Mine, originally scheduled to start again at yearend 1989, was postponed owing to lack of agreement on major issues. The Mauritanian Government, the principal shareholder in the operation, wanted underground mining to resume, in addition to the processing of copper and gold-bearing tailings. However, primary investor interest was in reworking the tailings and avoiding a more costly underground mining operation. Output ceased in 1978 owing to technical problems, with the existing plant capable of producing about 60,000 tons per year of concentrate grading 25% copper.

Gold.—Tailings at the Ajkoujt Mine amounted to 2.5 MMmt grading 3 to 5 grams of gold per ton. Several companies expressed interest in reworking the tailings, primarily for gold recovery. However, the Government wanted underground mining resumed at the site in addition to reprocessing of the tailings. By yearend 1989, the issue was unresolved with the potential project participant, Broken Hill Petroleum-Utah.

Iron Ore.—Commercial iron ore deposits have been exploited from the Kedia d'Idjill mountains near Zouirat in northwestern Mauritania for several decades. Mining operations conducted by SNIM initially focused on the surface hematite deposits at Rouessa and the massive hematite deposits at Tazadit, both in the Kedia d'Idjill region. Since 1984, a growing share of Mauritanian output has been the low-grade magnetite ore from the El Rhein Mine in the desert plains known as The Guelbs. Earlier estimates called for reserve depletion in the Kedia d'Idjill region by 1990, after which time all mine activity was to shift to the low-grade magnetite ores of The Guelbs. However, additional reserves were discovered by SNIM in 1989 in the Kedia d'Idjill region. Identified were high-grade reserves of about 100 MMmt of hematite ore grading 60% to 68% iron, 0.003% phosphorus, 0.001% sulfur, 2% to 7% silica, and 0.57% alumina. The deposit was at M'haoudat, about 30 kilometers (km) northeast of the El Rhein Guelbs Mine and 60 km from Zouirat. Mining from this deposit was

TABLE 2

MAURITANIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Cement	Societe Ciment de Mauritanie (Government, 71%; private investors, 29%)	N'Drahamcha	60.
Copper	Societe Arab Miniere d'Inchiri (Government, 37.4%; Arab Mining Co., 32.5%; Iraq, 2.5%; Libya, 10%; Arab Investment Co., 7.5%)	4 kilometers west of Ajkoujt	65, concentrate at 25% Cu.
Gypsum	Societe Arabe des Industries Metallurgiques (Societ Nationale Industrielle et Miniere, 50%; Kuwait Foreign Trading, Contract and Investment Co., 50%)	N'Drahamcha	120.
Iron ore	Societe Nationale Industrielle et Miniere (Government, 71%; private investors, 29%)	Kedia d'Idjill, near Zouirat	9, ore at 60% to 65% Fe.[2]
Do.	do.	The Guelbs	10, ore at 37% Fe.[2]
Petroleum products	Societe Mauritanienne d' Industrie de Raffinage (Government, 100%)	Nouadhibou	20.[3]

[1] Thousand metric tons per year unless otherwise specified.
[2] Million metric tons per year.
[3] Thousand barrels per day.

expected to begin by 1993 at the rate of 6 million tons per year. Output was to consist of 50% to 60% lump ore and 40% to 50% fines.

Development plans for The Guelbs deposits commenced in mid-1984 with the opening of the El Rhein open pit mine, which had estimated reserves of 285 MMmt of magnetite averaging 37% iron. At full capacity, mine output was planned at 13.8 MMmt of ore per year using conventional mining methods.

A second mine in The Guelbs Project, Oum Arwagen, was originally scheduled for operation in 1990. Forty km northeast of Zouirat and 12 km from El Rhein, the deposit had a reserve base of 150 MMmt. Its startup was postponed owing to the further discoveries made by SNIM at Kedia d'Idjill. The ore beneficiation plants designed and constructed to process the low-grade magnetite ores of The Guelbs employed a largely untested dry enrichment process involving magnetic separation. Combined output from the plants originally was to total 6 million tons per year of concentrate averaging 65% iron. Products were to include 1.2 MMmt of magnetic sinter-plant feed, 2.6 MMmt of oxidized sinter feed, and 2.2 MMmt fine-grained magnetite concentrate. However, operations at one of the two beneficiation plants was suspended in 1987, while the second operated at less than 70% capacity since its inauguration. Heavy dust buildup and the rapid wear on mechanical parts owing to the abrasive nature of the quartzite present in the ore were cited as problems. Plans for output from The Guelbs deposits were revised downward from 6 MMmt of concentrates yearly to 2.5 to 3.0 million tons per year. To achieve this goal, plant modifications are scheduled, which would include improving resistance to abrasion, modifications to improve material flow, and redesign to facilitate plant maintenance.

Industrial Minerals

Gypsum.—Production was derived from the N'Drahamcha quarry, 50 km northeast of Nouakchott. The quarry was owned and operated by the Société Arabe des Industries Metallurgiques Maritano-Koweitiennes (Samia). Although capacity was reported at 120,000 tons per year, actual output was dictated by the local market, and demand was estimated at 20,000 tons. Most of the output was processed into plaster, and additional amounts were used in the production of concrete blocks.

Phosphate.—The Bofal and Louboere deposits in southern Mauritania were discovered and evaluated by SNIM in conjunction with the Bureau des Recherches Geologique et Minieres of France, Geomin of Romania, and the Compagnie Senegalaise de Phosphates de Thies of Senegal. Resources were estimated at 120 to 150 MMmt of phosphate rock averaging 20% P_2O_5. The remote location of the deposit would require high infrastructure development costs.

Mineral Fuels

Petroleum.—**Exploration.**—Exploration activities were conducted by Texaco and Amoco in the southern and central coastal waters. Following the completion and analysis of seismic surveys under a 1984 exploration agreement, Texaco drilled an exploratory well in the early months of 1989 in Block 8. By a second agreement signed in July 1988, Texaco added the adjoining onshore Block 9 north of Rosso to its exploration concession. Amoco completed its investigation of hydrocarbon seepages as required by the terms of its exploration and production-sharing agreement signed in late 1987. A seismic survey was also conducted by Amoco in February 1989.

Refining.—Mauritania's sole refinery was owned by the Société Mauritanienne d'Industrie de Raffinage (SOMIR) at Nouadhibou. The 20,000 barrel-per-day-capacity refinery, designed to process Algerian crude oil, was closed from 1983 to 1987 owing to financial and technical difficulties. After completion of a $30 million renovation program funded by Algeria, the refinery reopened in September of 1987 under the technical management of Naftal, an Algerian oil corporation. Consumption of petroleum products averaged 7,200 barrels per day in 1989. Less than 60% was supplied by the Nouadhibou refinery. The remainder was from imports.

Reserves

Information of reserves is limited to copper, gold, iron ore, and phosphate rock. In addition to the iron ore reserves listed in table 3, iron ore reserves in the western Guelbs are described as probable and reported at 980 MMmt.

TABLE 3

MAURITANIA: RESERVES OF MAJOR MINERAL COMMODITIES

Commodity	Reserves (million metric tons)
Copper	100 ore at 2.25% Cu.
Gold	100 ore at 1.17 grams Au per ton. 2.5 tailings at 3 to 5 grams Au per ton.
Iron ore	155 hematite at 60% to 68% Fe. 531 magnetite at 36% to 40% Fe.
Phosphate rock	100 ore at 20% P_2O_5.

INFRASTRUCTURE

Iron ore was carried 670 km to the port at Nouadhibou by unit trains of up to 220 cars, each car having a capacity of 80 tons, and hauled by up to 5 diesel electric locomotives. At port, the railroad cars were discharged via a rotary dump unit into an underground receiving pit, from which ore was transferred to crushing and screening facilities and to the stockyard. Stored ore could be blended before ship loading. The shiploader was rated at 4,000 tons per hour with a 22-meter outreach. Water depth at the port was 17.5 meters, and the maximum vessel size that can be accommodated for loading was 150,000 deadweight tons.

SNIM's work force was reported at nearly 4,600 in 1989, representing about 9% of Mauritania's labor force.

OUTLOOK

Mauritania's fortunes are largely dependent on the successful development of the M'haoudat iron ore project and favorable world prices. If output from the M'haoudat Mine maintains the planned level of 6 MMmt tons annually, mine life will be 17 years.

Existing and proposed mining operations offer a more promising future for the nation. However, border disputes with Senegal and Western Sahara have on several occasions halted iron ore mining operations at Zouirat near the Western Sahara border. This may occur again as the issue is unresolved.

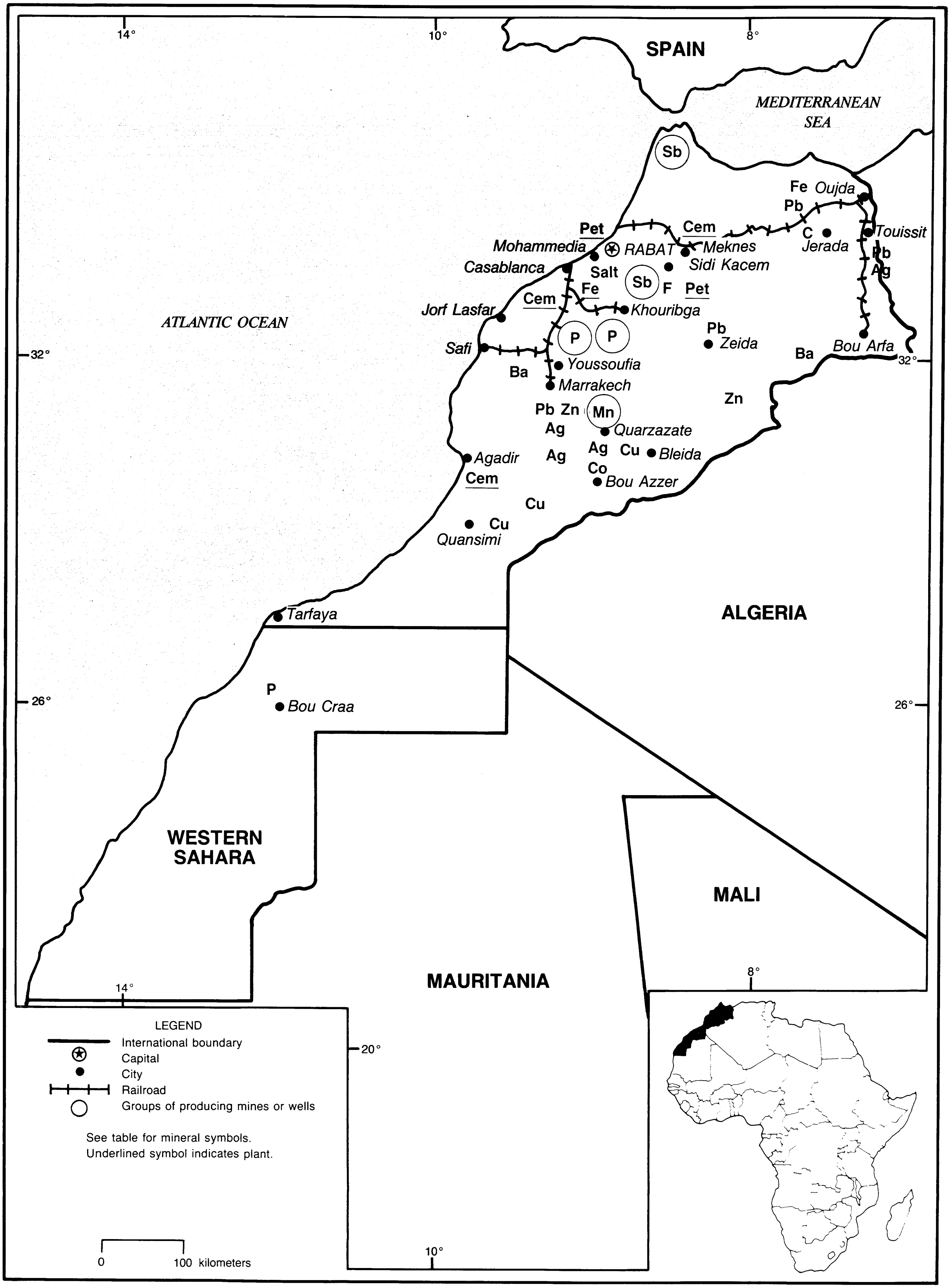
[1] Where necessary, values have been converted from Mauritanian Ouguiya (UM) to U.S. dollars at the rate of UM83.84 = US$1.00.

OTHER SOURCE OF INFORMATION

Société Nationale Industrielle et Minière (SNIM)
P.O. Box 42,
Nouadhibou, Mauritania
Phone 2222-45-170; Fax 2222-49-027

MOROCCO AND WESTERN SAHARA

AREA 446,550 km² **POPULATION 25.6 million**



THE MINERAL INDUSTRIES OF

MOROCCO AND WESTERN SAHARA

By Thomas P. Dolley

Mineral industry activity in Morocco produced mixed results in 1989 and early 1990. The mainstay of the Moroccan economy was the mineral industry, specifically, the production of phosphate rock and fertilizer products. Morocco was also the world's largest exporter of phosphate rock. However, phosphate rock production, chemical fertilizer production, exports, and sales declined significantly in 1989 when compared with the previous year. This situation was exacerbated by a dispute concerning phosphoric acid sales, reportedly worth $500 million,[1] between India and the Moroccan phosphate parastatal Office Cherifien des Phosphates (OCP). As a result of lost sales, the 1989 trade deficit doubled to approximately $2.2 billion. The phosphoric acid sales dispute was eventually settled in late 1989. Subsequently, economic improvement was indicated as exports rose by 23% in January 1990 when compared with the previous year.

Despite a recent decline in the mineral industry, Morocco showed a strong economic growth rate for the late 1980's. Steps toward a liberalization of the economy had led to a reduction of the Government's budget deficit and a surplus in the current account for 1987, the first time in 13 years. Morocco's cooperation with other Maghreb neighbors continued during the year.

GOVERNMENT POLICIES AND PROGRAMS

Current mining legislation in Morocco was based on Mining Code Bill No. 1-73-412 of August 13, 1973.

Since 1983, the Government initiated a series of economic reforms in cooperation with the International Monetary Fund (IMF) and the World Bank. A 25% devaluation of the Moroccan dirham, along with the reduction of tariffs on imports, decontrolling of prices, and dismantling of protective trade barriers were implemented by the Government.

Subsequently, prompted by the declining economy of 1989, the Government and leading creditor banks agreed to a restructuring of the country's foreign bank debt in April 1990. Efforts directed toward this lowering of the debt burden for Morocco were initiated by the Treasury Department of the United States, incorporating a new concept in international debt strategies. The new concept focuses away from the granting of new loans for the lowering of the candidate countries' debt burdens. To shift away from this latter practice, the IMF was to reschedule 86% of Morocco's $3.2 billion medium-term debt over 20 years at a reduced interest rate.

The Moroccan Parliament adopted legislation in 1990 to push ahead with the Government's objective of privatization of assorted banks and other business enterprises. However, this legislation would not affect the phosphate industry, including any railways, water, or electrical utilities.

PRODUCTION

Performance within the mineral industry remained mixed for 1989. Certain sectors of the base metal production industry declined, with the exception of copper, iron, and zinc. Antimony, cobalt, lead, and manganese all experienced declines in production. The declines were attributed to a 2-month strike that affected the industry during the year. Phosphate rock production, accounting for 90% of the mineral sector activity in Morocco, declined owing primarily to the phosphoric acid trade dispute with India. Parenthetically, downstream products of the phosphate industry, such as finished fertilizers, suffered production cuts and a concomitant loss of sales and export markets. Finished fertilizer production also decreased in 1989 to 2,059,000 tons from the 1988 figure of 2,101,000 tons. Other components of the industrial minerals sector, such as barite, experienced modest increases in production or remained stable.

TRADE

Morocco remained the world's largest exporter of phosphate rock in 1989. Despite this fact, owing to the dispute between OCP and India over phosphoric acid sales, Moroccan exports fell by 7% when compared with 1988 figures. This drop in exports was estimated to have cost a minimum of $400 million in export revenue. For the first 11 months of 1989, phosphoric acid exports dropped 75% to $149 million from the 1988 total of $604 million.

However, the doubling of the trade deficit in 1989 was owing not only to the slumping phosphoric acid sales, but also to a dramatic rise in the cost of crude oil and wheat imports. Petroleum imports rose approximately 39% to $765 million. Countries of the European Community (EC) contributed 55% of Morocco's total imports for 1989. According to the Government, France and Spain were ranked first and second, respectively, among European import suppliers.

STRUCTURE OF THE MINERAL INDUSTRY

Mining activity within Morocco was controlled by the Government through public sector companies and parastatals. The Bureau de Recherches et de Participations Minières (BRPM) was an

TABLE 1

MOROCCO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
METALS						
Antimony concentrate:						
Gross weight		1,749	1,468	1,058	555	316
Sb content		[e]750	617	444	250	142
Cobalt concentrate:						
Gross weight		—	—	2,113	2,384	1,144
Co content		—	—	224	253	121
Copper:						
Concentrates, gross weight		61,804	58,707	46,251	41,001	[3]44,033
Matte, gross weight		2,481	1,349	2,441	2,981	[4]2,126
Cu content, concentrates and matte		21,625	20,165	16,541	15,396	15,988
Iron and steel:						
Iron ore:						
Gross weight		190,528	195,600	210,200	114,209	175,600
Fe content		118,000	123,228	128,100	69,668	107,116
Metal:						
Pig iron[e]		15,000	15,000	15,000	15,000	15,000
Steel, crude[e]		6,000	6,000	6,000	7,200	7,200
Lead:						
Concentrate:						
Gross weight		152,549	104,398	105,090	100,221	93,513
Pb content		106,784	76,211	75,665	72,159	67,329
Cupreous matte, Pb content		645	351	635	775	553
Metal:						
Smelter, primary only		59,500	60,000	62,500	68,410	63,676
Refined:						
Primary		59,470	[e]60,000	62,497	68,410	[e]63,000
Secondary[e]		2,000	2,000	2,000	2,000	2,000
Total[e]		61,470	62,000	64,497	70,410	65,000
Manganese ore, largely chemical-grade		43,690	40,334	42,500	30,100	32,000
Silver:						
Ag content of concentrates and matte	kilograms	87,090	61,927	61,429	57,448	[5]50,221
Ag content of mine and smelter bullion	do.	84,135	163,355	108,302	168,767	[6]186,390
Total	do.	171,225	225,282	169,731	226,215	236,611
Zinc concentrate:						
Gross weight		27,153	24,344	19,874	21,304	33,913
Zn content[e]		14,700	13,100	10,300	10,865	[7]18,652
INDUSTRIAL MINERALS						
Barite		500,000	189,881	143,503	321,562	370,000
Cement, hydraulic	thousand tons	3,697	[e]3,700	3,800	4,220	[e]4,200
Clays, crude:						
Bentonite		2,877	3,834	2,948	3,445	3,970
Fuller's earth (smectite)		24,425	35,100	46,271	52,694	48,820
Montmorillonite (ghassoul)		4,656	4,313	4,981	4,367	4,133
Feldspar[e]		1,000	1,000	1,000	1,000	1,000
Fluorspar, acid-grade		74,350	83,000	78,000	100,500	105,000
Gypsum[e]		450,000	450,000	450,000	450,000	450,000

See footnotes at end of table.

TABLE 1—Continued

MOROCCO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
INDUSTRIAL MINERALS—Continued						
Mica		1,440	[e]1,500	1,500	1,500	[e]1,500
Phosphate rock (includes Western Sahara)	thousand tons	20,737	21,178	21,300	25,015	18,067
Salt, rock		92,263	96,514	107,838	132,661	89,075
MINERAL FUELS AND RELATED MATERIALS						
Coal, anthracite	thousand tons	774	[e]775	634	637	504
Gas, natural:						
Gross[e]	million cubic meters	74	74	74	74	74
Marketed[e]	do.	57	57	57	57	57
Petroleum:						
Crude[e]	thousand 42-gallon barrels	260	260	260	260	260
Refinery products:[e]						
Distillate fuel oil	do.	9,500	9,500	9,500	9,500	9,500
Gasoline	do.	3,300	3,300	3,300	3,300	3,300
Jet fuel	do.	1,500	1,500	1,500	1,500	1,500
Kerosene	do.	750	750	750	750	750
Other	do.	2,100	2,100	2,100	2,100	2,100
Refinery fuel and losses	do.	1,500	1,500	1,500	1,500	1,500
Residual fuel oil	do.	13,000	13,000	13,000	13,000	13,000
Total	do.	31,650	31,650	31,650	31,650	31,650

[e]Estimated. [p]Preliminary.
[1]Includes data available through June 1, 1990.
[2]In addition to the commodities listed, a variety of crude construction materials is produced, but available information is inadequate to make reliable estimates of output levels (limestone quarried for cement manufacture is substantial).
[3]Includes the following types of concentrates: Copper (41,417 tons at 35% Cu); gold-silver-copper (2,616 tons at 9.9% Cu, 105.3 grams per ton Au, 770 grams per ton Ag).
[4]Cupreous matte containing 58% Cu, 26% Pb, 1,500 grams per ton Ag.
[5]Contained in copper concentrates and matte identified in [3] and [4] above and in lead concentrates (93,513 tons at 500 grams per ton Ag).
[6]Contained in a presumably mine-produced bullion: 146.2 tons at 98.9% Ag and lead smelter product 42.9 tons at 99.8% Ag.
[7]Reported figure.

TABLE 2

MOROCCO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS				
Aluminum: Metal including alloys,				
Scrap	1,835	2,526	—	France 1,230; Netherlands 424.
Unwrought	24	25	—	All to France.
Semimanufactures	1	157	—	France 147; Saudi Arabia 7; Guinea 2.
Antimony: Ore and concentrate	NA	465	—	Belgium-Luxembourg 405; France 60.
Chromium: Ore and concentrate	19	1,400	—	All to Spain.
Cobalt: Ore and concentrate	NA	2,148	—	China 2,128; Belgium-Luxembourg 20.
Copper:				
Ore and concentrate	50,854	44,675	—	Spain 38,252; West Germany 6,118.
Oxides	NA	1	—	All to France.
Matte and speiss including cement copper	2,524	2,738	—	West Germany 1,476; Belgium-Luxembourg 1,257.

See footnotes at end of table.

TABLE 2—Continued

MOROCCO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued				
Metal including alloys:				
Scrap	2,649	3,312	—	United Kingdom 1,098; France 793; Belgium-Luxembourg 392.
Unwrought	12	—		
Semimanufactures	36	88	—	France 60; Belgium-Luxembourg 15.
Iron and steel:				
Iron ore and concentrate including roasted pyrite	—	84,484	—	Tunisia 37,500; Yugoslavia 15,000; Albania 14,300.
Metal:				
Scrap	62,799	91,430	14	Spain 65,360; Italy 12,450; Netherlands 6,027.
Pig iron, cast iron, related materials kilograms	NA	180	—	All to Mali.
Semimanufactures:				
Bars, rods, angles, shapes, sections	2	31	1	Cameroon 1; unspecified 30.
Universals, plates, sheets	62	16	NA	Guinea 12; unspecified 4.
Wire	1	1	—	All to Libya.
Tubes, pipes, fittings	12	68	—	Libya 50; France 17.
Lead:				
Ore and concentrate	30,556	43,487	—	Spain 15,750; Belgium-Luxembourg 11,031; West Germany 6,150.
Oxides	—	20	—	Pakistan 10; United Arab Emirates 10.
Metal including alloys:				
Scrap	228	653	—	United Kingdom 377; France 276.
Unwrought	58,010	62,528	—	Italy 26,608; Egypt 7,444; Iraq 6,204.
Semimanufactures	—	1	—	All to Mali.
Magnesium: Metal including alloys, scrap	8	18	—	All to United Kingdom.
Manganese: Ore and concentrate, metallurgical-grade	43,927	47,371	140	France 13,463; Spain 7,891; West Germany 5,825.
Nickel: Metal including alloys, semimanufactures	NA	3	—	All to Spain.
Silver: Metal including alloys, unwrought and partly wrought value, thousands	$16,758	$21,970	—	France $16,124; Switzerland $4,215.
Zinc:				
Ore and concentrate	23,797	23,098	—	Belgium-Luxembourg 13,718; Yugoslavia 7,700.
Matte	NA	281	—	France 198; United Kingdom 42; Italy 41.
Ash and residue containing zinc	662	423	—	All to France.
Blue powder	44	53	—	Do.
Metal including alloys, unwrought	—	20	—	Do.
Other:				
Ores and concentrates	1,011	—		
Oxides and hydroxides	2	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	—	148	—	All to Italy.
Grinding and polishing wheels and stones	([2])	11	—	Do.
Asbestos, crude	200	429	—	All to Tunisia.
Barite and witherite	254,463	398,090	94,684	Norway 129,020; Venezuela 53,050; United Kingdom 45,950.
Boron materials: Oxides and acids	—	2	—	All to Libya.

See footnotes at end of table.

TABLE 2--Continued

MOROCCO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued				
Cement	7,501	4,100	(2)	Mainly to Spain.
Chalk	NA	75	—	All to Spain.
Clays, crude	46,838	78,902	—	Spain 39,501; United Kingdom 24,008; Italy 12,000.
Diatomite and other infusorial earth	37	—		
Feldspar, fluorspar, related materials	88,424	89,694	—	Canada 32,400; Norway 22,978; West Germany 21,121.
Fertilizer materials: Manufactured:				
Phosphatic thousand tons	448	1,478	79	France 268; Saudi Arabia 168; Hong Kong 160.
Unspecified and mixed	256,848	216,486	—	Hungary 130,255; Italy 21,954; Portugal 18,300.
Gypsum and plaster	130,368	203,912	46,100	Spain 52,100; Japan 28,300; Côte d' Ivoire 25,300.
Iodine, elemental	NA	2	—	All to Libya.
Mica: Crude including splittings and waste	1,538	1,862	—	All to France.
Phosphates, crude thousand tons	13,060	14,260	728	Spain 2,301; Belgium-Luxembourg 1,350; Poland 1,220.
Pigments, mineral: Iron oxides and				
Natural, crude	NA	1	—	All to Guinea.
Iron oxides and hydroxides, processed	—	18	—	Mainly to Mauritania.
Precious and semiprecious stones other than diamond, natural value	NA	$300	—	All to France.
Salt and brine	59,183	17,050	—	Netherlands 13,550; Italy 3,500.
Sodium compounds, n.e.s.: Sulfate, manufactured	920	—		
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	9,827	7,422	—	Spain 4,000; Italy 1,483; France 1,093.
Worked	50	432	—	Spain 277; Italy 45.
Gravel and crushed rock	—	108,229	—	All to Spain.
Quartz and quartzite	—	1,253	—	Do.
Sand other than metal-bearing	55,634	68,166	—	Spain 68,165.
Sulfur:				
Elemental: Crude including native and byproduct	5	—		
Sulfuric acid	—	38	—	Mauritania 20; Gabon 18.
Talc, steatite, pyrophyllite kilograms	NA	32	—	All to Senegal.
Other: Crude	1,343	2,004	—	Mainly to Netherlands.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural kilograms	NA	300	—	All to Gabon.
Coal: Anthracite	20,070	10,655	—	France 6,355; Belgium-Luxembourg 4,200.
Petroleum refinery products:				
Gasoline thousand 42-gallon barrels	2,517	2,662	—	Netherlands 1,782; France 528.
Mineral jelly and wax do.	NA	(2)	—	All to Mauritania.
Kerosene and jet fuel do.	260	271	—	All for bunkers.
Distillate fuel oil do.	39	255	NA	Spain 209; unspecified 46.
Lubricants do.	326	342	—	France 68; Belgium-Luxembourg 65; United Kingdom 64.
Residual fuel oil do.	2	5	—	Mainly for bunkers.
Bitumen and other residues 42-gallon barrels	NA	362	—	All to Tunisia.

NA Not available.
[1]Table prepared by Virginia A. Woodson and P. J. Roetzel.
[2]Less than 1/2 unit.

TABLE 3

MOROCCO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988	
				United States	Other (principal)
METALS					
Alkali and alkaline-earth metals:					
Alkali metals	kilograms	NA	167	—	West Germany 161; France 6.
Alkaline-earth metals	do.	NA	1	—	All from West Germany.
Aluminum:					
Ore and concentrate		4,575	5,118	—	France 3,034; French Guiana 2,000; China 84.
Oxides and hydroxides		2,884	3,029	—	France 2,230; West Germany 681.
Metal including alloys:					
Scrap		54	112	—	Netherlands 97; West Germany 15.
Unwrought		1,139	1,717	—	Netherlands 1,131; France 198; West Germany 113.
Semimanufactures		5,720	5,422	10	Spain 2,267; France 1,385; West Germany 588.
Arsenic:					
Elemental including tellurium		NA	5	—	Mainly from China.
Oxides and acids		NA	9	—	West Germany 5; Italy 3.
Beryllium: Metal including alloys, all forms	kilograms	—	70	—	Mainly from France.
Cesium and rubidium	do.	NA	1	—	All from West Germany.
Chromium:					
Ore and concentrate		16	4	—	All from Norway.
Oxides and hydroxides		12	32	3	United Kingdom 20; France 4.
Cobalt:					
Ore and concentrate	kilograms	NA	35	—	West Germany 25; France 10.
Oxides and hydroxides		(2)	1	—	Mainly from West Germany.
Columbium and tantalum: Metal including alloys, all forms, tantalum value,	thousands	$2	$1	—	Mainly from France.
Copper:					
Oxides and hydroxides		NA	16	—	Norway 14; France 2.
Sulfate		NA	25	—	Netherlands 20; France 4; West Germany 1.
Metal including alloys:					
Scrap		20	15	—	France 10; Austria 5.
Unwrought		700	662	—	France 522; Italy 100.
Semimanufactures		12,083	11,549	1	France 4,149; Belgium-Luxembourg 3,599; Italy 661.
Germanium and zirconium: Oxides and hydroxides		NA	60	—	Mainly from Spain.
Gold: Metal including alloys, unwrought and partly wrought	grams	NA	7	7	
Iron and steel:					
Iron ore and concentrate excluding roasted pyrite		73	48	—	All from Norway.
Metal:					
Scrap		2,000	37	—	Belgium-Luxembourg 25; Austria 3.
Pig iron, cast iron, related materials		2,168	3,500	—	Brazil 2,834; Canada 215.
Ferroalloys:					
Ferroaluminum and silicoaluminum		NA	16	—	All from France.
Ferrochromium		NA	60	—	Italy 40; U.S.S.R. 5; Yugoslavia 5.
Ferromanganese		132	174	—	Belgium-Luxembourg 100; Spain 42; France 20.
Ferromolybdenum		NA	3	—	All from Austria.
Ferronickel		NA	5	—	All from Yugoslavia.

See footnotes at end of table.

TABLE 3—Continued

MOROCCO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988 United States	Sources, 1988 Other (principal)
METALS—Continued					
Iron and steel—Continued					
Metal—Continued					
Ferroalloys—Continued					
Ferrosilicomanganese		NA	12	—	West Germany 7; Norway 3; France 2.
Ferrosilicon		—	197	—	West Germany 102; U.S.S.R. 25; Norway 22.
Silicon metal		NA	22	—	France 19; Spain 3.
Unspecified		303	3	—	France 2; Austria 1.
Steel, primary forms		334,899	425,056	—	Brazil 149,679; Spain 89,953; Netherlands 85,236.
Semimanufactures:					
Bars, rods, angles, shapes, sections		83,020	103,160	8	France 21,930; Spain 18,712; Turkey 8,692.
Universals, plates, sheets		140,731	150,295	—	West Germany 35,390; France 30,989; Belgium-Luxembourg 13,914.
Hoop and strip		10,169	10,330	—	France 6,484; Spain 1,011.
Rails and accessories		1,796	14,591	—	Canada 10,751; France 2,329; Italy 1,262.
Wire		13,344	18,349	1	France 7,671; Spain 2,913; Belgium-Luxembourg 2,174.
Tubes, pipes, fittings		11,554	17,125	19	France 6,323; West Germany 2,460; Turkey 2,380.
Castings and forgings, rough		72	80	2	France 49; West Germany 15.
Lead:					
Ore and concentrate		—	6,773	—	Spain 3,463; Ireland 1,900; Algeria 1,410.
Oxides		1,090	445	—	Spain 236; France 94; West Germany 94.
Metal including alloys:					
Unwrought		277	282	—	France 215; Netherlands 61.
Semimanufactures		71	72	—	France 26; Netherlands 24; Portugal 19.
Lithium: Oxides and hydroxides		NA	20	16	U.S.S.R. 4.
Magnesium: Metal including alloys:					
Unwrought	value, thousands	$1	—		
Semimanufactures		17	1	—	Mainly from France.
Manganese:					
Ore and concentrate, metallurgical-grade		45	—		
Oxides		711	615	—	Ireland 440; Belgium-Luxembourg 173.
Mercury		NA	4	—	Mainly from Japan.
Molybdenum:					
Oxides and hydroxides		NA	6	—	Mainly from France.
Metal including alloys, all forms		NA	3	—	Do.
Nickel:					
Matte and speiss		6	7	—	All from Canada.
Oxides and hydroxides	kilograms	NA	4	—	Mainly from West Germany.
Metal including alloys:					
Unwrought		18	16	—	France 11; Canada 3.
Semimanufactures		681	288	—	West Germany 129; Italy 67.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	kilograms	NA	4	—	All from France.
Rare-earth metals		NA	2	—	Mainly from Belgium-Luxembourg.

See footnotes at end of table.

TABLE 3—Continued

MOROCCO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued					
Selenium, elemental		NA	1	—	Mainly from Japan.
Silicon, high-purity		NA	1	—	Mainly from Spain.
Silver: Metal including alloys, unwrought and partly wrought	kilograms	NA	1,270	—	Belgium-Luxembourg 376; West Germany 272; Italy 233.
Tin: Metal including alloys:					
Scrap	do.	NA	200	—	All from France.
Unwrought		128	122	—	Belgium-Luxembourg 31; Indonesia 24; Japan 20.
Semimanufactures		7	10	—	Netherlands 3; France 2.
Titanium:					
Ore and concentrate		NA	168	—	Mainly from Australia.
Oxides		2,321	2,118	—	France 1,241; Belgium-Luxembourg 765.
Tungsten:					
Ore and concentrate	kilograms	NA	412	—	France 212; West Germany 200.
Metal including alloys, all forms	do.	NA	1,144	(2)	France 997; Italy 93; Netherlands 34.
Vanadium: Oxides and hydroxides	kilograms	NA	20	—	All from Netherlands.
Zinc:					
Oxides		676	683	—	France 281; Portugal 183; West Germany 132.
Blue powder		NA	97	—	Belgium-Luxembourg 73; France 24.
Metal including alloys:					
Unwrought		2,676	2,922	—	France 1,165; Belgium-Luxembourg 991; Spain 354.
Semimanufactures		[3] 398	301	—	Belgium-Luxembourg 134; France 80; Italy 43.
Other:					
Ores and concentrates		—	22	—	Australia 21; Spain 1.
Oxides and hydroxides		121	2	—	Belgium-Luxembourg 1; Netherlands 1.
Base metals including alloys, all forms		27	16	—	China 10; France 6.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		2,022	3,435	—	Turkey 2,263; Greece 581.
Artificial:					
Corundum		332	380	—	France 215; Italy 79; Spain 51.
Silicon carbide		NA	220	—	Italy 195; West Germany 21; France 4.
Dust and powder of precious and semiprecious stones excluding diamond	grams	—	300	—	All from West Germany.
Grinding and polishing wheels and stones		318	379	(2)	Italy 129; France 98; Denmark 67.
Asbestos, crude		1,885	5,691	500	Republic of South Africa 2,045; Canada 2,028; Zimbabwe 1,000.
Barite and witherite		—	11	—	All from France.
Boron materials:					
Crude natural borates		2	1	—	Mainly from France.
Elemental	kilograms	NA	58	—	All from West Germany.
Oxides and acids		28	33	—	Italy 12; Turkey 11; France 9.
Bromine	kilograms	NA	230	—	France 190; West Germany 23.
Cement		39,936	43,660	—	Spain 29,980; France 13,599.
Chalk		932	697	—	Spain 387; France 238.

See footnotes at end of table.

TABLE 3—Continued

MOROCCO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Clays, crude		18,202	17,940	81	France 10,960; United Kingdom 4,113.
Cryolite and chiolite		10	—		
Diamond, natural:					
Industrial stones	carats	NA	17,250	—	All from Switzerland.
Dust and powder	do.	NA	4,000	—	Spain 2,000; Switzerland 2,000.
Diatomite and other infusorial earth		126	341	43	Spain 205; France 87.
Feldspar, fluorspar, related materials		1,023	1,096	—	Spain 557; Sweden 401; France 138.
Fertilizer materials:					
Crude, n.e.s.		51	96	—	France 86; Chile 10.
Manufactured:					
Ammonia		129,144	312,878	20,440	U.S.S.R. 93,048; Trinidad and Tobago 76,103; Mexico 35,104.
Nitrogenous		249,974	331,774	—	Belgium-Luxembourg 88,530; Romania 70,933; Yugoslavia 66,430.
Phosphatic		20	—		
Potassic		95,998	120,932	—	Spain 49,520; East Germany 24,002.
Unspecified and mixed		1,200	1,565	—	Belgium-Luxembourg 759; West Germany 339; France 199.
Graphite, natural		18	20	—	France 13; Austria 4.
Gypsum and plaster		21	8	—	All from Spain.
Iodine	kilograms	NA	485	—	France 329; West Germany 125; Spain 31.
Lime		608	1,285	—	All from France.
Magnesium compounds, unspecified		167	171	—	Spain 91; Austria 70.
Mica:					
Crude including splittings and waste		18	6	—	All from Norway.
Worked including agglomerated splittings		1	—		
Nitrates, crude		NA	10	—	Mainly from Chile.
Phosphorus, elemental		NA	8	—	Italy 7; Spain 1.
Pigments, mineral: Iron oxides and hydroxides, processed		1,445	1,339	—	West Germany 546; Spain 344; United Kingdom 187.
Precious and semiprecious stones other than diamond: Synthetic	value, thousands	$27	$4	—	All from France.
Pyrite, unroasted		11	2	—	All from Italy.
Quartz crystal, piezoelectric	kilograms	NA	2	—	Mainly from France.
Salt and brine		14	2,459	—	Tunisia 2,450.
Sodium compounds, n.e.s.:					
Soda ash, manufactured		NA	12,702	—	Spain 11,280; United Kingdom 740; Portugal 600.
Sulfate, manufactured		255	—		
Stone, sand and gravel: Dimension stone:					
Crude and partly worked		1,726	1,885	—	Italy 1,839; Portugal 21; Greece 20.
Worked		3,840	2,297	—	Italy 1,740; Spain 336.
Dolomite, chiefly refractory-grade		691	499	—	France 340; Spain 159.
Gravel and crushed rock		695	1,170	—	Spain 677; Belgium-Luxembourg 393.
Quartz and quartzite		898	569	—	Belgium-Luxembourg 504; Italy 63.

See footnotes at end of table.

TABLE 3—Continued

MOROCCO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988 United States	Sources, 1988 Other (principal)
INDUSTRIAL MINERALS—Continued					
Stone, sand and gravel—Continued					
Sand other than metal-bearing		29,591	34,787	—	Belgium-Luxembourg 33,789.
Sulfur:					
Elemental:					
Crude including native and byproduct	thousand tons	2,043	2,925	39	Canada 1,925; Mexico 448.
Colloidal, precipitated, sublimed		—	4	—	All from France.
Dioxide		NA	2	—	Mainly from France.
Sulfuric acid		13,266	1,789	—	Spain 1,772.
Talc, steatite, soapstone, pyrophyllite		1,417	1,914	—	France 1,218; Belgium-Luxembourg 451.
Vermiculite, perlite, chlorite		NA	140	—	France 105; Belgium-Luxembourg 35.
Other:					
Crude		18,862	20,318	—	France 12,313; Netherlands 4,205.
Slag and dross, not metal-bearing		NA	20	—	All from France.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		1	170	1	France 169.
Carbon black		5,873	5,702	8	Spain 2,675; Portugal 862; Mexico 843.
Coal: Anthracite and bituminous	thousand tons	1,041	1,018	36	Colombia 636; United Kingdom 158.
Coke and semicoke		17,950	32,650	—	Italy 16,750; West Germany 15,900.
Peat including briquets and litter		180	5,229	—	West Germany 5,191.
Petroleum:					
Crude	thousand 42-gallon barrels	34,821	36,009	—	Iraq 15,939; Kuwait 9,955; U.S.S.R. 4,587.
Refinery products:					
Liquefied petroleum gas	do.	2,086	2,155	—	Spain 797; France 592; Algeria 421.
Gasoline	do.	1	35	—	Portugal 17; Spain 10.
Mineral jelly and wax	do.	70	52	—	West Germany 25; France 14; Spain 9.
Kerosene and jet fuel	do.	—	1	—	Mainly from Netherlands.
Distillate fuel oil	do.	156	(2)	—	Do.
Lubricants	do.	41	42	(2)	France 10; Spain 8; West Germany 8.
Bitumen and other residues	do.	(2)	(2)	—	All from France.
Bituminous mixtures	do.	(2)	(2)	(2)	Mainly from France.
Petroleum coke	do.	—	11	—	All from Netherlands.

NA Not available.
[1]Table prepared by Virginia A. Woodson and P. J. Roetzel.
[2]Less than 1/2 unit.
[3]Includes dust.

autonomous public corporation involved directly or indirectly in the majority of Moroccan mining enterprises, excluding hydrocarbons and phosphates. Private, foreign companies were also active in the country. Omnium Nord Africain, involved in agriculture and mining, was Morocco's largest private-sector company, with net profits doubling in 1989 to $56 million.

COMMODITY REVIEW

Metals

In early 1990, the Ministry of Energy and Mines discussed the feasibility of developing the Douar Hajar polymetallic mineral deposit into a full production mining operation. The deposit was approximately 30 kilometers (km) south of Marrakech and contained lead, zinc, copper, silver, and sulfur. The prospect was owned by Cie. Minière de Guemassa (CMG), a joint venture of BRPM and Omnium Nord Africain with equity ownership of 30% and 70%, respectively.

BRPM discovered the Douar Hajar prospect in 1984 and carried on exploration and development work for CMG in

TABLE 4

MOROCCO: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Barite	Compagnie Marocaine des Barites (COMABAR) (50% BRPM)	Near Marrakech	270,000 concentrate.
Cobalt	Compagnie Tifnout Tiranimine (CTT) (40% BRPM)	Bou Azzer	1,996 concentrate 150,000 ore.
Copper	Société Minière de Bou Saffer (SOMIFER) (34% BRPM)	Bleida	50,000 concentrate.
Do.	Société Minière Marocaine (SOMINA) (75% BRPM)	Quansimi	NA.
Do.	Société du Developpement du Cuivre de l'Anti-Atlas (SODECAT) (99% BRPM)	Near Quansimi	NA.
Fluorspar	Société Anonyme de Entreprises Minières (SAMINE) (35% BRPM)	Near El Hammam	100,000 concentrate.
Lead	Compagnie Minière de Touissit (CMT) (50% Compagnie Royale Asturienne des Mines SA, Belgium)	Touissit	73,000 concentrate.
Do.	Société de Developpement Industrie et Minière (50% BRPM)	Zeida	40,000 concentrate.
Manganese	Société Anonyme Cherifienne d'Etudes Minières (SACEM) (43% BRPM)	Near Quarzazate	130,000 concentrate.
Phosphate	Office Cherifien des Phosphates (OCP) (100% Government ownership)	Khouribga and Youssoufia	25[2] concentrate.
Silver	Société Metallurgique D'Imiter (SMI) (69% BRPM, 31% Arab Mining Company, Jordan)	Near Quarzazate	73,000 ore.

NA Not available.
[1]Metric tons per year unless otherwise specified.
[2]Million metric tons per year.

1988 and 1989, including magnetic surveying, drilling and bulk sampling of ore. As of mid-1990, a developing mine and pilot plant for ore beneficiation are active. The first drift at the Douar Hajar Mine was constructed in 1987 to a depth of 235 meters. The orebody, Paleozoic in age, is currently mined to a depth of 400 meters, below a zone of oxidation.

The Douar Hajar orebody was further delineated in 1989. Lens-like in aspect, the thickness of the orebody varies between 15 to 20 meters. The total depth of the orebody is unknown. The mine area is overlain by Mio-pliocene gravels and an associated aquifer. The orebody is postulated to be of hydrothermal origin associated with metasomatic activity and fluid migration. Underground, the ore fluid migration and mineralization appears to have followed faulting surrounding the brecciated orebody. Ore mineralization is uniform and homogeneous. Room and pillar mining is the technique employed at Douar Hajar, with cement backfilling of mined out areas. Three mine shafts are located at Douar Hajar. Ore is transported by scoops to crushers located at each hoist. Shaft #1 is for the transport of ore and personnel and is sunk to a depth of 500 meters. Shaft #2 was constructed for a pipeline for cement backfilling of the galleries and chambers in the mine. Shaft #3 is to be built in the future, primarily for mine ventilation. Mine planning included main drifts with spiralling drifts surrounding the orebody. Production at the mine should increase to 2,000 tons per day by 1992, with a further increase to 3,000 tons per day in the future.

A pilot plant for the production of base metal concentrates was constructed in 1988 at the Douar Hajar Mine site. Initial testwork had been conducted on flotation parameters for the ore, magnetic separation and dewatering of concentrates and tailings, and research on secondary recovery of lead and copper. This initial testwork was not very successful, because the metals are tightly bound to the sulfides in the rock, making beneficiation difficult. CMG discovered that a catalytic activation recovery process achieved the best results and allows for recoveries of 85% for lead, 70% for copper, and 90% for zinc. The process is basically as follows: (1) Lime is added to a 10 millimeter feed of ore to the ball mill. The mixture is then cycloned down to a 10 micron size. (2) In flotation tanks, cyanide is added to chemically depress copper and zinc to allow for lead recovery. (3) Lead is collected. Zinc is depressed with the addition of lead nitrate. Copper is activated and collected. (4) Zinc is activated and collected with the addition of copper sulfate. Additionally, lime is also added between the copper and zinc circuit to raise Ph to 12. The resultant concentrates are dumped into pits adjacent to the pilot plant and trucked to appropriate destinations. Concentrates grades are as follows: lead concentrates of 60% to 70% Pb; copper concentrates of 25% to 35% Cu; and zinc concentrates of 50% to 54% Zn. Furthermore, 50 grams per ton of silver is recovered.

Compagnie Minière de Touissit produced approximately 421,000 tons of ore in 1989, primarily from the underground Bediane Mine. The Bediane Mine, within the Touissit mining district, is 40 km south of Oujda,in the northeast corner of Morocco, where the milling operations treated 438,000 tons grading 11.87% lead, 0.43% copper, and 75 g/t silver. The older Toussit Mine was depleted, but at one time extended across the Algerian-Moroccan border. The Algerian side is still mined. The Bediane deposit was discovered in 1982 when exploratory drilling delineated the orebody. The mine had to undergo significant drainage for 1 to 2 years before mining operations could commence. The Bediane Mine produces copper, zinc and a smaller amount of silver. The ore was formed during a remobilization associated with regional tectonics and volcanics in a karst environment. The most significant ore concentrations are found as massive galena and stratabound orebodies in a Middle Jurassic carbonate cover. Bedded, altered dolomites typify the Bediane Mine area.

A wide variety of classical mining techniques are utilized at Bediane, but are adapted to the complex geological conditions found there. Room and pillar, block caving, sublevel stoping and caving, are all techniques that are applied there. The thickness of the ore zone is 3 to 20 meters, with an estimated 5 km width, allowing for 98% recovery of ore at the Bediane Mine. When the ore occurs at a 3 meter thickness, room and pillar with access galleries are utilized. Generally, material is blasted and caved, loaded and then transported to the surface with load-haul-dump vehicles.

Lead concentrate output from the Bediane Mine was 73,300 tons, of which 2,800 tons was a mixed lead-copper concentrate. However, mine production was down from the previous year, due primarily to a 2 month mine strike. Despite this fact, CMT showed its highest net profit to date, over $5 million, in 1989. This was due primarily to higher global metal prices, milling of previously stockpiled ores, and cost cutting procedures utilized at the mine for the past 7 years.

Belgium's Compagnie Royale Asturienne des Mines SA had interests in the Moroccan lead mine Société Minière du Djebel Aouam, which produced approximately 193,000 tons of ore grading 5.51% lead and 1.85% zinc in 1989. Lead concentrate output for the year was 12,650 tons and zinc concentrate output was 4,860 tons. Production declined at Djebel Aouam in 1989, as at Bediane, due to a strike action. The Société Minière du Djebel Aouam operated in the Middle Atlas mountains, approximately 100 km south of Meknes. The company reported that a mechanized top slicing mining method was employed at this vein-type lead-silver deposit. This mining technique reduced the amount of gangue with a subsequent reduction in cost.

Industrial Minerals

Cement.—Total cement mill capacity was approximately 4 million tons per year (mt/yr.). In February 1990, plans were announced for the construction of a cement factory at Ras el-Maa in the Fez region. Production capacity was to be 450,000 mt/yr. Factory startup was slated for mid-1992.

Phosphate Rock.—Phosphate rock production and sales for Morocco and the Western Sahara experienced a record year in 1988. However, mine production and sales decreased significantly in 1989.

A major reason for the downturn was the phosphoric acid trade dispute between OCP and India, which was eventually resolved in November 1989. The dispute centered on the pricing of the phosphoric acid, of which India was the world's largest importer, accounting for approximatley 55% of Moroccan exports in 1988. The dispute lasted for the 11 months of 1989, at which time OCP agreed to drop the original price of $470 per ton from the contract. Shipments, totaling 200,000 tons of phosphoric acid, were renewed at a price of $428 per ton. Additionally, OCP curtailed a call for international arbitration in the trade dispute.

The Khourigba region, in west-central Morocco, was the area most extensively mined for phosphate in the country. Additionally, production at the Bou Craa Mine complex in the Western Sahara was 1.4 million tons in 1989. In 1990, OCP continued with prior plans to open a new opencast mine at Sidi Chenane, within a 20-km radius of another Khourigba mine at Sidi Daoui. The phosphate resources of Sidi Daoui were approaching exhaustion. Exploratory work began in 1987 with a large percentage of the infrastructure already in place. Plans drawn up in 1988 called for the Sidi Chenane Mine to be producing about 5 million tons of phosphate by 1992. As of March 1990, unopened bids had been submitted for the development of the mine. The bidders were Spain's Centunion, Huarte & Compania, Dragados & Construcciones, and Industrias Mecanicas del Noroeste. Additional foreign corporate interest was represented by France's Alsthom and Krupp of West Germany.

OCP hoped to double phosphate fertilizer production capacity at Jorf Lasfar by 1992. This $800 million scheme could be in financial jeopardy owing partly to the phosphate industry's poor performance in 1989.

Mineral Fuels

Coal.—Charbonnages du Maroc (CDM) was a Government parastatal that was 99% owned by BRPM. CDM mined modest amounts of anthracite coal at Jerada in northeastern Morocco. Production at the mine declined in 1989 from the previous year, and labor troubles at the mine in 1988 spilled into early 1989.

To fulfill increasing energy needs, importation of coal and coke grew in 1989 to about 1.3 million tons from the 1.1 million tons of 1988. Electrical utilities consumed approximately 60% of the imported coal; the cement industry consumed 35%; and the sugar industry and foundries consumed 5%. Moroccan coal imports had steadily increased since 1986. The United States and the United Kingdom were primary suppliers of the coal.

Natural Gas.—Ratification by the Moroccan Parliament of an accord to study the construction of a 2,000-km natural gas pipeline took place in April 1990. The pipeline would traverse northern Morocco at Oujda, Taz, Fez, Meknes, and Tangier from its starting point at Hassi R'Mel Gas Field in Algeria. Subsequently, the pipeline would cross the Mediterranean Sea floor to its destinations in Spain, France, and West Germany. The accord was originally signed in Fez in 1989 and provided for the creation of a joint-venture company to conduct the necessary technical studies. Construction of the pipeline would enable Morocco to tap into the liquefied natural gas (LNG) and earn additional revenue from transshipment rights. Algeria desired to market more of its natural gas as petroleum reserves are depleted. Spain's Enagas also expressed interest in the project.

Petroleum.—The petroleum industry of Morocco experienced a slight resurgance of international exploration interest in 1989 and 1990. Changes in investment regulations had helped to reverse a trend in diminishing interest in Morocco by international oil companies.

In September 1989, the Netherlands' Royal/Dutch Shell signed an oil exploration agreement in partnership with the Moroccan parastatal Office National de Recherches & d'Exploitations Petrolieres (Onarep). Exploration for oil should begin in the spring of 1990 in a 6,000-square-kilometer (km^2) tract located 100 km offshore of Tarfaya in the Atlantic Ocean. The joint venture had an equity interest of 65% for Shell and 35% for Onarep. Following a seismic survey that would indicate favorable conditions for hydrocarbon accumulation, drilling of seven exploratory wells will take place.

Similarly, Texaco of the United States and Onarep had also signed an exploration joint-venture, with an equity split of 65% for the former and 35% for the latter. The agreement, announced in March 1990, further stipulates that Texaco will implement and finance the operations for 8 years at a total investment of $57 million. Additionally, Texaco agreed to train Onarep technicians. Exploration should take place on a 6,000 km^2 tract offshore of Casablanca.

In January 1990, Occidental Petroleum Corp. of the United States held negotiations with the Government on a possible oil exploration agreement.

Reserves

The Government's estimated reserve of phospate rock was approximately 64 billion cubic meters. Sufficient reserves existed to sustain base metal production.

INFRASTRUCTURE

As of mid-1990, work had begun on the $27 million effort by Société Cherifienne des Petroles (SCP) to build an oil terminal and associated infrastructure at the port of Mohammedia. The terminal will accomodate oil tankers up to 150,000 dead weight tons, and crude oil should be piped to a refinery at Sidi Kacem. Other necessities included powerlines, transformers, loading stations, and pipelines.

Once again, infrastructure projects of great magnitude, such as the estimated $3 billion contracted M'Jara Dam Project, were wholly dependent on the performance of the economy and its effect on the Government's budgetary priorities.

Spain and Morocco resurfaced talks in November 1989 on a plan to build a permanent link across the Strait of Gibraltar, either in the form of a 15-km long bridge or tunnel. An intergovernmental committee was formed in 1979 to oversee the plan, with total estimated costs at $5 billion to $6 billion. Considering the current financial constraints on both Governments, this plan could remain in the future.

OUTLOOK

Debt servicing continued to remain a burden for Morocco at the close of the decade of the 1980's. Discussions with the IMF on debt servicing and economic reform continued during the year. Additionally, Morocco continued to import most of its energy needs. Discovery of significant domestic sources of energy was becoming critical to Morocco. Energy imports significantly contributed to the ever burgeoning trade deficit.

Despite being rich in phosphate rock resources, the Moroccan economy had shown itself to be sensitive to global phosphate rock prices. The prospect for future sales of phosphate rock was dependent on negotiations underway between OCP and India.

Negotiations continued in 1990 on further phosphoric sales of OCP to India. The outlook for the decade of the 1990's could be brightened by the Government's draft 1990 budget, which was to make an attempt to control deficit spending. Privatization and the opening of nonessential sectors to private investment were positive gestures toward the goal of a more decentralized economy.

WESTERN SAHARA

Western Sahara has a total land area of 266,000 km^2. It has been claimed and administered by Morocco since the mid-1970's. Economic activity, including all trade, is controlled by the Moroccan Government. The only significant mineral production from this region is from the phosphate mine at Bou Craa. Phosphate rock production from this mine has remained stable over the past several years, with 1989 production totaling approximately 1.4 million tons. Production data from Bou Craa is included with Moroccan phosphate output.

[1] Where necessary, values have been converted from Moroccan dirhams (DH) to U.S. dollars at a rate of DH8.49 = US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

Bureau de Recherches et de Participations Minières
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Ministere del-Energie et des Mines
5 Rue de Rich, Tour Hassan
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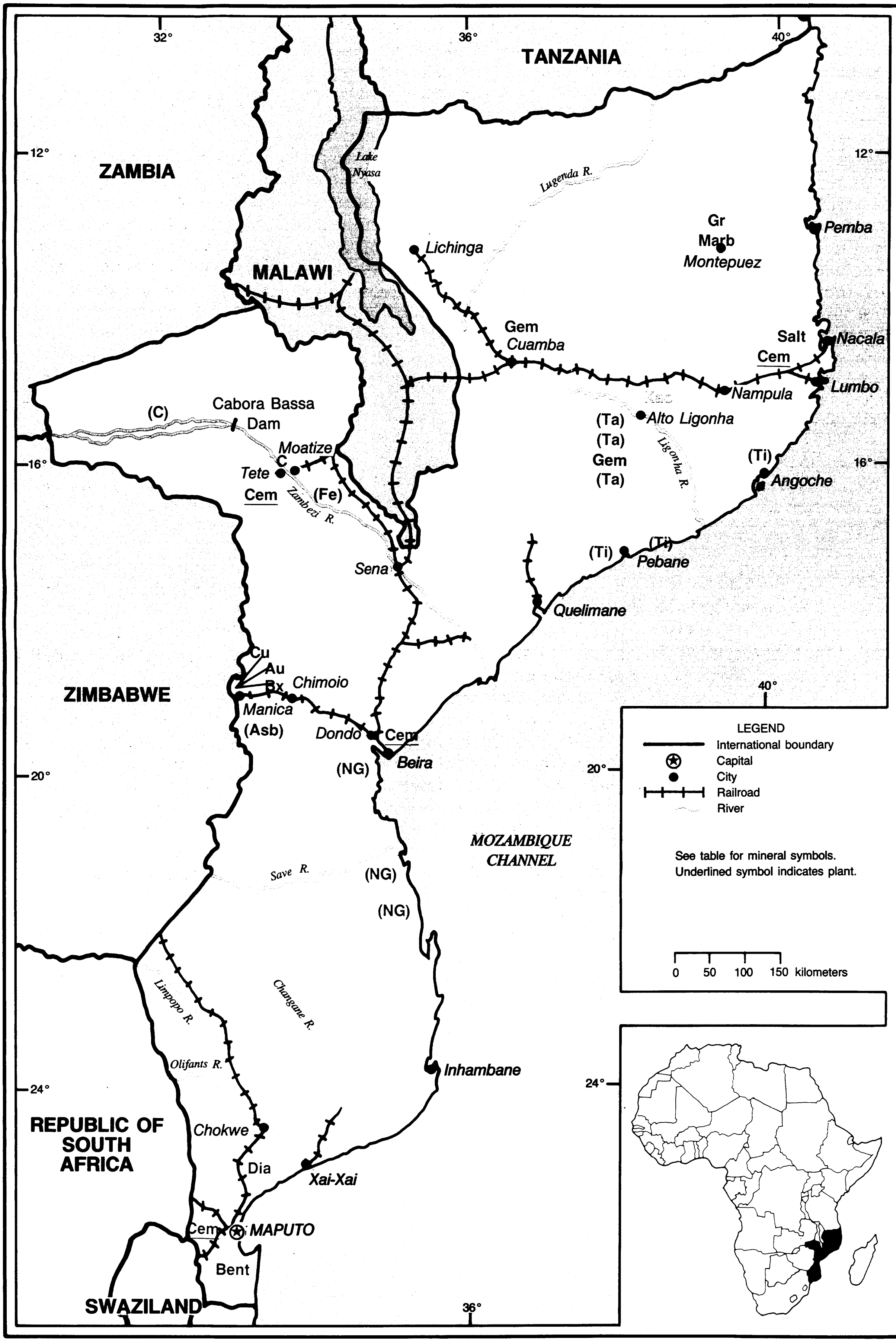
Office Cherifien de Phosphates
Angle Route de'El Jadidaet Bd de Grande Ceinture
Casablanca, Morocco

Publications

Statistique du Commerce Exterieur, Rabat, Morocco.
Marches Tropicaux et Mediterraneens, Paris, France.

MOZAMBIQUE

AREA 801,590 km² **POPULATION 14.6 million**



THE MINERAL INDUSTRY OF

MOZAMBIQUE

By Hendrik G. van Oss

Although sales of domestically produced mineral commodities were a relatively minor component of Mozambique's agriculture-dominated economy, transport of mineral commodities from Mozambique's inland neighbors was a significant component. These transshipments were a major justification for the ongoing rehabilitation of the country's transportation infrastructure. Mining is viewed by the Government as having the potential to attract significant foreign investment. Wages earned by Mozambique mineworkers abroad were also a significant factor in the domestic economy. A major proportion of Mozambique's imports were mineral commodities, dominantly energy minerals. As in years past, most facets of the Mozambique economy were adversely affected by the ongoing insurgency.

Mozambique's gross domestic product (GDP) fell about 20% to an estimated \$1.275 billion[1] in 1989, largely owing to lower world prices for the country's exports. Sales of domestically produced mineral commodities were worth an estimated \$5.8 million, of which about \$2.5 million were exports. Revenues from the transshipment of mineral commodities were worth an estimated \$18 million. Wages in the Mozambique mineral industry and related transportation sector totaled an estimated \$3 to \$4 million. However, if the repatriated wages of Mozambique mineworkers in the Republic of South Africa are counted, total mining-related wages in Mozambique were an estimated \$75 million. These wages support an estimated 300,000 persons. Imports of mineral commodities and energy amounted to an estimated \$95 to \$100 million.

Mozambique's ports and railways have traditionally been major components of the trade infrastructure of Southern Africa. The Mozambique economy has relied heavily on revenues earned by the transshipment of goods, especially mineral commodities, to and from its neighboring countries. Mozambique's ports offer shorter travel distance, and hence lower cost, for many of its neighbors over ports in the Republic of South Africa (Richards Bay and Durban), and in Tanzania (Dar es Salaam). Mozambique's transportation infrastructure has deteriorated since independence, largely because of civil disorder, and the country's economy has suffered accordingly. The Government has made the rehabilitation of the country's railroads and ports a top priority. This rehabilitation has taken the form of a number of international assistance programs, including troops from Zimbabwe to protect some of the routes and the rehabilitation programs thereon.

The geology of Mozambique is complex, and this is manifested in the diversity of the country's mineral deposits. The northeast third of Mozambique is predominately made up of Precambrian granitic rocks. This terrane is notable for containing myriad complex pegmatites that host significant resources of tantalum and related minerals containing columbium, antimony and bismuth, rare earth element minerals, lithium minerals, industrial and gem stone grades of quartz and beryl, and gem tourmalines. In the northern part of this terrane, granitic gneisses host potentially important graphite deposits. Metasedimentary inliers host some locally important metamorphic deposits, notably of marble and garnet. Rimming this terrane on the Indian Ocean coast are clastic rocks, dominantly of Tertiary and Quaternary ages. These include sediments eroded from the inland granitic rocks and host economically important concentrations of titaniferous minerals (ilmenite and rutile), zircon, and monazite derived from the granites.

In northwest Mozambique, adjoining the Zambia and Malawi borders, are additional Precambrian granitic rocks. Except for some deposits of graphite in the eastern portion near the Malawi border and some minor low-grade iron and copper-nickel deposits, this area has been relatively unimportant from a minerals standpoint. Immediately to the south of this terrane, however, is a 50- to 100-kilometer-wide east-west strip of Permian rocks bounded by the Zimbabwe border on the west and south and by the Malawi border on the east. These rocks, which are of the Karoo System, contain major coal deposits, some of which are currently exploited. Within this area, immediately north of Tete and Moatize, is a 50- by 100-kilometer (km) window of Precambrian gabbroic rocks, which host low-grade iron-titanium deposits. Some ultramafic rocks from this complex have returned weakly anomalous platinum assays, and the Government feels that this area warrants exploration for this commodity.

Adjoining the Zimbabwe border in west-central Mozambique is a west-facing crescentic area of Precambrian granitic rocks, extending about 350 km south of Tete. This terrane, especially near Manica, contains a variety of metasedimentary inliers, a number of which host stratabound and vein gold deposits, and some copper deposits. Both lode and derived placer gold deposits have been mined from this region, and Mozambique's only copper mine is here as well. Small but high-grade bauxite deposits are also found in this area, including one that is currently being mined. There are also low-grade iron deposits in the area, but these are not of economic grade.

Except for a narrow strip of Karoo volcanics along the Swaziland and the Republic of South Africa borders, the rest of Mozambique, amounting to about 50% of the country, is made up of Cretaceous and younger sedimentary rocks. These host a number of deposits of industrial minerals, especially clays and diatomite. In the coastal area near Beira, these rocks contain a number of structural basins, generally associated with normal faults related to the East African Rift system that are prospective for petroleum and natural gas. The country's natural gas reserves are in this area.

GOVERNMENT POLICIES AND PROGRAMS

The Government encouraged new mining investment in Mozambique because it sees the mining sector as having potential to provide significant revenues and employment. This interest is also justification for the rehabilitation of the country's transportation infrastructure. Apart from revising the country's mining and investment laws to attract foreign investment and international financial assistance, the Government has encouraged the improved dissemination of geologic information on the country. This has included the early 1986 compilation and release of an information packet on the country's petroleum potential and the completion in 1987 of a geologic map of the country at a scale of 1:1,000,000.

The current mining law of Mozambique is Law No. 2/86 of April 16, 1986, as modified by the Mining Law regulations, Decree No. 13/87 of February 24, 1987. The mining law provides for the formation of either wholly foreign-owned mining companies or joint ventures with the Government. Fiscal incentives in the law include a set 50% tax on profits, the right to repatriation of profits after tax, exemption from import duties on mining equipment and from export duties on minerals, and accelerated depreciation of capital investments. Royalties range from 3% to 10% of gross revenues, depending on the mineral(s) produced. Petroleum and natural gas exploration and exploitation are governed by Law No. 3/81 of October 3, 1981. Negotiations for hydrocarbon exploration leases are handled by the parastatal Empresa Nacional de Hidrocarbonetos de Moçambique (ENH).

PRODUCTION

Coal production in 1989 was the highest in 5 years but was still well below the capacity of the mines. Production continued to be hampered by civil disorder; the railroad to the mines remained closed, and power outages were common. A workers' strike toward yearend also negatively affected output. In 1986, civil disorder forced the cessation of mining in the Alto Ligonha area, the country's producing region for tantalum and related minerals and most of its gem stones. The Government secured the area in 1988, and gem stone production resumed at a modest level in 1989. The two tantalum mines that had been in production in 1986 remained closed pending rehabilitation. Copper production fell markedly, reportedly as a result of myriad equipment problems and numerous power outages.

TRADE

The Government reported an increase in mineral exports of 10% to about $1.1 million, compared with total exports of $101 million, presumably as a result of increased coal and gem stone exports. This reporting, however, did not include about $1.5 million in exports of salt and possibly some cement. Mozambique's other mineral commodity exports were bauxite, copper concentrates, and marble. The Government predicted a fourfold increase in mineral exports in 1990, largely based on anticipated improvements in coal and gem stone output and the potential startup of a gold mine.

Petroleum product imports amounted to an estimated $80 million of total

TABLE 1

MOZAMBIQUE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
Asbestos		55	—	—	—	—
Bauxite		5,037	4,247	5,113	6,548	5,502
Beryllium: Beryl concentrate, gross weight		6	1	—	—	—
Bismuth: Bismuth minerals	kilograms	1,052	80	—	—	—
Cement, hydraulic	thousand tons	77	73	[r e]73	69	[e]80
Clays:						
Bentonite		361	1,112	936	986	126
Kaolin		152	230	151	200	[e]200
Coal, bituminous		20,400	3,895	43,319	23,856	62,010
Copper:						
Ore, gross weight[e]		9,200	20,300	11,200	10,300	6,500
Concentrate, gross weight		590	1,303	719	660	420
Cu content[e]		[r]124	[r]274	151	139	88
Feldspar		67	100	—	—	—
Gem stone:						
Cut stones, all types	carats	[e]26,000	35,477	36,340	26,551	[e]30,000
Aquamarine	grams	3,600	568	—	—	—
Beryl, morganite	do.	50	7,303	—	—	913
Emerald	do.	5,000	[e]5,000	—	—	36
Garnet	kilograms	2,000	11,024	13,240	17,860	1,966
Tourmaline	grams	1,500	4,231	—	—	966
Lime, hydraulic[e]		10,000	10,000	[r]5,000	[r]5,000	5,000
Marble	cubic meters	715	1,137	1,140	940	687
Mica, waste[e]		300	300	—	—	—
Monazite concentrate	kilograms	[e]4,000	[r]117	—	—	—
Ornamental stones, rose quartz	do.	2,500	[e]1,000	—	—	—
Salt, marine[e]		28,000	28,000	[r]30,000	[r]37,500	40,000
Tantalum mineral concentrates, gross weight:						
Microlite	kilograms	6,283	2,649	—	—	—
Tantalite	do.	4,275	5,373	—	—	—

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Data available through Nov. 30, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

reported imports of $775 million, not counting an estimated 1.2 million barrels of petroleum products supplied to the country by the U.S.S.R. as part of an assistance program. Electricity imports, all from the Republic of South Africa, were estimated to have been worth about $10 million. Because of security problems with railroad shipments of limestone, Mozambique had to import most of its clinker requirements for the cement industry. Clinker imports were worth an estimated $3.5 million in 1989. Coal imports to fuel power stations in southern Mozambique were worth about $500,000.

Revenues from the transshipment of mineral commodities amounted to an estimated $18 million in 1989, of which about $9.5 million were revenues from the transshipment of petroleum products to Zimbabwe, about $1.5 million from the transshipment of Zambian copper, and almost $4 million from the transshipment of coal from the Republic of South Africa and Swaziland.

STRUCTURE OF THE MINERAL INDUSTRY

The mining industry of Mozambique was composed of three small operating coal mines, several small gem stone operations, and single mines for bauxite, bentonite, copper, kaolin, and marble. In addition, there were more than 20 small marine salt operations and 4 cement plants. The coal mines and cement mills were operating well below their design capacities. With the exception of the bauxite mine and most of the salt operations, all mineral commodity production was controlled by the Government.

Exploration for coal, diatomite, gold, graphite, and titaniferous minerals, were ongoing during the year by a number of foreign companies, all in partnership with the Government's Empresa Nacional de Minas. Owing to the prevalence of civil disorder, all exploration activity was conducted accompanied by Government troops. Although foreign companies are encouraged to explore for petroleum in Mozambique, exploration is also carried out for the Government through ENH.

Current data are not available on the mining component of the Mozambique labor force; however, it is estimated that in 1989 only about 6,000 workers were employed in the mining or related value added industries. Of these workers, about 1,000 were employed in the cement industry, and about the same number in the glass industry and quarries supplying the glass industry. It is estimated that the coal mines employed about 1,500 workers, despite the fact that current output is much less than in the early 1980's, when coal mine employment stood at approximately 2,500. An estimated 700 workers were employed by the country's small bauxite, clay, copper, gem stone, and marble mines. The production and polishing of gem stones probably currently employs no more than 750 workers, and some of these may be involved only on a part-time artisanal basis. An estimated

TABLE 2

MOZAMBIQUE: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Bauxite	E.C. Meikle Plc of Zimbabwe	Open pit mine extension of Penhalonga deposit in Zimbabwe, just west of Manica	10,000.[e]
Cement	Cementos de Moçambique (Government, 100%)	Cement plant at Dondo	75,000[e] cement.
		Cement plant at Matola	100,000[e] cement.
		Cement plant at Nacala	50,000[e] cement.
		Cement plant at Tete	30,000[e] cement.
Clays:			
Bentonite	Empresa Nacional de Minas (Government, 100%)	Luzinda deposit, 35 kilometers southeast of Maputo	6,000.[e]
Kaolin	do.	Boa Esperanca Mine, Ribáuè District, 120 kilometers west of Nampula	300.[e]
Coal	Empresa Nacional de Carvao de Moçambique (Government, 100%)	Underground mines near Moatize	100,000 bituminous coal.
Copper	Empresa Nacional de Minas (Government, 100%)	Mundonguara underground mine, 18 kilometers west of Manica	1,000[e] concentrates at 21% copper.
Gem stones	do.	Several small-scale lode, and placer operations near Alto Ligonha (beryl, tourmaline) and Cuamba (garnet)	NA.
Marble	do.	Quarry 5 kilometers north of Montepuez	2,500[e] cubic meters per year.
Salt	24 operations: 4 State-owned, 19 private, 1 co-operative	Small seawater evaporation operations near most coastal cities	40,000[e] combined capacity.

[e]Estimated. NA Not available.
[1]Metric tons per year unless otherwise specified.

500 workers were employed in the salt industry. The exploration projects for gold and for titaniferous sands probably employed no more than a total of 300 workers. In addition, it was estimated that about one-third of the country's railroad and port employees or about 10,000 workers were involved in the transportation of mineral commodities. None of these estimates included security personnel, generally Government soldiers; the larger operations may have in excess of 200 soldiers assigned to them.

Although a breakout of wages for the mineral sector is unavailable, the average industrial wage in Mozambique in 1989 was about $50 per month.

As in years past, Mozambique continued to significantly benefit from the wages earned by Mozambique workers abroad. Owing to events in Eastern Europe, large numbers of Mozambique workers there, notably in the German Democratic Republic, were expected to be repatriated. It was anticipated that this would lead to a reduction of repatriated wages of about $70 million per year. This has made even more important the employment of Mozambique workers in gold and coal mines in the Republic of South Africa. In 1989, almost 44,000 workers were so employed, of whom almost 43,000 worked in gold mines. Total wages in 1989 for Mozambique mineworkers in the Republic of South Africa were estimated to have been about $145 million.

COMMODITY REVIEW

Metals

Copper.—The Mundonguara Mine, the only copper producer in Mozambique, had an output in 1989 of only about one-third of that planned. The disappointing performance was attributed to numerous problems with the mining equipment and power outages. The latter were largely due to civil unrest. The Government considered privatizing the mine, but the low output in 1989, and evidence that the mine's reserves were nearing exhaustion, augured poorly for investor interest in the operation. In early 1990, the Government announced that it was considering closing the mine, if only temporarily, pending an improvement in security conditions.

Gold.—Lonrho Plc of the United Kingdom continued detailed feasibility work on its placer gold project near Manica. The company began exploration for placer and lode gold deposits in the area following the signing of an agreement with the Government in April 1988. The main area of interest was on the Chua River, about 14 km northeast of Manica. The Chua is a tributary of the Revuè River, which was first exploited for placer gold in 1904. From 1923 to 1949, Lonrho subsidiary Revuè Dredging Co. extracted 6.5 tons of gold from gravels in the area; the operation mined only to a maximum depth of 6 meters (m). The current project, in which Lonrho holds an 80% interest and the Government 20%, involves sampling the gravels to depths in places exceeding 30 m. A production decision was expected by mid-1990.

Tantalum.—In November 1989, Edlow Resources Ltd. (Edlow), a Bermuda-registered American company, signed a protocol with the Government to evaluate the possibility of rehabilitating the Muiane tantalum mine, 28 km southeast of Alto Ligonha. At about the same time, the U.S.S.R. signed an agreement to examine the Morrua tantalum mine, about 65 km southwest of Alto Ligonha. Both mines, and the Marropino Mine nearby, had been in operation until 1986, when civil unrest led to their closure. Although secured in 1988, both mines had been extensively damaged, and the Government then sought foreign investors interest in rehabilitating the mines. Total installed capacity at the three mines prior to closure was approximately 61 metric tons per year (mt/yr) of microlite concentrates, grading from 55% to 67% Ta_2O_5; and about 53 mt/yr tantalite concentrates, grading from 27% to 50% Ta_2O_5. According to the Government, reserves at Muiane and Morrua could support substantially higher production capacity once the mines were rehabilitated. Pegmatites in the vicinity also could be further explored.

Titanium.—In November 1989, following the completion of feasibility studies begun in late 1988, Kenmare Resources Plc of Ireland announced that it would proceed with development of its Congolone titaniferous sands deposit, about 190 km southwest of Nacala, near Angoche. The deposit was discovered in the early 1980's by Geoloski Zavod, the Yugoslavia Geological Survey, and Kenmare became involved with the project in 1987. Equity interest at yearend 1989 was held by Kenmare, 71.25%; the Government, 25%; and Geoloski Zavod, 3.75%. The approximately $100 million project will involve a 2,500-metric-ton-per-hour floating bucket wheel and suction dredge with an attached concentration facility, operating in paddocks 150 m by 400 m, and dredging to a depth of 15 m. The heavy-minerals concentrate will be trucked to a separation plant to be located near the center of the deposit; initially this will be about 3 km from the dredge. The project also involves the construction of shiploading facilities, including a jetty, adequate to allow the loading of 30,000-deadweight ton (dwt) vessels at a rate of about 500 metric tons per hour (mt/hr). A nearby stone quarry will supply hard core for jetty construction. The preproduction phase of the project was expected to take at least 6 months; production was forecast for 1992. Kenmare was reportedly holding talks with several international financial institutions toward financing the project. The company was also considering adding a synthetic rutile plant to the project, but no decision on this had been announced as of yearend. Annual output was expected to be about 421,000 mt/yr of ilmenite; 37,500 mt/yr zircon; about 8,100 mt/yr rutile, and about 1,000 mt/yr monazite. Two types of ilmenite will be produced: about 56% of the total output will be "sulfate-grade," containing 53.7% TiO_2 and 0.09% Cr_2O_3, and the remainder will be "standard-grade" ilmenite, grading 57.5% TiO_2 and 0.42% Cr_2O_3. The rutile reportedly grades 96.4% TiO_2, 0.18% ZrO_2, and 1.18% Fe_2O_3. The zircon grades 65.1% ZrO_2, 0.05% TiO_2, and 0.06% Fe_2O_3. Proven reserves were adequate for about a 10-year operation, and it is expected that the reserves will be increased as additional exploration is conducted.

Edlow Resources continued its exploration work on the Pebane titaniferous sand concession, which covers about 200 km of coastline stretching northeast from a point about 75 km southwest of the town of Pebane. The work in 1989 consisted of phase II sampling, consisting largely of truck-mounted reverse circulation drilling as infill to the phase I sampling program completed in 1988. The phase II program was completed in early 1990, and the company expected that the results would justify a phase III program in 1990 to prove reserves. Early results were sufficiently encouraging to lead the company to expand its concession area by acquiring, in April 1989, the Quelimane concession, which adjoins the Pebane property on the southwest.

Industrial Minerals

Cement.—The Mozambique cement industry continued to be adversely affected by the ongoing civil strife. Because of lack of security on the railroads, the limestone quarries supplying the Matola and Dondo calcining furnaces have been essentially inoperative since 1984. Consequently, the furnaces have been shut down for several years, and the cement plants have had to rely on imported clinker. The plant at Nacala was able to obtain some limestone and hence was not entirely import dependent for clinker. Power outages were an additional constraint on cement production, although power deliveries appear to have been better in 1989 than in the previous year. Most of the cement plant facilities in Mozambique were in need of extensive rehabilitation; the total cost of the needed work was reportedly in excess of $40 million. The International Development Association agreed to finance part of this rehabilitation as part of a $50 million facility to Mozambique announced in January 1990.

Diatomite.—Cluff Resources Plc and Rockwood Holdings Plc, both of the United Kingdom, signed a contract with the Government to evaluate and possibly develop a diatomite deposit 70 km north of Maputo. Cluff will be the project operator and will hold a 40% equity interest. Rockwood will also hold a 40% interest and will provide security services. The deposit reportedly covers an area 450 m by 3.8 km and was first explored by pitting in 1967. Cluff was expected to commence its work in mid-1990.

Graphite.—In late 1989, Irish companies Kenmare Resources Plc and Shamrock Mining Ltd. signed an agreement with the Government that will permit detailed reserve delineation and a final feasibility study of a large graphite deposit near Ancuabe, 120 km east of Pemba. The agreement followed work on the property conducted by Kenmare during 1987 and 1988. Both companies will hold a 40% equity interest in the project. Kenmare is to be the project operator and was hoping to prove reserves adequate to sustain an annual output of 10,000 to 20,000 mt/yr of coarse flake graphite.

Mineral Fuels

Coal.—Although coal output from the mines at Moatize increased significantly, it still fell well short of the Government's goal of 85,000 tons for the year. Production continued to be hampered by the lack of railing ability, the result of the continued security-related closure of the Sena railroad line. Consequently, the coal shipments, which largely went to Malawi, were by truck, reportedly at a transport cost in excess of $20 per ton. Coal output in 1989 was also slightly affected by a yearend strike at the mine over the nonpayment of wages since midyear. The strike was the first since independence in 1975.

As in 1988, there was a great deal of foreign interest in expanding the coal output of the country, especially from the Moatize region. During 1989, the Government was in negotiation with more than 10 foreign firms toward this end. The largest proposal was for a $1.2 to $1.5 billion project to expand production from Moatize to in excess of 5 million metric tons (MMmt) per year. The project involved new mines, repair of approximately 500 km of track to Dondo, and upgrading the coal-loading facilities at Beira. The principal companies involved in the project were Brazil's Companhia Vale do Rio Doce (CVRD), Trans-Natal Corp. of the Republic of South Africa, and Lonrho. CVRD would be responsible for the feasibility studies, estimated to cost at least $2 million, while the other two companies would be the operators. British Petroleum Coal Corp. also expressed interest in coal exploration in the country. Late in the year, the Government of the German Democratic Republic expressed a willingness to include the rehabilitation of the Moatize mines as part of an assistance package to Mozambique. Subsequent political events in Eastern Europe have, however, made this assistance unlikely.

Oil and Gas.—The only drilling conducted in Mozambique during 1989 for oil and gas was a single development hole in the onshore Pande gasfield, drilled by ENH to a depth of 1,240 m. The drilling was funded by the U.S.S.R. The hole was reported to have penetrated a pay zone in Upper Cretaceous calcarenites of the Grudja Formation. The Pande Field, 150 km south of Beira, was discovered in 1961, but although the field has significant reserves, it has never been put into production. A number of companies, including Lonrho, Anglo American Corp. of the Republic of South Africa, and Monte Edison of Italy, expressed interest during the year in developing the field. It has been estimated that this would involve a $200 million project; reportedly, the International Finance Corp. (IFC) has indicated a willingness to fund 25% of this.

The only exploration activity in Mozambique during the year was the completion of a shallow water seismic survey for ENH offshore the extreme north of the country. Most other offshore exploration has apparently come to a halt, with all leased acreage being relinquished during the year. This involved the offshore Xai-Xai permit, held by British Petroleum and the IFC, and offshore Blocks M5 and M6, south of Quelimane, held by Amoco.

Reserves

Mozambique is a mineralogically diverse country; deposits that are or have been exploited include asbestos, various clays, coal, copper, fluorspar, gem stones, gold, graphite, marble, and tantalum. Reserve data are unavailable for most of these commodities, although an upsurge in mineral exploration since 1986 will likely improve this picture.

Of the known mineralization in Mozambique, the most significant is coal. Mozambique's coal reserves are mostly in the Tete area and are known to be large. Exploitation to date has been confined to Moatize, where proven reserves, according to various Government publications, amount to several hundred million tons. The Government estimates, however, that the true reserves of the Moatize and similar sedimentary basins in the region amount to several billion tons. The reserve potential of the region has attracted a great deal of attention from international coal companies in recent years.

Mozambique's total resources of titaniferous sands have yet to be established, but are believed to be large. This belief is based on the results of the two exploration programs ongoing in 1989, the areal extent of the country's exposed granitic terrane, and the long coastline receiving sediment input from that terrane. Proven reserves were known only for Kenmare's Congolone deposit, which were announced toward yearend 1989 as 166.8 MMmt of dredgeable ore grading 3.25% heavy minerals. The recoverable heavy-mineral concentrate grades 77.35% ilmenite, 6.88% zircon, 1.66% rutile, 0.24% monazite, and 13.87% gangue minerals—mostly magnetite, kyanite, and sillimanite. Reserves for Edlow's Pebane concession had not been proved as of yearend 1989, but the deposit was believed to be larger than Kenmare's and of higher grade.

To date, economic crude petroleum resources have yet to be discovered. Mozambique has significant natural gas resources, most notably in the Pande Field. This field, confirmed in 1963, has estimated recoverable reserves, according to ENH, of about 1 trillion cubic feet out of a total reserve of approximately 2.3 trillion cubic feet.

Numerous gold occurrences are known in Mozambique, notably in the Alto Ligonha and Tete regions and, especially, in the Manica area. In the past, small lode and placer mines have operated in the country, but exploration in recent decades has been very limited, and little drilling has been done. The country's best reserve potential would appear to be in its placer deposits and in ferruginous quartzite deposits such as those once exploited at the old Monarch Mine, close to the Zimbabwe border west of Manica. Lonrho's gold reserves at its Chua River placer deposit had not been announced at yearend 1989.

Reserves of pegmatitic minerals such as tourmaline, beryl, columbite-tantalite, spodumene, and rare earths are difficult to determine, and few of Moambique's numerous known occurrences of these have been explored in detail. Similarly, few placer occurrences have been explored in detail. The true extent of Mozambique's resources of these minerals is, therefore, unknown. In recent years, only the Muiane, Marropino, and Morrua pegmatites have been mined, and these chiefly for tantalum minerals. Current reserve data are unavailable for these three deposits. Based on Government supplied pre-1986 tantalum mineral production capacity data for the Muiane, Morrua, and Marropino deposits, it can be estimated that a 10-year reserve for these would total 1,000 to 1,500 tons of combined microlite and tantalite.

Mozambique has significant graphite resources, some of which were mined in the past. Most of the known occurrences are near Tete or in the northeast part of the country. According to the Government, graphite ore reserves, grading approximately 6% to 10% graphite, much of it coarse flake, exceed 10 MMmt. However, recent exploration for graphite in northeast Mozambique has reportedly delineated well in excess of 20 MMmt of ore grading approximately 5% graphite.

According to the Government, the grade of the bauxite deposit near Manica was about 60% alumina. The United Nations Development Program was evaluating the bauxite resources of this area.

INFRASTRUCTURE

Mozambique has 3,288 km of railroad, of which 3,140 km are 1.067-m gauge, and the remainder 0.762-m narrow gauge. The bulk of the country's railroads are in six routes or "corridors." These routes are, from north to south, the Nacala Corridor, linking Nacala to Malawi (300 km); the Sena Corridor, linking Beira, via Dondo, to the coalfields at Moatize (513 km) and to Malawi (570 km); the Beira Corridor, linking Beira to Zimbabwe (315 km); the Limpopo Corridor, linking Maputo with Zimbabwe (534 km); the Ressano Garcia line, linking Maputo to the Republic of South Africa (88 km); and the Goba line, linking Maputo to Swaziland (68 km). Rehabilitation work in 1989 was largely on the Limpopo and Nacala railroads; work in 1988 largely restored the railing capacity of the Beira Corridor and the Ressano Garcia line, and both were operational throughout the year. The operation of the Beira Corridor and rehabilitation work on the Limpopo Corridor was made possible by the presence of large numbers of Zimbabwean troops. The Goba line was operational on an sporadic basis and carried about 155,000 tons of coal during the year. Portions of the Nacala Corridor were in intermittent use during the second half of the year. The concrete sleepers for the Limpopo Corridor were provided by the Government of Botswana, which is interested in the line as an export route for Botswana soda ash from Sua Pan.

The rehabilitation of the Sena Corridor has assumed greater importance since the renewal of investment interest in Mozambique's coal resources. Production from the existing mines at Moatize has suffered from an inability to rail the output; truck transport has been much more expensive and has also been subject to attacks. Another factor lending urgency to the rehabilitation of the line was the presence of, reportedly, 20 locomotives at Moatize. Mozambique's entire railing system and consequently much of its mining sector suffers from a severe shortage of locomotives, and the Moatize stock, which have been regularly maintained, are a much needed resource. Little work had been done on the line by yearend 1989.

Mozambique's major ports are Maputo-Matola, Beira, and Nacala; in recent years only the first two have handled significant quantities of mineral products. Rehabilitation of the port facilities at Beira continued during the year and included continued dredging of the harbor to allow the berthing of 60,000 dwt ships, up from the current capacity of 25,000 dwt. Beira is at the mouth of the Pungwe River, and funding was being sought for future maintenance dredging to counter the heavy siltation from the river. A new oil terminal was being built, and the coal handling facilities of the port were being upgraded to a capacity of 1.2 MMmt per year.

The port complex of Maputo-Matola handled about 3.1 MMmt in 1989, an increase of 15%. Shipments were expected to increase to 3.4 MMmt in 1990. Operational capacity of the port complex is reported to be about 7 MMmt per year, although this has not been approached in many years. The theoretical handling capacity is reported to be 14 MMmt per year. The port facilities at Matola are currently largely geared to coal. Small oil tankers can also offload there. The coal terminal at Matola handled 853,000 tons in 1989, which was 68% of capacity. The rehabilitation program of the coal terminal, begun in 1984, was nearly completed at yearend 1989, with only the rehabilitation of one stacker-reclaimer remaining. This was expected to be done by yearend 1990, at which time the throughput capacity of the terminal would rise to 1.75 MMmt per year. Total coal stockyard capacity at Matola is 250,000 tons. The port can handle ships of up to 40,000 dwt. The average coal loading capacity is quoted by the port as 5,000 tons per day (mt/d), although the port has achieved almost twice this on occasion.

The coal-loading facilities at Maputo proper are geared toward specialty size shipments, and can handle about 200,000 mt/yr, loading at 2,500 mt/d. Coal shipments in 1989 were 187,000 tons. There are also handling facilities for small shipments of relatively high value mineral commodities, such as vermiculite and ferroalloys.

In 1989, Mozambique's installed electrical generating capacity was about 2,300 megawatts (MW), of which 2,040 MW was accounted for by the Cabora Bassa hydroelectric plant. As in 1988, there was no generation of electricity by the Cabora Bassa plant as a result of the sabotage of hundreds of the power transmission pylons. Mozambique's production of electricity in 1988, the latest year for which data are available, was 475 million kilowatt hours (kWh); all but 50 million kWh was from thermal plants.

The Cabora Bassa facility is owned by the Portuguese consortium Hidroelectrica Cabora Bassa (HCB), but the parastatal Electricidade de Moçambique (EM) controls the sales of the output. The dam and hydroelectric plant and about 900 km of transmission lines were built with the expectation that the bulk of the sales would be to the Republic of South Africa's Electricity Supply Commission (Escom), and about 200 MW of this was to be returned to Mozambique (Maputo) via the South African grid. Owing to civil unrest, power generation at Cabora Bassa ceased in 1983, and in 1984, Escom waived all rights to the future output, save the 200 MW needed to replace that supplied to Mozambique. Negotiations were ongoing during the year among HCB, EM, Escom, and Zimbabwe Electricity Supply Authority (ZESA) toward supplying 500 MW of Cabora Bassa power to Zimbabwe. A link between the Cabora Bassa and ZESA would cost about $130 million. In addition, the parties discussed plans to double the Cabora Bassa output capacity by the installation of five new 400-MW generators on the vacant north bank of the dam.

OUTLOOK

Further positive developments in Mozambique are dependent on termination of the ongoing civil strife. In terms of mineral production, the near-term outlook is for Mozambique to become a significant producer of titanium minerals and a modest producer of gold. In the intermediate term, it appears likely that coal production will return to levels approaching the installed capacity of the mines. In the longer term, it is likely that new coal mines will be developed, allowing a major increase in coal exports. Mozambique has the potential to become a significant producer of graphite. The country may resume production of tantalum and related minerals and significantly increase its production of gem stones. Mozambique has large natural gas reserves, and it is likely that these will be developed in the next decade. In contrast, the outlook for the discovery and development of petroleum reserves is only modestly encouraging.

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[1]Where necessary, values have been converted from Mozambique meticais (M) to U.S. dollars at the rate of M747 = US$1.00.

OTHER SOURCES OF INFORMATION

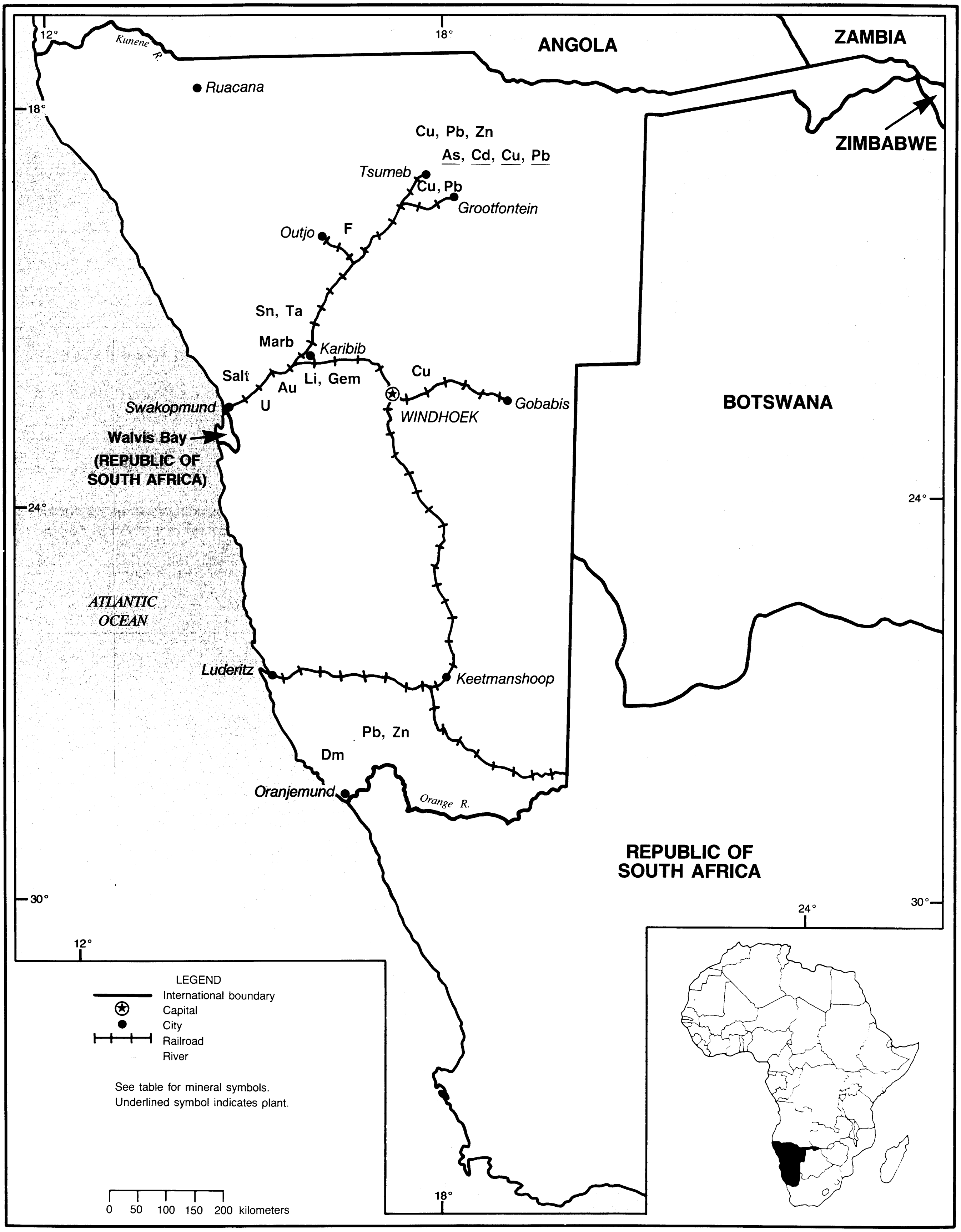
Ministério dos Recursos Minerais
Direcção Nacional de Minas
C.P. 2904, Maputo, Mozambique

Departamento de Cartografia e Produção de Cartas
Direcção de Geologia Regional
Instituto Nacional de Geologia
C.P. 217
Maputo, Mozambique

Empresa Nacional de Hidrocarbonetos de Moçambique
C.P. 2904
Maputo, Mozambique

NAMIBIA

AREA 823,000 km² **POPULATION 1.4 million**



THE MINERAL INDUSTRY OF

NAMIBIA

By George A. Morgan

Production of most minerals declined in 1989, primarily because of mine or plant related problems. Copper output and recovery of associated byproducts declined owing to exhaustion of reserves and to mine related difficulties. The production base for gold expanded with the startup of the Navachab Mine. Output of fluorspar at the Okorusu Mine showed signs of increasing with upgrading of the plant. The industry overall prepared for a new regime with modifications of the mining code underway and the gaining of the country's independence on March 21, 1990. The mining sector accounted for 28.1% of the gross domestic product, 18.6% of taxes collected, and nearly 73% of total foreign exchange earnings in 1988, the latest data available.

GOVERNMENT POLICIES AND PROGRAMS

The new Government released a policy document on the mining industry and its position relative to Namibia's economy. The Government indicated that it was favorably disposed to mining enterprises, and would welcome both exploration and new investment. However, nationalization or part Government ownership of certain mining operations was a long-term prospect. The Commonwealth Fund for Technical Assistance (CFTC), through its Technical Assistance Group (TAG), advised the Government to increase revenue from the sector by 6%. The Government also made a formal request to CFTC through TAG to draft new legislation for the mining industry. The Government was particularly interested in the diamond sector, and was considering a joint venture with Consolidated Diamond Mines (Pty.) Ltd. (CDM). Also considered was Government marketing of about 10% of CDM's production; currently all output is marketed by the Central Selling Organization of DeBeers Consolidated Mines Ltd.

The basic mining law of Namibia is the Mine Works and Minerals Ordinance 20 of 1968. The law vests ownership of all mineral resources in the state. The Rossing uranium mine reportedly remains subject to the Nuclear Energy Act of South Africa. The effective tax rate for most mining companies is 60% of net profits, with various deductions allowable.

PRODUCTION

Production and exports of mineral products are required to be reported to the Ministry of Mines and Energy. Production statistics are generally available from the Chamber of Mines, which represents most of the mining enterprises in Namibia.

Output of copper and its byproducts, antimony, arsenic, cadmium, lead, and silver, declined owing to a shortage of ore. The shortage was caused by exhaustion of reserves and delays in reactivating the flooded Kombat Mine. Gold output, normally stable at under 200 kilograms per year owing to its byproduct nature, increased sharply with commissioning of the Navachab Mine, a primary gold producer. The reported existence of other nearby ore bodies suggests the potential for further expansion of production. Dimension stone production increased as the quality and accessability of Namibian marble and granite, along with higher demand, led to further sales in the Republic of South Africa and Europe.

Funding for exploration in Namibia was entirely from companies in southern Africa. Prospecting by members of the Chamber of Mines amounted to $25[1] million in 1989, up 61% over that of 1988. The Department of Economic Affairs reported the issuance of 177 new prospecting licenses, the registering of 1,637 new claims, and the awarding of 31 new prospecting grants in 1989.

TRADE

Namibia exports nearly all its mineral industry products. Total exports were $1.006 billion in 1989, and total imports were $918 million. An estimated 75% of total exports were mineral based in 1989. Tin, zinc, lead, and some copper, as well as building stone and salt are exported to the Republic of South Africa. Western Europe is the major recipient of most of the remaining output, including uranium. Trade with African countries other than the Republic of South Africa is primarily for exports of salt and meat. Namibia remains a member of the Customs Union, which includes Botswana, Lesotho, the Republic of South Africa, and Swaziland. At official independence in March 1990, trade sanctions by the United States on Namibia were removed. Total U.S. exports to Namibia were $12.7 million, and total imports from Namibia were $14.7 million. Imports by the United States from Namibia have historically been small, and have included fluorspar and limited other minerals, while U.S. exports to Namibia have generally consisted of machinery, equipment, and some chemicals. An expanding agricultural sector made possible by a well developed water distribution system may lead to higher fertilizer imports by Namibia.

STRUCTURE OF THE MINERAL INDUSTRY

Practically all mining enterprises are privately owned, and most are represented in the Chamber of Mines. The chamber had 32 members in 1989, representing a total mine labor force of 12,776, compared with a labor force of 13,073 in 1988. The mine labor force has declined nearly 15% since 1985, while total cash remuneration, excluding housing, medical care, and transportation, to the labor force was about $112 million, up 85% in the same time period.

The Government reportedly has an effective controlling interest in the Rossing uranium mine through the Capricorn Trust, in which it has 3.5% equity. The latter, the result of arrangements between the Industrial Development Corp. of South Africa and RTZ Corp. of the

TABLE 1

NAMIBIA: PRODUCTION OF MINERAL COMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
METALS						
Antimony, Sb content of sodium antimonate		—	—	24	[r]73	[3]34
Arsenic, white		2,471	2,208	1,864	2,983	[3]2,399
Cadmium metal, refined		58	61	51	106	[3]88
Columbium and tantalum: Tantalite concentrate, gross weight	kilograms	[r]3,113	8,186	13,809	6,905	[3]5,730
Copper:						
Mine output, Cu content of concentrate		48,036	49,591	37,557	40,892	[3]26,929
Metal, blister		43,295	45,688	35,488	39,970	[3]37,978
Gold, Au content of smelter products	kilograms	194	184	172	195	[3]336
Lead:						
Mine output, Pb content of concentrate		34,640	37,494	32,997	37,200	[3]23,710
Metal, refined		38,511	40,047	40,634	44,447	[3]44,183
Silver, mine output, Ag content of concentrate	kilograms	105,876	107,525	103,264	116,520	[3]108,247
Tin, mine output, Sn content of concentrate		984	880	1,097	1,182	[3]1,120
Uranium, U_3O_8 content of concentrate		4,400	3,990	4,175	4,100	4,100
Zinc, mine output, Zn content of concentrate		[r]30,332	35,371	39,650	36,694	[3]41,675
INDUSTRIAL MINERALS						
Diamond:						
Gem[e]	thousand carats	865	970	970	890	910
Industrial[e]	do.	45	40	50	48	17
Total	do.	910	1,010	1,020	938	[3]927
Granite		NA	71	730	2,783	[3]6,496
Limestone and marble		35,209	33,829	[e]32,000	7,695	[3]11,663
Lithium minerals:						
Amblygonite		49	52	106	147	[3]131
Lepidolite		71	52	61	18	[3]41
Petalite		1,763	751	749	1,477	[3]1,226
Total		1,873	855	916	1,642	1,398
Mica		—	—	—	—	—
Quartz		300	851	2,173	48	100
Salt		153,447	134,644	125,031	125,387	[3]142,102
Semiprecious stones:						
Agate		65	87	100	99	[3]93
Amethyst		21	37	189	115	[3]149
Beryl		2	4	1	1	[3]—
Chrysocolla	kilograms	NA	1,000	8,250	8,200	[3]8,000
Dioptase	do.	NA	520	60	60	[3]190
Rose quartz		299	172	365	896	[3]602
Sodalite		140	NA	—	100	50
Tourmaline	kilograms	745	2,878	1,709	223	[3]973
Silica:						
High-purity		946	1,041	2,190	2,100	2,200
For flux		645	5,918	[e]6,000	[e]6,000	6,200
Sulfur, S content of pyrite concentrate		107,718	133,824	74,354	[e]134,500	135,000
Wollastonite		373	601	500	500	500

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through July 24, 1990.
[2]Data are compiled from the annual reports of the Chamber of Mines of Namibia, the Ministry of Mines and Energy, and from operating company annual reports as follows: Tsumeb Corp. Ltd. (TCL), South African Iron and Steel Corp. Ltd., Gold Fields Namibia Ltd., DeBeers Consolidated Mines Ltd., and others as available.
[3]Reported figure.

United Kingdom, reportedly provides the Government with 50% of the voting rights with the right to appoint a board director. Drilling and contract services for oil and gas are provided by the Government's South West African Oil Corp. (Swacor). The First National Development Corp. Ltd., formed in 1978 and funded by Government revenue, provides expertise and seed money for various projects, including mining, which show prospects for labor utilization and industrial output. The Geological Survey provides basic mapping services, and also assists in monitoring oil and gas activities in Namibia.

COMMODITY REVIEW

Metals

Copper.—A shortage of ore, brought about by depletion of reserves, mine strikes, and mining problems at several mines reduced the supply of domestic concentrates as well as smelter output at Tsumeb Corp. Ltd. (TCL). Exploration intensified in the vicinity of the Tsumeb smelter to locate minable copper resources. The Tsumeb Mine, near Tsumeb, reportedly had about 5 years of reserves, or 3.5 million tons of ore, available for extraction. Mining below the 1.6 kilometer (km) current depth of the mine was believed to be uneconomic for a sub-level shaft system. A copper prospect west of Tsumeb had a preliminary estimate of 10 million tons grading about 1.5% copper. TCL also smelts imported concentrates, and purchases hand-cobbed production from local farmers and ranchers.

Gold.—The Navachab Mine, southwest of Karibib, was commissioned in November 1989, only 5 years since discovery. The open pit mine is on a 60-meter (m) deep, 300-m wide, and 800-m long ore body plunging about 15° N. Actual mining is by a local drilling and transport contractor. Ore is variously classified as mottled dolomitic marble, banded grey marble, and banded calc-silicate marble, with 1.3 grams per ton (g/mt) as the cutoff grade of definable ore. Material below this grade is stockpiled, however, for possible future processing. Ore classified as high grade exceeds 3.5 g/mt. Transport is by truck to the northern border of the pit for blending and crushing; a 1.2 km covered conveyor moves ore crushed to minus 200 millimeters to the mill. Cyanidation, resin absorption, elution, and regeneration constitute the main plant. Output at full capacity was planned to be 1.5 tons per year of bullion grading 85% gold, and 15% silver with minor copper. Sales are directly to Switzerland.

Tin.—The Uis Mine, about 150 km northwest of Karibib, produced about 85,000 tons per month of ore grading 0.135% tin, and is one of the largest hard-rock tin mining operations in the world. All production is from open pits in a low-grade tin-bearing pegmatite belt containing a reserve of 70 million tons grading 0.135% tin. Some open pit mines are about 4.5 km from the plant, further increasing the cost of production. Concentrate is bagged in 40 kilogram reinforced plastic bags and trucked 200 km to a railroad siding in Swakopmund for transport to the Vanderbijlpark steel plant of the Iron and Steel Corp. of South Africa,

TABLE 2

NAMIBIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Copper	Tsumeb Corp. Ltd. (100% Gold Fields Namibia Ltd.)	Tsumeb	15,500 Cu in concentrate 58,000 blister copper.
Do.	do.	Kombat, 50 kilometers south of Tsumeb	12,000 Cu in concentrate.
Do.	do.	Otjihase,[2] near Tsumeb	16,500 Cu in concentrate.
Diamond	Consolidated Diamond Mines (Pty.) Ltd. (100% DeBeers Mining Corp.)	Oranjemund	1 million carats per year.
Fluorspar	Okorusu Fluorspar (Pty.) Ltd. (26% South African Iron and Steel Corp.; private citizens)	Okorusu	40,000 98% calcium fluoride.
Gold	Navachab Gold Mine Co. (70% Erongo Mining and Exploration Co. Ltd.; 20% Metall Mining Corp. of Canada; 10% Rand Mines Windhoek Exploration Co. Ltd.)	Navachab	1.5 Au.
Marble	Karibib Marble (100% Wittreich (Pty.) Ltd.)	Karibib	2,500 cubic meter per year marble; 600 cubic meters per year of granite.
Lithium	SWA Lithium Mines (Pty.) Ltd.	Near Karibib	1,500 concentrate.
Salt	Salt Company (Pty.) Ltd.	Swakopmund	150,000.
Tin	Imcor Tin (Pty.) Ltd. (100% South African Iron and Steel Corp.)	Uis, 100 kilometers north of Karibib	1,200 Sn in concentrate.
Uranium	Rossing Uranium Corp. (RTZ Corp., United Kingdom; Government 3.5%.)	Rossing, 30 kilometers east of Swakopmund	4,800 uranium oxide.

[1]Tons per year unless otherwise specified.
[2]The Otjihase Mine is a joint venture: 70% Gold Fields Namibia and 30% Johannesburg Consolidated Investment Co. Ltd. of South Africa.

near Johannesburg. Concentrate is also purchased from several hundred local diggers, each of whom produces, through hand winnowing methods, about 2 kilograms per day of coarse concentrate grading about 68% tin. Efforts were underway to increase recovery of byproduct columbite-tantalite, and muscovite, from the operation.

Industrial Minerals

Diamond.—Output was about 1 million carats per year of primarily gem diamond from coastal mining operations. These operations extend from the mouth of the Orange River north to latitude 26 at Hottentots Bay, north of Luderitz. Consolidated Diamond Mines (Pty.) Ltd., the largest producer, had a new mining site at Auchas, about 30 km east of Oranjemund on the Orange River, with a projected output of 40,000 carats per year. Two sampling plants were also operational at Bogenfels and Elizabeth Bay, on the coast south of Luderitz, where diamond prospects were under evaluation. Seaward mining is made possible by the erection of containment areas enclosed by manmade seawalls. A system of water wells 1 m apart along the main benches of the pit prevents water destabilization of the sand barrier. Actual mining is by scrapers, excavators, and front-end loaders, and transport is by truck to one of four processing plants.

Fluorspar.—Okorusu Fluorspar (Pty.) Ltd. commenced output from the Okorusu Mine east of Outjo in late 1988, and by late 1989 had reached a targeted production capacity of about 40,000 t/y grading over 98% CaF_2. Mining was from the flank of a 320-m high hill, in an area containing 6 million tons of reserves in three zones averaging 57% CaF_2. Blue, green, and yellow varieties of fluorspar, the latter associated with radioactive alteration, are found in cavities as euhedral crystals. Equipment modifications since commissioning include installation of a larger grizzly and primary crusher, and replacement of a diesel powered generator with a tie-in to the national electrical grid.

Lithium.—SWA Lithium Mines (Pty.) Ltd. was the main producer of lithium minerals, primarily petalite and amblygonite, in Namibia. Output from mines near Karibib is about 110 tons per month of hand-cobbed ore. The sporadic nature of economic reserves in the host pegmatite is the main inhibitor of increased output. Mining is by room and pillar, and transport by bucket loader for crushing and hand picking of marketable product. Very little lepidolite is produced; most output is petalite and amblygonite in the ratio of 10:1, respectively. Output has been as high as 700 tons per month. Byproducts include quartz, sugary albite, potash feldspar, pollucite, microlite, columbite-tantalite, beryl, and some bismutite and pyrolusite.

Salt.—Production is by the Salt Company (Pty.) Ltd., in Swakopmund, from man-made evaporation ponds. Total salt recovery area is 385 hectares. Salt harvesting is by modified scraper-elevators in two sweeps of the pan, each sweep removing about 15 centimeters of salt. The salt is cleaned with brine water, dried by centrifuge, and then screened into coarse and fine fractions. Salt for cattle consumption is sold both domestically and exported, while the bulk of exports is for chemical use. The company provides for Namibia's human needs of about 1,000-t/y total consumption, and also exports salt to central Africa for human consumption.

Mineral Fuels

Uranium.—The Rossing Mine, reportedly the largest open pit uranium mine in the world, was operating at about two-thirds of a total capacity of about 5,800 t/y U_3O_8. Five benches were worked and efforts were underway to push back the north side of the pit to work another five benches. The waste to ore stripping ratio on the north side was 3:1. Primary blasting of the tough Alaskite ore is often incomplete, and oversized boulders are hand drilled and blasted. Health and safety considerations are paramount at the mine, and rehabilitation plans for the site following exhaustion of reserves are continually modified for improvement. Exploration for additional uranium was underway; of particular interest were intersecting fault structures associated with dome structures in the vicinity of the existing mine. Mechanization and improvements at the mine, as well as sanctions prohibiting the export of uranium to the United States, resulted in a labor force reduction to 2,300 from 4,000 over a period of several years. The lifting of sanctions was expected to improve the potential for uranium sales from the underutilized plant.

Reserves

Reserves of diamond at CDM's operations were estimated by the company to provide 10 years of production at current output levels, or about 1 billion carats. Total copper reserves are not reported. However, based on individual mine data from mines in the Tsumeb group, positive and probable reserves for the Kombat Mine, plus recoverable copper in reported reserves at the Tsumeb and Otjihase Mines may total about 270,000 tons of contained copper. The Rossing Mine, the only active uranium producer in Namibia, estimated reserves at about 26 years at current production levels, or about 100,000 tons of U_3O_8. Gold reserves at the Navachab Mine, the only primary gold producer in the country, are estimated by the company to last about 13.4 years, or about 20 tons of gold from the existing ore body. However, as with copper other prospects are being evaluated, and these data may represent minimum reserve levels. Total tin reserves at the Uis Mine, the only tin producer excluding tributors, were 70 million tons grading 0.135% tin.

INFRASTRUCTURE

Existing mining installations are, for the most part, well serviced by railroad and paved road. Railroad traffic connects with port facilities at Walvis Bay, which is South African territory, or with the Republic of South Africa directly. Energy requirements are supplied by the South West African Water and Electricity Corp.; peak consumption is reported to be 200 megawatts (MW). Total peak supply is about 600 MW, including supplies from the South African national grid, and the average price is about 2 cents per kilowatt hour. A single thermal power station in Windhoek has a capacity of 120 MW, while the hydroelectric powerplant at Ruacana, south of the Kunene River, has a capacity of 240 MW. A 2.5 MW diesel plant serves the Caprivi area of northeast Namibia. The Namibian power grid is connected with the South African power network, from which another 200 MW can be drawn. About 240,000 t/y of coal is imported for electricity generation.

OUTLOOK

The mining sector and the transportation sector, with their mutual reliance upon each other, are expected to remain the main areas of activity, with most foreign exchange derived from mineral exports. Trade and communication may be expected to increase between Namibia and countries outside the Rand area, such as Angola and Zimbabwe. The construction trades, with their heavy requirements of sand, gravel, and cement, are in a major upswing, which may be expected to continue for some time. The enactment of a new mining code, as well as taxation policy, may have considerable effect, both on existing operations and new mining enterprises. Additionally, the new Government has indicated that it would seek part ownership in certain mining companies, but specific policy changes have not yet been made.

[1]Where necessary, values have been converted from rands (R) to U.S. dollars at the rate of R2.26=US$1.00 for 1988 and R2.62=US$1.00 for 1989.

OTHER SOURCES OF INFORMATION

Agencies

Chamber of Mines,
PO Box 2895,
Windhoek, Namibia

Geological Survey,
PO Box 2168,
Windhoek, Namibia

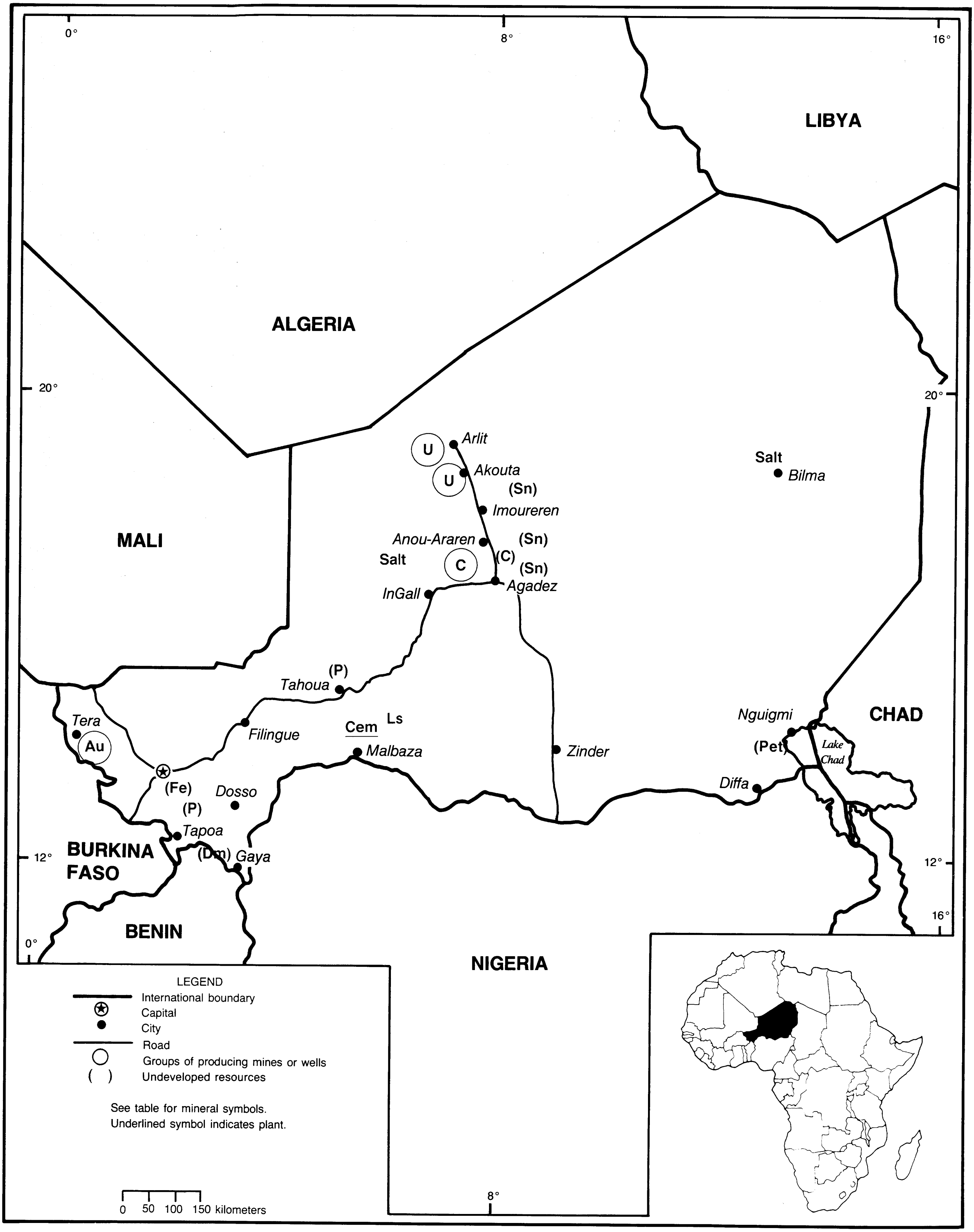
Ministry of Mines and Energy,
P/Bag 13297,
Windhoek, Namibia

Publications

Namibia, Development and Investment, Oct. 1989. First National Development Corp.

NIGER

AREA 1,267,000 km² **POPULATION 7.9 million**



THE MINERAL INDUSTRY OF

NIGER

By David Izon

Niger remained the world's seventh largest producer and third largest exporter of uranium in 1989. The mining sector dominated the economy mainly through the production of uranium, its principal foreign exchange earner. Niger had the fifth largest uranium reserves in the world. The minerals sector accounted for almost 9% of the gross domestic product in 1989. Uranium accounted for 75% of total export proceeds and about 15% of Government revenue. Although the annual export volume of uranium remained constant, the export contract price had declined steadily.

The Government encouraged joint venture or totally foreign controlled ventures in the minerals industry to avoid the country's almost total reliance on uranium exports. Exploration for gold was successful, but final arrangements were not completed to exploit the known deposits by some type of joint agreement with interested foreign firms. Private gold mining activities were common in 1989. The most recent major mineral initiative was made by Société des Salines de Tidekelt, mining salt from Tiggidan-Tessumt, north of In Gail. The Government was seeking to encourage and attract foreign and domestic private investment in all aspects of the country's economy with its liberal investment policies.

GOVERNMENT POLICIES AND PROGRAMS

Niger was undergoing a structural adjustment program of its economy in 1989. The goals of the program were to encourage nonmineral sector production, restrain civil service growth, reduce Government control of public companies, and increase public investment in infrastructure for the productive sector. The Government instituted two reform programs to implement these policies: the Economic Recovery Program (Program Significatif de Relance—PSR) and the Private Sector Support and Employment Generation Program (Program D'Appui Aux Initiatives Privees et a la Creation D'Emplois—PAIPCE). The adoption of the PSR had achieved price control reductions, relaxation of requirements for formation of new companies, reduction of tariffs and customs duties, and the privatization of 11 parastatals.

The Government was also undertaking a restructuring program for the uranium sector designed to reduce production costs to competitive levels relative to long-term contract prices. These were to include cost cutting measures at the level of the uranium companies themselves, especially with regard to wages and salaries, raw materials, reductions in electricity costs, and curtailing of other administration and transportation costs. Other policy objectives were directed toward diversifying the participation in exploration for and production of uranium and encouraging foreign investment with incentives in the form of tax breaks and the waiving of custom duties for imported materials. Results of the policies were yet to be fully realized. In 1989, France and the United States forgave certain debts owed by Niger.

PRODUCTION

Niger's mining industry was dominated by uranium production. Other mineral commodities produced included cement, clays, coal, gold, salt, and tin. Hindered by the uranium mines' high production costs, the Government had little success selling its uranium to new customers. Frequent mine collapses owing to heavy rains forced the Government to order the closure of gold mines exploited by small-scale miners in the Tsja region 100 kilometers (km) west of Niamey from June to September of 1989. Only one of the coal deposits was in production, in Anou-Araren, about 80 km

TABLE 1

NIGER: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic[e]	38,000	38,000	40,000	[3]26,400	[3]27,000
Coal	150,635	123,644	164,000	[e]160,000	[3]171,434
Gypsum[e]	3,000	3,000	3,000	3,000	3,000
Molybdenum concentrate, Mo content[e]	20	20	8	15	13
Phosphate rock, gross weight	200	—	—	—	—
Salt[e]	3,000	3,000	3,000	3,000	3,000
Tin, mine output, Sn content	134	80	94	119	[2]71
Uranium, content of concentrate	3,807	3,662	3,493	3,482	[3]3,013

[e] Estimated. [p] Preliminary.
[1] Includes data available through Dec. 20, 1990.
[2] In addition to the commodities listed, Niger also produced clay, gypsum, and sand and gravel for local construction purposes; however, available information is inadequate to make reliable estimates of output levels.
[3] Reported figure.

northwest of Agadez. Phosphate deposits at Tapoa in southwest Niger were estimated to contain about 400 to 500 million tons that had not been exploited. The Tahoua site was closed in 1984. Identified exploitable minerals in Niger include petroleum in Chad basin; bauxite and iron ore near Say, 50 km west of Dosso; diamonds in Liptako about 100 km northwest of Gaya; and lithium and manganese near Tera. Iron ore deposits were estimated to amount to about 650 million tons.

TRADE

Niger's major imports from the United States were food items, machinery, and spare parts valued at $10 million. Exports to the United States in the same period amounted to about $2 million. Total imports amounted to about $450 million in 1989, creating a negative trade balance of about $83 million. Principal export products for 1988 were uranium, agricultural products, and tin. In 1989, the value of uranium exports amounted to about $235 million. Areas of particular interest to the U.S. industries included oil exploration, industrial equipments, and other manufactured goods.

Niger's main trading partners were France and Nigeria. More than 80% of the country's recorded exports were to France, and 35% of imports were obtained from France, the largest purchaser of Niger's uranium. Niger imported vehicles, machinery, and electronic equipment from France and imported petroleum products and other consumer goods from Nigeria. Other important trading partners were the Federal Republic of Germany, Italy, and Japan.

STRUCTURE OF THE MINERAL INDUSTRY

The Government participated in equity sharing arrangements with several companies through its ministry of mines, Office National des Resources Miniere (ONAREM). Production of uranium concentrates were by two companies, the Sociéte des Mines de l'Air (SOMAIR) and Compagnie Miniere d'Akouta (COMINAK). There was no large-scale exploitation of gold in Niger. However, output by artisanal miners was significant. Major operating companies in the country were Societe Nigerienne de Charbon (SONICHAR) for coal, Societe Miniere du Niger (SMDN) for tin, and a joint venture of Elf Aquitaine Co. of France and Exxon Co. of the United States for oil exploration.

COMMODITY REVIEW

Metals

Gold.—Reports indicated that Niger had considerable gold potential, but the Government declined to lease a mining concession that had promise for future production. The Government was conducting a 3-year study on the extent of the gold deposits and their potential for production. At present, small-scale gold mining takes place in the Koma Bangou gold field, 120 kilometers northwest of Niamey, by artisanal miners. Most of the exploration and mining was centered in the Koma Bangou area. However, other deposits were known to exist along the Niger-Burkina Faso border. Details of the study delineating the extent of the resources were expected to be completed by 1991.

Tin.—Cassiterite was produced in small quantities from sites at El Mecki, Tarouadji, Timie, Agahak, and Cuissat in the Air Mountains. Tin was mined by private individual operators, but output was coordinated and marketed by Societe Miniere du Niger, a state-owned company. Production did not reach the planned level of 250 tons per year owing to lower demand in 1989.

Uranium.—Uranium concentrate was produced mainly from two concessions, one near the town of Arlit, 250 km northwest of Agadez, and the other at Akouta. The mines were operated by two independent companies, SOMAIR and COMINAK. SOMAIR operated three open pit mines near Arlit that produced uranium silicate while COMINAK operated a single underground mine at Akouta. Both companies were joint ventures between the Government

TABLE 2

NIGER: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Cement	Societe Nigerienne De Cimenterie. (Government, 100%)	Malbaza	37,000.
Coal	Societe Nigerienne De Charbon d'Anou Araren. (Government, 100%)	Anou-Araren	150,000.
Tin	Societe Miniere du Niger. (Government, 100%)	El Meki	100.
Uranium	Societe Des Mines De L'Air. (Government, 33%; Cogema-France, 27%; France's Coompagnie de Mokta, 19%; and Sogerem, 19%; Fed. Republic of Germany's Urangesellschaft, 6.5%; and Italy's Agip Uranio, 6.5%)	Arlit and Taza	3,500 combined.
	Compagnie Miniere d'Akouta. (Cogema-France, 34%; Government, 31%; Ourd-Japan, 25%; Enusa-Spain, 10%)	Akouta	2,000.

[1] Metric tons per year.

and several French, German, Japanese, and Spanish firms. The management of both companies were controlled by France's Compagnie Generale des Matieres Nucleaires (COGEMA), although the Nigerian Government held the largest equity shares in both firms.

Niger's total production for 1989 stood at about 3,000 tons (metal), a decline from the previous year stemming from low world demand for uranium and subsequent decline in prices. France, through its parastatals, was the largest buyer of Niger's uranium, accounting for about 75% of total sales. Most sales were made by long-term contracts to equity partners in the mining operations. France purchased Niger's uranium at premium rates and on occasions exceeded spot prices, considering Niger's uranium a critical reserve for its national thermonuclear energy program. This profitable arrangement for Niger decreased slightly in value each year the contracted quantity or price fell.

Production statistics to date at the Taza Mine, 4 km southwest of Arlit, had not been reported despite 2 years of operation. The open pit mine was on a concession owned by Societe Miniere de Tassa N'Taghalgue (SMTT) but was operated by SOMAIR. SMTT was a consortium of Cogema, Onarem, and Kuwait Foreign Trade and Contracting Co. in equal partnership. SOMAIR made an unspecified royalty arrangement with SMTT to operate the Taza deposit. The Taza deposit was estimated to contain approximately 57,000 tons of uranium metal, 21,000 tons of which were proven reserves. The shallower deposit at Taza was considered more economical for SOMAIR to bring on-line than deeper deposits in its own concessions. Initial studies estimated output from this mine to be about 1,000 tons per year of uranium, and expandable to 2,000 tons per year when the pit was enlarged.

RESERVES

There were no officially reported reserve figures for uranium in 1989, but Niger was estimated to have approximately 210,000 tons of uranium (metal) reserves that were commercially viable in the Arlit-Akouta region. According to the International Atomic Energy Agency's report and the Mining Journal, large deposits of uranium were also found in other parts of the country that remain undeveloped owing to the prevailing market conditions. Deposits at Imouraren, about 110 km south of Arlit, had an estimated 60,000 tons of uranium and an additional 187,600 tons of lower grade ore. Afasto-Ouest, midway between Imouraren and Arlit, had estimated reserves of 25,000 tons and an additional 60,000 tons of lower grade ore. Also, commercial deposits found at Akborun-Azelik were evaluated at 8,000 tons of uranium and an additional 1,700 tons of lower grade ore. There were also no official reserve figures for other minerals produced in Niger.

INFRASTRUCTURE

The transportation system in Niger was still inadequate, despite considerable road development. There were 39,970 km of roads in 1989. The total distance of paved roads were 13,500 km, of which 3,170 km was bituminous. The paved roads included a 902-km all-weather road between Niamey and Zinder and a 651-km "uranium road" from Arlit to Tahoua. Gravel and laterite roads covered a distance of 10,330 km—3,470 km was earthen and 23,000 km was tracks. There were no existing railways, but plans were under discussion to extend the Cotonou-Parakou line in the Republic of Benin to Niger. The inland waterway of the Niger River was navigable 300 km from Niamey to Gaya on the Benin border from mid-December to March. The bulk of foreign trade was shipped through Cotonou in Benin via the organization Commune Benin-Niger des Chemins de Fer et des Transports. Other transport routes were Burkina Faso, Nigeria, and Togo owing to the fact that Niger is landlocked. Ocean terminals in Benin and Togo were about 1,000 km from Niger.

There were 31 airports—29 usable and 7 with permanent-surface runways. The international airports were at Niamey and Agadez, together with four major domestic airports at Zinder, Diffa, Tahoua, and Dosso.

OUTLOOK

Uranium will remain the mainstay of the economy for the immediate future. However, in the long run, attention may be focused on new industrial development in Niger and should be gradually spread among other minerals such as gold, iron ore, and petroleum. The development of these resources will help to diversify the minerals industry, creating new jobs and providing new revenue sources for the country.

Although the short-term economic future of Niger is not very promising, uranium sales may improve as newly industrialized nations install thermonuclear plants for their energy needs. This is expected to provide new markets for Niger's uranium.

If sufficient amounts of iron ore are mined in Niger, the country may develop a steel industry or export its iron ore to neighboring Nigeria, which has great demand for iron ore in its steel industries. Also, efforts to explore for both fuel and nonfuel minerals may pay off in the foreseeable future. Particularly important is petroleum. Both Elf Aquitaine of France and Exxon have already established deposits of commercial quantity in the explored region. Prospects for commercial development of gold also appear good. The Government's economic recovery program, if continued, should improve the country's industrial growth. Foreign assistance in the mining industry is encouraging and is expected to continue when new deposits of mineral resources are found or confirmed.

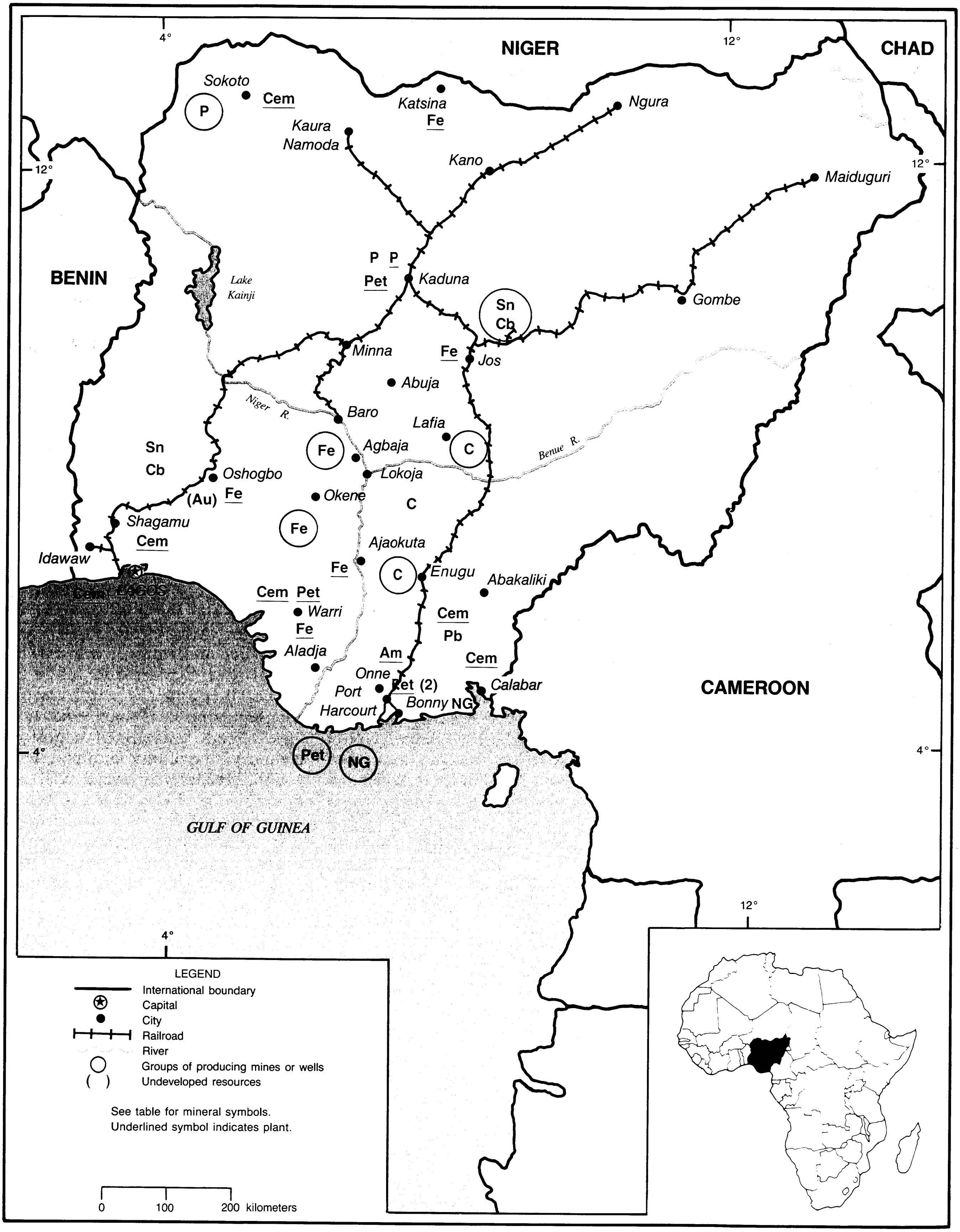
[1] Where necessary, values for Niger have been converted from Communauté Financière Africaine francs (CFA) to U.S. dollars at the rate of CFA310 = US$1.00 in 1989.

OTHER SOURCES OF INFORMATION

Office Nationale des Recherches Minieres,
B.P. 734,
Niamey, Niger

NIGERIA

AREA 923,770 km² **POPULATION 118.8 million**



THE MINERAL INDUSTRY OF

NIGERIA

By David Izon

In 1989, Nigeria was Africa's largest oil producer, accounting for 2.7% of world production, and became the 10th largest producer in the world. The hydrocarbon sector remained the mainstay of the economy, accounting for more than 30% of total gross domestic product (GDP), 75% of Government revenues, and about 90% of the country's export earnings. The country has considerable mineral wealth and potential for diversified development. Vast reserves of natural gas exist and have been barely exploited. The reserves of about 2.6 trillion cubic meters ranks Nigeria fifth in the world in natural gas resources. Its oil reserves were estimated to last about 40 years.

Revenues were significantly above the country's 1989 budget projections owing to the Middle East crisis, and Nigeria's foreign exchange reserves increased substantially during the year by about $1.4 billion. Nigeria was the second largest supplier of oil to the United States, accounting for 14% of U.S. total imports. The Government announced plans to give high priority to gas-based projects in an effort to diversify the country's hydrocarbon exports and ensure on-stream production by the mid-1990's. On June 30, 1989, the Government also announced the divestment of 20% of its interest in the liquefied natural gas (LNG) projects to its three partners. These projects were expected to become major foreign exchange earners. The Government announced its intention to establish several export processing zones, which were meant to encourage export-oriented investment.

GOVERNMENT POLICIES AND PROGRAMS

The thrust of Nigeria's economic policies and programs in 1989 were summarized in the Structural Adjustment Program (SAP) of the Government. As an integral part of the SAP, the Government instituted policies to remove the legal barriers that were erected in the past to limit foreign direct investment. A move was made to privatize or commercialize most of the nation's Government-owned corporations. To this end, average tariffs were lowered, businesses were permitted to remit 100% of their net profits, and expatriates were allowed to remit 75% of their salaries.

Because oil served as the main revenue source for the country, it was evident that the national policy was closely related to programs associated with fuel minerals. Nigeria's main policy was to maximize returns from petroleum exports by limiting domestic consumption. To this end, the Government adopted a policy to look for ways to substitute gas for other fuels for industrial and residential use, thereby freeing more crude oil for export. Progress was made on some of the major projects in the petroleum sector. Contracts were signed to build a petrochemicals plant at Eleme, near Port Harcourt, and develop the Oso condensate field, which was the core of the Nigerian LNG project. A new refinery was commissioned in Port Harcourt in March of 1989, which helped to alleviate the problems of product shortages created by an inadequate distribution system. The Government embarked on an incentive program that stressed the other factors of the economy such as agriculture and exploitation of other mineral resources.

The Nigerian Enterprises Promotion Decree, which had limited the number and types of businesses exclusively to Nigerians, was changed in December of 1989. This allowed foreign investors to own up to 100% of the equity if they invested the equivalent of $2.74 million as fully paid capital. A significant foreign exchange policy was adopted to move the exchange and interest rates closer to market value.

PRODUCTION

The mineral industry experienced some growth in 1989 resulting mainly from increased output of crude petroleum and natural gas. The Organization of Petroleum Exporting Countries was able to increase its total production ceiling to 19.5 million barrels per day (MMbbl/d), allowing member countries to produce above their allotted quotas. Most of Nigerian crude was produced by joint ventures between the state-owned Nigerian National Petroleum Corp. (NNPC) and 1 or more of 11 major international petroleum companies. Crude oil production in 1989 rose by 18% to 1.8 MMbbl/d. According to reports received, output of most other minerals declined in 1989.

TRADE

Nigeria recorded a trade surplus of $2.9 billion compared with $1.26 billion in 1988. Reports indicate that $2.58 billion was spent on imports in 1989, representing an increase of 46% over that of 1988. Mineral fuels, lubricants, and related materials accounted for about $7.508 billion or 89% of total export earnings in 1989. Mineral exports other than oil accounted for 4.9% of total exports. The United States remained Nigeria's largest export market, with imports from Nigeria amounting to about $4.6 billion in 1989, of which 98% was crude petroleum. The U.S. trade deficit with Nigeria in 1989 was more than $4 billion. The United States was the fifth most important supplier of industrial inputs and capital equipment. Other ma-

TABLE 1

NIGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[p]
METALS						
Columbium and tantalum concentrates, gross weight:						
Columbite		101	13	48	50	46
Tantalite		1	—	—	—	—
Iron and steel:						
Iron ore, gross weight	thousand tons	—	—	240	304	[e]300
Steel, crude	do.	254	200	184	192	[e]200
Lead:						
Mine output, Pb content[e]		260	100	86	85	[2]—
Metal, refined secondary		800	1,000	300	500	[e]500
Tin:						
Mine output, cassiterite concentrate:						
Gross weight		1,500	630	844	432	350
Sn content		1,100	460	603	300	[e]243
Metal, smelter		1,079	91	560	566	258
Zinc ore and concentrate, Zn content		1,000	([3])	([3])	([3])	—
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand tons	3,600	3,860	[e]3,800	[e]3,400	3,500
Clays:						
Kaolin		300	169	177	105	550
Unspecifed		20,000	15,000	15,000	15,000	13,341
Feldspar[e]		5,000	3,500	[2]485	190	[2]945
Nitrogen:						
N content of ammonia	thousand tons	—	—	225	377	364
N content of urea	do.	—	—	200	516	522
Stone:						
Limestone	do.	1,800	1,850	2,627	1,712	1,315
Marble		1,200	1,482	6,900	5,445	1,377
Shale	thousand tons	120	104	88	86	38
MINERAL FUELS AND RELATED MATERIALS						
Coal	do.	140	144	110	150	[e]150
Gas, natural:						
Gross	million cubic meters	17,499	18,179	18,687	20,740	24,831
Marketed	do.	3,058	3,285	2,852	3,193	3,833
Petroleum:						
Crude	thousand 42-gallon barrels	544,252	534,165	486,869	569,400	626,489
Refinery products:						
Gasoline	do.	23,000	18,600	19,000	21,000	23,337
Jet fuel	do.	400	400	490	500	[e]510
Kerosene	do.	10,200	8,700	9,000	10,600	11,873
Distillate fuel oil	do.	17,500	12,400	12,500	15,000	17,591
Residual fuel oil	do.	11,300	15,330	14,000	13,600	19,254
Unspecified	do.	3,650	4,700	5,000	5,000	2,274
Total	do.	66,050	60,130	59,990	65,700	74,839

[e]Estimated. [p]Preliminary.
[1]Includes data available through Oct. 15, 1990.
[2]Reported figure.
[3]Less than 1/2 unit.

jor trading partners were the United Kingdom, Japan, the Federal Republic of Germany, and France. The country was exploring ways of exporting its natural gas to the neighboring West African states.

STRUCTURE OF THE MINERAL INDUSTRY

The Nigerian mineral industry in 1989 was dominated by the oil and gas industry in terms of contributions to the country's GDP, employment, and export earnings. The Government had a 51% to 60% controlling interest in all foreign companies operating in the country. In an effort to commercialize its parastatal companies, Nigeria restructured its largest corporation, NNPC, into 10 subsidiary companies. They were to be run on a profit-and-loss basis without Government intervention. In June 1989, 20% of the Government's ownership of NNPC was sold to foreign partners to raise funds for successful operation of these new companies. Principal mineral agencies of the country included the Nigerian Mining Corp., Nigerian Coal Corp., NNPC, and the Nigerian Steel Development Authority. All other important minerals such as coal, columbite, and tin were mined by Government-owned companies or agencies.

COMMODITY REVIEW

Metals

Reports indicate that gold and lead occurrences were known in the country but were not economic for exploitation. In early 1989, a United Kingdom consultant, Mackay and Schnelman Ltd., in collaboration with Rockview International of France, undertook a feasibility study on small-scale production of base minerals from the Abakaliki deposits that had been extensively explored by the Nigerian Mining Corp. The results of this study revealed that lead-zinc-copper occurred in veins within a mineralized zone stretching from near Abakaliki in the southeast to Gombe in the northeast. The main ore minerals found were galena and sphalerite along the benue rift structure, with accessory barite and fluorspar.

Iron and Steel.—The National Iron Ore Mining Co. produced about 300,000 tons from the east and west open pit mines at Itakpe near Okene, with most of the output going to stockpile owing to structural and economic problems. The stockpile was destined for the Ajaokuta steel complex to be commissioned in 1992. Delta Steel Co. at Aladja, near Warri, produced direct-reduced iron (DRI) and cold briquetted iron (CBI), which serve as alternatives for pig iron in some cases. The billets from Delta and rolled products from the rolling mills can be fed to fabrications, machine, and forge shops. Required flat materials, medium-heavy sections, alloys, and special steel products for full development of the indus-

TABLE 2

NIGERIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity [1]
Coal	Nigerian Coal Corp. (Government, 100%)	Enugu	144,000.
Iron ore	National Iron Ore Mining Co. (Government, 100%)	Itakpe, near Okene	325,000.[e]
Iron and steel	Ajaokuta Steel Co. Ltd. (Government 100%)	Ajaokuta City	0.54 rolled steel.
Do.	Delta Steel Co. Ltd. (Government, 100%)	Aladja	1.00 liquid steel 0.32 rolled steel.
Do.	Jos Steel Rolling Co. Ltd. (Government, 100%)	Jos	0.21.
Do.	Katsina Steel Rolling Co. Ltd. (Government, 100%)	Katsina	0.21.
Do.	Oshogbo Steel Rolling Co. Ltd. (Government, 100%)	Oshogbo	0.21.
Nitrogen	National Fertilizer Co. of Nigeria (Government, 63%; M.W. Kellog, 37%)	Onne	1,500[2] N content of ammonia. 1,000[2] N content of urea.
Petroleum refinery products	Kaduna refinery (Government, 100%)	Kaduna	110,000.[3]
Do.	Warri refinery (Government, 100%)	Warri	125,000.[3]
Do.	New Port Harcourt refinery (Government, 100%)	Port Harcourt	150,000.[3]
Do.	Old Port Harcourt refinery (Government, 100%)	do.	60,000.[3]
Tin	Makeri Smelting Co. Ltd. (Government, 100%)	Jos	1,000.[4]

[1] Million metric tons per year unless otherwise specified.
[2] Metric tons per day.
[3] Barrels per day.
[4] Metric tons per year.

try can only be produced at Ajaokuta. There were eight steel plants in Nigeria capable of producing liquid steel. The Ajaokuta plant, when commissioned, will have a 1.30-ton capacity for liquid steel and 0.70 capacity for rolled steel per year.

Some of the pertinent problems facing the steel industry in Nigeria were dependency on imported inputs as feed materials, inadequate transportation system, and a lack of capital for proper funding of the projects. The ores that occur mainly around Okene and Agbaja near Lokoja were of a low grade and required beneficiation before being usable in the steel industry.

The $250 million Itak beneficiation plant was established primarily to supply iron ore for the Ajaokuta and Delta steel plants. It was capable of processing 5 million metric tons per year (MMmt/yr) of ore to yield 2.15 MMmt/yr of 55% iron-blast-furnace feed. The Government expected to complete the Itakpe Project by 1991 to reduce the importation of iron ore and save the country more than $70 million annually in foreign exchange. Because the Ajaokuta and the Itakpe Projects were still under construction, the higher grade ore required for direct feed into the furnace was imported from Liberia and Brazil for use at Delta's direct-reduction plant at Aladja. Also, steel billets were imported from Western Europe for the Government's three rolling mills.

The 51-kilometer Itakpe-Ajaokuta rail line project, which was designed to facilitate transportation of iron ore from Itakpe to Ajaokuta, was only 60% completed at yearend 1989. When completed, the rail line will carry 2.7 million tons of ore to the steelmaking facility. Other secondary and service roads were not yet completed. Production of raw material requirements in the country, such as graphite in the form of electric arc furnace electrodes, is very feasible. This is because graphite is produced from petroleum coke, which is derived from the refineries but is also very capital intensive. Funding so far by the Government had enabled the National Iron Ore Mining Co. to produce and stockpile a substantial quantity of iron ore and encouraged continued development of the project. However, the Government was unable to receive expected funding for the Ajaokuta Project through the World Bank and other international funding institutions. Stiff competition from foreign steel companies also contributed to undercut the ability of the Nigerian steel industry to generate enough funds to finance its projects.

Emphasis was also being placed on achieving a high level of production at the Delta Steel Co. and the three State-owned rolling mills at Katsina, Jos, and Oshogbo. The combined production of these plants was projected to reduce imports significantly.

Tin.—Official output of tin was reported at 1,200 tons per year. An additional estimated 400 tons may have been lost through smuggling to neighboring countries. The sole tin smelting company in Nigeria was the State-owned Makeri Smelting Co., which continued to operate well below capacity. Nigerian tin was mined commercially from alluvial deposits by two major companies, Consolidated Tin Mines Ltd. and Nigerian Tin and Allied Minerals Products Ltd. Cassiterite was mined in association with columbite, tantalite, and tungsten minerals.

INDUSTRIAL MINERALS

Fertilizer and Fertilizer Materials.—The National Fertilizer Co. of Nigeria (NAFCON) was the only plant producing ammonia and urea. The existing facility at Onne, near Port Harcourt, maintained its output of about 1,000 tons per day of ammonia at 97% of capacity. The complex also produced 1,500 tons per day of urea, as well as various nitrogen-phosphorous-potash (NPK) fertilizers. The plant was a joint-venture operation between the NNPC and M.W. Kellog Co. of the United States, which owns 35% of NAFCON. Natural gas for NAFCON was supplied from the Alakiri Field through a 14-kilometer pipeline system.

Mineral Fuels

Coal.—The Enugu coal field was the primary producing field in the country. Production was maintained at about 144,000 tons per year, mainly for use by the National Electric Power Authority (NEPA), the Nkalagu cement factory near Enugu, and the Nigerian Railway Corp. The Enugu-type coals were of low grade and showed very little coking properties for use at Ajaokuta. The Lafia-type coals were of a medium rank that had good coking properties but had high-ash and high-sulfur contents. Intensified exploration activities for coal were reported in 1989, which confirmed the existence of coal in other areas, such as at Lafia near Jos and the eastern and north-central parts of the country. The Government had envisaged to increase its production capacity to export coal. Production of coal was solely by the Nigerian Coal Corp.

Natural Gas.—Nigeria produced about 24,831 million cubic meters of natural gas in 1989, of which 15% was utilized. Most of the gas was produced as associated gas from oilfields, and about 73% of the gas produced in 1989 was flared. Gulf Oil Co. of Nigeria had proposed to gather all the associated gas from three of its fields as feed to a processing plant for production and export of natural gas liquids. The gas that remained after stripping was expected to be sold locally. The plant was to begin operation by 1995 with an initial capacity of 4.25 million cubic meters per day. NNPC markets the gas used in the country through its subsidiary, the Nigerian Gas Co.

In January of 1989, the Utorogu gas plant near Bonny was commissioned with an installed capacity of 7.65 million cubic meters per day. In May 1989, the shareholders and NNPC signed an agreement forming the Nigerian Liquefied Gas Co. (NLG). The contract for construction of the processing unit was awarded to Technip of France and M.W. Kellog of the United States. Shell Petroleum Co., another shareholder, acquired two tankers to transport the LNG for export. The plant was designed to be built at Bonny near Port Harcourt at a cost of $2.5 billion. Development and production costs were expected to be low because of the already existing infrastructure and the low impurities level of the gas used. NNPC set up a dedicated account to pay for its share of the startup costs and capital requirements. Construction was scheduled to begin in 1991 with export of LNG scheduled for 1995.

Petroleum.—The production of crude oil rose from 569.4 million barrels (MMbbl) in 1988 to about 626 MMbbl in 1989. During the first half of the year the production rate increased from 1.46 MMbbl/d in January to 1.86 MMbbl/d in June. In July, the rate decreased slightly but averaged about 1.8 MMbbl/d during the second half of the year.

Exports fluctuated from about 70% of production in February to about 90% in August, but averaged 83% of production for the rest of 1989. The balance of exports was disposed of mainly in deliveries to local and offshore refineries.

Exploration and Development.—Eleven companies explored for, developed, and produced crude oil in Nigeria. Eight of the 11 companies had joint ventures with NNPC, which had a 60% share in all of them. Shell Oil Co. was the largest producer of crude oil in the country, accounting for 50% of total production. The other joint-venture companies, in descending order of production, were Chevron (known as Gulf in Nigeria), Mobil, Agip Energy and Natural Resources Co.-Phillips, Elf Aquitaine, Texaco-Chevron, Ashland, and Pan Ocean. The production companies that were not joint ventures with NNPC were Ashland Oil Co., Dubri Oil Co.—the only private Nigerian-owned company—and Tenneco Oil Co. Tenneco sold its shares in the Nigerian company to British Gas but still retained its name.

The total number of wells drilled increased to 92 in 1989; 30 were exploratory and 62 were appraisal-development wells. Oil was discovered in 75 of the 92 wells, resulting in an 81.5% success ratio.

Several other activities were also underway. Shell Petroleum Development Co. planned to increase its $700 million investment in 1989 to $1.2 billion by 1992 and aimed at increasing its productive capacity to 1.3 MMbbl/d. Mobil developed the Iyak Field, which currently has a peak capacity of 52,000 barrels per day (bbl/d). The company expects reserves to total about 150 MMbbl by 1993. Gulf discovered new fields with reserves of about 300 MMbbl, which will augment the Escarvos Field crude production by 1993. Elf began developing two offshore fields, Obagi and Ukpomani, having an estimated output capacity of 95,000 bbl/d and 35,000 bbl/d, respectively.

Refining and Marketing.—Nigeria had four refineries with a combined design capacity of 445,000 bbl/d. The combined output for the year was 62% of capacity owing to various technical problems and fire at the Warri refinery. There were two refineries in Port Harcourt, the old one and a new one built near it. The new Port Harcourt refinery, commissioned in March 1989, was designed to meet rapidly rising domestic demand for petroleum products and operated at 75% of capacity. The Kaduna refinery was closed for 2 months in 1989 for its biannual turnaround maintenance and operated at 55% of capacity while the Warri refinery operated at 58% of capacity. Most products were used in the country except the heavier products, which were exported. Supply of crude oil to the domestic refineries increased by 6% over that of the previous year. Nigeria's plans to acquire equity in overseas refineries had been temporarily suspended. The infrastructure for distribution of petroleum products remained inadequate.

Petrochemicals.—A new development project for the Nigerian petrochemical industry was designed to be implemented in three phases. Phase I and phase II were designed to manufacture nitrogen and plastic products, respectively. Phase III, which will not begin until phase II has been completed, will produce advanced petrochemicals of simple aromatic-xylene type. The engineering, procurement, and construction contracts for phase II has been awarded to a consortium composed of Japanese, French, and Italian companies. The estimated costs of the projects were more than $1 billion. Export marketing agreements have been signed with Dupont Chemical Co. of Canada and Tochiat International of Italy. Contractors for the construction were Chiyoda and Kobe of Japan, Tecnimont of Italy, and Spie Batignolles of France. Plants constructed under phase I of the project were reported to have operated at 20% of optimum capacity.

Reserves

Nigeria was estimated to have oil reserves of approximately 16 billion barrels, which could be increased to 20 billion barrels by 1993. Known natural gas reserves were also estimated to be 2.6 trillion cubic meters. Almost 70% of the reserves were onshore and all were in the Niger Delta. Nigeria's oil reserves had high gas-oil ratios, and most of the new gas discoveries occurred during oil exploration. The total in situ reserves of Nigerian coal were put at 1.5 billion tons. A lignite belt exists across the southern portion of the country. Reserves of the lignite deposits were not accurately known but were believed to be as much as 300 million tons. Iron ore resources were estimated at about 800 million tons with an iron content averaging about 37%. There were no reported reserve figures for columbite, feldspar, lead, phosphate, tin, zinc, and other minerals.

INFRASTRUCTURE

The Nigerian railway systems, the fifth largest in Africa, consisted of 3,510 kilometers (km) of 1.067-meter gauge railroad. The two main north-south lines, from Lagos to Nguru (1,376 km) and from Port Harcourt to Maiduguri (1,443 km), were connected by an east-west line from Kaduna to Kafanchan (179 km). There were also five branch lines with railheads at Nguru, Kaura-Namoda, Jos, Idogo, and Baro. The Ajaokuta-Port Harcourt line was still under construction in 1989.

Highways totaled about 120,000 km of which 35,000 km was surfaced. Inland waterways of about 9,000 km consisted mainly of the Niger and Benue Rivers, their tributaries, and the navigable routes to Kainji Lake. The Kainji Dam was the major source of hydroelectric power for the country. A second hydroelectric dam at Shiroro, 60 km north of Minna, was finally commissioned in 1989. The associated power station was designed to release an additional 600 megawatts into the national grid, providing an expected wider and more predictable electricity supply. The Shiroro Project put Nigeria at an advantage of being able to have full control over the dam's water source. Major ports included Lagos, Port Harcourt, and Koko near Warri. Major airports were in Lagos (Murtala), Kano in the north, Port Harcourt, and most recently at Abuja, the proposed new capital of the country.

OUTLOOK

Petroleum and natural gas will remain the mainstays of the economy for the foreseeable future. However, the center of new industrial development in Nigeria will continue to be based on the successful completion and operation of the iron and steel complexes. The steel complex at Ajaokuta is expected to be commissioned before the end of fiscal year 1991. With the development of the steel industry, heavy equipment and metalworking industries are expected to grow, providing jobs for the extensive labor force yet untapped.

Exploitation of recent coal discoveries will reduce the importation of coal and coke, saving the Government several million dollars that may be used to fund other capital ventures. Some of the raw materials will continue to be imported because domestic supplies were insufficient. The mineral industry as a whole should continue to enjoy considerable growth because of increasing activity in the mineral fuels sector. The output of crude petroleum is expected to be raised to 2 MMbbl/d by 1995. Because of the abundance of natural gas, attention is continuously being drawn toward the promotion of gas utilization for an energy source and for a chemical and petrochemical feedstock.

Nigeria's enormous foreign debt of $30 billion will continue to limit its efforts at undertaking giant fiscal projects that are aimed at promoting rapid industrial growth. Future growth opportunities in the joint ventures will depend on the ability of NNPC to fund its majority interest in the new investment programs. If current oil prices remain effective for a prolonged period, Nigeria's goals of achieving industrial stability in the future may be feasible. Natural gas is expected to displace a small percentage of oil products from the local market and emerge into a substantial export business at the completion of the LNG program. When outlined plans for a pipeline system to neighboring countries are completed, gas could play a significant part in slowing the deforestation of West Africa. Various fiscal and financial incentive programs to encourage local and foreign investment in new development of the mineral industry is expected to continue through the mid-1990's.

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[1]Where necessary, values have been converted from Nigerian naira (N) to U.S. dollars at N7.65 = US$1.00 in 1989.

OTHER SOURCES OF INFORMATION

Agencies

Federal Office of Statistics
Former Ministry of Health Building
Broad Street
Lagos, Nigeria

Federal Ministry of Mines, Power, and Steel
Six Storey Building, Broad Street
Lagos, Nigeria

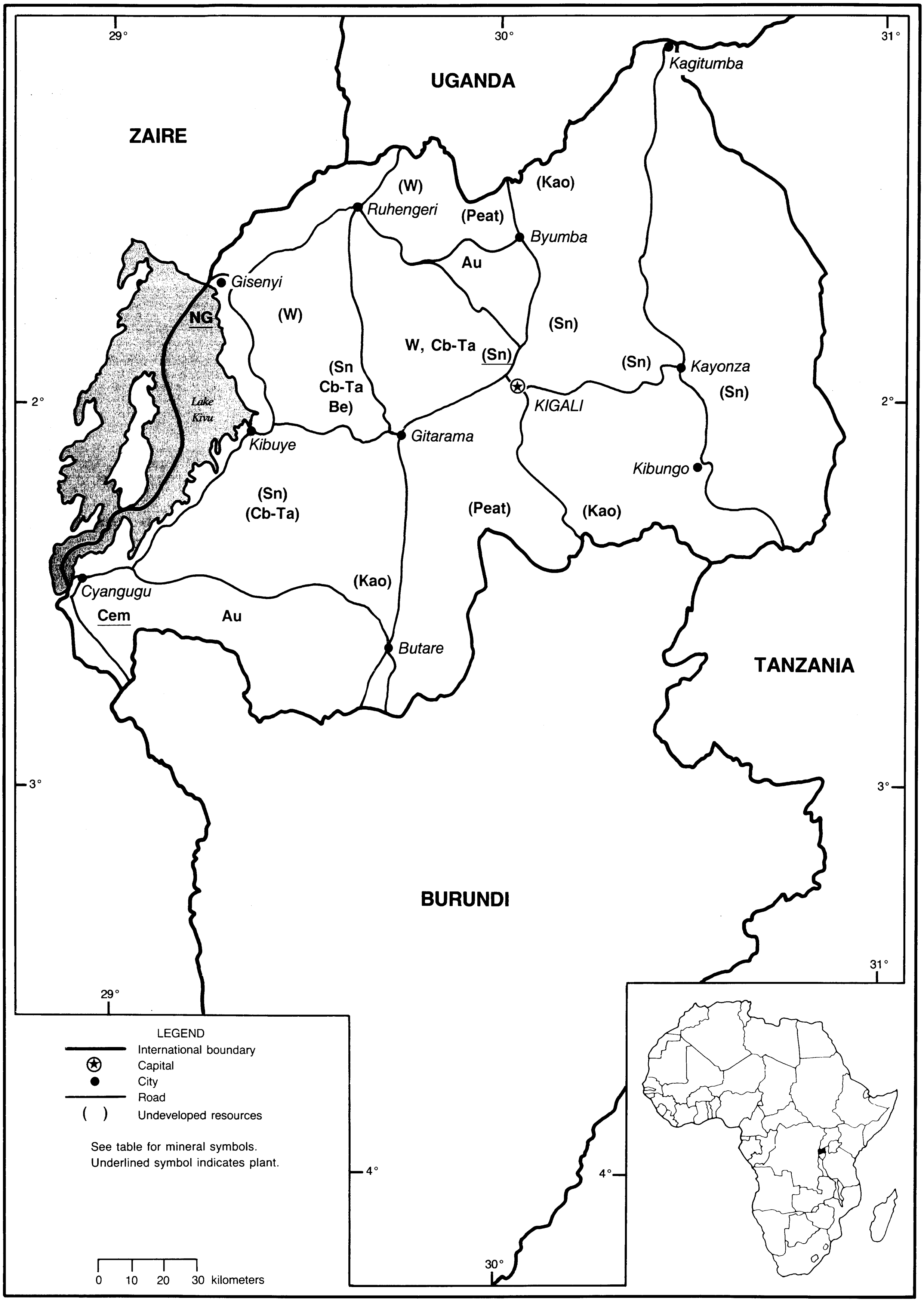
Nigerian National Petroleum Corp.
Falomo Office Complex, P.M.B. 12701
Lagos, Nigeria.

Publication

Nigerian Oil Directory, John West Publications Ltd., 1989.

RWANDA

AREA 26,340 km² **POPULATION 7.5 million**



THE MINERAL INDUSTRY OF

RWANDA

By Lloyd E. Antonides

The mineral industry of Rwanda remained small in 1989, as it has since the late-1985 bankruptcy of Societe Miniere du Rwanda (SOMIRWA), which had been, in effect, the country's only formal mining entity for more than 15 years. However, the rugged highland country, which contained portions of the Nile and Zaire River basins as well as an active volcanic area, had considerable mineral potential.

Before SOMIRWA's financial failure, minerals contributed about 20% to Rwanda's export earnings. However, at that time only about 2% of the gross domestic product (GDP) was attributed to the industry, even though it involved more than 7,000 formal employees and more than 10,000 individual workers. In 1989, the officially French-speaking country's very dense and rapidly growing population derived its livelihood mainly from subsistence farming and coffee cultivation, with coffee and tea exports being major sources of foreign exchange.

In 1989, the GDP was estimated on the order of $2 billion[1] and remained one of the world's lowest on a per capita basis. Nevertheless, although the estimated inflation rate of about 4% was higher than in recent years, it was still reasonably low. With coffee prices continuing to fall from the peak in the late 1970's and the economy being increasingly strained, continuation of foreign financial aid was an important factor in the fiscal picture.

GOVERNMENT POLICIES AND PROGRAMS

The Government of Rwanda long maintained a liberal approach to trade and investment. Its legislation encouraged foreign investment. A new investment code went into effect in 1987 that simplified procedure and offered more incentives. The Government considered how to restructure the industry, especially the tin sector, and has regularly budgeted for studies. In late 1989, a World Bank report stated the Government had not yet resolved how to proceed but was planning to implement a project to train artisans in mining-related activities. A 51% Government-owned agency, Regie d' Exploitation et de Development des Mines was created in 1988 for the purpose of reopening 20 old tin and tungsten mines.

PRODUCTION

Only gold and cement were produced. Crude construction materials were also produced, but available information is inadequate to make estimates of the quantities produced. Additionally, almost 1 billion cubic meters per year of methane natural gas from beneath Lake Kivu was produced from a pilot plant. The brewery in Gisenyi was the primary consumer as in past years.

TRADE

Mineral trade statistics are not available for Rwanda for recent years. In the

TABLE 1

RWANDA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Beryllium: Beryl concentrate, gross weight[3]		27	—	—	—	—
Cement		15,000	52,577	57,073	58,073	67,706
Columbite-tantalite, ores and concentrate, gross weight[4]		28	—	—	1	64
Gold, mine output, Au content	kilograms	7	6	9	15	731
Tin:						
Mine output, Sn content		813	29	—	1	762
Smelter output, Sn content[e]		800	—	—	—	—
Tungsten, mine output, W content		167	13	11	3	105

[e]Estimated. [p]Preliminary.
[1] Includes data available through July 1, 1990.
[2] In addition to commodities listed, various crude construction materials (clays, sand and gravel, stone, etc.) presumably are produced, but information is inadequate to make reliable estimates of output.
[3] Estimated 10% BeO.
[4] Reported 27% Ta_2O_5 (estimated 22% Ta plus 30% Cb).

past, Europe, especially Belgium, was the destination of almost all mineral commodities from Rwanda.

STRUCTURE OF THE MINERAL INDUSTRY

The Government was a major participant in mineral ventures in Rwanda in the recent past and planned to continue to play such a role with formation of the new Regie d'Exploitation et de Development des Mines in 1988. Most actual production historically was by individual artisans or small cooperatives.

COMMODITY REVIEW

Metals

Gold was the only commodity of significance produced in Rwanda, and artisanal operators continued to be active, but with very low reported output.

Reserves

Although a large number of deposits were referenced by general size and recorded by the French Bureau de Recherches Geologiqes et Minieres (BRGM) on a map published in 1982 for the Government of Rwanda, data are not available on reserves.

INFRASTRUCTURE

The road network in Rwanda was extensive, about 12,500 kilometers (km), of which about 1,000 km was paved or was being paved, another 1,750 km was gravel, and the balance was earth. The rugged terrain meant high maintenance and construction costs as well as vehicle operation costs. The principal roadwork effort was on main international roads. Routes into Tanzania, Uganda-Kenya, and Burundi-Lake Tanganyika were important links with rail and road systems to the Indian Ocean Ports of Mobassa (Kenya) and Dar es Salaam (Tanzania) about 1,500 km east of Kigali.

Lake Kivu provided some low-cost transportation to a limited area, and the international airport at Kigali was an important factor in the transportation picture.

Ample hydroelectric power and the availability of methane and peat for fuel were advantageous to further industrial and mine development. However, the distribution system was still rather limited.

OUTLOOK

No major mineral production was expected for at least a few years pending the Government's resolution of a comprehensive plan of action and the outcome of the new agency's efforts.

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[1] Where necessary, values have been converted from Rwanda francs (RF) to U.S. dollars at the rate of RF79.98 = US$1.00 for 1989 values.

OTHER SOURCES OF INFORMATION

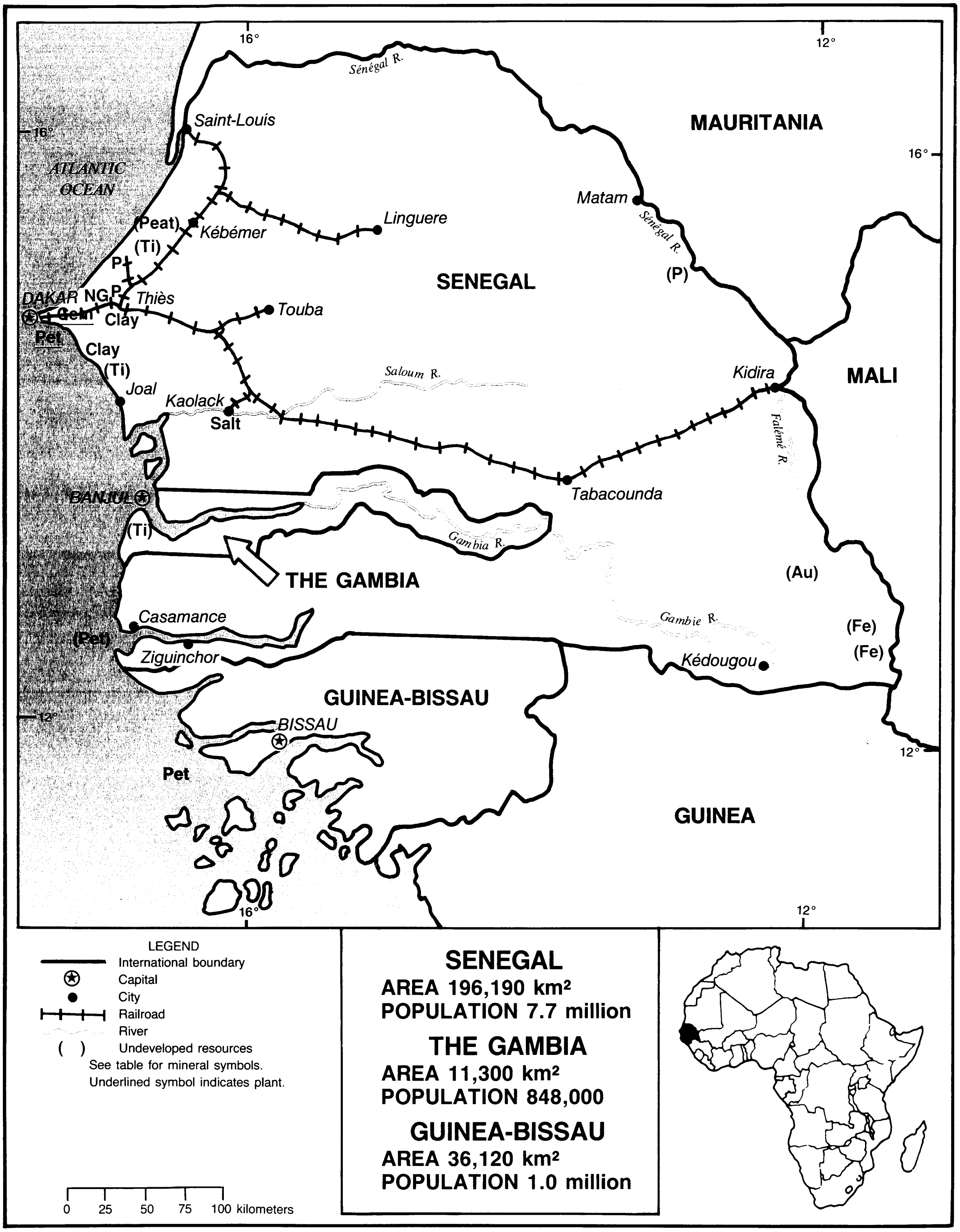
Agency

Ministry of Industry and Crafts
Republic of Rwanda
P.O. Box 73
Kigali, Rwanda
Phone: 011-250-75417

Publication

Map of Mineral Deposits of Rwanda, Ministry of Natural Resources, Republic of Rwanda, 1982.

SENEGAL, GUINEA-BISSAU, THE GAMBIA



THE MINERAL INDUSTRIES OF

SENEGAL, THE GAMBIA, AND GUINEA-BISSAU

By Hendrik G. van Oss and David Izon

SENEGAL

The production of mineral commodities was a significant factor in the Senegalese economy, accounting for an estimated 11% of the country's 1989 gross domestic product of about $4.6 billion,[1] if sales of petroleum products and manufactured fertilizers are included. Exports of mineral commodities accounted for an estimated 23% of Senegal's total exports. Of total exports, primary mineral exports accounted for 10%, fertilizer exports were 9%, and petroleum product exports the rest. The primary mineral industry was dominated by the production of calcium and aluminum phosphates, which made up 87% of the country's primary mineral exports, and 59% of total primary mineral sales, including those to the domestic market. Approximately 20% of Senegal's total imports were mineral commodities, largely crude oil and petroleum products, and sulfur and ammonia for the fertilizer industry. Exploration was ongoing during 1989 for additional phosphate reserves, crude oil and natural gas, and titaniferous sand deposits.

Most of Senegal is made up of Mesozoic and Tertiary sedimentary rocks of the Senegal Basin. Lower Tertiary rocks host the country's phosphate and clay deposits. Salt beds in Jurassic rocks offshore have yielded salt diapirs; some of these have formed stratigraphic traps for oil derived from Cretaceous source rocks. Other hydrocarbon traps are associated with folds that appear to have been formed by normal faulting related to the opening of the Atlantic Ocean. Senegal's coastline contains a large resource of titaniferous sands, presumably derived from Precambrian granites outside of Senegal and deposited in Senegal by longshore currents. In southeast Senegal, straddling the border with Mali, is a triangular window, about 200 kilometers (km) on a side, of lower Proterozoic granites and volcano-sedimentary rocks of the Birimian Series. The eastern one-third of this terrane lies within Mali. A number of gold deposits are known from this terrane, generally in quartz veins and/or iron sulfides, and commonly associated with northeast-trending shear zones. Large deposits of iron ore are also found in this terrane, as are scattered occurrences of base metals, tantalum, and columbium mineralization.

Government Policies and Programs

The Senegalese Government is an enthusiastic supporter of and major participant in the mining sector of the economy. A high priority of the Government is the development of nonphosphate mineral commodities for which reserves are fairly well known, notably titaniferous sands, iron ore, gold, and peat. Oil exploration is encouraged, and toward this end, bidding was opened in May 1990 for an offshore block adjoining Guinea-Bissau waters.

In an effort to encourage mineral exploration in Senegal, the Government has drafted new legislation governing new ventures in this sector. In 1986, a new petroleum code was adopted, thus abrogating the Petroleum Code of 1960. The new petroleum legislation was followed by the adoption of a new investment code, Law No. 87-25 of July 30, 1987. Apart from detailing certain licensing and tax exemptions for new investments, the new investment code identifies mining as a high-priority sector of the economy. A new mining code, Law 88-06, was adopted August 26, 1988, in time for the signing of a major agreement with an international company for the exploration and potential development of Senegal's resources of titaniferous sands.

Production

The production of most mineral commodities declined slightly in 1989. The decline in calcium phosphate production was entirely due to a decrease in output from Compagnie Sénégalaise des Phosphates de Taïba (CSPT), the larger of the two producers of this commodity. Crude aluminum phosphate production by Société Sénégalaise des Phosphates de Thiès (SSPT) was reported to be nil, but this reporting is believed to reflect the fact that all of the mine output was calcined. In previous years, quantities of crude aluminum phosphate were marketed directly, but in 1989, there was a lack of demand in Europe for the raw product. There was, however, relatively strong demand for calcined aluminum phosphate, which is commonly reported as clinker. A significant increase in the output of this product was reported, and on the basis of this output, a figure for crude product production was estimated.

Attapulgite production, from both SSPT and Compagnie des Produits Chimiques et Matériaux, fell significantly, largely owing to a reduction in demand. Although reported data for 1989 are incomplete, salt production appears to have increased significantly after a poor year in 1988. A portion of CSPT's total calcium phosphate production was sold to Industries Chimiques du Sénégal (ICS), and that firm's production of phosphoric acid in 1989 fell slightly to 188,573 tons. Production of mixed manufactured fertilizers by ICS fell 3% to 116,779 tons.

Natural gas production data for the year are not yet available. Toward yearend 1988, the country's sole producer reportedly had an output of 500,000 cubic feet per day. Efforts during 1989 to increase this output apparently were unsuccessful; output indeed may have declined, based on the decline in reported crude petroleum output, much of it condensate, from the same wells.

TABLE 1

SENEGAL: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
Cement, hydraulic	metric tons	406,890	[r]359,446	372,071	390,956	379,793
Clays: Fuller's earth (attapulgite)	do.	[3]95,957	[3]81,857	[3]111,048	118,725	98,882
Petroleum:						
Crude	thousand 42-gallon barrels	—	—	[e]11	20	13
Refinery products:						
Gasoline	do.	[e]540	550	800	951	[4]2,261
Kerosene and jet fuel	do.	[e]400	400	576	799	652
Distillate fuel oil	do.	[e]680	650	1,270	1,564	[e]2,000
Residual fuel oil	do.	[e]790	750	1,395	1,815	1,493
Other	do.	[e]20	20	43	[e]44	[e]57
Refinery fuel and losses	do.	[e]230	230	213	227	[e]185
Total	do.	[e]2,660	2,660	4,297	[e]5,400	[e]6,648
Phosphate rock and related products:						
Crude:						
Aluminum phosphate	thousand metric tons	355	131	191	119	[e 5]115
Calcium phosphate	do.	1,814	1,850	1,874	2,326	2,273
Manufactured:						
Aluminum phosphate, dehydrated[6]	do.	200	60	89	61	100
Other[7]	do.	8	5	4	2	2
Salt	metric tons	[r]145,770	[r]114,15	75,442	75,000	[e]100,000

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Includes data available through Nov. 9, 1990.
[2]In addition to the commodities listed, Senegal produced clay, sand and gravel, and stone for local construction purposes, and natural gas for electricity generation. Information is inadequate to make reliable estimates of output levels, although, at yearend 1988, gas production was reportedly at a rate of 500,000 cubic feet per day.
[3]Attapulgite production for 1985-87 is for Société Sénégalaise des Phosphates de Thiès (SSPT) only. Data are unavailable for the production from Compagnie des Produits Chimiques et Matériaux for this period, although it was likely to have been about 10,000 metric tons per year.
[4]Includes gasohol, reported as 66% of total production.
[5]Output was reported by SSPT as nil. Estimate based on required usable crude output for reported clinker (dehydrated aluminum phosphate) production.
[6]Derived from crude product output, including any stockpiled from previous year.
[7]SSPT products marketed under the trade names "Balifos" and "Phospal."

Trade

Exports from Senegal totaled approximately $801 million in 1989. The value of mineral commodity exports declined almost 25% to an estimated $111 million. This included reported non-oil mineral commodity exports of $81.2 million, a 7% decline. Mineral commodities were the third most valuable class of exports after fish and groundnuts. Despite a decline in exports of about 7% to about $67 million, calcium phosphates continued to be by far the dominant mineral commodity traded. All of the aluminum phosphate exports in 1989 were as calcined product, worth almost $4 million. Although this was a large increase over the 1988 exports of calcined product, it was a 9% decrease over the combined value of 1988 exports of aluminum phosphate plus calcined product from the company concerned. Attapulgite exports declined about 25% owing to a decrease in sales. The value of salt exports was essentially unchanged at about $4.5 million. Manufactured fertilizer exports from ICS, not included in the mineral commodity exports total previously mentioned, increased 17% to $72.6 million. Petroleum product exports, much of which were to Mali, were worth an estimated $30 million, an apparent decrease of about 50%.

About 76% of Senegal's calcium phosphate was exported; most of the remainder was sold locally to ICS. The largest foreign purchaser of Senegalese calcium phosphates was the Philippines, which took 17.4% of the total production. Other major customers were India, which took 13.5%; Spain, 10%; France, 8%; and Greece, 7%. Sales to the European Community (EC) accounted for 26% of the total output of calcium phosphate compared with 33% in 1988. This decline in part reflects recent EC environmental laws restricting the imports of commodities containing cadmium. In common with that of Togo, Senegalese phosphate is relatively high in cadmium. The decline in trade with the EC has been offset by an increase in phosphate sales to other countries, such as Canada, Cyprus, and Japan. Belgium and France took most of Senegal's calcined aluminum phosphate production. France and the Netherlands were the major customers for the country's attapulgite production. India took all of Senegal's phosphoric acid exports of 153,093 tons. In addition to phosphoric acid, ICS exported 91,647 tons of manufactured fertilizers. Although France purchased a small quantity of fertilizer, the bulk of the ICS fertilizer exports went to nearby African countries or was sold domestically.

Senegal's imports in 1989 totaled about $1 billion. Of this amount, mineral commodity imports are estimated to have accounted for about 20%. Of this trade, crude oil and petroleum product imports in 1989 are estimated to have been worth about $180 million. Imported mineral inputs for the fertilizer industry were worth an estimated $15 million, of which sulfur imports accounted for about 90%. Although petroleum products were imported from a variety of sources, Nigeria provided about 70% of Senegal's crude oil imports and Gabon the rest. In past years, Senegal has also imported crude oil from Angola. Senegal imported a reported $7.7 million in sulfur from the United States in 1989, which was the only significant mineral trade between the two countries. Canada supplied the rest of Senegal's sulfur imports.

Structure of the Mineral Industry

In 1989, the mining industry of Senegal was dominated by the production of phosphates. Calcium phosphates were mined by two companies, one of which also produced aluminum phosphate, calcined phosphate (clinker) for fertilizer, and attapulgite or fuller's earth. Attapulgite was also produced by another company, largely for drilling mud. The cement company produced its own cement clinker from domestically mined limestone. Salt was produced by one company by the evaporation of seawater. Senegal had one producing gasfield, of erratic output, which also produced a minor amount of petroleum, largely as gas condensate.

Calcium phosphate-base fertilizers and phosphoric and sulfuric acids were produced primarily by one company using domestic calcium phosphates and imported sulfur and ammonia.

An estimated 4,500 persons worked in the mining and related industries, of which about 2,400 were employed in phosphate mining and about 1,000 in the fertilizer industry. In addition, the majority of the country's approximately 2,000 railroad employees and a significant proportion of Dakar's port workers owed their livelihood to the transportation of mineral commodities.

Commodity Review

Metals.—Following the October 1988 signing of an agreement with the Government, Du Pont Senegal Inc., a subsidiary of E.I. du Pont de Nemours & Co., commenced detailed exploration of its concession for titaniferous sand deposits. Sampling south of Dakar began early in 1989, and the coastline between M'Bour and Joal was drilled between June 1989 and February 1990. In March 1990, the drill rigs were moved north of Dakar to an area west of Kébémer. The company is hoping to delineate a deposit capable of producing 100,000 tons per year of heavy-minerals concentrate containing mostly ilmenite, with minor rutile and zircon.

Industrial Minerals.—The output of the country's largest phosphate producer, CSPT, declined 2.5% to 2,189,000 tons of calcium phosphates. The decrease was attributed to a higher stripping ratio in the mine. Sales to overseas customers declined 20% to 1,420,865 tons owing in part to declining purchases by EC customers concerned about the high cadmium content of CSPT phosphate. The exports were worth $64.5 million. The Philippines was CSPT's largest customer, taking 28% of the company's exports. This, however, was a 29% decrease from 1988 levels. India took 22% of the total exports, a slight decline. Exports to France and Greece declined 13% and 22%, respectively, and were each 10% of total exports. Exports to Great Britain declined almost 94% to 11,330 tons. Spain's imports increased 42% to almost 220,000 tons; this was the only increase in sales to an EC country. In contrast to 1988, CSPT made no sales to Australia or South Korea, but added Mexico as a new customer. CSPT had local sales of 526,270 tons, slightly less than in 1988. These sales were worth $13.3 million. As in years past, virtually all of the company's local sales were to ICS for the manufacture of fertilizers.

In May 1989, it was announced that India's Minerals and Metals Trading Corp. had agreed to carry out a phosphate exploration program for CSPT as part of a barter arrangement whereby India would receive a discount on future phosphate purchases. The exploration was to take place around the Keur Mor Fall deposit, currently being mined in the hopes of finding higher grade, shallower material that would allow a return to higher production levels. It was further reported that in the meantime, CSPT would switch part of its operations to the nearby Tobène deposit.

Production of calcium phosphate by SSPT increased slightly to 83,600 tons. Virtually all of this production, worth $2.45 million, was exported. France purchased 58% of the exports, a 21% decline. In contrast, Greece's purchases, which were 32% of the total exports, represented a 122% increase. Côte d'Ivoire purchased 5% of the output, and the rest was sold locally. Traditionally, SSPT's major product has been aluminum phosphates. When calcined and ground, the product can be used directly as a fertilizer. In past years, because of high energy costs in Senegal, only about one-half of the material was calcined in country; the rest was sent to Europe where energy costs were lower. Demand for the raw product had been declining since 1987, and the company reported no production or sales of this commodity in 1989. Production did occur, however, albeit at reduced levels, to provide raw material for the calcined product. In 1989, all of the product evidently was calcined and reported as clinker, or, to a much lesser extent, the calcined and ground product called Phospal. Clinker sales increased 27% to 86,261 tons. France purchased 62% of this; Belgium, 35%; and Great Britain, the rest. SSPT was also one of two producers of attapulgite. Demand in 1989 was poor for this clay, and output fell 16% to 90,582 tons. France purchased 58% of the exports and the Netherlands 39%.

Production of phosphoric acid by ICS declined slightly to 188,573 tons, and fertilizer production fell slightly to 116,779 tons. Exports of phosphoric acid increased 3% to 153,093 tons, worth almost $54 million. All of the acid exports were to India. Fertilizer exports increased 34% to 91,648 tons, worth $18.7 million. Local sales, however, fell 14% to 15,971 tons, worth an estimated $3.3 million. Fertilizer sales to Europe fell 86% to 5,857 tons, worth $700,000, apparently because of European concerns about the high cadmium content of the material. France was the only European customer in 1989.

Mineral Fuels.—Output of petroleum products from Société Africaine de Raffinage (SAR), the country's only refinery, apparently increased significantly. This performance was despite the loss of about 40 days of production as a result of three extended shutdown periods for maintenance. Local de-

TABLE 2

SENEGAL: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Attapulgite	Compagnie des Produits Chimiques et Matériaux (Carbonisation et Charbon Actifs of France, 70%; other French shareholders, 30%)	Open pit mining of 4 deposits at Nianing, 80 kilometers southeast of Dakar	20.^{e}
Do.	Société Sénégalaise des Phosphates de Thiès (SSPT) (Rhône Poulenc Group of France, 50%; Government, 50%)	Open pit mine 15 kilometers southwest of Thiès	120.^{e}
Cement	Société Ouest-Africaine des Ciments (Government, 100%)	Limestone quarry and cement plant at Rufisque, 20 kilometers east of Dakar	700 kiln output.
Crude oil and natural gas	Tullow Oil PLC of Ireland (operator in joint venture with state-owned Société des Petroles du Sénégal)	Diam Niadio Gasfield, 40 kilometers northeast of Dakar	NA.
Petroleum products	Société Africaine de Raffinage (Société Nationale Elf Aquitaine of France, 30.0%; Royal Dutch/Shell, 23.6%; British Petroleum, 11.8%; Total of France, 11.8%; Mobil Corp., 11.8%; Government, 10%; Exxon Corp., 1.0%)	Oil refinery near Dakar	24[2] crude input.
Phosphates	SSPT	Open pit mine 17 kilometers north of Thiès	375^{e} aluminum phosphate.
Do.	Compagnie Sénégalaise des Phosphates de Thaïba (CSPT) (Government, 50%; Compagnie Française des Mines, 14.64%; others,[4] 35.36%)	Open pit phosphate mines at Thaïba, 38 kilometers north-ortheast of Thiès	2.3[3] calcium phosphate.
Do.	SSPT	Open pit mine near Thiès	90^{e} calcium phosphate.
Salt	Société Nouvelle des Salins de Siné-Saloum (Government; Compagnie des Salins du Midi et des Salines de l'Est of France)	Marine salt recovery ponds west of Kaolack	175.^{e}

NA Not available.
[1] Thousand metric tons per year unless otherwise specified.
[2] Thousand barrels per day.
[3] Million metric tons per year.
[4] The other owners of CSPT are Nouvelle Compagnie Financière pour l'Outre-Mer of France, 13.65%; International Minerals and Chemical Corp. of the United States, 10.42%; Caisse des Dépôts et Consignations of France, 4.26%; Banque Internationale pour le Commerce et l'Industrie au Sénégal, 3%; others, 4.3%.

mand for light petroleum products in 1989 was well in excess of refinery output; accordingly, imports of petroleum products increased 105% to about 322,000 tons. Local demand for fuel oil fell, reflecting, perhaps, the contribution of local natural gas output to the country's power generation.

A small amount of crude oil, mostly natural gas condensate, has been produced since late 1987 from the Diam-Niadio Gasfield, operated by Tullow Oil PLC of Ireland. The gas output is burned in a power station 18 kilometers (km) east of Dakar. Toward yearend 1988, natural gas production reportedly was at a rate of 500,000 cubic feet per day, but complete production data for 1988 and 1989 are unavailable. The company drilled three wells in the Diam-Niadio and nearby Kabor Gasfields in 1988 in an attempt to increase output. In 1989, the company drilled three more wells in these fields, but they were abandoned as dry after only minor shows. Walter International & Associates acquired the 75-square-kilometer (km^2) Rufisque offshore permit, about 80 km south of Dakar, which is part of the acreage dropped during the year by Marathon Oil Co. Walter drilled a wildcat on the Rufisque permit but abandoned it as dry after reaching a depth of 1,112 meters (m).

There was no reported onshore geophysical exploration conducted in 1989; however, a 3,600-line-km offshore seismic-gravity-magnetics survey was run for the Government petroleum agency Société Nationale des Petroles du Sénégal. In addition, 800 line-km of seismic data covering the Dôme Flore area, 60 km offshore Casamance, was reprocessed for the Government. This geophysical work was done in preparation of a promotional package for a 6,500-km^2 offshore block covering the Dôme Flore area. The block was opened to bidding in May 1990.

Reserves.—Exploration for phosphates has been ongoing in Senegal for about 50 years. The first commercial deposit was that of aluminum phosphate near Thiès, which has been in production by SSPT since 1949. The large calcium phosphate deposits at Taïba have been in production since 1960, and the calcium phosphates near Thiès have been in production since 1974. As outlined by the Government,[2] phosphate deposits are known to exist in many parts of the country, and although many have been extensively sampled, few have shown sufficient continuity to be envisioned as economic, and fewer still have published reserves. Near Thiès, SSPT has reserves of aluminum phosphate of about 100 million metric tons (MMmt) grading 27.5% P_2O_5, within which inventory are reserves of about 50 MMmt grading 28.5% P_2O_5. Original reserves of calcium phosphate on SSPT concessions totaled about 4 MMmt grading about 29.5% (concentratable to 34%) P_2O_5. Approximately 25% of this inventory had been mined by yearend 1989. Remaining reserves of calcium phosphate at the Keur Mor Fall deposit exploited by CSPT are 35 MMmt grading about 29% P_2O_5, concentratable to 37.5% P_2O_5. The adjoining Tobène deposit, reportedly about to go into production, has reserves, according to the company, of about 50 MMmt, capable of being concentrated to 36.2% P_2O_5. A number of phosphate occurrences are known just south of the Mauritania border in the Sénégal River valley. The largest resource is in two deposits near Semmé, 60 km southeast of Matam. The total resource at Semmé is 40.5 MMmt (36.5 MMmt recoverable) grading 28.7% P_2O_5. Development of the Semmé phosphates, except on a very small scale for local consumption, would require the construction of railing and port facilities, the cost of which has been estimated to be in excess of $100 million. Given the large remaining reserves in the Taïba-Thiès area, the Semmé deposits are not likely to become economic for many years.

Senegal has had past small-scale mining of titaniferous sand deposits. Numerous studies have been done to determine reserves of heavy minerals. Although resources in excess of 1 MMmt of heavy-mineral concentrates, dominantly ilmenite, have been delineated, the true reserves are not yet known. Results of Dupont's ongoing exploration program had not been made public as of yearend 1989.

Numerous gold occurrences are known in the Precambrian terrane of southeast Senegal. The Sabodala deposit, about 75 km north of Kédougou, is the only occurrence examined to date that may warrant exploitation. Société Minière de Sabodala, a joint venture between France's Bureau de Recherches Géologiques et Minières, 51%, and the Government, was formed in 1983 to explore and develop the deposit. According to the Government, a feasibility study completed in 1982 concluded that reserves amounted to 240,000 tons of oxide ore grading 7.42 grams of gold per ton, plus 2.42 MMmt of sulfide ore grading 4.92 grams of gold per ton. A 1983 study concluded that the oxide reserves were 235,260 tons grading 6.5 grams of gold per ton. No progress was announced in 1989 toward bringing the deposit into production.

Probably the most significant undeveloped mineral resources in Senegal are the iron occurrences of southeast Senegal, generally called the Falémé deposits, after the river that runs along the southern one-half of the Senegal-Mali border. Mines de Fer du Sénégal Oriental (MIFERSO) was formed in 1975 to explore the deposits. According to the company, the largest deposit is Koudékourou, 70 km east-southeast of Kédougou, which contains about 260 MMmt of hematite iron ore grading about 60% iron, plus about 60 MMmt grading 48% to 60% Fe. There are two other hematite deposits, 50 to 60 km north of the Koudékourou deposit; the Karakaène deposit has a resource of 60 MMmt, and the Kouroudiako deposit contains 51 MMmt. Both grade about 56% iron. About 35 km north of the Koudékourou deposit are two magnetite iron ore deposits; these contain a total resource of about 190 MMmt grading 41% to 45% iron. Exploitation of the Falémé iron ore deposits, which would start with the Koudékourou deposit, would require the construction of about 310 km of railroad to the existing line at Tambacounda and the construction of another 180 km of track to replace about 190 km of the existing track between Tambacounda and Kaolack. In addition, an ore port would be constructed at Bargny, about 30 km east of Dakar. The total cost of the project, including the mine and mill complex, has been estimated to exceed $700 million.

Senegal's oil and gas reserves are not well known. Despite sporadic exploration onshore and offshore for almost 40 years, including the drilling of approximately 150 wells, commercial discoveries have been limited to small gasfields east of Dakar. The most significant of these is the Diam-Niadio Field, currently in production. According to the Government, reserves in this field total about 1.75 billion cubic feet; large-scale production from this field has yet to be achieved. The offshore Dôme Flore Field has been explored intermittently since 1958 and has been the subject of a number of border disputes with Guinea-Bissau. These disputes were largely resolved in 1986, leaving the known resources in Senegal territory. According to the Government, known reserves in this field are approximately 640 million barrels of very heavy-weight crude oil (± 10° API), and perhaps 14 million barrels of light crude.

Senegal has extensive peat deposits along the coast between Dakar and Saint-Louis. The largest deposits are in the so-called Central Zone, a 1- to 3-km-wide belt extending 30 to 70 km northeast of Dakar. This zone contains an extractable resource estimated to be almost 23 million cubic meters, sufficient for 20 years of feed for a 30-megawatt (MW) electrical plant. Smaller deposits within this zone and in zones to the northeast and southwest contain an additional 6 million cubic meters that are not suitable for large-scale mining, but could be used for domestic heating purposes. In this regard, the peat is said to have a heat output 58% of that of charcoal. In addition, there are approximately 15 million cubic meters of peat that are too sandy for burning, but which could be used as mulch for agricultural purposes.

Infrastructure

Senegal's railroad infrastructure is relatively well-developed only in the northwest part of the country. The railroad network in 1989 consisted of 1,034 km of 1-m gauge track, all single track except for 70 km of double track line from Dakar to Thiès. Railroad construction in Senegal commenced in 1881, largely for the export of groundnuts. In 1923, the line connecting Dakar with Bamako, Mali, was completed, and trade along this route led to Dakar's early development as a significant regional port. In recent years, more than 95% of the total railing tonnage has been related to the transport of mineral commodities, including fertilizers. The bulk of freight and passenger railings are handled by the parastatal Régie des Chemins de fer du Sénégal. However, traffic related to ICS is handled by that company's own railroad company, Société d'Exploitation Ferroviaire des Industries Chimiques du Sénégal. Although the present railroad infrastructure is adequate for current mining output, the lack of railroads to the southeast part of the country is a severe hindrance to the development of the country's iron ore resources.

Senegal had about 14,000 km of roads in 1989, about 27% of which was paved. The country has about 900 km of navigable waterways, mostly on the Sénégal River, which forms the border between Senegal and Mauritania, and 115 km on the Saloum River as far as Kaolack.

Senegal has 4 main ports: Dakar, Saint-Louis, Kaolack, and Ziguinchor; the latter two are river ports that can handle oceangoing ships. Only Dakar is a significant mineral port, although some of the country's salt production is shiploaded at Kaolack. In 1989, Dakar had 43 docks of total length of 7,618 m and had a harbor entrance depth of 11 m. The port had facilities adequate for offloading approximately 1.5 million tons per year of crude oil and petroleum products, 220,000 tons per year of sulfur, and about 18,000 tons per year of ammonia. In 1988, the latest year for which data are available, trade through Dakar totaled about 5 MMmt, of which 752,000 tons were imports of mineral commodities (mostly crude oil, petroleum products, and sulfur), and about 2 MMmt were mineral commodity exports, including fertilizers.

Senegal had an electrical generating capacity of 210 MW in 1989, all of which was thermal. Production of electricity in 1989 was 760 million kilowatt-hours (kWh). Except for the burning of the country's modest natural gas output, all of the country's electricity generation used imported fuel.

Outlook

The mineral economy will continue to be dominated by the exploitation of phosphate deposits. There are large phosphate reserves at or near the existing mines; consequently, the near-term exploitation of the Semmé phosphate deposits, which would require extensive infrastructure development, is unlikely. Assuming a positive outcome of the ongoing titaniferous sand exploration program, Senegal could become an exporter of ilmenite within 2 to 3 years. There appears to be some modest potential for the discovery of commercial petroleum deposits. The production of natural gas, from known onshore fields, is likely to remain small, but may well increase above current levels. The high cost of imported fuel will provide a strong incentive for the exploitation of Senegal's large peat resources for electricity generation and for domestic heating purposes. The economics of exploiting the Falémé iron ore deposits are very uncertain, given the high cost of constructing the necessary railing and port infrastructure and current world market conditions for iron ore. It is likely that the Sabodala gold deposit will be brought into production within a few years, and that further exploration in southeast Senegal will lead to the discovery of additional gold ore deposits.

THE GAMBIA

In 1989, mining was a negligible component of the Gambian economy, which was dominated by the production of agricultural commodities, tourism, and the unregistered transshipment of goods into Senegal. Production of mineral commodities in The Gambia was limited to undocumented quantities of clay, laterite, sand and gravel, and cockle shells, for local construction purposes. Deposits of these materials are believed to be significant. Fewer than 100 persons were believed to be employed in mining. The geology of the country is dominated by Mesozoic and Cenozoic sedimentary rocks, deposited in a regional basin related to the opening of the Atlantic Ocean. There is believed to be some potential for the discovery of oil in this basin. Several thousand km of seismic surveys have been run over the past 30 years and a few petroleum exploration wells, all unsuccessful, drilled. In April 1990, talks were held with Texas-based oil companies regarding oil exploration in the country, and an agreement was signed with Petro Canada Corp. for International Assistance for the funding of a new seismic survey. The country's significant glass sand deposits have yet to be exploited. In the 1950's, titaniferous beach sands were mined. According to the Government, the remaining resource, at a 1% heavy-mineral cutoff, amounts to 20 MMmt grading 4.9% heavy minerals. At a 3% cutoff, the resource is 9 MMmt grading 8.6% heavy minerals. The heavy-mineral concentrates average 70.2% ilmenite, 15.9% zircon, 3.3% rutile, and 10.6% gangue minerals.

The Gambia has no railroads, but has about 3,100 km of highways, of which 14% is paved. The Gambia River is navigable for approximately 240 km by oceangoing ships of up to 5.5-m drafts. Electrical generating capacity, all from thermal plants, was 29 MW in 1989, and production in that year totaled 64 million kWh.

GUINEA-BISSAU

Mineral production in Guinea-Bissau during 1989 was limited to production of building materials for supplying brick and ceramic plants and other local construction industries. The country apparently is not well-endowed with mineral resources; nevertheless, the Government continued prospecting for deposits. Such exploration efforts have confirmed the existence of some bauxite and phosphate. Bauxite is found in the Boé region along the border of Guinea and Guinea-Bissau. Phosphate resources are known near Farim in the north-central part of the country. The development of these resources has been hampered by the lack of adequate infrastructure. Guinea-Bissau has about 3,200 km of roads, of which almost 2,700 km is paved. The country has no railroads. In 1989, electric power generation capacity was 22 MW, all in thermal plants; electricity output was reportedly 28 million kWh.

Petroleum exploration programs, consisting of seismic and geologic studies and the drilling of exploration wells, were being conducted by an unincorporated joint venture. The region being explored covered about 6,800 km^2 with water depths ranging between 20 and 200 m in the Anetibené area, off the coast of Guinea-Bissau. The equity investment of up to $4.68 million consisted of the following: Pecten, 48%; Walter International Guinea-Bissau, Inc. (Walter), 40%; and the International Finance Corp. (IFC), 12%. Empresa Nacional de Pesquisa e Exploracão Petroliferas (Petroguin), the Guinean state oil company, was also a participant in the project with a working interest of 21% carried by the other participants during the exploration stage. Thereafter, Petroguin is required to contribute 21% of the costs of the development and production of any commercial discovery. Pecten and Walter were prospecting in the Angorené area, which they hold jointly with Société Nationale Elf Aquitaine of France and Texaco. Pecten, the sole operator of two offshore permits, conducted exploratory drilling for petroleum during 1989. One wildcat well was drilled by yearend 1989. Drilling activities in the Angorené area have not located any commercial quantities of oil. However, the outlook for petroleum discoveries was relatively optimistic. Other ventures in the Antibené area, also known as the Bass, have potential reserves of about 135 million barrels, which could be increased to 230 million barrels. A second fault trap, Sheephead Field in the same Antibené area, has estimated reserves of about 75 million barrels.

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[1] Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF319 = US$1.00.

[2] Direction des Mines et de la Géology, 1984, Plan Minéral de la République du Sénégal.

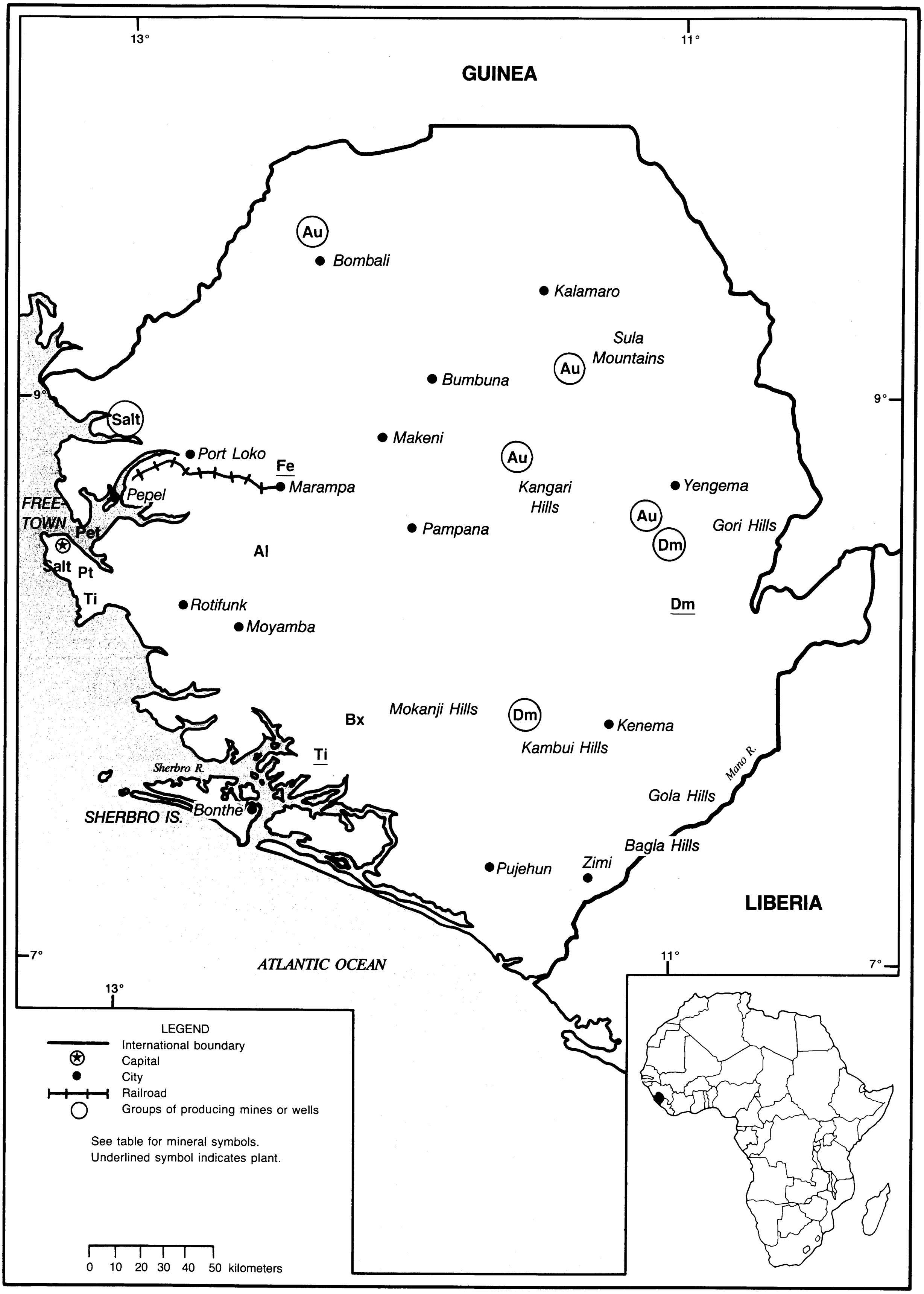
OTHER SOURCES OF INFORMATION

Direction des Mines et de la Géologie
B.P. 1238
Dakar, Senegal

The Ministry of Economic Planning
and Industrial Development
Central Bank Building
Banjul, The Gambia

SIERRA LEONE

AREA 71,740 km² **POPULATION 4.2 million**



THE MINERAL INDUSTRY OF

SIERRA LEONE

By Bernadette Michalski

The production and export of mineral commodities, particularly rutile, ilmenite, bauxite, diamonds, and gold, listed by order of value, have traditionally sustained Sierra Leone's economy, providing a means to obtain hard currency. In recent years, heavy revenue losses attributed to illegal trading in diamonds, and gold contributed to the country's serious trade deficits and faltering economy. In an effort to reverse this situation, a new mining policy was promulgated focusing on the diamond and gold industries. Under the new policy, the Ministry of Mines was empowered to periodically inspect production records and to determine the quantities and frequency of sales. Dealers were required to either export an average of $500,000 worth of diamonds or gold monthly or have their licenses revoked. Exporters were required to repatriate 60% of their hard currency earnings to the Central Bank of Sierra Leone. To encourage participation, the Government released and recommended for investment several promising diamond- and gold-mining properties throughout Sierra Leone. The success of the mining policy was yet to be determined, but it provided a framework for curbing illicit trading and channeling the much needed additional funds to the Central Bank.

GOVERNMENT POLICIES AND PROGRAMS

An emergency session of Parliament created the Currency Control and Economic Sabotage Act on December 15, 1989. The law prohibited local currency hoarding, controlled certain commercial transactions, and permitted fines and/or incarceration for economic and commercial sabotage.

The Government announced a new floating foreign exchange system in April 1990. The system permitted commercial dealers to trade between themselves or with the Bank of Sierra Leone at a mutually agreed on exchange rate. The Bank of Sierra Leone determined the official transactions rate during each ensuing week.

In a move to increase Government revenues and curb smuggling activities, regulations for the diamond- and gold-mining industries have undergone several revisions in recent years. As of 1990, diamond exporters were required to make an advance payment of $500,000 as well as a license fee of $10,000 annually. Gold export licenseholders must pay $250,000 as performance bond and $50,000 annually for the license.

Negotiations between Sierra Rutile Ltd. and the Government were concluded in 1989 and resulted in a favorable tax rate for Sierra Rutile Ltd. and deferred the date under which the Government can acquire an interest in the rutile operations from mid-1992 to January 1, 2000.

The Government, in collaboration with the World Bank, was engaged in developing a comprehensive mining investment code aimed at stimulating private investment in Sierra Leone.

PRODUCTION

With the exception of petroleum product output, the mineral industry made significant gains in 1989. Price increases on world markets for bauxite and rutile encouraged increased output in these commodities. Government efforts to curb diamond and gold smuggling have brought limited improvement to 1989 reported production levels for these commodities.

TRADE

The value of Sierra Leone's mineral exports was estimated in excess of $100 million in 1989, equal to approximately 80% of total exports for the year. Rutile continued to be the nation's principal mineral export with shipments totaling 139,000 tons in 1989. Ilmenite exports were reported at 66,000 tons. By yearend, inventories at Sierra Leone Rutile Ltd. were drawn down to minimum levels by shipments destined principally to Western Europe and the United States.

Although diamond exports have traditionally ranked second as the nation's foreign exchange earner, illicit trading has significantly reduced official exports. Bauxite exports earned approximately $25 million in 1989.

STRUCTURE OF THE MINERAL INDUSTRY

The Government maintained total control of petroleum refining operations and a controlling interest in the diamond and gold mining industries. The mining of bauxite, ilmenite, and rutile remained open to foreign investment.

COMMODITY REVIEW

Metals

Bauxite.—The Sierra Leone Ore and Metal Co., the nation's sole bauxite producer, completed the $2 million Mokanji Mine expansion program in time to take advantage of a favorable market price for that commodity in 1989. A second bauxite operation and an alumina plant were planned for development at Port Loko.

Gold.—The illegal mining and consequent smuggling of gold prompted the Government to adopt emergency measures, including selective reissuing of mining and export licenses. Licenses were issued only to investors with sufficient capital and expertise to conduct gold exploration, with emphasis on exploration along the Pampana River in central Sierra Leone, in the Kalmaro region, and near Bombali. Licensees would be required to keep accurate production records, which would be subject to periodic inspection by the Ministry of Mines. Licensees would also be required to sell

TABLE 1

SIERRA LEONE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
Aluminum: Bauxite, gross weight	thousand tons	1,184	1,242	1,390	1,379	[2]1,562
Diamond:						
Gem[e]	thousand carats	243	215	214	12	90
Industrial[e]	do.	106	100	100	6	39
Total	do.	349	315	314	18	[2]129
Gold	kilograms	591	272	422	44	[2]226
Gypsum[e]		4,000	4,000	4,000	4,000	4,000
Iron ore		[e]70,000	—	—	—	—
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	9	9	9	8	7
Gasoline	do.	287	270	250	225	190
Jet fuel	do.	162	148	150	125	100
Kerosene	do.	55	52	50	45	35
Distillate fuel oil	do.	443	470	450	425	375
Residual fuel oil	do.	379	355	360	350	300
Other	do.	1	1	1	1	1
Refinery fuel and losses	do.	60	60	60	60	55
Total	do.	1,396	1,400	1,330	1,239	1,063
Salt[e]	do.	200	200	200	200	200
Titanium:						
Rutile ore and concentrate 96% TiO_2, gross weight		80,611	97,100	113,300	126,332	[2]128,198
Ilmenite ore and concentrate 60% TiO_2, gross weight		—	—	5,600	42,118	[2]62,310

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Sept. 30, 1990.
[2]Reported figure.

TABLE 2

SIERRA LEONE: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Bauxite	Sierra Leone Ore and Mineral Co. (Subsidiary of Alusuisse, 100%)	Mokanji Hills near Moyamba	1.6.[2]
Diamond	National Diamond Mining Co., Ltd. (Government, 51%; British Petroleum Minerals International, 49%)	Yengema region	NA.
Gold	do.	do.	NA.
Petroleum products	Sierra Leone Petroleum Refining Co. (Government, 100%)	Refinery at Freetown	10.[3]
Titanium	Sierra Rutile, Ltd. (Nord Resources Corp., 100%)	Pejebu near the mouth of the Shrebro River	130 rutile. 65 ilmenite.
Do.	Rotifunk Rutile Co. (Intercontinental Old & Minerals NL, 50%; MC Mining NL, 50%)	Rotifunk, 60 kilometers southeast of Freetown	56 rutile. 83 ilmenite.

NA not available.
[1]Thousand metric tons per year unless otherwise specified.
[2]Million metric tons per year.
[3]Thousand barrels per day.

to exporters such quantities of gold as may be determined by the Ministry. Failure to comply with these sales requirements would result in loss of license. At least 37 licenses to export gold were granted in 1989.

The National Diamond Mining Co. holds exclusive licenses for gold prospecting in three areas of the country, including Pampana North and Gori Hills.

Iron Ore.—Production from the Marampa Mine ended in 1985 because of very poor world market conditions. However, the Ministry of Mines concluded an agreement in 1988 with two French firms to conduct a feasibility study of the mine and assess the potential and economic viability of the Marampa region, an area about 80 kilometers (km) east of Freetown.

Titanium.—In 1989, rutile production from Sierra Rutile Ltd. attained a record level of more than 128,000 tons containing 96% titanium dioxide. Byproduct ilmenite production exceeded 62,000 tons containing 60% titanium dioxide compared with 42,000 tons produced in the previous year. Mining operations were conducted in the extreme south and southwest of Sierra Leone. During the period covering mid-August to mid-September 1989, Sierra Rutile Ltd. shifted mining operations from the Bamba-Belebu deposit, which was depleted, to the Pejebu ore body, about 4 km to the south. Development work on the Lanti deposit commenced at the close of 1989. Activities consisted of land clearing, road building, and dam construction. Sierra Rutile Ltd. anticipates moving to this deposit after Pejebu is depleted, about early 1993. The Lanti deposit and its associated Gbeni deposit are expected to have a lifetime of 10 years at the current production rate. After these deposits are depleted, Sierra Rutile Ltd. plans to exploit the Sembehun deposits further north.

An agreement was signed in mid-1989 between the Government and Intercontinental Gold and Minerals NL and MC Mining NL of Australia to develop the titanium dioxide-bearing mineral deposits near Rotifunk, about 60 km southeast of Freetown. On development, mining operations were expected to yield 56,000 tons of rutile and 83,000 tons of ilmenite annually for a projected production life of 12 years commencing in 1992. A wet plant will be sited at Rotifunk, and its concentrate will be barged down the Ribbi River and along the Atlantic coast to a harbor-front processing plant to be built in Freetown.

Zirconium.—Engineering and process testwork were completed in 1989 on a plant to recover zircon and to a lesser extent rutile and ilmenite from both old mill tailings and current mine production from Sierra Rutile Ltd.'s mining operations. The plant was expected to come onstream in the fourth quarter of 1990 at a cost of $6.5 million.

Industrial Minerals

In an effort to maximize Government earnings and to reduce the level of illicit trading, the Government adopted a new diamond exporting policy. In early 1989, the Government began returning diamond and gold exporting activities to the private sector. Traders were permitted to retain 40% of export earnings while requiring that 60% be repatriated to the Central Bank of Sierra Leone at the official rate. At least 26 dealers were granted diamond export licenses in 1989. In accordance with the new policy, any applicant for a diamond-mining license would have to provide proof of sufficient capital and expertise to effectively conduct the mining operation. Licensees would be required to keep accurate records subject to periodic inspection by the Ministry of Mines. Licensees would be expected to sell to a dealer or exporter such quantities of diamonds as would be determined by the Minister of Mines. Failure to comply with these sales would result in loss of license. To protect the lease area of the state-owned National Diamond Mining Co. (NDMC), all diamond dealers in the area were obligated to engage in cooperative mining.

NDMC leases two alluvial diamond mines in southeastern Sierra Leone. The largest covers 409 square kilometers in Yengeme. At Tonga, the NDMC lease covers 196 square kilometers. After nearly one-half century of mining, the alluvial fields are near depletion and are being reworked with outdated and worn equipment with diminishing results. To improve existing diamond-mining operations, the Ministry of Mines signed an agreement with Sumatu Raygreen Mining Co. (Sierra Leone), which obligated the latter to loan $4 million to NDMC to enable the national company to rehabilitate and modernize its mining equipment.

The NDMC, in a joint venture with Outokumpu Oy of Finland, is considering mining two pipes and numerous kimberlite dykes at Kono. Capital cost of the first phase of development was estimated at $30 million; the cost of the second stage was projected to be $40 million. Initial output was estimated at 54,000 carats annually and was expected to rise to 250,000 carats annually after 8 years of operation. Possible financial support for the project included the Kuwait Fund for Arab Economic Development and the Kuwait Investment Fund.

Mineral Fuels

The Sierra Leone Petroleum Refining Co. of Freetown operated a 10,000-barrel-per-day capacity refinery based on imported crude. Traditional crude oil suppliers have been Nigeria and Iran, but overdue obligations have prompted Sierra Leone to seek a new supplier. Libya agreed to supply not only petroleum but also invest in agriculture, mining, and fishing.

Petroleum product prices have been considerably lower in Sierra Leone and often were less than one-half the price commanded in neighboring countries. To discourage massive smuggling of fuel into these countries, petroleum product price increases went into effect in mid-1989, raising gasoline prices from $0.75 to $1.50 per gallon. In February 1990, the price for gasoline was increased to $3.00 per gallon.

Reserves

Rutile and ilmenite reserves described as proven and probable were reported by Sierra Rutile Ltd. as 218 million tons averaging 1.56% recoverable TiO_2 equivalent at yearend 1989. This represents an increase of more than 3.4 million tons and an increase in average grade of all reserves by 0.06% over the reserves reported at yearend 1988. Reserves at the Rotifunk deposit were reported at 146 million tons containing 0.6% rutile and 0.8% ilmenite.

INFRASTRUCTURE

The nation's roadways totaled 7,400 km. Only 1,150 km of roadway was bituminous surfaced; the remainder was gravel or improved earth.

Before the closure of the Marampa Mine, the 1.067-meter-narrow-gauge-railroad delivered iron ore to the port at Pepel, 84 km away. The line remained operable but in limited use.

OUTLOOK

The nation's poor infrastructure, chronic fuel shortage, and often inconvertible currency have left little promise for the investor. The mining of titanium-bearing sands has met with limited success over recent years and will probably continue to face high infrastructure, development, and environmental restoration costs. The lake resulting from the mining operation at the Bamba-Belebu rutile-ilmenite deposit was to be developed as a significant source of fish for local consumption. A reforestation program oriented toward the rehabilitation of exposed tailings areas was successful, and plans are underway to extend the reforestation.

Average rutile prices increased by 20.2% in 1989 over the previous year and were expected to remain at a favorable level at least through the early 1990's.

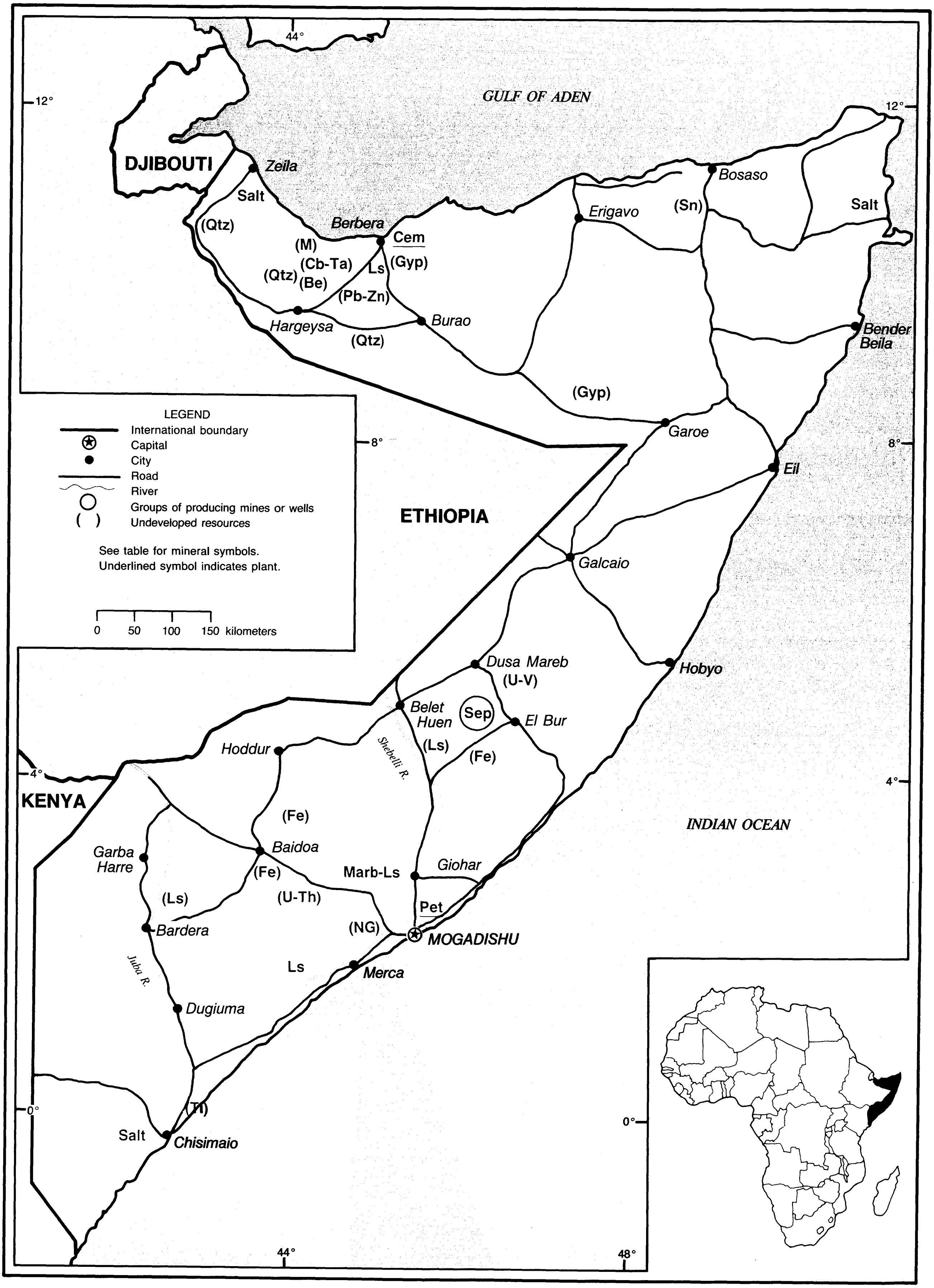
OTHER SOURCES OF INFORMATION

Agencies

Ministry of Mines
Freetown, Sierra Leone
Bank of Sierra Leone
Freetown, Sierra Leone

SOMALIA

AREA 637,660 km² **POPULATION 8.3 million**



THE MINERAL INDUSTRY OF

SOMALIA

By Lloyd E. Antonides

The mineral industry was an insignificant part of the primarily pastoral economy of mostly semidesert, Texas-size Somalia. Cement, construction materials, meerschaum, refined petroleum products, salt from imported crude, and possibly very minor amounts of metallic ores were produced. Meerschaum was the only noteworthy mineral export commodity. However, oil exploration continued to attract international companies, and many other potentially valuable mineral occurrences were reported as a result of surveys by international aid agencies.

The gross domestic product (GDP) was less than $2 billion,[1] and with population estimated at about 7.5 million, the country was one of the world's poorest. About 50% of the population was nomadic or seminomadic and dependent on raising livestock. The entire industrial sector, including mineral production, accounted for less than 10% of the GDP. Agriculture accounted for about 60% of the GDP. Foreign debt was about $3 billion at end of 1989, and annual balance of trade and Government budget deficits were both normally several hundred million dollars. The consumer price index inflation rate for 1988 was more than 80%. International financing agencies generally believed that Somalia would not only remain indefinitely dependent on foreign aid for any development projects but also for a portion of recurrent expenditures as well. Internal and external security concerns resulted in military-related items making up about 80% of total Government expenditures in 1989.

The mineral possibilities were an important concern of the country. During several decades investigators from various countries continued to explore several areas that had some potential for sizable mineral production: the highlands across the northern region, the southern highlands centered a few hundred kilometers (km) northwest of Mogadishu, and a central area centered a few hundred km north of Mogadishu. Oil and gas possibilities continued to be attractive, mostly in the north and offshore along the Indian Ocean coast.

GOVERNMENT POLICIES AND PROGRAMS

The Government had a mixed performance since the 1980 decision to start a program to liberalize the statist economic order imposed 10 years earlier. Its policy became one of encouragement of private investment, and the foreign investment law adopted in 1987 guaranteed against unreasonable expropriation. It also provided for the right to repatriate profits and investment costs, as well as for other reasonably attractive features. Additional economic reforms enacted in 1988 and revisions to the constitution in 1989 moved the Government from socialism to reliance on market forces.

In the mineral field, the Government also successfully promoted investigations by international agencies and foreign country Government organizations for many years.

PRODUCTION

Officially reported production data were not available. However, mineral production was estimated to be relatively unchanged from that of 1988. A 200,000-metric-ton-per-year (mt/yr) capacity cement plant began production in 1987, output from which is estimated at 100,000 mt/yr.

TRADE

Trade statistics continued to be generally unreported or unreliable. However, based on recent trends, Somalia's mineral commodity exports were at most 10 tons of meerschaum and some incidental petroleum refinery products. Livestock was the export item largest in terms of value, estimated at more than 60% of the total, and bananas were about 20% of the total. Hides and other items related to livestock were also significant exports. Arabian countries and Italy were principal destinations. Exports to the United States were negligible.

The most important import commodities were crude petroleum and refinery products, more than double the value of the next largest import commodity, foodstuffs. Imports of construction materials were almost as large in value as foodstuffs. Saudi Arabia and Bahrain appeared to be the principal sources of petroleum. Italy and the United States were important sources of other imports.

STRUCTURE OF THE MINERAL INDUSTRY

Parastatal organizations operated the two major mineral commodity ventures in Somalia: a petroleum refinery and a cement plant. However, a new petroleum refinery was reportedly being financed by Somali and Saudi Arabian private investors. Information was not available on ownership of other production operations, but the salt and meerschaum producers were believed to be in private hands. Aside from refining, oil and gas operations were limited to exploration by international oil companies.

TABLE 1

SOMALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Cement[e]		—	—	25,000	50,000	100,000
Nitrogen: Ammonia, N content[e]		26,000	15,000	[r]7,000	—	—
Petroleum refinery products:						
Gasoline, motor	thousand 42 gallon barrels	665	682	725	742	750
Jet fuel	do.	160	152	168	160	170
Kerosene	do.	93	77	70	77	80
Distillate fuel oil	do.	522	537	612	597	600
Residual fuel oil	do.	100	107	93	100	100
Other[3]	do.	189	301	259	252	250
Total	do.	1,729	1,856	1,927	1,928	1,950
Salt, marine[e]		30,000	30,000	30,000	30,000	30,000
Sepiolite, (meerschaum)[e]		10	10	10	10	10

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Includes data available through Nov. 16, 1990.
[2] In addition to the commodities listed, various crude construction materials (clays, sand and gravel, stone, et al.) presumably are produced, but available information is inadequate to make reliable estimates of output levels.
[3] Includes refinery fuel and losses.

COMMODITY REVIEW

Metals

Base and precious metal minerals were reported to have been accidently discovered in coastal sand dunes at Gesira on the coast 20 km southwest of Mogadishu. A Romanian construction company found the minerals during site work on a new oil refinery.

Further investigation and technical advice was being provided by Rompetrol-Geomin of Romania with a report of findings due in February 1990. Chromium, gold, manganese, nickel, silver, titanium, and tungsten occurrences were cited. One of the refinery partners, Haji Mohamed Hashi Haile & Co., was granted a Government permit to at least explore, if not mine, the area. Detailed work on the site was delayed pending the report due in February.

Industrial Minerals

Improvements were reportedly underway during 1989 at the Government-owned Berbera Cement Agency's operations. The first contract for plant design and construction was signed with North Korea in 1976, but after major technical, contractual, and financial difficulties, a French firm, LeFarge Coppee Corp., took over in 1981. It also ran into delays due to financial problems. Startup was reported to have been in 1987. Capacity was reported at 200,000 mt/yr.

Mineral Fuels

Natural Gas.—As of January 1, 1989, Somalia's natural gas reserves were reported to be 6 million cubic meters. The only reported field was at Afgoi about 30 km west of Mogadishu. Development was still pending, although World Bank funding was made available in 1984.

Petroleum.—Exploration started in the 1940's but at least from the late 1950's through 1989 hydrocarbon exploration concessions covering the entire country, onshore and offshore, were granted to at least two dozen international oil companies. At least 70 exploratory wells were drilled, but no production potential was announced. Many of the areas were relinquished, and some were transferred to other companies. The American Association of Petroleum Geologists indicates that at least one dozen companies were participating in maintaining concessions at yearend 1989. During the year, Phillip's Petroleum acquired a block in the northeast, and Shell gave up several blocks in the southwest. More than 6,000 km of seismic geophysical surveys were completed, more than double that in 1988 by Agip, Amoco, Conoco, Pecten, and Phillips. Conoco Somalia Ltd. contracted for Parker Drilling Co. to drill in the northeast, and at yearend, one exploratory hole was being drilled near Las Anod, about 800 km north-northeast of Mogadishu. Shell completed one hole started in 1987 near Bardera in the southwest on a concession it later vacated, and Chevron completed one hole started in 1988 near the coast west of Barbera in the northwest.

Refinery Products.—A Romanian construction company began site work for a new oil refinery at Gesira on the coast 20 km southwest of Mogadishu. Reportedly, financing for a $500 million, 190,000-barrel-per-day (bbl/d) plant was furnished by Somali businessmen in partnership with Al Sultan Trading & Construction Co. of Saudi Arabia. The venture planned to export to other African countries as well as supply domestic markets. Construction was scheduled for 18 months.

The 10,000-bbl/d Mogadishu refinery of Iraqsoma Refinery Co., at least partially Government-owned, continued to operate at about 50% nominal capacity using imported crude. The refinery was completed in 1979 with

Iraqi financing by an Italian construction firm.

Reserves

Officially reported data on reserves remained unavailable.

INFRASTRUCTURE

Considering the size of the country, Somalia's transport infrastructure was limited. It had about 22,000 km of roads, of which 12% was paved and 85% was earth, and no railroads. There were three main sea ports at Berbera, Chisimaio, and Mogadishu; essentially no internal waterways; and little coastal shipping. There were four paved airports, at the port cities and Hargeisa, plus other airfields at most towns. Road vehicles were the principal means of conveyance, but pack animals (donkey and camel) were also important. The major road linking the north and south, Berbera to Mogadishu, was almost completely bituminous surfaced, as were roads from Mogadishu to Baidoa, Berbera to Hargeisa, and some others around Chisimaio and Merca. The 5,000 km of primary and secondary roads was judged an adequate network but not all in satisfactory condition by World Bank investigators. Road improvements and maintenance were an important objective of foreign aid.

The port of Mogadishu handled more than 70% of export and import traffic in 1988; Berbera, mostly livestock exports, about 20%; and Chisimaio, mostly banana exports, about 4%. Coastal shipping was limited to northern ports because there was little interregional trade that was sustainable.

Electric power demand often exceeded the low output from the approximate 70-megawatt capacity of the country's public generating system. The major public plants were around Mogadishu, but there were six regional centers and also isolated rural plants as well. Many small, special-dedicated and private generating units provided at least 50 megawatts additional capacity. Most were diesel units. Enhancement of the system was a major focus of foreign aid.

Water resources were scanty and unevenly distributed. Wells were the main source of supply. Surface water of reasonably assured volume was limited to the area around two main rivers flowing south from Ethiopia across the southern third of the country.

Telecommunications were very limited. Telephone and telegraph service and facilities were reportedly among the poorest in Africa, with less than 10% of local calls and less than 2% of incoming international calls being successful.

OUTLOOK

It is doubtful that the mineral industry will develop into a significant factor in Somalia's economy for some time. Aside from the poor infrastructure and lack of any major mineral attraction other than oil, the competitive disadvantage of an unstable political situation will probably preclude any sizable foreign investment other than by international and bilateral aid agencies. Domestic investment in mineral commodity ventures will be limited by the same problems.

[1] Where necessary, values have been converted from Somalia shillings (SoSh) to U.S. dollars at the rate of SoSh490.68 = US$1.00 for 1989 and SoSh170 = US$1.00 for 1988.

OTHER SOURCES OF INFORMATION

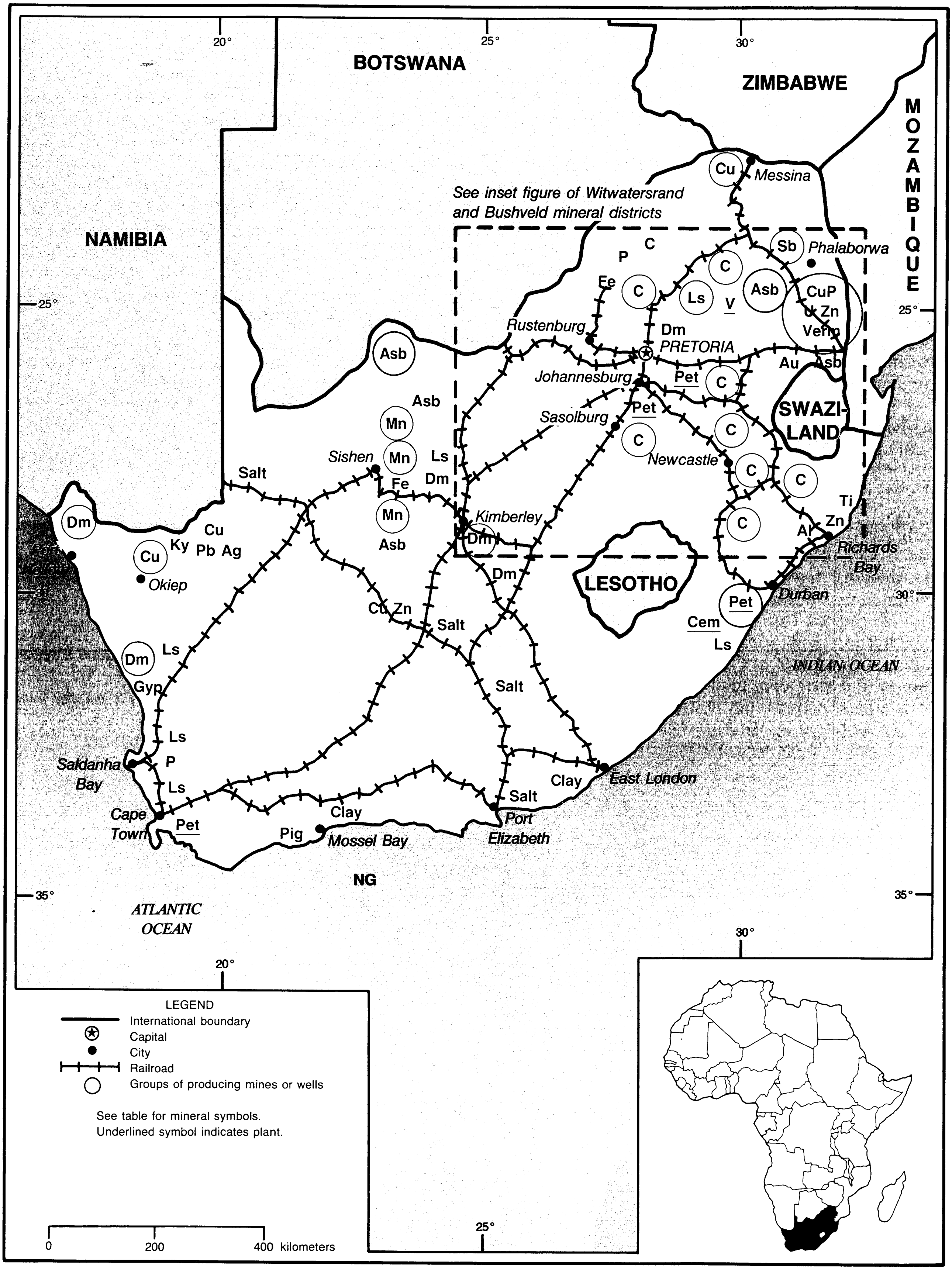
Agencies

Ministry of Mineral and Water Resources
P.O. Box 744
Mogadishu, Somalia

United Nations
Department of Technical Cooperation for Development
Natural Resources & Energy Division
1 United Nations Plaza
New York, NY 10017

REPUBLIC OF SOUTH AFRICA

AREA 1,221,040 km² **POPULATION 39.5 million**



THE MINERAL INDUSTRY OF

THE REPUBLIC OF SOUTH AFRICA

By George A. Morgan

In 1989 the mining and quarrying industry accounted for 11.1% of the gross domestic product (GDP) of $90.1 billion, and mineral exports were about 50% of total export earnings. Gold made up over $7.63 billion of total mineral exports of $11.5 billion.[1] If the value of processed mineral products such as base metals, ferroalloys, iron and steel, and refinery products produced from coal were included, the contribution from the mining industry would be significantly higher. About 14% of the nonagricultural labor force of 5.3 million was employed in mining and quarrying.

The industry was dynamic with numerous changes in corporate ownership and joint ventures, and active trading on the Johannesburg Stock Exchange. It remained influenced mainly by six major mining investment corporations: Anglovaal Ltd., Anglo American Corp. of South Africa Ltd. (AAC), Barlow Rand Ltd. (BRL), Gencor Ltd., formerly General Mining Union Corp. Ltd., Gold Fields of South Africa Ltd. (GFSA), and Johannesburg Consolidated Investment Co. Ltd. (JCI). These corporations had major holdings in each other, and in various subsidiary companies.

Total income tax from gold mines alone was $458 million. Total salaries, wages, and allowances for the industry were $3.6 billion, of which gold and coal mines made up $2.6 billion. The Employment Bureau of Africa (Teba) continued to recruit unskilled and semiskilled workers throughout southern Africa for members of the Chamber of Mines. About 670,000 workers were listed as unskilled and semiskilled in the industry, 75% of whom were employed by member mines of the Chamber of Mines. Teba's contracts for these workers lasted an average of 14.5 months. About $270 million was repatriated to Lesotho, Malawi, and Mozambique, mainly as compulsory deferred pay. Recruitment of labor from Malawi ended in February 1988, and the final contracts for Malawi workers expired January 1990.

GOVERNMENT POLICIES AND PROGRAMS

The Government has historically provided funding and organizational structure for the startup of large, high-risk mineral resource development projects. This has generally been through the Industrial Development Corp. (IDC). It has also sold such ventures to the private sector as they matured. The Government completed the sale of almost its entire holding of the South African Iron and Steel Corp. (Iscor), the country's dominant iron and steel producer. Besides iron- and steel-making facilities, the sale included coal, iron, fluorspar, and tin mines, in both the Republic of South Africa and Namibia. The Government also sold a portion of its interest in Alusaf (Pty.) Ltd., an aluminum producer.

The country's electric, communication, and transportation services, all Government owned, were placed on a more competitive operational basis. While no change in overall Government ownership was anticipated, certain subsidiaries may be privatized. Transnet, formerly the South African Transport Services, became liable for taxes and was free to invest its funds as necessary to achieve corporate profitability.

The Department of Mineral and Energy Affairs was the primary Government entity with responsibility for oversight of the country's mineral industry. Within the department were the Government Mining Engineer, the Geological Survey, and the Minerals Bureau. The country's long mining history, and its large and well developed mining sector have led to a proliferation of laws affecting the industry. Laws relating to the mining industry and administered by the department included: the Mines and Works Act, 1956; the Precious Stones Act, 1964; the Mining Rights Act, 1967; the Mining Title Registration Act, 1967; the Petroleum Products Act, 1977; the Nuclear Energy Act, 1982; the Coal Resources Act, 1985; the Energy Act, 1987; and the Mineral Technology Act, 1989. The Precious Stones Act, 1964, regulated the prospecting for and mining of precious stones. The Mining Rights Act, 1967, provided for the prospecting and mining of precious metals, base metals, and petroleum. The country was the world's largest producer of tiger's eye gem stones, and the Tiger's Eye Control Act, 1977, oversaw the mining and sale of this semiprecious gem stone. The mining and processing of sand, gravel, stone, and quarry products, as provided for in the Physical Planning Act, 1967, were also administered by the Department of Mineral and Energy Affairs.

The Geological Survey of South Africa had responsibility for monitoring seismic activity in southern Africa via 30 stations. Stations in Antarctica, Malawi, and Namibia were part of the network. Information from this monitoring activity was shared with the geological surveys of Malawi, Mozambique, Namibia, the United States, and Zimbabwe.

The National Energy Council, formed under the Energy Act of 1987, advised the minister of Mineral and Energy Affairs and Public Enterprises on matters relating to energy policy. It administered or implemented various Government policies related to energy, including the coal export program and the purchase and stockpile of crude petroleum.

Health and safety of mine labor was affected by new legislation dealing with flammable material and the control of noise. New mines were prohibited from using polyurethane and polyisocianurate foam as of January 1, 1989, and their removal from existing mines was emphasized. An industry standard of 85 decibels was established for noise levels.

Efforts to match the tax burden on the mining sector with that of other industries continued with implementation of various provisions of the 1988 Marais Technical Committee on Mining Tax. These provisions would lower the tax burden on the industry. The Government was implementing a 50% flat tax rate for nongold mines, and a phased reduction of the rate for gold mines. Nonmining sector corporate rates were currently 50%. The tax rate for gold mines is determined by the formula $y = a - ab/x$, where a and b are fixed by agreement between the Government and individual mines, and x is the ratio of taxable income to total income, both of which are from gold mining. Upon completion of the full phased reduction, ordinary rates for mines may drop to 40%. For the mining sector in 1989, effective tax rates, including surcharges, were 75% for marginal gold mines, 56.25% for diamond mines, and 57.50% for other mines. Producers of precious metals and precious stones also pay a royalty to the Government for the right to mine, adding about 5% to the effective tax rate.

The Government eliminated the ad valorem excise tax on jewelry completely, having initially reduced it from 35% to 20% in May, 1988. Elimination of the tax was expected to have a positive effect on consumption of gold in the domestic jewelry industry, which currently used only 2 tons in 1989. Also eliminated was the quota on precious metal use by jewelers, and the customs duty on imported sawn and cleaved diamonds can now be rebated.

The Government approved a provision that allows 25% of the capital costs of a new mine to be deducted from the profits of a company's other noncontiguous mining operations. Companies may also sell shares held longer than 10 years without incurring a capital gains tax.

PRODUCTION

The Republic of South Africa was one of the world's major producers and exporters of mineral commodities in terms of both quantity and diversity of minerals. The country reported production of 21 metals and 26 industrial minerals or classes of industrial minerals. In addition, it was a major producer and exporter of anthracite and bituminous coal. Metals that were among the world's leading producers, or were important owing to unique qualities included antimony, chromite, gold, manganese, platinum-group metals (PGM), titanium, uranium, vanadium, and zirconium. Industrial minerals of similar importance were andalusite, asbestos, diamond, fluorspar, pyrophyllite, and vermiculite. Owing to limited domestic consumption, most output was exported. However, increasing amounts of chromite, crude steel, diamond, gold, manganese, and dimension stone were being upgraded or consumed in higher value added products locally. These products were then being exported.

The costs of production continued to negatively impact the industry, while productivity increases have not kept pace with these costs. A wage settlement between the National Union of Mineworkers and the Chamber of Mines resulted in an increase in wages at gold mines of 13.5% to 21.5% for the lowest paid classification of workers in 1989, and 14.5% to 17% in 1990. Water rates for mines supplied by the Rand Water Board increased 12% to $0.201 per kiloliter. Transport rates increased 13% to 20%. The coal transport rate increased 17.5%, and for ores and minerals it increased 17%. The Electricity Supply Commission (Escom) increased rates an average of 14% to $0.030 per kilowatt hour. The mining industry consumed 35.7 million megawatts of electricity, or about 26% of Escom's sales. Gold mines alone that were members of the Chamber of Mines consumed 22.5 million megawatt hours, valued at $572.5 million.

TRADE

Total mineral sales, including domestic sales and exports, were $14.5 billion, up 12.5% from 1988. Exports of minerals, as reported by the Minerals Bureau, were $11.5 billion, of which gold accounted for 67%. Gold, coal, PGM, and diamonds, in order of importance, were estimated to make up 90% of mineral exports. Total local sales were $3 billion, of which coal was $1.36 billion, copper $210 million, quarry products $184.6 million, and limestone and lime $138.7 million.

Total imports by the United States from the Republic of South Africa in 1989 were $1.58 billion. Of this amount, $1.34 billion were mineral products, consisting primarily of PGM at $757 million and ferroalloys at $256 million. U.S. exports to the Republic of South Africa were $1.6 billion, consisting mainly of computer equipment, aircraft, and aircraft parts. Restrictions on imports by the United States of coal, gold, iron and steel, and uranium remained in effect. The European Community also had restrictions on the importation of iron and steel into Western Europe. Shipments of products from and to Namibia, formerly under the Republic of South Africa's administrative control, are now listed as part of official trade.

STRUCTURE OF THE MINERAL INDUSTRY

The mining industry was largely privately owned, both by domestic firms and foreign companies. In addition, the Government had an important interest in certain mining and mineral processing enterprises. Government participation was particularly pronounced in the synthetic fuels sector, which was based on domestic coal resources. It also was funding and overseeing the development of recently discovered natural gas reserves offshore Mossel Bay.

The six major domestic mining investment firms that dominated the mining industry in the Republic of South Africa varied their investments considerably. About 37% of AAC's net asset value was in mining finance, followed by gold 16%, diamonds 15%, industrial projects 9%, and PGM 6%. Gencor had 37% of its net asset value in industrial materials, gold 31%, base metals 19%, and PGM 9%. GFSA's net asset value by sector was as follows: gold 69%, base metals 6%, mining finance 4%, and other 21%. JCI's net asset value by sector was as follows: PGM 37%, industry and property 20%, gold 13%, diamonds 11%, mining finance 2%. Anglovaal had 45% of its net assets in the industrial sector, 25% in mining finance, 18% in gold, and the remainder in finance and base metals. BRL's net assets by sector were as follows: gold 26%, coal 26%, PGM 20%, base metals 14%, property and other assets 14%.

The Government Mining Engineer reported that the average number of persons employed in the mining sector in

TABLE 1

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[p]
METALS						
Aluminum metal		164,600	169,600	170,600	172,200	[e]170,000
Antimony concentrate:						
Gross weight		12,600	11,553	11,453	10,855	8,838
Sb content		7,390	6,816	6,673	6,240	6,167
Beryl concentrate (11% to 12% BeO)	kilograms	4,649	3,133	135	72	—
Cadmium, Cd content of cadmium cake		47	30	33	37	[e]40
Chromite, gross weight:						
More than 48% Cr_2O_3	thousand tons	65	39	65	20	[e]30
44% to 48% Cr_2O_3	do.	1,975	2,294	2,241	[e]2,721	[e]2,900
Less than 44% Cr_2O_3	do.	1,658	1,574	1,483	1,503	[e]1,645
Total[2]	do.	3,699	3,907	3,789	4,245	[e]4,575
Cobalt:[e]						
Mine output, Co content		690	690	720	720	730
Metal, powder		200	200	200	200	200
Sulfate, contained cobalt		300	300	320	320	325
Columbium-tantalum concentrate	kilograms	1	—	8	140	20
Copper:						
Mine output, Cu content		195,436	184,205	188,088	168,452	196,642
Metal:						
Smelter		191,700	[e]192,000	[e]192,000	[e]180,000	[e]190,000
Refined		164,304	158,631	152,699	139,400	145,700
Gold, primary	kilograms	670,754	638,047	596,456	617,719	605,452
Iron and steel:						
Ore and concentrate:						
Gross weight	thousand tons	24,414	24,483	22,008	25,248	29,958
Fe content	do.	15,076	15,424	13,865	15,906	18,873
Metal:						
Pig iron	do.	6,574	[e]6,800	[e]6,700	[e]6,500	6,435
Direct reduced iron	do.	417	789	844	662	[e]660
Ferroalloys, blast furnace and electric furnace:						
Ferrochromium	do.	851	870	951	963	972
Ferromanganese	do.	331	337	315	447	394
Ferrosilicochromium	do.	5	55	14	11	30
Ferrosilicomanganese	do.	261	303	314	267	267
Ferrosilicon	do.	75	83	83	116	123
Ferrovanadium	do.	([3])	1	[e]1	[e]1	[e]1
Silicon metal	do.	36	35	34	39	36
Total[2]	do.	1,560	1,685	1,712	1,844	1,825
Crude steel	do.	8,582	[e]8,800	8,400	8,800	8,900
Lead:						
Concentrate, Pb content		98,424	97,778	93,642	90,233	78,171
Smelter, secondary		32,836	40,463	38,268	37,361	36,000

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[p]
METALS—Continued						
Manganese:						
Ore and concentrate, gross weight:						
Metallurgical:						
More than 48% Mn	thousand tons	950	954	889	1,059	1,143
45% to 48% Mn	do.	213	338	438	568	659
40% to 45% Mn	do.	837	991	773	524	653
30% to 40% Mn	do.	1,442	1,280	666	1,181	1,093
Total[2]	do.	3,443	3,564	2,767	3,331	3,548
Chemical:						
More than 65% MnO_2	do.	1	4	3	2	1
35% to 65% MnO_2	do.	118	135	117	119	74
Less than 35% MnO_2	do.	38	16	5	2	—
Total[2]	do.	158	156	125	123	76
Grand total[2]	do.	3,601	3,719	2,892	3,454	3,623
Metal		31,825	32,900	31,900	[e]28,000	39,926
Monazite[e]		1,000	1,000	1,200	1,200	1,200
Nickel:						
Mine output, Ni content		29,000	31,800	[e]34,300	[e]34,800	[e]35,500
Metal, electrolytic[e]		[r]23,000	25,000	27,400	[e]27,800	[e]27,900
Platinum-group metals, metal content of concentrate, matte, refinery products[e 4]	kilograms	115,100	123,200	131,300	133,300	135,800
Silver:						
Mine output, Ag content	do.	208,384	222,244	208,118	199,745	177,917
Primary[e]	do.	2,000	2,000	1,900	1,800	1,700
Tin:						
Concentrate:						
Gross weight[e]		5,600	5,250	3,620	3,400	3,350
Sn content		2,153	2,054	1,438	1,377	1,306
Metal, primary[5]		2,069	2,001	1,508	1,389	1,307
Titanium:[e]						
Rutile concentrate		55,000	55,000	55,000	55,000	60,000
Slag		435,000	435,000	650,000	700,000	725,000
Uranium oxide (U_3O_8)		[r]5,751	5,460	4,735	4,583	3,456
Vanadium:						
Vanadiferous slag, gross weight		57,340	[e]68,170	[e]69,000	[e]77,200	[e]77,200
V content:						
Of vanadiferous slag[e]		8,085	9,600	[r]10,100	11,300	11,300
Of V_2O_3 and vanadate products[e]		5,930	5,761	[r]4,156	5,080	5,200
Total		14,015	15,361	14,256	16,380	[e]16,500
Zinc:						
Concentrate:						
Gross weight[e]		190,000	200,000	220,000	175,000	152,000
Zn content		96,943	101,859	112,686	89,551	77,334
Metal, smelter		93,700	81,000	96,051	84,357	84,997
Zirconium concentrate (baddeleyite) and zircon		160,533	[re]140,000	[re]140,000	[e]150,000	[e]180,000

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[p]
INDUSTRIAL MINERALS						
Asbestos						
Amosite		37,856	36,009	26,026	20,325	26,124
Chrysotile		92,318	91,001	101,722	113,468	115,420
Crocidolite		34,073	11,852	7,326	11,885	13,918
Total		164,247	138,862	135,074	145,678	155,462
Barite		4,387	8,653	8,617	8,735	8,570
Cement, hydraulic	thousand tons	7,034	6,712	7,256	8,486	[e]8,700
Clays:						
Attapulgite		5,885	10,125	6,026	7,161	6,609
Bentonite		43,472	48,265	48,953	66,750	62,987
Fire clay		168,145	202,883	230,519	267,184	282,885
Flint clay		123,810	130,721	106,915	139,112	127,750
Kaolin		128,899	126,129	151,730	175,033	139,711
Corundum, natural		10	9	5	2	2
Diamond, natural:						
Gem[e]	thousand carats	4,550	4,473	4,061	3,817	4,090
Industrial[e]	do.	5,652	5,755	4,990	4,687	5,026
Total	do.	10,202	10,228	9,051	8,504	9,116
Diatomite		947	1,800	194	199	133
Feldspar		33,012	52,762	66,513	81,889	72,934
Fluorspar:						
Acid-grade		310,211	293,368	[e]279,000	[e]282,986	[e]310,000
Ceramic-grade		5,724	7,703	[e]7,000	[e]8,000	[e]9,000
Metallurgical-grade		33,272	32,814	[e]30,606	[e]37,435	[e]49,340
Total		349,207	333,885	316,606	328,421	368,340
Gem stones, semiprecious:						
Emerald crystals	kilograms	102	23	—	—	—
Tiger's eye	do.	178,821	257,554	452,147	368,462	278,617
Gypsum, crude		458,399	404,205	349,079	372,169	406,743
Kyanite and related materials:						
Andalusite		194,693	181,466	194,373	259,556	284,048
Sillimanite		1,337	1,330	1,243	781	170
Lime[5]	thousand tons	2,014	1,944	1,582	1,916	1,939
Magnesite, crude		28,898	61,186	74,961	74,088	75,695
Mica:						
Sheet	kilograms	81	—	—	—	—
Waste		2,072	2,509	970	1,669	1,708
Nitrogen: N content of ammonia[e]		580,000	580,000	546,600	471,800	455,200
Phosphate rock, gross weight	thousand metric tons	2,433	2,920	2,623	[e]2,850	2,900
Pigments, mineral, natural:						
Ochers		528	1,340	621	1,944	1,327
Oxides		224	161	147	126	—
Total		752	1,501	768	2,070	1,327
Quartz, quartzite, glass sand (silica)	thousand tons	1,518	1,655	1,937	2,011	2,182
Salt		722,482	752,440	705,531	678,225	692,391

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[p]
INDUSTRIAL MINERALS—Continued						
Silcrete		47	—	—	—	—
Sodium sulfate		75	466	241	255	15
Stone, n.e.s.:						
Dimension:						
Granite:						
Sawn slabs		11,708	10,946	17,242	9,639	7,532
Rough blocks		315,707	317,079	323,582	[r]375,156	401,378
Marble	cubic meters	1,000	2,539	2,802	3,173	2,219
Slate		42,100	39,853	25,494	[5]25,522	[5]18,358
Crushed and broken:						
Limestone	thousand tons	20,520	20,898	21,372	21,884	19,284
Shale	do.	527	526	354	422	398
Sulfur:						
S content of pyrites	do.	562	499	468	505	459
Byproduct:[2]						
Of metallurgy	do.	85	108	105	110	110
Of petroleum	do.	100	110	110	120	120
Total[e]	do.	747	717	683	[e]735	689
Talc and related materials:						
Talc		10,220	8,641	8,005	10,111	11,714
Pyrophyllite (wonderstone)		4,227	4,606	3,467	3,162	3,942
Vermiculite		184,070	193,657	228,863	209,177	224,500
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Anthracite	thousand tons	4,910	4,990	5,252	4,951	4,208
Bituminous	do.	168,606	171,871	171,294	176,409	172,214
Total[e]	do.	173,516	176,861	176,546	181,360	176,422
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	37,400	[e]37,500	36,865	NA	NA
Jet fuel	do.	3,280	[e]3,300	3,285	NA	NA
Kerosene	do.	3,410	[e]3,400	3,285	NA	NA
Distillate fuel oil	do.	39,165	[e]39,200	39,055	NA	NA
Residual fuel oil	do.	21,645	[e]21,600	23,725	NA	NA
Lubricants	do.	2,520	[e]2,500	2,555	NA	NA
Other	do.	12,470	[e]12,500	9,125	NA	NA
Refinery fuel and losses	do.	[e]6,000	[e]6,000	8,030	NA	NA
Total	do.	125,890	[e]126,000	125,925	[e]130,000	[e]130,000

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Table includes data available through Sept. 4, 1990.
[2]Data may not add to totals shown because of independent rounding.
[3]Less than 1/2 unit.
[4]Includes osmiridium from gold ores, estimated at 2,500 troy ounces per year.
[5]Domestic sales plus exports.

TABLE 2

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988 United States	Destinations, 1988 Other (principal)
METALS					
Aluminum:					
Ore and concentrate		11,005	NA		
Oxides and hydroxides		115	NA		
Metal including alloys:					
Scrap		2,662	2,573	—	West Germany 1,546; Japan 669.
Unwrought		81,290	70,999	1,400	Japan 42,615; Taiwan 20,876; West Germany 4,578.
Semimanufactures		5,186	11,378	8,688	Taiwan 1,689; West Germany 737.
Antimony:					
Ore and concentrate		3,947	269	269	
Oxides		NA	4,057	3,931	Taiwan 126.
Metal including alloys, all forms		2	—		
Arsenic: Oxides and acids		2,126	1,017	1,017	
Cadmium: Metal including alloys, all forms		18	3	([2])	Mainly to West Germany.
Chromium:					
Ore and concentrate	thousand tons	[3]1,178	846	—	Japan 586; West Germany 157.
Oxides and hydroxides		250,765	386,583	386,583	
Cobalt:					
Oxides and hydroxides		3	8	8	
Metal including alloys, all forms		191	520	495	West Germany 25.
Columbium and tantalum:					
Ore and concentrate	kilograms	NA	957	957	
Metal including alloys, all forms	value, thousands	NA	$43	—	All to Japan.
Copper:					
Ore and concentrate		r42,628	NA		
Matte and speiss including cement copper		511	199	—	All to West Germany.
Oxides and hydroxides		33	5	—	All to Taiwan.
Sulfate		50	—		
Ash and residue containing copper		22,843	310	—	All to West Germany.
Metal including alloys:					
Scrap		r4,201	4,648	—	West Germany 2,193; Belgium-Luxembourg 1,363.
Unwrought		r107,385	92,417	1,820	West Germany 37,655; Belgium-Luxembourg 14,569; United Kingdom 13,690.
Semimanufactures		r5,526	6,896	4,336	Taiwan 1,371; Hong Kong 698.
Gold:					
Waste and sweepings	value, thousands	$458	$1,668	—	All to Switzerland.
Metal including alloys, unwrought and partly wrought	grams	118	74	—	West Germany 22; Taiwan 23; Hong Kong 20.
Iron and steel:					
Iron ore and concentrate:					
Including roasted pyrite		262,312	324	—	All to Austria.
Excluding roasted pyrite	thousand tons	[3]8,802	8,209	—	Japan 4,900; United Kingdom 2,094; West Germany 879.
Pyrite, roasted		2	—		

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal:				
Scrap	69,913	54,869	—	Taiwan 54,260.
Pig iron, cast iron, related materials	458,083	367,367	—	Japan 288,368; Taiwan 70,726.
Ferroalloys:				
Ferrochromium	[3]828,310	582,642	169,642	Japan 264,472; Taiwan 50,746.
Ferromanganese	213,577	266,028	180,230	Taiwan 20,654; West Germany 17,471.
Ferromolybdenum	4	192,798	—	All to West Germany.
Ferronickel	5	112	32	West Germany 78.
Ferrosilicochromium	1,559	7,406	973	Japan 6,413.
Ferrosilicomanganese	71,521	182,722	88,455	Japan 53,285; West Germany 23,944.
Ferrosilicon	11,707	42,690	1,755	Japan 21,601; Taiwan 15,034.
Silicon metal	16,202	32,205	5,202	Japan 13,738; United Kingdom 5,642; West Germany 5,608.
Unspecified	422,055	3,032	—	Hong Kong 2,330; Argentina 319.
Steel, primary forms	835,953	404,763	—	Taiwan 270,091; Hong Kong 65,347; Argentina 50,330.
Semimanufactures:				
Bars, rods, angles, shapes, sections	[r]407,547	351,370	—	Hong Kong 201,124; Taiwan 84,276; West Germany 32,166.
Universals, plates, sheets	[r]314,366	153,651	—	Taiwan 75,683; Hong Kong 47,489; Switzerland 13,004.
Hoop and strip	837	17	—	All to Taiwan.
Rails and accessories	22,082	6,687	—	Do.
Wire	15,802	13,192	—	Austria 7,212; West Germany 3,084; Taiwan 2,160.
Tubes, pipes, fittings	76,135	64,387	—	Hong Kong 34,299; Taiwan 21,035; West Germany 7,528.
Castings and forgings, rough	415	30	—	Hong Kong 29.
Lead:				
Ore and concentrate	[3]90,790	38,981	—	Japan 30,844; West Germany 8,137.
Oxides	173	1	—	All to Belgium-Luxembourg.
Ash and residue containing lead	NA	303	—	All to West Germany.
Metal including alloys:				
Scrap	1,546	144	—	Taiwan 121; Belgium-Luxembourg 23.
Unwrought	[r]18,259	2,731	—	Austria 2,656.
Semimanufactures	146	278	—	Ecuador 198; Hong Kong 80.
Unspecified	21	—		
Magnesium: Metal including alloys:				
Scrap	[r]152	13	13	
Unwrought	—	43	—	Austria 23; Switzerland 20.
Unspecified	562	NA		
Manganese:				
Ore and concentrate: Metallurgical-grade thousand tons	[3]1,562	2,031	—	Japan 1,069; Norway 292; West Germany 311.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued				
Manganese—Continued				
Oxides	3,608	1,480	542	Spain 359; Japan 194.
Metal including alloys, all forms	10,985	23,275	10,588	Japan 7,506; West Germany 3,134.
Molybdenum: Ore and concentrate	120	2,104	—	All to Argentina.
Nickel:				
Matte and speiss	r222	65	—	Switzerland 40; West Germany 25.
Ash and residue containing nickel	—	48	—	All to West Germany.
Metal including alloys:				
Scrap	297	16	—	West Germany 15; Spain 1.
Unwrought	r8,165	9,875	1,371	West Germany 3,369; United Kingdom 1,547.
Semimanufactures	739	41	—	Austria 25; West Germany 16.
Platinum-group metals:				
Waste and sweepings value, thousands	$2,358	$18,470	—	United Kingdom $18,439.
Metals including alloys, unwrought and partly wrought:				
Palladium kilograms	22,000	23,220	20,480	West Germany 2,326.
Platinum do.	[4]38,000	60,973	28,742	Japan 19,041; West Germany 9,589.
Rhodium do.	3,000	3,972	3,787	West Germany 151.
Iridium, osmium, ruthenium do.	2,000	4,916	3,600	West Germany 1,276.
Unspecified do.	8,000	28,000	—	All to United Kingdom.
Rhenium: Metal including alloys, all forms	6	—		
Silicon, high-purity	—	63	—	All to New Zealand.
Silver:				
Ore and concentrate, Ag content value, thousands	$88,738	NA		
Waste and sweepings do.	$2,756	NA		
Metal including alloys, unwrought and partly wrought kilograms	46,000	16,537	16	West Germany 16,521.
Tin:				
Ore and concentrate	[3]1,508	NA		
Ash and residue containing tin	72	—		
Metal including alloys, unwrought	r591	318	—	United Kingdom 164; Belgium-Luxembourg 112; West Germany 37.
Titanium:				
Ore and concentrate	41,930	38,900	18,052	West Germany 14,270; Belgium-Luxembourg 3,067.
Oxides	1,866	1,325	1,325	
Metal including alloys, semimanufactures	14	—		
Tungsten:				
Ore and concentrate	1,677	25	—	All to West Germany.
Metal including alloys:				
Scrap	18	55	55	
Unwrought kilograms	607	NA		
Unspecified	17	—		

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued					
Uranium and thorium:					
Ore and concentrate	value, thousands	$6,365	NA		
Oxides and other compounds		NA	333	—	All to West Germany.
Metal including alloys, all forms	value, thousands	$42	—		
Vanadium:					
Oxides and hydroxides		2,765	7,091	6,875	West Germany 216.
Ash and residue containing vanadium		12,040	NA		
Metal including alloys, all forms		—	22	—	West Germany 12; Japan 10.
Zinc:					
Ore and concentrate		[3]15,506	18,623	—	Japan 16,764; Belgium-Luxembourg 1,859.
Oxides		54	18	—	Taiwan 17; Spain 1.
Blue powder		36	NA		
Matte		325	NA		
Ash and residue containing zinc		530	NA		
Metal including alloys:					
Scrap		NA	86	—	Taiwan 81; Spain 5.
Unwrought		50	1,023	—	Hong Kong 604; Taiwan 301; West Germany 118.
Semimanufactures		599	377	85	West Germany 263; Hong Kong 15.
Zirconium:					
Ore and concentrate		66,520	82,256	23,380	Japan 24,790; Spain 18,085; United Kingdom 14,309.
Metal including alloys, unwrought		1	—		
Other:					
Ores and concentrates:					
Of base metals		r632,935	30,367	—	Japan 22,510; United Kingdom 5,668.
Of precious metals, n.e.s.	value, thousands	$2,423	$1,476	$82	Belgium-Luxembourg $1,394.
Oxides and hydroxides		173	1,814	119	Belgium-Luxembourg 1,479; Argentina 94.
Ashes and residues		r309,630	238,579	214,670	Austria 21,180.
Base metals including alloys, all forms		r20,304	1,203	975	Hong Kong 135.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.		2,034	20	—	All to West Germany.
Dust and powder of precious and semiprecious stones including diamond	value, thousands	$161	$178	—	All to Argentina.
Grinding and polishing wheels and stones		272	2	—	All to Austria.
Asbestos, crude		[3]134,607	123,152	4,288	Japan 88,005; Taiwan 13,407; Algeria 3,894.
Barite and witherite		9,000	NA		
Cement		53	—		
Clays, crude:					
Bentonite		[3]580	3,580	—	West Germany 2,600; Taiwan 980.
Chamotte earth		1,974	6,659	—	All to West Germany.
Flint clay		[3]13,582	1,746	—	All to Taiwan.
Kaolin		[3]682	—		
Unspecified		29,282	46,683	—	Japan 36,255; Belgium-Luxembourg 1,574.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Diamond:					
Natural:					
Gem, not set or strung	value, thousands	r$370,811	$345,755	$90,916	Belgium-Luxembourg $200,159; Hong Kong $45,539.
Industrial stones	do.	r$1,777	$16,918	—	West Germany $13,615; Japan $1,568; Belgium-Luxembourg $1,303.
Dust and powder	do.	$119	$265	—	All to West Germany.
Synthetic: Dust and powder	do.	—	$25	—	All to Belgium-Luxembourg.
Feldspar, fluorspar, related materials:					
Feldspar		[2]3,475	2,214	—	Spain 1,113; West Germany 1,101.
Fluorspar		[3]281,427	333,603	175,559	West Germany 98,494; Japan 59,550.
Unspecified		217,193	24,844	—	United Kingdom 20,980; Taiwan 3,468.
Fertilizer materials:					
Crude, n.e.s.		1,855	1,805	—	Belgium-Luxembourg 1,245; West Germany 442.
Manufactured:					
Ammonia		331	—		
Nitrogenous		26,535	NA		
Phosphatic		200	2,499	—	Belgium-Luxembourg 1,999; Ecuador 400.
Unspecified and mixed		11,630	54,864	20	West Germany 39,932; Taiwan 7,577; Spain 6,419.
Graphite, natural		286	340	340	
Gypsum and plaster		60	—		
Kyanite and related materials:					
Andalusite		[3]117,622	NA		
Sillimanite		[3]979	NA		
Unspecified		34,259	NA		
Magnesium compounds:					
Magnesite, crude		2,131	NA		
Oxides and hydroxides		—	43	—	All to Taiwan.
Other		1,000	2	—	All to Switzerland.
Mica:					
Crude including splittings and waste		[3]1,105	173	—	Japan 102; West Germany 71.
Worked including agglomerated splittings	value, thousands	$6	—		
Phosphates crude		761,474	842,613	—	Belgium-Luxembourg 357,980; Japan 209,306; West Germany 204,223.
Phosphorus, elemental		1,216	1,605	—	All to Taiwan.
Pigments, mineral:					
Natural crude		261	—		
Iron oxides and hydroxides, processed		1,360	56	—	Belgium-Luxembourg 36; Hong Kong 20.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	$12,906	$61,673	$5,059	Spain $51,000; West Germany $1,899.
Synthetic	do.	NA	$28	—	Belgium-Luxembourg $21; Argentina $7.
Pyrite, unroasted		2,214	NA		
Salt and brine		[3]81,715	NA		

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.: Sulfate, manufactured		62	—		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		[r]292,058	211,186	10,212	Japan 110,213; Belgium-Luxembourg 23,008; Taiwan 15,572.
Worked		4,877	5,968	1,356	United Kingdom 2,304; West Germany 2,159.
Gravel and crushed rock		206	1,089	788	Taiwan 238; West Germany 63.
Limestone other than dimension		[3]74,501	NA		
Quartz and quartzite		62	843	82	Taiwan 371; West Germany 200; Japan 123.
Sand other than metal-bearing		11,971	14,103	318	Belgium-Luxembourg 13,207.
Sand and gravel		—	116	116	
Sulfur: Elemental, crude including native and byproduct		—	24	—	All to Spain.
Talc, steatite, soapstone, pyrophyllite		NA	318	80	West Germany 238.
Vermiculite		[3]186,273	63,032	—	United Kingdom 47,191; West Germany 11,079.
Other:					
Crude		[r]76,480	47,571	—	United Kingdom 22,382; Japan 18,180; Spain 3,325.
Slag and dross, not metal-bearing		88,388	137,907	—	Japan 101,557; United Kingdom 36,260.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		1,071	NA		
Carbon:					
Carbon black		35	108	—	Taiwan 100; Spain 7.
Gas carbon		98	100	—	All to Taiwan.
Coal:					
Anthracite and bituminous	thousand tons	[3]42,431	14,512	—	Japan 6,378; Hong Kong 4,997; West Germany 2,742.
Briquets of anthracite and bituminous coal		610	1,727	—	Switzerland 1,420; Austria 307.
Lignite including briquets		228,290	4,292,526	—	All to Taiwan.
Coke and semicoke		1,087	NA		
Peat including briquets and litter		68	—		
Petroleum:					
Crude	thousand 42-gallon barrels	NA	1,501	—	United Kingdom 1,500.
Refinery products:					
Gasoline	do.	31	NA		
Mineral jelly and wax	do.	155	228	140	West Germany 47; Japan 33.
Kerosene and jet fuel	do.	56	NA		
Distillate fuel oil	do.	801	NA		
Lubricants	do.	287	3	—	Mainly to Taiwan.
Nonlubricating oils	value, thousands	$1	NA		
Residual fuel oil	thousand 42-gallon barrels	1,047	265	210	Spain 55.
Bitumen and other residues	do.	2	([2])	—	All to Spain.
Petroleum coke	do.	NA	59	—	Mainly to Switzerland.

[r]Revised. NA Not available.
[1]Table prepared by Virginia A. Woodson. This table should not be taken as a complete representation of this country's mineral exports. These data have been compiled from United Nations information and data available from trading partner countries. Data presented are exports by the common customs area of Botswana, Lesotho, the Republic of South Africa, and Swaziland.
[2]Less than 1/2 unit.
[3]Data issued by the Government of the Republic of South Africa.
[4]Excludes unreported quantity imported by Japan valued at $551,584,000.

TABLE 3

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS				
Alkali and alkaline-earth metals	1	39	—	All from West Germany.
Aluminum:				
Ore and concentrate	120	82	—	All from Japan.
Oxides and hydroxides	9,445	9,422	—	Netherlands 3,671; West Germany 1,892; United Kingdom 1,676.
Ash and residue containing aluminum	1,268	NA		
Metal including alloys:				
Scrap	155	61	61	
Unwrought	189	182	—	West Germany 167; Belgium-Luxembourg 15.
Semimanufactures	r7,656	5,987	453	West Germany 4,152; Belgium-Luxembourg 624.
Unspecified	—	6	6	
Antimony:				
Oxides	—	25	—	All from West Germany.
Metal including alloys, all forms	1	10	—	All from Belgium-Luxembourg.
Beryllium: Metal including alloys, all forms	224	NA		
Bismuth: Metal including alloys, all forms	2	—		
Cadmium: Metal including alloys, all forms	1	—		
Chromium:				
Ore and concentrate	5,500	28	3	West Germany 25.
Oxides and hydroxides	34	348	—	West Germany 346; Belgium-Luxembourg 2.
Metal including alloys, all forms	75	1	1	
Cobalt:				
Oxides and hydroxides	6	—		
Metal including alloys, all forms	15	7	5	West Germany 1; Taiwan 1.
Columbium and tantalum: Metal including alloys, all forms	1	3	2	Austria 1.
Copper:				
Ore and concentrate	32	—		
Oxides and hydroxides	24	33	—	All from West Germany.
Sulfate	5	—		
Ash and residue containing copper	—	2,904	—	Do.
Metal including alloys:				
Scrap	8	—		
Unwrought	177	112	5	Belgium-Luxembourg 54; Netherlands 53.
Semimanufactures	r2,044	4,202	68	West Germany 3,333; Belgium-Luxembourg 481.
Unspecified	—	2	2	
Gold:				
Waste and sweepings value, thousands	$144	NA		
Metal including alloys, unwrought and partly wrought kilograms	([2])	41	—	All from Switzerland.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	50	—		
Metal:				
Scrap	344	1	—	All from Taiwan.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Pig iron, cast iron, related materials	345	152	—	All from West Germany.
Ferroalloys:				
Ferrochromium	NA	113	—	West Germany 63; Japan 34; Belgium-Luxembourg 16.
Ferromanganese	109	NA		
Ferromolybdenum	100	NA		
Ferrosilicon	392	442	373	West Germany 66.
Silicon metal	—	1	([3])	Mainly from West Germany.
Unspecified	1,938	95	30	West Germany 39; Japan 20.
Steel, primary forms	r169	1,406	—	West Germany 1,405.
Semimanufactures:				
Bars, rods, angles, shapes, sections	r9,560	8,127	505	West Germany 3,397; Japan 3,332.
Universals, plates, sheets	r40,652	6,290	6,156	Netherlands 63; Taiwan 48.
Hoop and strip	r7,625	271	271	
Rails and accessories	86	114	53	West Germany 43; Belgium-Luxembourg 11.
Wire	r5,188	4,509	43	Belgium-Luxembourg 1,913; Japan 1,073.
Tubes, pipes, fittings	r55,537	51,609	475	Japan 28,494; West Germany 10,545; Spain 6,057.
Castings and forgings, rough	3,806	959	—	Taiwan 910; Netherlands 49.
Lead:				
Ore and concentrate	15,721	NA		
Oxides	31	—		
Metal including alloys:				
Scrap	203	2,804	2,692	New Zealand 112.
Unwrought	259	688	73	Netherlands 613.
Semimanufactures	12	123	([3])	Belgium-Luxembourg 101; West Germany 20.
Lithium: Oxides and hydroxides	94	—		
Magnesium: Metal including alloys:				
Unwrought	18	—		
Semimanufactures	103	60	45	West Germany 15.
Manganese:				
Ore and concentrate: Metallurgical-grade	4,196	5,708	—	All from Netherlands.
Oxides	r65	—		
Mercury	26	—		
Molybdenum:				
Ore and concentrate	276	105	—	West Germany 71; Netherlands 34.
Oxides and hydroxides	85	—		
Metal including alloys:				
Semimanufactures	2	5	5	
Unspecified	8	35	35	
Nickel: Metal including alloys:				
Scrap	6	—		
Unwrought	5	—		

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988	
				United States	Other (principal)
METALS—Continued					
Nickel: Metal including alloys—Continued					
Semimanufactures		96	508	12	West Germany 460; Austria 32.
Platinum-group metals:					
Waste and sweepings	value, thousands	$10,499	NA		
Metals including alloys, unwrought and partly wrought:					
Palladium	kilograms	NA	63	—	West Germany 53; Switzerland 10.
Platinum	value, thousands	NA	$2,019	$147	Switzerland $1,777; West Germany $95.
Rhodium	do.	NA	$410	—	All from Switzerland.
Unspecified	do.	$2,131	$42	$36	Spain $6.
Rare-earth metals including alloys, all forms	kilograms	1,996	379	379	
Selenium, elemental		14	—		
Silver:					
Waste and sweepings	value, thousands	$1,117	NA		
Metal including alloys, unwrought and partly wrought	kilograms	32,150	16,537	16	West Germany 16,521.
Tin:					
Ore and concentrate		1	—		
Oxides		15	—		
Metal including alloys:					
Unwrought		14	1	—	All from Taiwan.
Semimanufactures		r81	15	1	Taiwan 14.
Titanium:					
Ore and concentrate		2	—		
Oxides		r52	87	—	West Germany 70; Japan 17.
Metal including alloys:					
Scrap		38	27	20	West Germany 7.
Unwrought		—	(3)	(3)	
Semimanufactures	kilograms	9	16	16	
Unspecified		9	(3)	(3)	
Tungsten:					
Ore and concentrate		90	18	—	All from West Germany.
Ash and residue containing tungsten		—	20	—	Do.
Metal including alloys:					
Scrap		5	—		
Semimanufactures		19	13	2	West Germany 11.
Unspecified		11	1	—	All from Austria.
Zinc:					
Oxides		r271	61	—	West Germany 59; Japan 1.
Blue powder		—	81	—	All from Belgium-Luxembourg.
Matte		NA	449	—	All from West Germany.
Ash and residue containing zinc		23	—		

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988	
			United States	Other (principal)
METALS—Continued				
Zinc—Continued				
Metal including alloys:				
Scrap	199	NA		
Unwrought	841	143	18	Belgium-Luxembourg 125.
Semimanufactures	[r]12	23	4	Taiwan 19.
Zirconium:				
Ore and concentrate	1	—		
Metal including alloys, semimanufactures	2	—		
Other:				
Ores and concentrates	159	348	345	Switzerland 3.
Oxides and hydroxides	11	70	—	Spain 53; Belgium-Luxembourg 17.
Ashes and residues	1,950	417	—	All from Belgium-Luxembourg.
Base metals including alloys, all forms	[r]243	12	12	
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	2,096	62	—	Belgium-Luxembourg 27; Japan 17; Taiwan 14.
Artificial:				
Corundum	1,478	2,566	—	West Germany 1,772; Japan 789.
Silicon carbide	68	49	29	Spain 20.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$279	$42	—	Belgium-Luxembourg $33; Taiwan $9.
Grinding and polishing wheels and stones	229	516	14	Taiwan 283; West Germany 125.
Asbestos, crude	215	19	19	
Barite and witherite	354	86	—	Spain 84.
Boron materials:				
Crude natural borates	1,630	690	—	All from Netherlands.
Oxides and acids	941	36	—	All from Argentina.
Bromine	1	—		
Cement	[r]64,945	4,048	—	Netherlands 1,909; West Germany 1,067; Spain 927.
Chalk	1,988	124	—	West Germany 105; Switzerland 19.
Clays, crude:				
Bentonite	12,773	375	363	Netherlands 12.
Fire clay	6	155	—	West Germany 142; Taiwan 13.
Kaolin	20,487	22,224	22,224	
Unspecified	2,278	6,542	6,524	Switzerland 18.
Diamond:				
Gem, not set or strung value, thousands	$30,899	$55,015	$2,145	Belgium-Luxembourg $46,472; United Kingdom $3,560.
Industrial stones do.	$222	[4]$107	—	All from Belgium-Luxembourg.
Diatomite and other infusorial earth	32	4,546	4,537	Japan 9.
Feldspar, fluorspar, related materials	6	8	—	All from Switzerland.
Fertilizer materials:				
Crude, n.e.s.	136	9,770	—	Jordan 9,750.

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials—Continued				
Manufactured:				
Ammonia	12,419	2	—	All from West Germany.
Nitrogenous	r16,069	1,295	—	West Germany 916; Netherlands 299.
Phosphatic	r112	NA		
Potassic	14,833	34,813	—	All from West Germany.
Unspecified and mixed	r11,101	289	—	Belgium-Luxembourg 224; West Germany 43.
Graphite, natural	540	NA		
Gypsum and plaster	15,836	5,551	—	All from West Germany.
Kyanite and related materials	276	NA		
Lime	582	686	—	Japan 674; West Germany 12.
Magnesium compounds:				
Magnesite, crude	r 5 10,413	6	—	All from Belgium-Luxembourg.
Oxides and hydroxides	r9,100	2,890	—	Japan 2,742; West Germany 128.
Other	648	NA		
Meerschaum, amber, jet	204	(3)	—	All from Taiwan.
Mica:				
Crude including splittings and waste	17	20	—	Belgium-Luxembourg 15; West Germany 3.
Worked including agglomerated splittings	r52	51	—	Switzerland 35; Austria 16.
Nitrates, crude	184	1,567	—	All from West Germany.
Phosphates, crude	21	—		
Pigments, mineral: Iron oxides and hydroxides, processed	262	7,309	—	West Germany 7,089; Spain 196.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$446	$252	—	Switzerland $221; Taiwan $31.
Synthetic do.	$251	$81	$4	Switzerland $63; Japan $14.
Pyrite, unroasted	14	37	—	All from West Germany.
Quartz crystal, piezoelectric value, thousands	NA	$54	—	All from Japan.
Salt and brine	r3,336	4	—	All from Switzerland.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	141,102	5,244	—	Taiwan 5,241.
Sulfate, manufactured	1,249	129	—	All from Spain.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	2,348	210	—	Spain 162; West Germany 39.
Worked	2,136	19	—	Spain 16; West Germany 3.
Dolomite, chiefly refractory-grade	NA	495	—	All from West Germany.
Gravel and crushed rock	61	6,203	—	Austria 6,166.
Quartz and quartzite	24	2,819	—	All from West Germany.
Sand other than metal-bearing	3,310	46	—	Switzerland 27; West Germany 19.
Sulfur:				
Elemental:				
Crude including native and byproduct	r212,289	254	—	West Germany 237; Japan 17.
Colloidal, precipitated, sublimed	60	—		

See footnotes at end of table.

TABLE 3—Continued

REPUBLIC OF SOUTH AFRICA: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur—Continued					
Sulfuric acid		51,773	229	—	Taiwan 200; West Germany 29.
Talc, steatite, soapstone, pyrophyllite		r4,336	811	614	Austria 130; West Germany 45.
Other:					
Crude		8,592	556	—	West Germany 454; Taiwan 58.
Slag and dross, not metal-bearing		915	1,150	—	All from Taiwan.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		r4,317	257	242	Argentina 15.
Carbon:					
Carbon black		r1,932	1,527	—	West Germany 1,217; Netherlands 283.
Gas carbon		262	(3)	—	All from Taiwan.
Coal:					
Anthracite and bituminous		85,114	36	—	All from West Germany.
Lignite including briquets		44	—		
Coke and semicoke		58	3	—	All from Japan.
Peat including briquets and litter		391	18	—	All from West Germany.
Petroleum refinery products:					
Liquefied petroleum gas	42-gallon barrels	2,327	NA		
Gasoline	do.	r97,575	51,000	—	Belgium-Luxembourg 42,000; West Germany 8,000.
Mineral jelly and wax	do.	r64,039	211,801	—	West Germany 151,000; Japan 50,801.
Kerosene and jet fuel	do.	r269,699	2,101	—	Belgium-Luxembourg 2,000.
Distillate fuel oil	do.	r2,265,453	20,000	—	Belgium-Luxembourg 16,000; West Germany 4,000.
Lubricants	do.	r189,043	89,485	—	West Germany 45,000; Spain 42,000.
Nonlubricating oils	do.	—	13	—	All from Taiwan.
Residual fuel oil	do.	r958,474	NA		
Asphalt	do.	655	309	309	
Bitumen and other residues	do.	226,880	NA		
Bituminous mixtures	do.	333	109	—	Netherlands 91; West Germany 18.
Petroleum coke	do.	399,487	365,405	361,405	West Germany 4,000.

rRevised. NA Not available.
[1]Table prepared by Virginia A. Woodson. This table should not be taken as a complete representation of this country's mineral imports. These data have been compiled from United Nations information and data available from trading partner countries. Data presented are imports by the common customs area of Botswana, Lesotho, the Republic of South Africa and Swaziland.
[2]Unreported quantity valued at $1,167,000.
[3]Less than 1/2 unit.
[4]Excludes 37,819 carats imported from the United Kingdom.
[5]Excludes unreported quantitites valued at $843,000 imported from Japan and $23,000 from Canada.

1989 was 740,804, compared with over 738,000 in 1988. The 1989 average labor force was distributed as follows: 520,023 in gold mines, 103,065 in coal mines, and 117,716 in all other mines. The industry as a whole reported 735 deaths in 1989 compared with 674 in 1988. Total injuries reported were 10,097 compared with 11,357 in the same time periods. The death and injury rates per 1,000 people employed were thus 0.99 and 13.63, respectively, in 1989, and 0.91 and 15.38, respectively, in 1988.

COMMODITY REVIEW

Metals

Aluminum.—The IDC sold a 30.7% interest in Alusaf (Pty.) Ltd. for $25.6 million. It retained about 35% interest in the operation. Alusaf was the country's sole aluminum producer.

Antimony.—Consolidated Murchison Ltd., the sole producer of antimony sulfide concentrate in South Africa, continued to reduce output. In the year ended June 30, 1989, 457,063 tons of ore was milled, and 8,838 tons of concentrate was produced grading 58.85% antimony. While plant recovery improved from 80% to 83%, ore grade declined to

TABLE 4

REPUBLIC OF SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating company (ownership)	Location of main facilities	Capacity[1]
Andalusite	Weedons Minerals (Pty.) Ltd.	Timeball Mine, near Thabazimbi	120,000.
Do.	Annesley Andalusite (Pty.) Ltd. (Zaaiplaats Mining Ltd., 50.04%)	Annesley Mine, near Penge	42,000.
Antimony	Consolidated Murchison Ltd. (JCI and Anglovaal)	50 kilometers west of Phalaborwa	9,500 Sb in concentrate.
Asbestos	Gencor Ltd.	Penge Mine, west of Phalaborwa	48,000 amosite.
Do.	do.	Klipfontein, 50 kilometers south of Kuruman	NA.
Do.	Anglo Dutch Exploration & Mining Co. (Pty.) Ltd.	Stella Mine, 25 kilometers east of Barberton	NA.
Chromite	Lavino South Africa (Pty.) Ltd. (Anglovaal, 100%)	Grootboom Mine, near Lydenburg	500,000 ore.
Do.	Dilokong Chrome Mine (Pty.) Ltd. (Mining Corp. Ltd., 100%)	Dilokong Mine, near Lydenburg, Lebowa	480,000 ore.
Do.	Cromore Ltd. (S A Manganese Amcor Ltd., 100%)	Mooinooi Mine, 30 kilometers west of Brits	456,000 ore.
Do.	Chromecorp Technology (Pty.) Ltd.	Chroombronne Mine near Rustenburg	576,000 ore 432,000 concentrate.
Coal	Anglo American Coal Corp. Ltd. (AAC, 100%)	13 collieries in eastern Transvaal and Natal	46[2] anthracite and bituminous.
Do.	Trans-Natal Collieries Ltd. (Gencor Ltd., 100%)	Matla Colliery, 45 kilometers south of Witbank	10.3[2] bituminous.
Do.	do.	Optimum Colliery, 40 kilometers southwest of Witbank	10.2[2] bituminous.
Do.	Rand Mines Ltd. (Barlow Rand Ltd., 100%)	Duvha Colliery, 18 kilometers southeast of Witbank	11[2] bituminous.
Do.	Rietspruit Opencast Services (Pty.) Ltd. (Barlow Rand 50%, Shell S A 50%)	Rietspruit Colliery, 30 kilometers southeast of Witbank	9[2] bituminous.
Do.	Sasol Mining (Pty.) Ltd.	Sigma Mine, 75 kilometers south of Johannessburg	7[2] bituminous.
Do.	do.	Secunda Collieries, 75 kilometers south of Witbank	30[2] bituminous.
Diamond	De Beers Consolidated Mines Ltd.	Finsch Mine, 100 kilometers west of Kimberley	4.6 million carats per year.
Do.	do.	Koffiefontein Mine, 70 kilometers south of Kimberley	250,000 carats per year.
Do.	do.	Premier Mine, 70 kilometers east of Pretoria	2.25 million carats per year.
Fluorspar	Transvaal Mining and Finance Co. Ltd. (Gencor Ltd., 100%)	Buffalo Mine, 110 kilometers northeast of Pretoria	250,000 acid grade fluorspar.
Do.	Vergenoeg Mining Corp. (Pty.) Ltd. (Bayer AG, 100%, Federal Republic of Germany)	Vergenoeg Mine, 90 kilometers east of Pretoria	115,000 acid and metallurgical grade fluorspar.
Do.	Phelps Dodge Mining (Pty.) Ltd. (United States, 100%)	Witkop Mine, 130 kilometers west of Johannesburg	99,000 acid grade fluorspar.
Do.	Van Den Heever Vloeispaat Werke	120 kilometers west of Johannesburg	NA.
Gold	Anglo American Corp.	Freegold near Welkom, Vaal Reefs near Klerksdorp, Western Deep Levels 70 kilometers southwest of Johannesburg	250 Au.
Do.	Goldfields of S.A. Ltd. (Rembrandt Group Ltd., 20%, Asteroid Pty. Ltd., 20%, Consolidated Gold Fields Plc., 8%)	East Driefontein and West Driefontein 65 kilometers southwest of Johannesburg, Kloof 55 kilometers southwest of Johannesburg, and others	125 Au.
Do.	Gencor Ltd.	Buffelsfontein near Klerksdorp, Beatrix 35 kilometers southeast of Wekom, Winkelhaak 120 kilometers southeast of Johannesburg, and others	90 Au.

See footnotes at end of table.

TABLE 4—Continued

REPUBLIC OF SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating company (ownership)	Location of main facilities	Capacity[1]
Gold	Rand Mines Ltd.	Harmony Mine 20 kilometers southeast of Welkom, and others	55 Au.
Do.	Anglovaal Ltd.	Hartebeestfontein Mine near Klerksdorp, and others	45 Au.
Do.	Johannesburg Consolidated Investment Co. Ltd.	Randfontein Mine 20 kilometers west of Johannesburg, Western Areas Mine 30 kilometers southwest of Johannesburg, and others	41 Au.
Iron ore	Iscor Ltd. (Government, 16%; minority shareholders, 84%)	Sishen Mine, 50 kilometers south of Hotazel	20.8[2] ore.
Do.	do.	Thabazimbi Mine, 150 kilometers northeast of Pretoria	2.3[2] ore.
Iron and steel and ferroalloys	Chromecorp Technology (Pty.) Ltd.	Rustenburg	120,000 ferrochromium.
Do.	Consolidated Metallurgical Industries (Pty.) Ltd. (JCI, 49.9%)	Lydenburg	210,000 ferrochromium.
Do.	do.	Rustenburg	120,000 ferrochromium.
Do.	Ferrometals Ltd. (Samancor, 100%)	Witbank	320,000 ferrochromium.
Do.	Middelburg Steel and Alloys (Pty.) Ltd. (BRL, 100%)	Krugersdorp	120,000 ferrochromium.
Do.	do.	Middelburg	210,000 ferrochromium.
Do.	Tubatse Ferrochrome (Pty.) Ltd. (Samancor, 100%)	Steelpoort	300,000 ferrochromium.
Manganese	Associated Manganese Mines of South Africa Ltd. (Anglovaal Ltd.)	Belgravia, Blackrock, Gloria, N'Chwaning, and Perth Mines near Hotazel	NA.
Do.	Samancor Ltd. (Gencor Ltd.)	Hotazel, Mamatwan, and Wessels Mines near Hotazel	NA.
Pyrophyllite	Wonderstone 1937 Ltd. (The Associated Ore and Metal Co. Ltd., 100%)	Gestoptefontein Wonderstone Quarry near Ottsdal	4,000.[e]
Platinum-group metals	Rustenburg Platinum Mines Ltd. (AAC, JCI, 32.6%)	Rustenburg Mine near Rustenburg, Union and Amandelbult Mines near Northam	70[e] PGM.
Do.	Lebowa Platinum. Mines Ltd. (AAC, JCI, 20.1%, Lebowa Homeland, 9%)	Atok Mine 70 kilometers northwest of Lydenburg	NA.
Do.	Impala Platinum Ltd. (Gencor Ltd.)	Bafokeng North and Bafokeng South Mines, Wildebeestfontein North and Wildebeestfontein South Mines 20 kilometers north of Rustenburg	55[e] PGM.
Do.	Western Platinum Ltd. (Lonrho Plc United Kingdom, 99%)	20 kilometers east of Rustenburg	10[e] PGM.
Do.	Eastern Platinum Ltd. (Lonrho Plc United Kingdom, Impala Platinum Ltd.)	40 kilometers northeast of Rustenburg	3[e] PGM.
Do.	Gazelle Platinum Ltd. (Western Platinum Ltd., Impala Platinum Ltd.)	Karee Mine 25 kilometers northwest of Rustenburg	5[e] PGM.
Do.	Barplats Investments Ltd. (Rand Mines Ltd., 60.7%; Vansa Vanadium SA Ltd., 24.1%)	Crocodile River Mine near Brits	10 PGM.
Titanium concentrate	Tisand Pty. Ltd. (Gencor Ltd., Industrial Development Corp.)	Opencast operations near Richards Bay	60,000 rutile concentrate; 1,280,000 ilmenite concentrate.
Titanium slag	Richards Bay Iron and Titanium Corp. (RTZ Corp. United Kingdom, Gencor Ltd., Industrial Development Corp.)	Smelter at Richards Bay	750,000 slag.
Uranium	Vaal Reefs Exploration and Mining Co. (AAC)	Mine and plant near Klerksdorp	2,000[e] uranium oxide.

See footnotes at end of table.

TABLE 4—Continued

REPUBLIC OF SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating company (ownership)	Location of main facilities	Capacity
Uranium	Freestate Consolidated Gold Mines Ltd. (AAC)	Mine and plant near Welkom	500[e] uranium oxide.
Do.	Buffelsfontein Gold Mining Co. Ltd. (Gencor Ltd., AAC)	Mine and plant 15 kilometers southwest of Klerksdorp	500[e] uranium oxide.
Do.	Hartebeestfontein Gold Mining Co. (Anglovaal Ltd., AAC)	Mine and plant 5 kilometers southeast of Klerksdorp	400[e] uranium oxide.
Vanadium	Highveld Steel and Vanadium Corp. (AAC)	Mapochs Mine near Lydenburg	23,700[e] vanadium pentoxide.
Do.	Vametco Minerals Corp. (Strategic Metals Corp., 100%, United States)	Krokodilkraal Mine and plant near Brits	10,000[e] vanadium pentoxide.
Do.	Transvaal Alloys Pty. Ltd.	Wapadskloof Mine and plant near Witbank	2,250[e] vanadium pentoxide.
Do.	Vansa Vanadium SA Ltd. (Barlow Rand, Barplats Investments Ltd.)	Kennedy's Vale Mine and plant near Lydenburg	3,000 vanadium pentoxide.
Do.	Rhombus Vanadium Holdings Ltd. (Private, Usko Ltd.)	Ba-Mogopa Mine and plant near Brits	9,000 vanadium pentoxide.
Vermiculite	Palabora Mining Co. Ltd. (AAC, RTZ Corp., 38.9%)	Palabora Mine and plant at Palaborwa	230,000.[e]
Zirconium	Tisand (Pty.) Ltd. (Gencor Ltd., Industrial Development Corp.)	Opencast operations near Richards Bay	155,000[e] zircon.
Do.	Palabora Mining Co. Ltd. (AAC, RTZ Corp., 38.9%)	Palabora Mine and plant at Palaborwa	13,200[e] Baddeleyite.
Do.	Phosphate Development Corp. Ltd. (Industrial Development Corp., 100%)	do.	12,500[e] Baddeleyite.

[e]Estimated. NA Not available.
[1]Metric tons per year unless otherwise specified.
[2]Million metric tons per year.

1.37% antimony from 1.54%. A labor strike over wage issues halted production for several weeks in September and October. A market oversupply situation, along with continued erratic pricing by the Chinese, has led to a 25% planned reduction in the milling rate. Output at this lower level was to be maintained for 1 year. Exploration was conducted at the Athens, Beta, and Monarch shafts, and reserves were reported to be about 3 million tons. Total employment at Murchison was 800 surface workers and 900 underground workers.

Arsenic.—The presence of arsenic in the Barberton area gold mines, and subsequent ground water pollution caused by this element, has led to its economic recovery. While the total level of output has not been reported, both the Fairview and Barbrook Mines in the Barberton area have arsenic recovery facilities. At Fairview arsenic is recovered from plant residues and either sold or rendered harmless. At Barbrook, a new gold mine, the original plant process has an integrated arsenic recovery step, with all output expected to be sold. Arsenic trioxide recovery in the pyrite roaster baghouse was to be about 2,400 metric tons per year (mt/yr).

Chromite.—Cromore Ltd.'s Mooinooi Mine produced both lump ore and fines, for both chemical and metallurgical use. Output was primarily from the Middle Group 1 (MG1) chromitite seam, dipping 12° N. Mine depth was 220 meters (m), and average stope height was 1.3 m. Ore was moved to the surface by inclined conveyors, and worker transport was by chair lifts. The MG1 seam is within a pyroxenite unit and is harder than the Lower Group chromitites, yielding about 50% lumpy ore. Reserves of the main seam were 40 million tons. Output was shipped by railroad from a private siding 6.5 kilometers (km) from the mine at Turfgrond. Railroad distance to domestic users at Witbank was 177 km, and for export through Richards Bay 764 km.

The Chroombroone Mine was upgraded by Chromecorp Technology (Pty.) Ltd. to supply 300,000 mt/yr of ore to the company's ferrochromium plant at Rustenburg. The mine produced ore from two chromitite seams. The upper seam was 20 to 30 centimeters thick, and the lower seam was 80 to 100 centimeters thick. A 45- to 55-centimeter-thick waste rock seam of norite separated the two chromite seams, and led to a stope height for production purposes of 150 to 180 centimeters. The ore seams dip 8° to 11° north, and production stopes were 30 m to 100 m deep. Six load-haul-dump vehicles with 3.5- to 4.5-ton carrying capacity and profiles of only 1.5 m feed stope conveyors. These in turn supplied a main incline conveyor system for transport to the surface. Mill capacity was 500,000 mt/yr of run-of-mine material. Heavy-medium separation and a system of spirals produced three products, which were transported by truck to the ferrochrome plant 17 km distant. Total labor force at the mine was 200 people.

Copper.—Ore output from Palabora Mining Co. was 202,000 tons per month.

The open pit was projected to remain operational until 2000. A 460-m shaft was to be sunk in the floor of the open pit, and 1 km of development work was planned over a 2-year period to assess underground reserves. Grade averaged 0.5% copper, with slightly higher grades expected as the open pit narrowed and deepened to its final point.

Gold.—Despite lower market prices for gold, it remained the bellwether of the Republic of South Africa, accounting for about 6% of the GDP in 1989, compared with 12% in 1980. High production costs and low prices have led to rationalization at many mines. Six of 33 gold mines that were members of the Chamber of Mines were not profitable in 1989, and an estimated 50% of the 33 mines may operate at a loss in 1990. Large, deep, low-grade gold mines in particular were reducing their labor force at yearend.

The new Rand Refinery poured its first gold in September 1989, and was officially opened in October. Total cost for the refinery was $30.5 million to gold members of the Chamber, who owned the refinery. All gold output continued to be sold through the South African Reserve Bank. African Explosives and Chemical Industries Ltd., in a joint venture with the Rand Refinery, established Goldchem (Pty.) Ltd. to produce gold potassium cyanide for gold plating in the jewelry industry. Goldchem's product was to contain 70% gold, and was to be sold mainly to Asia.

Exploration expenditures for gold were about $152.7 million annually. AAC, Gencor, and JCI had underway the sinking of 10 new gold mine shafts at a total cost of $1.54 billion. AAC's projects included the $404.6 million, 2,162-m-deep No. 1 shaft at Freddies Mine, which included winding and headgear, and the $187 million, 4,000-m-deep No. 1 shaft at Western Deep Levels.

Vaal Reefs Exploration and Mining Co. commenced operation of a large-scale pilot plant for the treatment of gold-bearing pyritic material using bacterial oxidation. Commissioned June 1990, the plant can treat 20 tons per day of concentrate. Bacterial oxidation of the pyritic material also enhanced recovery of uranium in the cyanidation step. *Thiobacillus ferrooxidans, Thiobacillus thiooxidans,* and *Leptospirillum ferrooxidans* were the main species of bacteria used at Vaal Reefs, with an optimal process temperature of 30° C to 40° C.

Iron and Steel.—Iscor Ltd., Government owned for over 60 years, was privatized and its shares traded on the Johannesburg Stock Exchange. With privatization Iscor was no longer considered to be a parastatal organization subject to embargo of its iron and steel products by the United States. Total steel output by Iscor was 6.98 million metric tons (MMmt), of which the Vanderbijlpark plant produced 4.135 MMmt, Newcastle 1.921 MMmt, Pretoria 0.776 MMmt, and Cisco 0.148 MMmt. Total sales were 5.408 MMmt, of which 63% were local sales and 37% exports.

Iscor's direct coal reduction (Corex) plant at Pretoria operated at its design capacity of 300,000 mt/yr of liquid iron. Reported to be the first commercial Corex plant in the world, the plant provided a 25% saving in direct operational costs, lower capital cost, reduced pollution, and lower dependence on scrap iron. Iscor continued to operate six blast furnaces, one of which broke down in December. Iscor supplied 76% of its coking coal requirements for the blast furnaces from four coal mines; the remainder was imported. The company approved modest capital expenditures for 1991 for improvements to existing plants. These efforts were expected to effectively add 0.6 MMmt per year of steel production capacity without adding a new plant by June 1992. New product lines underway were a chrome-plating plant and an electrolytic galvanized steel plant. Total costs for Iscor were distributed as follows: salaries and wages 24%, raw materials 22%, depreciation 16%, electricity 16%, spares 13%, transport 7%, and financing 2%.

A joint venture between Iscor Ltd. 40%, and Dorbyl (Pty.) Ltd. 60%, resulted in the construction and commissioning of a $45.8 million seamless pipe mill. Initial capacity was 50,000 mt/yr, and pipe with outside diameters up to 18 centimeters can be produced.

Middelburg Steel and Alloys, a Barlow Rand subsidiary, continued to be the country's only producer of stainless steel. However, two ferroalloy producers, Gencor and Highveld Steel and Vanadium Corp., planned to build a $750 million stainless steel plant in Witbank. Foreign partnership in the plan was yet to be determined.

The Council for Mineral Technology (Mintek) developed a process for the application of plasma-arc technology for the recovery of metals collected in baghouse dusts generated at iron and steel plants. Mintek had developed plasma-arc technology for the recovery of PGM from the Upper Group 2 (UG2) chromitite seam.

Total ferroalloy production declined slightly owing to a decline in demand for steel worldwide. Ferrochromium output reached the highest level ever recorded at 972,000 tons. However, by yearend the falloff in demand allowed the industry to undertake repairs and maintenance procedures. These had been postponed during the period of high demand for ferrochromium for the stainless steel industry.

SA Manganese Amcor (Samancor) was the largest producer of ferrochromium. With the startup of a new furnace in April 1990, Samancor had a potential capacity of 620,000 mt/yr.

Consolidated Metallurgical Industries Ltd. (CMI) commissioned a new furnace January 1990. Although it brought total ferrochromium capacity to 210,000 mt/yr, maintenance of existing furnaces was expected to limit output to 170,000 mt/yr. CMI purchased Purity Chrome for $69.5 million, acquiring a chrome mine and an additional 120,000 mt/yr of ferrochromium capacity near Rustenburg.

Middelburg was expected to have over 400,000 mt/yr of ferrochromium capacity by yearend 1990. Krupp SA (Pty.) Ltd. provided the engineering requirements to construct facilities to produce an additional 120,000 mt/yr of ferrochrome for Middelburg. The facility would include a new rotary furnace for prereduction of chromite, an automatic furnace charging system, and installation of a new submerged arc furnace. Rand Mines Ltd., also a Barlow Rand subsidiary, sells some of its chromite ore to CMI.

Chromecorp Technology (Pty.) Ltd., which commenced output of charge ferrochromium at its Rustenburg smelter in December 1988, reached its design capacity of 10,000 tons per month in March 1989. Total capital cost for the project, including the purchase of the Chroombronne Mine 17 kilometers from the plant, was $26 million. The plant had two 30-megavolt-ampere open-top submerged arc furnaces. A railroad siding was constructed at the site for direct connection with the main railroad system. Marketing of exports was handled by Marc Rich and Co.

About 200 tons per month of ferrosilicon was used in the treatment of kimberlite at the Finsch Mine.

Iron Ore.—In the year ending June 30, 1990, Iscor produced 22.218 MMmt of iron ore. Output from the Sishen Mine was 19.945 MMmt and output from the Thabazimbi Mine was 2.273 MMmt. Exports from Sishen were 13.535 MMmt. A $1.7 million computerized truck allocation system was completed at Sishen, yielding an 11% increase in tonnage hauled by the mine's 60 trucks. By yearend 1990, capacity at Sishen was to increase to 22.1 MMmt per year from 20.8 MMmt per year. Mine rehabilitation was underway at Thabazimbi using grass and tree plantings.

Highveld Steel and Vanadium Corp. expected to commission a new $30.5 million iron ore pelletizing plant in October 1990. About 50% of iron ore feed from the Mapochs Mine to the iron-making plants would be pelletized. The new plant would include grinding mills, magnetic separators, and a binding agent to make pellets 13 millimeters in diameter. The new plant will allow postponement of a major mine expansion program at Mapochs. Eventually all ore was expected to be pelletized.

Magnesium.—Consumption of magnesium metal was about 1,100 mt/yr, all from imports. AAC and the Trans Hex Group were conducting a joint feasibility study on the production of magnesium metal from a dolomite near Vredendal in Western Cape Province. The property was owned by Cape Lime (Pvt.) Ltd., a subsidiary of the Trans Hex Group. Process metallurgy presumably would use plasma-arc technology developed by Mintek and Samancor.

Manganese.—Samancor completed construction of its dense media separation plant near Hotazel in Cape Province in December and commenced trial startup at yearend. The plant was designed to process standard-grade Mamatwan ore at 37% to 38% manganese (Mn), yielding a 42% to 43% Mn product. Production would be adequate to supply the sinter plant with sufficient feed to meet its output capacity of 500,000 mt/yr. Sinter plant product would grade 48% Mn.

G&D Mining and Export Co. acquired the manganese operations of Transwest Mineral Co. in the western Transvaal. The Lichtenburg Mine was to be operated for the production of 36,000 mt/yr of chemical-grade manganese dioxide. Two grades would be marketed, and customers would include dry cell battery makers.

Nickel.—AAC completed drilling on a nickel prospect in the eastern Transvaal, and metallurgical studies were underway. If successful, and the mining project approved, the country's first primary nickel producer may be operational by yearend 1992. Output would be 17,000 mt/yr of nickel. Byproduct copper and precious metals could make up 25% of total mine revenue.

Platinum-Group Metals.—Rustenburg Platinum Mines Ltd. had underway expansion of its Amandelbult section by 140,000 tons per month by July 1992. About 100,000 tons was to be from the UG 2 chromitite reef. Expansion at the Union section was to include an additional 30,000 tons per month of UG 2 ore. The Rustenburg Base Metals Refinery and the Precious Metals Refinery were at Rustenburg.

Lebowa Platinum Mines Ltd. expanded output at the Atok Mine to 50,000 mt/yr in August 1989. A reassessment by Lebowa led to deferred development of the Maandagshoek Mine, preferring instead to expand capacity at the Atok Mine to 70,000 tons per month. A further expansion to 100,000 tons per month was planned by August 1992. Additionally, in a 50% to 50% joint venture with Rustenburg Platinum Mines Ltd. via Potgietersrust Platinum Ltd., it planned a 200,000-ton-per-month mine on the Platreef near Potgietersrust. Trial mining of the platreef was scheduled for completion by Sept. 1990. The Platreef at Potgietersrust averaged 8.7 grams per metric ton of PGM and gold, and 0.37% nickel. The platinum-palladium ratio of the Platreef was about 1.1:1. Average ore seam width was 3.7 m, and reserves to a depth of 200 m were about 17 million tons. Planned output of PGM was about 5.5 mt/yr.

Lonrho PLC of the United Kingdom controlled mining operations at the Western and Eastern Mines, both of which mined UG 2 chromitite ore. Mill capacity at Western Mine reached 270,000 tons per month in January 1989, following commissioning of a new concentrator. Ore milled in the year ending September 30, 1989, was 2.843 million tons. Output of PGM plus gold in the matte produced was 11.2 tons. A new smelter was commissioned, and the No. 4 shaft was completed to its planned depth of 1,000 m. Mining at Eastern Mine, entirely in Bophuthatswana, began after midyear 1989. Initially milled at Western Mine, the ore was stockpiled pending commissioning of a concentrator at Eastern Mine. Startup was planned for February 1990 at a capacity of 80,000 tons per month. Open pit ore supplemented mill feed pending complete operation of the incline shafts.

Impala Platinum Holdings Ltd. reported that in the year ended June 30, 1989, sales revenue from PGM and metal byproducts was $802 million, royalties to the Bafokeng Tribe were $28.5 million, and to the Government of Bophuthatswana $5.5 million. Lease payment to Bophuthatswana was $60.5 million, and taxes $106.3 million. Taxes paid to the Government of the Republic of South Africa were $47.2 million, and $1.6 million to the United Kingdom. Gazelle Platinum Ltd., a subsidiary of Impala, shipped its first PGM concentrator matte from its Karee Mine for toll refining at Impala in August. Output of platinum at Karee was scheduled to reach about 5 mt/yr by yearend 1994.

Rand Mines Ltd. commenced PGM output through its subsidiary Barplats Investments Ltd. at its new Crocodile River Mine in November 1989 with a capacity of 80,000 tons per month. However, it experienced production problems in reaching a first phase output of 160,000 tons per month of ore. Owing to difficult underground conditions, Barplats was switching from a mechanized stoping system underground to conventional labor-intensive mining. Mechanized methods were being continued for development work. Also, an open pit mine was established to augment ore feed to the mills. It also ceased development of its Kennedy's Vale PGM mine as part of a rationalization program for its mining interests. Formerly called the Rhodium Reefs Mine, the Kennedy's Vale Mine was rescheduled to begin production in 1995. Crocodile River, formerly known as the Lefkochrysos Mine under Salene Mining (Pty.) Ltd., was taken over by Barplats Investments Ltd. in September 1988. Concentrates, produced solely from the UG 2 chromitite seam, were smelted to matte and then shipped to Barplats' base metal refinery and precious-metals refinery at Brakpan. PGM output was estimated at 800 kilograms per month, or nearly 10 mt/yr. Rand Mines expected to establish its Crocodile River Mine on a firm footing before proceeding further with the Kennedy's Vale operation. Barplats received the first matte shipment from Crocodile River in April and produced its first refined metal in June. Smelter matte was 50% nickel, about 30% copper, and less than 1% PGM. The base metal refinery produced PGM concentrate and the byproducts copper cathode, nickel sulfate, and selenium. The PGM concentrate was refined at the precious-metals refinery to platinum, palladium, and gold. Iridium, osmium, rhodium, and ruthenium were shipped as concentrate to the Federal Republic of Germany for toll refining. Complete refining of the matte at Barplats was not expected for several years.

Northam Platinum Ltd. continued development of its deep-level mine, sinking the No. 1 shaft to 1,751 m, with a depth of 2,097 m planned. Initial ore output was scheduled for July 1991, and was to average 50,000 tons per month. Full production of 150,000 tons per month was planned for 1993.

Construction of two plants to produce auto catalysts in the Republic of South Africa by 1991 were announced. Consumption would be about 5 mt/yr of PGM. Johnson Matthey's facility in Germiston would produce 2 million catalysts per year. A joint venture between Degussa Inc. of the Federal Republic of Germany and the IDC in Port Elizabeth would have a capacity of 1 million catalysts per year. Both plants would coat refractory bricks with a three-way PGM compound, while the stainless steel converter canisters for housing the coated bricks would be supplied locally.

Rare Earths.—Philips Components (Pty.) Ltd. began commercial production of high-temperature superconducting yttrium powder for pressing and for plasma spraying. The company also produced specialty ferrites and piezoceramics.

Titanium.—Richards Bay Minerals, a subsidiary of Quebec Iron and Titanium Corp. Ltd., postponed exploration and development of the sand dunes surrounding St. Lucia in Natal Province. An environmental impact study was to be completed prior to resumption of the project.

Uranium.—The Atomic Energy Corp. commenced operation of a commercial plant for the enrichment of uranium. Capacity was not reported, but output was to be sufficient to meet the short-term uranium requirements of the country's nuclear program. The Atomic Energy Corp.'s pilot enrichment plant was closed in February.

Vanadium.—USKO Ltd. commenced recovery of vanadium from vanadiferous magnetite supplied by Rhombus Vanadium Holdings Ltd. Rhombus, in a venture with USKO Ltd., recently commenced output of vanadiferous magnetite from its open pit Ba-Mogopa Mine near Brits. Ore grading 2% vanadium pentoxide was crushed, milled, and magnetically separated at the mine, then shipped to USKO's converted plant at Vereeniging for pelletizing and recovery of vanadium pentoxide flake. Flake capacity was 9,000 mt/yr. Brandeis Ltd., which markets production from other vanadium producers, would also be the sole marketing agent for USKO's output.

Vansa Vanadium SA Ltd., with a 1989 output of about 2,300 tons of vanadium pentoxide, ceased production in November owing to low vanadium prices. Company profits had fallen 95% to about $500,000 in the year ending September 1990. Spot prices for vanadium were below $2.50 per pound compared with nearly $12 per pound a year earlier. One of five companies in the Republic of South Africa which produced vanadium, Vansa, accounted for about 7% of South Africa's total output. The company, a subsidiary of Rand Mines Ltd., had been in operation only 2 years since commencing production in September 1988. Ore grade at the company's Kennedy's Vale Mine was 2.3% vanadium pentoxide.

Highveld Steel and Vanadium Corp. constructed a rotary kiln at its Vantra Division's vanadium pentoxide production facility. The new kiln was expected to increase production capacity of vanadium pentoxide by about 20%.

Industrial Minerals

Bentonite.—A 1.8 m diameter by 22 m long rotary dryer was installed at Cullinan Holdings Ltd.'s Cape Bentonite Heidelberg Mine in Cape Province. The system included a bag filter and heavy fuel oil burner. Capacity was 10 tons per hour of wet bentonite.

Cement.—The South African Cement Producers Association reported sales of 8.2 MMmt compared with 8.4 MMmt in 1988. The decline was mainly due to a lack of new construction projects. Output consisted of 5.5 MMmt of ordinary portland cement, 1.4 MMmt of ordinary cement containing 15% blast furnace slag or fly ash, 679,000 tons of rapid hardening cement, 378,000 tons of portland blast furnace cement, and 19,000 tons of sulfate resistant cement. Total production capacity was 12.2 million tons from 26 kilns, and capacity utilization averaged 66% for the year. Five kilns were kept on care and maintenance. Exports by the association were 41,000 tons of cement to several small offshore countries. Clinker exports were 171,000 tons, mainly to Mozambique and Zimbabwe. Sales to Namibia were listed as exports for the first time and were 158,000 tons. About 75% of bulk cement shipments were by road transport, and 25% were by railroad. No imports were reported. Cement imports were not subject to tariff protection, but were subject to antidumping legislation.

The association consisted of Anglo-Alpha Ltd., Blue Circle Ltd., Natal Portland Cement Co. (Pty.) Ltd., and Pretoria Portland Cement Co. Ltd. Raw material consumption by the group amounted to 12.53 MMmt tons of limestone, 314,000 tons of gypsum, and 420,000 tons of slag and fly ash. Coal consumption was 1.23 MMmt, and electricity consumed was 1,012 million kilowatt hours. About 40% of the total cost of cement to a buyer was from transport costs.

Diamond.—A $2.86 million diamond processing plant opened in Pietersburg. Cutting and polishing capacity, primarily of small stones, was about 6,000 stones per day. The labor force was 800 people, primarily women from Lebowa. The value added in the processing plant was dependent on stone size and quality, and could average three to four times the value of the stone.

The Finsch Mine continued development of its underground mining plan, with output to commence in the last quarter of 1990. The open pit was scheduled for closure at that time, with mill feed supplemented by low-grade surface stockpiled ore.

The Premier Mine had difficult mining conditions as development and output of ore expanded below the Gabbro Sill. The sill reportedly failed, and new block caving areas had to be developed. Diamond yield has continued to decline, from 37.4 carats per 100 tons in 1983 to 30.4 carats per 100 tons in 1989.

Industrial and Commercial Holdings (Pty.) Ltd. (ICH) owned 12.5% of Saturn Mining and Development Corp. Saturn's sole asset was the Venetia diamond prospect in northern Transvaal Province, which was under development by De Beers Consolidated Diamond Ltd. Capitalization cost for the Venetia Mine was $420 million. Saturn was eligible for 6.25% of the profits from Venetia.

Fluorspar.—Phelps Dodge Mining (Pty.) Ltd. of the United States continued operations at the Witkop Mine, producing 91,900 tons of acid-grade fluorspar. The company reported that 667,600 tons of ore was milled, grading 15.68% CaF_2. Sales were 84,600 tons.

Peat.—The Geological Survey conducted an inventory of peat deposits, commencing with a selected number of areas in the western Transvaal for detailed analysis. Peat resources were being categorized by type and potential use. In concert with this research, the Republic of South Africa became a member of the International Peat Society.

Perlite.—Output of perlite was from one mine in Natal Province by Pratley Mining Co. (Pty.) Ltd. Production commenced in 1989 at the Pratley Perlite Quarry, where total reserves were over 2 MMmt. Open pit bench operations took place only in winter, and involved the use of a rockbreaker, front-end loaders, and truck haulage. Primary crushing took place at the mine, where fines were removed by cycloning. Crushed ore was trucked 35 km to a railroad siding, and thence to a plant at Krugersdorp. Secondary crushing was followed by heating to 750° C to 1,350° C, depending on moisture, in a gas-fired furnace. The end product can have a density of between 0.7 grams per milliliter and 0.15 grams per milliliter. The product, expanded beads 20 times original grain size, was then bagged and sold. The company also made a product called Pratliperl from the beads, shaped as blocks and panels, for fireproofing. In addition to fireproofing in mines, Pratliperl was being tested as an insulating material for water chilling systems in deep-level mines.

Stone, Dimension.—The domestic granite industry was being rationalized owing to stiff competition. Additionally, demand for granite was high, and local companies were moving toward increased beneficiation of output compared to the general practice of cutting and shipping of block granite. Slabbing, polishing, and fitting of the blocks could result in a threefold increase in value. About 50% of total output was grey granite, valued at about $500 per cubic meter. Other colored granites varied in value from $600 per cubic meter to $900 per cubic meter. Although an estimated 50% of granite exports were to Europe, mainly Italy and Spain, much of it was reexported after further processing.

Minaco (Pty.) Ltd., with its subsidiary Marble Lime Inc., reportedly was the country's largest granite processor. It recently acquired Tivoli Granite (Pty.) Ltd., thereby increasing its overall capacity. It also had an arrangement to purchase 150 cubic meters per month from another producer.

Kudu Granite (Pty.) Ltd. acquired 50.01% of Aurora Granite (Pty.) Ltd. Kudu's main product was grey granite from the Marikana area. Aurora's main product was black granite.

The Belfast Division of Impala Granite (Pty) Ltd. produced black granite at Diamond Black Granite Quarry in the northeastern Transvaal. Total rock mined was about 15,000 tons per month, of which about 600 tons qualified as exportable product. The company recently purchased Bell Equipment Co. articulated dump trucks to handle mine road gradients of up to 18°.

Wollastonite.—Pella Refractory Ores Ltd. commenced output of wollastonite from a deposit at Garies in Namaqualand. Plant equipment included a receiving hopper, primary and secondary crushers, a 100-ton capacity storage bin, and a pneumatic pipe conveyor to supply the recovery building. The mine was South Africa's only producer of wollastonite. Production was about 72,000 mt/yr of ore and 13,600 mt/yr of wollastonite concentrate.

Mineral Fuels

The Government approved construction of a plant in the Richards Bay area to produce ethanol from sugar. Construction cost was put at $43 million, and output was planned to begin in early 1992 at about 1 million barrels of ethanol annually. Employment generated by the project was expected to reach 14,000 workers. Sugar normally produced for export but adversely affected by sanctions would be used at the facility. Ethanol was also produced from Sasol Ltd.'s oil from coal process.

The National Energy Council began an investigation of the implications of using unleaded fuel in the domestic market place. The study was to be completed yearend 1990.

The Southern Oil Exploration Co. (Soekor) controlled all offshore oil and gas prospects. It conducted all exploration efforts offshore, with the exception of test drilling in which private companies could participate. Soekor operated three semi-submersible drilling rigs, one off the west coast and two off Mossel Bay. Crude petroleum has been discovered, though not in commercial amounts. Production of crude oil was reported to be economic if output could be sustained at 12,000 to 15,000 barrels per day with reserves of 25 million barrels.

Coal.—According to the Minerals Bureau, total coal sales were 175.34 MMmt, of which 128.69 million was domestic sales and 46.66 million was exports. Domestic sales of coal by sector were as follows in MMmt: electricity generation 73.34, industry, including synthetic fuels 40.81, metallurgy 7.95, home use 6.15, mining 0.29, and transport 0.16. The decline in domestic sales from 142.79 MMmt in 1988 was attributed to drawdown in stocks and reduced consumption. The country ranked third in the world in exports of coal after the United States and Australia. About 92% of all coal exports were through Richards Bay Coal Terminal, 6% through Durban, and the remainder through Maputo in Mozambique.

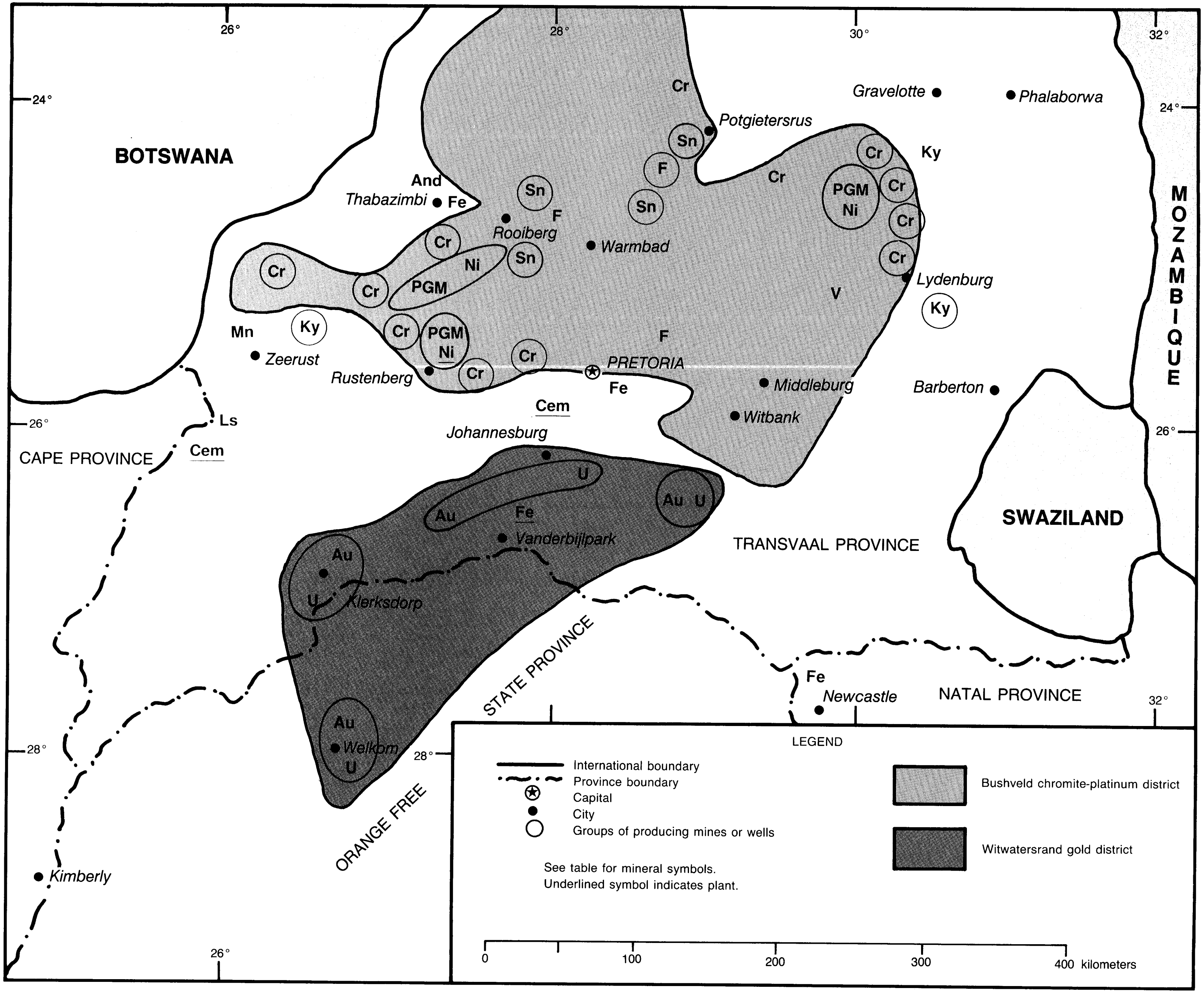
Coking coal production by Iscor Ltd. was 3.973 MMmt in the year ending June 30, 1990. Output was from Grootegeluk Mine 1.830 MMmt; Durnacol Mine 1.266 MMmt; Hlobane Mine 0.669 MMmt; and the Tshikondeni Mine, in Venda, 0.208 MMmt. Iscor also sold 8.1 MMmt of coal to Escom. Output from Grootegeluk was to increase to meet a sales contract to Escom for 12 MMmt per year by July 1992.

Exports of anthracite were 3.2 MMmt in 1989, compared with total world trade of 9.6 MMmt. Exports to the Japanese cement industry have been reduced considerably owing to competition. Anthracite exports were expected to stabilize at about 3 MMmt per year.

Natural Gas.—Construction of the Republic of South Africa's first integrated synthetic fuel project to produce liquid fuel from natural gas discovered offshore in Mossel Bay was about 45% complete. Offshore production platforms and gathering pipelines were to be linked to an onshore refinery by 85-km pipelines. Gas and field condensate would be shipped by separate pipelines of 46 centimeters and 20 centimeters, respectively. A large section of the refinery was being built below ground level. Production was targeted to commence in March 1992 at 80% of the facility's design

FIGURE 1

SOUTH AFRICA: WITWATERSRAND AND BUSHVELD MINERAL DISTRICT



capacity of 25,000 barrels per day. Output would be about 50% gasoline and 50% diesel, and byproducts would include nitrogen, oxygen, and alcohol. The synthetic fuel project was reported to be viable at a 1992 crude oil price of $19 per barrel. Breakeven price for the project may be $16 per barrel. Ownership of the project was Gencor 30%, the Central Energy Fund (Pty.) Ltd. 50%, and the IDC 20%.

Petroleum Refining.—Gencor acquired Mobil South Africa Ltd. and began an integration of the acquisition with its own refinery products distribution subsidiary Trek Petroleum (Pty.) Ltd. Mobile South Africa Ltd. owned a refinery at Durban and about 1,000 filling stations throughout the Republic of South Africa and Namibia. Gencor's 30% interest in the Mossel Bay gas project would also come under Trek Petroleum's control.

The Government privatized Sasol Ltd., but continued to own 30% through the IDC. It also maintained 50% ownership of Sasol 3.

Reserves

The country's mineral wealth was derived primarily from three major structural or stratigraphic sequences; the Witwatersrand Super Group, the Bushveld Complex, and the Transvaal and Griqualand West Sequences. The Witwatersrand Super Group, dating from about 2.9 billion years, consists of successive layers of quartzites, conglomerates, siltstones, and shales in an elongated basin. The basin is located between northern Cape Province and southern Transvaal Province, and includes Johannesburg. It is considered to the world's largest single repository of gold and uranium. Some silver and PGM are also present in the Witwatersrand. The Bushveld Complex, in Transvaal Province, is a layered igneous lopolith which intruded the overlying Transvaal Super Group, and is dated at about 2 billion years. Within it are major reserves of chromite, PGM, and vanadiferous magnetite. Cobalt, copper, and nickel are also found in the Bushveld Complex and economically recovered in the mining of PGM. Within the vicinity of the contact between the Bushveld Complex and upper layers of the Transvaal Super Group are important reserves of andalusite, fluorspar, and tin. The Transvaal and Griqualand West Sequences, dating from about 2.6 billion years, are series of dolomites, ironstones, and shales found in northern Cape Province and in central Transvaal Province. Within them are found major reserves of amosite and crocidolite asbestos, iron ore, limestone, and manganese.

The Minerals Bureau of the Republic of South Africa reported the country's total reserves in terms of reserve base for many mineral commodities.

In addition to the data listed in the table, the Minerals Bureau reported a reserve base of 50.8 MMmt for andalusite, sillimanite, and kyanite. This figure consisted almost entirely of andalusite. The reserve base of 4.8 MMmt contained lead was broken down further to 2.33 MMmt of demonstrated reserves, and 2.43 MMmt of demonstrated marginal reserves. Of demonstrated reserves, Broken Hill Mine had 2.34 MMmt, Gamsberg Mine had 715,000 tons, and Pering Mine, close to being closed, had 86,000 tons. The zinc reserve base of 14.872 MMmt contained zinc was broken down to 11.768 MMmt of demonstrated reserves. Broken Hill Mine had 726,599 tons, Gamsberg Mine had 10.6 MMmt, Prieska Mine had 15,248 tons, and Pering Mine 430,860 tons. Demonstrated marginal reserves of zinc were 3.1 MMmt. Potash was not produced in the Republic of South Africa. However, potential resources, according to the Minerals Bureau, were 200 MMmt in phlogopite at the Phalaborwa Complex, and 700 MMmt in glauconite in seabed sediments off Cape Town.

Other research centers involved in mineral reserve assessments in the Republic of South Africa reported updated data for certain minerals. The Economic Geology Research Unit of the Witwatersrand University estimated that 40,000 tons of gold remained to be mined in the country, compared with 42,000 tons mined to date. About 23,000 tons of the 40,000 tons would be derived from existing mines. Recovery of the remainder would involve development of new deep-level mines.

Recoverable reserves of anthracite coal were 863 MMmt, mainly in Natal Province in the Kliprivier and Zululand coal-fields. About 31% of the total reserve occurred at 15- to 200-m depth, in seams 0.7 to 2 m thick. At these same depths, another 13% of the reserves were in seams 2 to 4 m thick. The remaining 56% of the reserves occurred at 200 to 500 m depth, in seams 0.7 to 2 m thick.

TABLE 5

REPUBLIC OF SOUTH AFRICA: RESERVES OF MINERAL COMMODITIES

(Million metric tons unless otherwise specified)

Commodity	Reserve base
Andalusite	50.8.
Antimony	120,000 tons contained Sb.
Asbestos	8.2.
Chromium	3.2 billion tons.
Cobalt	16,000 tons contained Co.
Copper	8 contained Cu.
Fluorspar	32.
Gold	20,000 tons Au.
Gypsum	86.3.
Iron ore	6 billion tons contained Fe.
Lead	4.8 contained Pb.
Manganese	3.992 billion tons.
Nickel	11.4 contained Ni.
Platinum-group metals	30,200 tons contained PGM.
Silver	9,500 tons Ag.
Titanium	31 contained Ti.
Vanadium	7.8 contained V.
Zinc	14.9 contained Zn.
Zirconium	6.9 contained Zr.

Source: Minerals Bureau, Department of Mineral and Energy Affairs, 1989.

INFRASTRUCTURE

The country had an extensive, well-maintained road and railroad system, serving not only the Republic of South Africa, but also southern Africa. Public and private trucking firms handled road shipments for the mining industry. Transnet, the Government-owned railroad and road transport utility, moved nearly all of the country's bulk mineral shipments of ores and concentrates. It also moved finished goods from South African producers and land-locked countries to South African ports for export.

The Central Statistical Service reported that nongovernment public transporters shipped 322.2 MMmt of goods in 1989, and employed 66,660 people. About 7% of the total was coal and unspecified ores. Transnet shipped a total of 186.2 MMmt of goods by both its road and railroad divisions.

Total electricity generated was 162,320 gigawatt hours (GW·h). Imports were 272 GW·h, exports were 4,080 GW·h, and electricity consumed in power stations was 12,351 GW·h. Of the total produced, Eskom, the Government-owned public utility, accounted for 151,559 GW·h.

The Richards Bay Coal Terminal at Richards Bay had design capacity of 44 MMmt per year of coal, and has operated with this capacity for about 13 years. A $91.2 million project to refurbish the facility and improve efficiency was underway, and had the potential to expand throughput capacity to 48 MMmt per year.

The Government passed legislation permitting joint ventures between Government-owned harbor facilities and private companies. The Durban Coal Terminal Co. upgraded the aging Bluff Coaling Appliance at Durban to handle 2.5 MMmt per year of coal at yearend 1989, and was to have a capacity of 5 MMmt per year by 1992. Export capacity in 1988 was 1.5 MMmt per year. Coal exports from Durban were generally small consignments of sized or graded bituminous and anthracite coal destined for specific markets.

OUTLOOK

The sharp increases in costs that have occurred for transportation, electricity, water, and wages in the past few years will continue to weigh heavily on the mining industry, particularly for deep-level gold mines. The rates for these services change on an annual basis, and further increases of 8% to 20% annually in them can only incumber the industry further. However, full implementation of a revised taxation scheme should help counterbalance the fixed costs facing the industry.

The country will continue to expand downstream processing of its mineral materials to higher value products. The liberalization of trade in eastern Europe should also bode well for South African exporters.

The main constraints to expansion of the mining industry remain the shortage of skilled labor, and the shortage of foreign investment caused by sanctions.

[1]Where necessary, values have been converted from South African rands (R) to U.S. dollars at the rate of R2.26=US$1 for 1988 and R2.62=US$1 for 1989.

OTHER SOURCES OF INFORMATION

Agencies

Minerals Bureau
Private Bag X4
2017 Braamfontein
Republic of South Africa

Geological Survey
Private Bag X112
0001 Pretoria
Republic of South Africa

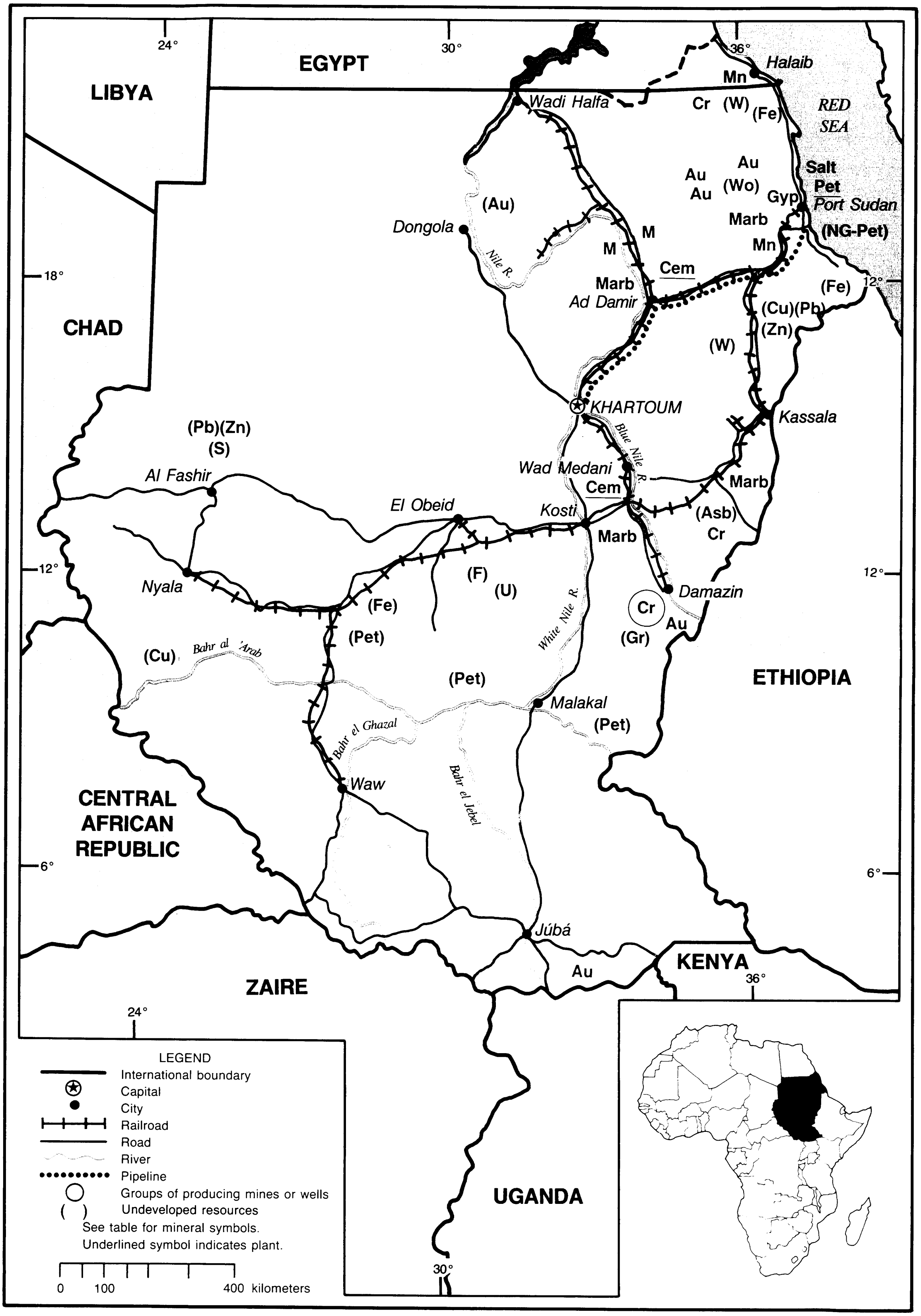
Council for Mineral Technology (Mintek)
Private Bag X3015
2125 Randburg
Republic of South Africa

Publications

Anhaeusser, C. R., and Maske, S. Mineral Deposits of Southern Africa, Vols. I & II, Geol. Soc. of South Africa, 2,376 pp.

SUDAN

AREA 2,505,810 km² **POPULATION 24.7 million**



THE MINERAL INDUSTRY OF

SUDAN

By Lloyd E. Antonides

Africa's largest country, more than one-fourth the size of the United States, had a promising mineral potential, including chrome, gold, petroleum, and manganese ores, and several industrial minerals. Nevertheless, the mineral industry was of minor significance to Sudan's economy, which had a gross domestic product estimated by the World Bank to be about $15 billion[1] for fiscal year ending June 30, 1989. Mineral production was mainly cement, chromite, gold, gypsum, limestone, petroleum refinery products, and salt. Chromite, gold, and salt were the main mineral exports but provided a small fraction of 1% of export revenues. Imports of petroleum refinery products and crude oil were significant factors of trade.

The economy suffered a high inflation rate, about 25%; a fast changing dual exchange rate; and high deficits in the Government budget and balance of trade. Even though Sudan had many natural resources and a reasonably well-trained work force base, its economy deteriorated at an increasing rate, the same as it had since independence in 1956. Since independence, several development plans and economic reform programs, including several in the mining sector, failed owing to relentless political and economic problems. Among these were a civil war that split the country for 17 years, ending in 1972 only to resume again in 1983; successive severe droughts and floods; unstable Governments with several coups; and generally deficient political leadership and economic management. Also cited for their negative impact were poorly conceived and mismanaged projects pursued by international lending institutions in the late 1970's and early 1980's. The new Government installed by a military coup in June 1989 was attempting to resolve the problems, but at yearend, had not yet had a significant affect on the economy. Indications of success were mixed, with little progress made toward ending the civil war, the most pressing need.

GOVERNMENT POLICIES AND PROGRAMS

The Government maintained a policy of encouraging foreign and particularly mineral venture investments the same as it had since even before the Investment Encouragement Act of 1980. However, some reports identified lengthy bureaucratic procedures as a problem. The Government has been involved in mineral projects through state-owned companies such as the Sudanese Mining Co. and the Public Petroleum Co. since nationalization of private industries in 1971. Since 1979, when Sudanese nationals regained control of their companies, there has been no known Government involvement with local firms. However, apparently there usually was Government participation in any foreign company venture.

Despite the civil war, a Geology and Mineral Resource Department of the Ministry of Energy and Mining continued to be active in producing geologic maps and preparing reports on mineral occurrences.

PRODUCTION

Gold production reported by operators continued to increase in 1989 with a new producer added. This follows a major jump in official figures in 1988, after new mines started up in 1988 and 1987. Additionally, unreported gold production by small operators was considered likely, but precise data are not available. Officially reported chrome ore output showed a major increase, more than triple the 1988 figure, probably mostly from the Ingessana Hills, 500 kilometers south of Khartoum. However, several minerals remain unreported or require confirmation of their output levels. Manganese ore output was reported for the first time since 1977, although small primitive operators in the north near the Red Sea may have had unreported production in the intervening years. Also not reported, and therefore not listed in table 1, is limestone production. However, about 1.75 tons of limestone is required per ton of cement clinker produced. Thus, for the estimated cement production in 1989 in Sudan, at least 250,000 tons of limestone was quarried, and some additional quantity was undoubtedly produced for construction aggregate. Oil refinery production is estimated to have fallen in view of crude oil supply problems.

TRADE

Mineral exports had little significance in value or volume to overall trade figures, but included chrome ore, gold, salt, and probably manganese ore. Mineral imports were significant to trade values and volumes, with petroleum refinery products and crude oil being the major components. Fertilizer imports also were significant. In terms of value of all imports, Arab countries and Western Europe were equal sources for a combined total of about 65% and the U.S. for about 15% in fiscal year 1988.

STRUCTURE OF THE MINERAL INDUSTRY

State-owned companies have been a major factor in the mineral industry of

TABLE 1

SUDAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
Cement, hydraulic[e]		192,882	[r]150,000	121,732	150,000	150,000
Chromium: Chromite, mine output (48% Cr_2O_3), gross weight		8,799	8,500	13,015	8,000	[3]25,000
Gold, mine output, Au content[e]	kilograms	55	70	85	500	650
Gypsum and anhydrite, crude		6,400	7,000	7,000	5,000	[3]10,000
Mica, all grades[e]		10	10	5	—	—
Petroleum refinery products:[e]						
Liquefied petroleum gas	thousand 42-gallon barrels	50	100	100	101	100
Gasoline	do.	900	1,100	700	1,275	1,200
Jet fuel	do.	400	500	400	669	500
Kerosene	do.	50	100	100	128	100
Distillate fuel oil	do.	1,600	1,900	1,000	2,026	2,000
Residual fuel oil	do.	1,800	2,100	1,300	1,573	1,500
Other[4]	do.	200	200	200	208	200
Total, including refinery fuel and loss[e]		5,000	6,000	3,800	5,980	5,700
Salt		38,467	40,000	51,662	50,000	[3]91,000

[e] Estimated. [p] Preliminary. [r] Revised.
[1] Includes data available through July 1, 1990.
[2] In addition to the commodities listed, various crude construction materials (clays, sand and gravel, and stone) presumably are produced, but available information is inadequate to make reliable estimates of output; also production of manganese ore (48% to 50% Mn) was reported for 1989 at 1,100 tons.
[3] Reported figure.
[4] Includes refinery fuel and losses.

Sudan since the early 1970's. However, private firms have also operated since 1979. Although most larger mineral ventures have foreign participation, there are many small primitive operations as well.

COMMODITY REVIEW

Metals

Copper.—A joint venture between Armeno Resources and the Government was planning to develop the Hofrat en Nahas copper deposit in Western Sudan according to a press release in late 1989. Preliminary estimates made by a United Nations Development Program of the project in 1960 were said to have indicated 8.7 million tons of ore grading 4% copper. More recently, estimates of possible ore reserves were 20 million tons grading 5.9% copper.

Gold.—Bashken Mining Co. Ltd., a joint venture of Kenmare Resources PLC, an Ireland-based firm (49%), and Central Desert Mining Co., a private Port Sudan-based company (51%), produced its first gold in March from tailings at the El Aberketeib Mine about 300 kilometers (km) northwest of Port Sudan. The 55-ton-per-day ore agglomeration and vat-leach processing plant started treating some 28,000 tons of 7.4-gram-per-ton tailings in February. The processing plant is expected to be progressively enlarged owing to the historical nature of the site. Mining reportedly started more than 3,000 years ago, but the property was last worked in 1970. Sampling of tailings started in 1988, followed by exploration of near-surface quartz-vein mineralization. Exploration is to continue into underground workings.

A preliminary agreement was signed between Kenmare and the Geological Research Authority of Sudan to explore a 25,000-square-kilometer license area surrounding the plant site. The area has potential for massive sulfide copper-lead-zinc deposits as well as gold.

The Bureau de Recherches Geologiques et Minieres (BRGM) of France was operating a 150-ton-per-day open pit mine and heap-leach plant with mobile carbon-column extraction unit at Hassai in the Ariab Basin, about 200 km west of Port Sudan. BRGM had investigated mineral possibilities in that Red Sea Hills region and many other parts of the country as well starting in the mid-1970's. The joint venture to search for gold in the region was formed in 1981 and consisted of the Sudanese Mining Corp., 60%; Total Compagnie Miniere, 30%; and BRGM, 10%.

Operations at Hassai started in 1987, and output in 1988 was reported at more than 100 kilograms of gold. For 1989, the planned rate was 5,000 tons per month of ore to produce 250 kilograms per year of gold. Further expansion was being planned, and reserves at the mine were estimated to contain 6.2 tons of gold. For the Ariab locality, an estimate was 1.8 million tons grading about 7.2 grams per ton.

In February 1990, the joint venture between Minex Minerals, 49%, and the Sudanese Mining Corp., 51%, put operations at the Gebeit Mine on care and maintenance. Problems cited were lower than expected ore grade, low gold recovery, and high costs. The mine, about 175 km northwest of Port Sudan, started vat leaching of 50-year-old tailings in 1984 and, in 1987, began underground ore production from new openings in the previously worked deposit. Minex, a wholly owned subsidiary of Greenwich Resources PLC of Canada and the United Kingdom, had started exploring in various parts of Sudan in the 1970's. Robertson Research International of the United Kingdom, which had some participation in Greenwich, was involved in developing the underground mining plan announced in 1985. Geostatistical methods were used to establish reserves of gold in steeply dipping veins that exhibited rapid variation in grade over short distances. The property was believed to be one of the oldest gold mines in the world, having been worked periodically for more than 3,500 years. The operation was designed for 50,000 tons per year of mine production and 300 tons per day of ore milled. Plant feed reported for year ending September 1989 from an initially estimated reserve of 363,000 tons averaging 32.2 grams per metric ton (g/mt) was 30,801 tons at 4.75 g/mt. Even though it included development rock, it was still far below the 16 g/mt expected in 1988. The production rate was less than one-half that planned, and 16,537 tons of old tailings containing 1 g/mt were also processed. Gold production for the period was 162.8 kilograms. At yearend 1989, recoverable reserves were revised to 41,700 tons grading 10.0 g/mt. However, the extensive other licenced areas on which Minex has done some work offer additional possibilities.

Industrial Minerals

Cement.—Equipment deliveries were made for a new cement plant expected to be completed in 1991 at Rabak, 250 km south of Khartoum. Improvements were also being made to existing plants at Rabak and Athara, 275 km northeast of Khartoum.

Mineral Fuels

Natural Gas.—Panoco Sudan Ltd. and its principal owner, United States Oil Co., began assessment drilling in March on their shared concession. The area covers Chevron Oil Co. of Sudan's surrendered gas-condensate discoveries of 1976 in the Red Sea offshore Suakin about 50 km south of Port Sudan. Production was expected to start in 1990 and reach more than 59 million cubic feet per day of gas and almost 10,000 barrels per day of oil condensate. Gas was to be reinjected until ammonia, urea, and other petrochemical plants were constructed and local markets were developed.

Petroleum.—Since oil exploration started in 1959, more than a dozen companies have surveyed and/or drilled onshore and offshore in most of the country, with many having given up their concessions by 1989. Chevron Oil Co. of Sudan has been exploring all parts of the country since 1974, following the Government's adoption of favorable investment regulations. In 1989, it continued

TABLE 2

SUDAN: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Cement	Maspio Cement Co. (Government, 100%)	Atbara, 275 kilometers northeast of Khartoum	150 (kiln).
Do.	Nile Cement Co. (Government, 100%)	Rabak, 250 kilometers south of Khartoum	100 (kiln).
Chrome ore	Ingessana Hills Mines Corp. (Sudanese Mining Corp.—Government, 100%)	Gam Mine, 500 kilometers southeast of Khartoum	15.
Gold	Joint venture between Minex Minerals (Sudan) Ltd., 49% (Greenwich Resources PLC of Canada and the United Kingdom, 100%) and Sudanese Mining Corp., 51% (Government, 100%)	Gebeit Mine, 175 kilometers northwest of Port Sudan	50 (ore).
Do.	Bashken Mining Co. Ltd. (Kenmare Resources PLC (Ireland) 49%; Central Desert Mining Co., 51%)	Aberketeib Mine, 275 kilometers west-northwest of Port Sudan	21 (ore).
Do.	Joint venture between Bureau Recherches Geologiques et Minieres (France), 10%; Total Cia Miniere (France), 30%; Sudanese Mining Co., 60% (Government, 100%)	Hassai Mine, 200 kilometers west of Port Sudan	60 (ore).
Gypsum	Khor Eit Gypsum Quarries (Sudanese Mining Corp.—Government, 100%)	Bir Eit Mine, 60 kilometers north of Port Sudan	20.
Marble	Pentco Engineering & Trading Co.	Port Sudan, and Gedaref, 375 kilometers east-southeast of Khartoum	100.
Petroleum, crude	Chevron Oil Co. of Sudan	Unity, Heglig, and other oilfields and gasfields, 750 kilometers southeast of Khartoum	80[2] planned output.
Petroleum refinery products	Port Sudanese Refinery Ltd. (Royal Dutch/Shell Oil Co., 25%; British Petroleum (Sudan) Ltd., 25%; Public Petroleum Corp., 50%)	Port Sudan	23.8.[2]

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

to drill a well started in November 1988 in the Muglad area, about 750 km southwest of Khartoum, and also started two new wells in the Bientu area, about 250 km southeast of Muglad. Even though the wells closely straddled potentially economic fields discovered by Chevron starting in 1979, all were terminated by yearend, and only seismic work was planned for 1990. Early in the year Royal Dutch/Shell, to whom Chevron had sold 25% of its Sudan interests in 1984, withdrew from the joint venture.

Total Sudan, operator for a consortium exploring concession areas north of Muglad, about 700 km southwest of Khartoum, announced it did not intend to resume work that was suspended in 1985 until the hostilities in the south were resolved. The consortium included Total Sudan, 32.5%; Marathon Petroleum Sudan, 32.5%; state-owned Public Petroleum Corp., 10%; and Kuwait interests, 25%.

Sun Sudan Oil Co., operator of another consortium that included the Public Petroleum Corp. as well as Marathon, British Gas, and a Republic of Korea company, completed the sixth dry well in its licensed area south of Khartoum in November. Exploration work in its northern licensed area, which had been agreed upon with the government in 1987, apparently was not very promising either, since at yearend Sun reportedly was not encouraged to continue work anywhere in Sudan.

Panoco Sudan Ltd. stated it expected to produce almost 10,000 barrels per day of crude oil by 1992 from gas wells it planned to have operational in 1990 on Chevron's former offshore concession south of Port Sudan.

Refining.—The Port Sudan oil refinery, started in 1984 by owners Royal Dutch/Shell Oil Co. and British Petroleum Corp. and now in partnership with the Public Petroleum Corp., continued to operate below capacity, processing mostly Saudi and Libyan crude. Distribution of products through the 8-inch, 800-km pipeline to Khartoum was expected to be supplemented by 100 tanker trucks donated by Saudi Arabia.

INFRASTRUCTURE

Sudan's transport system was inadequate for the country's size, including desert and swamp. According to World Bank information, there was only 20,000 km of roads, of which less than 2,500 km was paved. Roads were the primary transportation mode and were badly in need of repair. A 4,800-km railway network linked major cities, but was in very poor condition and carried only a fraction of the tonnage it had in the early 1970's. A refined petroleum products pipeline 800 km from Port Sudan to Khartoum was opened in 1977. It mainly handled gasoline and diesel fuel, but was operating only at 60% of capacity, and more fuel was carried by tanker trucks. There also was approximately 3,000 km of waterways, mostly connected to the Nile; but, that least expensive mode of transportation was little used. About 20 airports supplement surface transport. Major foreign aid programs were directed toward improving the transportation system.

Electric power generation and distribution improvements also were a major focus of foreign aid. Hydropower was an important component, but liquid fueled steam-turbine units were widely used.

OUTLOOK

In spite of the promising mineral potential of Sudan, political and infrastructure obstacles to a significant mineral production will be difficult to overcome in the near term. Nevertheless, opportunities for smaller mineral ventures near the Red Sea may be found feasible, especially with the examples set by the gold producers in the past few years.

[1]Where necessary, values have been converted from Sudan pounds (Ls) to U.S. dollars at the rate of Ls4.50 = US$1.00 in 1989, the official rate. However, the World Bank considered the average for converting its data for fiscal year ending June 30, 1989, to be Ls6.50 = US$1.00, a trade-weighted average of the official and commercial rate of Ls12.2 = US$1.00. Furthermore, according to World Bank data, the illegal market rate was Ls20.00 = US$1.00 in 1989.

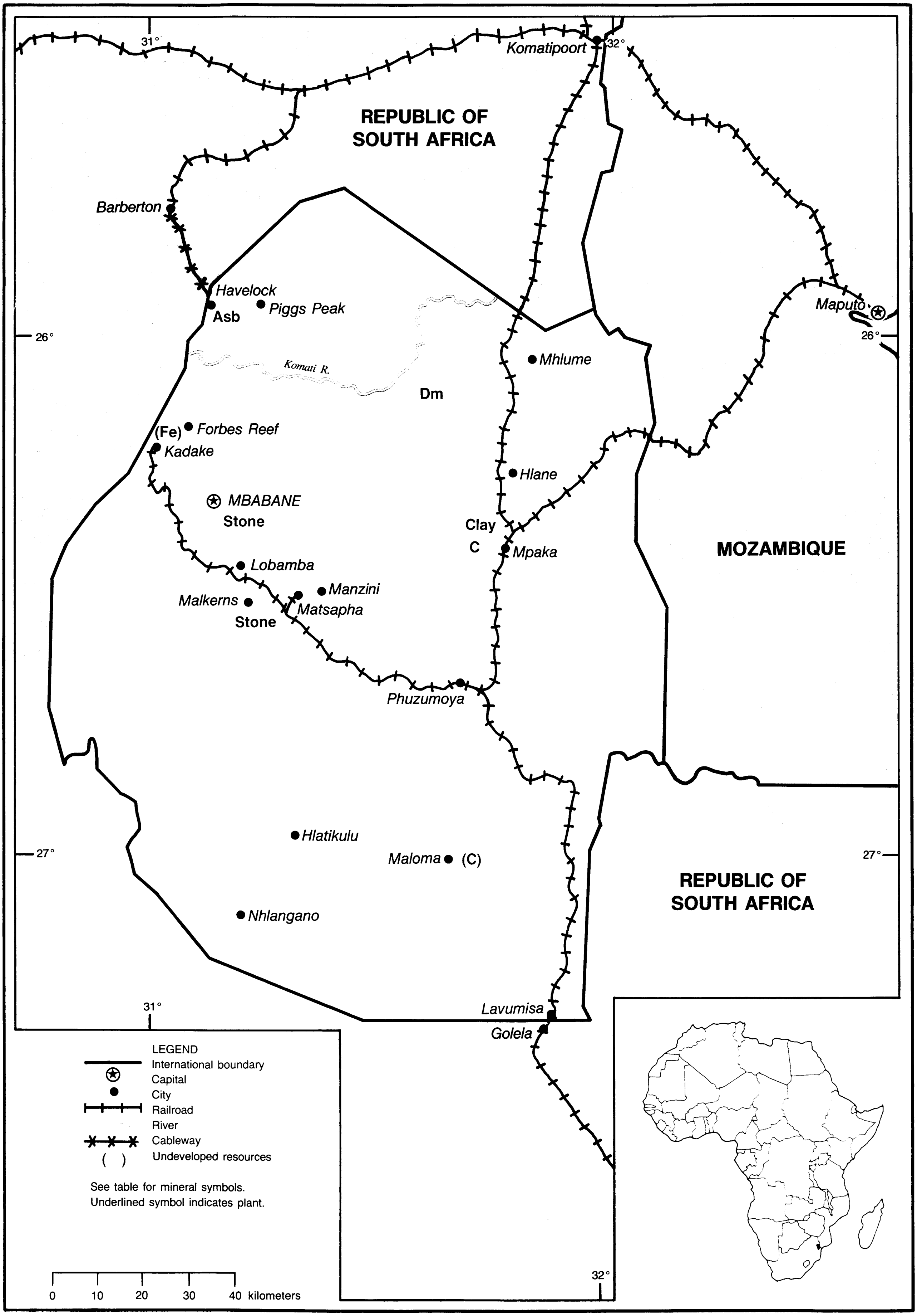
OTHER SOURCES OF INFORMATION

Ministry of Energy and Mining
Republic of the Sudan
P.O. Box 2087
Khartoum, Sudan
Phone 75595/81043 Telex 22638

Geological Research Authority
P.O. Box 410
Khartoum, Sudan
Phone 75189/77939

SWAZILAND

AREA 17,360 km² **POPULATION 778,500**



THE MINERAL INDUSTRY OF

SWAZILAND

By Hendrik G. van Oss

Although the Swaziland economy is dominated by agriculture, mineral production is an important component, accounting for approximately 5% of the country's estimated 1989 gross domestic product of $561 million[1] and about 5.5% of total exports. Revenues from mineral sales have traditionally been a major funding source for national health, housing, and scholarship programs. In 1989, mining sector wages, including those of Swazi miners in the Republic of South Africa, directly support an estimated 13% of the Swazi population. The bulk of the country's heavy transport infrastructure was built to service the mining industry.

Historically, Swaziland has been a significant regional producer of asbestos, iron ore, and gold. Coal mining commenced at Mpaka in 1964; production through 1989 totaled about 3.3 million metric tons (MMmt). The Havelock Mine has produced almost 1.5 MMmt of chrysotile asbestos fiber since its startup in 1939. A total of 26.4 MMmt of iron ore was produced at Ngwenya, 18 kilometers (km) northwest of Mbabane from 1964 to the mine's closure in 1977. Prehistoric diggings on the Ngwenya deposit for ochre are believed to be the world's oldest mine workings. Gold production has occurred in the Forbes Reef and Piggs Peak areas, commencing in 1884, but production data are poor for the period up until 1900. Recorded gold production has totaled about 4,150 kilograms, most of it prior to World War II, and with essentially no production since the mid-1960's. Since 1984, Swaziland has had a modest output of diamond; production through 1989 has totaled about 285,000 carats. Brick clay, stone, and a variety of other construction mineral commodities are also produced. Swaziland has had past small production of a number of other minerals, such as barite, fluorspar, pyrophyllite, and tin (in cassiterite).

Swaziland's geology is dominated by Archean granitic rocks, which make up most of the western two-thirds of the country. Tin-bearing pegmatites in some of these rocks have given rise to alluvial tin (cassiterite) deposits, which have been worked in the past, and host occurrences of base metals and industrial minerals. In northwest Swaziland, along the Republic of South Africa border, is an Archean greenstone belt that is an extension of the Barberton Mountain Land in that country. The belt in Swaziland has hosted asbestos, iron, gold, and barite deposits; only asbestos is still being mined. The belt is also the type locality of ultramafic volcanic rocks called komatiites. In east-central Swaziland, there is a 20-km-wide north-south belt of Karoo sedimentary rocks; these host Swaziland's large coal reserves and some occurrences of industrial minerals. The eastern one-third of the country is made up of a north-south belt of volcanic rocks forming the Lubombo Plateau. Economic mineral deposits appear to be absent from this terrane.

GOVERNMENT POLICIES AND PROGRAMS

The Government views minerals as a national resource, to be exploited where such will benefit the country. Although mining plays a much smaller role in the Swaziland economy than agriculture, it has traditionally been a comparatively steady revenue generator and has been responsible for the development of much of the country's heavy transport infrastructure. Further, the mining sector, both in Swaziland and in the Republic of South Africa, has been a major employer of Swazis, an issue of interest to both Governments. Rising concern over the unemployment levels in Swaziland has led to direct Government loan support of the ailing asbestos mine, the largest mining employer in the country. Foreign investment in the mining sector is actively encouraged, especially such projects that will diversify the mining commodity base.

All minerals in Swaziland are vested in the King, in trust for the Swazi Nation. The Minerals Committee, appointed by the King in consultation with the Ministry of Natural Resources and Energy, oversees mining matters. In late 1987, the Minerals Negotiations Committee was formed to renegotiate the royalty provisions of certain existing mine leases. All future negotiations on such mining matters as royalties and state participation will be through this committee. In the past, certain construction materials, such as clay, sand and gravel, and stone, were treated differently from "minerals," such as asbestos and coal. However, the Mining (Amendment) Act of 1990 altered the definition of "mineral" to include such materials; this change will allow a more uniform system of leasing and royalty payments. Applications for prospecting and mining licenses are made through the Geological Survey and Mines Department, which transmits them to the Minerals Committee.

Equity participation in mining ventures by the Swazi Nation is through the national trust organization Tibiyo Taka Ngwane (TTN), which was formed in 1968. Through its equity holdings, TTN became financially self-supporting in 1976. Since that time, in accordance with the Mineral Rights Taxation Regulations of 1976, all mineral royalties and lease revenues have been paid to another national trust organization, Tisuka Taka Ngwane, for the support of housing and infrastructure development. In 1987, the Swaziland Industrial Development Co.

Ltd. (SIDC) was set up as a private development finance company to promote private-sector projects, including mining, in Swaziland. SIDC can provide financing up to 50% of a project's total cost and can take up a minority shareholding of up to 35%, but will not participate in the management of a project.

PRODUCTION

The total reported value of mineral production increased 12% to $21.45 million in 1989, although this only includes asbestos, coal, diamond, and stone. Based on the output of bricks made from local ball clay, the true total value of Swaziland mineral production in 1989 is estimated to be at least $26.5 to $28.5 million. Production of asbestos increased significantly in 1989 largely owing to the startup of operations on a new, higher grade ore body at the Havelock Mine. Coal production was essentially stagnant. Diamond production fell sharply largely as a result of higher stripping ratios that required emphasis on overburden removal. This decline was more than mitigated by an increase in the quality of the stones produced and generally higher world prices for diamond in 1989. Production of crushed stone increased significantly largely because of continued strong demand by the construction industry.

A clay quarry is operated near Mpaka by the Langa National Brickworks. Clay production data are not available; however, the brick factory had an output in 1988 of 34.4 million units, about one-half of the factory's capacity. The value of this output is estimated to be $5 to $7 million.

TRADE

Along with Botswana, Lesotho, and the Republic of South Africa, Swaziland is a member of the South Africa Customs Union, which provides for duty-free internal shipping, a common external tariff, and access to a market of about 35 million persons. As in years past, Swaziland's economy in 1989 was dominated by trade with the Republic of South Africa. Perhaps 75% of Swazi exports was to that country; Republic of South Africa customers purchased about one-half of this amount and the rest was transshipped. Almost 90% of Swaziland's imports either originate in or transit the Republic of South Africa. Trade with the United States accounted for about 6% of total Swazi exports in 1989 and about 1% of imports and did not involve a significant quantity of mineral commodities.

Swaziland's exports totaled about $436 million in 1989. Government data show separately only the value of asbestos, coal, and diamond sales, which totaled $20.3 million. If the estimated value of brick exports is added, the true value of Swaziland's mineral commodity exports was about $23.5 to $24.8 million. Mineral commodity exports were of asbestos, coal, and diamond. All of the asbestos output was exported through the Republic of South Africa. Asbestos sales revenues were $9.7 million in 1989. This 14% increase was due to the higher quality of the asbestos from the company's new ore body. About 40% of the asbestos exports was to Republic of South Africa customers; the remainder was sold to overseas customers, largely in east Asia and Japan.

Sales of coal were worth $3.1 million; virtually all of the coal was exported. Most of the production was railed out through Republic of South Africa ports because of continued security problems with the railroad to Maputo, Mozambique. As in years past, almost all of the coal exports went to the Bamburi Cement Works in Kenya.

The country's diamond output was auctioned in Antwerp, Belgium. Revenues increased 17% to almost $7.7 million or about $139 per carat.

Approximately 22 million bricks are exported annually to the Republic of South Africa. Data on the value of this trade were not available, but the value can be estimated as between $3 million and $4.5 million.

Swaziland's imports in 1989 were about $425 million. Imports of mineral commodities, virtually all of which were from the Republic of South Africa, totaled an estimated $88 million. Of this amount, mineral fuels and lubricants accounted for about 75%. Imports of fertilizers, including phosphate rock, amounted to about $16 million. Coal imports of about 160,000 tons are estimated to have amounted to about $5 million. Republic of South Africa coal is preferred by Swaziland customers because it ignites more easily than the domestic product (anthracite). Swaziland imports Republic of South Africa-generated electricity; purchases in 1989 amounted to about $8 million.

TABLE 1

SWAZILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[p]
Asbestos, chrysotile fiber		25,130	20,908	25,925	22,804	27,291
Coal, anthracite		166,179	172,145	165,371	164,845	165,122
Diamond	carats	21,128	39,144	[e]80,000	72,676	55,264
Stone: Quarry product	cubic meters	83,903	120,723	96,114	107,205	128,463
Tin, mine output, Sn content		—	—	—	—	—

[e]Estimated. [p]Preliminary.

[1]Includes data available through Oct. 31, 1990.

[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

STRUCTURE OF THE MINERAL INDUSTRY

In 1989, asbestos production was from two mining leases operated by the same company; the ore body from one of the leases was not expected to last beyond 1990. Diamond and coal were produced at one mine each. Crushed stone was produced from two quarries throughout the year; there was additional, intermittent production from other stone quarries to meet local road construction demands.

Approximately 2,500 Swazis were directly employed by the mining industry in Swaziland, equivalent to about 3% of the formal sector labor force. In addition, approximately 18,000 Swazis were employed in gold, coal, and platinum mines in the Republic of South Africa. It is estimated that about 13% of Swaziland's population is directly supported by mine wages, which are estimated to have totaled about $60 million in 1989.

COMMODITY REVIEW

Metals

A consortium of small Australian companies and TTN were involved in a project to build a ferrochrome plant at Mpaka. The project received a temporary boost early in 1989 when it was announced that Western Mining Co. of Australia had taken an option to buy controlling interest. The project was to utilize coal from the Mpaka Mine and electricity and chromite imported from the Republic of South Africa. However, following a visit to Swaziland in April 1989, Western Mining announced that it was pulling out of the venture. This decision appeared to have been in light of decreasing world prices and increased world production capacity for ferrochrome. No further progress with the project had been announced as of yearend.

Industrial Minerals

Asbestos.—The Havelock Mine's reserves at Bulembu were expected to be exhausted by yearend 1990. Faced with the impending layoff of the company's 1,500 workers, the Government loaned the company almost $6 million in 1989 to finance the opening of a new mine by the company on reserves in what is termed the Far West Area. The new ore body is of much higher grade and has asbestos of higher quality than that being mined at the old mine. The new reserves were reported to be adequate for mining through about 1996. A number of delays were experienced early in the year getting the new operation on-stream. A strike in November over a 25% wage increase demand further hurt production. Nevertheless, asbestos fiber output was up significantly for the year, and it was hoped that output would attain a level of 3,500 tons of asbestos fiber per month by mid-1990.

Diamond.—Diamond production from the Dvokolwako Mine fell significantly in 1989 apparently as a result of an increased stripping ratio and some problems with the mill grinding circuit. The production decline, however, was more than offset by higher world diamond prices in 1989 and by an apparent increase in the quality or quantity of gem stones produced. The mill's grinding circuit was being altered to improve the handling of fines, and the company was considering the installation of an in-pit crusher. Mining in the open pit reached an overall depth of 25 meters (m) in 1989 according to the company. Mining was expected to reach a depth of about 40 m by yearend 1990, and the ultimate open pit depth of 85 to 90 m was expected to be reached by about 1995.

TABLE 2

SWAZILAND: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Asbestos	Havelock Asbestos Mines (Swaziland) Ltd. (Swazi Nation,[2] 20%; Msauli Asbestos Bpk., Republic of South Africa, 35%; Turner and Newell Group, United Kingdom, 20%; Credo (Swaziland) Ltd., 5%)	Underground mines at Bulembu, 5 kilometers southeast of Havelock	40 asbestos fiber.
Coal	Emaswati Coal (Pty.) Ltd. (Trans Natal Coal Corp., Republic of South Africa, 50%; Swazi Nation, 50%)	Open pit and underground mine 5 kilometers southwest of Mpaka	200[e] anthracite.
Diamond	Dokolwayo Diamond Mines (Pty.) Ltd. (Trans Hex Group Ltd., Republic oflSouth Africa, 50%; Swazi Nation, 50%)	Open pit mine at Dvokolwako, 45 kilometers northeast of Manzini	100.[e 3]
Stone	Kwalini (Pty.) Ltd. (Trans Hex Group Ltd, Republic of South Africa, 100%)	Crofthead Quarry near Malkerns	95.[e 4]
	Wales Crushers (Pty.) Ltd. (Private Swaziland interests)	Crushed stone quarry at Tonkwane Estates, Mbabane	NA.

[e] Estimated. NA Not available.
[1] Thousand metric tons per year unless otherwise specified.
[2] Equity participation by the Swazi Nation, as distinct from the Government, is represented by the National organization Tibiyo Taka Ngwane.
[3] Thousand carats per year.
[4] Thousand cubic meters per year.

Stone.—The production of crushed and shaped stone increased significantly in 1989, largely because of continued strong demand from the construction industry. Two quarries were in operation for the full year. Most of the increase in the country's stone production was from the Crofthead Quarry near Malkerns and was made possible by the installation of new equipment. The stone quarry near Mbabane fared less well and reportedly was shut down at yearend because of a legal dispute. A number of small, Government-operated stone quarries were in intermittent production during the year, mostly to meet short-term local demand for road construction projects.

Mineral Fuels

Coal production from the Mpaka Mine was essentially unchanged in 1989. New storage bins and conveyors were installed during the year, mostly to improve efficiency rather than output. The company was negotiating in early 1989 to supply coal to a proposed ferrochrome plant near the mine. This project would have required that the mine's output more than double. The ferrochrome project ran into severe financial problems in April, and it was considered doubtful that it would ever come to fruition.

In October, following 2 years of negotiations, a prospecting license was granted to Carbonex Co. of Denmark to delineate anthracite reserves near Maloma. The company commenced drilling in January 1990 and expected to complete its assessment by mid-1990. The project's goal is to develop a mine producing 300,000 tons per year for a period of 20 years. Apart from the fact that this would cause a tripling of the country's coal production, the Government viewed the project as a timely source of employment, given the expected closure of the Havelock asbestos mine, the largest mining-sector employer in the country, by 1997. Further, the development of this deposit would require an upgrade of the country's railroads and would give added weight to the Government's ongoing search for funding for such rehabilitation. Given a favorable outcome of the drill program, Carbonex hoped to be in production by 1992.

Reserves

According to the Government, Swaziland has about 1 billion tons of recoverable coal reserves. Much of the coal is anthracite. Proven reserves at the Mpaka Mine are estimated to total almost 40 MMmt (all classes), of which about 20% are proven.

Known reserves of asbestos at the old Havelock Mine are believed to be virtually exhausted—perhaps adequate for limited production through 1990. Reserves in the newly opened Far West Area, however, are adequate for 5 to 7 years of production, according to the Government, and grade about 10% asbestos fiber. At planned fiber output levels, this mine life implies reserves of about 2.5 MMmt of ore.

Although several diamond occurrences are known in Swaziland, notably at Dvokolwako and Hlane, only the former deposit has, to date, proven economic. Reserve data for the Dvokolwako Mine are not available. Based on statements in the company's annual reports, original open pit reserves were adequate for an 8-year operation. At stated processing capacities and outputs, this implies original open pit reserves of approximately 6 MMmt grading about 0.10 carat per ton. In addition, underground minable reserves exist at this deposit, but data are inadequate to allow an estimate of the reserves.

Swaziland has occurrences of a number of industrial minerals, such as aluminosilicates, barite, various clays, diaspore, fluorspar, and pyrophyllite, but, in general, economic reserves of these commodities have been adequate for but small production. Significant quantities of gold were mined, mostly in the late 1800's, from quartz vein and alluvial deposits near Piggs Peak and Forbes Reef. Although exploration has occurred in these areas in recent years, the discovery of economic reserves have not been announced. The high-grade iron ore reserves at Ngwenya, which were mined until 1977, are exhausted. Resources of lower grade material in the area and elsewhere in Swaziland are known but are not currently economic. Approximately 10,000 tons of tin in cassiterite was produced from 1907 to 1984 from a number of small alluvial deposits along a belt running about 20 km southeast from Mbabane. Production ceased in 1984, and reserves have not justified a renewal of operations.

INFRASTRUCTURE

Swaziland's transportation infrastructure is relatively well-developed by African standards. Much of the railroad infrastructure was developed to facilitate the export of mineral commodities. The country has 369 km of railroads, all of 1.067-m gauge, and 297 km of which is active. The country's first railroad was the 220.4-km line, opened in 1964, to allow the shipment of iron ore from the Ngwenya Mine (KaDake station) in western Swaziland to the Mozambique border and thence by a further 74 km of line to the port of Lourenço Marques (now Maputo). The Ngwenya Mine closed in 1977, and stockpiled ore shipments ceased in August 1980, after which the western 72-km of the line running from KaDake to Matsapha was placed on inactive status.

In 1978, a 93-km branch line was constructed from Phuzumoya south to the Republic of South Africa border at Golela. This connected with the Republic of South Africa's railroad grid leading to the port of Richards Bay and allowed the export of coal through that port at a time when difficulties were being experienced with the efficient export of coal through Mozambique. In late 1985, a 58-km branch line was completed, running north from near Mpaka to the Republic of South Africa border and thence to Komatipoort. This has allowed the more efficient export of agricultural produce to the Republic of South Africa and imports from that country. It has also provided an efficient transit route for the Republic of South Africa's goods through Swaziland, largely to access the ports of Richards Bay and Durban, and so substitute for the often-closed line from Komatipoort to Maputo.

In 1988, the latest year for which data are available, Swaziland's railroads handled 3.8 million tons of goods—a 46% increase from 1987 railings. About 1.5 million tons of this was mineral commodities. The Government was seeking funds to reopen the line to KaDake and for general track rehabilitation.

Swaziland has about 2,800 km of roads, of which about 20% is paved. A 20.4-km aerial cableway from the Havelock Mine to the railroad at Barberton, Republic of South Africa, is used to export Swaziland's asbestos fiber production.

Swaziland's electrical generating capacity is about 95 megawatts (MW), of which 43 MW is installed capacity in hydroelectric plants. These are operated by the Government, as is a 10-MW thermal plant. Another 42-MW capacity is installed in privately operated plants. Hydroelectric power output is hampered by frequent drought conditions. Swaziland is linked to the Republic of South Africa's grid and has an import capacity of 67 MW. Production and sales data are available only from the Swaziland Electricity Board, which, in 1989, sold about 400 million kilowatt-hours. Approximately 68% of this was imported. The possibility of reducing the country's dependence on imported electricity was being studied in terms of several infrastructure projects. The largest of these was the Komati River Project, projected to start in 1992 at the earliest, which would involve a dam and hydroelectric plant about 12 km southeast of Piggs Peak.

OUTLOOK

The overall economic outlook will remain highly dependent on the economy of the Republic of South Africa. The local mineral economy will continue to be dominated by asbestos, coal, and diamond for the near future. Asbestos production is expected to cease by about 1996 owing to exhaustion of reserves. Coal output is predicted to triple within 2 to 3 years if a new mine is developed near Maloma and could grow further if additional mines are developed. A present limiting factor is the export railing capacity; this will improve considerably if the current problems with security in Mozambique are resolved and the railroad and loading facilities in that country are fully rehabilitated. The potential for increasing output from the Dvokolwako diamond mine is considered good; other diamond deposits are known within the country and may attract serious exploration interest. Widespread gold occurrences in western and northwestern Swaziland, and significant past production of gold, augur well for the development of at least small-scale gold mining. Swaziland has significant resources of a number of industrial minerals; some of these are likely to be developed, at least for domestic use. It is unlikely that future market conditions for tin will justify the significant development of Swaziland's tin resources. The development of a ferrochrome smelter in Swaziland, using Swazi coal, remains undetermined owing to market prices for ferrochromium.

[1] Where necessary, values have been converted from Swazi emalangeni (E) to U.S. dollars at the rate of E2.62 = US$1.00.

OTHER SOURCES OF INFORMATION

Geological Survey and Mines Department
P.O. Box 9
Mbabane, Swaziland

TANZANIA

AREA 945,090 km² **POPULATION 25.9 million**

THE MINERAL INDUSTRY OF

TANZANIA

By David Izon

Tanzania has not been a major player in the production of minerals in the world. The principal minerals produced remain diamond, cement, and coal, but recent developments indicate that gold production may become significant to the Tanzanian economy in the foreseeable future. Although crude oil was entirely imported, most of the oil was used in the petroleum refinery industry for manufacture of products that made significant contributions toward the economy. The minerals sector accounted for only a fraction of the gross domestic product (GDP). In 1989, the main foreign exchange earner was agriculture, accounting for 75% of export earnings and 44% of the GDP.[1]

The Government has embarked on a program to search for and develop new mineral deposits in an effort to promote industrial growth. To this end, it was actively seeking technical and financial aid from foreign investors for the expansion of existing mines and development of new mineral deposits. In 1989, the industrial sector as a whole reported a productivity increase of about 5.1% resulting from increased availability of raw materials and spare parts.

A coal mine at Cowrie, completed in 1988, operated at about 26% of projected capacity. It is believed that when this operation achieves full capacity production, it will save the country more than $3 million per year in oil imports.

Despite the increase in revenues from cash crops, only one-third of the foreign exchange requirements were covered by these products. The Government was able to pay most of its debts to international monetary institutions. There were no significant changes in investment patterns during 1989.

GOVERNMENT POLICIES AND PROGRAMS

The thrust of Tanzania's economic policies and programs in 1989 were summarized in the Economic Recovery Program (ERP) of the Government. Priority was given to production of food, which would make Tanzania self-sufficient and able to export food surpluses. In the industrial sector, policies were adopted to encourage exploration, development, and exploitation of mineral resources of the country.

Success of the new policies included an agreement signed with Placer Dome Inc. to develop the Bulyanhula gold deposits. Gold sales were taken over by the Bank of Tanzania. As part of the latter policy, the Government bought gold from private sources and prohibited any direct sale by mining companies or individuals. Also, to further resource development, the Government authorized the exploration for oil and gas in concessions both offshore and onshore. This involved several foreign firms, including Shell Co., Esso Oil Co., Agip Oil Co., and Elf Aquitaine Co. of France. Plans were underway to build a urea plant at Kilwa, south of Dar Es Salaam, with a capacity of about 300,000 metric tons per year (mt/yr). Natural gas from the Songo-Songo Field is to be utilized at the urea plant. Texaco Oil Co. of the United States signed an agreement with the Government and Tanzania Petroleum Development Corp. (TPDC) to drill a test well in the Ruvuma basin along the Mozambique border. The agreement covered 11,427 square kilometers and permits the Government to participate in up to 15% of the venture through the TPDC. Other Government programs focused on the development of the iron ore deposits in the Kipengere mountain range. However, to date the Government's efforts to acquire technical and financial aid for the Ruvuma project have not been successful.

PRODUCTION

The mineral industry experienced some decline in 1989, resulting mainly from lack of capital, adequate equipment, and infrastructure. Diamond operations were reported to be faced with dwindling reserves at the Mwandui Mines. Known reserves at the mines were reported to be about 3.8 million carats and found at depths of about 100 meters. Gold was mainly mined by smallholders and often smuggled out of the country. There were similar problems with gem stones. Coal production was mainly for domestic consumption as an alternative to oil imports and to reduce rural consumption of firewood as a primary fuel.

TRADE

Tanzania's main trading partners were the Federal Republic of Germany, Italy, the Netherlands, the United Kingdom, and neighboring east African countries. Total value of exports for 1989 was estimated at about $442.8 million. Total imports amounted to about $1.1 billion in 1989, creating a negative trade balance of about $657.2 million. Principal export products for 1988 were agricultural products and diamonds that amounted to approximately $436.4 million.

In 1988, the latest year for which data were available, Tanzania's imports from the United States amounted to $26.97 million, and exports to the United States amounted to $15.75 million. Major import items were manufactured goods, machinery and transport equipment, and crude oil. Other significant import products for 1988 were electrical equipment, transport equipment, chemicals, and farm implements. Major export items to the United States were diamonds, cashew nuts, coffee, textiles, and apparel. Areas of particular interest to the U.S. industries included mineral and oil exploration, industrial equipment, and other manufactured goods.

STRUCTURE OF THE MINERAL INDUSTRY

All land continues to be state owned since so declared in 1964. The National Development Corp., formed in 1966, took over most private enterprises. The

TABLE 1

TANZANIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[p]
Cement, hydraulic		301,000	[e]300,000	[e]300,000	189,390	540,000
Clays:						
Bentonite[e]		75	75	75	75	75
Kaolin		1,636	1,600	1,446	528	1,554
Coal, bituminous		20,000	20,000	2,860	3,349	46,000
Diamond[3]	carats	236,000	190,000	150,000	[e]150,000	[e]150,000
Gem stones, precious and semiprecious excluding diamond:[e 4]	kilograms	[5]646	650	4,400	9,400	9,300
Gold, refined	do.	55	85	201	52	116
Gypsum and anhydrite, crude		14,411	[e]14,000	24,648	19,570	5,895
Lime, calcined and hydrated[e]		[5]2,472	3,000	3,000	3,000	2,505
Limestone, crushed		NA	NA	680,701	792,454	986,537
Mica, sheet		([6])	([6])	([6])	([6])	([6])
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	80	80	44	73	49
Gasoline	do.	800	800	909	784	835
Kerosene	do.	220	220	330	325	321
Jet fuel	do.	300	300	220	232	107
Distillate fuel oil	do.	1,050	1,050	1,069	1,088	1,097
Residual fuel oil	do.	1,750	1,750	525	1,771	1,543
Other	do.	300	300	540	320	321
Total including refinery fuel and losses	do.	4,500	4,500	3,637	4,593	4,273
Phosphate minerals: Apatite		15,000	10,000	18,386	4,466	4,657
Salt, all types		21,108	21,868	41,123	19,777	20,010
Sand, glass		NA	NA	6,071	12,043	13,101
Soda ash[e]		300	300	300	300	300
Tin, mine output, Sn content[e]		2	2	2	2	15

[e]Estimated. [p]Preliminary. NA Not available.
[1]Includes data available through Nov. 19, 1990.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (other clays sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]Diamond figures are estimated to represent 70% gem-quality or semigem-quality and 30% industrial-quality stones.
[4]Exports.
[5]Reported figure.
[6]Less than 1/2 unit.

State Mining Corp. (STAMICO) controlled the mineral industry and operated most mines and plants. Few mining companies, such as Canadian-owned Placer Dome Inc., are foreign owned and pay royalties to the Tanzanian Government. Oil and gas prospecting was conducted by joint-venture agreements with foreign partners in equity sharing arrangements.

COMMODITY REVIEW

Metals

Gold.—Reports indicated that Tanzania has considerable gold potential, but progress in mining has been slow. At present, small-scale gold mining takes place in Musoma east of Lake Victoria, at Lupa southeast of Lake Rukwa, and at Mpanda east of Lake Tangayika. Mining is done mainly by STAMICO, and production from these small mines provided most of 1989's total output.

Placer Dome Inc. of Canada signed a $100 million mining agreement with the Government to develop the Bulyanhula gold deposits in the Kahama district of northern Tanzania near the southwestern end of Lake Victoria. The deposits were within the gold belt that extended from Mara, northeast Tanzania, to Geita and Sengerema on the northwestern side of Lake Victoria near Kabanga. Feasibility studies conducted by Placer Dome Inc. outlined a resource of 4.33 million tons with an average mill feed grade of 11.82 grams per metric ton (g/mt) of gold. At peak output, annual production would be worth about $70 million with Placer Dome as the operator. The Government expects to acquire up to 51% of Placer Dome after 10 years. Initial studies focused on evaluating mining methods and the most economic means of gold production.

Two Finnish companies, Kome and Outokumpu Oy, that have been interested in the Kahama district filed a suit to nullify the agreement between Placer Dome

TABLE 2

TANZANIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Cement	Tanga Cement Co. Ltd. (Government, 100%)	Tanga	500
	Tanzania Portland Cement Co. (Government, 100%)	Wazo Hill, near Dar Es Salaam	600
	Mbeya Cement Co. (Government, 100%)	Mbeya, southwest of Dar Es Salaam	250
Coal	State Mining Corp. (Government, 100%)	Songwe-Kiwira	150
Diamond	Williamson Diamonds Co. (Stamico, 50%; Willcroft of Canada, 50%)	Mwadui	[2]3.5
Gold	Place Dome (Kahama) Ltd (Placer Dome, 90%; Government, 10%)	Bulyanhula	34
Petroleum, refinery products	Tanzania and Italian Petroleum Refining Co. Ltd. (Government, 50%, Agip Petroli SpA of Italy, 50%)	Dar Es Salaam	[3]17

[1]Thousand metric tons per year unless otherwise specified.
[2]Million metric tons per year.
[3]Barrels per day.

and the Government. The Finnish companies claimed that they invested heavily in prospecting for 7 years and were denied a license to prospect and exploit the Bulyanhula deposit. At the time, Kome, Outokumpu, and STAMICO formed a joint venture, Kahama Gold Mines Corp., to develop the region. Action in the case was pending in the High Court of Tanzania.

Iron Ore and Iron and Steel.—The country's iron and steel requirements were estimated to be about 500,000 mt/yr, of which only 30,000 mt/yr was being produced locally at the rolling mills in Tanga and Dar Es Salaam. Raw materials such as billets were provided by another company, Aluminium Africa Ltd. of Tanzania.

Iron ore deposits were reported to be in the Kinpengere (Lingaga) mountain range of Iringa region, along the northern edge of Lake Nyasa. The deposits were estimated to contain about 45 million metric tons (MMmt) of ore grading 51% iron, 13% titanium, and 0.6% vanadium. The Government was seeking financial and technical aid to develop and exploit the deposits, but the cost of nearly $360 million for the complex and associated infrastructure has deterred progress.

Nickel.—Nickel has been found in Kabanga near the Burundi border. The nickel sulfide deposits have an approximate reserve of 40.5 MMmt grading 1.05% nickel, 0.11% cobalt, 0.21% copper, and 0.31 grams combined gold and platinum per ton. Other targets were also identified that were estimated to contain an additional 37.8 MMmt grading 0.42% nickel, 0.04% cobalt, and 0.06% copper. Exact locations of the latter deposits were not disclosed.

A Vancouver-based company, Sutton Resources, through an agreement with Romanex International, was to acquire 55% interest in the Kabanga nickel deposits. The nickel mines were to be operated by Kabanga Nickel Co., a wholly owned subsidiary of Romanex, when the property is fully explored. License for exploration has been issued to Kabanga Nickel Co., which is to form a joint venture with Sutton Resources after Sutton earns its 55% interest in the property. When production is started, the Government would be entitled to a minimum of 7.5% equity interest in the Kabanga operations and a 3% net smelter royalty. The Government has an option of acquiring up to a maximum of 32.5% additional equity interest or increase the mine tax rate. At this stage, Kabanga Nickel Co. is required to spend $3.5 million during a 3-year period to explore and evaluate the mine.

Industrial Minerals

Diamond.—The Mwadui diamond mines were estimated to have a life of about 19 to 25 years, assuming current production rates of between 150,000 and 200,000 carats per year. They were operated by Williamson Diamond Mines Co. near Shinyanga, about 200 kilometers (km) south of Mwanza. The mines' treatment plant required extensive rehabilitation at an estimated cost of $5 million. Existing reserves were in very deep locations, which may prove very expensive to mine. The Tanzania Diamond Cutting Co. at Iringa was responsible for polishing about 20% of the diamonds produced at the Mwadui Mines, as well as some obtained from foreign operators.

Phosphate.—Phosphate production was by STAMICO in association with Kone Corp. of Finland at Minjingu, at the southern end of Lake Manyara. The deposit, which is 100 km southwest of the railway terminal at Arusha, has been worked as an open pit mine. Output from the mine is used in the fertilizer plant operated at the port of Tanga by Tanzania Fertilizer Co. The phosphate rock reportedly contains an average of 18.5% P_2O_5 for fine-grained friable rock and 10% P_2O_5 for hard to semihard siliceous phosphate. The ore can be upgraded by drying and screening to 21.4% P_2O_5 for use in the fertilizer plant. The plant, temporarily closed in 1988, was reopened in May 1989. Mixed fertilizer production for 1989 was about 45,000 mt/yr, and the plant was estimated to be running at 45% of installed capacity.

Mineral Fuels

Coal.—The country's only coal mine in 1989 was at Cowrie, northeast of the Kipengere Range. It operated at about 31% of capacity. The Chinese-built mine was expected to produce 150,000 tons of raw coal for production of 93,000 tons of processed coal annually, of which 82,000 tons was to be sold locally. The Government is seeking export markets for the coal. It is anticipated that output could eventually rise to 180,000 mt/yr in 1995 and to 300,000 tons by the year 2000. Nine known coalfields, mainly in the southern part of the Rift Valley, were estimated to contain about 1.2 billion tons of coal. It is also anticipated that the coal industry will provide about 1,500 jobs for the country.

Petroleum and Natural Gas.—The country totally depended on imported oil for its refinery at Dar Es Salaam. Imported oil cost the country almost 60% of its foreign exchange earnings.

Exploration for hydrocarbons has been undertaken on the mainland of Tanzania between Lake Tangayika and Lake Rukwa and also in offshore concessions by several foreign firms, including Shell, Esso, Agip, and Elf Acquitaine of France. No significant oil deposits were found. However, large deposits of natural gas were found at the Songo-Songo Field just offshore in the Indian Ocean about 300 km south of Dar Es Salaam. Plans were underway to utilize the gas for the proposed Kilwa ammonia and urea plant with a capacity of 300,000 mt/yr. Exploration efforts for additional gas reserves continued during 1989. The World Bank has agreed to fund exploration activities along the southern coastline. However, funding depended on a pricing study meant to establish an efficient distribution system for natural gas and petroleum products.

Reserves

Tanzania was estimated to have natural gas reserves of approximately 41 billion cubic meters. All of the reserves are offshore and all were in the Songo-Songo Field just off the southern coast. The total in situ coal reserves were 1.2 billion tons in nine main coalfields in the southern part of the Rift Valley. Iron ore resources were estimated at about 45 MMmt with an iron content averaging about 51%. Gold reserves at the Bulyanhula deposits were put at about 4 tons. Phosphate reserves were about 10 MMmt. There were no officially reported reserve figures for other minerals, but other sources have estimated diamond reserves at the Mwandui Mines to be about 3.8 million carats.

INFRASTRUCTURE

The Tanzanian railway system, the fourth largest in Africa, consists of 3,555 km of total railroad. Dar Es Salaam is the ocean terminus of the railway to Kigoma and Lake Tangayika and to Nwanza on Lake Victoria. Tanzania is connected to Zambia by three ground links: the Tanzania-Zambia Railway Authority (TAZARA) railroad, the Tanzania-Zambia highway, and the Tanzania-Zambia pipeline. The 982-km crude oil pipeline transits the country from Dar Es Salaam into Zambia. The Tanzanian Railway Corp. (TRC) operates all the rail lines except TAZARA. TAZARA is used to transport goods mainly for Zambia and Malawi while the TRC handles freight for Burundi, eastern Zaire, Uganda, and Rwanda. Of the 81,900 km of roads, 3,600 km is paved, 5,600 km is gravel or crushed stone, and the remainder is in seriously deteriorating condition. The road conditions are having an adverse effect on the economy of the country. Major ocean ports are at Dar Es Salaam, Mtwara, Tanga, and Zanzibar. Mwanza on Lake Victoria and Kigoma on Lake Tangayika are inland ports.

Tanzania relies largely on hydroelectric power for its electricity. The Tanzania Electric Supply Co. on the mainland and the Zanzibar State Fuel & Power Corp. on the island are responsible for all public power generation and delivery.

OUTLOOK

Nonfuel minerals such as diamond will not be expected to play a significant role in the economy of the country for the immediate future. Further development of gold resources may improve the chances of nonfuel minerals becoming important to the country's economy in the long run. However, the center of new industrial development in Tanzania is expected to be based on the successful completion and operation of the Songo-Songo natural gasfields and successful development of iron ore deposits. Assuming iron ore production commences, development or improvement of existing steel facilities may contribute to a more steady growth in the industrial sector. The World Bank funded petroleum exploration program currently underway has yet to prove successful. The Government's economic recovery program should continue to improve the country's industrial growth. Road and rail improvement projects being studied may help to alleviate transportation problems when implemented. Transportation problems have been responsible for the inefficient distribution of commodities in the country. Foreign assistance in the mining industry is encouraging and is expected to continue as new deposits are found.

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[1]Where necessary, values have been converted from Tanzanian shillings (Shs) to U.S. dollars at Shs44.4=US$1.00 in 1989.

OTHER SOURCES OF INFORMATION

Agencies

Ministry for Energy and Minerals
P.O. Box 2000
Dar Es Salaam, Tanzania

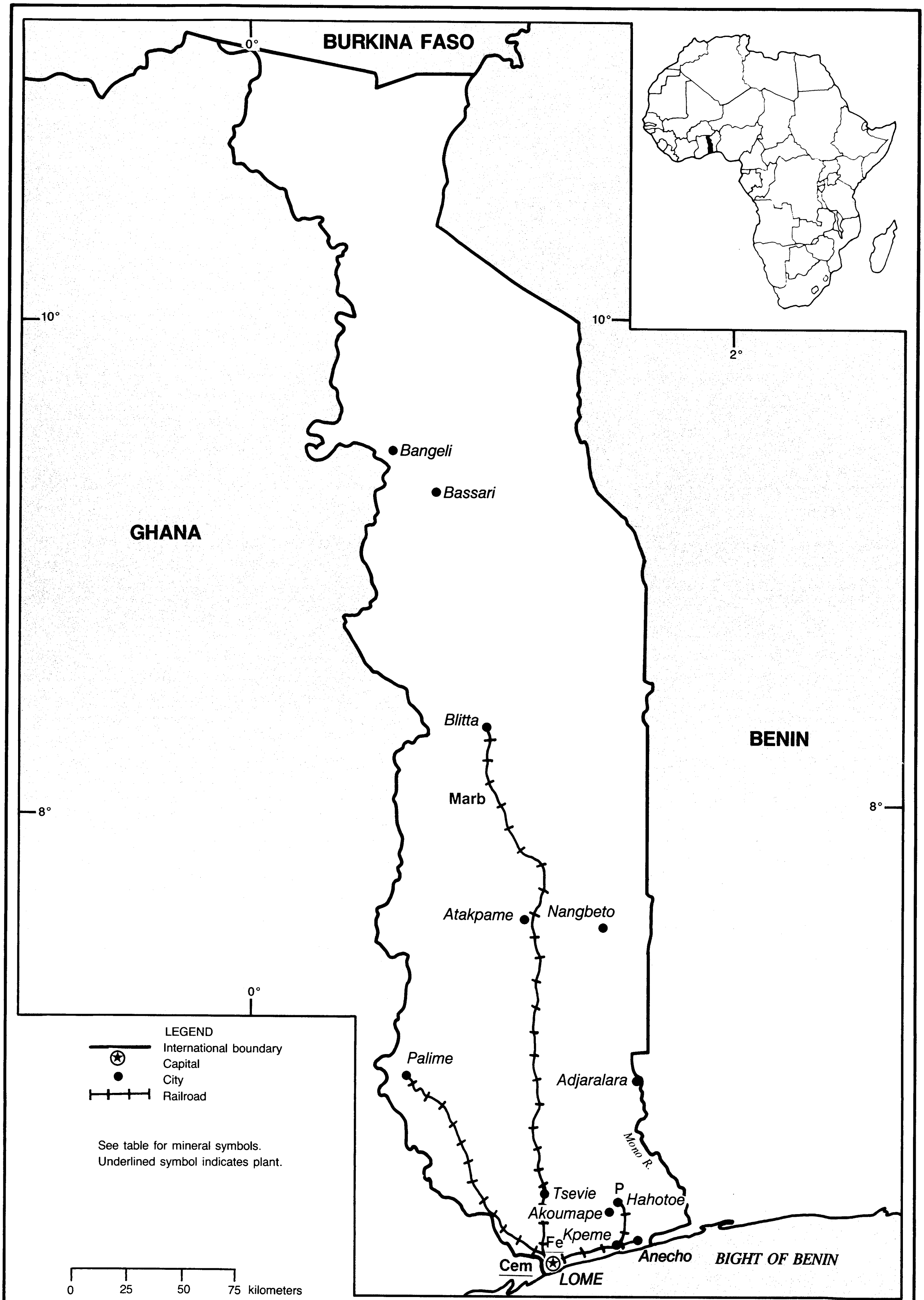
Ministry of Industries and Trade
P.O. Box 9503
Dar Es Salaam, Tanzania

Publication

Bank of Tanzania, P.O. Box 2939, Dar Es Salaam: Economic Bulletin, bimonthly.

TOGO

AREA 57,000 km² **POPULATION 3.7 million**



THE MINERAL INDUSTRY OF

TOGO

By Audie L. King

Mining remained Togo's most important industry despite recent concerns over relatively high cadmium levels in the country's phosphate ore. Phosphate rock production by the Government-owned phosphate company, Office Togolaise des Phosphates (OTP) continued to dominate the country's mining industry. Worries over the potentially negative environmental effects of cadmium had caused phosphate exports to shift away from traditional markets in Western Europe and the United States. However, in recent years Togo had negotiated new foreign contracts for the delivery of its exceptionally high-grade phosphate rock. With rising world demand and prices, Togo managed to achieve record levels of production and sales in 1989.[1] Togo's phosphate industry accounted for more than 42% of the country's total export earnings, more than 10% of its gross domestic product (GDP), and about one-fifth of Togolese Government revenues in 1989. In an effort to regain its European phosphate market, Togo applied for and received an $18.8 million grant from the European Community (EC) to research cadmium removal methods.

The Government-owned cement factory continued its steady pattern of production growth. Production increased by 3% in 1989 to 389,000 tons. Marble production suffered a 57% decline to 11,700 square meters. The country's only marble producer reverted back to Togolese Government control when it was unable to supply local demands. It had been owned and operated by a Norwegian company since it was privatized in 1986. Togo's only metal manufacturer, an American-owned steel mill, reported that production decreased nearly 50% since 1987, when production data was last reported, to 6,197 tons.

Togo's liberal policies, aimed at stimulating economic development, produced yet another year of real growth in the GDP. The economy grew by 3.6% in 1989 compared with a 4.9% increase the previous year. Overall exports were up by about 2% to $331.5 million. A 15% increase in the value of phosphate rock exports more than compensated for declines in the value of Togo's major agricultural export commodities. The value of imports declined by more than 2% in 1989 to $344.3 million. The trade deficit had been steadily declining in recent years. It was $12.8 million in 1989, down from $27.6 million in 1988 and $79.6 million in 1987. Inflation has been under control for a number of years, and the consumer price index actually fell by 1.2% in 1989.

Despite the disproportionately large value of its mineral production with respect to other sectors of the economy, Togo remained primarily an agrarian society. Its per capita GDP was less than $400 in 1989. Agriculture was the main vocation of nearly 80% of the population. The production of cocoa, coffee, and cotton for foreign markets accounted for about 25% of total exports. Including staple food crops, the agricultural sector accounted for 30% of the nation's GDP.

GOVERNMENT POLICIES AND PROGRAMS

Based on profits from a sudden rise in phosphate prices in the mid-1970's, the Government of Togo borrowed money to build a state-run industrial complex. When the price of phosphate fell in the late 1970's, the country of less than 4.0 million inhabitants was left with a foreign debt of more than $1 billion. Its resources were further drained by losses incurred by the more than 70 parastatal companies it had created. In 1982, a rigorous structural adjustment program supported by the World Bank and the International Monetary Fund was undertaken. This program has so far resulted in Togo receiving three structural adjustment loans, with a fourth being currently negotiated. The cornerstone of the program has been the privatization or simple liquidation of the state's lossmaking enterprises. Of the 73 companies in this position, 10 had been liquidated, 14 had been privatized, and 23 more were slated for privatization. The Government of Togo had declared a continuing interest in the remaining 26 companies. Since 1985, Togo had recouped about $77 million, but it had made substantial losses on its original investment. In a recent development, the country's sole marble producer had reverted to the state. Many of the other privatized companies had operated for 3 or 4 years without making money. Many of these businesses may still turn a profit in the future since production is generally up and the staffs at the factories have been trimmed.

The Togolese steel industry was regarded as a success story of privatization. It was bought by an American entrepreneur in 1984 and is already claiming 6% profit on turnover and a 14% return on capital. Doubts remain as to how reliable a beacon the Togolese steel industry's example will be to future investment in Togo, mainly because the impressive results had been achieved with the aid of a 43% import tariff.

Privatization had stopped the outflow of Government funds but had failed so far to create new jobs or attract new investment. The Government had responded by offering further incentives to private investment. Export processing zones (EPZ), similar to those already operating successfully in 24 other countries, will be set up in Togo beginning January 1, 1990. They will be the first private, duty-free EPZ's in Sub-Saharan Africa. The EPZ will grant custom-free imports and exports and tax exemptions for 10 years to companies that export at least 80% of their production. A 15% profit tax will apply thereafter. There had been 40 applications so far of which 10 are said to be definite. The steel company had filed an EPZ application to build the largest wire and fence factory in west Africa. Estimates for new job creation owing to the implementation of the EPZ range from less than 10,000 to as many as 100,000 new employees.

PRODUCTION

Favorable world markets and an expanding domestic economy contributed to moderate growth in phosphate rock mining and cement production. Despite an almost 14% price rise in Togolese phosphate rock to about $42 per ton, production was not able to greatly increase because OTP's mine was already operating at its rated capacity following a similar 12% price rise in 1988. Marble production was down due to production difficulties. Steel production was almost 50% lower than 1987, when production figures were last reported.

The mineral industry increased in importance to Togo's economy in 1989. This was due mainly to an increase in price and demand for Togo's high-grade phosphate ore, which resulted in a large increase in production starting in 1988. The mineral industry accounted for about 11.5% of the GDP in 1989 compared with about 10% in 1988 and 8% in 1987. Mineral exports accounted for about 46% of the nation's exports in 1989 compared with 41% in 1988 and 35% in 1987.

TABLE 1

TOGO: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity		1985	1986	1987	1988[p]	1989[e]
Cement[3]	metric tons	284,000	348,000	370,000	378,000	[4]389,000
Iron and steel, semimanufactures	do.	6,500	8,868	12,100	14,000	[4]6,197
Phosphate rock, beneficiated product:						
Gross weight	thousand metric tons	2,450	2,314	2,644	3,464	3,500
P_2O_5 content	do.	890	840	960	1,257	1,270
Stone: marble, dimension	square meters	5,671	5,000	10,800	27,000	11,700

[e]Estimated. [p]Preliminary.
[1]Includes data available through Dec. 12, 1990.
[2]In addition to the commodities listed, Togo presumably produced a variety of crude construction materials (clays, sand and gravel, and other stone) but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]In 1984, production of domestic clinker ended. Since that time, all cement has been produced from imported clinker.
[4]Reported figure.

TRADE

Commerce played an important role in the Togolese economy. Togo had pursued a relatively open trade policy. New laws had simplified the tax and tariff structure and had eliminated export taxes. Togo's port and other infrastructural improvements are among the best in west Africa, enhancing its status as a regional trading center. Most of the products approved for production under the new EPZ law will be aimed at the west African regional market. The country's products also enjoyed preferential entry into the United States under the Generalized System of Preferences and into the EC under the Lome Convention. Togo's trade balance improved significantly in 1989 when the value of exports increased while imports decreased. The merchandise trade deficit was down almost 54% to $12.8 million. Exports increased in 1989 by about 2% to $331.5 million and accounted for almost 25% of the nation's GDP. Phosphate rock accounted for about 42.5% of the total, while its principle cash crops of coffee, cotton, and cocoa composed 22% of exports. Togo's imports fell by more than 2% to $344.3 million.

Exports to the United States fell from $5.8 million in 1988 to only $2.8 million in 1989 and consisted mainly of live animals and crafts. Imports from the United States, which consisted mainly of wheat, textiles, cigarettes, rice, and petroleum products, increased by more than 36% to $27.9 million in 1989.

The Togolese marble factory, Nouvelle Societe Togolaise de Marbre (Nouvelle Sotoma), exported about 10% of its production to Benin, Ghana, Mali, and Burkina Faso. The company reported the production of 11,206 square meters of marble slab, 354 tons of marble blocks, and 977 tons of crushed marble.

Cement produced in Togo in 1989 was from imported clinker from Angola, Eastern Germany, Greece, Spain, Syria, Tunisia, and Venezuela. Togo exported cement to Burkina Faso, Equatorial Guinea, Gabon, Ghana, Mali, Niger, and Nigeria. In 1989, 330,000 tons of clinker was imported and 389,000 tons of cement was produced, of which 122,631 tons was exported according to the Togolese cement factory, Ciments du Togo (Cimtogo).

In 1989, petroleum products used in Togo originated in Côte d'Ivore, Gabon, and the United States. Natural gas products that consisted mostly of butane were imported from Ghana and Nigeria. Destinations of reexports are Burkina Faso, Mali, and Guinea.

Phosphate rock remained Togo's principle foreign exchange earner. Export levels increased by 17% in 1989 following a 14% increase in 1988. Although Togo had fewer phosphate buyers than in past years, the contracts were larger. Mexico was a new buyer, while longtime importers, Holland, Norway, and Portugal, purchased no phosphate rock in 1989. Although the United States stopped purchasing Togolese phosphate rock in 1988 because of concerns over relatively high cadmium levels, Canada had more than made up for the market loss. One of the largest increases came from higher shipping rates to Esso in Canada that began in 1988. Esso signed a 1 million metric ton per year (mt/yr) long-term contract with OTP, the state-owned production and sales company, to supply Esso's Redwater plant in Alberta. Other increases came from sales to Mexico, which bought 81,000 tons of phosphate rock with World Bank funds for the first time. Australia, India, and Indonesia also increased imports of Togolese phosphate rock. Australia had been looking for replacement for the phosphate ore that it imported from Christmas Island until 1988 when that island shut down phosphate operations. There continued to be market losses in Western Europe. Cyprus stopped its imports, and France, Italy, and Spain remained the sole European importing countries.

STRUCTURE OF THE MINERAL INDUSTRY

Togo's mineral industry was dominated by the Government-owned phosphate producer, OTP. With 2,500 workers, it was by far the country's largest industrial employer. Many of

TABLE 2

IMPORTS OF TOGOLESE PHOSPHATE

(Metric tons)

Country	1987	1988	1989
Australia	—	141,250	261,653
Belgium	—	54,850	—
Canada	262,880	840,006	890,380
China	23,700	—	—
Cyprus	51,130	110,210	—
France	287,570	301,850	319,840
Germany, Federal Republic of	15,750	—	—
Greece	31,850	—	—
Holland	217,120	48,600	—
India	89,600	137,600	178,700
Indonesia	29,580	—	—
Italy	177,760	239,747	58,688
Mexico	—	—	80,800
Norway	42,850	44,100	—
Philippines	116,050	223,700	285,116
Poland	260,189	351,918	293,680
Portugal	16,500	17,300	—
Spain	283,450	283,575	384,865
Turkey	21,000	—	—
United Kingdom	230,650	404,787	296,800
United States	339,570	—	—
Uruguay	25,000	46,650	33,000
Yugoslavia	51,700	66,630	65,625
Total	2,646,070	3,312,773	3,347,147

these employees held high-paying engineering positions in a country where even low-paying jobs are scarce. It operated phosphate strip mines centered around the cities Hahotoe and Akoumape about 30 kilometers from its treatment plant and export terminal at Kpeme. The marble company, Nouvelle Sotoma had reverted to 100% state control and had changed names to Nouvelle Societe. Its operations are near the railway about 40 kilometers south of Blitta. It employed about 60 people. Cimtogo, a joint venture with the Government and a Norwegian company, operated a cement factory in Lome. It was originally built to process clinker from the large Cement Co. of West Africa (Cimao) project that Togo jointly owned with Côte d'Ivoire, and Ghana. The Cimao clinker manufacturing plant, near a large limestone deposit about 60 kilometers northeast of the cement plant, was not able to compete with imported clinker and had since shut down. Cimtogo had rapidly increased its production capacity since it first opened in 1971 from 120,000 mt/yr to 500,000 mt/yr based on strong domestic and regional demand.

COMMODITY REVIEW

Metals

In 1989, the American-owned steel company, Societe Togolaise de Siderurgie (STS), expanded operations at its 12,000-mt/yr rolling mill in Lome by inaugurating a 3,000-mt/yr galvanized steel production plant, STS Metaux. This expanded the company into the area of product fabrication with an emphasis on telephone poles and high- and low-tension electrical towers. The plant employed 60 people and had already received orders, both domestically and abroad.

STS had submitted an application for a project in the new EPZ for a baling wire factory that would supply wire to the cotton industry throughout the region. The new STS Metaux pylon plant was also seeking a EPZ status change. Future plans called for restarting the steel mill's arc furnace if STS were allowed to do so under the EPZ laws, which would provide the company with lower electricity rates.

Industrial Minerals

Cement.—Côte d'Ivoire, Ghana, and Togo agreed to liquidate Cimao, a joint project set up in 1968 to produce and supply clinker to member nations. The decision to close the facilities after only limited production, was made at a board of directors meeting held in Togo in February 1989. Clinker production at the Cimao cement complex, one of Togo's largest industrial undertakings, had decreased steadily since the plant opened in 1980 due to production costs that reportedly were higher than similar material that could be imported from Europe.

Marble.—The marble company, Sotoma, had reverted to the state, which was again its sole owner. The marble factory was privatized in 1986 and put under the management of Norsen Corp., a Norwegian company. Before the reorganization, the Government held a 39% share of Sotoma, while Norsen owned a 37% share and the state-operated cement company Cimtogo, one-half owned by Norsen, had a 24% share.

Sotoma was reported to be experiencing production difficulties and could not supply contracts for two major construction projects in Lome that required large marble panels. The company was still generating some money through the sale of decorative brick and roofing materials.

Phosphate.—Togo had been experiencing a serious decline in its Western European phosphate exports because of rising concerns over the cadmium content of its ores. The EEC's share of Togolese phosphate exports had fallen from 90% in recent years to about 30% in 1989. It was estimated that Togo's phosphate ore contained about 50 to 60 parts per million of cadmium, which would need to be lowered to about 10 to 20 parts per million to compete with other world phosphate suppliers. In an effort to regain some of its lost markets, the country

TABLE 3
TOGO: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership	Location of main facilities	Capacity[1]
Cement	Ciments du Togo (Cimtogo) (Government, 50%; Norsaen, Norwegian, 50%)	Lome	500,000.[e]
Iron	Societe Togolaise de Siderurgie (STS) (Private U.S. interest, 100%)	do.	20,000.[e]
Marble	Nouvella Societe Togolaise de Marbre (Nouvella Sotoma) (Government, 100%)	40 kilometers south of Blitta	90,000.[e 2]
Phosphate rock	Office Togolaise des Phosphates (OTP) (Government, 100%)	Near Hahotoe and Akoumape	3,600,000[e] beneficiated product.

[e]Estimated.
[1]Metric tons per year unless otherwise specified.
[2]Square meters per year.

made a submission to the EC for assistance. An agreement was signed on November 27, 1989, granting an allocation of $18.8 million from the Sysmin compensation fund. Of the total, $12.0 million would be spent on equipment with the remainder going to research. Under the accord, two cadmium removal procedures can be investigated. The preferable method would use a calcination process to volatilize the cadmium from the ore before it leaves Togo. The money could also be used on research to remove the toxic metal at the individual export country's fertilizer plants. A pilot plant for removing the cadmium from phosphoric acid by solvent extraction was being developed by the West German group Budenheim. The EC would also allow improvements to be made in the Togolese ore drying process with the aim of increasing productivity by as much as 26%.

The French had funded a $14.4 million grant to allow the Togolese phosphate industry to continue producing ore at the present rate. Capacity was 3.5 million mt/yr, and a slime recovery system installed in 1988 allowed for annualized production rates of up to 3.8 million tons for short periods.

A project to build a phosphoric acid plant and associated fertilizer production facilities was dormant but could be reactivated were funding to become available from a joint-venture partner. The proposed plant would process lower grade Dagbati ore from known reserves along the coast south of the presently active phosphate mines near Kpeme.

Mineral Fuels

The state-owned petroleum complex a few miles from Lome was sold for $20 million to Shell International in February 1990. The refinery was built in 1977 by the British company Humphery and Glasgow for $52.9 million and operated for 4 years before being shut down in 1981. The complex included the dormant oil refinery and storage facility that Shell had leased and used as a depot since 1984. Shell will take a 60% share of the new company called Complex Petrolier de Lome (Compel), and the Government will retain a 40% share. There were no plans to restart the refinery because Shell believed that it would not be profitable. Shell had already invested $10 million in improvements to the storage facilities and was said to be keeping the refinery in shape by running fluids through the pipes.

Reserves

Industry sources estimate that Togo's total phosphate reserves were about 260 million tons of commercial-grade ore (about 130 million tons of product equivalent). It also was reported to have had very large deposits of lower grade carbonate phosphates. Four high-grade phosphate deposits near Bassari in north-central Togo had been determined to be noncommercial by the Bureau de Recherches Geologiques et Minieres (BRGM) of France. The determination was made because of their relatively low potential reserves of only a few million tons per deposit and the lack of heavy transport routes to the coast. The BRGM believed, however, that these deposits could be exploited on a modest scale for local use.

The existing phosphate pit contained reserves for about 7 years at 1989 levels of mining of about 3.5 million mt/yr. OTP was working with the BRGM on the development of a new mining area next to the current workings.

Apart from phosphate rock and small quantities of marble and limestone, exploitation of minerals in Togo had been negligible despite emphasis on the need to diversify the country's resource base. A number of potentially valuable mineral deposits had been discovered, but development awaited more detailed exploration and infrastructural improvements. Relatively large deposits of iron ore, estimated to total 95 million tons occur east of Bassari. The ore averaged more than 40% iron and occured mainly as magnetite. These deposits had been investigated periodically by the local Bureau National de Recherches Minieres and most recently in conjunction with the BRGM. Laterites containing 46% to 53% Al_2O_3 and 18% to 30% Fe_2O_3 occured on Mount Agou, the highest point in the Atakora Mountains, near Palime, 100 km northwest of Lome. Manganese deposits had been reported in the Bayega area in northern Togo.

INFRASTRUCTURE

Togo had a good highway network

that consisted of 1,762 km of paved roads. The network linked the capital, Lome, with neighboring Benin, Burkina Faso, and Ghana. Its port and airport facilities at Lome were among the most modern in the region. About 515 km of 1.0-meter gauge, single-track railway connected Lome with the cities of Anecho, Blitta, and Palime. All of the principle mineral deposits being mined had access to the rail lines. Exploitation of the iron and manganese deposits in the northern part of the country would require infrastructural improvements.

The Nangbeto hydroelectric power station on the Mono River in southern Togo near the border with Benin will eventually produce 150 megawatts. Production of electricity started in September 1987 and was sufficient to meet 25% of the combined demand of Togo and Benin. A 15- to 20-megawatt hydroelectric plant was also proposed for Adjaralara, 75 km downstream on the Mono River.

Togo will remain largely dependent on electricity imported from Ghana's Akosombo hydroelectric plant. Most of the supply was purchased from Communaute Electrique du Benin, a company set up jointly by Benin and Togo in 1975.

OUTLOOK

Togo's economy will continue to be dominated by the phosphate industry well into the next century. New industry attracted to the country by the Government's liberal economic policies will provide an important economic buffer during periods of low phosphate prices. However, even with optimistic growth projections, the industrial sector will remain too small to isolate Togo from economic slowdowns when commodity prices are low. Togo will remain vulnerable to droughts that directly affect the majority of the population who survive by subsistence agriculture.

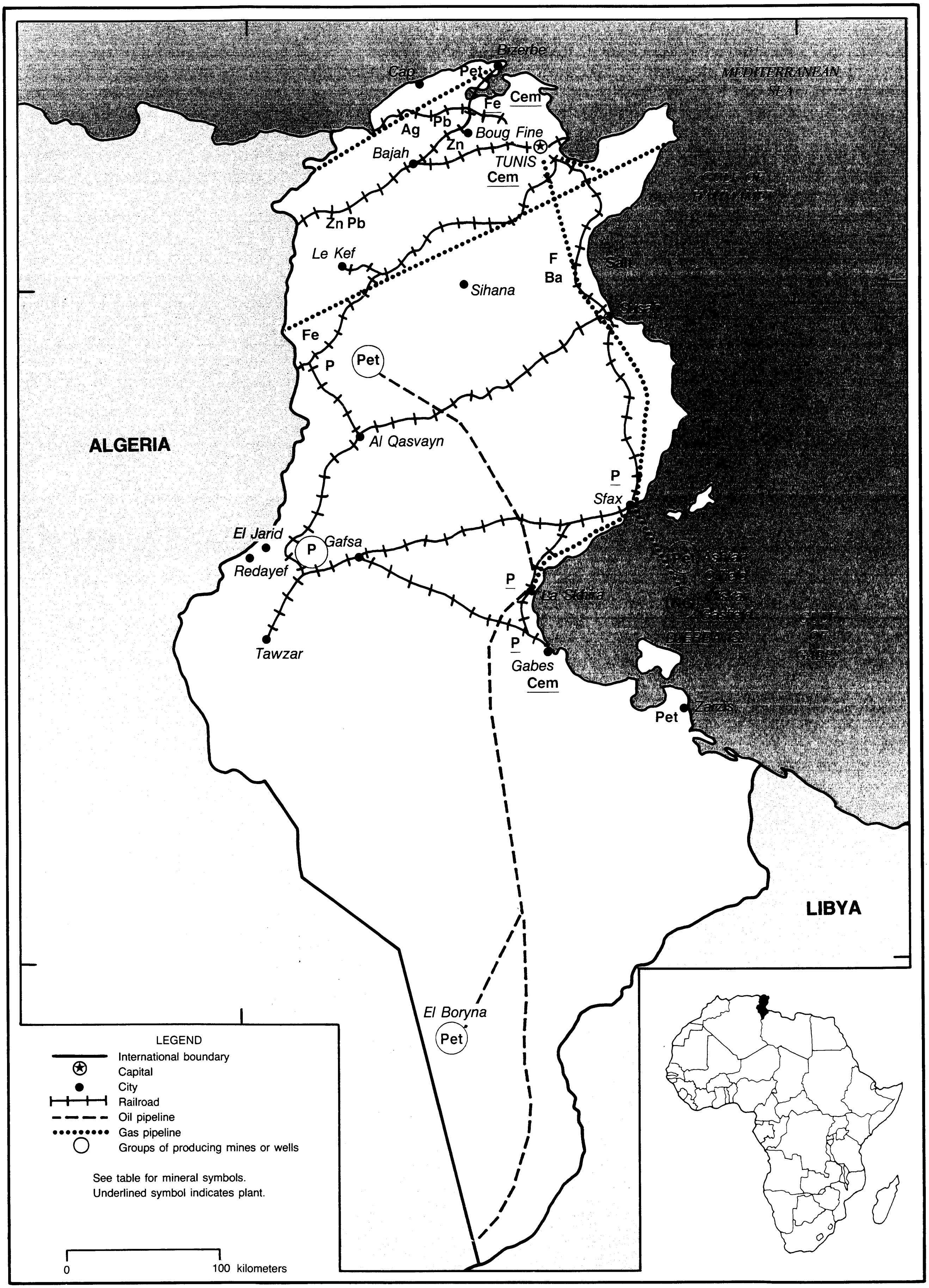
[1]Where necessary, values have been converted from Communaute Financiere Africine francs (CFAF) to U.S. dollars at the rate of CFAF319.01 = US$1.00.

OTHER SOURCES OF INFORMATION

Togo, Chambre de Commerce D'Agriculture et D'Industrie du Togo, Lome, Togo: Bulletin Mensuel, monthly.

TUNISIA

AREA 164,000 km² **POPULATION 7.9 million**



THE MINERAL INDUSTRY OF

TUNISIA

By Thomas P. Dolley

Mineral industry activity remained stable in Tunisia for 1989 and early 1990, continuing a trend from the previous year. Phosphate rock production and crude petroleum production increased by a modest amount over the 1988 figures. Decreased amounts of production for certain commodities were not significant enough to cause repercussions in the domestic mineral industry. The 1985 hydrocarbons law, amended in 1987, attracted foreign investment in the form of new oil and gas exploration permits in 1989 and 1990. Additionally, a World Bank loan was received for the rehabilitation of the Tunisian parastatal Compagnie des Phosphates de Gafsa's phosphate mining operations.

Tunisia finished the decade of the 1980's in a slightly improved economic condition than when it started. The early 1980's featured declining oil production in Tunisia, which currently remained a problem, and a drop in worldwide petroleum prices. As of 1986, tourism superseded petroleum production as the main foreign exchange earner. Additionally, world phosphate prices suffered a decline in the mid-1980's but improved at the close of the decade, although a downward trend in prices was noted for 1989. As a result, a restructuring of the Tunisian phosphate industry was taking place in 1989 and continuing in 1990.

External debt in Tunisia could rise to approximately $6.5 billion[1] in 1990 from $5.7 billion in 1989. The gross domestic product failed to maintain growth in 1989, although population growth continued unabated. Additional food importation may be likely in 1990 to counter the effects of previous drought on agricultural products. Thus, increased investment to diversify the economy was needed, thereby creating employment and allowing Tunisia to compete more efficiently in international markets.

GOVERNMENT POLICIES AND PROGRAMS

Current investment codes covering mining legislation in Tunisia were based on Law Number 72-38 of 1972, concerning industries producing exclusively for the export market, and Law Number 74-74 of 1974, concerning domestic industries.

Certain public-sector companies had been targeted by the Government for privatization. Tunisia had progressed slowly into this arena owing primarily to the size of the Government and the fear of lost employment when public-sector companies convert to private ownership. The mineral industry had not been initially affected to a great degree by this privatization. Successful privatizations within the mineral industry did include the marble quarries at Thala, which experienced a sevenfold increase in production since 1986, and a threefold increase in employment, along with a new plant acquisition. In 1990, the cement industry was targeted for privatization, in whole or part, and reportedly was worth $900 million.

PRODUCTION

Drops in production were noted for chemical-grade fluorspar, iron ore, lead concentrates, and marine salt. Output of the key industrial minerals of Tunisia, crude oil and phosphate rock, increased slightly in 1989. These increases were significant in retrospect, reversing a 2-year trend of declining production in both of these key commodities. Reversals of these trends could be attributed in part to replacement of antiquated mining equipment at phosphate operations and increased petroleum production owing to higher domestic demand.

TRADE

On April 27, 1990, Tunisia signed a Protocol of Accession to the General Agreement on Tariffs and Trade. Pending ratification by the Tunisian Legislative Assembly, the new agreement would set up free-trade zones, bind tariffs, and abolish import licenses.

Phosphate exports have been an important foreign exchange earner for Tunisia since 1895, when the Government parastatal, Compagnie des Phosphates de Gafsa (CPG) was founded. Major export markets for Tunisian phosphate remained with France, Turkey, Indonesia, and Belgium.

Countertrade remained a significant aspect of the Tunisian economy. Counterpurchases of phosphates for machinery and other manufactures were typical of countertrading with Tunisia.

STRUCTURE OF THE MINERAL INDUSTRY

Phosphate rock production in Tunisia was entirely controlled and operated by CPG. Hydrocarbon exploration and production was overseen with a series of production sharing agreements with foreign operators and the Tunisian Government-controlled Enterprise Tunisienne d'Activites Petrolieres (ETAP), usually with ETAP as a 45% to 55% equity partner. ETAP attracted more foreign investment during the year, primarily because of the perceived political stability of Tunisia and lack of a large signature bonus upon signing petroleum exploration contracts.

COMMODITY REVIEW

Metals

Metallgesellschaft AG of the Federal Republic of Germany was awarded partnership by the Tunisian parastatal Office des Mines to jointly develop a lead-zinc mine at Bougrine in northwestern Tunisia. Office des Mines announced in 1989 that Bougrine had estimated reserves of 6 million tons of ore grading 12% zinc and 3% lead. The initial investment was estimated at $40 million, with a production startup slated for 1992 at 100,000 metric tons per year (mt/yr) of concentrates.

The mining firm Bulgar-Geomin of Bulgaria conducted preliminary talks

TABLE 1

TUNISIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity [2]		1985	1986	1987	1988[p]	1989[e]
METALS						
Iron and steel:						
Iron ore and concentrate, gross weight	thousand tons	306	311	295	325	[3]280
Metal:						
Pig iron	do.	150	150	150	150	150
Steel, crude	do.	170	181	180	180	180
Lead:						
Mine output, Pb content		2,484	1,930	3,465	3,653	[3]2,702
Metal:						
Primary[4]		2,040	2,208	2,200	2,200	2,200
Secondary[e]		500	500	500	500	500
Total[e]		2,540	2,708	2,700	2,700	2,700
Silver metal, primary	kilograms	809	1,555	1,555	1,555	1,555
Zinc, mine output, Zn content		5,580	4,488	4,500	8,500	8,500
INDUSTRIAL METALS						
Barite		20,000	15,718	14,412	18,868	[3]33,104
Cement, hydraulic	thousand tons	3,070	2,984	3,400	3,228	3,228
Clays, construction[e]	do.	350	350	350	350	350
Flourspar, chemical and metallurgical-grades		42,240	36,828	43,298	55,416	[3]53,575
Gypsum[e]		90,000	100,000	100,000	100,000	100,000
Lime	thousand tons	[e]600	650	650	650	650
Phosphate rock, gross weight	do.	4,530	5,951	6,390	6,103	[3]6,610
Salt, marine	do.	382	415	425	485	[3]480
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross[e]	million cubic meters	464	436	391	368	388
Marketed	do.	232	218	195	184	[3]29.4
Petroleum:						
Crude	thousand 42-gallon barrels	42,916	39,055	37,960	37,230	[3]37,595
Refinery products:						
Gasoline	do.	[e]1,800	1,825	1,800	1,800	1,800
Kerosene	do.	[e]2,400	1,095	2,400	2,400	2,400
Distillate fuel oil	do.	[e]3,000	3,650	3,000	3,000	3,000
Other	do.	[e]400	730	400	400	400
Refinery fuel and losses	do.	[e]200	1,095	200	200	200
Residual fuel oil	do.	[e]4,000	4,380	4,000	4,000	4,000
Total	do.	[e]11,800	12,775	11,800	11,800	11,800

[e]Estimated. [p]Preliminary.
[1]Table includes data available through Aug. 9, 1990.
[2]In addition to the commodities listed, a variety of crude construction materials (common clays, sand and gravel, and stone) is produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels. Limestone quarried for cement manufacture is substantial; however, information is inadequate to make accurate estimates of output.
[3]Reported figure.
[4]From domestic and imported ores.

TABLE 2

TUNISIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988	
			United States	Other (principal)
METALS				
Aluminum: Metal including alloys:				
Scrap	1,103	1,152	—	Italy 378; West Germany 343; Netherlands 267.
Unwrought	487	502	—	Italy 484; Japan 18.
Semimanufactures	754	238	—	Algeria 144; France 59.
Copper:				
Matte and speiss including cement copper	—	1	—	All to West Germany.
Metal including alloys:				
Scrap	2,088	6,916	—	France 1,120; West Germany 1,108; Italy 970.
Semimanufactures	20	270	—	Iraq 147; France 117.
Iron and steel:				
Iron ore and concentrate, including roasted pyrite	2,933	4,429	—	France 2,079; Italy 1,200; United Kingdom 1,150.
Metal:				
Scrap	243	16,198	—	Italy 15,862.
Pig iron, cast iron, related materials	—	11	—	All to Italy.
Steel, primary forms	3,008	—		
Semimanufactures:				
Bars, rods, angles, shapes, sections	62	5,970	—	Algeria 1,920; Côte d'Ivoire 943; Burkina Faso 791.
Universals, plates, sheets	1,136	4,238	([2])	Italy 2,653; Greece 980; Libya 443.
Hoop and strip	36	—		
Rails and accessories	—	3	—	All to Libya.
Wire	2,744	319	—	Morocco 203; Mauritana 70.
Tubes, pipes, fittings	11,143	11,298	([3])	Algeria 10,829; Netherlands 217.
Castings and forgings, rough	—	16	NA	Libya 7; unspecified 9.
Lead:				
Ore and concentrate	2,000	5,000	—	Spain 3,500; Greece 1,500.
Metal including alloys:				
Scrap	1,592	407	—	Italy 367; West Germany 40.
Unwrought	60	240	—	Egypt 150; France 90.
Semimanufactures	—	171	NA	France 115; unspecified 51.
Zinc:				
Ore and concentrate	15,256	17,510	—	Italy 8,100; France 6,910; Yugoslavia 2,500.
Metal including alloys:				
Scrap	24	66	—	All to Italy.
Unwrought	—	162	—	All to Belgium-Luxembourg.
Semimanufactures	—	20	—	All to France.
Zirconium: Metal including alloys, scrap	24	—		
Other: Ores and concentrates	11,000	7,406	—	Netherlands 5,200; Italy 2,201.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones	15	—		
Barite and witherite	4,822	3,851	—	All to France.
Cement thousand tons	([4])	1,066	—	Spain 422; France 224; Algeria 144.
Clays, crude	—	9	NA	Netherlands 2; unspecified 6.

See footnotes at end of table.

TABLE 2—Continued

TUNISIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued				
Diamond, natural: Gem, not set or strung value, thousands	$8,462	$7,561	—	All to Belgium-Luxembourg.
Feldspar, fluorspar, related materials	8,536	15,000	—	Italy 14,900.
Fertilizer materials: Manufactured:				
Nitrogenous	71,750	87,927	—	France 82,512; United Kingdom 5,410.
Phosphatic	1,614,178	1,536,325	26,250	Italy 287,665; U.S.S.R. 183,363; China 119,880.
Gypsum and plaster	1,200	1,571	—	Côte d'Ivoire 1,311; Senegal 230.
Lime	4	25	—	Côte d'Ivoire 19; Burkina Faso 5.
Phosphates, crude thousand tons	1,241	1,114	—	France 188; Bulgaria 155; Greece 148.
Precious and semiprecious stones other than diamond: Natural value, thousands	—	$29	$19	Egypt $7; Senegal $3.
Salt and brine	340,702	295,682	23,799	Italy 66,330; Norway 51,230; Iceland 43,238.
Stone, sand and gravel:				
Dimension stone: Worked	65	468	—	Libya 205; Algeria 74; unspecified 167.
Gravel and crushed rock	—	354	—	All to Libya.
Quartz and quartzite	1	1	—	All to Italy.
Sand other than metal-bearing	5	11	—	Italy 4; West Germany 4.
Talc, steatite, soapstone, pyrophyllite	—	1	—	All to Libya.
Other:				
Crude value, thousands	$2	$15	NA	NA.
Slag and dross, not metal-bearing	2,000	—		
MINERAL FUELS AND RELATED MATERIALS				
Petroleum:				
Crude thousand 42-gallon barrels	26,038	22,433	—	Italy 10,424; France 7,244; Spain 1,424.
Refinery products:				
Liquefied petroleum gas do.	194	379	—	Italy 338; France 41.
Gasoline do.	808	603	—	Netherlands 232; Italy 189; France 182.
Kerosene and jet fuel do.	—	705	12	Italy 135; United Kingdom 97; unspecified 371.
Distillate fuel oil do.	—	18	NA	NA.
Lubricants do.	([3])	([3])	—	Mainly for bunkers.
Residual fuel oil do.	1,786	2,295	—	France 2,287.

NA Not available.
[1]Table prepared by Virginia A. Woodson.
[2]Unreported quantity valued at $20,000.
[3]Less than 1/2 unit.
[4]Unreported quantity valued at $24,986.

TABLE 3

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS				
Alkali and alkaline-earth metals value, thousands	$8	$5	—	France $3; Switzerland $1.
Aluminum:				
Ore and concentrate	508	26,308	([2])	Italy 19,830; France 6,027.
Oxides and hydroxides	21,285	42	4	France 37.
Metal including alloys:				
Scrap	—	150	—	Libya 144.
Unwrought	937	1,296	—	Egypt 749; Canada 299; Netherlands 197.
Semimanufactures	3,608	3,177	1	Italy 1,067; France 484; Egypt 444.
Chromium:				
Ore and concentrate	—	7	—	All from Italy.
Oxides and hydroxides	36	40	—	West Germany 25; France 8.
Cobalt: Oxides and hydroxides	([2])	1	—	All from Italy.
Copper:				
Matte and speiss including cement copper	96	164	—	Italy 120; France 40.
Metal including alloys:				
Scrap	—	130	—	Libya 127.
Unwrought	601	508	—	Italy 452; Belgium-Luxembourg 50.
Semimanufactures	7,493	8,264	([2])	France 5,013; Belgium-Luxembourg 1,580; Italy 916.
Iron and steel:				
Iron ore and concentrate including roasted pyrite	63,066	46,511	—	All from Morocco.
Metal:				
Scrap	1,753	598	60	France 206; Italy 200; Japan 120.
Pig iron, cast iron, related materials	1,501	4,684	—	France 2,638; Netherlands 1,030; Spain 1,008.
Ferroalloys:				
Ferromanganese	32	627	—	All from France.
Ferrosilicon	NA	741	5	Egypt 516; France 110.
Unspecified	840	351	—	France 143; U.S.S.R. 108; West Germany 100.
Steel, primary forms	39,388	79,215	([3])	Spain 44,074; Greece 30,061.
Semimanufactures:				
Bars, rods, angles, shapes, sections	88,380	143,672	([2])	Turkey 94,507; Spain 12,032; France 11,495.
Universals, plates, sheets	102,595	131,095	1	Italy 30,196; West Germany 24,192; France 20,488.
Hoop and strip	3,221	3,789	([2])	Italy 1,051; France 1,038; West Germany 803.
Rails and accessories	4,535	6,129	—	Republic of Korea 6,086.
Wire	2,257	3,040	1	France 1,171; West Germany 514; Italy 506.
Tubes, pipes, fittings	15,000	13,764	1,326	France 3,316; Belgium-Luxembourg 2,496; Japan 2,008.
Castings and forgings, rough	178	104	([2])	France 24; Spain 24; Belgium-Luxembourg 21.
Lead:				
Oxides	201	153	—	France 70; Spain 55; Hungary 17.
Metal including alloys:				
Scrap	3	1	—	All from Belgium-Luxembourg.
Unwrought	3,038	3,714	—	Morocco 3,413; Belgium-Luxembourg 298.
Semimanufactures	23	3	—	France 2; Netherlands 1.

See footnotes at end of table.

TABLE 3—Continued

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Magnesium: Metal including alloys:				
Unwrought	—	6	5	Belgium-Luxembourg 1.
Semimanufactures value, thousands	$5	—		
Manganese:				
Ore and concentrate: Metallurgical-grade	181	260	—	All from Gabon.
Oxides	77	129	—	Belgium-Luxembourg 43; France 31; West Germany 24.
Mercury	11	10	—	Mainly from Algeria.
Molybdenum: Metal including alloys, all forms value, thousands	$20	—		
Nickel:				
Matte and speiss do.	$10	$7	—	France $4; Italy $3.
Metal including alloys: Semimanufactures	70	76	([2])	Japan 26; France 14; Norway 16.
Platinum-group metals: Metals including alloys, unwrought and partly wrought: value, thousands	$1	$20	—	West Germany $10; France $8.
Silver: Metal including alloys, unwrought and partly wrought do.	$50	$373	—	France $215; Morocco $101.
Tin: Metal including alloys:				
Scrap	1	1	—	All from France.
Unwrought	39	30	—	Indonesia 15; France 8; Malaysia 5.
Semimanufactures	27	28	—	West Germany 13; France 10.
Titanium: Oxides	339	197	—	France 123; Yugoslavia 23.
Tungsten: Metal including alloys, all forms value, thousands	$45	—		
Uranium and thorium: Metal including alloys, all forms do.	—	$115	—	China $108; Italy $4.
Zinc:				
Oxides	223	281	—	France 166; West Germany 55; Spain 41.
Metal including alloys:				
Scrap value, thousands	—	$1	—	All from France.
Unwrought	1,168	2,348	—	Belgium-Luxembourg 1,210; Algeria 558; Italy 299.
Semimanufactures	279	—		
Other:				
Ores and concentrates	47	21	—	Italy 20.
Oxides and hydroxides	162	149	46	West Germany 85; France 15.
Base metals including alloys, all forms	35	—		
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	2,618	5,019	—	Turkey 4,320; France 219.
Artificial: Corundum	153	266	—	France 187; Italy 78.
Dust and powder of precious and semi-precious stones including diamond value, thousands	$11	$38	—	Belgium-Luxembourg $36.
Grinding and polishing wheels and stones	227	463	([2])	Italy 231; Spain 111; France 43.
Asbestos, crude	7,057	5,825	—	Canada 2,930; Greece 1,836.
Barite and witherite	20	147	—	France 100; West Germany 45.
Boron materials:				
Crude natural borates	1	4	—	France 3.

See footnotes at end of table.

TABLE 3—Continued

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued				
Boron materials—Continued				
Oxides and acids	33	45	—	Italy 40; France 4.
Cement	60,064	5,661	—	Italy 3,602; France 1,533.
Chalk	1,847	2,710	—	France 2,137; Italy 493.
Clays, crude	58,663	37,731	(2)	Spain 17,239; France 7,967; United Kingdom 6,314.
Cryolite and chiolite	—	2	—	All from Denmark.
Diamond, natural: Gem, not set or strung value, thousands	$12,024	$15,102	—	Belgium-Luxembourg $11,486; Tanzania $2,872.
Diatomite and other infusorial earth	436	—		
Feldspar, fluorspar, related materials	4,302	4,839	—	Spain 2,798; Turkey 1,155.
Fertilizer materials: Manufactured:				
Ammonia	273,651	232,126	35,521	U.S.S.R. 93,432; Saudi Arabia 83,899.
Nitrogenous	12,514	42,299	1	Bulgaria 25,263; Italy 12,101.
Phosphatic value, thousands	—	$1	—	All from United Kingdom.
Potassic	3,501	45,500	—	Jordan 23,000; U.S.S.R. 10,500; East Germany 10,000.
Unspecified and mixed	13	64	—	France 39; Italy 21.
Graphite, natural	11	19	—	France 13; United Kingdom 6.
Gypsum and plaster	478	299	—	All from France.
Lime	14	19	—	Do.
Magnesium compounds, unspecified	698	958	—	Greece 626; Netherlands 197.
Mica:				
Crude including splittings and waste	8	9	—	Norway 6; Denmark 2.
Worked including agglomerated splittings value, thousands	$7	—		
Phosphates, crude do.	$1	$1	—	All from France.
Pigments, mineral: Iron oxides and hydroxides, processed	280	258	—	West Germany 162; Spain 34; Belgium-Luxembourg 31.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$6	$14	$5	United Arab Emirates $5; Saudi Arabia $2.
Synthetic do.	$17	$59	—	Turkey $37; France $14.
Pyrite, unroasted	5	30	—	Italy 17; West Germany 13.
Salt and brine	77	73	—	West Germany 47; United Kingdom 15.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	4,722	10,747	—	Bulgaria 6,020; France 2,015.
Sulfate, manufactured	50,121	51,798	—	France 26,117; Spain 24,641.
Stone, sand and gravel:				
Dimension stone: Crude and partly worked	14,531	16,120	—	Italy 15,979.
Dolomite, chiefly refractory-grade	125	254	—	Spain 200; France 50.
Gravel and crushed rock	14,512	16,746	—	Italy 15,622; Spain 916.
Quartz and quartzite	1,336	1,018	—	Belgium-Luxembourg 895; Italy 85.
Sand other than metal-bearing	1,542	586	—	Belgium-Luxembourg 500; Italy 41.
Sulfur:				
Elemental:				
Crude including native and byproduct thousand tons	1,120	1,305	20	Canada 604; Poland 214; Saudi Arabia 144.
Colloidal, precipitated, sublimed	73	106	—	West Germany 87; Italy 9.
Sulfuric acid	4,224	6,543	—	Spain 6,175; Libya 365.

See footnotes at end of table.

TABLE 3—Continued

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988 United States	Sources, 1988 Other (principal)
INDUSTRIAL MINERALS—Continued					
Talc, steatite, soapstone, pyrophyllite		1,991	1,222	—	France 552; Belgium-Luxembourg 352; Italy 201.
Other: Crude		11	16	—	Spain 7; France 5.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		13	10	—	France 7; Italy 2.
Carbon black		1,917	2,449	—	Italy 1,870; France 281.
Coal: Anthracite and bituminous		11,951	28,505	—	France 11,026; United Kingdom 9,137; Poland 3,045.
Coke and semicoke		92,164	96,459	—	Italy 45,133; Egypt 31,744; Algeria 17,769.
Peat including briquets and litter		2	24	—	Mainly from Netherlands.
Petroleum:					
Crude	42-gallon barrels	2,974	—		
Refinery products:					
Liquefied petroleum gas	do.	2,930	12,455	—	Algeria 11,532.
Gasoline	do.	(2)	(2)	—	From Belgium-Luxembourg and France.
Mineral jelly and wax	do.	12	9	(2)	West Germany 4; France 3.
Kerosene and jet fuel	do.	1,074	1,272	—	Italy 814; Greece 408.
Distillate fuel oil	do.	3,868	3,232	—	Italy 2,284; Greece 776.
Lubricants	do.	209	58	(2)	Italy 31; France 10.
Residual fuel oil	do.	2,956	6,381	—	Spain 3,764; Italy 1,364; France 629.
Bitumen and other residues	do.	225	259	—	Mainly from Spain.
Bituminous mixtures	do.	2	3	—	France 1; Spain 1.
Petroleum coke	do.	—	(2)	—	All from United Kingdom.

[1]Table prepared by Virginia A. Woodson.
[2]Less than 1/2 unit.
[3]Unreported unit valued at $10,000.

TABLE 4

TUNISIA: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Barite, fluorite	Société Tunisienne d'Expansion Miniere (Government, 100%)	Zirba Mine	3,000 barite, 40,000 fluorspar.
Cement	Société Tunisienne d'Expansion Miniere (Government, 100%)	Bizerte, Gabes, Tunis	2.5.[2]
Iron	Société Tunisienne d'Expansion Miniere (Government, 100%)	Djebel Djerissa iron mine, El Fouladh steel mill	145,000. 180,000.
Lead, zinc	Société Tunisienne d'Expansion Miniere (Government, 100%)	Fedj Hassen Mine, Bou Jaber, Megrine smelter	4,000 Pb, Zn, concentrate. 3,000 Pb, Zn, concentrate. 30,000 Pb concentrate.
Petroleum, crude	Elf Aquitaine, Enterprise Tunisienne d'Activities Petrolieres (ETAP) (Société National Elf Aquitaine, France, 50%; ETAP, 50%)	Ashtart offshore oilfield	25,000.[3]
Do.	Agip-Tunisia, Société Italo-Tunisienne d'Exploitation Petroliere (SITEP) (Azienda Generali Italiana Petroli-Tunisia, (Agip-Tunisia), Italy, 50%; SITEP, 50%)	El Borma oilfield	71,000.[3]

[1]Metric tons per year unless otherwise specified.
[2]Million metric tons per year.
[3]Barrels per day.

with the Government in December 1989. The discussion was on a possible joint-venture project to work the lead and zinc mine at Fel el-Heddoun near Siliana. No decision was reported on timeframe or design parameters for actual development of the project.

Industrial Minerals

Cement.—Total cement capacity for 1989 in Tunisia was approximately 3.4 million tons per year. Cement production facilities were ideally located in the coastal regions of Tunisia to take advantage of the growing tourist industry and hotel construction boom.

Phosphate Rock.—Phosphate rock was utilized for either direct exportation or domestic production of phosphatic fertilizers and products for eventual export. Approximately 25% of CPG's average annual output of phosphate rock was exported with the remaining 75% purchased by domestic companies and processed into phosphate fertilizer products such as triple superphosphate (TSP). The largest of these Tunisian domestic fertilizer companies was Société Industrielle d'Acide Phosphorique et d'Engrais (SIAPE). Approximately 80% of the phosphate-based fertilizers produced were exported, and CPG hoped to eventually sell all phosphate rock produced to domestic processors.

CPG had not closed any mines in the Gafsa region since the company was founded. Company officials thought that this step should be taken in light of rising costs for phosphate mining. Underground mine production costs exceeded the world market price for phosphate, with greater labor requirements than an open pit operation. Underground operations required an estimated 500 laborers to produce 450 tons of rock, whereas an open pit operation would require only 50 laborers to produce an equivalent amount of phosphate rock. Additionally, CPG was involved in divestiture of financially unstable, unrelated industries which the company had invested in during the 1970's. These reforms were aimed at refocusing CPG back to phosphate rock mining and marketing.

Substantial loans were granted to CPG in 1989 by both the World Bank and the African Development Bank. The World Bank loan was signed in September 1989 and totaled $130 million. This loan was to be shared among several public-sector companies in Tunisia. The African Development Bank loan totaled $43.1 million. It was signed in October 1989 and was intended solely for CPG. The loans were intended to restructure CPG and to increase phosphate rock production through the upgrading of mines in Kef Eddour and Redayef, renovation of CPG's plant, and the purchasing of modern mining equipment. The major goal of CPG was to utilize the loans to raise total phosphate rock output to 7 million mt/yr.

The Tunisian phosphate industry's goal of raising output of phosphate rock led CPG to award a contract in April 1990, specifically for the construction of two washery lines at its new Kef Eddour phosphate mining operation. The contract was awarded to Neyrtec of France, and each of the new lines will have the processing capacity of 2.6 million mt/yr. A Roloflux rotary scrubber washes the crushed and screened phosphate rock to disperse clay and break up large blocks. Oversize material would then be screened and drained prior to disposal. Undersize material would be cycloned with the greater than 80-micron size fraction being further treated to remove the clay. Marketable product would be in the 50-micron to 70-micron size range, and dewatering would take place on a belt filter. The flowsheet of the plant at Kef Eddour featured continuous control of cutting size and water circulation and overflow control.

Mineral Fuels

Several exploration and drilling permits were awarded in 1989 and 1990 to foreign operators. These operators included Amoco of the United States, France's Société National Elf Aquitaine (Elf), and British Gas of the United Kingdom. BG Tunisia, a subsidiary of British Gas, was drilling test wells in the offshore Miskar gasfield with capital investment that could total $400 million. A decision on commercialization of the field would be made later in 1990. Government estimates indicated natural gas reserves at the field to be 30 billion cubic meters. Tunisia also received gas royalties in payment for transit over its territory of the Algeria-Italy gas pipeline, with Tunisia utilizing some of the natural gas to meet its energy needs.

Elf sold a 15% share in the Kairouan Nord permit to the Kuwait Foreign Petroleum Co. (Kufpec) in September 1989 following Kufpec's April 1989 discovery of the Sidi Kilani-1 well, producing at 2,930 barrels per day (bbl/d). As a result of the equity sale, Kufpec held 45% of the shares in the concession, with ETAP controlling the remaining 55%. Conquest Exploration Tunisia, a subsidiary of the United States' Conquest Exploration Co., signed a joint-venture agreement with ETAP at yearend 1989.

Additionally, Canada's Coho Resources signed an oil and gas exploration agreement in April 1990 with ETAP covering the new Zarat concession south of the offshore Ashtart oilfield. This was Coho's only current international operation, a 996-square-kilometer (km) tract in the Gulf of Gabes region. The agreement, with an equity partnership of 55% ETAP and 45% Coho, called for the drilling of two wells and the shooting of 250 kilometers of seismic geophysics over a 2-year period.

Virtually 50% of Tunisia's total annual petroleum production was utilized for domestic demand. Domestic demand was rising at an estimated 5% to 6% per year. The El-Borma Field in the Sahara Desert represented approximately 55% of total crude oil production in Tunisia. Most of the natural gas produced in Tunisia also came from the El-Borma Field. El-Borma was declining in production at a rate of 12% per year. Tunisia needed additional domestic discoveries of economic crude petroleum because it risked becoming a net energy importer by the early 1990's.

The Société Italo-Tunisienne d'Exploitation Petroliere (SITEP) announced in February 1990 plans for an agriculture industry project that would tap geothermal energy from land near the El-Borma oilfield.

The Tunisian petroleum industry received encouraging news in June 1990 when the Government announced the discovery of several small oil deposits. These new discoveries were primarily on the country's southern coast near Sfax, Zarzis, the Gulf of Gabes, and El Jerid. The Government felt that bringing these deposits to full production capacity could forestall declining production at existing fields. Additionally, the Government hoped that because of the new discoveries, production could be maintained at an estimated average rate of approximately 35 million barrels per year until 1996. In October 1989, Shell Tunirex, a Tunisian exploratory subsidiary of the Netherlands Royal Dutch/Shell, announced a small hydrocarbon find at Somaa, southeast of Tunis, in its onshore Cap Bon-Gulf of Hammamet concession. The Government reported that testing at 2,600 meters produced a 1,200-bbl/d medium-quality crude flow, with further testing planned. The exploratory drilling rig was provided under contract with Italy's Saipem. A larger rate of flow from this discovery would be required before further development was warranted. Additionally, offshore drilling by Shell was occurring in the Marin Centre Oriental concession, with other equity partners being Italy's Azienda Generali Italiana Petroli (Agip) Africa, France's Compagnie Francaise des Petroles (Total), and ETAP. Shell also planned to drill at the Metlaoui permit, first signed in 1988 as the first production-sharing agreement with ETAP.

Inauguration of a joint prospecting and exploitation venture between ETAP and the Libyan National Oil Co. took place in June 1990. Capitalized at $5 million, a newly formed joint-venture company will carry out drilling operations in a 3,000 km area offshore of both nations. The area's sovereignty had previously been disputed by both countries.

Reserves

The African Development Bank estimated Tunisian phosphate reserves at 3.5 to 4 billion tons, which was approximately 5% of the world reserve of phosphate rock. Petroleum and natural gas, Tunisia's other major mineral commodities, required further evaluation to determine reserve potential.

INFRASTRUCTURE

Railways were the primary mode of transportation of phosphate rock to chemical plants or seaports. Plans to develop a free port at Zarzis moved ahead in 1989 and 1990 and included the construction of a factory to recycle waste aluminum and an oil port capable of accommodating tankers of 25,000 dead weight tons. Construction of the oil port had been contracted by Spain's Dragados and Construcciones.

OUTLOOK

The Government hoped to attract more foreign investment in the petroleum exploration and production arena. Dwindling energy sources may leave Tunisia in a position of being a net energy importer by 1992. However, new discoveries could hopefully forestall this evaluation. Natural gas, once considered an unnecessary, flared component of oil production, was being considered as the power source of Tunisia's future.

Significant changes in Tunisia's trade position may occur with the integration of the European Community into a single market in 1992. Further economic overhaul, which included limiting state spending and Government subsidies, was expected. A near term, substantial rise in imports and public spending could tip economic scales unfavorably.

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[1] Where necessary, values have been converted from Tunisian dinars (D) to U.S. dollars at a rate of D0.949 = US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

Direction des Mines et de la Geologie
Ministere de l'Economie Nationale
195 Rue de la Kasbah
Tunis, Tunisia

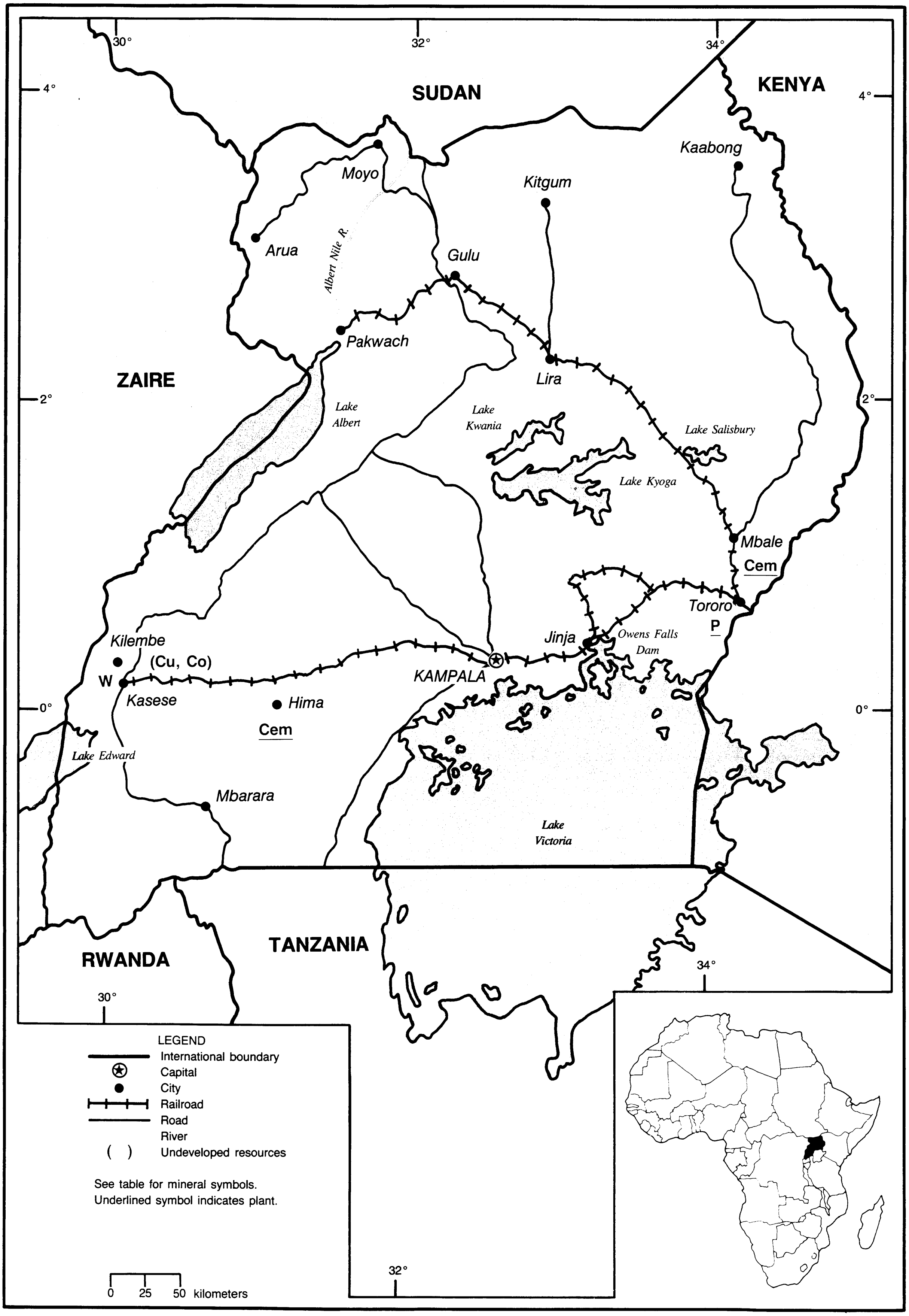
Ministere de l'Industrie, des Mines et de l'Energie
195 Rue de la Kasbah
Tunis, Tunisia

Service Geologique de Tunisie
95 Avenue Mohamed V
Tunis, Tunisia

Compagnie des Phosphate de Gafsa
GAFSA
Cité Bayache, Tunisia

UGANDA

AREA 236,040 km² **POPULATION 17.96 million**



THE MINERAL INDUSTRY OF

UGANDA

By David Izon

The mineral industry was insignificant to the country's economy. The economy continued to grow in 1989 with a gross domestic product of about $9.8 billion.[1] The leading sectors remained the same as the previous year, with agriculture, construction, and manufacturing dominating the industry. Uganda earned 97% of its foreign exchange from coffee sales, which declined in prices in 1989. The Government's implementation of the Special Import Program helped to slow down the monetary expansion within the economy, which in turn helped to reduce the inflation rate to 55% in late 1989.

The Government's major policies focused on rehabilitation of its infrastructure. Emphasis was also put on revitalization of small-scale mining. Uganda's major export products, in order of importance, were coffee, salt, sugar, tea, and tin. Its major trading partners were France, the Federal Republic of Germany, Kenya, the United Kingdom, and the United States. The country imported machinery, parts, and clothes mainly from the Federal Republic of Germany, the United Kingdom, and the United States. Petroleum products were imported from neighboring Kenya. The Government planned to set up an investment center to provide guidance for both local and foreign investors. Plans were also underway to establish the Kampala Stock Exchange.

Mineral production was minimal due to the lack of financing for the repair of old equipment and reconstruction or rehabilitation of degenerated mining facilities. An agreement signed with North Korea for the rehabilitation of the Kilembe copper-cobalt mine was not implemented, and no significant progress had been achieved in the development of the iron ore deposits in Kabale district. However, rehabilitation of the Hima cement plant was completed in 1989 owing to the Government providing substantial investment for rehabilitation.

Uganda has two cement plants, at Tororo and Hima. Production at these two plants was below expectation owing to numerous financial, technical, and management problems. The Tororo plant produced three times as much as the Hima plant but needed extensive rehabilitation to stay in operation for a considerable period. A plan to increase production at the Hima plant to about 70% of designed capacity of 200,000 tons per year was not met owing to frequent power shortages. The plant was able to operate for only 3 months in 1989 owing to these power shortages.

There were no officially reported reserve figures for minerals, but the outlook was encouraging. The country planned to undertake a comprehensive exploration program for minerals, including gold, gypsum, kaolin, limestone, marble, phosphate, and tin, at a cost of approximately $3.6 million. Funding was to be internally financed. General Motors of Kenya offered to assist the Ugandan Government to exploit minerals for export. The company was interested mainly in the mining of tin. Mineral resources of copper, iron, phosphate, tin, and salt were known to exist in southwestern Uganda.

Other projects of importance were the construction of the oil pipeline from Tanga port in northern Tanzania to Jinja in Uganda, the rehabilitation of the Kampala-Kasese railway line, and the expansion of the Owens Falls Dam to provide additional power for the country's energy needs. Also, there was an agreement signed for a joint venture between the Governments of Zaire and Uganda for the exploration and exploitation of oil reserves in Lakes Albert and Edward along the common western Rift Valley. The World Bank provided $7 million for the Kampala-Kasese rail line and has indicated continued support for the above projects in which it has already undertaken considerable investment.

TABLE 1

UGANDA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	1987	1988[p]	1989[p]
Cement, hydraulic	[e]20,000	15,000	15,908	14,244	13,755
Lime, hydrated and quick[e]	500	500	500	500	500
Phosphate minerals: Apatite[e]	100	100	100	100	100
Salt, evaporated[e]	5,000	5,000	5,000	5,000	5,000
Tin, mine output, Sn content[e]	18	18	10	10	10
Tungsten, mine output, W content[e]	4	4	4	4	4

[e]Estimated. [p]Preliminary.

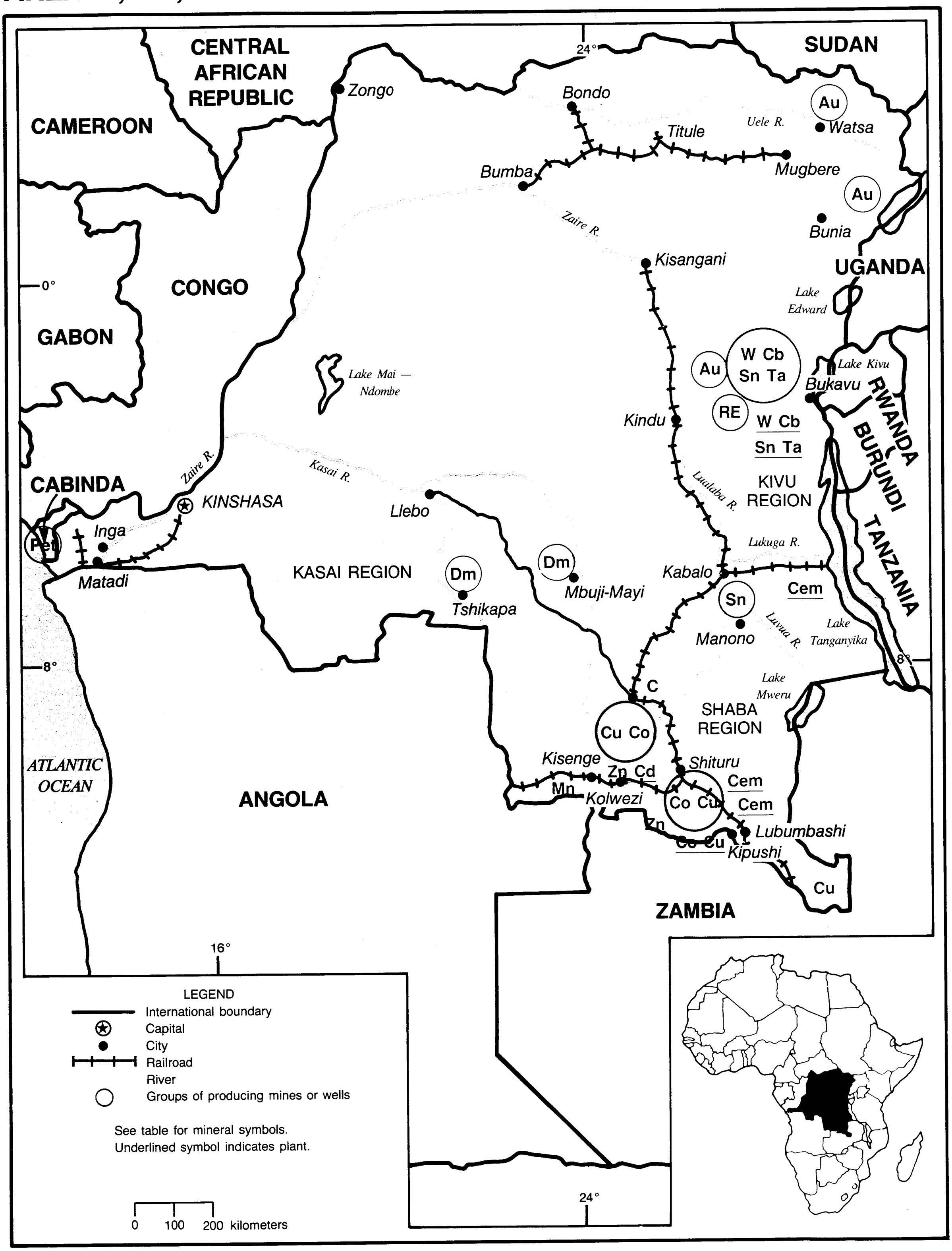
[1]Includes data available through Jan. 20, 1991.

[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

[1]Where necessary, values have been converted from Ugandan shillings to U.S. dollars at USHS370.00=US$1.00 in 1989.

ZAIRE

AREA 2,345,410 km² **POPULATION 34.3 million**



THE MINERAL INDUSTRY OF

ZAIRE

By George A. Morgan

A record value of sales was posted by the mining industry in 1989 because of high world market prices. However, the industry was unable to take full advantage of its productive capacity owing to numerous problems. Overall the mining industry declined both on a production and sales volume basis owing to the poor performance of its four main sectors, copper, diamond, petroleum, and tin. Cobalt production, a byproduct of copper, as well as other byproducts such as cadmium, gold, silver, and zinc also declined. Reasons cited for the poor output performance were exhaustion of reserves, lack of investment funds, aging equipment, and lack of mechanization and transportation. Also cited were loss of electric power, late implementation of development and renovation programs, poor management, and difficult fiscal regime of the main parastatal, Generale des Carrieres et des Mines du Zaire (Gecamines). The increased costs of production for copper, the most important mineral commodity produced, were reported to nearly exceed the sales price.

According to the Bank of Zaire, the mining industry accounted for about 25% of the gross domestic product, estimated at $5.56 billion[1] in 1988, the latest year available, and about two-thirds of total export revenues. Despite the decline in output of its major minerals, the sector was estimated to have retained its relative importance in 1989 owing to high prices received for several commodities. Gecamines alone accounted for about 60% of total export revenues, and almost 25% of Government revenues.

GOVERNMENT POLICIES AND PROGRAMS

The Government planned and implemented economic activity on the basis of 5-year plans. Delayed implementation of several aspects of the 1985-90 plan were partly the cause of lower production for Gecamines. A number of multilateral and bilateral agreements were in effect to promote various schemes, including transportation, education, equipment and plant purchases, and supplementary financing.

PRODUCTION

Although output of most minerals was down, total sales value reached a record high owing to high market prices. However, shortages of railroad cars and certain weather-related transportation problems diminished the quantity of both copper and zinc available to the market. Power outages owing to failures in the Inga-Shaba transmission line to Shaba Region, and the unavailability of backup power from Zambia owing to fire damage reduced the quality and quantity of copper and cobalt cathode produced.

Output by Gecamines declined owing to shortages of replacement parts, inefficient managerial control of mines and plants, lack of carrying capacity to move ore from mines to mills, and delayed overburden removal.

TRADE

Sales of mineral commodities were estimated at a record $1.9 billion in 1989, and consisted of the following major mineral commodities: copper, $1.245 billion; diamond, $246 million; crude petroleum, $176 million; cobalt, $159 million; zinc, $83 million; and gold $13 million. U.S. exports to Zaire were $122.3 million in 1988, the latest year available, and consisted mainly of wheat, rice, and mining and agricultural equipment. Imports by the United States from Zaire were $383.7 million, and consisted mainly of mineral commodities. Zaire's main trading partners in order of importance were Belgium, the United States, Japan, France, the Federal Republic of Germany, and the Republic of South Africa. Official trade statistics for Zaire were not available. Data included in tables 2 and 3 are partial data only, and represent trade with Zaire as reported by the European Economic Community and the United States.

STRUCTURE OF THE MINERAL INDUSTRY

The Government maintained at least part ownership, and generally majority ownership, of nearly all the productive and service sectors of the economy. Gecamines, the principal parastatal company, operated on its own fiscal regime. It had subsidiary companies that produced coal, cement, and other materials required for its primary mineral interests.

Legislation exists relating to all aspects of the mineral industry. Article 10 of the Constitution states that the soil and subsoil belonged to the state. Prospecting and exploration, research, and exploitation in the mineral sector was regulated by Ordinance No. 81-013 of April 2, 1981. All such undertakings require permits from the Ministry of Mines and Energy.

COMMODITY REVIEW

Metals

Cobalt.—Zaire remained the world's largest producer of cobalt. Production

TABLE 1

ZAIRE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988[p]	1989[e]
METALS						
Cadmium, smelter		296	364	299	281	[2]224
Cobalt:						
Concentrate, Co content		29,200	33,373	22,517	[e]25,400	25,000
Refined		10,791	14,518	11,871	10,026	[2]9,429
Columbite-tantalite concentrate:						
Gross weight	kilograms	147,000	[e]50,000	[e]50,000	30,000	42,000
Cb content[e]	do.	40,000	13,000	13,000	7,800	10,900
Ta content[e]	do.	41,200	14,000	14,000	8,400	11,800
Copper:						
Concentrate, Cu content		557,900	566,030	[r][e]525,000	[e]530,000	475,000
Blister and leach cathodes		486,800	498,100	487,400	466,779	[2]425,000
Refined		221,400	218,000	210,100	202,604	[2]181,910
Gold	kilograms	1,960	5,220	4,372	3,563	[2]2,032
Monazite concentrate, gross weight		—	7	97	168	[2]175
Silver	kilograms	[r]42,772	34,328	36,767	23,500	20,000
Tin:						
Mine output, Sn content		3,100	2,650	2,378	2,775	[2]2,346
Smelter, primary		85	56	90	120	100
Tungsten, mine output, W content		18	27	21	20	[2]16
Zinc:						
Mine output, Zn content		105,600	126,700	134,000	[e]130,000	[e]115,000
Concentrate, Zn content		77,457	81,286	74,700	[e]80,000	[e]75,000
Metal, primary, electrolytic		64,046	63,928	54,878	61,086	[2]54,041
INDUSTRIAL MINERALS						
Cement, hydraulic		444,000	444,700	491,600	[r][e]450,000	470,000
Diamond:						
Gem[e]	thousand carats	4,032	4,661	3,885	2,734	3,000
Industrial[e]	do.	16,127	18,643	15,540	15,493	17,000
Total	do.	20,159	23,304	19,425	18,227	20,000
Lime		115,365	136,400	98,500	[e]100,000	[e]100,000
Stone, crushed	thousand tons	452	432	418	[e]400	400
Sulfur:						
Byproduct of metallurgy, S content of sulfuric acid from sphalerite[e]		36,000	38,500	34,500	35,000	34,500
Sulfuric acid, gross weight[3]		169,000	146,400	140,300	140,000	140,000
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous	thousand tons	121	119	122	100	100
Petroleum:						
Crude	thousand 42-gallon barrels	12,226	11,857	11,418	10,230	[2]9,779
Refinery products:						
Gasoline	do.	18	60	336	490	500
Kerosene and jet fuel	do.	—	40	226	640	650
Distillate fuel oil	do.	—	179	520	1,015	1,100
Residual fuel oil	do.	—	124	339	450	1,100
Refinery fuel and losses	do.	19	39	72	115	120
Total	do.	37	442	1,493	2,710	3,470

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Aug. 14, 1990.
[2]Reported figure.
[3]Includes acid produced from imported sulfur.

TABLE 2

ZAIRE: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS				
Antimony:				
Ore and concentrate value, thousands	—	$1	—	All to Belgium-Luxembourg.
Metal including alloys, all forms	13	—		
Cadmium: Metal including alloys, all forms	[r]348	239	—	United Kingdom 115; West Germany 70; France 48.
Chromium: Ore and concentrate	5	—		
Cobalt:				
Ore and concentrate	—	100	100	
Oxides and hydroxides	337	15	15	
Metal including alloys, all forms	[2]9,367	7,844	1,835	Japan 3,070; West Germany 1,545.
Columbium and tantalum:				
Ore and concentrate	25	—		
Ash and residue containing columbium and tantalum	—	62	—	All to West Germany.
Metal including alloys, all forms, tantalum	—	24	24	
Copper:				
Ore and concentrate	[2]38,884	46,784	—	NA.
Matte and speiss including cement copper	—	6,007	3,005	France 3,002.
Ash and residue containing copper	—	39	—	All to France.
Metal including alloys:				
Scrap	72	312	—	Belgium-Luxembourg 192; France 50; Italy 50.
Unwrought	372,439	217,242	31,881	Belgium-Luxembourg 73,805; West Germany 59,339; Italy 17,166.
Semimanufactures	652	60	—	Netherlands 51; Belgium-Luxembourg 9.
Gold:				
Waste and sweepings value, thousands	$45	—		
Metal including alloys, unwrought and partly wrought kilograms	3,352	1,258	—	Belgium-Luxembourg 717; United Kingdom 339.
Iron and steel: Metal: Pig iron, cast iron related materials value, thousands	$1	—		
Lead: Metal including alloys:				
Unwrought	415	—		
Semimanufactures	5	—		
Lithium: Ore and concentrate	—	36	36	
Manganese: Metal including alloys, all forms	1	—		
Molybdenum: Ore and concentrate	—	3	—	All to United Kingdom.
Nickel: Metal including alloys, unwrought	70	—		
Platinum-group metals: Metals including alloys, unwrought and partly wrought, platinum kilograms	3	—		
Silver: Metal including alloys, unwrought and partly wrought do.	4,000	—		

See footnotes at end of table.

TABLE 2—Continued

ZAIRE: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued				
Tin:				
Ore and concentrate	[2]3,328	1,843	—	Netherlands 1,337; Spain 506.
Oxides	56	—		
Ash and residue containing tin	—	15	—	All to West Germany.
Metal including alloys, unwrought	36	25	—	All to Belgium-Luxembourg.
Tungsten: Ore and concentrate	10	52	—	West Germany 32; Japan 20.
Zinc:				
Ore and concentrate	—	598	—	All to Belgium-Luxembourg.
Metal including alloys:				
Scrap	—	2	—	All to Spain.
Unwrought	[2]46,115	29,946	21,086	Taiwan 1,699; Republic of Korea 1,438.
Semimanufactures	1	—		
Other:				
Ores and concentrates	[r]12	—		
Base metals including alloys, all forms	282	57	31	Japan 26.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Dust and powder of precious and semiprecious stones including diamond kilograms	418	528	—	Italy 360; Japan 167.
Clays, crude: Kaolin	10	—		
Diamond, natural:				
Gem, not set or strung thousand carats	43,425	15,441	2,969	Belgium-Luxembourg 12,472.
Industrial stones do.	3,364	398	—	Japan 146; Spain 75; France 58.
Dust and powder do.	2,664	21	—	France 8; Portugal 6; Spain 6.
Precious and semiprecious stones other than diamond:				
Natural kilograms	6,056	7,731	([3])	Taiwan 5,340; Japan 1,599.
Synthetic do.	—	103	—	Thailand 100; France 2.
Stone, sand and gravel: Dimension stone:				
Crude and partly worked	—	11	[4]11	
Worked value, thousands	$3	—		
MINERAL FUELS AND RELATED MATERIALS				
Carbon black:	1	—		
Petroleum:				
Crude thousand 42-gallon barrels	133,644	11,754	11,754	
Refinery products:				
Gasoline do.	283	—		
Residual fuel oil do.	—	144	144	

[r] Revised. [p] Preliminary. NA Not available.
[1] Table prepared by Virginia A. Woodson. Owing to a lack of available official trade data published by Zaire, this table should not be taken as a complete presentation of this country's mineral exports. These data have been compiled from trade statistics of individual trading partners unless otherwise specified.
[2] Conjoncture Economique (printed in Belgium).
[3] Unreported quantity imported by the United States valued at $1,366,000.
[4] Excludes an unreported quantity valued at $22,000.

TABLE 3

ZAIRE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS				
Alkali and alkaline-earth metals	—	10	—	All from Belgium-Luxembourg.
Aluminum:				
Oxides and hydroxides	106	—		
Metal including alloys:				
Unwrought	—	1	—	Do.
Semimanufactures	[r]856	523	—	Hong Kong 288; Belgium-Luxembourg 235.
Unspecified	—	10	—	All from Belgium-Luxembourg.
Chromium:				
Oxides and hydroxides kilograms	—	500	—	All from Hong Kong.
Metal including alloys, all forms value, thousands	—	$3	—	All from Belgium-Luxembourg.
Cobalt: Metal including alloys, all forms kilograms	—	199	—	All from Taiwan.
Copper: Metal including alloys:				
Scrap	—	1	—	All from Belgium-Luxembourg.
Unwrought	1	—		
Semimanufactures	77	79	34	Belgium-Luxembourg 23; Sweden 16.
Gold: Metal including alloys, unwrought and partly wrought kilograms	—	4	4	
Iron and steel: Metal:				
Scrap	2	—		
Pig iron, cast iron, related materials	2	2	—	All from Belgium-Luxembourg.
Ferroalloys: Unspecified	1	—		
Steel, primary forms	267	15	—	Do.
Semimanufactures:				
Bars, rods, angles, shapes, sections	[r]6,565	8,800	289	Belgium-Luxembourg 4,849; China 3,654.
Universals, plates, sheets	[r]11,598	1,303	—	China 869; Taiwan 296; Hong Kong 100.
Hoop and strip	[r]351	—		
Rails and accessories	229	4,606	—	Belgium-Luxembourg 4,605.
Wire	194	661	—	China 375; Belgium-Luxembourg 259.
Tubes, pipes, fittings	2,328	4,383	1,414	Belgium-Luxembourg 1,719; China 1,063.
Castings and forgings, rough	138	35	—	All from Hong Kong.
Lead:				
Ore and concentrate	1	—		
Oxides	25	—		
Metal including alloys:				
Scrap	12	—		
Unwrought	1	270	—	All from Belgium-Luxembourg.
Semimanufactures	—	7	—	Do.
Magnesium: Metal including alloys, scrap	70	—		
Nickel: Metal including alloys:				
Unwrought	—	6	—	All from Belgium-Luxembourg.
Semimanufactures	2	1	—	All from Switzerland.
Platinum-group metals: Metals including alloys, unwrought and partly wrought kilograms	([2])	130	—	Do.
Silver: Metal including alloys, unwrought and partly wrought value, thousands	$147	NA		
Tin: Ore and concentrate	1,332	NA		

See footnotes at end of table.

TABLE 3—Continued

ZAIRE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988[p]	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Titanium:				
Ore and concentrate	—	1	—	All from Belgium-Luxembourg.
Oxides	[r]76	8	—	Do.
Uranium and thorium: Oxides and other compounds kilograms	—	61	—	All from Taiwan.
Zinc:				
Oxides	25	—		
Metal including alloys: Semimanufactures value, thousands	—	$2	—	All from Belgium-Luxembourg.
Other: Base metals including alloys, all forms	—	392	—	All from China.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	2	2	—	All from Belgium-Luxembourg.
Artificial:				
Corundum	1	—		
Silicon carbide	11	—		
Grinding and polishing wheels and stones	46	23	([3])	Mainly from Belgium-Luxembourg.
Asbestos, crude	569	—		
Barite and witherite	5	24	—	All from Belgium-Luxembourg.
Boron materials: Crude natural borates	3	—		
Cement	1,080	—		
Chalk	138	—		
Clays, crude:				
Bentonite	[r]17	243	92	Belgium-Luxembourg 151.
Kaolin	9	27	—	Do.
Unspecified	—	44	—	Japan 40; Belgium-Luxembourg 4.
Diamond, natural:				
Gem, not set or strung value, thousands	$5	$3	—	All from Belgium-Luxembourg.
Industrial stones do.	—	$4	$4	
Diatomite and other infusorial earth	61	8	Do.	
Feldspar, fluorspar, related materials	10	—		
Fertilizer materials:				
Crude, n.e.s.	11	1	—	All from Belgium-Luxembourg.
Manufactured:				
Ammonia	72	56	—	Belgium-Luxembourg 36; Netherlands 20.
Nitrogenous	[r]14,424	3,506	—	Japan 2,739; Belgium-Luxembourg 757.
Phosphatic	[r]2,873	5	—	All from Belgium-Luxembourg.
Potassic	200	—		
Unspecified and mixed	3,037	3,226	—	Japan 3,101.
Gypsum and plaster	13,313	5,600	—	All from Spain.
Lime	1,234	1,627	—	All from Belgium-Luxembourg.
Magnesium compounds: Magnesite, crude	2	—		
Mica:				
Crude including splittings and waste	21	([3])	—	All from Belgium-Luxembourg.
Worked including agglomerated splittings value, thousands	—	$3	—	Do.
Phosphates, crude	—	10	—	Do.

See footnotes at end of table.

TABLE 3—Continued

ZAIRE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988[p]	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Pigments, mineral: Iron oxides and hydroxides, processed		4	2	—	All from Belgium-Luxembourg.
Precious and semiprecious stones other than diamond: Natural	value, thousands	$4	$2	—	All from Hong Kong.
		[4]40,048	78	—	All from Belgium-Luxembourg.
Sodium compounds, n.e.s.: Sulfate, manufactured		[4]11,954	NA		
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		51	—		
Worked		1,170	NA		
Quartz and quartzite		17	—		
Sand other than metal-bearing		25	—		
Sulfur:					
Elemental: Crude including native and byproduct		47	—		
Sulfuric acid		462	144	—	Netherlands 142.
Other:					
Crude		17	—		
Slag and dross, not metal-bearing		52	—		
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		34	—		
Carbon:					
Carbon black		6	415	415	
Gas carbon		5	—		
Coal: Briquets of anthracite and bituminous coal		125	—		
Coke and semicoke		1,002	12	—	All from China.
Peat including briquets and litter		5	—		
Petroleum:					
Crude	thousand 42-gallon barrels	—	([3])	—	All from Belgium-Luxembourg.
Refinery products:					
Liquefied petroleum gas	do.	([3])	—		
Gasoline	do.	1	—		
Mineral jelly and wax	do.	3	1	—	Do.
Kerosene and jet fuel	do.	[4]758	—		
Distillate fuel oil	do.	[4]1,700	NA		
Lubricants	do.	60	7	([3])	Mainly from Belgium-Luxembourg.
Residual fuel oil	do.	[4]67	—		
Asphalt	do.	—	1	1	
Bitumen and other residues	do.	9	1	—	All from Belgium-Luxembourg.
Bituminous mixtures	do.	([3])	2	—	Do.

[r] Revised. [p] Preliminary. NA Not available.
[1] Table prepared by Virginia A. Woodson. Owing to a lack of available official trade data published by Zaire, this table should not be taken as a complete presentation of this country's mineral imports. These data have been compiled from trade statistics of individual trading partners unless otherwise specified.
[2] Unreported quantity valued at $21,000.
[3] Less than 1/2 unit.
[4] Conjoncture Economique (printed in Belgium).

was in two forms: granules and cathode flake. Output declined in concert with copper, from which cobalt was a byproduct, owing to inadequate supply of ore to the mills. However, the decline in sales was not as severe as the decline in output because of a drawdown in stocks, and an interest by the Government in maintaining stable market prices. Gecamines salesprices reportedly were $7.20 per pound in 1989 compared with $6.40 per pound in 1988.

Copper.—Gecamines and the Societe de Developpement Industriel et Minier du Zaire (Sodimiza) were the country's two copper-producing companies. Sodimiza was managed by Gecamines, and concentrates produced by the company at the Musoshi mill from ores produced at the Musoshi and Kinsenda Mines were shipped to Zambia for processing. The availability of higher grade ore from the Kinsenda Mine for blending with Musoshi ore was negatively affected by the failure of pumping equipment, leading to a 34% decline in concentrate output to 39,682 tons of contained copper for 1989.

Gecamines experienced a difficult year for all facets of its operations except for commodity prices, over which, with the exception of cobalt, it had little control. Silting of the port of Matadi from heavy upstream rains, and inoperative cargo handling equipment at the port delayed shipments of primarily copper. An alternative route was established to handle shipments to Point Noire in the Congo, and additional copper was shipped to Dar es Salaam in Tanzania, and Port Elizabeth in the Republic of South Africa. Throughout the year Gecamines was unable to meet most of its targeted production, citing labor and equipment problems at all levels, but primarily in the open pit mines. These mines reportedly produced 35 million tons of ore, about 70% of the amount actually programmed for production. The lower level of ore available for concentrating led to lower concentrate output; oxide concentrate production in particular was about 12% lower than expected. Power shortages in May on the Inga-Shaba line to Gecamines mining and processing facilities at Kolwezi also caused short term interruption of production.

TABLE 4

ZAIRE: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Cobalt	Generale des Carrieres et des Mines du Zaire (Government 100%)	Shituru	9,000 metal as granules.
Do.	do.	Luilu	9,000 metal as flake.
Copper	Generale des Carrieres et des Mines du Zaire (Government 100%)	Lubumbashi	165,000 blister Cu.
Do.	do.	Shituru	250,000 refined Cu.
Diamond	Societe Miniere de Bakwanga (Government 80%, Societe d'Entreprise et d'Investissements S.A. 20%)	Mbuji Mayi	9.2.[2]
Do.	Artisanal miners	Tshikapa	15.[2]
Tin	Societe Miniere et Industrielle de Kivu Compagnie Financiere, Miniere. et Industrielle Ltd. 72%, Government 28%)	Kindu, Kalima	3,000 Sn in concentrate.
Zinc	Generale des Carrieres et des Mines du Zaire (Government 100%)	Kipushi	85,000 Zn in concentrate.
Do.	do.	Kolwezi	75,000 refined Zn.

[1] Metric tons per year unless otherwise specified.
[2] Million carats per year.

Gold.—Lencourt Ltd. of Canada reportedly optioned the right to develop an alluvial gold deposit at Twangiza northeast of Kindu, to Billiton International Metals Ltd. of the Netherlands, a 100% subsidiary of Shell Oil Corp. Currently held by the Société Minière et Industrielle de Kivu (Sominki), Lencourt expected to acquire the 72% of Sominki held by Compagnie Financiere, Miniere, et Industrielle Ltd. (Cofimines) of Belgium. Sominki was a producer of tin, monazite, tungsten, gold, and columbite-tantalite. Capital costs for developing the Twangiza deposit were $70 million. A feasibility study completed in 1983 indicated four separate zones, grading 6.7 grams per metric ton (g/t) in zone A, 6.3 g/t in zone B, and 4.6 g/t in zones C and D. Assured reserves were about 15,000 kilograms of recoverable gold. Probable reserves were about 8,600 kilograms.

Zinc.—Output was a byproduct of Gecamine's Kipushi Mine west of Lubumbashi. Both mine and metal output declined owing to lack of transport and emphasis on copper recovery. Although only about 80% of the planned production was reached, higher prices led to overall higher sales of $82.8 million compared with $64.3 in 1988. Both the mill at Kipushi and the zinc metallurgical plant north of Kolwezi were under review for renovation or relocation.

Industrial Minerals

Diamond.—The Société Minière de Bakwanga (MIBA) was the sole company producing diamond in Zaire. The company's 1989 performance was much improved over that of 1988 owing to higher availability of its dredge and the record-high level of 8.4 million cubic meters of material excavated. However, the ratio of gem to industrial diamond recovered continued to deteriorate, primarily owing to the presence of illegal diggers on MIBA's prime concession areas.

Artisanal workers have historically accounted for the largest portion of diamond production in Zaire. Production by artisanal workers, who are scattered through the diamond regions of

Tshikapa and Mbuji Mayi, was based on the quantity of diamond purchased from them by licensed buyers and counters. The ratio of gem to industrial diamond recovered by artisanal workers was higher than for MIBA, but their level of recovery was lower. Sales to the licensed buyers were very sensitive to exchange rates, and to changes in the taxes imposed on the artisanal worker. Thus, reported purchases in Zaire may have declined while output remained unchanged, with actual sales taking place in Brazzaville or Bujumbura.

Mineral Fuels

Petroleum, Crude.—Despite a modest increase in output by Zaire Gulf Corp., overall crude petroleum production continued to decline. Declining reserves and failure to make additional discoveries were the primary reasons for the fall in output.

Reserves

Reserves were considered sufficient for many years of production of Zaire's major minerals. Financing for transportation, mine development, and maintenance of mining operations is one of the main reasons for the reduced level of exploration. In its 1977 Annual Report, the Department of Mines and Energy reported reserves as of December 31, 1977, for a number of major operating companies, as shown in the table 5.

TABLE 5

ZAIRE: RESERVES OF MAJOR MINERAL COMMODITIES

Commodity		Thousand tons (unless otherwise specified)
Cobalt		2,944
Copper		45,714
Gold	kilograms	85,985
Manganese, manganese dioxide		[1]3,000
Tin, cassiterite		[2]654

[1] Reserves of carbonate ore were reported to be several million tons.
[2] Includes 200,000 tons in Gecamines concession, and 300,000 tons in Societe Zairetain's concession.

Sources: 1977 Annual Report of the Department of Mines and Energy; 1983 Annual Report of the Societe Miniere et Industrielle du Kivu; and 1985 Minerals Perspective, Zaire, U.S. Bureau of Mines.

INFRASTRUCTURE

Zaire is a land-locked country except for a small coastal area on the Atlantic Ocean where the port of Matadi had a capacity of about 2 million tons per year. Zaire had a combination of railroad, road, and riverboat transport to move equipment, food, and other supplies into the mining and mineral processing regions, and to move ores, concentrates, and finished mineral products, both within the country and for export. Much of this transport network was in varying degrees of disrepair, or required upgrading. Shortages of railroad cars and engines continue to limit the availability of ore at the mills, as well as limiting the quantity of finished product available for export. The major companies involved in transportation and electrification were Government owned; small, private trucking and riverboat companies provide limited local service. Mineral products were shipped on the Voie National, the only transport route entirely within Zaire, as well as other routes to Dar es Salaam in Tanzania, and to ports in the Republic of South Africa.

An increasing portion of the electricity consumed in Shaba Region, site of most of the country's mining activity, was via the 1,800-kilometer Inga-Shaba electric line. An estimated 40% of the electric energy consumed in 1989 was via the transmission line. Gecamines was dependent on imported coke and petroleum refinery products for its mine and metallurgical operations.

OUTLOOK

Zaire possesses large reserves of copper, cobalt, diamond, and tin, and should continue as a supplier of these commodities. However, the inability to meet several goals for improvement of internal transport, mining, and processing of copper and cobalt ore may lead to a continuation in decline in output of the country's most important company, Gecamines. Changes in tax structure, exchange rates, and reporting requirements have decreased the amount of diamond purchased by licensed buyers and counters, and such production may instead be sold through the alternative markets of Bujumbura and Brazzaville. High grade gold resources are known, and developments are underway to expand production.

[1] Where necessary, values have been converted from Zaires (Z) to U.S. dollars at the rate of Z274.0 = US$1.00 for 1988 and Z454.62 = US$1.00 for 1989.

OTHER SOURCES OF INFORMATION

Agencies

Department of National Economy and Industry
Kinshasa, Zaire

Publications

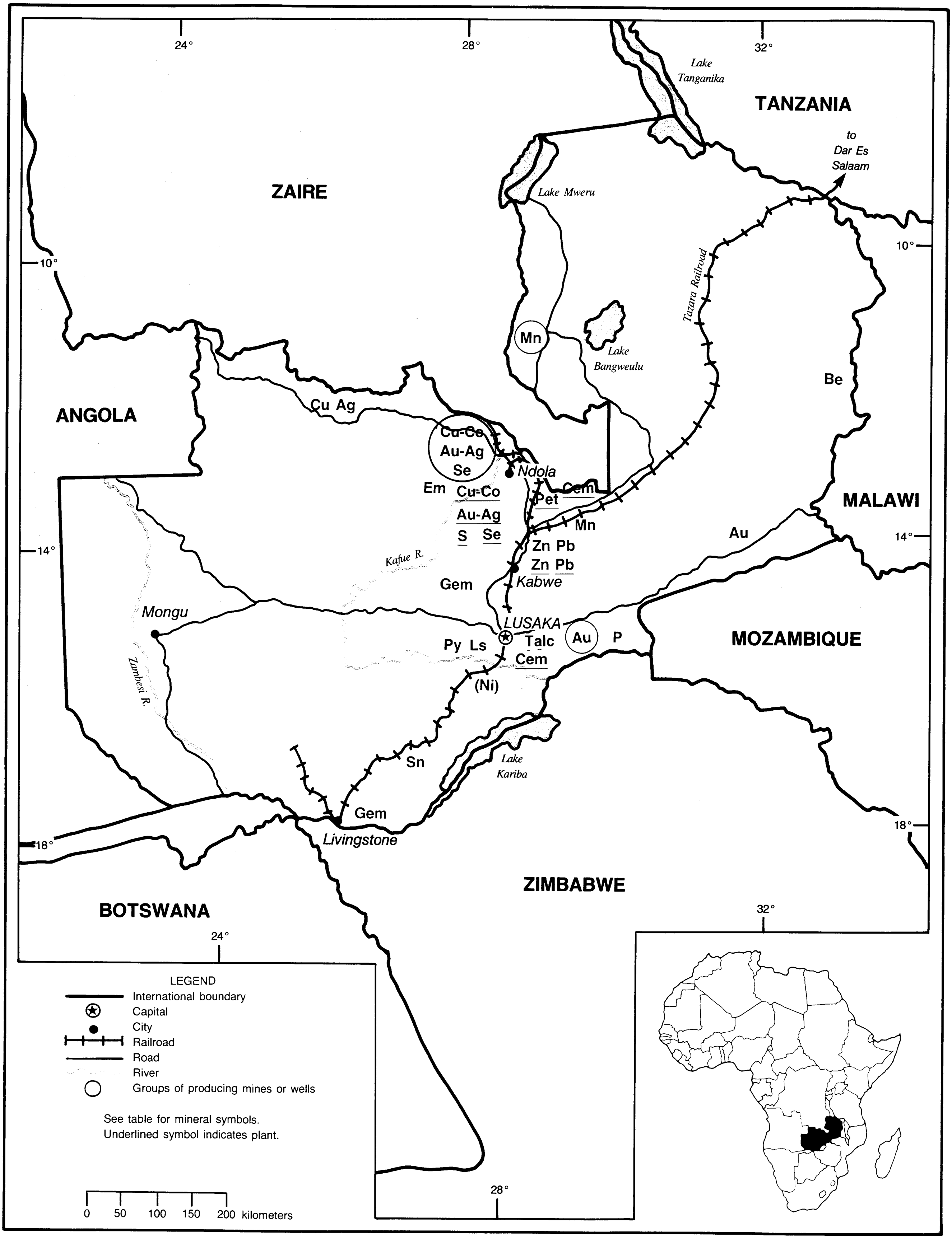
Republic du Zaire: Conjoncture Economique, Dec. 1988.,

Morgan, G. A., Connor, K., and Kornhauser, B. A. Zaire.

BuMines Mineral Perspectives, 1985, 36 pp.

ZAMBIA

AREA 753,000 km² **POPULATION 8 million**



THE MINERAL INDUSTRY OF

ZAMBIA

By Lloyd E. Antonides and George A. Morgan

The mineral industry continued to be the most significant sector in Zambia, accounting for nearly 90% of foreign exchange earnings and about 8% of the gross domestic product (GDP). Copper and cobalt were the most important metals produced, with Zambia being the world's second largest producer of cobalt.[1]

The country's balance of trade improved for the third straight year as both the quantity and value of copper exports increased. Modifications in the investment code have led to prospects for further mineral industry developments for gold, marble, and talc.

GOVERNMENT POLICIES AND PROGRAMS

The mineral export tax for small-scale miners was to be reduced from 11% to 5% to encourage production and reduce smuggling. In addition, small-scale miners were to receive 20% of their export earnings in foreign currency. These modifications were aimed mainly at small producers of gem stones. Although such producers were required by law to sell to specified buying agencies, most emeralds and other gem stones were probably exported illegally.

The Government decontrolled all prices in 1989, excluding certain food staples, and devalued the kwacha by 52% in 1 year. Parastatals, such as Zambia Consolidated Copper Mines Ltd. (ZCCM), with external debt obligations were required to make counterpart deposits with the Central Bank of Zambia to cover such arrears. The Government also instituted a two-tier exchange system to facilitate trade.

The Investment Act of 1986 provided incentives to primarily rural-based industries. Some foreign investors have been allowed nearly 100% retention of export earnings earned from export-oriented commercial agricultural enterprises. Most foreign-owned companies have been allowed to repatriate only 50% of after-tax profits. However, the investment code is being reviewed to broaden the opportunities outside of agriculture for attracting foreign investment.

PRODUCTION

Production of copper remained the single most important commodity to Zambia. Completion of certain rehabilitation plans and streamlining of ZCCM's operations should help improve the company's overall operation. However, output was limited owing to shortages of spare parts and sulfuric acid. Production of lead and zinc continued to decline owing to the lower grade of ore mined and depletion of the ore body. Mining ventures were planned in gold and marble that would further diversify the industry.

TRADE

Copper accounted for $1.24 billion of total exports of about $1.4 billion, earning an additional $333 million for the economy compared with copper exports of $907 million in 1988.

Total imports were about $1 billion. Zambia was dependent on imports of liquid fuels, having no crude oil sources of its own. U.S. exports to Zambia were $49.6 million, and consisted mainly of aircraft, mining equipment, and spare parts. U.S. imports were $24.1 million, and consisted mainly of cobalt.

STRUCTURE OF THE MINERAL INDUSTRY

The state-owned Zambia Industrial and Mining Corp. Ltd. (ZIMCO) was the Government agency through which all or part of other state parastatals were owned. ZIMCO held 60.3% of ZCCM. It controlled 67% of Tazama Pipelines, which ships imported crude petroleum, 100% of the Zambia Electricity Supply Corp., and 100% of Zambia Railways. It also had control of 40 companies that accounted for about 60% of all manufacturing in Zambia through a wholly owned subsidiary. An estimated 60% of the GDP and nearly one-third of the total wage employment was accounted for by parastatals.

COMMODITY REVIEW

Metals

Cobalt.—Ion exchange columns were added to the electrolyte circuit at the Chambishi cobalt refinery in 1988 as part of a program to improve the quality of cobalt metal produced. Nickel content of the cobalt metal produced at Chambishi was reduced to 0.06% to 0.08% with the change. A vacuum refining furnace installed at Chambishi earlier reduced the level of volatile impurities such as cadmium, lead, and zinc to under 1 part per million. The improvements made at Chambishi affected about 50% of Zambia's total cobalt output.

Copper.—The overall copper situation was positive at yearend, primarily owing to strong copper prices and the decline in value of the kwacha. ZCCM continued several programs to reach its stated production goal of 540,000 tons per year (mt/yr) of copper, but output remained far short of that target. The Nkana Division of ZCCM commenced drilling of ground water drainage holes in highly folded rock. The work was part of a long-term expansion program underway at Nkana. Techpro Mining and Metallurgy Corp. of the United Kingdom was involved in several renovation, modernization, and planning schemes at ZCCM.

ZCCM's Small Mines Development Unit had underway the reopening of the Kansanshi Mine. Cost was $419,000 to equip the mine with used equipment. Planned output was 1,200 mt/yr of copper concentrate. Reserves were 300,000

TABLE 1

ZAMBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
METALS						
Beryllium: Beryl	kilograms	482	723	1,131	1,343	[3]880
Cobalt:[4]						
Mine output:						
Ore milled:[5]						
Gross weight	thousand tons	[r]6,699	6,864	7,015	6,634	6,600
Co content		[r]10,539	8,656	11,198	10,687	10,000
Concentrate:						
Gross weight		[r]245,851	294,569	295,285	268,662	280,000
Co content		[r]6,773	[r]5,869	7,365	7,090	7,000
Metal:						
Materials treated:						
Gross weight		230,649	281,189	286,024	313,897	280,000
Co content		6,459	5,743	7,261	7,519	7,000
Refined electrolytic cathode		4,565	4,160	4,694	4,871	4,500
Copper:[4]						
Mine output:[6]						
Ore milled:						
Gross weight	thousand tons	25,372	26,010	24,419	24,040	24,000
Cu content		553,161	537,261	507,446	540,701	540,000
Concentrate:						
Gross weight		1,624,252	1,682,355	1,642,907	1,507,632	1,500,000
Cu content		429,450	423,397	403,450	394,122	400,000
Metal:						
Electrowon:						
From tailings leachate[7]		63,182	90,598	98,306	97,690	100,000
From copper concentrate leachate		18,695	22,654	18,940	20,041	20,000
From cobalt concentrate leachate		22,033	26,556	27,228	29,986	30,000
Total		103,910	139,808	144,474	147,717	150,000
Smelter output, blister/anode[8]		386,963	349,469	347,909	308,928	325,000
Refined:						
Electrorefined[9]		383,450	352,150	347,342	311,983	320,000
Shapes[10]		79,872	94,376	79,281	85,728	80,000
Subtotal		463,322	446,526	426,623	397,711	400,000
Electrowon[11]		33,193	51,068	69,638	51,848	50,000
Total		496,515	497,594	496,261	449,559	450,000
Gold[4 12]	kilograms	285	268	356	227	225
Iron ore: Magnetite ([e]65% Fe), gross weight		984	637	910	445	[3]318
Lead:[4]						
Mine output, Pb content of ore milled		[r]16,279	[r]12,201	12,510	12,118	10,000
Metal, refined, gross weight[13]		[r]7,684	[r]6,793	7,554	6,345	5,000
Manganese concentrate ([e]48% Mn), gross weight		1,870	554		502	[3]351
Selenium: Metal, refined, gross weight[4 14]	kilograms	15,405	22,150	26,819	24,083	25,000
Silver[4 12]	do.	21,745	26,397	27,843	24,093	25,000
Tin concentrate ([e]70% Sn), gross weight		22	3	24	2	[3]2
Zinc:[4]						
Mine output, Zn content of ore milled		[r]32,860	[r]26,964	30,287	25,169	25,000
Metal, refined, gross weight		[r]21,600	[r]22,112	20,899	18,343	18,000

See footnotes at end of table.

TABLE 1—Continued

ZAMBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1985	1986	1987	1988[p]	1989[e]
INDUSTRIAL MINERALS						
Cement, hydraulic		316,761	333,716	374,982	404,600	[3]385,937
Clay:						
Brick[15]		2,612	4,627	6,606	[e]5,000	[3]5,126
Building, not further specified		2,290	[r]4,095	3,096	[e]1,000	[3]45
China		642	515	315	367	[3]—
Feldspar		185	214	45	120	[3]20
Gem stones:						
Amethyst	kilograms	19,612	6,991	3,757	4,701	[3]6,275
Aquamarine	do.	3	([16])	63	56	[3]89
Emerald	do.	115	413	992	1,039	[3]334
Lime, hydraulic and quicklime	thousand tons	256	243	235	239	[3]320
Nitrogen: N content of ammonia		17,600	24,700	33,330	16,200	20,000
Sand and gravel, construction	thousand tons	61	129	150	200	[3]226
Stone:						
Limestone	do.	702	705	720	999	[3]775
Phyllite	do.	13	19	22	25	[3]22
Building, not further specified	do.	108	134	130	1,536	[3]933
Sulfur:[4]						
Pyrite concentrate:						
Gross weight		[r]67,522	[r]40,590	56,122	74,952	68,000
S content[e]		[r]28,400	[r]17,000	[r]23,600	[r]31,500	29,000
In sulfuric acid:[e 17]						
From pyrite roaster gas, S content		28,000	17,000	23,000	31,000	29,000
From smelter gas, S content		[r]74,000	[r]87,000	[r]86,000	[r]75,000	73,000
Total, S content		[r]102,000	[r]104,000	[r]109,000	[r]106,000	102,000
Talc		[e]1,900	266	258	73	[3]114
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous	thousand tons	471	557	463	524	[3]395
Petroleum, refinery products:[4]						
Liquefied petroleum gas	thousand 42-gallon barrels	75	60	77	84	[3]43
Motor gasoline	do.	873	916	972	1,149	[3]1,237
Jet fuel	do.	291	361	416	520	540
Kerosene	do.	198	239	253	318	323
Distillate fuel oil	do.	1,604	2,078	2,041	2,149	[3]2,071
Residual fuel oil	do.	670	624	615	564	[3]623
Other	do.	362	418	407	466	[3]431
Total, including refinery fuel and losses	do.	4,073	4,696	4,781	5,250	5,268

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Sept. 1, 1990.
[2]In addition to commodities listed, various crude construction materials (clays, sand and gravel, stone, et al.) presumably are produced, but information is inadequate for making reliable estimates of output.
[3]Reported figure.
[4]Data are for year beginning Apr. 1 of year stated.
[5]Ores from which both a copper concentrate and a cobalt concentrate or a cobalt concentrate only are produced.
[6]Includes ore and concentrate shown under cobalt entry above, all of which contain copper that is recovered, but separate quantitative data are not available.
[7]Apparently includes metal recovered from ores toll processed by ZCCM for another company in 1986 (501 tons) and 1987 (106 tons).
[8]Includes the following quantity of blister anodes produced on toll from Zairean concentrates, in metric tons: 1985—32,300; 1986—26,897; 1987—29,205; 1988—24,812; 1989—[e]30,000.
[9]Includes the following quantity of electrolytic cathodes (presumably refined grade) produced on toll from blister smelted from Zairean concentrates, in metric tons: 1985—33,161; 1986—26,111; 1987—28,886; 1988—28,886; 1989—[e]30,000.
[10]Reported as "finished production, shapes" (wirebar and billets), presumably refined grade produced from furnace- or fire-refined blister anodes and/or lower grade electrowon cathodes, and/or from high-grade electrowon cathodes.
[11]Reported as "finished production, leach cathodes" presumably refined grade which apparently were a portion of the total electrowon cathodes that were not further refined. Also includes electrowon cathodes produced on toll by ZCCM for another company and not further refined in 1986 (501 tons) and 1987 (106 tons).
[12]Mostly from copper and cobalt refinery mud-slimes.
[13]For practical purposes, outputs of crude (smelted) and refined metal are regarded as equal.
[14]Presumably recovered from copper and cobalt refinery mud-slimes processed at ZCCM's Ndola precious metal plant. A similar quantity may be contained in mud-slimes not processed in-country and possibly sold for treatment elsewhere, but information is inadequate for reliably estimating content.
[15]Weight of finished brick.
[16]Less than 1/2 unit.
[17]Additional acid is produced by burning imported sulfur, starting third quarter fiscal year 1988.

tons grading 3.6% copper, and were sufficient for 8 years of production at planned output levels.

Gold.—ZCCM began evaluation of the Matala deposit, 130 kilometers west of Lusaka. Resources were about 1 ton of gold. The company also was to reopen the Dunrobin Mine near Mumbwa. Reserves at Dunrobin were estimated at 58 kilograms in 69,000 tons of ore, and mining was to last about 2 years.

Iron and Steel.—An agreement signed with the U.S.S.R. provided for the study of the first phase of a steel industry for the country. Initial capacity was to be 100,000 mt/yr. Both the United Nations and the World Bank were exploring assistance to this project. Results from an aid program with India indicated that iron ore resources in the Mumbwa and Kabwe areas could support a sponge iron plant with a capacity of 30,000 mt/yr. Coal from Maamba and local limestone would be used at the plant.

Nickel.—The Munali nickel sulfide deposit 65 kilometers southwest of Lusaka remained under investigation. Apollo Mining (Pvt.) Ltd. financed the feasibility study, which was done by Mineral Resources Development Inc. The latest reserve assessment was 11.7 million tons of ore grading 1.04% nickel and 0.15% copper, with minor gold, silver, and platinum-group metals. Development of the deposit reportedly could support output of about 43,000 mt/yr of nickel.

Industrial Minerals

Fluorspar.—Agip Corp. of Italy was to mine a fluorspar deposit 80 kilometers southeast of Mazabuka. Reserves were estimated at 2 million tons, but grade was not reported.

Gem Stones.—The Government was to ban the export of rough gem stones. Emerald was to be cut and polished in Zambia by Zambian Emerald Industries Ltd., and marketing would be by Gem-Impex Ltd., a Swiss firm. The Zambia Gemstone and Precious Metals Association was formed as a new trade association.

Marble.—ZCCM and the Zambia Industrial Development Corp. signed a joint venture with Italmat Co. of Italy for a $1.7 million marble facility at Lusaka. Planned output was not reported, but was to be sufficient to provide for all of Zambia's needs.

Mineral Fuels

No viable petroleum deposits were known in Zambia. However, exploration commenced on the Zambia-Zimbabwe border with a major international oil company.

Petroleum.—The Indeni crude oil refinery was closed for 1 month beginning April 23 because of fire damage. The refinery provided for 90% of the country's consumption, and had an annual throughput of about 5 million barrels of crude oil. Kuwait was the primary source of crude oil for the refinery. Because of the shutdown, exports of refinery products to neighboring countries were briefly suspended.

Uranium.—Cogema Corp. of France and Agip Corp. ceased exploration for uranium in Zambia's North-Western Province. About $18 million had been spent during an 8-year period with no positive results.

Reserves

Officially reported reserves for most mineral commodities were not available. However, the director of ZCCM reported that copper and cobalt reserves were adequate for 15 years of production at current levels, or about 350 million tons of ore.

INFRASTRUCTURE

The mining industry in the copper belt consumed 4,350,457 megawatt hours of electricity, 99% of which was from the Zambia Electricity Supply Corp. The country was virtually self-sufficient in hydroelectric power, although minor trade occurs with Zaire and Zambia. However, in 1989 Zambia imported 6,990 megawatt hours from Zaire, primarily because of fire damage to the Kafue Gorge hydroelectric station on the Zambia River. Copper and cobalt transport was primarily by the Tazara railroad to Dar es Salaam. Equipment shortages and numerous delays indicated that the number of railroad cars required on the line should be doubled to 3,200, and locomotives tripled to 90.

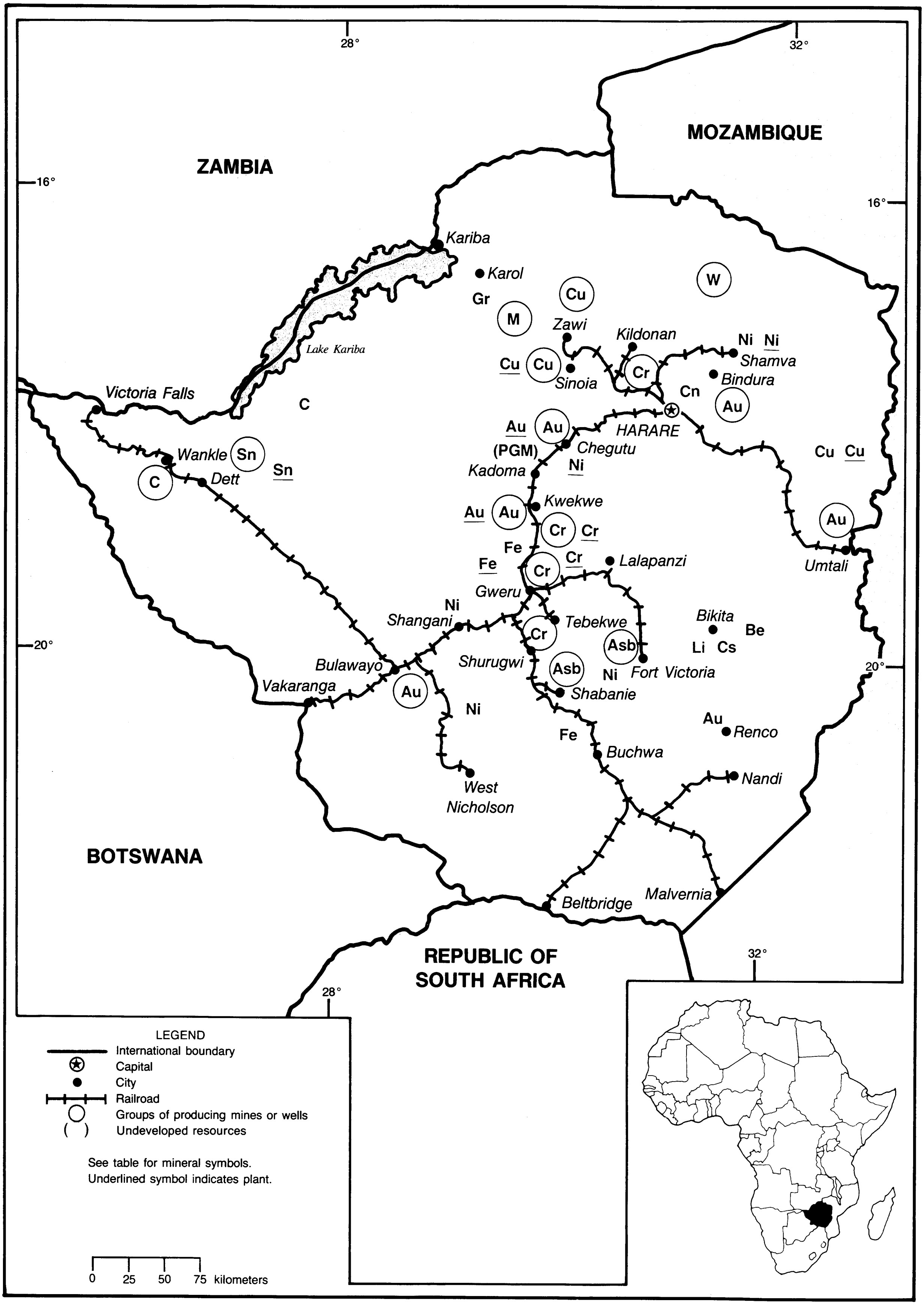
OUTLOOK

Despite the planned diversification of other sectors of the mining industry, and even the economy, Zambia will continue to depend heavily upon production and sales of copper and cobalt. Modernization of existing facilities should continue, and will require further expenditures by ZCCM and foreign aid donors. The extent of such aid will be dependent on the discovery and development of additional ore reserves in the Zambian copper belt.

[1]Where necessary, values have been converted from Zambian kwachas (K) to U.S. dollars at the rate of K8.2237=US$1.00 for 1988, and K12.9033=US$1.00 for 1989.

ZIMBABWE

AREA 390,580 km² **POPULATION 10.4 million**



THE MINERAL INDUSTRY OF

ZIMBABWE

By David Izon

Zimbabwe continued production of a wide variety of economic minerals. The country played a major role in world supply of chrysotile asbestos, ferrochrome, and lithium minerals in 1989. It was also a moderate supplier of copper, gold, nickel, and tin. The most important minerals, in order of economic value, were gold, asbestos, nickel, coal, copper, chromite, tin, and silver.

Although the mining sector contributed a small proportion to the gross domestic product (GDP) in 1989, it played a vital role in Zimbabwe's economy mainly because of its enormous foreign exchange earning capacity. The mining industry accounted for about 8% of the GDP and about 45% of the country's foreign exchange earnings. The mining industry was inhibited by a chronic shortage of foreign exchange, transport problems, and high inflation. Despite these problems the export of minerals and mineral products amounted to about 1.1 million metric tons (MMmt) in 1989. Investment incentives were announced to stimulate more imports, give industry more foreign exchange, and allow foreign investors to repatriate a higher percentage of their profits.

GOVERNMENT POLICIES AND PROGRAMS

The Government established policies and programs to ensure continued modest growth in the mining sector. An economic reform scheme was adopted that aimed at increasing exports and foreign investment. These included trade liberalization measures that were intended to alleviate some of the foreign exchange constraints on the mining industry. Efforts were made to curtail spending and subsidies to parastatals to reduce the budget deficit. Progress was made in this regard by implementing spending cuts that resulted in the reduction of the deficit from 11% in 1988 to 9% of the GDP in 1989.

Under the new investment code, companies that exported more than 75% of their production were allotted unlimited foreign exchange. Also, import restrictions on equipment for the manufacturing industry were to be lifted. The Government established an investment center to process applications and approve proposals involving investments of up to $2.2 million. Larger projects were referred to the minister of finance who made decisions after consultation with appropriate sectoral ministers. The center was also responsible for investment promotion and monitoring of project implementation.

The new mining law required that prospectors must be citizens of Zimbabwe or employ local agents. Also, mining industries were allowed to retain 5% of their export earnings for the purchase of imported raw materials and capital goods, and allocations of foreign exchange for the mining and agricultural sectors were to be made every 6 months.

Major projects planned for implementation were the development of the country's extensive chromium and platinum reserves, the rehabilitation and expansion of Zimbabwe Iron and Steel Co. (ZISCO) that would cost $100 million, and the construction of a $200 million, 900-ton-per-day fertilizer plant. Another significant project under consideration included construction of an $800 million, 1,600 megawatt hydroelectric facility at Batoka Gorge on the Zambezi river 50 kilometers (km) downstream from Victoria Falls.

The country's transportation problems were being studied by the World Bank and the Government. Plans to improve the transport system were underway with an allocation of $178 million. Most of the money was used for the National Railways of Zimbabwe (NZR) traffic development program. This involved building roads and bridges and performing immediate improvements at the international airport. Also, NZR leased some locomotives from the Republic of South Africa until the arrival of its new locomotives that were purchased with foreign aid. The Government planned to allocate $451 million to the transport sector during the next 5 years.

PRODUCTION

Overall mineral output increased by 21% in value and by 4% in volume in 1989. In terms of volume, total mining production grew by about 7% from 1980 to 1989. A 14% depreciation of the Zimbabwe dollar against the U.S. dollar over that time period contributed to the apparent large increase in value but only a moderate increase in real output. The value of mineral production increased largely because of a 43% rise in the value of nickel output of approximately $135 million. Higher world market prices were the reason for the increase. Ten minerals—asbestos, chromite, coal, copper, gold, iron ore, nickel, phosphate, silver, and tin—accounted for 96% of the value of crude mineral production in 1989. Gold had the highest value at 35% or $198 million. Most of the country's mineral industries were export orientated, and thus were exposed to world market fluctuations and possible recessions.

TRADE

Zimbabwe's trade balance has been in surplus since 1983, mainly owing to strict import controls. The trade balance for 1989 was reported at a surplus of $310 million. The main export commodities, in order of importance, were tobacco, gold, ferroalloys, cotton, nickel, asbestos, iron and steel, coffee, sugar, and copper. Most of the minerals produced were exported in beneficiated form, such as ferrochrome, pig iron, steel, and coke. Total mineral export earnings in 1989 amounted to about $752 million. This accounted for about 45% of total export earnings. All export sales of minerals and beneficiated products were conducted by the Minerals Marketing Corp.

TABLE 1

ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988^p	1989^p
METALS						
Aluminum: Bauxite, gross weight		20,877	24,284	—	—	—
Antimony, mine output, concentrate, Sb content		194	175	153	165	210
Beryllium: Beryl concentrate, gross weight		38	103	83	33	46
Chromium: Chromite, gross weight		536,490	533,105	570,298	561,477	627,424
Cobalt:[2]						
Mine output, Co content^e		^{r}92	^{r}48	^{r}88	^{r}104	90
Metal		92	76	110	126	112
Columbium and tantalum: Tantalite concentrate:						
Gross weight	kilograms	40,000	33,000	37,000	66,000	32,000
Cb content^e	do.	6,000	5,000	2,600	9,900	4,800
Ta content^e	do.	14,000	11,600	6,100	23,100	11,200
Copper:						
Mine output, concentrate, Cu content^e		21,570	21,390	19,800	16,900	16,400
Metal:						
Smelter output, blister/anode, primary^e [3]		20,670	20,500	19,000	16,300	15,800
Refinery output, refined/cathode, primary		20,389	20,423	18,819	16,116	15,659
Gold	kilograms	14,691	14,853	14,710	14,191	16,003
Iron and steel:						
Mine output, iron ore:						
Gross weight	thousand tons	1,100	1,110	1,328	1,020	1,143
Fe content^e	do.	660	670	824	632	686
Metal:						
Pig iron^e	do.	674	644	575	600	520
Steel, crude	do.	^{e}465	490	515	500	650
Ferroalloys:						
Ferrochromium		156,000	155,000	212,300	224,000	173,000
Ferrochromium-silicon		53,527	50,000	21,192	29,000	25,000
Ferromanganese		2,044	2,000	—	2,000	—
Total		211,571	207,000	233,492	255,000	198,000
Nickel:						
Mine output, concentrate, Ni content^e		11,116	10,370	12,320	13,500	13,600
Refinery output, refined metal[4]		9,381	9,730	10,394	11,490	11,633
Platinum-group metals:						
Palladium	kilograms	30	35	29	46	43
Platinum	do.	19	26	18	28	25
Total	do.	49	61	47	74	68
Silver	kilograms	24,851	26,150	25,351	21,953	22,305
Tin:						
Mine output, Sn content^e		1,670	1,470	1,410	1,140	^{e}1,130
Smelter output, metal		1,207	1,079	1,038	855	848
Tungsten, concentrate:						
Gross weight		14	2	1	1	([5])
W content^e		10	1	1	1	([5])
INDUSTRIAL MINERALS						
Asbestos		173,580	163,989	193,925	186,581	187,006

See footnotes at end of table.

TABLE 1—Continued

ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1985	1986	1987	1988^p	1989^p
INDUSTRIAL MINERALS—Continued						
Barite		400	298	191	3,400	1,900
Cement, hydraulic		^{e}700,000	^{e}750,000	810,712	775,736	719,469
Clays:						
Bentonite (montmorillonite)		68,533	71,987	116,802	113,157	104,865
Fire clay		9,747	12,591	16,022	16,171	19,100
Kaolin		1,104	901	780	95	17
Feldspar		2,300	2,026	2,962	3,730	2,697
Gem stones, precious and semiprecious: Emerald	kilograms	13	59	1,979	6,380	6,300
Graphite		10,450	15,000	13,530	11,441	18,147
Kyanite		—	1,851	—	1,795	1,869
Lithium minerals, gross weight		27,910	32,760	14,959	15,073	20,647
Magnesium compounds: Magnesite		19,385	22,649	28,991	30,121	33,423
Mica		582	1,340	800	1,797	1,471
Nitrogen: N content of ammonia		68,900	49,100	53,300	64,400	^{e}61,500
Phosphate rock, marketable concentrate	thousand tons	135	136	155	125	134
Pigments, iron oxide		^{e}1,000	207	^{e}200	363	287
Quartz[6]	thousand tons	103	145	41	55	62
Stone: Limestone	do.	1,323	1,407	1,537	1,408	1,370
Sulfur:						
Pyrite: Gross weight		57,392	62,506	46,606	39,659	47,561
S content^e		25,000	25,000	^{r}20,500	^{r}17,500	20,900
Byproduct acid, metallurgical and coal process gas^e		5,000	5,000	5,000	5,000	5,000
Total		30,000	30,000	25,500	22,500	25,900
Talc		437	797	516	976	1,513
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous	thousand tons	3,120	4,047	4,848	4,900	5,111
Coke, metallurgical^e [7]	do.	200	200	[3]592	600	600

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

[1]Table includes data available through Dec. 20, 1990.

[2]"Mine output" figures are calculated from "metal" figures. "Metal" may include metal content of compounds and/or salts, and may include cobalt recovered from nickel-copper matte imported from Botswana for toll refining.

[3]Smelter copper includes impure cathodes produced by electrowinning in nickel processing.

[4]May include nickel content of nickel oxide.

[5]Less than 1/2 unit.

[6]Includes rough and ground quartz as well as silica sand.

[7]Data represents output by the Wankie Colliery Co. Ltd. for years 1985-86 ending Aug. 31 of that stated; additional output by the Redcliff plant of ZISCO may total 250,000 metric tons per year of metallurgical coke and coke breeze.

of Zimbabwe (MMCZ) except for gold and silver, which were controlled by the reserve bank. Principal exports to the United States were coffee, clothing, ferrochrome, nickel, sugar, and textiles, amounting to about $120 million.

Major import commodities were machinery and transport equipment, chemicals, farm equipment, petroleum products, and computers. Principal imports from the United States were aircraft, computers, farm equipment, synthetic fibers, and packaging materials. Imports from the United States amounted to about $126 million.

Zimbabwe's leading trade partners were West Germany, Japan, the Republic of South Africa, Switzerland, the United Kingdom, and neighboring African countries.

STRUCTURE OF THE MINERAL INDUSTRY

Mining in Zimbabwe was carried out by about 13 major companies and their subsidiaries. They were in many cases privately owned but subsidiaries of international mining companies. The mines belonging to these companies produced

TABLE 2

ZIMBABWE: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS				
Aluminum: Metal including alloys, semimanufactures	3	—		
Antimony: Ore and concentrate	168	NA		
Beryllium: Ore and concentrate	73	NA		
Chromium:				
Ore and concentrate[2]	r26,351	49	—	Thailand 39; Mexico 10.
Oxides and hydroxides	2,471	NA		
Cobalt:				
Oxides and hydroxides	—	3	—	All to Spain.
Metal including alloys, all forms	—	36	—	Japan 31; West Germany 5.
Columbium and tantalum: Ash and residue containing columbium and tantalum	NA	284	—	All to West Germany.
Copper:				
Ash and residue containing copper	NA	946	—	Do.
Metal including alloys:				
Scrap	94	220	—	Austria 120; Belgium-Luxembourg 100.
Unwrought	r13,815	1,559	—	All to West Germany.
Gold:				
Waste and sweepings value, thousands	NA	$152	—	All to Switzerland.
Metal including alloys, unwrought and partly wrought kilograms	([3])	4,108	—	West Germany 4,061; Switzerland 47.
Iron and steel: Metal:				
Scrap	2,173	1,556	—	Republic of Korea 1,520.
Pig iron, cast iron, related materials	NA	790	—	All to Taiwan.
Ferroalloys:				
Ferrochromium	74,214	143,991	71,950	Japan 49,584; United Kingdom 9,066.
Ferromanganese	120	132	—	Austria 72; Philippines 60.
Ferromolybdenum	NA	38,562	—	All to West Germany.
Ferronickel	22	—		
Ferrosilicochromium	3,509	11,315	2,398	Japan 5,801; Spain 1,544.
Unspecified	41,867	NA		
Steel, primary forms	106,929	47,919	—	Japan 19,913; Taiwan 19,409.
Semimanufactures:				
Bars, rods, angles, shapes, sections	r7,676	1,629	—	Taiwan 1,496; Hong Kong 133.
Universals, plates, sheets	1,858	NA		
Hoop and strip	NA	39	—	All to China.
Rails and accessories	78	NA		
Wire	r667	1,493	—	West Germany 1,051; Belgium-Luxembourg 442.
Tubes, pipes, fittings	1,872	25	—	Spain 20; Austria 3.
Lead: Metal including alloys, unwrought	25	—		
Lithium: Ore and concentrate	7,672	4,660	4,660	
Nickel:				
Matte and speiss	18	1,298	—	Norway 1,297.
Metal including alloys:				

See footnotes at end of table.

TABLE 2—Continued

ZIMBABWE: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988: United States	Destinations, 1988: Other (principal)
METALS—Continued				
Nickel—Continued				
Metal including alloys—Continued				
Scrap	(4)	65	—	All to Japan.
Unwrought	9,909	12,612	3,123	Japan 5,192; West Germany 2,554.
Semimanufactures	18	—		
Platinum-group metals:				
Waste and sweepings value, thousands	$18	$30	—	All to Switzerland.
Metals including alloys, unwrought and partly wrought:				
Platinum kilograms	—	4	—	Do.
Unspecified value, thousands	$69	NA		
Silver: Ore and concentrate do.	$96	$1,280	—	All to United Kingdom.
Tin: Metal including alloys:				
Unwrought	237	413	—	Belgium-Luxembourg 281; West Germany 132.
Semimanufactures	9	—		
Titanium: Metal including alloys, semimanufactures	1	—		
Zinc: Metal including alloys, unwrought	NA	1,663	1,663	
Other:				
Ores and concentrates:				
Of base metals	—	262	—	Belgium-Luxembourg 252; Sweden 10.
Of precious metals kilograms	25	—		
Ashes and residues	r1,322	181	—	Austria 113; Belgium-Luxembourg 68.
Base metals including alloys, all forms	NA	17	—	All to Japan.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Natural, corundum, emery, pumice, etc.	NA	18	—	All to West Germany.
Asbestos, crude	97,342	94,238	1,026	Japan 47,254; Spain 12,290; Republic of Korea 8,976.
Clays, crude	697	36	—	All to Japan.
Feldspar, fluorspar, related materials	NA	30	—	All to Taiwan.
Graphite, natural	1,263	1,776	634	Taiwan 796; Spain 261.
Kyanite and related materials	662	NA		
Magnesium compounds: Oxides and hydroxides	—	36	—	All to Taiwan.
Precious and semiprecious stones other than diamond: Natural value, thousands	$1,643	$6,511	$237	Spain $5,000; Switzerland $1,217.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	40,038	49,672	(5)	Japan 47,800; Taiwan 739.
Worked	12	1,128	(6)	Japan 1,127.
Gravel and crushed rock	—	6	—	All to Taiwan.
Quartz and quartzite	258	676	—	West Germany 443; Switzerland 55.
Talc, steatite, soapstone, pyrophyllite value, thousands	$7	—		
Other: Crude	3,611	6,593	—	Japan 3,914; West Germany 2,571.

See footnotes at end of table.

TABLE 2—Continued

ZIMBABWE: APPARENT EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Destinations, 1988	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS				
Coal: Briquets of anthracite and bituminous coal	—	18	—	All to Sweden.

[r]Revised. NA Not available.
[1]Table prepared by Virginia A. Woodson. Owing to a lack of official trade data published by Zimbabwe, this table should not be taken as a complete representation of this country's mineral exports. These data have been compiled from various sources, which include United Nations information and data published by trading partner countries.
[2]Japan, Malaysia, Mexico, and Thailand report importing chromium ore and concentrate from Zimbabwe.
[3]Unreported quantity valued at $168,000.
[4]Unreported quantity valued at $159,000.
[5]Unreported quantity valued at $64,000.
[6]Unreported quantity valued at $54,000.

TABLE 3

ZIMBABWE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988	
			United States	Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	1	—		
Metal including alloys:				
Scrap	22	—		
Unwrought	1	49	—	All from West Germany.
Semimanufactures	364	784	—	Egypt 511; Hong Kong 133; West Germany 88.
Antimony: Oxides	—	7	7	
Arsenic: Oxides and acids	1	—		
Chromium: Oxides and hydroxides	—	3	—	All from West Germany.
Copper: Metal including alloys, semimanufactures	61	24	—	Sweden 22; Japan 2.
Iron and steel: Metal:				
Pig iron, cast iron, related materials	1	—		
Ferroalloys: Ferrosilicon	NA	21	—	All from West Germany.
Steel, primary forms	1	—		
Semimanufactures:				
Bars, rods, angles, shapes, sections	199	332	—	West Germany 216; Sweden 61.
Universals, plates, sheets	[r]2,215	2,697	—	Egypt 2,672.
Hoop and strip	247	243	—	All from Egypt.
Wire	167	63	—	Belgium-Luxembourg 47; China 8.
Tubes, pipes, fittings	135	321	3	Japan 265; West Germany 53.
Lead:				
Oxides	10	—		
Metal including alloys, semimanufactures	1	—		
Lithium: Oxides and hydroxides	12	—		
Magnesium: Metal including alloys, semimanufactures	16	—		
Manganese:				
Ore and concentrate: Metallurgical-grade	52	158	—	All from Netherlands.

See footnotes at end of table.

TABLE 3—Continued

ZIMBABWE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
METALS—Continued				
Manganese—Continued				
Oxides	36	—		
Nickel: Metal including alloys, semimanufactures	1	—		
Silver: Metal including alloys, unwrought and partly wrought value, thousands	$1	—		
Tin: Metal including alloys, unwrought	1	—		
Titanium:				
Oxides	2	216	—	All from Norway.
Metal including alloys, semimanufactures	—	2	2	
Uranium and thorium: Metal including alloys, all forms kilograms	—	37	—	All from Taiwan.
Vanadium: Oxides and hydroxides	1	—		
Zinc: Oxides	4	15	—	All from West Germany.
Zirconium: Metal including alloys, semimanufactures kilograms	—	34	34	
Other: Oxides and hydroxides	NA	3,400	—	All from United Kingdom.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	322	48	—	All from Hong Kong.
Grinding and polishing wheels and stones value, thousands	(2)	$3	—	All from Japan.
Asbestos, crude	734	NA		
Boron materials:				
Crude natural borates	NA	305	—	All from Netherlands.
Oxides and acids	9	1	—	All from West Germany.
Cement	110	NA		
Chalk	11	—		
Diamond, natural: Industrial stones value, thousands	$1	—		
Fertilizer materials: Manufactured:				
Nitrogenous	31	131	—	West Germany 93; Netherlands 20.
Potassic	NA	12,216	—	West Germany 12,211.
Unspecified and mixed	—	5	—	All from West Germany.
Magnesium compounds: Other	1	1	1	
Mica: Worked including agglomerated splittings	4	—		
Pigments, mineral: Iron oxides and hydroxides, processed	—	16	—	All from West Germany.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$36	$6	—	All from Switzerland.
Synthetic do.	$5	NA		
Salt and brine	323	NA		
Stone, sand and gravel: Dimension stone, crude and partly worked	472	NA		
Sulfur:				
Elemental: Colloidal, precipitated, sublimed	—	1	—	All from West Germany.
Sulfuric acid	—	2	—	Do.

See footnotes at end of table.

TABLE 3—Continued

ZIMBABWE: APPARENT IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	Sources, 1988: United States	Sources, 1988: Other (principal)
INDUSTRIAL MINERALS—Continued					
Talc, steatite, soapstone, pyrophyllite		25	54	—	All from Republic of Korea.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		159	NA		
Carbon black		13	545	—	Hong Kong 452; Netherlands 65.
Petroleum refinery products:					
Gasoline	42-gallon barrels	1,593	1,000	—	All from Netherlands.
Mineral jelly and wax	do.	181	5,480	—	West Germany 5,000; China 464.
Distillate fuel oil	do.	52	194	—	All from West Germany.
Lubricants	do.	14,749	1,300	1,027	Belgium-Luxembourg 273.
Residual fuel oil	do.	1,232	NA		
Bitumen and other residues	do.	109	NA		
Bituminous mixtures	do.	170	NA		

[r]Revised. NA Not available.
[1]Table prepared by Virginia A. Woodson. Owing to a lack of official trade data published by Zimbabwe, this table should not be taken as a complete representation of this country's mineral imports. These data have been compiled from various sources, which include United Nations information and data published by trading partner countries.
[2]Unreported value of 2 tons.

85% of the country's mineral output. The rest of the production was from approximately 500 small mines. These small mines were operated by small workers, having 10 to 200 employees. They were mostly engaged in gold mining, but a few of them produced other minerals such as tantalite, tin, tungsten, and semiprecious stones.

The state-owned Zimbabwe Mining Development Corp. (ZMDC), formed in 1982, held equity shares in coal, copper, graphite, and tin mines. ZMDC's subsidiaries were also involved in the mining of copper, gold, graphite, tin, and industrial minerals such as diatomite and kyanite aimed mainly at import substitution. ZMDC also assisted other small, private mining cooperatives that mine chromite, gold, tantalite, and tin. The Government controlled the country's only iron and steel producer, ZISCO, and intended to buy out its minority shareholders. All mineral rights were vested in the President, and the Government had a 40% share in Wankie Colliery. It also had a controlling share in mining and smelting operations acquired from Messina Transvaal Development Corp. (MANGULA) in 1984, which was renamed Manghura Copper Mines Ltd. Finally, ZMDC controlled the Kamativi tin mine.

Most of the minerals produced in Zimbabwe were processed before being exported through the Minerals Marketing Corp. of Zimbabwe. Refractory minerals containing gold were treated at the state-owned and state operated roasting plant.

The mining industry employed approximately 56,000 workers, about 5% of the national labor force. The mining industry accounted for 50% of rail tonnage and its annual electricity consumption amounted to one-third of the total electricity consumed in the country. A large share of the locally manufactured goods and industry's output, such as chemicals, explosives, coal, and liquid fuels, were consumed by the mining industry.

Oil and gas prospecting was conducted around the Zambezi valley by joint-venture agreements with foreign partners in equity sharing arrangements.

COMMODITY REVIEW

Metals

Chromite.—Chromite production was derived from two different types of deposits: the podiforms in the greenstone belts with high-grade ore and limited reserves, and the large stratiform deposits in the Great Dyke. All output was used locally in the production of ferroalloys. Zimbabwe was estimated to have more than 40% of the world's chromite reserves. Two companies, Zimbabwe Alloys Ltd. (ZIMALLOYS) and Zimbabwe Mining and Smelting Ltd. (ZIMASCO), owned several mines that produced chromite ore for the smelters. ZIMASCO owned the Kwekwe smelter that processed high-carbon ferrochromium and had ownership ties to other podiform resources. ZIMASCO had two underground mines at Shurugwi and Lalapanzi, the largest producer on the North Dyke. ZIMALLOYS owned and operated the Gweru smelter that processed low-carbon ferrochromium and also had ownership ties to the Inyala podiform resources and to other stratiform resources including some in the Great Dyke seam. The Gweru smelter had six furnaces and produced low-carbon ferrochromium and silicochromium only.

Both companies relied heavily on cooperatives that operated the the small mines in the Mutorashanga area of the North Dyke. There were 26 chromite-mining cooperatives operating in the North Dyke that supplied about 15% of ZIMASCO's ore requirements and 30%

TABLE 4

ZIMBABWE: STRUCTURE OF THE MINERAL INDUSTRY

Commodity	Major operating companies (ownership)	Location of main facilities	Capacity[1]
Asbestos	Shabanie and Mashaba Mines (Pvt.) Ltd. (Turner and Newall Ltd., 100%)	Shabanie	300,000.
Chromite	Zimbabwe Mining and Smelting Co. (Pvt.) Ltd. (Union Carbide Corp., 100%)	Kwekwe	1[2] ore.
	Zimbabwe Alloys Ltd. (Anglo American Corp., 100%)	Gweru	
Coal	Wankie Colliery Co. Ltd. (Government 100%)	Wankie	1.[2]
Cobalt	Bindura Nickel Corp. (Anglo American Corp., 100%)	Shangani, Samva	100[e] Morgan's estimate.
Copper	Mhangura Copper Mines (MCM) (Government, 54.5%; MCM, 45.5%)	Sinoia	30,000.
Gold	Cliff Minerals Zimbabwe Ltd. (Cliff Minerals PLC of the United Kingdom, 100%)	Bindura	2,500.[3]
Do.	Rio Tinto Mining (Zimbabwe) Ltd. (Rio Tinto-Zinc Corp. PLC; 56%)	Renco	1,000.[3]
Iron and steel	Zimbabwe Iron and Steel Co. (Government, 50%; British Steel Corp., 16%; Anglo American Corp., 13%; Messina of South Africa, 13%; Lancshire Steel, 8%)	Redcliff, near Gweru Buchwa	1[2] crude steel.
Nickel	Bindura Nickel Corp. (Anglo American Corp., 100%)	Bindura	12,000.
Do.	Empress Nickel Refinery Ltd. (Rio Tinto Zimbabwe Ltd., 100%)	Eiffel Flats near Chegutu	12,000.
Tin	Kamativi Tin Mines Ltd. (Government, 91%; Private, 9%)	Near Dett	1,000.

[1]Metric tons per year unless otherwise specified.
[2]Million metric tons per year.
[3]Kilograms per year.

of ZIMALLOYS' needs in 1989. The cooperatives were administered by ZMDC.

Gold.—Most of the gold mined in Zimbabwe came from the greenstone belts except for the Renco Mine that was within the Limpopo Mobile belt. The mineral occurred mainly in quartz veins but also in banded ironstones and sulphide-containing lodes, either as free gold or in association with sulfides. It was also a byproduct of copper. Production increased primarily owing to Cluff Resources' Freda-Rebecca Project in Bindura, which produced about 1,900 kilograms (kg) of gold. The increase would have been larger if the main Dalny Mine of the Falcon Mines Group had not experienced some serious mining problems. Illegal gold panning activities were common, which cost the Government almost $22.5 million per year in lost revenue. There were no reports of any major new gold mines coming on-stream, but in November, Rio Tinto commissioned its expanded dump retreatment plant. The plant's recovery process was expected to improve, increasing production from about 150 kg per year to about 650 kg per year of gold. However, Rio Tinto's production for 1989 was 189 kg lower than that of 1988, at 2,242 kg, largely as result of lower grades at the Renco Mine. Lonrho PLC, the largest producer of gold in the country, suspended its planned expansion project at How Mine near Bulawayo. The total production for 1989 was 4,500 kg, stemming from expansion projects at other mines such as Shamva, Athens, Tiger Reef, and Mazoe. The How Mine expansion was expected to increase production by about 1,500 kg per year. Other developments in the gold-mining industry were the investment of $1.35 million in a small heap-leaching operation called the Isabella in Matabeleland, 100 km north of Bulawayo, by Anglo American Corp., and the official opening of the country's $1.58 million gold refinery in February 1989.

Iron and Steel.—ZISCO had two mines at Buchwa and Ripple Creek which supplied approximately 1.14 MMmt tons of ore to the steel complex at Redcliff. Production from both mines for 1989 increased to 1,143,000 MMmt from 1,020,000 MMmt for 1988. The Buchwa Mine accounted for about 78% of the total production with a grade of 61% Fe.

ZISCO bought a used coldstrip mill from Sweden to produce flat sheet products. The mill was to be used as a downstream operation for the hot-rolling mill. ZISCO also announced plans to purchase the remaining 10% of the company's shares currently remaining in private hands. The company operated at a loss of $25 million in fiscal year 1989. The losses were attributed to the sale of products on the local market at extremely low prices, which the company claimed were the result of Government price regulations.

Nickel.—Bindura Nickel Corp. was a major producer of nickel in the country. Bindura's four mines milled a total of more than 12,000 tons of nickel in concentrates. Zimbabwe's acute rail transport problems had affected the smelting and refining operations. In particular, a reduction in power supplies was caused by fuel shortages. Bindura reported a profit of about $73 million in 1989. The Empress Nickel Refinery also reported production of a record level of nickel cathode for BCL Ltd. in Botswana, for whom it was toll refining matte.

Platinum-Group Metals.—The Great Dyke was explored by a consortium of companies for its copper, nickel, and platinum potential. The companies involved were Mohndoro Mining, a subsidiary of United Kingdom's Plateau Mining Finance; Rio Tinto Zimbabwe Ltd.; and Anglo American Corp. The joint-venture agreement signed indicated that Anglo American and Rio Tinto will have equal shares of 38%, while Mohndoro will have 24% of the shares. The total amount invested in the initial feasibility study was reported to be about $2.35 million. Delta Gold (Pty.) Ltd. of Australia continued to work toward development of a platinum operation near Chegutu on the Hartley complex of the Great Dyke. Initial studies showed that it was feasible for 2 MMmt of ore to be mined, producing about 311 kg of platinum per year. The estimated cost of the project was about $185 million.

Industrial Minerals

A $42.4 million expansion of United Portland Cement Co.'s plant was planned, which could raise annual production to 750,000 tons per year. The plant was expected to purchase a new kiln, mill, and ancillary equipment from Krupp Polysius of West Germany. Krupp was awarded a contract to supply equipment for the rawmeal grinding plant through to the clinker cooling system. Kreditanstalt fuer Wiederaufbau of West Germany was to provide foreign exchange funds in the amount of $19.5 million, and Portland's shareholders were to fund the local costs of $8.48 million. The rest of the cost was covered by a syndicated loan of $19.08 million from local banks, arranged by Standard Chartered Merchant Bank of Zimbabwe.

Reserves

Officially reported reserve figures were not available. However, various data have been reported by researchers regarding some resources. Reserves of chromite in the Great Dyke have been reported at 448 MMmt. Coal reserves were estimated at more than 30 billion tons, copper at about 13 MMmt, gold at more than 31,000 kg, lithium ore at about 6 MMmt, nickel at about 23 MMmt, and platinum at the Hartley complex at about 37 MMmt.

INFRASTRUCTURE

The NRZ, one of the largest in Africa, consisted of 2,745 km of total railroad. The system was operated by the Government along with its Motor Transport Service for transport of goods to railroad sidings. In 1989, the Government decided to make the parastatal a private corporation along the lines of ZISCO. The country had a total of 85,237 km of highways, of which 15,800 km was paved roads and 39,090 km was crushed stone, gravel, or stabilized soil. The remaining were 23,097 km of improved earth and 7,250 km of unimproved earth. The only inland waterway was Kariba Lake.

NRZ carried about 4.5 MMmt of minerals within Zimbabwe, of which about one-half was coal, mainly for power plants, ZISCO, and the two ferrochromium plants. NZR experienced a serious shortage of locomotives and rail cars in 1989, and several mining operations were unable to move all their output.

OUTLOOK

Nonfuel minerals such as asbestos, chromite, gold, and nickel will remain the mainstays of the economy for the immediate future. The recovery in mine production is expected to continue in the 1990's with increases mainly in the production of coal and gold. The transport problems should be alleviated when new locomotives being purchased arrive and more lightweight commercial vehicles are imported for transportation of goods. The new investment regulations should encourage further foreign participation and increase output. Limitations of foreign exchange availability for the import of spare parts and new equipment may continue to have a negative effect on the entire industry. The construction of a new dam to provide electricity and an efficient transport system in the second 5-year development plan are expected to address the needs of the mining, energy, and transport sectors. The country expects to import electricity from the neighboring Republic of South Africa until vital repair and improvement work is completed.

[1]Where necessary, values have been converted from Zimbabwe dollars (ZD) to U.S. dollars at ZD2.22=US$1.00 for 1989.

OTHER SOURCES OF INFORMATION

Thompson Publications Zimbabwe (Pvt) Ltd., Harare: The Zimbabwe Chamber of Commerce Directory, annual report.
Thompson Publications Zimbabwe (Pvt) Ltd., Harare: Mining in Zimbabwe, annual report.

MAP SYMBOLS

Commodity	Symbol
Alunite	Alu
Alumina	Al
Aluminum	AL
Andalusite	And
Antimony	Sb
Arsenic	As
Asbestos	Asb
Asphalt	Asp
Barite	Ba
Bauxite	Bx
Bentonite	Bent
Beryllium	Be
Bismuth	Bi
Bitumen (Natural)	Bit
Boron	B
Bromine	Br
Cadmium	Cd
Calcium	Ca
Carbon Black	CBl
Cement	Cem
Cesium	Cs
Chromite	Cr
Clays	Clay
Coal	C
Cobalt	Co
Columbium	Cb
Copper	Cu
Corundum	Cn
Cryolite	Cry
Diamond	Dm
Diatomite	Dia
Dolomite	Dol
Emerald	Em
Feldspar	Feld
Ferroalloys	FA
Ferrochrome	FeCr
Ferromanganese	FeMn
Ferronickel	FeNi
Ferrosilicon	FeSi
Fertilizer	Fert
Fluorspar	F
Gallium	Ga
Germanium	Ge
Gold	Au
Graphite	Gr
Gypsum	Gyp
Ilmenite	Il
Indium	In
Iron and Steel	Fe
Iron Ore	Fe
Kaolin	Kao
Kyanite	Ky
Lapis Lazuli	Laz
Lead	Pb
Lignite	Lig
Lime	Lime
Limestone	Ls
Liquefied Natural Gas	LNG
Liquefied Petroleum Gas	LPG
Lithium	Li
Magnesite	Mag
Magnesium	Mg
Manganese	Mn
Marble and Alabaster	Marb
Mercury	Hg
Mica	M
Molybdenum	Mo
Natural Gas	NG
Natural Gas Liquids	NGL
Nepheline Syenite	Neph
Nickel	Ni
Nitrates	Nit
Nitrogen (Ammonia Plants)	N
Oil 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
Precious and Semiprecious Stones	Gem
Pumice	Pum
Pyrite	Py
Pyrophyllite	Pyrp
Quartz or Quartzite	Qtz
Rare Earths	REE
Rhenium	Re
Rutile	Ru
Salt	Salt
Sand and Gravel	Sd/Gvl
Sandstone	Ss
Selenium	Se
Sepiolite, Meerschaum	Sep
Serpentine	Serp
Shale	Sh
Silicon	Si
Sillimanite	Slm
Silver	Ag
Soapstone	Soap
Soda Ash, Trona	NaAsh
Sodium Sulfate	$NaSO_4$
Stone	Stone
Strontium	Sr
Sulfur	S
Talc	Talc
Tantalum	Ta
Tellurium	Te
Thorium	Th
Tin	Sn
Titanium	Ti
Titanium Dioxide	TiO_2
Tungsten	W
Uranium	U
Vanadium	V
Vermiculite	Verm
Wollastonite	Wo
Wonderstone	Ws
Yttrium	Y
Zinc	Zn
Zirconium	Zr

MAP LEGEND

Symbol	= Mine, including beneficiation plants, well
Circled Symbol	= Group of producing mines or wells
Underlined Symbol	= Processing plant or oil refinery, including smelters and metal refineries
(Symbol)	= Undeveloped resource