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MINERAL INDUSTRIES OF

AFRICA

U.S.
DEPARTMENT
OF THE
INTERIOR

BUREAU
OF
MINES

1993

UNITED STATES DEPARTMENT OF THE INTERIOR • Bruce Babbitt, Secretary

BUREAU OF MINES

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 sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; 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 by encouraging stewardship and citizen participation in their care. 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 1993 and provides background information to assist in interpreting that performance. Content of the individual Yearbook volumes follows:

Volume I, Metals and Minerals, contains annual reports 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, 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 175 foreign countries and discusses the importance of minerals to the economies of these nations. The reports also incorporate location maps, industry structure tables, and an outlook section.

The annual international 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 Central Eurasia, Mineral Industries of the Middle East, and Minerals in the World Economy. Due to budget constraints, detailed mineral trade statistics by country will no longer be included in this publication. However, in the future abbreviated trade data for the major mineral trading countries will be made available by electronic or other means. For information on trade statistics call the Chief, Section of International Data at (202) 501-9700.

The U.S. Bureau of Mines continually strives to improve the value of its publications to users. Therefore, constructive comments and suggestions by readers of the Yearbook are welcomed.

Rhea L. Graham, *Director*

Acknowledgments

The Country Specialists in the Division of International Minerals, U.S. Bureau of Mines, in preparing the International Review regional books of Volume III of the Minerals Yearbook, 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 also was 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 10 Regional Resource Officers assigned to minerals and petroleum reporting and by economic and commercial officers and other officials of the Department of State located in U.S. Embassies worldwide. Their contributions are sincerely appreciated. Internal statistical support is provided by the staff of the Section of International Data, Division of Statistics and Information Services. The text and production, structure of the mineral industry, and reserve tables of this volume were prepared by the respective country authors.

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

Contents

Tables

Vitae

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THE MINERAL INDUSTRY OF

AFRICA

By Staff, Branch of Africa and Middle East

INTRODUCTION

The 53 countries that constituted Africa in 1993 accounted for a significant portion of total world output of a number of mineral commodities. For the continent as a whole, world shares of most commodities showed little change from those of 1992 although most output volumes showed a slight decline. There were no significant production increases, but there were significant decreases of cobalt and copper because of political instability in Zaire and production problems in Zambia, of chromite resulting from cutbacks in South Africa and Zimbabwe, and of phosphate rock owing to a lower output by producers in general. (*See tables 1 and 2.*)

Among the most significant mineral commodities produced in Africa, ranked by portion of world production in 1993, were diamond, cobalt, chromite, gold, phosphate rock, manganese ore, uranium and petroleum. Others of importance in world trade were andalusite, antimony, asbestos, bauxite, coal, copper, fluorspar, lithium minerals, platinum-group metals (PGM), titanium minerals (ilmenite and rutile), vanadium, vermiculite, and zircon. Several of these—chromite, cobalt, diamond, and manganese—were not produced in the United States.

Liberalization of investment and mining laws in a number of countries had a positive effect as investor interest broadened primarily in precious metals and gemstones, but also in base metals. Privatization of state enterprises continued as part in economic restructuring programs in several countries. International conferences and presentations by African Governments continued to play a part of an effort to attract foreign investment.

Environmental issues were the focus of increasing attention in Africa. In Guinea and Tanzania, environmental impact statements must now be included with requests for a mining license. Comoros and Mauritius sought substitutes for coral mining to protect reefs. The World Bank provided funding to Tunisia for abatement of pollution of the Mediterranean Sea from industry, ship ballast, and oil spills.

U.S. imports in 1993 from African nations were mainly raw materials, and 10 of the countries were considered to be major import sources for the United States. Among these were Gabon for manganese; Guinea for bauxite; Madagascar for graphite; Morocco for barite; Namibia for quartz crystal; South Africa for andalusite, antimony, asbestos, chromium, diamond, fluorspar, gemstones, manganese, PGM, 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.

Despite the underdevelopment of much of Africa, mineral raw materials play a very important part in the national economies of many of its countries. Additionally, integrated product manufacturing is occurring, such as in South Africa and Morocco. In many cases, the production of minerals is the dominant economic activity in the country, often having the largest and most sophisticated work force. In several countries, one or two mineral commodities are dominant in a weakly diversified economy. Among these are petroleum and diamonds in Angola, petroleum in the Congo and Nigeria, gold in Ghana, bauxite in Guinea, uranium in Niger, phosphate in Senegal and Togo, and copper and cobalt in Zaire and Zambia.

Mineral exports were important to foreign exchange earnings, and governments clearly saw the advantages of expanding both the variety and quantity of such exports for funding internal development. In Botswana, Gabon, Namibia, South Africa, and Zimbabwe, relatively successful diversification has grown from the central core of mineral development and its attendant infrastructure. Increased mineral activity is happening despite the time lag for development and substantial initial capital requirements for opening significant mines. The advantages of developing an economic-mineral resource base in those countries with such identified underused wealth continue to be employment, education and training, improved health facilities, export earnings, and infrastructure development.

The most significant mineral economies in Africa in terms of diversity and value of output of nonfuel minerals, in order of importance, were South Africa, Zambia, Zaire, Morocco, Zimbabwe, and Namibia. Also important in terms of value of mineral production from several high-valued minerals or those produced in large volume were Botswana (diamond), Gabon (manganese), Ghana (gold), Guinea (bauxite), Niger (uranium), and Togo (phosphate rock). South Africa ranked among the top five world producers in value of nonfuel minerals. It was a major world producer of andalusite, chromite, diamond, fluorspar, gold, manganese, PGM, pyrophyllite, titanium, uranium, vanadium, vermiculite, and zircon.

Nigeria and Libya were the largest producers of crude petroleum, followed by Algeria, Egypt, and Angola. The

western coast of Africa remained a significant exploration target for additional oil and gas resources. The main coal producers, in order of importance, were South Africa (the world's third largest exporter of coal), Zimbabwe, and Botswana.

Although Africa has been a significant source of minerals for centuries and its land area is about 3.2 times that of the United States, production for all of Africa was less than U.S. production in many mineral commodities. Major exceptions were gold and uranium and those commodities not produced in the United States. Among the factors contributing to this discrepancy are the large areas of Africa that are under thick vegetative or sand and alluvial cover, which impede exploration. Other large areas are in political turmoil or subject to legislation detrimental to risk investment, which have set back the pace of mineral industry development and even exploration. Mining in Africa in many cases involves labor-intensive methods and ore bodies of low grade or small size that would not normally be economic in more developed regions. Documentation and interpretation of mineral reserves in such cases may be misleading for normal economic planning. Nonetheless, in the absence of other viable economic activity, and with very low labor costs and capital inputs, these minerals should continue to be marketable. Minerals that are likely to be produced in small quantities in such situations include cassiterite (tin), columbite and tantalite, natron, and salt. Precious metals, such as gold and platinum, and precious and semiprecious stones, such as diamond, also are more likely to be produced, particularly if found in alluvial or eluvial deposits.

The population of Africa is about 700 million, compared with about 260 million for the United States. However, Africa's labor force for the most part consists 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.

Additionally, the generally low level of economic activity in Africa results in a shortage of domestic investment capital for development. By comparison, the combined gross domestic product (GDP) of all countries of Africa is about $440 billion versus the $5,900 billion GDP for the United States. South Africa had the highest GDP at $112 billion, followed by Algeria at $42 billion and Nigeria at $35 billion.

All tons are metric in this report unless otherwise specified.

SELECTED GENERAL SOURCES OF REGIONAL INFORMATION

African Concord Ltd., London: Africa Economic Digest, weekly.
British Sulphur Corp. Ltd., London: Nitrogen, bimonthly. Phosphorus and Potassium, bimonthly. Sulphur, bimonthly.
Bureau de Recherches Geologiques et Minières, Paris: Chronique de la Recherche Minière, quarterly.
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.
Maclean Hunter Publishing Co., Chicago, Illinois: Engineering and Mining Journal, monthly.
Metal Bulletin Journals Ltd., London: Metal Bulletin, semi-weekly.
Mining, Financial Mail Survey, Johannesburg.
Mining Journal Ltd., London: Mining Magazine, monthly. Mining Journal, weekly. Mining Annual Review, July.
PennWell Publishing Co., Tulsa, Oklahoma: International Petroleum Encyclopedia. Oil and Gas Journal, monthly.
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: UN trade statistics.
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, Energy Information Administration. International Energy Annual, DOE/EIA-0219. Annual Energy Review, DOE/EIA-0384. Uranium Industry Annual, DOE/EIA-0478.
U.S. Department of the Interior, U.S. Bureau of Mines: Mineral Commodity Summaries. Minerals Yearbook, V. I, Metals and Minerals; V. III, Area Reports: International. Bulletin 675, Mineral Facts and Problems. Information Circular 8610, Summary of Mining and Petroleum Laws of the World (in five parts), part 4, Africa. Mineral Perspectives, International Strategic Minerals Inventory Summary Report: A Regional Assessment of Selected Mineral Commodities in Subequatorial 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 MINERAL COMMODITIES[1] FOR 1993

(Thousand metric tons unless otherwise specified)

	Aluminum	Cement	Chromite	Cobalt, mine, Co content (tons)	Copper, mine, Cu content	Diamond (thousand carats)	Gold (kilograms)	Iron ore	Lead, mine, Pb content	Manganese ore	Petroleum, crude (thousand barrels)	Phosphate rock	Steel, crude	Uranium concentrate, U_3O_8 content (tons)	Zinc, mine, Zn content
Algeria	—	6,400	—	—	—	—	—	2,311	2	—	432,400	718	1,400	—	7
Angola	—	e250	—	—	—	e500	—	—	—	—	210,000	—	9	—	—
Benin	—	e380	—	—	—	—	—	—	—	—	e1,000	—	8	—	—
Botswana	—	—	—	205	e24	14,730	192	—	—	4	—	—	—	—	—
Burkina Faso	—	—	—	—	—	—	e5,500	—	—	e17	—	—	—	—	—
Burundi	—	—	—	—	—	—	e20	—	—	—	—	—	—	—	—
Cameroon	86	e620	—	—	—	—	e10	—	—	—	42,705	—	—	—	—
Central African Republic	—	—	—	—	—	495	e150	—	—	—	—	—	—	—	—
Congo	—	e114	—	—	—	—	e5	—	—	—	61,000	—	—	—	—
Cote d'Ivoire	—	e500	—	—	—	e15	e1,500	—	—	—	—	—	—	—	—
Egypt	180	16,000	1	—	—	—	—	2,190	—	—	322,660	1,585	e2,500	—	—
Ethiopia	—	e350	—	—	—	—	e3,387	—	—	—	—	—	—	—	—
Gabon	—	132	—	—	—	(2)	120	—	—	1,400	113,834	—	—	600	—
Ghana	175	1,203	—	—	—	e710	39,235	—	—	295	—	—	—	—	—
Guinea	—	—	—	—	—	95	2,100	—	—	—	—	—	—	—	—
Kenya	—	e1,500	—	—	—	—	20	—	—	—	—	—		—	—
Liberia	—	8	—	—	—	e150	e700	—	—	—	—	—	—	—	—
Libya	—	e2,300	—	—	—	—	—	—	—	—	502,605	—	—	—	—
Madagascar	—	60	69	—	—	—	200	—	—	—	—	—	—	—	—
Malawi	—	e118	—	—	—	—	—	—	—	—	—	—	—	—	—
Mali	—	e20	—	—	—	—	e5,500	—	—	—	—	—	—	—	—
Mauritania	—	90	—	—	—	—	875	9,300	—	—	—	—	—	—	—
Morocco	—	6,300	e1	397	e14	—	—	82	76	43	—	18,305	e7	—	22
Mozambique	—	e20	—	—	—	—	149	—	—	—	—	—	—	—	—
Namibia	—	—	—	—	33	1,141	1,954	—	11	—	—	—	—	1,966	28
Niger	—	e29	—	—	—	—	—	—	—	—	—	—	—	e2,900	—
Nigeria	—	e3,500	—	—	—	—	—	400	(2)	—	748,260	—	140	—	—
Rwanda	—	e60	—	—	—	—	e1,000	—	—	—	—	—	—	—	—
Senegal	—	590	—	—	—	—	—	—	—	—	—	e1,600	—	—	—
Sierra Leone	—	—	—	—	—	158	157	—	—	—	—	—	—	—	—
Somalia	—	e25	—	—	—	—	—	—	—	—	—	—	—	—	—
South Africa	175	7,356	2,827	300	166	10,324	619,201	29,385	100	2,507	—	2,496	8,726	2,008	77
Sudan	—	e250	e10	—	—	—	e1,600	—	—	—	e360	—	—	—	—
Swaziland	—	—	—	—	—	62	—	—	—	—	—	—	—	—	—
Tanzania	—	540	—	—	—	68	e6,000	—	—	—	—	22	—	—	—
Togo	—	e350	—	—	—	—	—	—	—	—	—	e1,750	—	—	—
Tunisia	—	e3,300	—	—	—	—	—	299	e1	—	35,770	5,500	e190	—	e3
Uganda	—	e5	—	—	—	—	—	—	—	—	—	e100	—	—	—
Zaire	—	150	—	2,459	56	15,626	6,000	—	—	—	8,308	—	—	—	7
Zambia	—	e350	—	e5,300	e360	—	e250	—	e5	(2)	—	—	—	—	e14
Zimbabwe	—	e1,000	252	90	e9		18,916	375	—	—	—	153	221	—	—
Total Africa	616	53,870	3,160	8,751	662	44,074	714,741	44,342	195	4,249	2,478,902	32,229	14,021	7,474	158
Percent of world total[e]	3	4	32	39	7	[3]41	31	5	7	20	11	24	2	18	2
United States	3,695	75,117	—	—	1,801	—	331,013	55,661	362	—	2,499,155	35,494	88,793	1,389	512

[e]Estimated

[1]Data may be different from that appearing in individual country production tables owing to availability of more current data.

[2]Less than 1/2 unit.

[3]Excluding synthetic diamond.

TABLE 2

AFRICA: PRODUCTION OF SELECTED MINERAL COMMODITIES[1] FOR 1992[r]

(Thousand metric tons unless otherwise specified)

	Aluminum	Cement	Chromite	Cobalt, mine, Co content (tons)	Copper, mine, Cu content	Diamond (thousand carats)	Gold (kilograms)	Iron ore	Lead, mine, Pb content	Manganese ore	Petroleum, crude (thousand barrels)	Phosphate rock	Steel, crude	Uranium concentrate, U_3O_8 content (tons)	Zinc, mine, Zn content
Algeria	—	6,400	—	—	—	—		2,560	1	—	427,050	1,136	1,400	—	8
Angola	—	e300	—	—	—	1,180	—	—	—	—	200,000	—	10	—	—
Benin	—	370	—	—	—	—	—	—	—	—	—	—	8	—	—
Botswana	—	—	—	208	24	15,946	165	—	—	1	—	—	—	—	—
Burkina Faso	—	—	—	—	—	—	5,400	—	—	—	—	—	—	—	—
Burundi	—	—	—	—	—	—	e32	—	—	—	—	—	—	—	—
Cameroon	82	620	—	—	—	—	10	—	—	—	50,370	—	—	—	—
Central African Republic	—	—	—	—	—	414	155	—	—	—	—	—	—	—	—
Congo	—	115	—	—	—	—	5	—	—	—	58,035	—	—	—	—
Cote d'Ivoire	—	510	—	—	—	15	1,500	—	—	—	—	—	—	—	—
Egypt	178	17,000	(2)	—	—	—	—	2,400	—	—	317,805	2,000	2,500	—	—
Ethiopia	—	e320	—	—	—	—	2,224	—	—	—	—	—	—	—	—
Gabon	—	116	—	—	—	(2)	70	—	—	1,455	115,000	—	—	700	—
Ghana	180	1,024	—	—	—	e710	31,032	—	—	276	—	—	—	—	—
Guinea	—	—	—	—	—	95	2,113	—	—	—	—	—	—	—	—
Kenya	—	1,508	—	—	—	—	20	—	—	—	—	—	—	—	—
Liberia	—	8	—	—	—	155	e700	1,742	—	—	—	—	—	—	—
Libya	—	2,300	—	—	—	—	—	—	—	—	541,295	—	822	—	—
Madagascar	—	60	69	—	—	—	200	—	—	—	—	—	—	—	—
Malawi	—	112	—	—	—	—	—	—	—	—	—	—	—	—	—
Mali	—	e20	—	—	—	—	e5,700	—	—	—	—	—	—	—	—
Mauritania	—	90	—	—	—	—	—	8,202	—	—	—	—	—	—	—
Morocco	—	6,340	(2)	461	14	—	—	83	77	44	—	19,145	7	—	--
Mozambique	—	e30	—	—	—	—	296	—	—	—	—	—	—	—	—
Namibia	—	—	—	—	25	1,549	2,025	—	e15	—	—	—	—	1,986	36
Niger	—	29	—	—	—	—	—	—	—	—	—	—	—	3,497	—
Nigeria	—	e3,500	—	—	—	—	—	400	(2)	—	723,430	—	140	—	—
Rwanda	—	e60	—	—	—	—	e1,000	—	—	—	—	—	—	—	—
Senegal	—	601	—	—	—	—	—	—	—	—	—	2,284	—	—	—
Sierra Leone	—	—	—	—	—	296	92	—	—	—	—	—	—	—	—
Somalia	—	e25	—	—	—	—	—	—	—	—	—	—	—	—	—
South Africa	173	7,028	3,363	350	176	10,166	614,071	28,226	76	2,464	—	3,051	9,061	2,222	72
Sudan	—	e250	e10	—	—	—	e1,000	—	—	—	e110	—	—	—	—
Swaziland	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tanzania	—	e540	—	—	—	68	e6,000	—	—	—	—	22	—	—	—
Togo	—	350	—	—	—	—	—	—	—	—	—	2,100	—	—	—
Tunisia	—	3,300	—	—	—	—	—	291	—	—	40,259	6,400	181	—	4
Uganda	—	e50	—	—	—	—	—	—	—	—	—	(2)	—	—	—
Zaire	—	174	—	5,700	275	13,501	7,000	—	—	—	8,698	—	—	—	22
Zambia	—	e347	—	6,910	367	—	271	—	4	(2)	—	—	—	—	15
Zimbabwe	—	e900	522	80	—	—	18,278	1,179	—	—	—	142	547	—	—
Total Africa	613	54,397	3,964	13,709	881	44,095	699,359	45,083	173	4,240	2,482,052	36,280	14,676	8,405	157
Percent of world total[e]	3	4	36	51	9	[3]42	30	5	6	20	11	25	2	20	2
United States	4,042	71,426	—	—	1,765	—	330,212	55,593	407	—	2,617,415	46,965	84,322	2,560	552

[e]Estimated. [r]Revised.

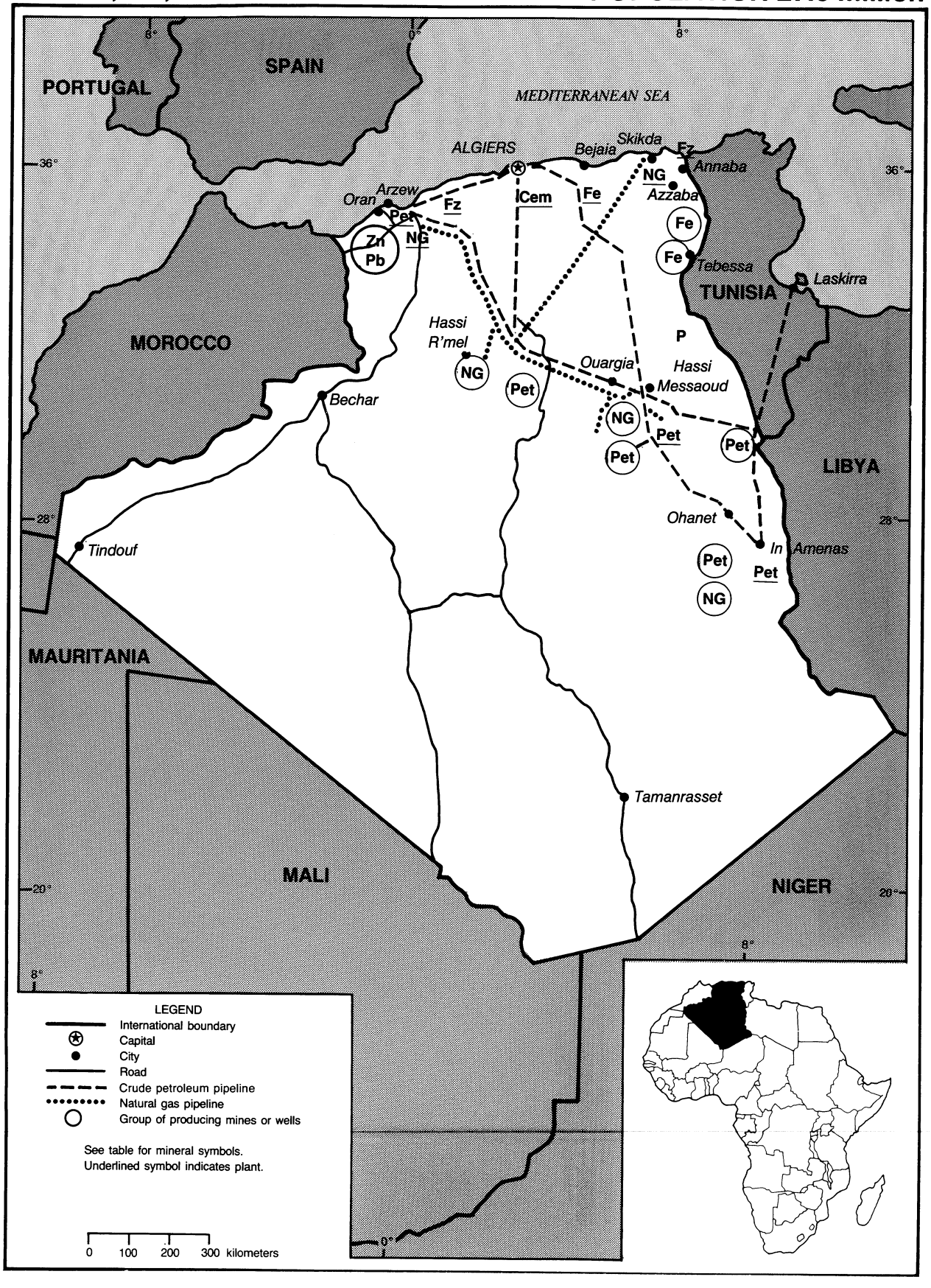
[1]Data may be different from that appearing in individual country production tables owing to availability of more current data.

[2]Less than 1/2 unit.

[3]Excluding synthetic diamond.

ALGERIA

AREA 2,381,740 km² **POPULATION 27.3 million**



THE MINERAL INDUSTRY OF

ALGERIA[1]

By Bernadette Michalski

The nation enjoys a diverse but modest production of metals and industrial minerals; however, hydrocarbons remained by far the leading mineral sector, providing more than $9 billion in export earnings in 1993. The Government announced its chief priorities as expanding exploration activities, improving the recovery rate of oil and gas, augmenting hydrocarbon reserves in place, and increasing hydrocarbon production, transport, and export capacities. It also sought to maintain the overall level of Algerian hydrocarbon exports at 1.8 Mbbl/d of oil equivalent in the immediate future and increase exports to 2.5 Mbbl/d of oil equivalent by the start of the next century.

With an accumulated external debt of $26 billion, the sharp decline in oil prices since mid-1993 has been particularly difficult for Algeria. Hydrocarbon export earnings fell about $1 billion short of covering the nation's debt servicing charges in 1993. The prospect of even lower oil revenues in 1994 had serious implication for the Government's domestic finances. By April 1994, the Government made concessions necessary to conclude an agreement with the International Monetary Fund (IMF) bringing financial assistance totaling $1 billion. The concessions included a 40% devaluation of the dinar and a sharp increase in interest rates. After concluding the IMF agreement, discussions were scheduled with public-sector creditors for the purpose of rescheduling about $13.5 billion in debts, which would further alleviate Algeria's debt servicing burden, which was $9.3 billion in 1993.

The dinar was devalued by 40% in the spring of 1994, opening the road to a $1 billion IMF package and international debt rescheduling. The Government's debt service burden for 1994 is estimated at $9.5 billion, more than the projected hydrocarbon revenues of $8 billion.

GOVERNMENT POLICIES AND PROGRAMS

The stipulation that the Government's Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialization des Hydrocarbures (SONATRACH) was to hold a 51% interest in all associations with foreign partners was relaxed except for equity holding in existing fields where SONATRACH will retain at least 51%. Exploration activity reflected the improved incentives offered under the December 1991 legislation, which modified the terms and conditions of oil exploration in Algeria. The Government also offered foreign companies equity interest in producing fields, an area from which they were excluded previously. At least 10 fields, including the giant Hassi Messaud Field, have been open to foreign investment with expertise particularly in secondary and tertiary recovery.

PRODUCTION

Although petroleum production remains significant, the nation's more mature wells required gas reinjection to maintain pressures. Other enhanced recovery technology was under consideration.

A variety of nonhydrocarbon minerals were produced in minor amounts, but only iron ore, mercury, and phosphate rock are produced on a significantly large scale. The entire output of iron ore was consumed by the national iron and steel industry. Phosphate rock production is exported. Mercury is produced entirely for export, and production fluctuates with the price of this commodity in the world market. *(See table 1.)*

TRADE

Natural gas and liquid fuels accounted for about 95% of Algeria's export earnings. Crude oil exports are expected to increase in mid-decade with the application of enhanced recovery technology and the development of recently discovered fields.

Western Europe absorbed more than 90% of Algeria's crude oil exports in 1993. The average monthly spot price for Algerian Saharan Blend crude oil ranged from a high of $19.23/bbl in March to a low of $14.19/bbl in December. The average price per barrel in 1993 was $17.49 compared with $20.03 in 1992 and $24.22 in 1990.

Depleting oil reserves in mature fields diverted marketing attention to natural gas, condensates, and refined products. Natural gas exports dipped to 34.7 billion m^3 in 1993 compared with 35.6 billion m^3 in the previous year. In 1993, 20.23 billion m^3 of natural gas was exported in the form of liquefied methane (LNG) and nearly 14.5 billion m^3 of natural gas was exported in the gaseous state via pipeline to Tunisia, Italy, and Slovenia. Italy continued as the principal market for Algerian natural gas, importing approximately 15 billion m^3, followed by France at 9 billion m^3, Spain and Belgium at about 4.3 billion m^3 each, and the United States at 2.3 billion m^3 in 1993 and 1 billion m^3 in the first half of 1994. By 1996, Algerian exports should approach 60 billion m^3/a. Contracts have been concluded for 24 billion m^3/a of LNG and 34 billion m^3/a of natural gas in

a gaseous state. The latter will be delivered to Europe through the two gaslines across the Mediterranean.

The export of petroleum products averaged 420,000 bbl/d in 1993. Three-fourths of the product exports were destined for Europe. France alone imported an average of 90,000 bbl/d.

Crude oil and product exports to the United States averaged 240,000 bbl/d for 1993 and 249,000 bbl/d in the first half of 1994.

Other exports, by order of value, are metals and metal products, phosphates, and iron ore. Helium exports commenced in mid-1994. Algeria enjoys the advantage of proximity to the European market, which has formerly relied on the United States for its helium requirements.

As a result of a $600 million credit agreement granted by the Spanish Government, 400,000 to 500,000 tons of rebar is to be imported from Spain commencing in 1993.

STRUCTURE OF THE MINERAL INDUSTRY

The Algerian Government traditionally has controlled all mining and mineral processing industries. However, private capital is being encouraged as SONATRACH'S majority participation in all hydrocarbon production contracts had been relaxed except for equity in existing fields where 51% majority participation by SONATRACH is still required.

Local mining companies and agencies are to be amalgamated into the Office de Recherche Geologique & Minieres (ORGM) with the objective of bringing international involvement to the Algerian mineral industry. Working with local and international companies, ORGM will become responsible for information distribution relating to the mining sector, as well as the publication of geological maps and the development and evaluation of deposits. ORGM has identified several exploitable mineral deposits, however; their location is in remote areas devoid of any infrastructure. To further interest foreign investment capital, ORGM has the 1991 Mining Code under review and plans to introduce more attractive terms to the Investment Code.

COMMODITY REVIEW

Metals

Aluminum.—Plans for the construction of a 220,000-mt/a-capacity aluminum smelter at Mostaganem in western Algeria progressed. The proposed $1 billion aluminum smelter would be a joint venture between Algeria and the International Development Corp. of Dubai. Financing for the smelter and a 400-MW powerplant is to be secured through purchase agreements.

Gold.—Nationale De L'Or, an Algerian parastatal, has completed a $5 million feasibility study focusing on the Amesmessa and Tirek gold deposits in the eastern Hoggar Mountains of southeastern Algeria. Mining is projected for 1997 pending finance availability.

Iron Ore.—Most of Algeria's iron ore output was extracted from the mine at Ouenza. Mining operations were spread over 17 km^2, with the main seam 2 km long and 500 m wide. Production totaled 2.3 Mmt of hematite ranging from 53% to 60% iron content. Iron ore was mined also at Bou Khadra and shipped with Ouenza ore by rail to the El Hadjar processing plant, a distance of 170 km. Both mines are operated by Entreprise Nationale de Fer et de Phosphates.

Iron and Steel.—Site preparation for the 2-Mmt/a-capacity Bellara steel complex, east of Algiers, was completed by Algerian firms. No construction contracts as yet had been made for the $3 billion complex.

Algeria is seeking foreign capital for a hot-briquetted iron (HBI) project. The plant site selected was the port of Jenjen where ore carriers of up to 180,000 dwt can be accommodated. Plans include the installation of two furnaces with a combined capacity of 1.5 Mmt/a of HBI. About one-half of the output will be consumed domestically.

Mercury.—Algeria is a significant world producer of mercury, supplying about 10% of the world's total output. Entreprise Nationale des Nonferreur et Substances Utiles reported the average production cost of mercury in Algeria at $300 per flask.

Industrial Minerals

Cement.—Algerian cement demand was estimated at 15 Mmt in 1993. Supply was reported at 8 Mmt, including about 2 Mmt of imported cement. Major investments are required to modernize and rehabilitate the industry before it can sustain the domestic market.

Limited renovation has been achieved at Entreprise des Ciments et Derives de l'Est's (ERCE) installations in Hamma Bouziane, Hadjar Soud, and in El Kebira and at Entreprise des Ciments et Derives de l Qust's (ERCO) plant at Zahana.

Phosphate Rock.—All production was derived from the Djebel Onk open pit mine 330 km south of Annaba and 22 km west of the Tunisian border. Operated by Entreprise Nationale de Fer et de Phosphates, the deposit site covers 2,100 km^2.

Mineral Fuels

Natural Gas.—Gross production of natural gas was 127.2 billion m^3, and more than 60% was reinjected to maintain petroleum reservoir pressure. Liquefaction of natural gas for the export market averages about 90,000 m^3/d. 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. Contracts for engineering and other services involved in overhauling and upgrading the complexes were awarded to Bechtel Corp. and M. W. Kellogg Co. of the United States and Sofregas of France.

Financing for the expansion of the trans-Mediterranean pipeline through Algeria, Tunisia, and Sicily to the Italian mainland had been secured. Pipeline

capacity is scheduled to be increased from its current 15.5 billion m^3/a to 23.8 billion m^3/a by 1995. Access to the Slovenian gas network is achieved through a 35-km spur line near the Italian end of the trans-Mediterranean pipeline.

The Hassi R'Mel Gasfield should be linked with Spain via Morocco and the Straits of Gibraltar by the close of 1995. The agreement covers delivery of 6 billion Mm^3/a to Spain and up to 1 billion Mm^3/a to Morocco starting in October 1995. In the second phase of construction, the pipeline will be extended to provide access to Portugal, France, and Germany.

LNG deliveries to Cove Point Trading Co. in the United States were resumed in mid-1992, marking Algeria's reentry into the U.S. LNG market after a long absence owing to a pricing formula dispute.

The production of helium commenced in mid-1994 from the Helios Co.'s Bethious plant, near Arzew. SONATRACH enjoys a 51% equity in the company, and Air Products & Chemicals, Inc. (APCI) of the United States with L'Air Liquide of France share the remaining equity. The plant's capacity is 16 Mm^3/a of liquid helium, which represents 20% of world output, and 33,000 mt/a of liquid and gaseous nitrogen. Helium exports are destined for Europe, principally to France, Italy, Germany, and Spain. The nitrogen will be sold in Algeria and other north African markets. The plant employs APCI's production process and also has a retreatment process for cooling and distillating the residual gas produced by the GL 2-Z liquefaction complex, which contains on average 10% helium and 45% nitrogen.

***Petroleum.*—Exploration.**—Between 1993 and early 1994, Anadarko Oil Co. reported three oil discoveries and Broken Hill Petroleum reported one oil discovery in the Ghadames Basin. Evaluation studies are underway. Developmental work is being conducted at the SONATRACH/Agip Bir Rebaa Nord Field where output is anticipated at 60,000 bbl/d and at Compania Espanola de Petroleos (Cepsa)'s Rhourde Yacoub Field where production is scheduled for 1996 at the initial rate of 5,000 bbl/d.

Production.—Crude oil production averaged 760,000 bbl/d and field condensate production averaged 430,000 bbl/d in 1993. 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. Algeria's production quota allotted from the Organization of Petroleum Exporting Countries (OPEC) was 764,000 bbl/d in the first quarter of 1993, reduced to 732,000 bbl/d in the second and third quarter, and raised to 750,000 in the last quarter of 1993.

The Government has offered foreign participation in Algeria's maturing fields. Equity interest was offered in the following fields: Hassi Messaoud, Haoud Berkaoui, Ben Kahla, Guellala, Rhourde El Baguel, El Gassi, Zarzaitine, El Adeb Larache, Hasi R'Mel, and Rhourde Nous. About 15 companies submitted bids. However, no awards were made as the Government reported that the bids were lower than expectations.

Refining.—Refining capacity has been stabilized since the early 1980's when the 323,000-bbl/d-capacity Skikda refinery and the 6,500-bbl/d-capacity In Amenas refinery entered production elevating national refining capacity to 474,500 bbl/d.

Petrochemicals.—Plans to construct a 600,000-mt/a methyl tertiary butyl ether (MTBE) unit, an unleaded fuel component, at Arzew took form with the awarding of the process engineering contract to Italy's Snamprogetti SpA. Partners in the $400 million project with SONATRACH are Total of France and Ecofuel of Italy.

Reserves

Hydrocarbon reserves as reported by the Ministry of Mines and Industry as of January 1994 were 3.6 trillion m^3 of natural gas. Unassociated natural gas accounted for 85% of these reserves. Recoverable petroleum reserves were reported at 9.24 billion bbl of light, low-sulfur crudes.

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

INFRASTRUCTURE

Algeria's railroad system, which totals 4,060 km of track, and its road network, which spreads over 90,000 km, are in the northern section of the country supporting that nation's long-established mining and other export-oriented industries. The existing infrastructure is too distant to lend support to the development of commercial mineral deposits reported in the south of Algeria.

About 10,000 km of pipeline serve the hydrocarbon industries. A network involving nearly 1,500 km of pipeline is the conduit for natural gas from Hassi R'Mel to the Mediterranean Ports of Arzew and Skikda. Nine lines carry dry gas, and four lines carry condensates and liquefied petroleum gases (LPG). A pipeline network totaling another 1,500 km transports natural gas from Alrar, Rhourde Nouss, and Gassi Touil to Hassi Messaoud and Hassi R'Mel. Major crude petroleum pipelines exceed 5,800 km in length, serviced by another 800 km of feeder lines. Petroleum product pipelines exceed 300 km.

Algeria employs seven marine terminals for the export of hydrocarbons, including La Skhirra in Tunisia. The largest terminal is Arzew-Bethioua, which accommodates 40% of all hydrocarbon exports. Port capacity at Skikda is limited to 90,000-m^3 liquid natural gas carriers. Efforts are underway to augment facilities to permit the accommodation of 125,000-m^3 carriers.

In operation since 1983, the Transmed natural gas export pipeline extends for 2,340 km from Algeria through Tunisia, Sicily, and the Italian mainland. Current capacity is 16 billion m^3/a. However, expansion activities should increase throughput to 30 billion m^3/a by mid-

decade. The 1,265-km Maghreb-Europe pipeline is under construction and will traverse Algeria, Morocco, and the Straits of Gibraltar to Seville, Spain. The pipeline is scheduled for completion by the close of 1995 at the initial capacity of 8 billion m^3/a. The second phase of the Maghreb-Europe pipeline construction will include extensions to Portugal, France, and Germany.

OUTLOOK

Algeria's huge sedimentary basins may very likely contain larger reserves of crude oil than present estimates suggest. Improved geochemical, petrophysical, and reservoir studies and the installation of enhanced recovery systems would most likely enable much of the probable reserve base to be reclassified as proven reserves. Stimulating foreign investment interest in Algeria's aging energy industries is vital to the economy because the nation does not have cash or access to sufficient credit to sustain economic activity. In pursuing this course of action, the Algerian Government has not only encouraged exploration agreements but has offered a portion of production rights in existing oil and gasfields to private companies with capital and enhanced recovery capabilities. This action represents the most significant change in oil policy since nationalization in 1971. Without sufficient foreign capital to refurbish the natural gas extraction and processing facilities, as well as the transport infrastructure, Algeria may be unable to satisfy demand within a few years. Natural gas exports to Italy alone will double to 30 billion m^3/a when the Trans-Mediterranean pipeline is expanded. The demand for natural gas may outstrip Algeria's capacity to supply it. Algeria's top industrial priority must be to revamp and expand its processing and export facilities.

[1]Text prepared Aug. 1994.

[2]Where necessary, values have been converted from Algerian dinars (AD) to U.S. dollars at the rate of AD27.78=US$1.00in 1993 and AD36=US$1.00 after the devaluation of Apr. 1994.

OTHER SOURCES OF INFORMATION

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TABLE 1
ALGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Cadmium, refined		46	65	78	75	75	80
Iron and steel:							
Iron ore, gross weight	thousand tons	2,748	2,941	2,344	2,560	[3]2,311	3,500
Metal:							
Pig iron	do.	1,300	1,037	877	900	1,300	1,500
Steel, crude	do.	943	836	1,393	1,400	1,400	1,400
Lead, concentrate, Pb content e		1,400	1,100	900	1,200	[3]1,538	1,550
Lead, refined		2,700	4,500	4,500	4,500	4,500	5,000
Mercury		587	637	431	476	[3]545	650
Silver e	kilograms	2,800	2,500	2,500	3,500	3,500	3,500
Zinc:							
Concentrate, Zn content		6,263	4,160	7,900	7,500	[3]6,800	8,000
Metal, smelter output		28,000	23,600	24,917	31,000	[3]35,000	35,000
INDUSTRIAL MINERALS							
Barite, crude		49,000	53,078	44,361	51,150	[3]47,232	60,000
Cement, hydraulic	thousand tons	6,819	6,337	6,319	6,400	[3]6,940	7,000

See footnotes at end of table.

TABLE 1—Continued

ALGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Clays:							
Bentonite		39,200	33,700	25,803	25,000	[3]20,823	40,000
Fuller's earth e		3,500	4,000	4,526	4,550	[3]3,229	5,000
Kaolin		18,000	18,000	21,460	20,000	[3]12,586	20,000
Diatomite		4,400	4,156	3,629	3,600	[3]3,471	4,500
Gypsume[4]	thousand tons	275	250	152	234	200	300
Lime, hydraulic		27,000	32,000	61,345	62,000	62,000	65,000
Nitrogen: N content of ammonia		131,500	288,000	269,000	r438,000	[3]380,000	450,000
Phosphate rock:							
Gross weight	thousand tons	1,124	1,128	1,090	1,136	[3]718	1,500
P_2O_5 content	do.	371	333	322	340	225	450
Salt	do.	229	222	259	251	247	250
Sodium compounds: Caustic soda e		700	700	700	700	700	800
Strontium minerals: Celestite, gross weight e		5,400	5,400	5,400	5,400	5,400	5,500
Sulfur, elemental e		20,000	20,000	20,000	20,000	20,000	20,000
MINERAL FUELS AND RELATED MATERIALS							
Gas, natural:							
Gross	million cubic meters	108,000	110,000	126,270	127,000	127,200	130,000
Dry[5]	do.	48,400	48,500	54,760	55,800	56,000	56,000
Natural gas plant liquids	thousand 42-gallon barrels	56,492	56,000	55,000	52,855	53,000	55,000
Petroleum:							
Crude	do.	253,675	290,175	203,852	270,100	277,400	300,000
Condensate	do.	170,000	154,075	151,575	156,950	155,000	175,000
Refinery products:							
LPG	do.	8,395	10,585	10,700	10,000	10,000	11,000
Gasoline	do.	17,760	18,604	18,980	18,800	18,900	19,000
Naphtha e	do.	28,300	28,000	28,000	30,000	32,000	35,300
Kerosene	do.	3,903	3,850	3,100	3,000	3,500	4,000
Distillate fuel oil	do.	57,233	57,546	56,400	56,400	57,000	58,000
Residual fuel oil	do.	37,660	38,235	37,376	37,300	37,400	38,500
Lubricants	do.	959	840	835	825	825	850
Other e	do.	4,050	3,000	3,000	4,000	4,000	6,000
Total	do.	158,260	160,660	158,391	160,325	163,625	172,650

e Estimated. r Revised.

[1] Table includes data available through Aug. 1, 1994.

[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.

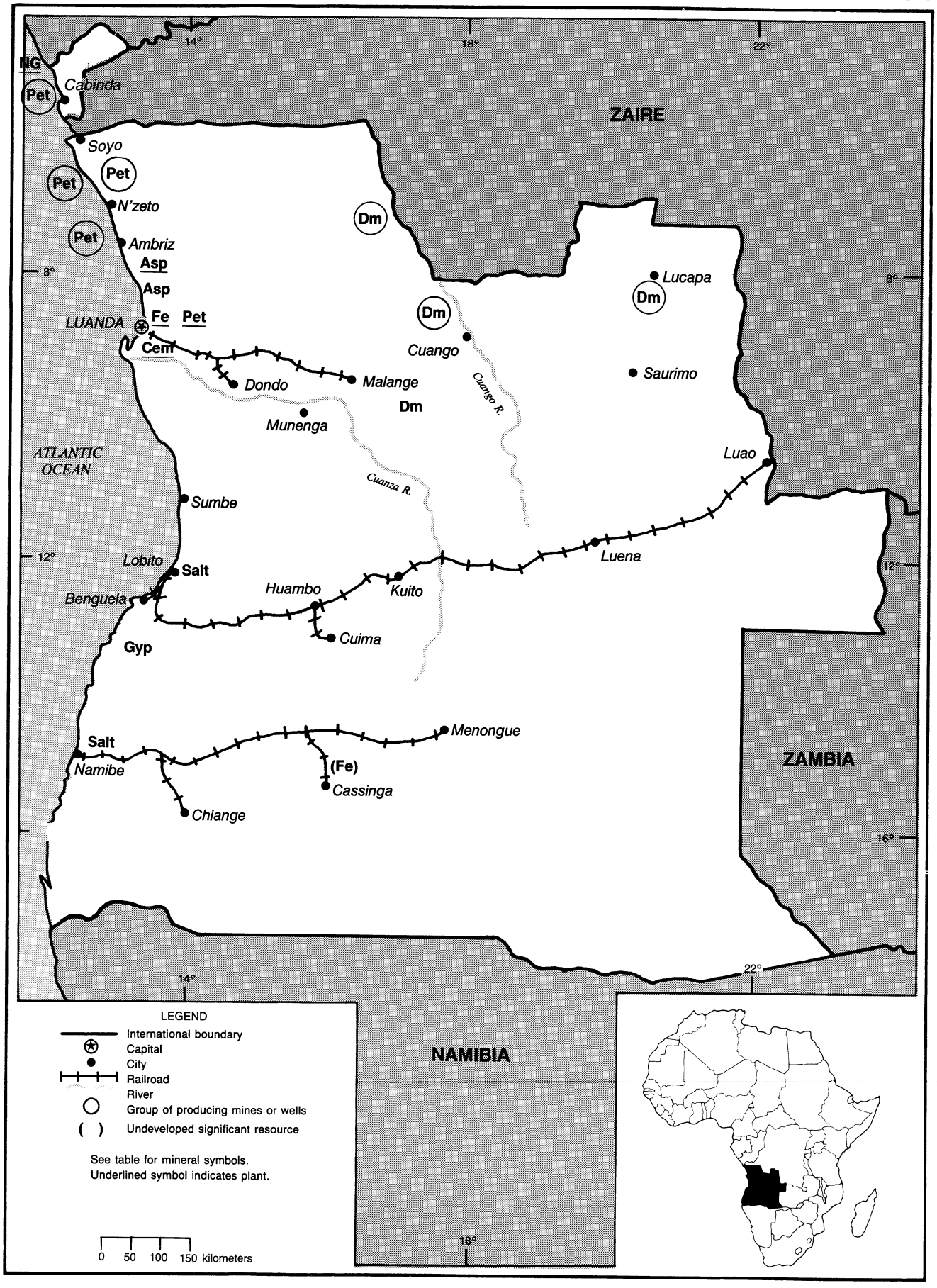
[3] Reported figure.

[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.

ANGOLA

AREA 1,246,700 km² **POPULATION 9.5 million**



THE MINERAL INDUSTRY OF

ANGOLA[1]

By Philip M. Mobbs

The mineral economy of Angola was dominated by petroleum and diamonds in 1993. The anticipated development of Angola's varied mineral resources was again delayed by the resumption of the civil war.

All mineral resources were the property of the state. Foreign oil companies operated in joint ventures or under production-sharing agreements with the Government's Sociedade Naçional de Combustiveis de Angola. Diamonds were traditionally mined by the state-owned Empressa Naçional de Diamantes de Angola (Endiama), its contractors, and small-scale miners (garimpéiros). Government enterprises were involved in mining and processing all other minerals. However, foreign company mining activity was officially encouraged.

Most of Angola's official diamond production of 145,000 carats, worth approximately $26 million,[2] was marketed through De Beers Centenary AG's Central Selling Organization. The National Union for the Total Independence of Angola (Unita) controled many of the garimpéiro operations in Lunda North Province and along the Cuango River on the Zairian border. The precipitous drop in diamond output was attributed to the renewed hostilities.[3] A significant volume of rough diamond, estimates range from 1 to 2 million carats, was smuggled out of the country into Congo via Zaire.

Crude oil exports accounted for approximately 99% of the country's official export earnings. The United States imported approximately 70% of Angolan oil exports. Angolan onshore petroleum operations were reduced owing to war-related damage to wells and surface facilities. Offshore Cabindan fields produced approximately 60% of Angola's 520,000 bbl/d output.[4] Both Cabindan separatists and Unita posed a threat to oilfield personnel and facilities.

Much of the nation's rail system was damaged or destroyed during the war, and most of Angola's 45,000 km of road was in poor condition.[5]

Petroleum should continue to dominate Angola's economy for the foreseeable future. Unregulated garimpéiro operations, which mine primarily high-grade diamonds, could damage Angola's ability to restore the alluvial segment of the industry. The minerals industry should revive once security issues are resolved and local and international mining companies become involved in exploration and development of Angola's mineral deposits; however, there are substantial transportation problems and generally weak world markets for many of Angola's mineral products.

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[1]Text prepared June 1994.

[2]Where necessary, values have been converted from new Kwanzas (nKz) to U.S. dollars at the rate of nKz6611=US$1.00.

[3]Industrial Minerals. Angola Diamond Output Crashes. No. 313, Oct. 1993, p. 91.

[4]Africa Energy & Mining. No. 122, Nov. 17, 1993, p. 1.

[5]Ministry of Geology and Mines. Opportunity for Mining Investment in Angola. Paper presented at the African Conference on Mining Investment, Denver, Colorado, June 6-8, 1994. 42 pp.

OTHER SOURCES OF INFORMATION

Agency

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TABLE 1
ANGOLA: PRODUCTION OF MINERAL COMMODITIES[1]

(Thousand 42-gallon barrels, unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Cement, hydraulic e	thousand metric tons	r300	r260	r260	r300	250	1,000
Diamond:[3]							
Gem e	thousand carats	1,165	1,060	899	r1,100	470	1,200
Industrial e	do.	80	73	62	r80	30	150
Total	do.	1,245	1,133	961	r1,180	500	1,350
Gas, natural:							
Gross[4] e	million cubic meters	5 2,820	2,605	2,870	2,800	2,900	2,900
Dry	do.	427	e538	r577	r564	600	600
Iron and steel: Steel, crude e	metric tons	10,000	10,000	10,000	10,000	9,000	10,000
Natural gas plant liquids e		2,480	2,500	2,500	2,500	2,500	2,500
Petroleum:							
Crude		167,000	174,000	184,000	200,000	210,000	210,000
Refinery products[6]		r9,355	r9,555	r e9,600	e9,000	9,000	12,600
Salt e	metric tons	r50,000	r30,000	r40,000	r20,000	r30,000	30,000

eEstimated. rRevised.

[1]Table includes data available through July 5, 1994.

[2]In addition to the commodities listed, a variety of industrial minerals and construction materials (clay, gypsum, sand and gravel, and stone) is produced for local consumption, but information is inadequate to make reliable estimates of output.

[3]Does not include smuggled production.

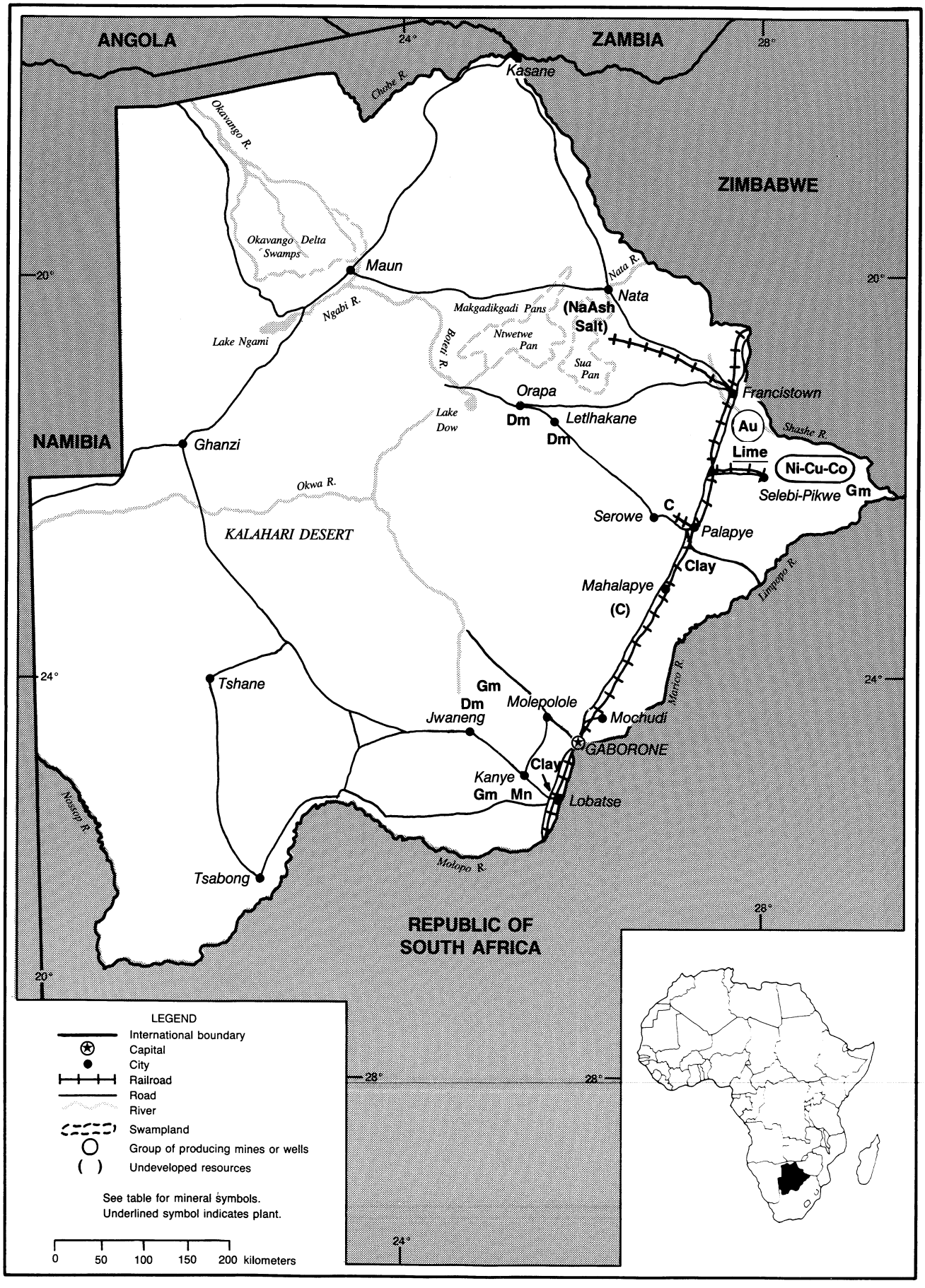
[4]Angola has no natural gas distribution system. Most gas is vented, except for a small fraction from which natural gas liquids are produced. Propane and butane canisters are filled at the well site. See "Natural gas plant liquids" in the table.

[5]Reported figure.

[6]Includes asphalt and bitumen, natural, previously listed separately.

BOTSWANA

AREA 600,370 km² **POPULATION 1.3 million**



THE MINERAL INDUSTRY OF

BOTSWANA

By Lloyd E. Antonides

Diamonds remained the base of Botswana's economy in 1993 as they had for the nearly two decades since production began, and the country was the world's leading producer by value and third by weight. Nickel and copper also played a significant though smaller role in the economy. Coal production was an important source of energy, and soda ash and salt production were commencing to have an impact on the economy after startup in 1991. Other valuable minerals produced included gold and silver, manganese, semiprecious gemstones, and construction stone, sand, and clay. Platinum-group metals were the target of exploration as were additional deposits of minerals already in production. There were also some possibilities of finding petroleum. But much of Botswana's potential mineral resources remained unexplored.

The mineral industry was the principal reason the country had a high per capita gross domestic product (GDP) and a surplus in balance of payments. The industry typically accounted for more than 40% of a GDP estimated at about $4 billion[1] for 1993. It also provided more than 85% of exports estimated at more than $2 billion, as well as about 50% of Government revenue. Yet employment in the domestic mining industry was only about 5% of a total formal (wage earning) employment of about 250,000. Of the total labor force, estimated at 450,000, apparently less than 3% was in mining versus more than 35% in agriculture, 40% in other industry and commerce, and 20% in Government. However, not included in mining but presumably included at least in the total labor force, possibly as other industry, were 10,000 to 15,000 employees (2% to 3%) that worked in South African mines.

A major basis for continued interest in the country by the mining industry and others was a history of a stable political environment. The development-oriented Government's fiscal prudence, free market philosophy, and flexibility and fairness in dealing with investors were also factors. Furthermore, the Government recognized and actively promoted the very attractive mineral potential. However, there also was a desire for diversification away from the economy's heavy dependence on diamonds. Private-sector growth and job creation, especially in manufacturing and agriculture, were emphasized as development objectives by the Government.

Botswana encouraged foreign investment. There were no restrictions on reinvestments or repatriation of earnings and capital, and exchange controls were liberal. Botswana never nationalized or expropriated any foreign business. It carefully followed its established rules for investment, and its courts repeatedly upheld contracts. Government corruption was rare and penalties severe. An investment guarantee agreement with the United States was signed in 1968, and Botswana also was a member of the Multilateral Investment Guarantee Agency (MIGA), the World Bank's political insurance unit. In June 1994, the Government participated and provided literature at an African Mining Investment Conference in Denver sponsored by MIGA.

To aid the private sector's participation in the economy, the Government took measures to better the human resources aspect in the areas of training, education, and health. Infrastructure improvements were implemented in transportation, power, communication, and water supply. Increased availability of capital for small- to medium-size ventures was to come through expansion of Botswana's Development Corp.'s operations. Being especially aware of the adverse impact that lack of infrastructure had on potential mineral projects, the Government stated its willingness to assist in securing funding for such work.

The Ministry of Mineral Resources and Water Affairs had responsibility for the mining sector. The Ministry granted reconnaissance permits (for 1-year general prospecting) and prospecting licenses (for 3 years plus two 2-year extensions with minerals and area specified). It negotiated mining leases for 25 years with project plans, financial aspects, and lease extension conditions specified. Subunits of the Ministry also carried out geological surveys, made mine safety and environmental inspections, and collected mineral production information.

Mineral rights, vested in the state, were separate from surface rights. On significant mineral ventures, the Government normally exercised its legal right to acquire, free, an equity interest of 15% to 25%. Royalties were also collected on certain mineral sales such as 3% on base metals, 5% on gold, and 10% on diamonds. Though also subject to corporate income tax, reduction of the basic rate of 40% was typically part of lease negotiation.

The mining industry continued to be adversely affected in 1993 by the general worldwide economic recession. According to the Department of Mines Annual Report, [2] diamond sales were negatively impacted, resulting in a decline of more than 7% in production at Debswana Diamond Co. Ltd., jointly owned by De Beers Centenary AG and the Government. In September 1992,

quotas for deliveries to the Central Selling Organization (CSO) of the De Beers group were reduced to 75%, but in May 1993 the quota was raised to 80% and in July to 85%. The excess production was stockpiled. Construction of a fourth stream at the Jwangeng Mine to increase ore throughput by one-third was on schedule to be commissioned in late 1994. A second diamond cutting and polishing factory opened in Molepolole operated by Lazare Kaplan International Inc. of New York. The first factory was opened in late 1992 by a subsidiary of Debswana.

Depressed prices for copper and nickel resulted in BCL Ltd. mines operating under very difficult financial conditions. However, production of high-grade copper-nickel-cobalt matte was about 6% above the 1992 output. Drastic cost reduction measures were reported. Amax Inc. sold its 29.8% equity interest to the Government, which already held a 15% interest. The Government subsequently sold 50% of the acquired interest to Anglo American Corp. (AAC), making the Government and AAC the major shareholders. The shareholders and creditors of BCL Ltd. agreed to another debt restructuring arrangement during 1993 to allow for the continuation of operations.

The weak Southern African market for both soda ash and salt compelled Soda Ash Botswana (Pty.) Ltd. (SAB) to operate its plant at reduced capacity, producing only 126,000 tons and 98,800 tons of soda ash and salt, respectively. In addition to the weakened soda ash market, SAB also faced fierce competition from traditional suppliers of soda ash to the region as these fought to maintain their market shares.

Coal production, at 890,000 tons during 1993, was 1.3% below the previous year's output. Production was constrained by reduced consumption by major consumers, especially SAB.

A number of medium- and small-scale mines operated, some intermittently, producing aggregate, brickmaking clay, gold, and manganese. Expansions of existing plants and development of new small mine ventures were hampered by the prevailing recession and depressed commodity prices.

In recognition of the need for environmental protection, air quality monitoring networks were expanded throughout the country. An air pollution laboratory also was completed and became operational at Selebi Phikwe.

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[1]Where necessary, values have been converted from Botswana pula (P) to U.S. dollars at the rate of P2.5648 for 1993 and P2.2568=US$1.00 for 1992. These were Bank of Botswana official rates at yearend as published by International Monetary Fund in International Financial Statistics.

[2]Mining Commissioner, Annual Report 1993, Mar. 1994. Department of Mines, Republic of Botswana, Gaborone, Botswana.

OTHER SOURCES OF INFORMATION

Ministry of Mineral Resources and Water Affairs
P.O. Box 0018
Gaborone, Botswana
Telephone: 267-352-454
Facsimile: 267-372-738

Department of Mines
P.O. Box 0049
Gaborone, Botswana
Telephone: 267-352-641
Facsimile: 267-352-141

Department of Geological Survey
P.O. Box 0014
Lobatse, Botswana
Telephone: 267-330-687

TABLE 1

BOTSWANA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Coal, bituminous		663,045	794,041	783,873	901,452	890,000	1,000,000
Cobalt: Smelter output,							
Co content of matte[3 4]		215	205	208	208	205	300
Copper:							
Mine output, Cu content of ore milled		24,700	25,300	24,800	24,400	[e]24,000	26,000
Smelter output,							
Cu content of matte[3 4]		21,709	20,612	20,576	20,413	20,132	22,000
Diamond:							
Gem and near gem[e]	thousand carats	10,680	12,150	11,550	11,160	10,310	12,500
Industrial stones[e]	do.	4,570	5,200	4,950	4,790	4,420	5,500
Total[5]	do.	15,252	17,352	16,506	15,946	14,730	18,000
Gemstones, semiprecious[6]	kilograms	146,000	500	205	[r]348	40,000	40,000
Gold[7]	do.	67	46	20	165	192	500
Lime		—	55	6	[r]—	[r]—	200
Manganese ore[e] (45% Mn)[8]		—	—	—	1,318	3,700	30,000
Nickel:							
Mine output, ore	thousand tons	3,338	3,369	3,451	3,490	3,440	4,000
Mine output, Ni content of ore milled		23,700	23,200	23,500	23,000	[e]26,000	26,000
Smelter output, matte, gross weight[3]		49,754	47,959	48,319	48,071	50,780	60,000
Smelter output, Ni content of matte[4]		19,759	19,022	19,294	18,873	21,621	22,000
Salt[9]		—	—	2,600	53,708	98,000	650,000
Sand, construction[10]	cubic meters	147,300	164,978	340,825	190,305	150,000	400,000
Soda ash, natural		—	—	62,000	123,593	126,000	300,000
Stone, crushed	cubic meters	458,900	589,999	783,487	804,242	760,000	900,000

[e]Estimated. [r]Revised.

[1]Table includes data available through Sept. 1, 1994.

[2]In addition to commodities listed, the following were produced, but information was inadequate to reliably estimate output: silver (estimated about 2% of reported gold bullion production) and clay for brick and tile (brick units output reported was 12.7 million for 1992 and 20.7 million for 1993, estimated as equivalent in metric tons of clay to 25,000 and 41,000 metric tons, respectively.

[3]Smelter product was granulated nickel-copper-cobalt matte.

[4]Figures also used for recoverable mine output in world production tables appearing in Volume I of the Minerals Yearbook. Included some product from direct smelting ore, i.e., ore not reported as milled.

[5]Only total reported; assumed to contain about 70% gem and near gem. Data may not add to total shown because of independent rounding.

[6]Presumably, principally agate. Reported as sales. Reported as rough through 1989 and as polished or processed thereafter. Only cut or polished stones could be legally exported after 1989.

[7]Reported as bullion; historically included silver estimated at about 2%.

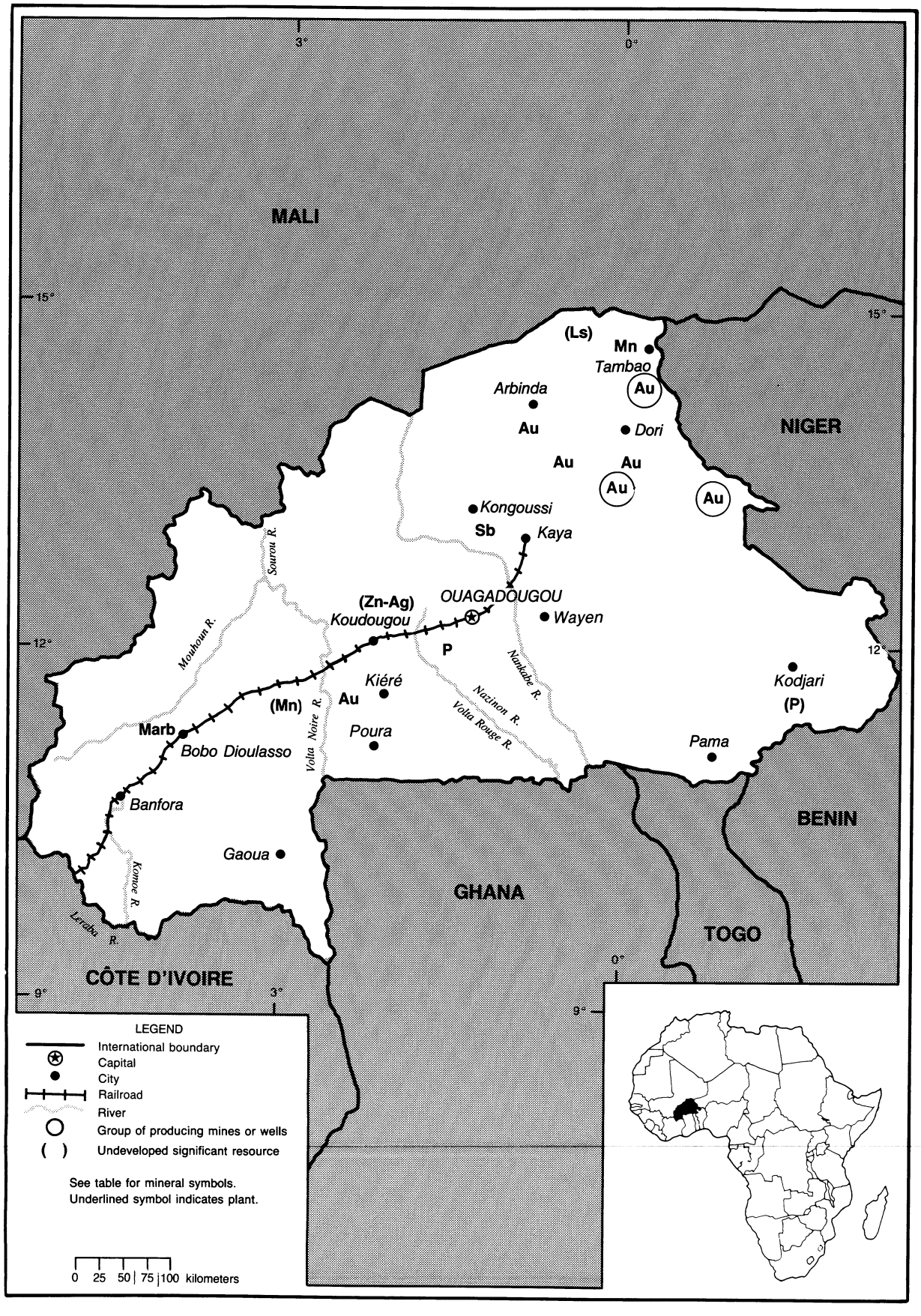
[8]Production commenced in 1992 and ceased in Nov. 1993.

[9]From natural soda ash production.

[10]Additional production of sand and gravel from small local operations was periodically reported, but information was inadequate to reliably estimate output.

BURKINA FASO

AREA 274,200 km² **POPULATION 9.8 million**



THE MINERAL INDUSTRY OF

BURKINA FASO[1]

By Philip M. Mobbs

Mineral production levels in Burkina Faso in 1993 were similar to those of the previous year. *(See table 1.)* Mining revenues remained dominated by gold, which was produced by the Poura Mine, operated by the parastatal Société de Recherches et d'Exploitations Minères du Burkina (Soremib), complimented by the output of tens of thousands of artisanal miners (orpaillages) and the modest output of the nation's four semiindustrial operations, including Compagnie d'Exploitation des Mines d'Or au Burkina, which had begun heap-leaching orpaillage tailings at Essakane in 1992. Gold output was estimated because, despite the legal requirement for all gold to be sold to the Government, it was generally acknowledged that in recent years 40% to 60% of artisanal output had been smuggled out of the country. Gold exports were the primary base of Burkina Faso's 1993 mineral export revenues. Refined petroleum products accounted for much of the nation's mineral commodity imports, with cement, clinker, and fertilizers making up most of the difference.

Joint ventures with the Government were required for all international company mineral production operations. A revision of Burkina Faso's mining law was under consideration by the National Assembly during 1993.

InterStar Mining Group of Canada began test mining of the Tambao manganese deposit in May at a reported rate of 250 mt/d. Output was increased to 300 mt/d near the end of September.[2] Ore was trucked about 240 km from Tambao to the Kaya railhead and subsequently moved by rail to Abidjan, Côte d'Ivoire. Additional truck routes were being examined. This deposit had been investigated by several major companies over the past 20 years; however, its remote location and the lack of infrastructure had previously discouraged development of the deposit.

Boliden International Mining of Sweden continued to study ore transport routes for zinc ore from its Perkoa joint venture near Koudougou. Potential difficulties associated with low zinc prices and concentrate transportation through adjacent countries temporarily halted the project.[3]

The Government encouraged mineral industry development. A number of gold prospects, primarily in the country's extensive Birimian greenstone belts, were being explored, mostly in the north and northeast.[4] Other significant mineral deposits include copper at Gaoua and Wayen, graphite at Kaya, and phosphate at Kodjari.[5] Development was subject to surmounting the nation's infrastructure problems, including significant transportation costs to coastal ports in adjacent countries and the relatively high cost of power produced by imported diesel fuel.

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[1]Text prepared May 1994.

[2]American Metal Market. Tambao Manganese Hiked. V. 101, No. 175, Sept. 10, 1993, p. 7.

[3]Metal Bulletin Monthly. Decision Pending on New Spanish Mine. V. 277, Jan. 1994, p. 49.

[4]Minorex, Mining Consultants Inc. Burkina Faso, Guide for the Mining Investor, 1992, 34 pp.

[5]Mining Journal. Burkina Faso Country Supplement. V. 321, No. 8237, Aug. 13, 1993, 8 pp.

TABLE 1
BURKINA FASO: PRODUCTION OF MINERAL COMMODITIES[1]

(Thousand metric tons, unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity (Jan. 1, 1994)
Gold[e 3]	kilograms	7,600	7,800	5,600	5,400	5,000	6,000
Manganese, Mn content of ore[e]		—	—	—	—	17	45
Pumice and related volcanic materials[e]		10	10	10	10	8	10
Salt[e]	metric tons	6,500	6,500	6,500	6,500	6,500	6,500
Stone: Marble[e]		100	100	100	100	100	100

[e]Estimated.

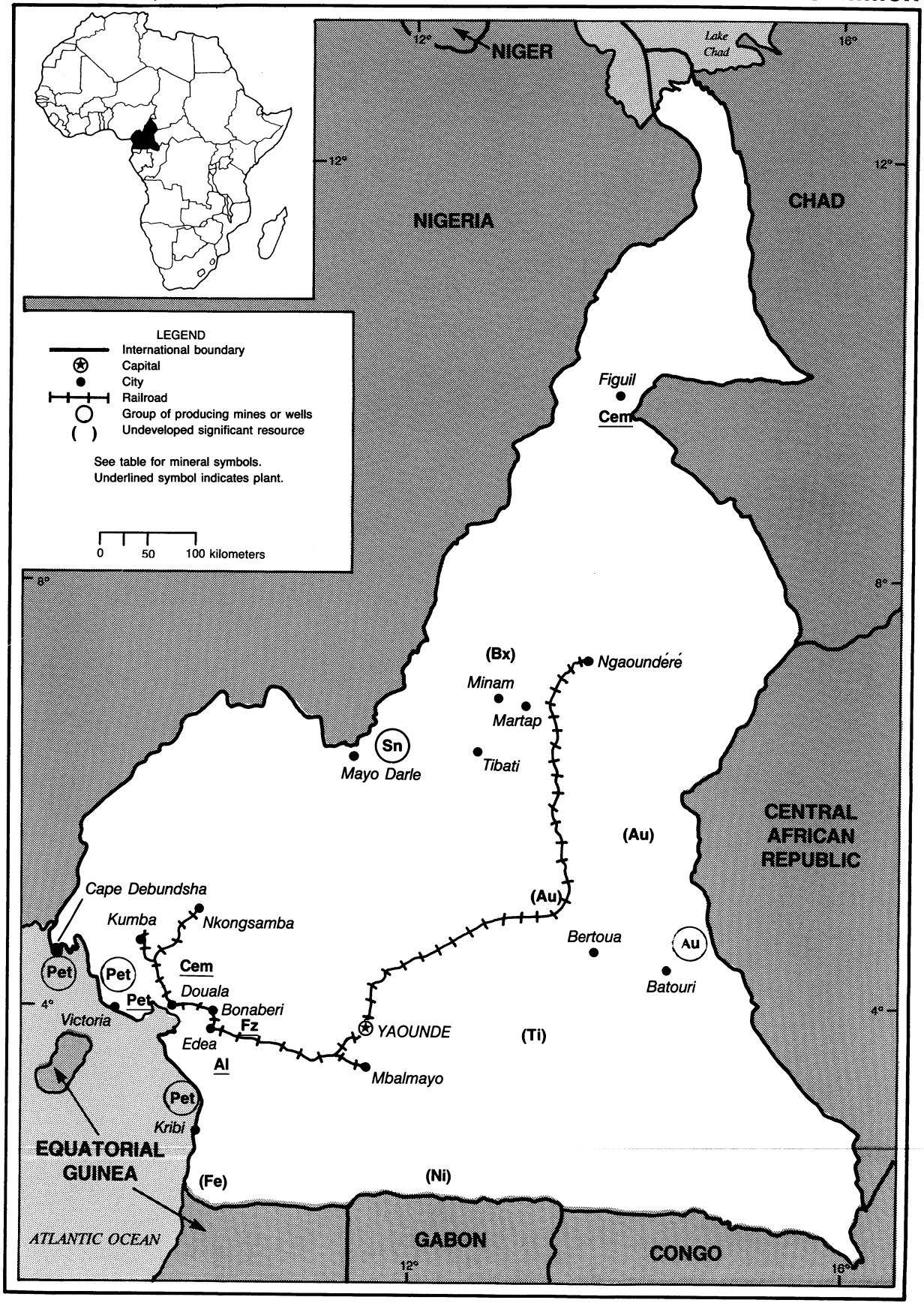
[1]Includes data available through May 3, 1994.

[2]In addition to the commodities listed, Burkina Faso produced clay, and sand and gravel for local constructional uses; however, information is inadequate to make reliable estimates of output levels.

[3]Estimate based on reported doré production, assumed to be 90% gold, and an estimate of smuggled artisanal production. Reported doré production was as follows, in kilograms: 1989—3,013; 1990—4,002; 1991—2,953; and 1992—2,604.

CAMEROON

AREA 475,440 km² **POPULATION 12.8 million**



THE MINERAL INDUSTRY OF

CAMEROON[1]

By Thomas P. Dolley

Declining crude petroleum production from existing oilfields was the most serious problem faced by the mineral industry of Cameroon in 1993. However, Cameroon remained sub-Saharan Africa's fifth largest petroleum producer following Nigeria, Angola, Gabon, and Congo. The decrease in global petroleum prices notwithstanding, crude oil production is of major economic importance to Cameroon and accounted for most of its foreign exchange earnings in 1993. In the previous decade, more favorable world oil prices enabled the oil sector to account for about 45% of total Government revenues. Cameroon's gross domestic product (GDP) for 1991, the last year for which data were available, was $11.6 billion.[2] A lack of sufficient infrastructure continues to hamper the development of a viable mineral industry in Cameroon. Additionally, political strife continued to plague the country in 1993.

The legal system of Cameroon is modeled after French civil law. 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.

The primary mining organization in Cameroon is the Government's Ministry of Mines, Energy and Water Resources. The Government actively promotes investment in the mining sector, and foreign companies are usually involved in joint ventures with Cameroonian partners. Société Nationale des Hydrocarbures (SNH) is the state-owned company involved in hydrocarbon exploitation. SNH consults with the Ministry of Mines, Energy and Water Resources in the awarding of exploration permits and production concessions. Under current agreements, the Government is entitled to 60% to 70% of total domestic crude petroleum production from the existing operators, depending on the production levels.

Additionally, the parastatal Fonds de Soutien aux Hydrocarbures was formed to aid oil exploration and production. Compagnie Camérounaise de l'Aluminium (Alucam), and the Société Nationale de Raffinage (Sonara) are the state-owned companies that manage the aluminum smelting and oil refining facilities, respectively. SNH holds a 20% equity share of the Sonara refinery. By yearend 1993, Government officials were negotiating with Iran for assistance in developing Cameroon's mining industry.

Crude petroleum remained the major mineral commodity of Cameroon in 1993. However, crude petroleum exports fell in 1993, almost 17% to about 40 Mbbl. Additionally, sales to the Sonara refinery, which is producing below capacity, dropped to less than 1 Mbbl in 1993 due to an increase in the smuggling of Nigerian petroleum products. The small-scale mining of cassiterite appears to have ceased. In the past several years, it has become increasingly difficult to obtain Government statistics on the mining industry. The Ministry of Mines, Energy, and Water Resources, along with the Ministry of Planning and Regional Development's Department of Statistics and National Accounts, is unable to publish mineral production statistics owing to financial difficulties. *(See table 1.)*

The most prolific crude oil-producing regions are the offshore Rio del Rey Basin, northwest of Victoria, and the adjacent Lokélé concession about 35 km off the coast. The two main petroleum operators in Cameroon are Pecten International Co. (Pecten), a subsidiary of Shell Oil of the United States, and France's Société Nationale Elf Aquitaine subsidiary Elf Serepca (Elf). Pecten and Elf account for about 80% of Cameroon's oil production. Elf is the operator of the Rio del Rey concession with equity ownership of 26% by Elf, 24% by Pecten, and 50% by SNH. Pecten is the operator of the Lokélé concession with equity ownership of 40% by Pecten, 10% by Elf, and 50% by SNH. The Rio del Rey concession went into production in 1977 and Lokélé in 1983. These mature oilfields are experiencing declining production, and both operators are beginning to utilize natural gas reinjection to obtain a more productive life out of the fields. Natural gas reinjection is more environmentally favorable than the traditional natural gas flaring. To comply with sound environmental practices, both Pecten and Elf are attempting waste minimization programs and the monitoring of oil and grease produced at their wellheads.

Kelt PLC of the United Kingdom finalized its takeover, by yearend 1993, of the Cameroonian exploration and production assets of France's Total. The assets include five offshore permits, the declining Moudi oilfield, and other small, undeveloped discoveries that lie offshore of Victoria and near the island of Bioko. Kelt plans further exploration in 1994. Additionally, by yearend 1993, the Government rejected plans to acquire a 49% equity stake in the future Chad-Cameroonian oil pipeline. The Government felt that the investment was risky if payment for the transit of crude oil was based on the wellhead price in

Chad and the price of the crude oil at the future marine terminal. However, further negotiations by the Government on the pipeline were not ruled out.

The existing aluminum smelter at Edea is managed by Alucam and has a design production capacity of 85 kmt/a; however, the actual production capacity is somewhat lower. Alucam's equity ownership is by Pechiney of France (58%) and the Government (42%). The plant utilizes alumina imported from Guinea. Capacity expansion of the Edea smelter to 160 kmt/a remains in the planning stage.

According to World Bank estimates, recoverable crude oil reserves in Cameroon's mature oilfields are about 210 Mbbl. Cameroon's reserves of natural gas are considerable and have been estimated at 100 billion m^3. Cameroon hosts a variety of mineral deposits, but few have been commercially exploited. The development of a viable mineral industry in Cameroon has been delayed owing to inadequate infrastructure, insufficient electrical power, and a lack of financing. Additionally, the Government is hoping that the recent devaluation of the Communauté Financière Africaine franc will attract much-needed foreign investment in the country's development projects.

[1]Text prepared Apr. 1994.

[2]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF286.50=US$1.00.

TABLE 1
CAMEROON: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Aluminum metal, primary	metric tons	91,716	93,284	82,516	e82,000	82,000	685,000
Cement, hydraulic	do.	614,000	624,229	622,000	e620,000	620,000	624,000
Gold, mine output, Au content e	kilograms	[3]15	[3]10	10	10	10	10
Petroleum, crude	thousand 42-gallon barrels	58,648	64,605	55,480	50,370	[3]42,705	64,000
Pozzolana e	metric tons	130,000	130,000	130,000	130,000	130,000	130,000
Stone: e							
Limestone	do.	57,000	57,000	57,000	57,000	57,000	57,000
Marble	do.	200	200	200	200	200	200
Tin, ore and concentrate: e							
Gross weight	kilograms	4,800	4,300	4,300	4,300	4,300	4,300
Sn content	do.	3,400	3,050	3,050	3,050	3,000	3,000

eEstimated.

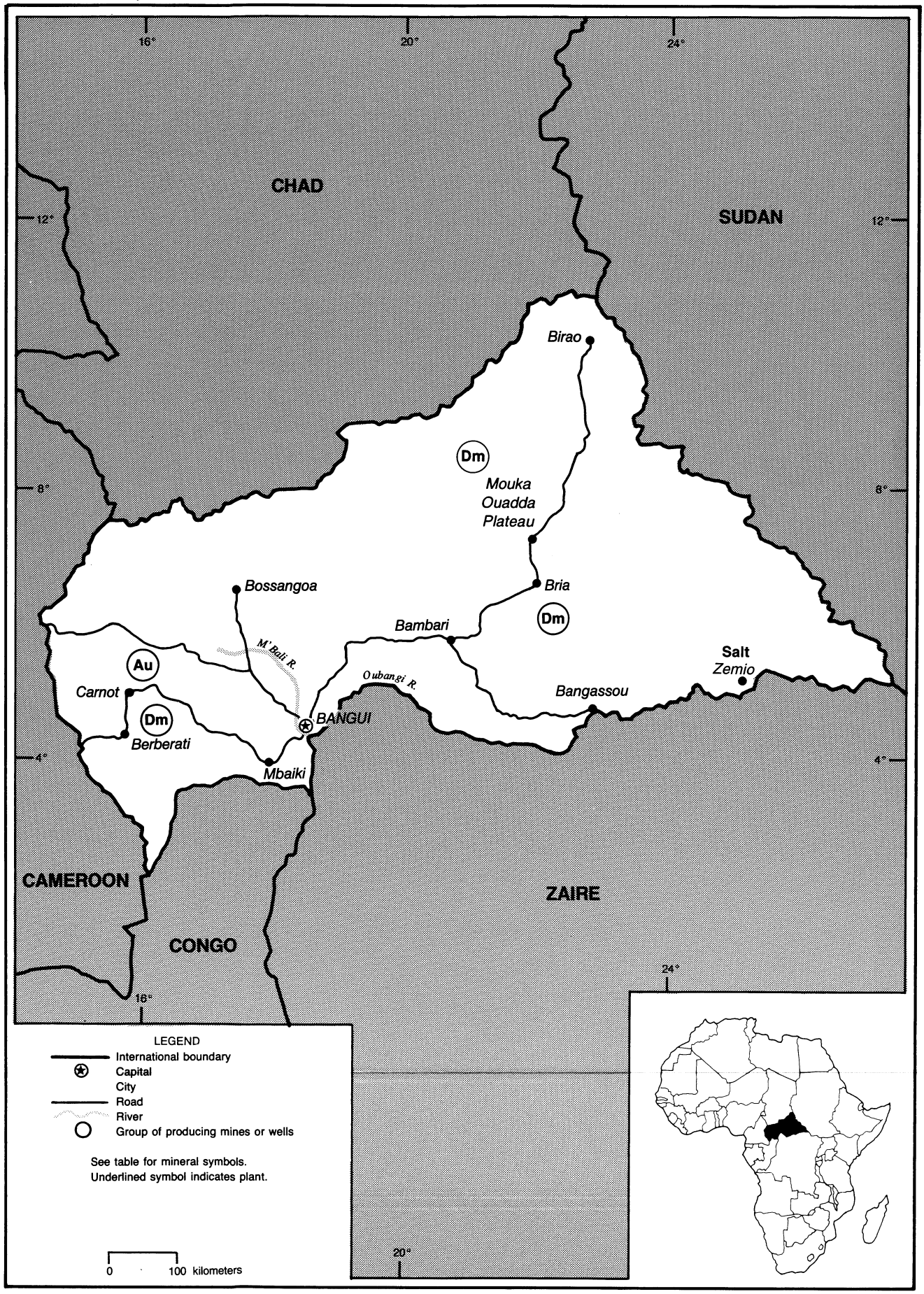
[1]Includes data available through Mar. 31, 1994.

[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and other 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.

CENTRAL AFRICAN REPUBLIC

AREA 622,980 km² **POPULATION 3.1 million**



THE MINERAL INDUSTRY OF

THE CENTRAL AFRICAN REPUBLIC[1]

By Thomas P. Dolley

In 1993, the Central African Republic's mining industry remained dominated by the production and export of alluvial diamonds of gem quality and the production and export of modest amounts of gold. Indeed, diamonds are the most important commodity produced in the landlocked Central African Republic. Diamond production and export figures for 1993 reached their highest levels in more than a decade. Production increased by about 20% from that of 1992. Accordingly, the monetary value of diamond exports from the Central African Republic rose to $69 million in 1993.[2] Increased production and export of diamonds were due partly to the Government's recent administrative and regulatory reforms with regard to the diamond sector.

Diamond production supports an artisanal labor force of about 40,000, primarily in the riverbeds surrounding Carnot and Berberati, where the stones are more abundant but of lower quality. Additionally, diamonds are mined at Bria. Diamond mining cooperatives also are present in the country. Officially, 9,052 miners were registered in 1992. The balance of the artisanal miners are subject to paying a license fee to the Government.

The highest recorded diamond production, which started in 1925, was in 1968 at 636,000 carats. By mid-1993, the Government was concerned that some foreign diamond companies were not mining in large parts of their concessions. As a result, several existing diamond concessions were further subdivided and new concessions were granted to other firms. Only Canada's Howe Centrafrique Ltd. maintained its entire claim. Two other Canadian firms, Sikaman Gold Resources Ltd. and United Reef Petroleums Ltd., have direct and indirect interest in a 1,000-km^2 and a 1,500-km^2 concession, adjacent to the Mouka Ouadda plateau, respectively.

In general, accurate production and export figures for both diamonds and gold are unavailable due to widespread smuggling. Additionally, Government statistics are underreported, reflecting perhaps only 50% of the total diamond exports and the avoidance of the 12% export tax in effect in 1992. In 1993, the Government reduced the export tax to 10% with the resultant higher legal exports of diamonds. Due to this success, the Government plans to further reduce the export tax to 8% with a new Finance Law in 1994.

Mining legislation in the country was based on the Mining Code, law No. 61/208, of April 11, 1961. The law was subsequently modified, beginning in 1979. Additional amendments have been made to the law to provide guidelines for the ownership, exploitation, possession, and marketing of gold and raw diamonds. Permission of the Ministry of Mines is required for mining and purchasing of precious stones and minerals. Hydrocarbon legislation was based on the Petroleum Code, Ordinance No. 73/016, of February 10, 1973. Rewritten in 1990, the Central African Republic's Investment Code seeks to encourage foreign investment through guarantees against nationalization, expropriation, and freedom from political or economic interference under certain circumstances.

The export market of the country is dominated by diamonds, followed by cotton, coffee, tobacco, and livestock. France remains the major trading partner of the Central African Republic and supplies 50% of total imports. Other European Community (EC) countries are the source of another 14% of imports.

The Central African Republic has no crude petroleum or natural gas production and no hydrocarbon refining capacity. All petroleum needs are imported by the parastatal Petroca. However, a large percentage of petroleum products are smuggled and sold illegally. Crude oil reserves have been indicated in the northern regions of the Central African Republic. Prior seismic exploration activities, conducted between 1975 and 1985 by Petty Ray, Rogers, and Geosource of the United States, were financed by a consortium of oil companies comprised of the Netherland's Royal Dutch/Shell and Chevron, Conoco, and Exxon of the United States. A wildcat well that was drilled at Aoukale between 1985 and 1986, near the Chadian border, revealed no significant hydrocarbon deposit. In mid-1993, Western Atlas International Inc. of the United States was contracted by the Government to supply seismic data to interested foreign investors.

Other minerals found in the Central African Republic include copper, iron ore, limestone, manganese, and uranium. A lack of adequate transportation and industrial infrastructure, to include no railway system, continues to hinder the development of a viable mineral industry in the Central African Republic. However, the diamond and gold sectors should continue to benefit from further Government administrative and regulatory reforms. *(See table 1.)*

[1]Text prepared Apr. 1994.

[2]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF286.50=US$1.00.

TABLE 1

CENTRAL AFRICAN REPUBLIC: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Diamond:							
Gem	carats	334,396	302,530	296,320	307,442	370,000	370,000
Industrial	do.	80,806	78,496	82,323	106,522	125,000	125,000
Total	do.	415,202	381,026	378,643	413,964	[3]495,000	495,000
Gold	kilograms	328	241	176	155	150	300

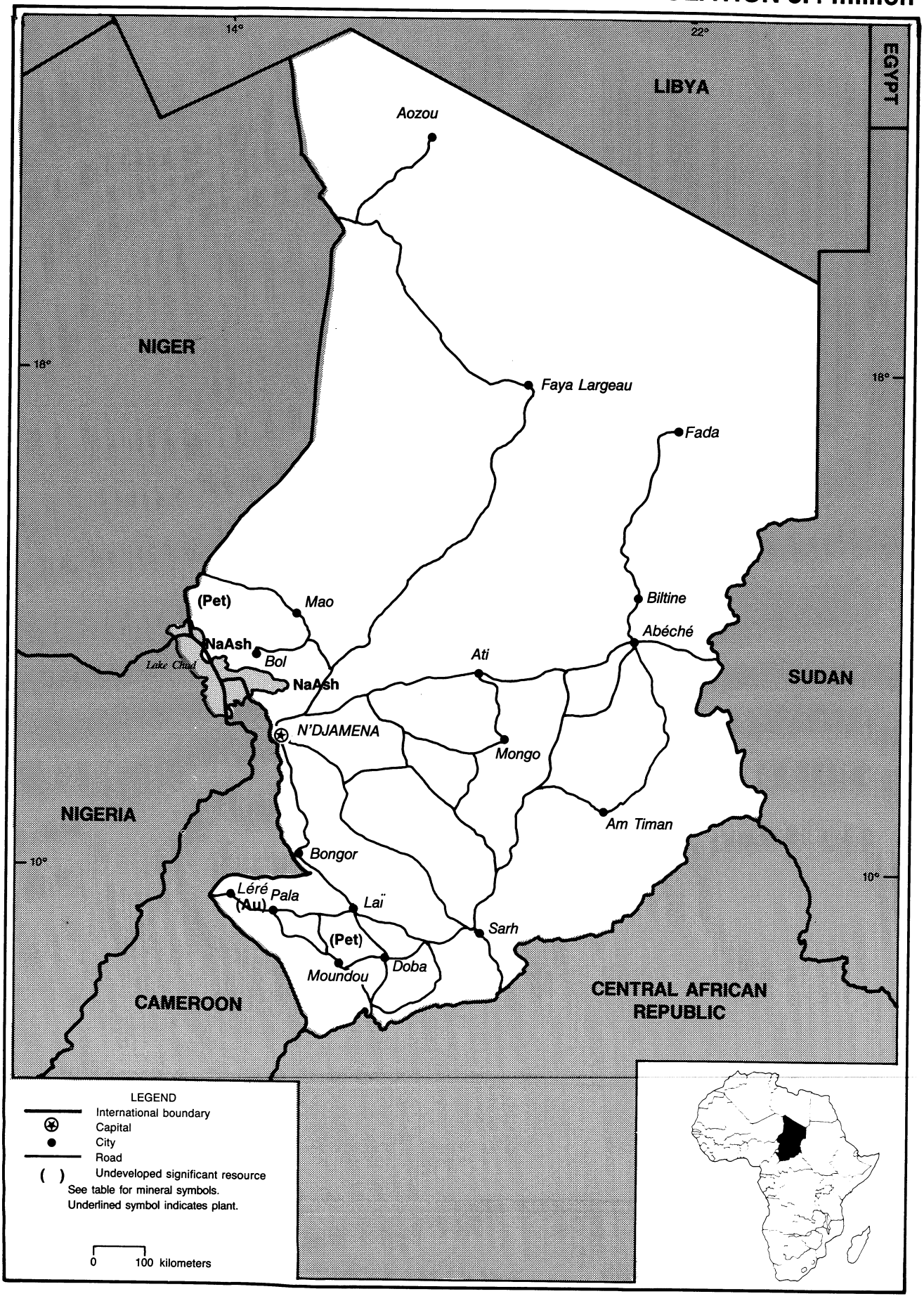
[1]Includes data available through Mar. 31, 1994.

[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]Reported figure.

CHAD

AREA 1,284,000 km² **POPULATION 5.4 million**



THE MINERAL INDUSTRY OF

CHAD[1]

By Thomas P. Dolley

The mineral industry did not play a significant role in the Republic of Chad's economy in 1993. Natron and salt are the only mineral commodities produced, primarily for domestic consumption, and only on a small scale. Agriculture accounted for 45% of the gross domestic product (GDP), which was $1.1 billion in 1991, the last year for which data were available.[2] In early 1994, the International Court of Justice at The Hague rejected Libya's longstanding claim to the supposedly mineral-rich, 45,000-km² Aozou Strip in northern Chad.

The Government encouraged the privatization or liquidation of practically all Government-owned companies and parastatals in 1993. The Government actively encourages foreign investment, but a lack of suitable infrastructure and landlocked geography remain impediments to foreign companies' participation.

Chad's investment code allows for 100% foreign ownership of companies with the exception of those involved in national security and strategic industries. 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. The Government continued to support a mineral policy centered on the exploration and development of domestic hydrocarbons.

Chad has no significant hydrocarbon production. Crude oil was discovered in Chad in 1974 at Sedigi, north of Lake Chad, about 300 km from N'Djamena. In 1989, Esso Chad, a consortium of Royal Dutch/Shell, Chevron, and Exxon of the United States, confirmed the presence of crude oil with reserve estimates of 10.5 Mbbl. In early 1993, France's Société Nationale Elf Aquitaine purchased the 20% interest held by Chevron in the consortium. Pending funding, the proposed construction of an oil pipeline from Sedigi to a microrefinery in N'Djamena, to include oilfield development and a pipeline extension to an export terminal in Cameroon, was on indefinite hold.

Petroleum products consumed in Chad are exclusively imported from Nigeria and Cameroon. Lacking railway or pipeline facilities, importation of petroleum in Chad is by trucks, which are privately owned and operated. Distribution of the majority of petroleum products is through Shell Oil Corp. and Mobil Oil Corp. of the United States and Total of France. However, smuggling of petroleum products into Chad from Nigeria and Cameroon is significant. In the past several years, illegal fuel importing has undercut the profits of the major petroleum importing companies in Chad. Jet fuel is the only petroleum commodity that is not extensively smuggled, owing to stricter international controls.

Traditional fuels such as wood are still heavily utilized in Chad. All electrical power is produced by diesel generators utilizing imported fuel. Total installed electric generating capacity, managed by Société Tchadienne d'Energie Electrique, amounted to 38 MW. Only the major cities of N'Djamena, Moundou, and Abéché possess electric power and are not interconnected. The communications network infrastructure is embryonic. Chad has no railroad or river port facilities. The country's predominantly landlocked commerce relies heavily on roadways, of which only about 300 km is paved for intracountry and intercountry trade. According to the United Nations, though the geology of Chad has been incompletely examined, some small alluvial gold deposits exist, along with diatomite and natron.

The continued depletion of water in Lake Chad has worsened environmental problems in the country. Representing an important resource for people in the area, Lake Chad provides fish and natron. In the past several years, Lake Chad has shrunk from its earlier extent of 25,000 km² to the current 500 km².

Civil war, drought, famine, lack of infrastructure, and recurrent political instability remain detrimental to foreign investment in Chad. A short-term strategy for mineral development in Chad should emphasize development of industrial minerals and hydrocarbons to satisfy domestic requirements.

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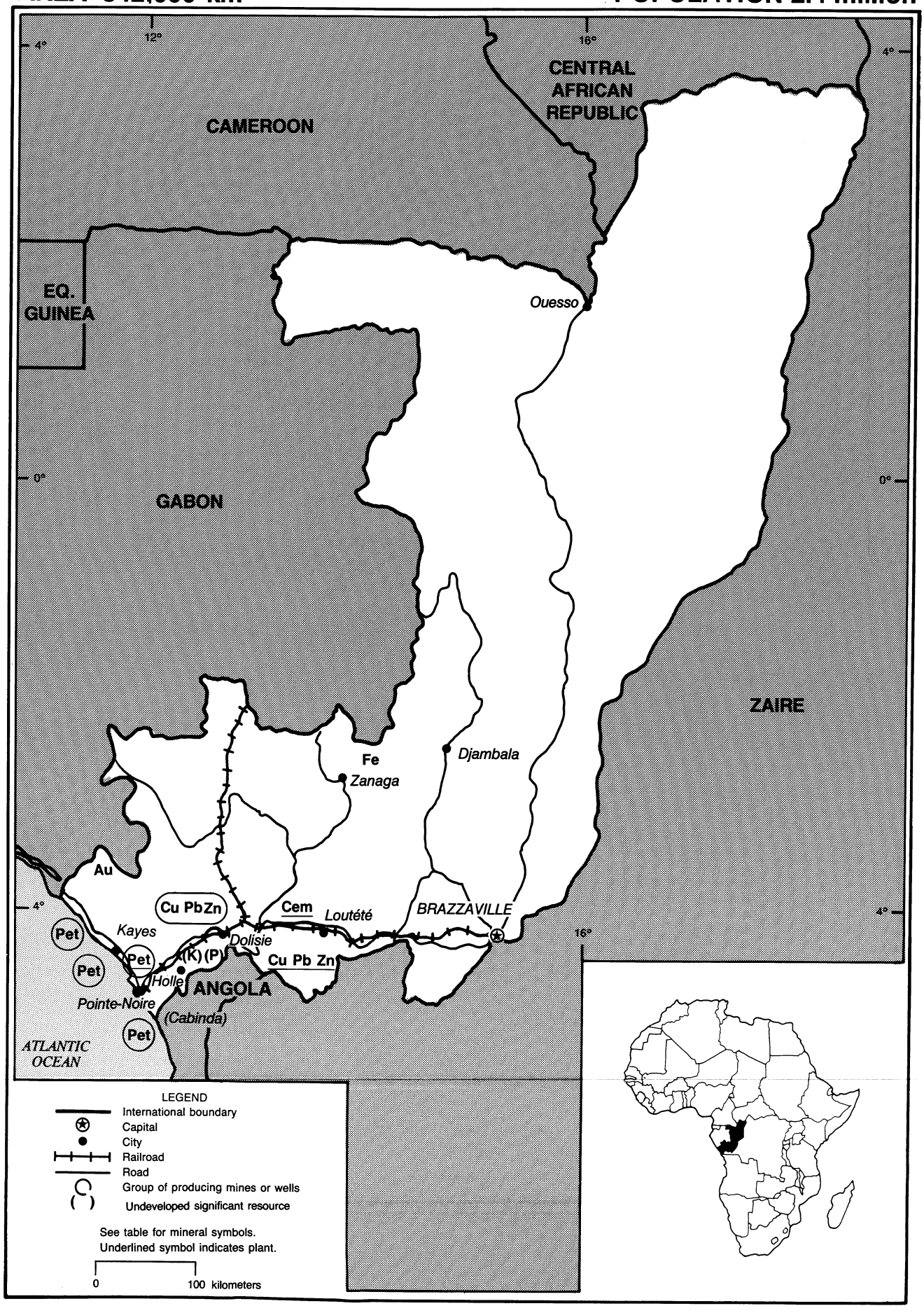
[1]Text prepared Apr. 1994.

[2]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF286.50=US$1.00.

CONGO

AREA 342,000 km² **POPULATION 2.4 million**



THE MINERAL INDUSTRY OF

CONGO[1]

By Thomas P. Dolley

Crude petroleum production and export remained the most important economic activity in the Republic of the Congo in 1993. Typically, crude petroleum and natural gas generate approximately 90% of Congo's export earnings. Congo's gross domestic product (GDP) was about $2.5 billion[2] in 1991, the last year for which data were available. Crude oil production increased over that of the previous year and is expected to rise further by the close of the decade. New hydrocarbon discoveries are in the development stages and will eventually contribute to overall production. More than 90% of oil production comes from offshore sources, with onshore production contributing only about 63 kbbl in 1993.

The production of other minerals, specifically copper, gold, lead, and zinc, has declined or been terminated for an indefinite period. Small private firms involved in gold mining have been closing, which is one reason for the mining downturn. Officially reported gold production generated about $48,000 in 1992.

During the year, the Government proceeded with economic austerity measures, to include beaucratic streamlining. Privatization of parastatals is in an embryonic stage. The Government actively encourages foreign investment. The investment code of 1992 should facilitate increased business activity and profit reinvestment through tax breaks and easing the bureaucratic process. Mining legislation in 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 Government has planned to draft a new hydrocarbons code in 1994 to increase incentives for oil companies currently operating in Congo and to facilitate new investment by other interested companies.

Created in 1979, the Government parastatal Société Congolaise de Recherche et d'Exploitation Minière is involved with the exploitation of all nonfuel ores and minerals. Hydro-Congo is the state-owned petroleum company, and Société de Cimenterie du Congo is the parastatal charged with cement production and sales.

The United States remained a major importer of Congolese crude oil in 1993. Investment by U.S. companies is primarily in the petroleum sector; however, Amoco of the United States was to sell its asset in the Yhombo Field in 1994. France supplies about 50% of Congo's imports, which include heavy machinery, vehicles, clothing, medicines, consumer goods, business equipment, and foodstuffs. Owing predominantly to transport costs, the United States accounts for only 2% to 4% of Congo's total imports.

Congo is not a member of Organization of Petroleum Countries (OPEC) and is not subject to OPEC-imposed production quotas. Foreign companies and expertise play a primary role in the continuing development of the hydrocarbons sector. Two main companies manage the vast majority of petroleum production in Congo. France's Société Nationale Elf Aquitaine (Elf), operating through its subsidiary Elf-Congo, was the primary petroleum producer with about 71% of Congo's total crude oil output at approximately 43 Mbbl in 1993. Elf's most prolific oilfield in Congo is the offshore Tchibouela Field, which produced about 14 Mbbl in 1993. Accounting for much of the remaining 29% of Congo's 1993 oil production, at 18 Mbbl, is Italy's Azienda Generali Italiana Petroli S.p.A. (Agip-Congo). Agip-Congo's most prolific oilfield in Congo is the offshore Zatchi Field, which produced more than 7 Mbbl in 1993.

Estimated petroleum reserves in Congo totaled 340 Mbbl; however, this figure will fluctuate as new oilfield discoveries come on-line and as declining fields close. Reserves of natural gas have been estimated at 77 billion m^3, representing about 0.05% of the world's total reserves. In the past, mineral surveys have been conducted in Congo, but are largely incomplete. The Government's Ministry of Mines stated that exploitable minerals in Congo include copper, diamonds, gold, and platinum. Coastal deposits of phosphate and potash have yet to be fully exploited. Additionally, deposits of bentonite, granite, gypsum, kaolin, marble, and talc also are found in Congo. One of the largest impediments to mineral development in Congo is the embryonic state of the transportation infrastructure. By yearend 1993, the Ministry of Mines was seeking interested companies to conduct a mineral survey of Congo.

Environmentally, the Congo has experienced some offshore oil spills and a decline in forest ecosystems in recent years. Unregulated logging has destroyed some forest animal habitats. Congo is second only to Zaire in the range of its tropical forests, accounting for 62% of the country's territory. By yearend 1993, the World Bank alerted the Government to prevent the construction of a toxic waste dump by a foreign company. *(See table 1.)*

[1]Text prepared May 1994.

[2]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF286.50=US$1.00.

OTHER SOURCES OF INFORMATION

Ministry of Mines
Director of Mineral Resources
Brazzaville, Congo
Telephone: (242) 83 58 73
Fax: (242) 83 62 43

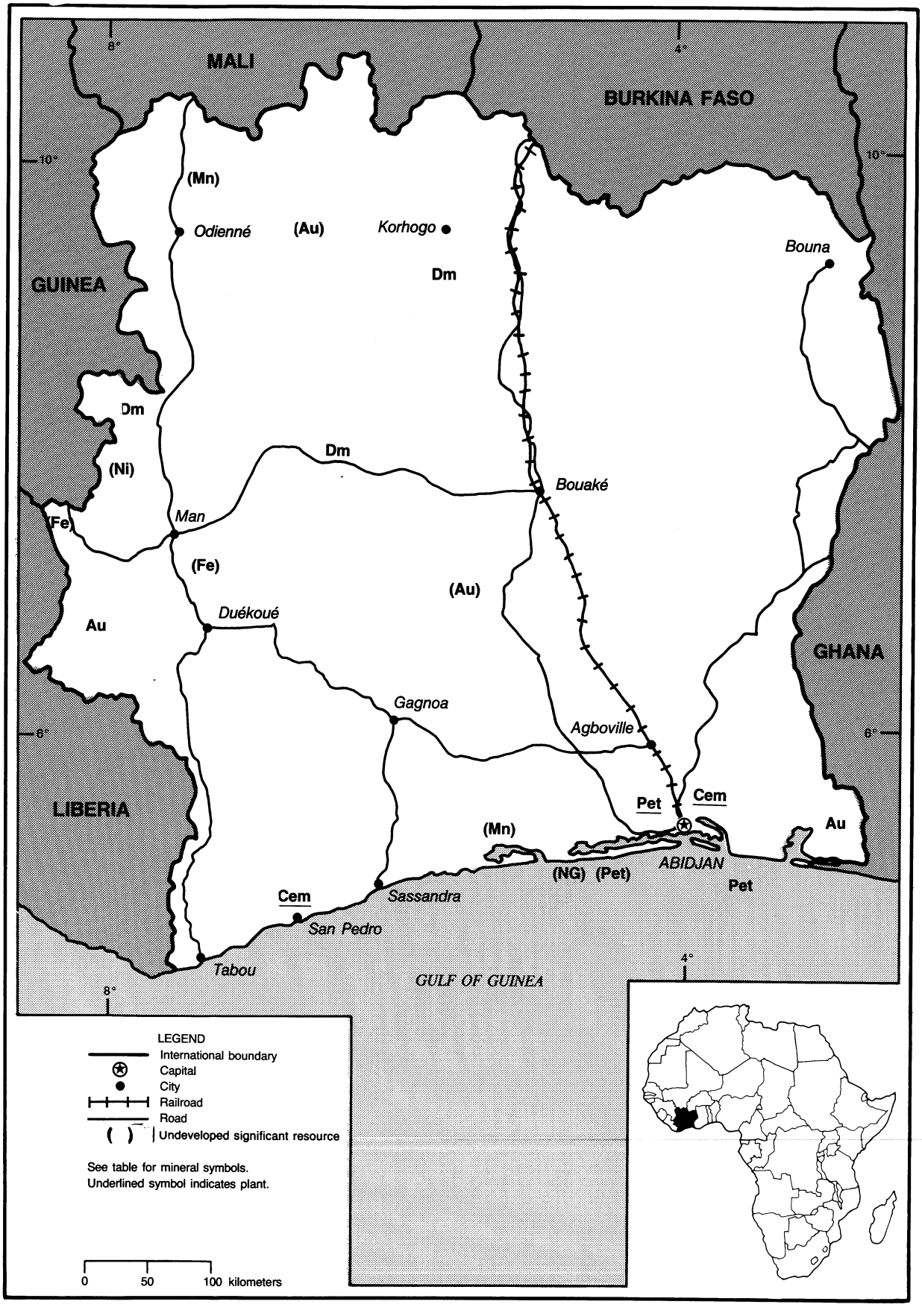
TABLE 1
CONGO: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic	metric tons	121,690	90,326	102,571	114,854	114,000	121,000
Gas, natural:[e]							
Gross	million cubic meters	368	368	368	360	360	368
Marketed	do.	350	350	350	350	350	350
Gold, mine output, Au content	kilograms	6	7	12	5	5	12
Lime	metric tons	398	298	300	240	240	390
Petroleum, crude	thousand 42-gallon barrels	55,000	58,765	56,575	58,035	[3]61,000	58,000

[e]Estimated.
[1]Includes data available through Mar. 31, 1994.
[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]Reported figure.

CÔTE D'IVOIRE

AREA 322,460 km² **POPULATION 13.8 million**



THE MINERAL INDUSTRY OF

CÔTE D'IVOIRE[1]

By Thomas P. Dolley

Primarily an agrarian economy, Côte d'Ivoire has a mineral industry that contributes less than 2% to the nation's gross domestic product (GDP). The 1992 GDP was $10.17 billion, the last year for which data were available.[2] Mineral production in Côte d'Ivoire is dominated by gold and diamonds. As of 1993, the mining, exploration, and development of gold deposits are the primary focus for the minerals industry. During the year, the 50% devaluation of the Communauté Financière Africaine franc and concomitant social unrest placed pressure on the Government. In an effort to stabilize the economy, financial assistance has been provided by the International Monetary Fund and the World Bank.

The Government actively encourages the responsible development of the country's mineral resources. The basic mining law of Côte d'Ivoire was the Mining Code (Law No. 64-249) of July 3, 1964. In the hydrocarbons arena, several amendments have been made up through 1990 to the Petroleum Code (Law No. 70-849) of August 3, 1970. The Government recently reduced its income tax rate for the petroleum industry from 50% to 35% to encourage offshore exploration activities.

New legislation featuring comprehensive fiscal reform should benefit the mining sector. Typically, an exploration permit is valid for 7 years, with one extension. Mining rights are in effect for the commercial life of an operation. In 1993, the value added tax for extracted gold and diamonds has been reduced from 5% to 3%. No export tax exists for metals or ores.

The Government's Ministry of Mining and Energy holds the primary role of mineral development in Côte d'Ivoire. The Ministry of Mining and Energy has 100% of equity ownership in the parastatal Société pour le Développement Minier 'de la Côte d'Ivoire (SODEMI). SODEMI promotes the exploration and exploitation of mineral resources other than hydrocarbons in the country. Société Nationale d'Opérations Pétrolières de la Côte d'Ivoire (PETROCI) is the parastatal charged with managing the hydrocarbons sector.

Côte d'Ivoire's primary exports are cocoa and coffee. Typically, mineral commodities account for only about 14% of the country's total exports. Approximately 84% of these mineral exports are refined petroleum products from imported stocks.

In Côte d'Ivoire, gold is mined by two foreign companies in joint ventures with SODEMI. The first company is Société des Mines d'Afema (SOMIAF), an equity joint venture between SODEMI at 32% and Eden Roc Mineral Corp. of Canada at 68%. Eden Roc Mineral Corp. is 58% owned by Canada's Marshall Minerals Corp. SOMIAF operates the open pit Aniuri Mine, utilizing heap-leach recovery, 120 km east of Abidjan. Production commenced in 1992, and output for 1993 was about 1,200 kg. SOMIAF reported that gold reserves in ore bodies, including and within 10 km of the Aniuri Mine, total 5.5 Mmt averaging 4.52 g/mt gold. The reserves are equivalent to about 25,000 kg contained gold. The second gold operation is another open pit gold mine, 90 km southwest of Man and operated by Société des Mines d'Ity (SMI), has been in production since 1991. SMI has equity ownership by SODEMI at 60% and France's Cie. Française de Mines at 40%. Lateritic ores that are exploited there are heap leached and contain 15 tons of gold with the ore averaging 7 g/mt. Artisanal gold activity exists in Côte d'Ivoire, but production figures and smuggling are clandestine and unreported. Additionally, diamond mining within the country is almost entirely artisanal.

By yearend 1993, Canada's Trillion Resources Ltd. and Falconbridge Ltd. had signed a joint-venture agreement with SODEMI for a 3-year exploration program in the Biankouma nickel deposits in western Côte d'Ivoire. The equity venture breakdown is Falconbridge Ltd. at 60%, Trillion Resources Ltd. at 15%, and SODEMI at 25%. Falconbridge Ltd. expects to spend $1.5 million on the nickel project. Specific reserve details are not currently available, but the deposit is supposedly world class in extent and grade.

Côte d'Ivoire is an insignificant producer of crude petroleum. However, as of late 1993, wildcat offshore petroleum exploration in the western Gulf of Guinea by United Meridian Corp. of the United States has revealed a significant oil, condensate, and natural gas find. Additionally, a consortium of French and U.S. companies, in conjunction with PETROCI, was continuing with the development of the offshore Foxtrot natural gas field. The project aims to supply natural gas for power generation and refining operations in Abidjan. Total throughput refining capacity at Côte d'Ivoire's sole petroleum refinery is 50 kbbl/d.

Mineral resources in Côte d'Ivoire are considerable, particularly in variety, as is the geology that hosts these deposits. In addition to gold and diamonds, which are currently the targets of exploration, other minerals found in Côte d'Ivoire include cobalt, copper, ilmenite, iron ore, manganese, monazite, rutile, tin, and tungsten. *(See table 1.)*

[1]Text prepared May 1994.
[2]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF286.50=US$1.00.

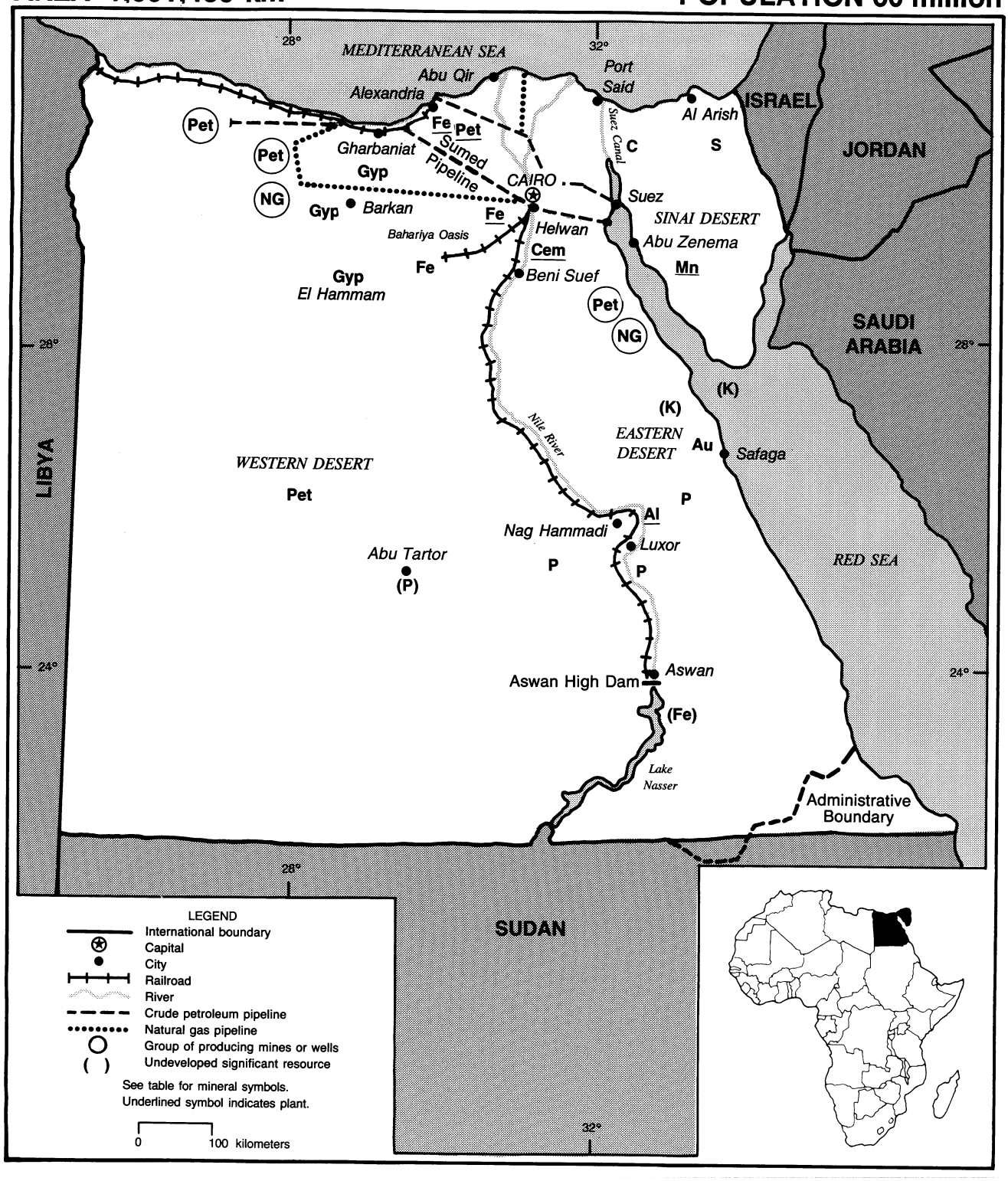
TABLE 1
CÔTE D'IVOIRE: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Cement[3]	thousand metric tons	e500	500	500	510	500	770
Diamonde [4]	carats	[5]11,689	12,000	15,000	15,000	15,000	20,000
Gold[4]	kilograms	13	20	1,100	1,500	1,500	1,500
Petroleum:							
Crude	thousand 42-gallon barrels	771	770	730	[6]300	[6]—	770
Refinery products:e							
Motor gasoline	do.	1,794	1,800	1,800	1,800	1,800	3,500
Kerosene and jet fuel	do.	1,538	1,600	1,600	1,600	1,600	3,200
Distillate fuel oil	do.	3,618	3,700	3,700	3,700	3,700	4,300
Residual fuel oil	do.	2,644	2,800	2,800	2,800	2,800	3,500
Liquefied petroleum gas	do.	174	175	175	175	170	170
Other	do.	196	200	200	200	200	200
Total	do.	9,964	10,275	10,275	10,275	10,270	14,870

eEstimated.
[1]Includes data available through Mar. 1994.
[2]In addition to the commodities listed, Côte d'Ivoire produces clays, stone, sand and gravel, and crushed granite 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]Bélier Field shut down in 1992.

EGYPT

AREA 1,001,450 km² **POPULATION 60 million**



THE MINERAL INDUSTRY OF

EGYPT

By Thomas P. Dolley

In 1993, Egypt remained a major industrial minerals producer and an important producer of mineral fuels in north Africa. The Egyptian economy traditionally has been underpinned by petroleum revenues, tourism, remittances from Egyptian workers abroad, and Suez Canal revenues. Of these economic activities, tourism was the most negatively affected by militant Islamic violence in 1993. Generally, the hydrocarbons sector accounts for more than 15% of the gross domestic product (GDP). The GDP for 1992 was $41.2 billion,[1] the last year for which data were available.

GOVERNMENT POLICIES AND PROGRAMS

Mining legislation dated back to the Mining Code law No. 86 of 1956, the evaporite salt Mining law No. 151 of 1956, and the Mining and Petroleum Code law No. 66 of 1953. These laws provide the legal template for mineral exploration and exploitation. Additionally, laws No. 43 of 1979 and No. 50 of 1981 provide the governorates and local councils the power of administration for quarries in their particular districts. The Ministerial Decree No. 8 of 1990 was designed to assist the private sector in obtaining the required permits for mining. The Egyptian General Petroleum Corp. (EGPC) was created under law No. 20 of 1976. Recent 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.

Egypt has one of the largest public sectors in the developing world. Within the framework of its economic reform program, the Government offered for privatization the shares in several cement companies during the year. Shares from two public-sector cement producers, the Helwan Portland Cement Co. and Tourah Portland Cement Co., were offered for sale in 1993. Additionally, shares worth $35.8 million in the El Ameriya Cement Co. were made available for sale during the year. Privatization of some other mining companies also was being planned for the future.

In 1993, the Egyptian Geological Survey and Mining Authority (EGSMA) completed a draft unified law for quarries, mines, and salt operations. However, the draft law was submitted for reexamination to the newly appointed Minister of Industry and Mineral Wealth and thus is unlikely to be ratified by yearend 1994. In addition to providing the private sector with new incentives for mining, highlights of the proposed law are as follows: (1) increasing state revenues by adjusting the fees for mineral exploitation rights concomitant with market value, (2) prohibiting companies from controlling unexploitable quarries under the concessions, (3) clearly defining the role of EGSMA and local districts in mining exploitation, and (4) adopting improved mine safety standards.

Egypt was not a member of the Organization of Petroleum Exporting Countries (OPEC). Thus, a Government commission sets the price per barrel of crude oil to be exported on the 1st and 15th of each month. As of 1992, the Government's pricing formula stipulated that Egypt's benchmark crude oil, Gulf of Suez 33° API, be priced at 60% of the prevailing price of North Sea benchmark crude oil, plus 20% of the value of Iranian heavy crude oil, coupled with 20% of the international assessed value of the Gulf of Suez crude oil.

ENVIRONMENTAL ISSUES

A newly drafted unified environmental law, law No. 4/1994, was ratified in early 1994. The law empowers the Egyptian Environmental Affairs Agency (EEAA) with the right to enforce environmental regulations and standards on all aspects of Egyptian industry. The law also provides for the caveat that any new mining or quarrying projects initially will require an environmental impact assessment. Additionally, the EEAA will strictly protect bodies of air, land, and water from pollution. Extant mining operations will have a 3-year grace period to conform to the new law, and the Government reserves the right to extend this period for 2 years if progress is being made toward compliance with the law.

PRODUCTION

Egypt produces approximately 25 different minerals from more than 600 mines, quarries, and salt deposits. Phosphate rock and iron ore remain the most important, in terms of value and ore grade, nonfuel minerals produced in Egypt. *(See table 1.)*

TRADE

Industrial mineral exports account for approximately 25% of total exports. Total export revenue for 1992 was about $3.6 billion, of which almost 50% is oil export earnings. The value of exported oil in 1993 was $1.14 billion. Nations of the European Union (EU) are by far the largest trading partners with Egypt. Mineral trade operating via the Suez

Canal is critical to the Egyptian economy. The Suez Canal Authority administers the Suez Canal and collects the tolls. The Suez Canal, 193.5 km long, generated about $2 billion in revenue in 1993, despite operating below capacity.

Egypt's primary industrial mineral exports are phosphate rock, aluminum manufactures, coke and semicoke, fertilizers, and salt. Industrial mineral exports amounted to $828.9 million in 1992 and declined to $814.6 million in 1993. Egyptian mineral imports account for 8.8% of total imports. Egypt's mineral imports increased in value from $878.4 million in 1992 to $918.2 million in 1993. Typical mineral imports include chromite, copper, iron and steel products, lead, nickel, silver, tin, titanium, tungsten, and zinc. Industrial mineral imports include asbestos, barite, coal, graphite, pumice, and sulfur.

STRUCTURE OF THE MINERAL INDUSTRY

A cabinet reorganization in November 1993 shifted oversight responsibility for EGSMA from the Ministry of Petroleum to the Ministry of Industry and Mineral Wealth. Virtually all mining and mineral processing in Egypt was carried out by Government-owned mining companies. Egypt's parastatal Mining and Refractories Corp. (Maric) controlled the mining and refractories industries. In turn, Maric controls five major parastatals that dominate the Egyptian mining industry. These companies are the El Nasr Phosphate Co., Red Sea Phosphate Co., Misr Phosphate Co., the Sinai Manganese Co., and the El Nasr Saline Co.

Foreign investors in the mining industry coordinate exploration activities through EGSMA. In the event that a foreign mining investor enters the production stage of development, a joint-venture company is formed with EGSMA. Additionally, EGSMA is actively involved in mineral exploration, particularly in Egypt's desert regions. EGSMA's expenditures for mineral exploration average about $900,000 per year. *(See table 2.)*

COMMODITY REVIEW

Metals

Iron and Steel.—Iron ore is mined in the El Gedida area of Bahariya Oasis in the Western Desert. Primarily high-grade iron ore, at 55% Fe, is mined instead of the lower grade ore also found in the vicinity of Bahariya.

During 1993, the Islamic Development Bank agreed to make a $15 million loan to the Egyptian Iron & Steel Co. for the purchase of equipment to construct a specialty steels plant at Sadat City, located midway between Cairo and Alexandria. Scheduled to commence in 1994, construction of the complex will cost between $120 to $150 million with the first production to start in 1996. Planned production capacity at the plant will eventually be 150 kmt/a.

Manganese.—In March 1993, Sinai Manganese Co. completed the reconstruction of its ferromanganese plant at Abu Zenema on the Sinai peninsula. The plant has a 40-kmt/a production capacity and produces high carbon ferromanganese and slag utilizing ore grading 48% manganese imported from a wide range of countries, including Australia, Brazil, and the Republic of South Africa. The imported high-grade ore is blended with locally mined lower graded manganese, which grades 25% to 40% Mn. More than 50% of the ferromanganese produced is used in Egypt's steel industry. The main export markets for Sinai Manganese Co. are Germany, Japan, Libya, Taiwan, and some Persian Gulf states. The Abu Zenema plant is located at the Suez Canal.

Industrial Minerals

Cement.—After an unsuccessful first round of privatization, the Government planned to offer for sale in 1994 the Ameriya Cement Co., Asyut Cement Co., Helwan Portland Cement Co., and the Tourah Portland Cement Co. All of the aforementioned companies registered a profit in 1993. The nation's installed cement production capacity is approximately 20 Mmt/a. Egypt is virtually self-sufficient in the mineral commodities needed to manufacture cement. However, the industry has been under increasing pressure to address environmental problems.

Phosphate Rock.—Despite delays due to a lack of sufficient funding, the Government was moving ahead with the development of the Abu Tartor phosphate project, the largest industrial mineral project in Egypt. About 50 km west of the Kharga Oasis in the Western Desert, the Abu Tartor project will cost an estimated $900 million. The expected starting date for production at the phosphate operations is yearend 1994. Phosphate production capacity is to be 2.2 Mmt/a at 31% P_2O_5, with the construction of a 650-km railway to transport the phosphate from Abu Tartor to Safaga on the Red Sea coast and housing for 5,000 families at the mine site. Electrical power at Abu Tartor is being supplied from the recently completed 278-km-long high-tension electrical transmission line from the Qena power station in the Nile Valley. Egypt's sole phosphoric acid plant is at Abu Zaabal, northeast of Cairo.

Mineral Fuels

Egypt's planned buildup of its natural gas utilization was given a boost during the year by both a major increase in production and estimated reserve base. Currently, Egyptian natural gas accounts for 28% of total energy consumption in the country. The Government plans to further utilize natural gas resources through improvements in production, transportation, and infrastructure. The Government predicts that over the next 3 years the production of natural gas and its derivatives will increase by an average of 5.2% annually. At yearend 1993, Amoco Corp. of the United States purchased the United Kingdom's British Petroleum's stake in the El Qar'a gasfield in the Nile Delta region.

Nine natural gas plants operate in Egypt in three different regions of the

country. The regions are the Nile Delta, the Mediterranean region with more than 50% of the total output, and the northern edge of the Western Desert with more than 30% of the output. Some associated gasfields are also in production in the Gulf of Suez and the Sinai peninsula.

Reserves

Egypt's crude petroleum reserve estimates vary between 3.5 and 6.3 billion bbl. Natural gas reserves were upgraded during 1993 to 594 billion m^3. Phosphate rock reserves are estimated at 1.27 billion tons. Estimated iron ore reserves total 450 Mmt, with varying grades. Manganese ore reserves total about 1.5 Mmt.

During each year, EGSMA conducts a geological and mineral resource appraisal of the country. In 1993, the survey revealed a coal deposit of an estimated 16 Mmt at Al Rakb, west of the extant Maghara coal deposits on the Sinai peninsula. This new discovery brings total coal reserves on the Sinai to 37 Mmt.

INFRASTRUCTURE

Railways within Egypt total 5,110 km. Roadways total more than 51,925 km, and there is 1,171 km of crude oil pipelines. Electrical generation capacity was 14,175,000 kW. The merchant marine comprises 168 ships totaling about 1.6 Mdwt. Major port facilities are at Alexandria, Bur Safajah, Damietta, Port Said, and Suez.

OUTLOOK

The Government, through EGSMA, is actively reforming bureaucratic procedures to increase foreign mining investment in Egypt. The allowance of 100% cost recovery on mineral resource concession agreements, privatization, along with lower royalty payments should favor future investment. Real reform in environmental issues combined with controlling the Islamic militant movement represent new challenges to the Government in the near future.

[1]Where necessary, values have been converted from Egyptian pounds (£E) to U.S. dollars at a rate of £E3.37=US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

Egyptian Geological Survey and Mining Authority
3 Salah Salem Road
Abbassiya, Cairo
Egypt
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Egyptian General Petroleum Corp.
Osman Abdul Hadiz St.
Box 2130
Nasr City, Cairo
Egypt

Publication

Wali, A. M. A., and B. C. Schreiber. Industrial Minerals of Egypt. Presented at SME Annual Meeting, Salt Lake City, UT, Feb. 26 to Mar. 1, 1990. Society for Mining, Metallurgy, and Exploration, Inc., Preprint 90-77, 1990.

TABLE 1
EGYPT: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991e	1992e	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Aluminum metal		179,500	179,167	[2]177,707	[2]177,838	[2]179,900	179,000
Chromite		[2]2,448	[2]399	[2]649	600	600	2,400
Copper, refined, secondary e		3,600	3,600	3,600	3,600	3,600	4,000
Iron and steel:							
Iron ore and concentrate	thousand tons	2,562	2,405	[2]2,144	[2]2,400	[2]2,190	2,500
Metal:							
Pig iron	do.	1,105	1,100	1,250	1,200	[2]1,130	1,250
Ferroalloys: Ferrosilicon		7,800	7,922	7,900	7,900	[2]40,136	40,000
Steel, crude	thousand tons	2,114	2,235	[2]2,541	2,500	2,500	2,500
Ferromanganese e		—	—	—	10,000	30,000	30,000
Manganese		—	—	—	[2]11,000	15,000	11,000
Asbestos		312	369	[2]450	[2]373	[2]436	450
Barite		7,295	6,197	[2]5,943	5,900	[2]4,094	6,000
Cement: Hydraulic	thousand tons	12,480	4,111	[2]16,427	[2]17,000	[2]16,000	20,000
Clays:							
Bentonite		3,512	4,904	4,900	4,900	[2]14,994	14,900
Fire clay		250,000	128,130	[2]475,359	475,000	[2]421,292	475,000
Kaolin		121,515	49,032	[2]192,870	190,000	[2]156,589	192,000

See footnotes at end of table.

TABLE 1—Continued

EGYPT: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991e	1992e	1993e	Annual capacity e (Jan. 1, 1994)
METALS—Continued							
Feldspar, crude		27,731	9,894	[2]32,636	32,000	38,900	38,900
Fluorspar		1,721	1,249	[2]1,790	1,700	[2]773	1,800
Gypsum and anhydrite, crude		1,309,426	1,229,000	[2]1,238,519	1,200,000	[2]1,199,068	1,300,000
Lime e		95,000	67,650	[2]749,421	749,000	[2]747,636	749,000
Ammonia, N content	thousand tons	728	735	[2]863	[2]943	[2]941	860
Phosphate: Phosphate rock	do.	1,347	1,143	[2]1,652	[2]2,000	[2]1,585	2,000
P_2O_5 content	do.	e337	e286	e413	e500	e390	500
Salt, marine	do.	1,162	989	[2]891	890	[2]972	1,100
Sodium compounds:							
Soda ash		47,000	52,180	[2]51,817	51,000	[2]50,492	52,000
Sodium sulfate		45,677	41,418	[2]41,110	41,000	[2]25,600	45,000
Stone, sand and gravel:							
Basalt	thousand cubic meters	873	870	[2]1,016	1,000	[2]551	1,000
Dolomite e	thousand tons	500	500	[2]910	900	[2]952	1,000
Granite, dimension	cubic meters	21,487	21,000	[2]10,496	10,000	[2]12,856	21,000
Gravel	thousand cubic meters	11,527	11,000	11,000	11,000	[2]7,177	11,000
Limestone and other calcareous n.e.s.	do.	16,347	286	280	[2]18,000	[2]18,093	18,000
Marble blocks (including alabaster)	cubic meters	27,857	743	[2]57,960	57,000	[2]15,752	58,000
Sand:							
Industrial sand (glass sand)	thousand tons	41	507	500	500	[2]743	750
Construction sand	do.	18	26,004	26,000	26,000	[2]21,684	26,000
Sandstone	thousand cubic meters	316	e300	[2]182	180	180	300
Sulfur:							
Elemental, byproduct e		7,600	7,600	7,600	7,600	[2]4,100	7,600
Sulfuric acid		31,000	65,268	[2]101,000	100,000	[2]100,000	101,000
Talc, steatite, soapstone, pyrophyllite		7,146	6,340	[2]9,091	9,000	[2]2,091	9,000
Vermiculite		272	28	[2]519	500	[2]942	500
MINERAL FUELS AND RELATED MATERIALS							
Coke: Oven and beehive	thousand tons	930	1,077	[2]1,210	1,000	[2]1,180	1,200
Gas, natural:							
Gross production	million cubic meters	9,542	9,620	[2]9,620	9,600	[2]13,428	13,500
Marketed e	do.	8,749	8,800	8,800	8,000	12,000	12,000
Dry	do.	7,730	7,900	7,900	8,000	8,000	8,000
Petroleum and refinery products:							
Crude	thousand 42-gallon barrels	310,980	9,375	[2]320,470	[2]317,805	[2]322,660	327,000
Refinery products: e							
Gasoline and naphtha	do.	27,000	[2]18,615	18,000	18,000	18,000	27,000
Kerosene and jet fuel	do.	20,000	[2]21,170	21,000	21,000	21,000	21,000
Distillate fuel oil	do.	30,000	[2]29,565	29,000	29,000	29,000	30,000
Residual fuel oil	do.	60,000	[2]18,110	78,000	78,000	78,000	78,000
Lubricants	do.	1,000	[2]1,460	1,000	1,000	1,000	1,400
Liquefied petroleum gas	do.	5,000	[2]4,015	4,000	4,000	4,000	5,000
Asphalt	do.	2,000	6,000	6,000	6,000	6,000	6,000
Unspecified	do.	4,500	8,000	18,000	18,000	18,000	18,000

See footnotes at end of table.

TABLE 1—Continued

EGYPT: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991e	1992e	1993e	Annual capacity e (Jan. 1, 1994)
Petroleum—Continued:							
Refinery products—Continued:							
Refinery fuel and losses	thousand 42-gallon barrels	6,500	[2]8,760	8,000	8,000	8,000	8,000
Total e	do.	156,000	185,695	183,000	183,000	183,000	194,400

eEstimated.
[1]Table includes data available through Mar. 1994.
[2]Reported figure.

TABLE 2

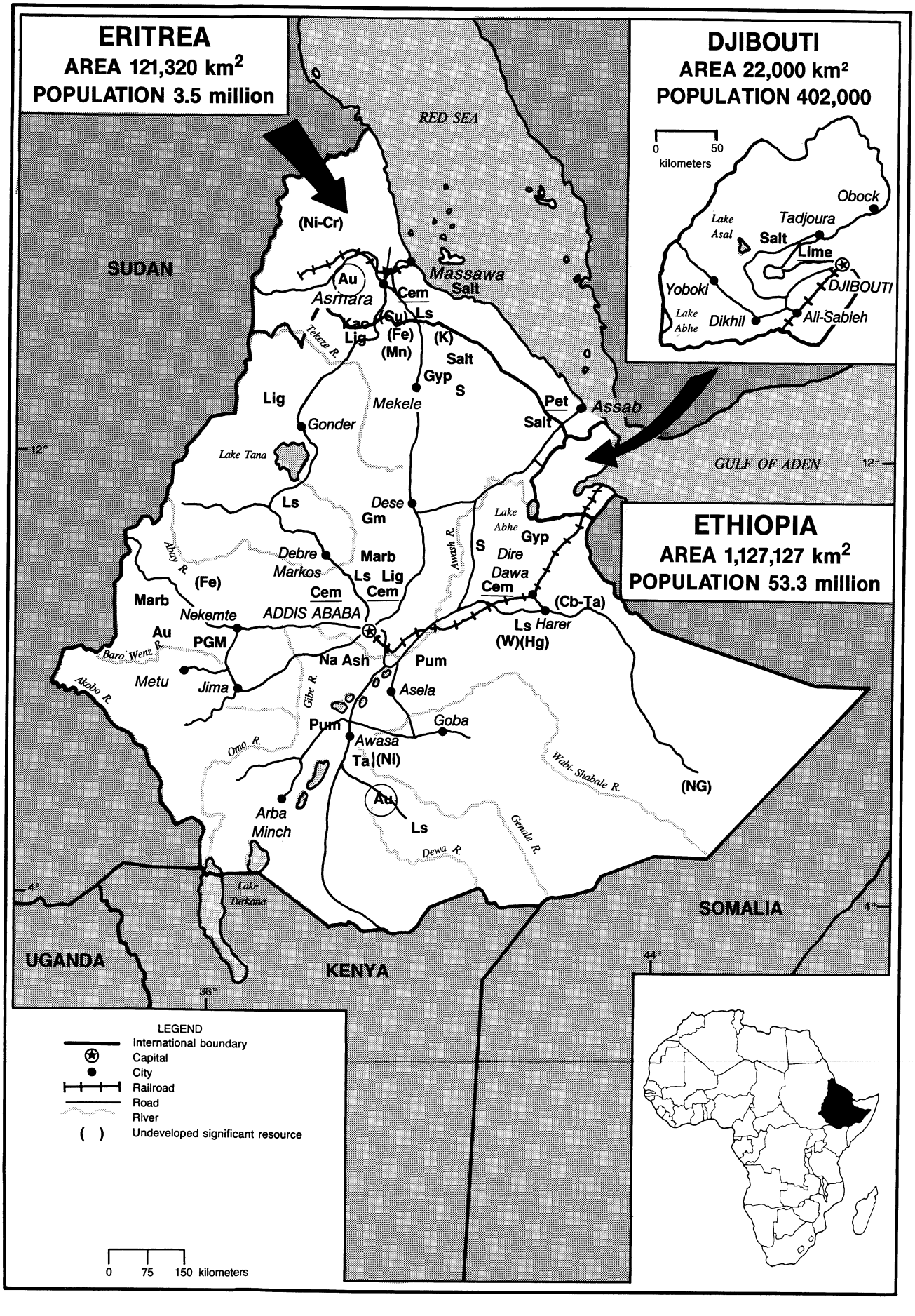
EGYPT: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Major commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum		Aluminum Co. of Egypt (Government, 100%)	Nag Hammadi	179.
Cement		Helwan Portland Cement Co. (Government, 100%)	Helwan	1,400.
Do.		Tourah Portland Cement Co. (Government, 100%)	Tourah	1,400.
Fertilizers		Societe d'Engrais & d'Industries Chimiques Chimiques (Government, 100%)	Talkha	1,370 (nitrogen).
Do.		do.	Abu Qir	900 (nitrogen).
Iron		Egyptian Iron and Steel Co. (Government, 100%)	Helwan steel plant	1,500.
Petroleum, crude	million 42-gallon barrels	Egyptian General Petroleum Corp., (Government, 100%) and Amoco Egypt Oil Co.	El Morgan, Suez Gulf	42.
Do.	do.	do.	July, Suez Gulf	51.
Do.	do.	do.	Ramadan, Suez Gulf	37.
Petroleum, refined	do.	Suez Oil Processing Co. (Government, 100%)	Mostorod	28.5.
Do.	do.	Alexandria Petroleum Co. (Government, 100%)	Alexandria	23.4.

ETHIOPIA, ERITREA, AND DJIBOUTI

AREA 1,221,900 km² **POPULATION 53.3 million**



THE MINERAL INDUSTRIES OF

ETHIOPIA, ERITREA, AND DJIBOUTI[1]

By Lloyd E. Antonides

ETHIOPIA

Although mineral commodities historically contributed little to Ethiopia's gross national product, the Transitional Government established in mid-1991 was actively promoting further mineral development and in June 1993 introduced two new mining laws. They were designed to offer low royalties, exemption from custom tariffs, liberal foreign currency transfer and exchange provisions, reasonable tax regulations, and other competitively attractive benefits.

The Government presented a rather thorough review of the industry, including policy on mining and mining investment, as well as geology, status of mapping, mineral commodity occurrences, infrastructure, and other pertinent background information in a paper at the African Mining Conference in Denver during June 1994. The organizer was the Multilateral Investment Guarantee Agency (MIGA), a World Bank unit that offers investment insurance against certain political risks. A comprehensive set of investment promotion documents on gold, other minerals, country and economic information, and geology and mining were to be issued in September 1994 by a U.S. consulting firm under contract with the Government, funded by the United Nations (UN).

Construction materials, including cement, probably continued to be the most significant mineral commodity group both in value and quantity of production in Ethiopia during 1993. Gold remained the principal export revenue-earning mineral commodity. A variety of other metallic and industrial minerals also was produced. (*See table 1.*) However, after the independence of Eritrea in May 1993, all petroleum refinery products, most of the salt, some artisanal gold, and a small portion of the cement were no longer part of Ethiopia's mineral production.

Many additional valuable minerals, such as natural gas, potash, phosphate, and lignite, are known to occur in deposits of potentially economic size and grade in various parts of the country, which was almost twice the size of Texas. A mountainous high plateau in the northwestern half of the country is capped mostly by thick Tertiary basalt flows rather barren of valuable mineral deposits. But Precambrian basement, hosting many metallic and industrial mineral resources, is exposed below Meszoic sediments in deep river gorges, as well as in the far northern highlands and in the western and southern lowlands. In general the highlands are well-watered as are those lowlands, much of which are covered by rain forest. Drainage, with high potential for hydroelectric power, is mostly westward into the Nile River system. Cutting off the southeastern fourth of the highlands and splitting the country about in half, a major rift valley extends southwesterly from Djibouti in the northeast to Lake Turkana in the southwest. That steep-walled valley, underlain by Tertiary and Quaternary volcanics and sediments, at places below sea level, is the locale for a number of evaporite and other industrial mineral deposits, salt lakes, and geothermal sources. The eastern third of the country, mainly covered by Mesozoic sediments, is a dry southeasterly sloping plain that offers construction materials sources and oil and gas targets. Oil and gas evidence also was found in the lowlands along the southwestern border with Sudan.

Gold production was expected to increase. The major mine, the Government-owned Lega Dembi open pit primary gold operation, 350 km south-southeast of Addis Ababa, was planning a $50 million expansion to be funded by the African Development Bank (ADB). In June 1993, a French geophysical company won a $2.2 million contract for survey work in the same region, funded by a UN agency. In mid-1994, the Government invited proposals for development of four unidentified gold deposits, probably in the same area as Lega Dembi, but some could be in a known area 400 km west of Addis Ababa.

Phosphate production viability from the Bikalal apatite-magnetite deposit about 300 km west of Addis Ababa is to be studied using a $1.8 million grant from ADB. The Government also announced plans to study an iron ore production project for the same deposit.

Geothermal-generated electricity for the town of Adami Tulu, about 150 km south of Addis Ababa near Lake Langano, studied since the mid-1980's, came closer to realization early in 1994 with a Government invitation for proposals on design-construction.

Natural gas from the Calub Field in the Ogaden region in the southeast was to be used to produce liquid fuels (liquefied petroleum gas, gasoline, kerosene, and diesel oil) in a $130 million project. The project received pledges of a $74 million loan from the World Bank's International Development Association and a $4 million grant from the Netherlands Government. It was expected the ADB would cover the road rehabilitation costs of $20 million, and other donors would grant $5 million for community

development. The Government was to provide the balance of financing as needed. Shares in the new company were alloted about equally to private Ethiopians, foreign investors, and the Government.

Petroleum exploration activity continued with International Petroleum Corp. in the west on the Sudan border, Hunt Oil Co. in the south, and Maxus in the east. In June 1994, the Government offered production-sharing agreements on 13 blocks in the Ogaden.

ERITREA

The small minerals production was not an important factor in Eritrea's economy even though the economy was at a bare subsistence level in the rather mountainous, semiarid, Pennsylvania-sized country. The former Italian colony (1890-1941), then Ethiopian province, and subsequently autonomous region, was officially declared independent of Ethiopia in May 1993 shortly after a referendum that followed a 30-year civil war that ended in 1991. But the Government was making an effort to offer attractive features to foreign investors and was especially interested in the mining and petroleum sectors, which were considered to have good potential for improving the economy. A petroleum code was issued in July 1993, and a mining code was in final review early in 1994. Establishment of a geological survey agency was being pursued with Australian assistance, and a thorough review of mineral occurrences was being prepared.

Mineral commodity production statistics were not available but facilities reported to exist in early 1994 were: an 18,000-bbl/d petroleum refinery at Assab on the Red Sea; a 45,000-mt/a cement plant at Massawa, the country's main Red Sea port; and solar sea salt plants near Massawa and Assab, said to have respective capacities of about 30,000 mt/a and 120,000 mt/a; as well as dimension stone (granite and other) quarries and sources of silica sand and other raw materials for a 20-mt/d glassworks. Artisanal gold production was estimated at about 300 kg/a of unspecified purity from unidentified types of deposits in the southwestern hills. Small quantities of lignite presumably were also mined southwest of Asmara. Additional mineral occurrences characterized as having some potential for development included: many primary gold deposits in quartz veins and schists of the Precambrian terranes just west of Asmara in the less arid central highlands; a small but high-grade deposit of sulfide copper with other metallic minerals in similar rocks south of Asmara; potash extending from Ethiopia in the arid below sea level Danakil depression of sedimentary rocks southeast of Asmara; and petroleum in the sedimentaries all along the mostly desert coastal plain and in the Dahlak Islands off Massawa. Several U.S. and European oil producers were reported discussing oil and gas concessions early in 1994.

A reasonably adequate infrastructure suffered severe war damage but was steadily being rehabilitated with financial assistance from a number of countries in the European Community. The work force was generally considered to have a large component that was rather industrious and self-disciplined with reasonably broad skills, Asmara and Massawa having been significant manufacturing and commercial centers for many years.

DJIBOUTI

The mineral industry was never a significant part of Djibouti's gross domestic product (GDP), more than $400 million in 1993, of which 70% was services related to free trade port activities, banking, government, and support of a French military contingent. Less than 5% of GDP was attributed to agriculture, mostly stock breeding, in the arid climate and poor soil of the rather hilly, Massachusetts-sized country. However, the Government was trying to attract foreign investors and demonstrated a keen interest in developing the mineral potential.

The few reports on mineral activity available indicated entrepreneural production of small but unspecified quantities of solar-evaporated sea salt, limestone (some of which was at least periodically calcined to lime), and construction materials, including clays, sand, gravel and crushed stone, as well as some marble and granite dimension stone. Other minerals of economic interest include gypsum, perlite, pumice, and diatomite, and especially geothermal fluids, gold, and possibly petroleum.

At yearend 1993, the ADB planned funding $1 million of a $1.7 million study to be tendered by the Ministry of Industry, Energy and Mining on the feasibility of any specific mineral production and on establishing a mining bureau. In January 1994, the U.S. Geological Survey made a proposal to the UN Development Program for a $500,000 feasibility study on gold production from deposits related to hydrothermal fluids associated with the Red Sea crustal rift, but shortage of funds resulted in no action as of mid-1994. A project funded in 1989 by the World Bank and others to generate electricity based on heat from geothermal fluids was never implemented and was canceled at yearend 1992 because confinanciers failed to agree on the program. In earlier work, plugging of the geothermal wells by base metal depositions was of interest and a concern.

[1]Text prepared Aug. 1994.

OTHER SOURCES OF INFORMATION

Ethiopia
Ministry of Mines and Energy
P.O. Box 486
Addis Ababa, Ethiopia
Telephone: 251-151-8250
Facsimile: 251-151-5054

Eritrea
Ministry of Energy, Mining and Water Resources
P.O. Box 5285
Asmara, Eritrea
Telephone: 291-111-6872
Facsimile: 291-112-7652

Djibouti
Ministry of Industry, Energy and Mining
P.O. Box 175
Djibouti, Djibouti
Telephone: 253-350-340
Facsimile: 253-350-174

TABLE 1

ETHIOPIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992e	1993e	Annual capacity e (Jan. 1, 1994)
Cement, hydraulic e		370,000	3340,000	290,000	320,000	350,000	400,000
Clays: e 4							
Brick		8,000	17,000	14,000	15,000	15,000	20,000
Kaolin (China clay)		390	670	370	420	500	1,000
Diatomite e		10	3 3	3 1	5	10	25
Gold: Mine output, Au content	kilograms	745	848	3 3,038	3 2,224	3 3,387	4,000
Gypsum and anhydrite, crude e 4 5		2,100	2,250	1,750	2,650	2,500	2,500
Lime		145	70	45	100	100	200
Petroleum refinery products: 6							
Liquid petroleum gas	thousand 42-gallon barrels	74	65	e 40	3 30	50	50
Gasoline	do.	1,060	904	e r 800	3 370	700	800
Jet fuel	do.	503	400	e r 300	3 210	300	400
Kerosene	do.	82	40	e 60	3 —	50	50
Distillate fuel oil	do.	1,534	1,409	e r 900	3 680	1,000	1,300
Residual fuel oil	do.	2,412	2,271	e r 1,200	3 980	1,600	2,100
Other	do.	50	468	e r 300	3 260	300	300
Total	do.	5,715	5,556	e r 3,600	3 2,530	4,000	5,000
Platinum: Mine output, Pt content e	grams	1,500	1,500	1,000	500	1,000	1,500
Pumice e 4		23,000	23,000	37,000	49,000	40,000	50,000
Salt: e							
Marine		100,000	100,000	85,000	100,000	120,000	150,000
Rock		10,000	10,000	8,000	10,000	10,000	15,000
Scoria e		10,000	10,000	8,500	8,000	8,000	15,000
Soda ash, natural		e 500	1,408	18,465	500	3 248	20,000
Stone, sand and gravel: e 4							
Construction stone, crushed	thousand tons	4,630	1,560	2,640	860	1,000	5,000
Dimension stone		600	3,300	2,800	2,000	3,000	4,000
Limestone[5]	thousand tons	150	100	90	100	100	200
Sand	do.	780	1,250	1,000	700	1,000	1,500
Tantalite, concentrate (40% to 60% Ta_2O_5)		—	6	10	14	3 17	20

eEstimated. rRevised.

[1]Data are for year ending July 7 of the year listed. Includes data available through Aug. 1, 1994. For 1993, some production (particularly cement, gold, petroleum refinery products, salt, and stone) may be in Eritrea, which became independent in May 1993.

[2]In addition to the commodities listed, some lignite and semiprecious gemstones reportedly were produced and some additional artisanal gold and crude construction materials (clays, sand, gravel, stone, et al.) presumably were produced locally on a small scale, but information is inadequate to reliably estimate output.

[3]Reported figure.

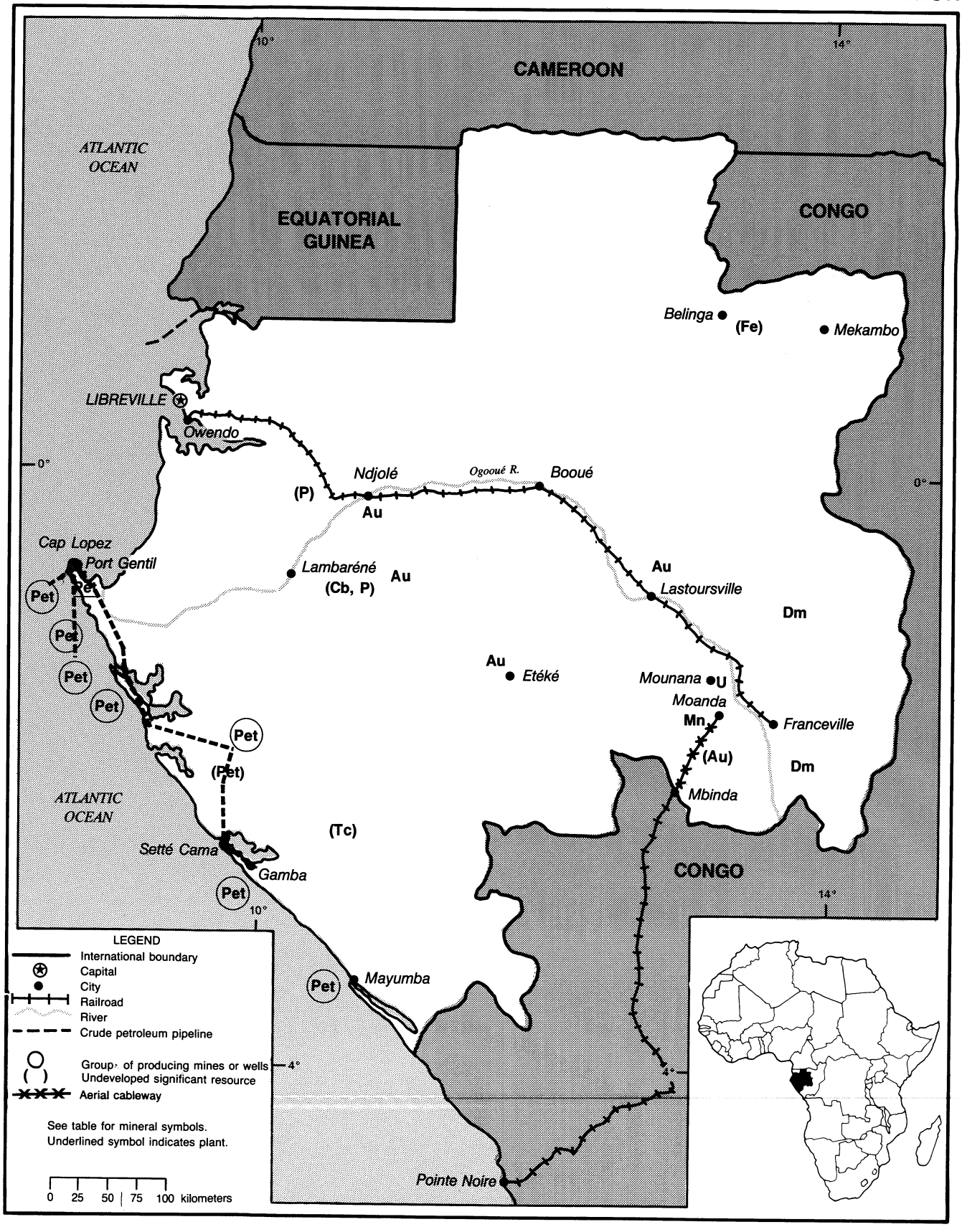
[4]When reported as volume or pieces, conversions to metric tons are estimated.

[5]Aparently does not include production for cement manufacture. Normally the manufacture of cement requires 30 to 50 kilo-grams of gypsum and 1.5 to 1.8 tons of limestone per ton of finished cement.

[6]When reported in metric tons, conversion to barrels is calculated using Department of Energy factors. Refinery fuel and losses were distributed among individual products in 1989, 1991 (estimated to total 350,000 barrels), and 1993 but were included in "Other" in 1990 (394,000 barrels) and 1992 (247,000 barrels). Data may not add to totals shown because of independent rounding. Refinery located in Eritrea, which became independent in May 1993.

GABON

AREA 267,670 km² **POPULATION 1.1 million**



THE MINERAL INDUSTRY OF

GABON

By Philip M. Mobbs

In 1993, Gabon's mineral industry, and its economy, were significantly influenced by the activities of the petroleum sector. Crude oil production and refined petroleum products output had recently accounted for about 65% of the gross domestic product (GDP) and 90% of total exports.[1] Manganese ore and uranium concentrate production also had a notable influence on the nation's economy; however, the continuing recession in the energy and steel sectors of the industrialized countries resulted in below-capacity operations for both minerals.

In 1992, the latest year for which data were available,[2] Gabon's GDP grew by an estimated 9% to about $5.9 billion.[3] Gabon's developed, though small, primary mineral industries have resulted in a relatively high standard of living for its relatively small population of about 1.1 million. The discovery and development of crude petroleum have been key milestones in its economic advancement. The construction of important elements of its infrastructure, particularly the Trans-Gabon Railroad and the Port of Owendo, should provide for further diversification and growth.

GOVERNMENT POLICIES AND PROGRAMS

The Government had recently shifted from an emphasis on taxation to spending commitments by private companies. Crude petroleum production-sharing agreements had provided for Government participation as a joint-venture partner in addition to a royalty of 20%. The drifting of international interest toward Angola, Namibia, and Nigeria, owing to their geologic structures and investment incentives, resulted in Gabon's liberalizing its mineral concession contract terms. During 1993, the Government authorized a 1-year exploration period extension to all Elf-Gabon operated activities.[4]

The basic mining law of Gabon was 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 reregulated in 1982 by law 14/82.

ENVIRONMENTAL ISSUES

The Gabonese environmental law, Law 16/93 relating to the improvement and protection of the environment, dated August 26, 1993, contains a section that addresses mining and petroleum activities. The Direction Générale de l'Environnement administers environmental oversight.

Petroleum companies' environmental actions, such as flying in equipment instead of constructing haul roads through the coastal forests, have frustrated increased local expectations that the international mineral companies should provide public infrastructure.

PRODUCTION

Gold and cement production continued to increase. *(See table 1.)* Continued reduced demand in domestic and foreign markets for primary raw materials accounted for the cutback in production of manganese and uranium.

TRADE

France was Gabon's principal trading partner. In 1992, the latest year for which data were available, the value of Gabon's merchandise exports increased by 2% to $2.3 billion. This was a slight improvement following the 11% decrease in exports from 1990 to 1991. Petroleum accounted for about 90% of Gabon's 1992 exports. Other major export commodities included manganese, wood, and uranium. The United States primarily imported petroleum from Gabon.

Almost one-half of Gabon's imports were machinery, equipment, and manufactured goods destined to support the petroleum and mining sectors. In 1991, the latest year for which data were available, France furnished about 64% of total imports, while the United States accounted for about 10%.

STRUCTURE OF THE MINERAL INDUSTRY

A number of private companies were active in Gabon's mineral industry. Most of them were subsidiaries of French companies, although several U.S. firms were active in the petroleum sector. The Government had a share in nearly every mineral venture, ranging from 15% to more than 90%. *(See table 2.)* The structure of the mineral industry continued to be shaped by the Government's push to diversify its partner mix by soliciting new international participants for the Gabonese mineral industry and by the State's active oversight of the sector.

COMMODITY REVIEW

Metals

Gold.—All production of gold was by artisanal miners, with the Etéké gold field being the largest. Aurtec Mining Development Inc., a Canadian company,

planned to bring the Bakoudou project into production. Bakoudou, approximately 30 km south of Moanda, had been an artisinal operation from 1950 to 1956.

Manganese.—At the end of November, Gencor Ltd. of South Africa acquired the 15.1% share in Compagnie Minière de l'Ogooué SA (Comilog) that the U.S. firm USX Corp. had divested earlier in the year.[5]

Comilog's production was significantly below capacity owing to lack of demand by the steel industry. Ore was drawn from a number of open pit operations on the Mangombe Plateau at Moanda and blended to provide the correct specifications for consumers. The company produced high-grade manganese ore (48% to 52% Mn) for the metallurgical and specialty chemicals markets. Comilog also produced battery-grade ore (82% to 85% MnO_2) for the export market. All marketable product was shipped to the Port of Owendo via the Trans-Gabon Railroad.

Uranium.—Although uranium production dropped only slightly, exports plummeted owing to a very depressed world uranium market. Production by the Compagnie des Mines d'Uranium de Franceville (COMUF) was from the country's only underground operation. Two mines were active, the Oklo and Okelobondo Mines. Owing to its higher grade ores, emphasis was placed on the Okelobondo Mine, which is actually an extension of the Oklo Mine at 400 m depth. Mechanization of operations continued at Okelobondo with the aim of improving its productivity. All reserves currently known would be mined by underground methods, excluding the Mberse deposit, which contains 250 tons of contained uranium.

Industrial Minerals

Société Minière de Moyenne Ogooué, 62% Government owned, began a prefeasibility study of the Mabounié phosphate deposit approximately 100 km southeast of Owendo.

Mineral Fuels

Amoco Co. and Conoco Inc. had withdrawn from Gabon in 1992. Amoco had sold its interest in Gombe Marin Beta and the Oguendjo Fields to Kelt Energie France. Agip Gabon[6] and Apache Corp.[7] closed their respective exploration offices in 1993.

The Government expected continued international exploration interest and oilfield development as an additional 20 exploration blocks were offered for leasing by Gabon's Ministry of Mines, Energy and Hydraulic Resources during the year. Elf-Gabon operated 22 offshore and 11 onshore fields,[8] including the Hylia and Vaneau Fields, which came on-stream at the end of 1993. Elf was responsible for contracting offshore three-dimensional (3-D) seismic work during the year as well as acquiring additional ordinary (2-D) seismic data on its onshore permits. Production increased at Shell-Gabon's Rabi-Kounga onshore oilfield, Gabon's largest, after an additional 14 horizontal wells were drilled.

Reserves

Gabon had an estimated 45 Mmt of recoverable manganese reserves. Comilog estimated uranium reserves at 28,000 tons as uranium metal in ores averaging 0.3% U.

Geologic gold resources were estimated to total 19 to 24 tons of gold to a depth of 200 m in four mineralized areas. The Dango area had 14 tons in four structural units, grading 2.4 to 9.8 g/mt. Gold in the Dondo-Mobi area was about 15 g/mt to a depth of 150 m over a strike length of 400 m. The Ovala area has 2 tons of gold in ore grading 11 g/mt in subvertical lenses, while the Western Ikoy and Migoto placer deposits grade 1.2 g/m^3 and contain about 700 kg of gold.

Iron ore resources at Belinga were 566 Mmt grading 64.24% Fe, 2.18% silica, and 0.122% phosphorus, according to the Government. Of this amount, approximately 345 Mmt was low phosphorus (less than 0.07% phosphorus) material.

INFRASTRUCTURE

The 669-km-long, 1.437-m-gauge Trans-Gabon Railroad is the most important infrastructure unit in Gabon, linking the Atlantic coast Port of Owendo with Franceville in the southeast. It provides for the shipment of both manganese and uranium, as well as wood products, fuel, and equipment. It is expected to facilitate further mineral development, such as diamond, iron ore, and gold. Gabon's petroleum pipeline infrastructure was particularly well developed, terminating at loading terminals at Cap Lopez and Gamba.

OUTLOOK

Further development and expansion of the mineral sector remains dependent upon world markets for crude petroleum, manganese, and uranium owing to the export nature of Gabon's output. The possibility of the establishment of a formal gold mining sector is good. Further industrial activity along the route of the Trans-Gabon Railroad is expected.

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[1]U.S. Department of State, Washington, DC: Investment Climate Reports Sub-Saharan Africa. Apr. 1993, p. 17.

[2]International Monetary Fund, International Financial Statistics. V. XLVII, No. 5, May 1994, Washington, DC: p. 614.

[3]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the average rate of CFAF283.16=US$1.00 for 1993 and CFAF264.69=US$1.00 for 1992.

[4]Africa Energy and Mining. No. 127, Feb. 2, 1994, p. 5.

[5]Industrial Minerals, "Gencor Acquires Stake in Comilog." No. 316, Jan. 1994, p. 12.

[6]Africa Energy and Mining. No. 117, Sept. 8, 1993, p. 5.

[7]Journal of Petroleum Technology. V. 45, No. 12, Dec. 1993, p. 1158.

[8]Oil and Gas Journal. V. 91, No. 2, Dec. 27, 1993, p. 59.

OTHER SOURCES OF INFORMATION

Ministere des Mines, Energie, et Resources Hydrauliques
Libreville, Gabon
Facimile: (241) 72-49-90
Direction Générale de l'Environnement
B.P. 3241
Libreville, Gabon

TABLE 1

GABON: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
Cement:							
Clinker		113,000	113,000	125,677	[r]138,381	[3]141,283	350,000
Cement, hydraulic[4]		115,442	[r]116,000	117,000	[r]116,000	[3]132,398	400,000
Diamond, gem and industrial[e]	carats	500	500	500	500	500	500
Gas, natural, gross[5]	million cubic meters	2,100	[r]2,492	[r]2,500	[r]2,610	2,621	2,800
Gold, mine output, Au content[6]	kilograms	81	80	50	[r]70	[3]120	140
Manganese:							
Metallurgical-grade ore, gross weight (50% to 53% Mn)		2,500,800	2,360,390	1,565,348	[r]1,455,134	[3]1,400,000	2,590,000
Pellets, battery- and chemical-grade, gross weight (82% to 85% MnO_2)		91,607	62,578	55,040	[r]101,280	100,000	110,000
Total		2,592,407	2,422,968	1,620,388	[r]1,556,414	1,500,000	2,700,000
Petroleum:							
Crude	thousand 42-gallon barrels	75,819	100,000	109,500	115,000	113,834	115,000
Refinery products	do.	5,575	5,665	[r]5,434	[r]5,542	5,513	8,760
Uranium oxide (U_3O_8), content of concentrate		1,047	828	700	700	[3]600	1,770

[e]Estimated. [r]Revised.

[1]Table includes data available through July 21, 1994.

[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]Reported.

[4]Includes cement produced from imported clinker.

[5]Reinjected for repressuring.

[6]Gold production figures do not include production smuggled out of the country, for which there are no reliable data.

TABLE 2

GABON: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

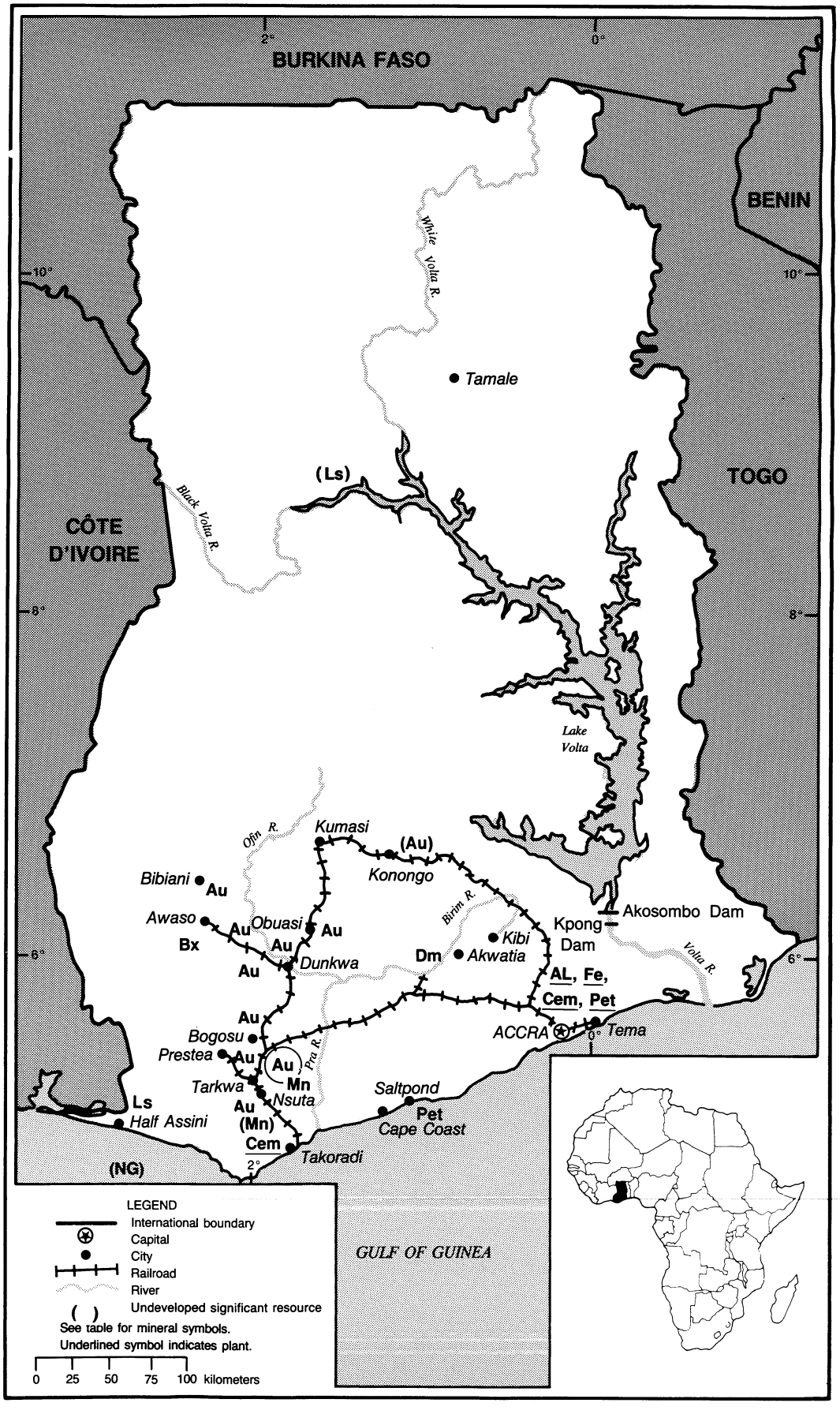
(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement:			
Cement	Société des Ciments du Gabon (Government, 90.54%; Elf-Gabon, 9.44%; other, 0.01%)	Clinker-grinding plant at Owendo	270
Do.	do.	Clinker-grinding plant at Franceville	130
Clinker	do.	Clinker plant at N'Toum, 40 kilometers east of Libreville	350
Manganese	Compagnie Minière de l'Ogooué (Government, 29.23%; Compagnie Française de Mines, 17.60%; Gencor Ltd., 15.10%; others,[1] 38.7%)	Open pit mine at Moanda	2,700
Petroleum, crude thousand barrels	Elf-Gabon (Société Nationale Elf Aquitaine of France, 75%; Government, 25%)	33 fields	40,000
Do.	Shell Gabon (Royal Dutch-Shell, 75%; Government, 15%; Amerada Hess Corp., 10%)	Lucina Marine offshore field, 15 kilometers south of Mayumba	4,000
Do.	do.	Gamba-Ivinga Field, onshore at Gamba	4,000
Do.	Shell Gabon, 42.5%; Elf-Gabon, 25.5%; Elf-Aquitaine, 17%; Gabonese interests, 8.3%; Amerada Hess Corp., 6.7% joint venture	Rabi Kounga Field, 100 kilometers north of Gamba	55,000
Do.	Kelt Energie France, 45%	Oguendjo offshore field, 85 kilometers southeast of Port Gentil	6,000
Do.	British Gas Corp., 50% and LASMO Plc, 50% joint venture	Obando, Octopus, and Pelican offshore fields, 60 kilometers southwest of Port Gentil	5,000
Petroleum products thousand barrels	Compagnie Gabon-Elf de Raffinage (Elf-Gabon, 70%; Government, 30%)	Refinery at Port Gentil	8,760
Uranium, oxide tons	Compagnie des Mines d'Uranium de Franceville (Compagnie des 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	1,770

[1]The other equity shareholders in Comilog are: Maaldrift B.V. of the Société Auxiliare du Manganèse de Franceville (SAMAF) of France, 10.01%; Elkem AS. of Norway, 5.70%; and Société de Ferromanganèse de Paris-OuGabonese nationals, 0.62%.

GHANA

AREA 238,540 km² **POPULATION 16.7 million**



THE MINERAL INDUSTRY OF

GHANA[1]

By Hendrik G. van Oss

Ghana is one of the most heavily mineralized countries in Africa. A major producer of gold for several centuries, Ghana in 1993 ranked second in Africa in the production of that commodity. It was the largest African producer of aluminum during the year, the third largest in manganese ore, and a significant producer of bauxite and diamonds. The country has become one of the largest world producers of arsenic. Ghana's mining and mineral exploration industry, once in severe decline, has experienced a resurgence since the adoption in the 1980's of favorable investment and mining laws.

Agriculture has long been the dominant sector of the Ghanaian economy in terms of overall revenues and employment but has been in decline in recent years in terms of exports because of frequent droughts, reduced timber harvests, and falling prices for cash crops, particularly cocoa. Mining thus has grown in importance in both absolute and relative economic terms. In 1992 and 1993, gold was Ghana's single most valuable export.

Virtually all of Ghana's primary mineral production other than construction materials was exported. In 1993, the total value of official exports of primary minerals was about $500 million, or about one-half of total goods exports, and equivalent to about 8% of the country's gross domestic product of $6.05 billion.[2] Legal exports of gold dominated the trade and were worth about $455 million. This was a 32% increase over the value in 1992 and reflected both a large increase in gold output in 1993 and a 5% increase in the average world gold price. These data do not include the value of smuggled gold and diamonds, estimates of which vary widely. In particular, Ghana appears to be an entrepôt for smuggled diamonds produced elsewhere in Africa. Ghana has an important secondary mineral sector, mostly in the form of aluminum, which is toll refined from imported alumina. Aluminum exports in 1993 were worth about $205 million; the Ghanaian value-added component of this amounted to about $71 million. Cement production was worth about $100 million, but was sold almost entirely on the domestic market. In comparison, revenues from cocoa, the most important agricultural export, amounted to only about $200 million, a 34% decline from 1992 levels. Exports of timber were worth an estimated $100 million.

Ghana's mineral commodity imports were dominated by petroleum products, alumina, fertilizers, and clinker for cement. These are estimated to have totaled almost $400 million in 1993, or about 23% of total imports of goods.

In terms of economic importance, Ghana's geology is dominated by a series of northeast-trending lower Proterozoic greenstone belts made up of volcanic and sedimentary rocks of the Birimian Series. Most of Ghana's gold deposits have developed in quartz veins, or with sulfide (pyrite and arsenopyrite) mineralization in shear zones, associated with the greenstone belts. The Birimian belts can have the gross form of synclinoria, some of which are cored by clastic rocks of the Tarkwaian Series, including gold-bearing conglomerates similar to the banket conglomerates of the Witwatersrand gold field in the Republic of South Africa. By yearend 1993, three mines were exploiting Tarkwaian conglomerate gold ore. Proterozoic granites intrude much of the Birimian, especially in the south-central and northwest parts of the country. Near the Birimian gold belts, some of these granites are gold-bearing. Gold also is found in widespread placer deposits derived from the auriferous Precambrian terrane; these deposits are exploited formally and on an artisanal basis.

In places, Birimian metasedimentary rocks contain alluvial diamonds, and the erosion of these rocks is at least partly responsible for the formation of the modern placer deposits that are the basis of the country's diamond mining. In 1993, the discovery of strongly altered and sheared diamond-bearing kimberlite near Akwatia was announced; it was as yet unclear whether this material would prove to be of economic grade.

The Nsuta Mine exploits manganese ore developed in Birimian Series rocks, and deep weathering of aluminous Birimian rocks has produced a number of bauxite deposits, including that exploited by the Awaso Mine.

The southeast corner of the country is dominantly made up of lower Precambrian Dahomeyan gneisses and schists. 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. As yet unexploited Upper Cretaceous limestones found near Half Assini are to be mined for the manufacture of quicklime for gold processing and perhaps for cement.

GOVERNMENT POLICIES AND PROGRAMS

During the 1970's a number of factors led to the severe deterioration of Ghana's

mine and mineral transportation infrastructure, an unfavorable climate for mining investment, and a significant decline in the output of mineral commodities. A 1980 report by a committee formed to analyze the mining industry's problems identified as aggravating factors Ghana's unrealistic and confusing mining and investment laws, overly tight controls on the availability of foreign exchange, inefficient management of state-owned mining companies, low wages, and the exodus of skilled workers. The report, together with declining revenues from agriculture, led to an increased Government awareness of the importance of the mining sector, which is now recognized as being a key component of Ghana's future economic growth. The report was a direct stimulus to the Government's adoption of legal and financial policies that have promoted the growth of the mining sector.

Restoration of the mining industry has been a keystone of the ongoing general Economic Recovery Program (ERP), launched in 1983, and structured in consultation with the World Bank. A significant component of this program was the adoption of a new mining code, the Minerals and Mining Law 1986 (PNDCL 153). In addition to new mining legislation, the ERP has sought to reverse the deterioration throughout 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, including several mines.

Apart from the 1986 mining law, legislation affecting mining and mineral exploration in Ghana includes 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. 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 purchase, directly and through licensed buyers, the output of such mining. The PMMC's right to market diamonds from the Akwatia Mine was transferred in late 1991 to a private company, although the PMMC still markets diamonds (and gold) produced by artisanal miners.

Although the aforementioned legislation has been generally well-received by the international mining community, a point of contention has been the high general mine taxation rate of 45%. Negotiations to reduce the mining tax were given a boost by the Government's 1993 decision to sell in 1994 a large part of its holdings in the Ashanti Mine. The Minerals and Mining (Amendment) Act of 1994, passed early in that year, reduced the general mining tax rate to 35%, the same as that imposed on other industries.

Coincident with new legislation have been programs to rehabilitate and expand the existing mines and mineral railing and shiploading facilities and, more recently, to privatize the parastatal mining companies. The rehabilitation and expansion program has seen its greatest success at the Ashanti Mine, the country's largest gold producer, where output has increased dramatically since the startup of rehabilitation in 1984. Through yearend 1993, the Konongo (Southern Cross) and Tarkwa gold mines had been privatized, and, apart from the decision to sell shares in the Ashanti Mine, negotiations were well advanced toward the privatization of the Prestea and Dunkwa gold mines and the Akwatia diamond mine and Nsuta manganese mine.

The Ministry of Lands and Natural Resources has authority over all aspects of the Ghanaian mineral economy and is the entity that grants mineral exploration and mining leases. Within the Ministry, the Minerals Commission has overall responsibility for recommending mineral policy, promoting mineral development, advising the Government on mineral 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 also must be reported to the Ghana Chamber of Mines. The Chamber also provides information on Ghana's mining laws to the public and negotiates with the mine labor unions on behalf of its member companies. All of the mining companies operating in 1993 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.

ENVIRONMENTAL ISSUES

Until recently, environmental issues have not been a high priority in Government planning but now all new mining operations are required to conduct and submit environmental impact studies and plan their operations to minimize environmental damage. Similarly, rehabilitation of existing mines now includes environmental planning.

Most of Ghana's mines have been or were in operation for several decades, and towns significantly larger than the original villages of the area have grown up around them. In this respect, environmental damage due to mining towns has been little different than that associated with nonmining communities of similar size. As expected, such population growth has led to extensive cutting of the rainforest to provide space for farming and for the mines, to provide timber for underground mine supports and surface facilities, and for wood fuel for both domestic and mine heat and/or power needs. Likewise, some of the original fauna, particularly the edible species, has disappeared. Water has become polluted from domestic sewage. Because the mines are now connected to the country's electrical grid, and the

smelter roasters are now mostly fuel oil-fired, wood cutting by mines for fuel has diminished in recent years. Forest clearances for open pit gold mining have involved, in the main, second growth vegetation.

Environmental damage directly connected to mining, other than that resulting from wood cutting and population growth, has been related to the mining and mineral processing methods employed. In this respect, the greatest effects have been associated with gold mining. In the early days of gold mining, the ores processed were primarily either quartz vein material containing free-milling gold or placer gravels, again with free gold. At least some of the mines used mercury to amalgamate and hence recover gold from their gravity circuit concentrates. None of the formal gold mines continues to use mercury, but it remains popular among artisanal miners—this notwithstanding the fact that the Government officially discourages its use. Sodium cyanide has replaced mercury in gold recovery circuits at the formal mines. Until the recent adoption of heap leaching, cyanide use was volumetrically small, and most of the mines recycled or neutralized the spent reagent. Such treatment has been part of the rehabilitation programs at the older gold mines and is required for new ones.

More recently, sulfide gold ores have been exploited to an increasing degree. This material cannot be efficiently leached with cyanide without prior oxidation of the ore. In Ghana, this has been accomplished by roasting the ore. However, roasting releases sulfur oxides to the atmosphere and, where arsenopyrite ores are, significant amounts of arsenic oxides. The environmental effects of the sulfur oxide emissions have been fairly local and only the arsenic oxides have been considered a major problem. The new Bogosu Mine included an arsenic scrubber in its roaster complex and began recovering arsenic trioxide in 1991. The much larger Ashanti Mine arsenic recovery facility became operational in 1992. Apart from cleaner smelter emissions, these scrubbers have led to Ghana becoming one of the world's largest producers of arsenic.

The Ashanti Mine, as part of its expansion project, is going to process a large volume of relatively low-grade open pit sulfide ores. Roasting these ores would be uneconomic. Instead, the ores will be processed using bacterial oxidation, a new technology. The bacterial oxidation plant at Ashanti, which became operational early in 1994, is the world's largest to date. Bacterial oxidation of sulfide ores is environmentally benign, and precipitates an iron arsenate product from solution without liberation to the atmosphere. Sulfur is precipitated as gypsum. If the facility works well at Ashanti, similar technology may be used to replace the roasting circuit presently used for the mine's underground sulfide ores. The Prestea Mine, the other mine processing arsenopyritic ores, has yet to install an arsenic recovery system. It is, however, a very small operation compared with Ashanti and Bogosu.

Open pit mining of bauxite and manganese, as well as dredging for gold, presumably has increased the sediment load of streams and rivers in the mining areas.

PRODUCTION

Output of most of Ghana's major mineral commodities increased in 1993 (*see table 1*). Ghana's official gold production in 1993 was by far the highest to date, and 1993 was the first year in which official production had exceeded the 1-million-troy-oz (31,104-kg) mark. Virtually all of the country's gold mines recorded production increases for the year. Artisanal gold output, as recorded in sales to the PMMC, also increased significantly. Some artisanally produced gold is smuggled out of Ghana, but data are lacking for this commerce and estimates of its magnitude are not included in table 1. Arsenic trioxide production, a byproduct of gold ore smelting, increased dramatically owing to the first full-year operation of the larger of the country's two recovery units.

Bauxite production increased significantly, but sales (exports) fell owing to bottlenecks in railing the mine production to the port. Manganese ore production increased somewhat. Crude petroleum production increased, but was still at very modest levels. Although data were lacking, the output of refined petroleum products is believed to have decreased significantly, owing to the reported closure, for maintenance, of the country's sole refinery for much of the year.

Diamond output reported for Ghana's only formal diamond mine was essentially unchanged in 1993 and is believed to have included local purchases of artisanally mined stones. But reported sales to the PMMC of artisanally produced diamonds fell dramatically. Because artisanal diamond mining activity was reported to have been at normal levels, it has been assumed for table 1 that the level of smuggling increased significantly in 1993.

Aluminum production fell slightly in 1993, largely owing to power disruptions at the smelter.

TRADE

Ghana's exports of goods totaled $1.02 billion in 1993, up slightly from the total in 1992. The increase was due mostly to much higher revenues for gold and would have been significantly higher still but for very disappointing agricultural export revenues. In particular, cocoa exports amounted to only $200 million, down from $305 million in 1992. Official exports of primary minerals totaled about $500 million, well above the $395 million estimated for 1992. Official exports of gold accounted for about $455 million of this, up 32%. Although data are lacking, it has been estimated that gold smuggled out of Ghana during the period 1990-92 was worth about $20 million annually. In 1993, the PMMC reported much higher purchases of artisanally produced gold, and it thus may be that smuggling of gold in 1993 was reduced, perhaps to only about $10 million.

Official exports of Ghanaian diamonds fell about 16% to $18.5 million owing to a large reported decline in PMMC purchases of artisanally mined stones.

However, it is believed that the amount of smuggled diamonds increased significantly and that the true value of exports of Ghanaian diamonds thus totaled about $25 million. It is of interest that, apart from smuggling some of its own production, Ghana is credited as being the source of stones apparently produced elsewhere in Africa. This is based on the fact that although most of Ghana's official diamond sales are through Antwerp, U.S. Customs has in recent years reported significant imports of stones directly from Ghana, as follows: 1991—about 933,000 carats worth $63 million; 1992—about 742,000 carats worth $40 million; and 1993—about 522,000 carats worth $126 million. Although some of this material, particularly stones in the $7 to $50 per carat price range, could represent Ghanaian material, these stones total only about $5 million per year. The bulk of the value of the U.S. diamond imports from Ghana is in so-called rough gemstones—these amounted to about 202,000 carats worth almost $120 million ($374/carat) in 1993—and almost certainly are not Ghanaian stones.

Exports of bauxite in 1993 fell 9.5% to $8.6 million owing both to reduced shipments and modest world bauxite prices. Manganese ore sales, almost all as exports, fell 16%, largely because of the depressed world manganese market. Although data were unavailable, the value of the arsenic trioxide output shown in table 1 would have been about $5 million to $6 million; it is unclear how much of this material was exported.

Aluminum was the principal value-added mineral commodity exported from Ghana. The metal is toll smelted in Ghana from imported alumina, petroleum coke, and certain other inputs. Aluminum exports in 1993 declined 11% to about $205 million as a result both of a modest decline in output and a drop in world aluminum prices. The value-added component of the aluminum production was worth an estimated $71 million, of which electricity accounted for about $50 million. The aluminum smelter is Ghana's largest customer for electricity. Electricity exports in 1993 are estimated to have been worth about $35 million.

Few data on Ghana's imports in 1993 were available. Total imports of goods were $1.77 billion, up 22% from the value in 1992. Total mineral commodity imports are estimated at $375 million to $400 million, of which 65% to 70% was accounted for by mineral fuels, primarily refined petroleum products. The fuel import estimate is almost double that for 1992 and is based on the reported shutdown for much of the year of the country's only refinery, and hence on the need to import more refined petroleum products and less crude oil. Alumina imports for Ghana's aluminum smelter were worth about $58 million, petroleum coke for the same operation about $14 million, and clinker for the country's sole cement plant about $40 million. Most of the remaining mineral commodity imports were of fertilizers. Data on imports of mine and mill equipment, explosives, and reagents such as sodium cyanide were unavailable, but the value probably exceeded $200 million for the year.

In terms of trading partners for mineral commodities, sales of most of Ghana's aluminum output in recent years has been on the London Metal Exchange. The United States in some years has been a significant customer as well but, in 1993, imported only about 330 tons of aluminum from Ghana. Official exports of gold are to Europe, where it is toll refined before being sold on the world market or to meet hedging requirements. Most of Ghana's legally exported diamonds have gone to Belgium. Bauxite exports mostly have been to British Alcan facilities in the United Kingdom or elsewhere in Europe. Manganese oxide ore is sold to a variety of European customers, and manganese carbonate ore is exported mostly to Japan and to Norway. Arsenic trioxide exports have been to various countries, including France and the United States.

Nigeria continued to be Ghana's main supplier of crude oil and refined petroleum products. Jamaica supplied virtually all of Ghana's alumina requirements in 1993, although in some years the United States also has supplied significant amounts of this material. Ghanaian imports of alumina from the United States totaled 41,000 tons in 1992 but only 7,000 tons in 1993. Mining machinery and reagents traditionally have been from British sources, but more recently have been from other countries as well, including the United States.

STRUCTURE OF THE MINERAL INDUSTRY

Ghana's mineral industry is dominated by primary mineral production (*see table 2*), particularly of gold. Value-added mineral production is dominated by aluminum and cement. With the major exception of gold, formal Ghanaian output of mineral commodities was from single operations only.

Less than 1% of the Ghanaian work force was employed by the minerals industry. Including temporary laborers, the formal mineral sector employed about 20,000 workers; about 15,000 of these worked for the gold mines. These numbers included workers directly employed in the mining and ore milling operations, in exploration, 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 and related 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. About 2,000 persons were employed by the Government in agencies dealing with minerals. About 30,000 Ghanaians worked at least part time as "galamsey" or artisanal miners; this estimate may include workers from the formal mining sector who engaged in artisanal mining on weekends and holidays.

COMMODITY REVIEW

Metals

Aluminum and Bauxite.—The Volta Aluminum Co. (VALCO) aluminum smelter at Tema has been the only producer of aluminum in Ghana and since becoming operational in 1967 has consumed, annually, about 60% of the country's entire electricity output. Hot metal output fell slightly in 1993 because of electrical supply problems. Water levels in Lake Volta were low during much of the year, and the Volta River Authority (VRA), the operator of the Akosombo Dam and other hydroelectric facilities, reportedly instituted a large number of 10- to-30-minute power cuts or reductions during the year. This led to a reduction of cell efficiency on the potlines. Further aggravating potline efficiency was a number of worker stoppages and slowdowns; none of these was long-lived. A new labor contract was signed in April 1993. Net salable aluminum production was 174,235 tons.

A number of bauxite deposits have been explored in detail in Ghana, but the Awaso Mine has been the only bauxite mine to date. The mine produces chemical-grade ore for export to Europe; it is not converted to alumina in Ghana. Mining has long been constrained by an inadequate railing and shiploading infrastructure; the mine shares rail cars with the Nsuta manganese mine. Bauxite storage and shiploading facilities at Takoradi have been expanded in recent years and could support mining well in excess of 500,000 mt/a. The company hopes to expand output and exports to 1 Mmt/a by the year 2000. Indeed, mine production increased significantly in 1993, but the company was unable to rail a significant portion of this to the port.

Gold.—Ghana has been an important gold producer for centuries, although large-scale formal gold mining did not commence until the 1880's. A large number of gold mines were developed up to World War II, after which the number declined substantially. Gold output remained high, however, through 1959, after which declining grades and poor management and fiscal policies began to erode production levels. A steady decline followed until 1983 when more favorable policies began to show results. Gold output has risen dramatically since, with official output in 1993 for the first time exceeding the 1-million-troy-ounce (31,104-kg) mark.

Much of the gold output increase since 1983 can be attributed to the ongoing rehabilitation and expansion projects at the Ashanti Mine at Obuasi. However, the development of new mines, spurred by the 1986 mining law, has been important as well. During the period 1988-92, four major open pit mines were opened (one has subsequently closed), as did a few small placer and/or tailings reprocessing operations. In 1993, these new mines contributed 31.5% of Ghana's total reported gold production and 55% of the growth in production since 1992. Apart from the formal mines, a significant amount of gold is produced by artisanal miners. The true level of artisanal output is unknown because a component of production is smuggled out of the country, mostly to Togo.

One of the richest gold mines in the world, the Ashanti Mine complex has from its startup in 1897 through yearend 1993 produced a total of about 700,000 kg of gold. Output in 1993 was 23,825 kg of gold, the mine's highest calendar year performance ever and an 11% increase over the previous record, set in 1992. The mine exploits quartz and sulfide ores from a steeply dipping vein and shear zone system hosted by Birimian rocks. Ashanti gold ore grades have averaged about 20 g/mt gold for much of the mine's history, but have declined in recent years as the ratio of quartz to sulfide underground ore has decreased and as large quantities of lower grade surface ores and tailings have begun to be mined. In the 1992-93 fiscal year, for example, underground ores milled had an average gold grade of 12.74 g/mt, whereas surface ores averaged 0.99 g/mt (heap-leach ore) or 4.09 g/mt (oxide plant ore). For the mine overall (including tailings), the average gold grade was 4.11 g/mt.

Since 1984, the Ashanti Mine has been involved in a major rehabilitation and expansion program costing in excess of $700 million. Facets of this program have evolved as new reserves were developed, new mining technologies and methodologies were adopted, and annual production targets were regularly exceeded. The latest phase is called the Ashanti Mines Expansion Project (AMEP) and commenced in 1992. The ultimate goal of the various expansion programs is to bring the Ashanti Mine's annual gold output to 1 million troy ounces (31,103 kg). The target period for first achieving this has, for several years, been stated as the fiscal year 1995-96 (ending September 30, 1996). However, the mine has regularly and significantly exceeded past production targets and, in an early 1994 company profile accompanying the sale of part of the Government's holdings in the mine, it was stated that the target was now expected to be met in fiscal year 1994-95.

A major component of the rehabilitation and expansion program at Ashanti involves the mining and processing of large underground sulfide and lesser quartz ore bodies found in the central and southern parts of the mine complex. Toward this end, new ventilation and hoisting shafts and winzes were being sunk, old stopes were being consolidated, and mining methods were being mechanized, including the installation of underground ore conveyor belts. Given the resulting increased sulfide ore feed, the Pompora Treatment Plant (PTP) at Ashanti has been upgraded to improve its sulfide ore flotation and roasting capacity. Pollution monitoring and control facilities for the PTP roasting circuit has been installed, including, in 1992, an arsenic scrubber. This was needed because the dominant sulfide ore mineral is arsenopyrite. The arsenic scrubber reportedly was recovering about 25 mt/d of arsenic trioxide during 1993. About 5,000 mt/a of this material was being sold to a French company and the rest stockpiled at the mine.

Another component of the expansion program is the Sansu project, which

involves open pit mining of a large amount of relatively low-grade, oxidized gold ores that are the surface extension of the underground ore bodies. Better grade oxide ore from the open pits is being processed in a dedicated carbon-in-pulp (CIP) plant and this now also recovers gold from the pregnant solution generated by heap leaching of low-grade ores. Certain higher grade oxide ores and some sulfide ores from the open pits have been processed by the PTP. A third component of the expansion program is the processing of a large volume of tailings from the PTP and its predecessor plant using a CIP circuit at the PTP.

Under AMEP, the Sansu open pits are being enlarged and deepened to access a significant quantity of low- to moderate-grade shallow sulfide ores. These are of too low grade to be processed economically at the PTP, which, in any case, has insufficient tonnage capacity for this feed. Accordingly, it was decided to build a dedicated processing facility for this material, to include both oxide and sulfide circuits. The oxide (milling and cyanidation) circuit was completed in September and began processing oxide ores immediately. The sulfide ore was to be processed in a bacterial oxidation plant, under construction in 1993 and expected to be commissioned in April 1994. Bio-oxidation is environmentally benign compared to roasting in that arsenic and sulfur are precipitated as a stable iron arsenate and gypsum, respectively, instead of being vented to the atmosphere. The facility, the largest of its type in the world, utilizes Gencor Ltd. of South Africa's BIOX technology. It was anticipated that the BIOX plant eventually would handle some low-grade underground sulfide ores and that a bio-oxidation circuit might eventually be installed at the PTP to replace the roasting circuit. Bio-oxidation requires the addition of limestone or quicklime, and although it was planned initially to import quicklime, the company was planning to develop by early 1995 a limestone deposit near Half Assini to provide this material.

Another component of AMEP is the North Ramp project, which, through a spiral ramp decline, will allow trackless mining access to certain high-grade quartz ore left as old pillars and as backfill in the upper reaches of the northern section of the Ashanti Mine complex.

Beyond the term of the present expansion program are plans to mine deep ores (below about 1,500 m) at the north end of the mine; this will, however, require the installation of refrigeration.

In its annual report, the company listed proven plus probable reserves for the Ashanti Mine, as of September 30, 1993, of 73.6 Mmt grading 7.6 g/mt gold. Underground ores made up 72% of the reserves (contained gold), open pit ores 22%, and tailings the rest.

The Government has for years owned 55% of the Ashanti Mine. In late November, following months of speculation and negotiations, the Government announced that it would sell an approximately 25% stake in the mine, probably in early 1994. About 95% of the offering would be sold on the London Stock Exchange, and the remaining 5% would be sold on the Accra Exchange. Lonrho PLC, the operator and 45% owner of the mine, agreed not to seek to increase its own holdings.

The Teberebie, Iduapriem, and Tarkwa Mines, operating on adjacent concessions near Tarkwa, all exploit Tarkwaian conglomerate ore having similarities to that of the Witwatersrand in the Republic of South Africa. In this respect, all three operations are much simpler—geologically and metallurgically—than the Ashanti Mine. The Teberebie Mine is an open pit operation that processes ore by conventional heap leaching, as opposed to milling plus carbon-in-leach (CIL) processing at the Iduapriem open pit mine, and conventional milling plus gravity recovery at the Tarkwa underground mine.

In 1993, the Teberebie Mine was in only its second year of operation at full capacity and recorded a 28% increase in gold output to 5,129 kg. It was Ghana's second most productive gold mine. In May 1993, the company announced the commencement of site preparation work to expand the mine. This was to be accomplished by developing a second pit on an adjacent concession and was expected to be completed in August 1994. The goal of the expansion program is to increase total gold output to 7,775 kg by 1995. Gold recoveries of late from the heap leach have been somewhat less than expected and, accordingly, the company was studying the possibility of installing a CIP circuit for the higher grade ores, while retaining the heap-leach processing for the lower grade material. It was felt that between the more efficient CIP technology and an increase in the mining rate, gold output could be increased even further. A relatively minor amount of gold was to be recovered by heap leaching the dumps, but recoveries from this were disappointing.

Proven plus probable reserves at the Teberebie Mine at yearend 1993 were stated by the company to be about 149,000 kg contained gold, of which 79% was considered recoverable using heap-leach processing.

The Iduapriem Mine had its first full year of operation in 1993 and recorded a gold output of 3,835 kg, well above the partial year production of 1,178 kg in 1992. At full production levels, the mine is expected to produce about 4,040 kg/a of gold. Most of the ore processed to date has been at a gold grade of about 1.9 g/mt. Some lower grade ore was processed in the mill/CIL circuit late in 1992, although most of this material has been stockpiled for later treatment. In late 1993, trial heap leaching of this material was conducted. Reserve data for yearend 1993 for the original ore body were not available, but at midyear 1992 stood at 18.64 Mmt of ore grading 1.85 g/mt gold (proven plus probable). The proven recoverable gold inventory in this amounted to 17,110 kg, and the probable gold inventory totaled 15,700 kg. These reserves were to a depth of 120 m; the deposit was (at yearend 1992) considered open at depth. Reserve delineation drilling was ongoing in 1993 and, presumably, at least upgraded part of the probable-class reserves.

The company is planning a second open pit, on the adjacent Ajopa concession—this is expected to add about 1,000 kg/a to the total mine gold output.

Reserves for this new pit were reported to be about 5.6 Mmt grading about 2.1 g/mt gold. The ore would be processed at the existing mill.

The Bogosu Mine was in its third full year of operation in 1993. Bogosu is an open pit mine exploiting limited oxide ores and substantial sulfide ores remaining from an earlier open pit operation (the Marlu Mine). At Bogosu, gold mineralization is hosted in sheared Birimian rocks and, like the Ashanti Mine, has sulfide ore rich in arsenopyrite. Since its startup, the Bogosu processing plant has been plagued with technical problems. At midyear 1993, these necessitated the closure of the fluidized bed roasting circuit for a short period. Reportedly, a desliming unit was added to the grinding plant to improve the efficiency of the sulfide flotation circuit. Problems notwithstanding, the mine managed to increase its gold output in 1993 by 21% to 2,940 kg. Gold ore reserves (all classes) were unavailable for 1993 but amounted to about 17 Mmt grading about 3.4 g/mt gold at the beginning of 1992; presumably, about 1 Mmt of this inventory was depleted in 1993. The Bogosu Mine's roaster is equipped with an arsenic scrubber that, reportedly, recovered 1,550 tons of arsenic trioxide during the year.

The parastatal State Gold Mining Corp. (SGMC) operated the Tarkwa Mine through June 1993 and the Prestea and Dunkwa gold mines for the full year. All three mines have had severe production problems and have made losses in recent years owing to a number of factors, including overstaffing, deterioration of infrastructure, declining ore grades, and/or poor grade control. The Tarkwa and Prestea Mines have had some rehabilitation work done on them in recent years, but it has had little effect on gold output and the rehabilitation programs have been essentially halted pending privatization of the mines.

For the first half of the year the Tarkwa Mine, under SGMC management, produced 557 kg of gold, which presaged a significant increase for the year over the 826 kg recorded for 1992. At midyear, the mine was sold to Gold Fields of South Africa (GFSA), the first operating parastatal mine to be privatized in Ghana. Immediately, GFSA began a cost-cutting program at the mine, including reducing the work force by about one-half, replacing worn machinery to the degree spares became available, and paying careful attention to grade control. Ore deliveries to the mill were improved; GFSA was targeting a level of 15,000 mt/month, which represented a 25% to 40% increase over typical past levels. Inadequate deliveries to the mill had been a major problem for the operation in the past. The conglomerate ore presents few metallurgical difficulties. Production for July through December was 666 kg, and the mine was reported by GFSA to have been profitable during this period.

Reserves at yearend for the Tarkwa Mine were unavailable, but in the recent years prior to the sale to GFSA, little exploration work had been done. Based on reported reserves for 1988, it seemed likely that remaining proven reserves available for mining at midyear 1993 were less than 1 Mmt, at a grade of about 8 g/mt gold. A much larger inventory, tied up in pillars and shaft collars and otherwise unavailable for underground mining, existed. The reserves could change significantly, given the fact that GFSA was engaged in an extensive program of surface and underground drilling during the year. The company hoped both to locate additional underground reserves and to develop shallow reserves suitable for open pit mining.

Gold output from the Prestea Mine in 1992 was abnormally low at 525 kg, largely because of labor problems—including lengthy work stoppages. Production in 1993 improved to 654 kg, still well below that needed for profitability. Geologically, the Prestea and Ashanti Mines are similar, although Prestea has lower grade ore and much smaller reserves. Unlike Tarkwa, Prestea's ores are refractory and metallurgically complex, being high in arsenic (as arsenopyrite) and active carbon. The antiquated mill, particularly the roasting circuit, has in recent years been unable to adequately handle the increasingly wet and sulfidic ores and, as a result, gold recoveries from the cyanidation circuit have been low. The mine is overstaffed.

As with the Tarkwa Mine, little reserve delineation or other exploration work has been done at Prestea in recent years. Reserves for 1993 were unavailable, but in 1988 were given by the company as 7.2 Mmt grading 7.88 g/mt, of which about 30% was proven. However, as with Tarkwa, much of this inventory was in pillars or was otherwise not available for mining. Reserves available for mining amounted in 1988 to only 680,000 tons grading 5.7 g/mt, and it is likely that about one-half of this material had been mined by yearend 1993. Because of the poor condition of the existing mine workings and the mill, private investor interest in Prestea has been largely in the exploration potential of the concession away from the existing operations. But interest remains in the potential to develop additional underground reserves at the mine itself, even though exploiting such reserves would require extensive rehabilitation of the workings. Developing an open pit above the existing underground workings remains a possibility, but would involve the social morass of moving the Prestea townsite.

Negotiations were ongoing at yearend to privatize the Prestea Mine, but were complicated by seemingly conflicting interest in the concession's resources. Johannesburg Consolidated Investment Co. Ltd. of South Africa was reported to have been interested in acquiring the full concession. However, another company was negotiating to buy just the rights to the Prestea Mine's dumps and tailings. It was unclear what advantage to the privatization process would be achieved by dividing the concession's resources in this manner.

The Dunkwa Mine is an extensive placer operation whose five dredges have been plagued for many years by technical problems. Output has fallen steadily in recent years, in 1993 by 16% to just 122 kg, and losses have mounted. According to the company, the concession has large

reserves, exceeding 200 Mm^3 grading 0.15 g/m^3 gold, and there was interest shown during the year by several small companies in buying the operation.

The Bonte placer gold mine produced 232 kg of gold in 1993, up from the 151 kg produced in 1992, but still only about 20% of the output planned. Production in 1992 had been hampered by the high clay content of the gravels. For much of 1993, the operation was shut for lack of adequate water supplies. A 15-km water pipeline was constructed to solve this problem, and production resumed in the fourth quarter. The company claims proven reserves on its concession of 16 Mm^3 grading about 0.75 g/m^3.

The Goldenrae placer gold mine, too, has been beset with technical problems, mostly relating to the high clay content of the gravels and the too frequent occurrence of boulders therein. A new washing plant was installed late in 1992 to handle the clay problem, and although this led to a threefold increase in output in 1993 to 229 kg, this was still only about 50% of the plant's design capacity. The mine's earthmoving equipment was having difficulty handling the many boulders encountered. Under the circumstances, it was unclear what portion of the mine's gold resources, claimed to be about 7,500 kg (all classes), was still economically viable.

A number of companies, mostly from Australia, Canada, and Ireland, were active in gold exploration in Ghana in 1993. In response to pressure from the Minerals Commission to get busy, a large number of Ghanaian companies holding concessions were reported to have become very active in exploration during the year.

At yearend 1993, Cluff Resources PLC of the United Kingdom was finalizing negotiations to finance the development of the Ayanfuri deposit, about 15 km west of Dunkwa. Mineralization at Ayanfuri is unusual for Ghana in that the gold is found both in weathered granitic rocks and the immediately adjacent Birimian metasediments. Mineralogically, the gold can occur free, associated with iron oxides, or associated with sulfides. Both sulfide and oxide gold resources have been delineated, but attention has been focused on the oxide ore. Reserve delineation drilling on the deposit was completed in 1991 and a feasibility study was completed in May 1992. The oxide ore, which extends to a depth of 65 m, would be open pit mined. Although the oxide ore is amenable to heap leaching, the feasibility study favored the use of a convention CIL recovery circuit. Proven and probable open pit oxide reserves, according to Cluff, amount to 6.06 Mmt having a gold grade of 1.68 g/mt. Sulfide resources amount to about 4.8 Mmt grading 1.9 g/mt gold; presumably, there is a higher grade core within this inventory.

Another advanced gold project was centered on the old Abosso Mine, about 10 km northeast of Tarkwa. Apart from having about 4 Mmt of mineralized old mine tailings, the concession appears to have significant gold resources within sheeted quartz veins within laterites. The property is held by Ranger Minerals of Australia.

Manganese.—The Nsuta Mine has been the only significant producer of manganese ore in Ghana and has been worked since 1916. Reported ore production increased modestly in 1993, as did exports. The mine produces both oxide and carbonate ores, as well as a transitional ore referred to as "Carbox." In 1993, the mine's washing plant was modified through the installation of jigs. These will allow the upgrading of chemical-grade oxide ore fines, currently stockpiled, to metallurgical-grade material for export. Although the Nsuta Mine has large reserves of carbonate ores remaining, the mine for years has been reported as being near exhaustion of its oxide reserves. Exploration at and around the mine has managed to locate enough oxide material, generally in small pods, to support continued production. In 1993, oxide made up 41% of the total ore mined.

Apart from unfavorable world manganese ore prices, the Nsuta Mine's total production has been constrained by limited railing capacity; the railroad is shared with the Awaso bauxite mine.

The Government was negotiating with three international manganese companies interested in purchasing the Nsuta Mine and its concession. The negotiations were complicated by the fact that the concession is also of exploration interest for gold. BHP Minerals of Australia, one of the interested parties, was engaged in a major regional manganese exploration program and had acquired exploration rights to much of the land between the Nsuta concession and the coast for this purpose. Portman Mining of Australia, another company interested in Nsuta, conducted an exploration program in 1993 on the Kwesikrom manganese property near the coast. No results of their efforts had been announced at yearend.

Industrial Minerals

The Akwatia Mine, operated by Ghana Consolidated Diamonds Ltd. (GCD), was the only formal diamond mining operation in Ghana in 1993. Production credited to Akwatia in 1993 was 214,442 carats, virtually unchanged from that of the previous year. However, about one-half of the 1992 output consisted of purchases by the mine of artisanal "tribute" production from parts of the concession unworkable by the company's draglines, and it is likely that a similar credit could be made in 1993.

For most of the Akwatia Mine's 70-year operation life, the placer operation has exploited rich so-called terrace gravels, but these reserves were nearing exhaustion by the early 1980's. A United Nations (UN)-sponsored drilling program at this time established significant new reserves, in younger gravels along the Birim River, beginning about 10 km from the mill facilities. Most of the production was shifted to the new reserves, but the long haulage of the gravels to the mill proved costly. In addition, the mill facilities had been cannibalized over the years for want of spare parts and proved not to be adequate for the new feed. The mine began losing money and output declined. With Ghana's shift in economic policies, some funds became available for

limited rehabilitation work at Akwatia, and in recent years, output has improved modestly. A 1989 study of the operation recommended abandoning the old mill in favor of small semimobile plants to be installed along the Birim River. Lacking funds for this, the Government, in 1990, began seeking buyers for the operation. In late 1991, an agreement was announced to sell the mine to a joint venture between Inco Ltd. of Canada and Lazare Kaplan International (LKI) of the United States, each to take 40% of GCD with the Government retaining 20%. The initial agreement was for Lazare Kaplan to market Akwatia's diamonds—these had hitherto all been sold to the PMMC—and for Inco, as an interim partner, to help secure financing for the rehabilitation and to do further feasibility studies. Inco dropped out of the venture in early 1993 following a fall in world nickel (Inco's major business) and diamond prices. However, LKI continued to market the diamonds, at far higher prices than had ever been had from the PMMC. The higher prices, about $30 to $35 per carat, were justified because, although Akwatia's diamonds are mostly very small, many are of high quality and could be cut in India. Accordingly, the stones were not really just high-quality industrial stones, worth $12 to $13 per carat only, as hitherto claimed. Because much higher mine revenues could now be expected, it was felt that a new rehabilitation study was warranted, in that retaining the old mill (after rehabilitation) might now be economical. After Inco withdrew from the venture, a new partner was sought, and in late 1993 it was announced that De Beers had agreed to acquire an option for 40% of the venture.

The origin of the Akwatia diamonds has long been controversial because no kimberlites had been found. The diamond and quartz-rich so-called terrace gravels showed little evidence of significant lateral transport. Further, diamonds commonly were found within the Birimian bedrock, and not just in placers. In 1993 it was announced that diamondiferous kimberlite, albeit highly altered and deformed, had been found on the property. The economic ramifications of this discovery as yet were unclear.

Artisanal production of diamonds was widespread, but the true level of production was not known owing to smuggling. Except from stones produced at Akwatia or nearby, which were marketed by LKI, legal sales of artisanal output were to the PMMC, which recorded a 22% decline in purchases to 376,400 carats. Because the level of artisanal mining probably did not decline significantly for the year, it is surmised that the PMMC decline represented a higher level of smuggling during the year; the 1993 entry in table 1 reflects this.

Several Canadian companies were involved in diamond exploration along the Birim River in the general Akwatia area.

Reserves

GBC claims that it has about 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/a, 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 Mmt grading 48.9% to 51% alumina and 2.8% to 4.4% silica. The Kibi area bauxite resource totals 120 Mmt grading 40.8% to 45.7% alumina and 1.8% to 3.9% silica.

Ghana has large gold reserves, although the summation of such from the existing mines and advanced projects is made difficult by differences in reserve reporting methods used by the different companies. A conservative estimate for yearend 1993, excluding resources at the idle Southern Cross Mine, of claimed proven plus probable reserves in Ghana would be about 900 tons of gold. This almost 50% increase from reserves claimed in 1992 was due mainly to upgrading of resources to reserves at the Ashanti Mine. This mine had about 62% of total Ghanaian gold reserves in 1993 and dwarfed the known inventories at any of the other mines. Ghana's total gold resources are undoubtedly much larger than exist at the present mines, based on the known extent of host rocks, the widespread artisanal production of gold, and the encouraging results of a number of ongoing exploration programs. In addition, there remain a number of closed old mines, many of which shut down without having depleted their gold resources and which have not yet been evaluated under a current economic scenario.

Although several manganese deposits are known in Ghana, the only large established 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 of approximately 0.5 Mmt, sufficient for about 5 more years of production at 1993 levels. Direct-shipping carbonate ore reserves calculated in 1964 by the Ghana Geological Survey Department were listed as about 17 Mmt grading 31% manganese. Remaining reserves of carbonate ore are likely adequate for 50 to 60 years of production at current levels.

Ghana's diamond resources are large, based on known reserves at the Akwatia Mine and the widespread artisanal production of diamonds. Virtually all of the future placer diamond production from the Akwatia Mine will be from gravels along the Birim River. The proven reserves in these gravels were delineated by the UN during a drilling program from 1980 to 1983; according to GCD, the reserves amount to about 15 Mm^3 grading about 1.1 carats/m^3. However, because of access difficulties in marshy areas, the UN drilling program was restricted to only about one-half of the area of interest. It is believed that the true reserves amount to about twice those determined by the UN. Kimberlites now

have been found at Akwatia, but the potential diamond resources in these rocks have yet to be ascertained.

Ghana's oil and gas resources are not well known, although ongoing drilling programs were testing resources in a couple of fields. As of yearend 1993, virtually all of Ghana's oil production had been from the offshore Saltpond Field, which produced approximately 3.8 Mbbl of oil during about a 7-year period ending in 1985, when production was shut down for technical reasons. Production, at a modest rate, resumed in 1992. The field's original reserves, as indicated by the Government, were approximately 8.9 Mbbl. Earlier tests of the South Tano Field indicate that oil resources there may total about 82 Mbbl, although recovery would be difficult. Test production was under way during the latter half of 1992, but results had not been announced by yearend 1993. Work was ongoing to better delineate the natural gas reserves of this field, although they are estimated at about 2.8 billion m^3. The North Tano Field's recoverable gas resources have been estimated at about 1.7 billion m^3.

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. Many of Ghana's roads were in poor condition, although some of the major ones were being rehabilitated. The roads in general are not suitable for significant transport of mineral commodities, but are satisfactory for mineral exploration activity by determined teams. Ghana has 953 km of 1.067-m-gauge railroad forming an A-shaped network linking the ports of Takoradi and Tema with Accra and Kumasi. There is an important branch line to the Awaso Mine. By the early 1980's, the entire railroad network had deteriorated severely. Rehabilitation work started in the late 1980's on the western line, which is the export route for the country's manganese ore and bauxite production and serves the major gold-producing area. Despite improvements, the western line in 1993 still was considered a constraint on bauxite and manganese shipments, largely because of a continued shortage of railing stock.

Ghana's major ports are Takoradi and Tema, each of which can handle ships up to about 30,000 dwt. 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 and in 1993 was estimated to be about 350,000 mt/a for manganese ore and about 700,000 mt/a for bauxite. 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 mt/h and has storage facilities for 75,000 tons of alumina and 22,500 tons of petroleum coke.

In 1993, Ghana's electrical generating capacity remained about 1,185 MW, of which 1,072 MW was from hydropower, installed in the Akosombo Dam (912 MW) and the Kpong Dam. Ghana reportedly produced 4,140 GW•h in 1991, the latest year for which data were available. Output was likely less in 1993 owing to reduced water levels in the reservoirs, and as evidenced by power interruptions during the year to the VALCO aluminum smelter. VALCO typically consumes about 60% of Ghana's total electrical output. Hydroelectric output could decline in the next few years owing to scheduled retrofitting of the turbines at Akosombo. Electricity consumption by Ghana's mines has, in recent years, averaged about 400 GW•h/a. The major mines all are connected to the national grid, but most have backup oil- or wood-fired generators. Ghana's domestic grid is being rehabilitated and expanded. The grid was extended to the northern part of the country in 1989 and has been further extended in this region since. It was likely that the country's existing hydroelectric powerplants would be inadequate to meet the demand from the expanded grid and generating capacity was to be supplemented with new thermal plants, especially a natural gas-fired unit on the southwest coast.

OUTLOOK

Given the rehabilitation and expansion work at several existing gold mines and the high level of gold exploration activity in the country, gold output is likely to increase significantly and easily remain Ghana's main primary mineral export for many years. Barring major increases in prices for cash crops, gold also should remain Ghana's single most valuable export for some time. Based on production forecasts for the existing mines and those still in development, gold output could exceed 50,000 kg by 1995 or 1996. Long-term production at or near this level will depend on the ability of the Ashanti Mine to sustain its targeted output levels, and will likely require the bringing on-stream of significant new production at other mines. Exploration activity is likely to stay high, although Ghana's ability to attract such investment may be hurt somewhat by competiton from other countries in west Africa. In this respect, Ghana's superior infrastructure and more diversified economy should prove advantageous.

Ghana's diamond output could increase significantly in the near term, if the planned rehabilitation and expansion of the Akwatia Mine proceeds. Ghana's manganese production could increase if railing bottlenecks are eliminated and the world market improves. Long-term output, especially of oxide ores, is constrained by limited reserves. Ghana has the potential to significantly increase its exports of bauxite through the expansion of output from the Awaso Mine; this too is constrained by existing railing capacity. Inadequate infrastructure remains a deterrent to the development of other bauxite deposits in Ghana, many of which, additionally, are of but modest grade.

There is good potential for Ghana to produce sufficient natural gas and crude petroleum for domestic use. However, there appears to be little potential to develop exportable quantities of these mineral fuels.

[1]Text prepared May 1994.
[2]Where necessary, values have been converted from Ghanaian cedis (C) to U.S. dollars at the rate of C649=US$1.00.
[3]Kesse, G. O. The Mineral and Rock Resources of Ghana; A.A. Balkema, Rotterdam, 1985, 610 pp.

OTHER SOURCES OF INFORMATION

Geological Survey Department
P.O. Box M.80
Accra, Ghana
Minerals Commission
P.O. Box M. 248
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Fax: 233-21-773-324
The Ghana Chamber of Mines
P.O. Box 991
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Precious Minerals Marketing Corporation
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TABLE 1
GHANA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1989	1990	1991	1992e	1993e	Annual capacity e (Jan. 1, 1994)
Aluminum:							
Bauxite:							
Gross weight	metric tons	347,065	381,273	r e352,500	[3]338,244	[3]423,747	500,000
Sales	do.	374,646	368,659	324,313	[3]399,155	[3]364,641	450,000
Metal, smelter, primary	do.	168,581	174,241	175,437	[3]179,930	[3]175,235	180,000
Arsenic, trioxide e	do.	—	—	500	4,500	9,000	9,000
Cement, hydraulic[4]	thousand metric tons	565	675	750	[3]1,024	[3]1,203	1,000
Diamond: e							
Gem	thousand carats	395	520	560	570	570	600
Industrial	do.	99	130	140	140	140	1,550
Total	do.	[5]494	[5]650	[5]700	[5]710	[5]710	750
Gold[6]	kilograms	13,358	16,840	26,311	[3]31,032	[3]39,235	40,000
Manganese:							
Ore, gross weight	metric tons	[7]279,210	246,869	319,727	[3]276,019	[8]295,306	320,000
Mn content e	do.	110,000	96,000	120,000	106,000	115,000	120,000
Petroleum:							
Crude	thousand 42-gallon barrels	—	—	—	[3]657	[3]2,190	2,200
Refinery products:							
Liquefied petroleum gas	do.	58	70	58	60	15	70
Gasoline	do.	r2,142	r1,734	r1,785	r1,700	300	2,000
Jet fuel	do.	200	200	r216	200	50	200
Kerosene	do.	r1,062	r915	r930	1,000	250	1,000
Distillate fuel oil	do.	r1,955	r1,529	r1,567	r1,600	400	2,000
Residual fuel oil	do.	r799	r899	r919	r900	225	900
Other e	do.	r265	r299	r319	r300	75	300
Refinery fuel and losses e	do.	300	280	300	300	75	300
Total e	do.	r6,781	r5,926	r6,094	r6,060	[9]1,390	6,770
Salt e	metric tons	50,000	50,000	50,000	50,000	50,000	50,000
Silver, Ag content of gold ore e	kilograms	670	840	1,315	1,550	1,960	2,000
Steel, semimanufactures e	metric tons	17,500	25,500	27,000	25,000	25,000	33,000

eEstimated. rRevised.
[1]Table includes data available through Apr. 29, 1994.
[2]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) are produced, as is limestone for processing of some gold ore. Output of these commdities is not reported and information is inadequate to make reliable estimates of output levels.
[3]Reported figure.
[4]All from imported clinker.
[5]Production, in carats, includes that of Akwatia Mine (1989—134, 030; 1990—151, 627; 1991—145, 887; 1992—214, 155; 1993—214, 442), PMMC purchases of artisanal production (1989—151, 606; 1990—484, 876; 1991—541, 849; 1992—479, 874; 1993—376, 400), and estimates of smuggled artisanal production.
[6]Does not include estimate of smuggled production.
[7]Manganese ore for 1989 is the reported mine production minus carbox fines, which were unsalable.
[8]Reported as wet metric tons.
[9]Refinery was reported closed for maintenance for much of the year.

TABLE 2

GHANA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum		Volta Aluminum Co. Ltd. (VALCO) (Kaiser Aluminum & Chemical Corp., 90%; Reynolds Metals Corp., 10%)	Aluminum smelter at Tema	200.[1]
Bauxite		Ghana Bauxite Co. Ltd. (Government, 55%; British Alcan Chemicals Ltd., United Kingdom, 45%)	Bauxite mine at Awaso	500.
Cement		Ghana Cement Works Ltd. (Government, 75.5%; Scancem International ANS, Norway, 24.5%)	Clinker grinding plants at Takoradi and Tema	800.
Diamond	thousand carats	Ghana Consolidated Diamonds Ltd. (Government, 100%)	Placer mine at Akwatia	200.e
Gold	kilograms	Ashanti Goldfields Corp. (Ghana) Ltd. (Government, 55%; Lonrho Plc, United Kingdom, 45%)	Underground and surface mine at Obuasi	26,000.e
Do.	do.	Billiton Bogosu Gold Ltd. (Billiton International Metals B.V., Netherlands, 81%; IFC, 9%; Government, 10%)	Open pit mine at Bogosu	3,000.
Do.	do.	Bonte Gold Mining Ltd. (Akrokeri- Ashanti Gold Mines, Inc., Canada, 85%; Government, 10%; Buosiako Co., Ltd., Ghana, 5%)	Placer mine at Esase, about 40 kilometers southwest of Kumasi	500.e
Do.		Ghana Australian Goldfields Ltd. (Golden Shamrock Mines, Ltd., Australia, 68.95%; Government, 20%; IFC, 10%; private shareholders, 1.05%)	Iduapriem open pit mine near Tarkwa	4,050.
Do.	do.	Goldenrae Mining Co. (Roan Selection Trust Overseas S.A., 85%; Government, 10%; Akyem Abuakwa Development Fund, Ghana, 5%)	Placer mine at Kwabeng, 16 kilometers north of Kibi	250.e
Do.	do.	Gold Fields Ghana[2] (Gold Fields of South Africa, 90%; Government, 10%)	Underground mine at Tarkwa	1,500.
Do.	do.	State Gold Mining Corp. (Government, 100%)	5 gold dredges near Dunkwa underground mine at Prestea	200. 675.e
Do.	do.	Teberebie Goldfields Ltd. (Pioneer Group Inc., United States, 90%; Government, 10%)	Open pit mine near Tarkwa	5,500.
Manganese ore		Ghana National Manganese Corp. (Government, 100%)	Open pit mine at Nsuta	300.e
Steel		Steelworks Co. subsidiary of Ghana Industrial Holdings Co. (Government, 100%)	Steel mill at Tema	2.5 (rebar).
Do.		Wahome Steel Ltd. (private Taiwanese investors, 95%; Ghanaian investor, 5%)	do.	30 (rod, rebar, and wire).
Petroleum products	thousand barrels	Tema Oil Refinery (Government, 100%)	Refinery at Tema	10,600 (crude input).

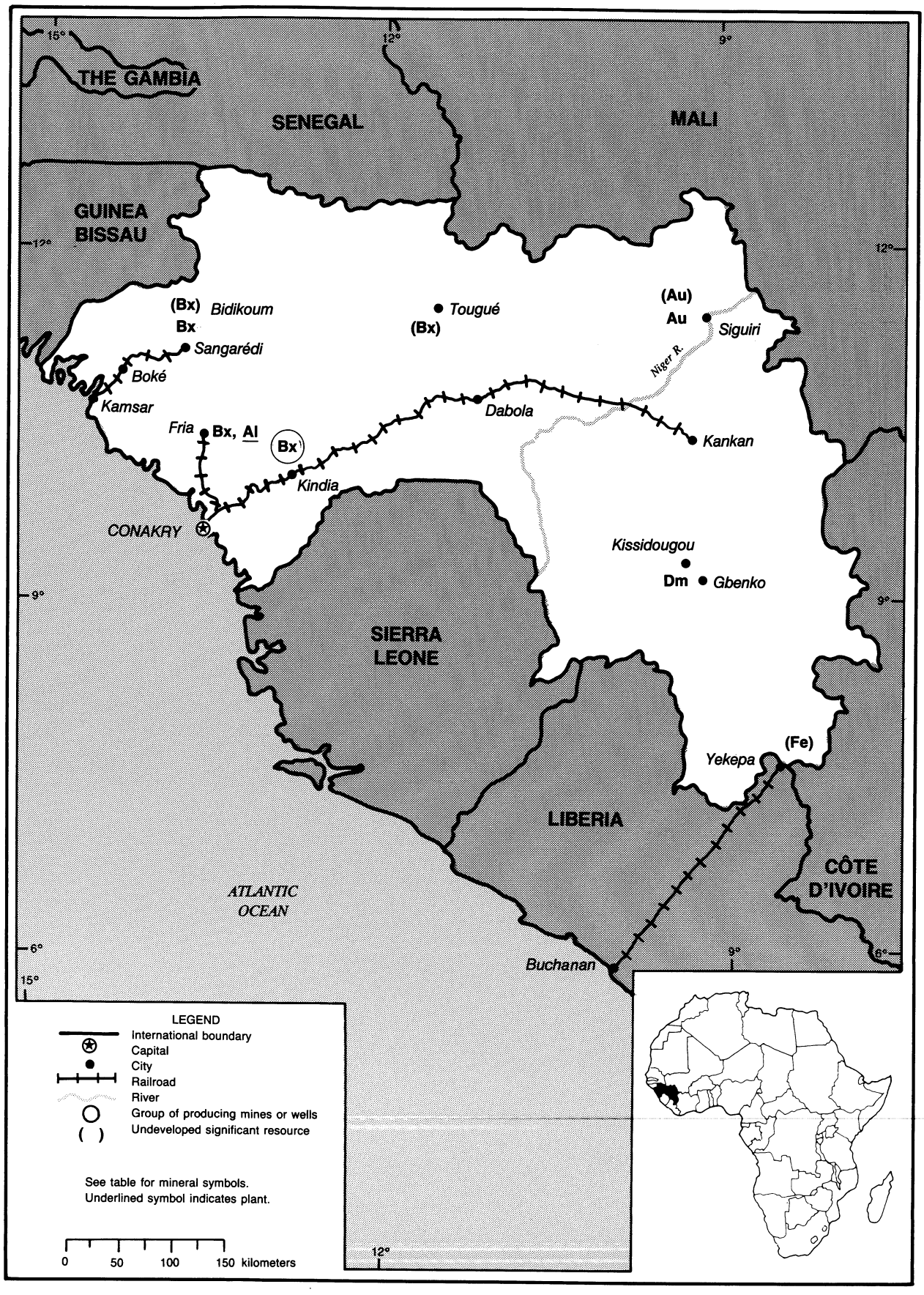
eEstimated.

[1]Based on five potlines. Operational capacity in 1993 was 180,000 tons.

[2]The Tarkwa Mine was operated by State Gold Mining Corp. through June 1993, but was purchased by Gold Fields of South Africa, which assumed operation of the mine in July 1993.

GUINEA

AREA 245,860 km² **POPULATION 6.2 million**



THE MINERAL INDUSTRY OF

GUINEA

By David Izon

In 1993, Guinea remained second to Australia in production of bauxite. The country possessed one-third of the world's known bauxite deposits, as well as high-grade iron ore deposits, diamonds, gold, manganese, and other gemstones and precious metals. Only bauxite and diamonds were produced commercially in 1993, and the only gold mine in the country was closed in August 1992. However, artisanal gold production continued, and the Central Bank continued its program of buying back gold at 50% of market price. The mineral sector accounted for about 25% of the gross domestic product (GDP) of about $3.4 billion[1] in 1993. Sales of three main commodities, bauxite, diamond, and gold, account for more than 98% of all mineral sales. The revenue from mineral exports amounted to about $548 million. Alumina and bauxite accounted for more than 91% of all mineral exports, despite the slump in the mineral sector due to low world market prices for aluminum. In general, mineral exports accounted for more than 90% of the country's total exports and about 35% of Government revenues.

The MIFERGUI-Nimba iron ore mining project is held indefinitely because of lack of financing, inadequate infrastructure, and political instability in Liberia. Guinea's iron ore deposits are on the border of Liberia and therefore are affected by the civil insurgencies in Liberia. The resolution of the Liberian conflict would determine when the development of the Nimba project would begin. Guinea's iron ore ranks potentially among the most important worldwide because of its high iron content. The country's 1987 investment code offers liberal taxation and regulatory privileges to companies or individuals investing in strategic sectors, particularly mining. However, ongoing revisions to the tax code could increase income and import taxes that could affect medium to large foreign ventures and reduce the margin of benefits for investors.

GOVERNMENT POLICIES AND PROGRAMS

The current mining code is code No. 076/PRG of March 1986, as amended by orders Nos. 10236 to 10245, issued on October 22, 1988. The ongoing revision of the existing mining code is intended to liberalize it and provide more opportunities for prospective investors. The current investment code is as adopted in code No. 001/PRG/87 of January 1987. Because the mining sector's base law of 1984 is still in effect, the terms of all mining concessions are negotiated on a case-by-case basis until the proposed liberalized new mining code, which allows for majority ownership and a new revision of the investment code, is completed.

In 1993, the Government signed an $18 million agreement with the Government of Iran to undertake a bauxite mining project in the Dabola-Tougue region in northern Guinea, 60 km east of Labe and 350 km northeast of Conakry. Also, an Australian-based company, Golden Shamrock Mining Ltd., and the Colorado-based Cyprus-Amax Minerals Co. signed agreements to explore for gold in the Suguiri and Mandiana regions, respectively.

Previously adopted policies under the Government's structural adjustment program continued to be implemented. Other fiscal policies being implemented for the 1993-94 fiscal year were intended to diversify the mineral industry and reduce the Government's dependence on revenue and export earnings from bauxite mining. However, closure of the gold mine set back diversification efforts.

ENVIRONMENTAL ISSUES

The Ministry of Natural Resources, Energy and Environment administers the mining sector and grants licenses and permits for exploration, exploitation, and marketing of minerals produced in Guinea. Under this ministry is the Department of Environment, which makes policy and regulates environmental issues, particularly with regard to mining. Procedures for minerals production and processing require an environmental impact statement to be attached to an application before approval for a mining license is given. The environmental study on the Nimba project was in search of ways to avoid pollution of the Cavalli River, which flows into Cote D'Ivoire. Sterile earth dug up from mining sites was to be dumped on the mountainside, where the material could flow into the river. Other design factors are being considered to minimize the adverse effects of this project on the environment.

PRODUCTION

In 1993, mineral production was mainly from five mines excluding quarries: four bauxite mines at Bidikoum, Fria, Kindia, and Sangarédi, and one diamond mine at Gbenko. Development and production of one of Guinea's potentially important minerals, the high-grade iron ore deposits at the Nimba Mountains, have been hindered by lack of adequate infrastructure, financing, and regional stability. The country's only gold mine, which was closed in 1992, has not reopened, but two companies have signed agreements to explore and develop the existing and new sites. *(See table 1.)*

TRADE

The mineral sector dominated exports as nearly all major minerals produced were sold in overseas markets. Guinea remained dependent on mining exports for Government revenue and foreign exchange earnings. Major mineral commodities traded in 1993 were alumina, bauxite, and diamonds. Another export commodity was palm kernel. Revenues from sale of diamonds and gold do not include the value of smuggled artisanal production. The total value of mineral exports for 1993, mainly alumina, bauxite, and diamonds, was about $548 million. Low world prices for bauxite and alumina, combined with shortfalls in projected revenues, left Guinea with a trade deficit of about $340 million.

In 1993, Guinea's principal trading partners were Australia, Cameroon, Canada, Commonwealth of Independent States, France, Germany, Nigeria, Norway, Portugal, the United Kingdom, and the United States. Mineral exports to the United States were mainly bauxite. Guinea's imports from the United States included industrial machines, vehicles, construction materials, fertilizers, petroleum products, and pharmaceuticals.

STRUCTURE OF THE MINERAL INDUSTRY

The mineral industry remained dominated by the production of bauxite by three companies, one of which was entirely state-owned. There was widespread artisanal production of diamonds and gold for which official estimates were not available.

Guinea's labor force is estimated to be about 2.6 million workers, an estimated 20% of whom are in the industrial sector. Guinea's formal mining industry employed about 6,550 workers in 1993. About 78% of these were in the bauxite and alumina sector. Government policy encourages the training of Guinean staff to replace expatriates. The latter account for about 6% of the mining labor force. *(See table 2.)*

COMMODITY REVIEW

Metals

Aluminum and Bauxite.—In 1993, Guinea signed an $18 million agreement with Iran to undertake a bauxite mining project at Dabola over a 5-year period. The new venture will produce about 600,000 mt/a of bauxite. Feasibility studies are being undertaken to determine possibility of increased production. The first phase of the project, during which 600,000 mt/a will be produced, would rely on the rehabilitation of the old Niger rail line from Dabola to Conakry. Because the rail line was not constructed for the transportation of minerals, additional investment may be required to replace the line with a rail system capable of accommodating up to 1 Mmt/a. Also, the former Government of Guinea-USSR bauxite mining company, Office des Bauxite de Kindia, was restructured. The new enterprise is named Societe de Bauxite de Kindia (SBK). The restructuring occurred with the assistance of the World Bank, and SBK is open to private investment under the new arrangement.

In 1993, Compagnie des Bauxites de Guinea (CBG) maintained its role as Guinea's largest producer of bauxite at above 12 Mmt/a wet basis, with an alumina (Al_2O_3) content of 57.74%. CBG undertook a program for upgrading and extension of facilities that included the startup of Bidikoum deposit and the renovation of Kamsar plant. The Bidikoum Mine was opened to enable blending with the production from Sangarédi Mine to prolong the life of the high-grade ore found in Sangarédi. The Bidikoum project is forecasted to cost about $170 million, 70% of which is to be funded by the African Development Bank. Of 2,517 employed at CBG, 17 were expatriates. Bauxite operations at the SBK employed 1,841 workers, including 67 expatriates. An accident destroyed 36 railcars used for bauxite transportation. It would cost about $80,000 to replace each car. However, export volumes from operations at SBK recovered from the low levels experienced due to disruptions in the early 1990's.

Gold.—Gold occurs as hydrothermal quartz veins in Birimian rocks at several locations in Guinea. Artisanal operators mined lateritized gold placers for a long time in Kankan, Kouruossa, Mandiana, and Siguiri regions as "la zone du Boure." Reserves in the mineralized zones are estimated at about 140 tons. After the pullout of Union Miniere in 1992, the Government of Guinea authorized an Australian affiliate of a U.S. company, Golden Shamrock Mining Ltd., to explore and undertake mining of the Koron Mine. The transaction involved Shamrock's purchase of Union Miniere's 50% shares, as well as all but 15% of the Government's shares. The Government's role in the venture will be limited to regulatory and fiscal issues. There is no commercial mining at the Koron Mine, but artisanal miners continued to operate. In other developments, Cyprus-Amax Minerals Co. of Colorado signed an agreement with the Government of Guinea to explore and develop gold properties on a 3,000-km^2 area in the Mandiana region. Cyprus-Amax will own 85% of the interest and the Government of Guinea 15%. The agreement called for Cyprus-Amax to explore Guinea's western region extensively for new gold deposits.

Industrial Minerals

There was significant increase in production at the Aredor[2] diamond mine in Gbenko in 1993. The widespread disruptions contributing to the 1991-92 decline subsided giving way to more profitable operating conditions at Aredor. In 1993 production and export levels increased by about 25% over those of the previous year. According to reports from the Ministry of Natural Resources and the Environment, estimated artisanal production in 1993 was 374,000 carats, of which 126,000 carats was exported. There were also reports of continued smuggling of diamond out of the country. Of the nonartisanal 93,428 carats

produced in 1993, 91,764 carats was exported. Total value of diamond exports in 1993 was about $44.5 million. Aredor's work force also declined to 950, 30 of whom were expatriates.

Reserves

According to Direction Generale de Geologie of Guinea, estimates of total bauxite resources vary but are on the order of 20 billion tons, and proven reserves were about 18 billion tons. Reserves remaining at Sangarédi were about 175 Mmt grading between 50% and 60% alumina and 0.5% and 2% SiO_2. Reserves at Bidikoum were about 20 Mmt grading about 55% alumina. There were large additional deposits of lower grade ore in the area. Reserves at the Debelé deposit were about 28 Mmt grading 45% to 46% alumina. Friguia's reserves were reported to be in excess of 200 Mmt grading about 40% alumina. Official reserve estimates for diamond and gold were not available but are believed to be significant.

Iron ore reserves at the Nimba Mountains were estimated to be about 350 Mmt grading 66.5% iron. A number of other lower grade iron ore resources occur elsewhere in Guinea, but they are of little or no commercial value.

INFRASTRUCTURE

The mining railroads totaled 239 km of standard-gauge 1.435-m line and 806 km of 1-m line. A 135-km standard-gauge 1.435-m line linked the Sangarédi Mine with the Port of Kamsar, and a 104-km standard-gauge line linked the Kindia Mine with Conakry. A 145-km, 1-m line linked the Fria Mine with Conakry. In addition to the mine railroads, there was 661 km of 1-m gauge line linking Conakry with Kankan in very poor condition, but which was undergoing rehabilitation with French assistance. The Dabola-Conakry rail line is to be upgraded. Guinea has two main ports: Kamsar and Conakry. Kamsar serves the Sangarédi Mine, handling only bauxite shipments. Conakry serves the Fria and Kindia Mines and is also the country's main general cargo port. The country has 1,280 km of navigable waterways, which also could provide hydroelectric power for future demand. The European Investment Bank's $10 million water supply project in Conakry is in progress. The project involves the extension and modernization of existing facilities, including the construction of a second treatment plant and two reservoirs.

The $150 million Energie Electrique de Guinee (Enelgui) program to build a dam at Garafiri that started in 1992 has not received adequate financial backing. With a planned output of 260 GWh, the project is expected to reduce power supply problems in the country.

OUTLOOK

Bauxite and alumina should continue to dominate the economy of Guinea. The addition of the Bidikoum Mine should help maintain high-quality exports of bauxite. Friguia's production capacity of alumina should increase as renovations and expansions are completed. Projects requiring major hydroelectric power such as the proposed aluminum smelter could become technically feasible as the power generation capacity is increased under current plans.

There is reason to believe that Guinea's formal diamond and gold industries would survive with new investments and adequate exploration programs now being undertaken to secure continued production at current or higher levels. The addition of the Mandiana gold deposits should provide extra revenue for the Government. The MIFERGUI-Nimba iron ore project remains dependent on a solution to Liberia's civil war.

The deterioration of the country's infrastructure in the past 15 years tends to diminish the country's comparative advantage in attracting foreign private capital to invest and develop the mineral industry.

[1]Where necessary, values have been converted from Guinean francs (GF) to U.S. dollars at the rate of GF825=US$1.00, which was the exchange rate for Dec. 1993.

[2]"Aredor" is an acronym for Association pour la Recherche 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 Corp., 11.28%.

OTHER SOURCE OF INFORMATION

Ministry of Natural Resources and the Environment
P.O. Box 295
Conakry, Republic of Guinea

TABLE 1
GUINEA: PRODUCTION OF MINERAL COMMODITIES[1] [2]

(Thousand metric tons unless otherwise specified)

Commodity	1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Alumina:						
Production:						
Hydrate	627	642	640	601	642	700
Calcined	619	631	610	561	656	700
Shipments: Calcined	624	631	610	553	656	700
Bauxite:						
Mine production:						
Wet basis[3]	17,547	17,524	17,184	14,933	16,259	17,700
Dry basis[4]	r15,792	r15,772	r15,466	13,773	14,100	14,500
Calcined[5]	143	140	132	96	90	150
Shipments (dry basis):						
Metallurgical	14,886	13,968	13,533	12,314	13,617	1,400
Calcined	136	133	92	95	90	150
Diamond:[6]						
Gem[e] thousand carats	137	119	91	90	90	200
Industrial[e]	10	8	6	5	5	10
Total	147	127	97	95	100	210
Gold[7]	2,120	6,340	4,453	2,113	500	2,200

[e]Estimated. [r]Revised.

[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. Table includes data available through Mar. 14, 1994.

[2]All figures were reported by Bureau de Stratègie et de Marketing Minier of Guinea.

[3]Metallurgical plus calcinable ore estimated at 13 % water.

[4]Data are for wet-basis ore estimated at 13 % water, reduced to dry basis estimated at 3 % water.

[5]Data are for Compagnie des Bauxite de Guinéé, the sole producer of calcined bauxite.

[6]Figures do not include undocumented artisanal production believed smuggled out of the country.

[7]Figures include undocumented artisanal production. Aurifere de Guinea (AuG) is the only reporting gold mining company, reporting the following, in kilograms: 1988—324; 1989—1,202; 1990—1,745; 1991—1,453; 1992—1,113; and 1993—500.

TABLE 2

GUINEA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Million metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Bauxite and alumina	Compagnie des Bauxites de Guinéé (Halco Mining Inc.;[1] 51%, Government, 49%)	Sangarédi Mine, about 242 kilometers north of Conakry. Drying and shiploading facilities are at Kamsar, 160 kilometers northwest of Conakry	12.2 bauxite.
Do.	Société d'Economie Mixte Friguia (FRIALCO Holding Co.,[2] 51%; Government, 49%)	Fria Mine and Kimbo alumina plant are at Fria, 75 kilometers north of Conakry	2.5 bauxite, 0.7 alumina.
Do.	Societe des Bauxites de Kindia (Government, 100%)	Kindia Mine (Debele deposit) at Kindia, about 110 kilometers northeast of Conakry	3 bauxite.
Diamond carats	Société Mixte Aredor de Guinéé S.A.[3]	Aredor placer mine and mill are at Gbenko, 475 kilometers east of Conakry	200,000.
Gold[4] kilograms	Golden Shamrock Mining Ltd.	Koron placer mine near Siguiri, about 540 kilometers northeast of Conakry	2,000.

[1]Halco Mining Inc. consists of Aluminum Co. of America, 27%; ALCAN Aluminum Ltd. (Canada), 27%; Pechiney of France, 10%; Vereinigte Aluminium-Werke A.G. of Germany, 10%; Commonwealth Aluminium Co. of Australia, 8%; Aluminium S.p.A. of Italy, 6%; Billiton International Metals B.V. of the Netherlands, 6%; and Reynolds Metals Co. of the United States, 6%.

[2]FRIALCO is consortium of North America and European companies consisting of Pechiney of France, 30%; Noranda Minerals Inc. of Canada, 20%; British ALCAN Aluminium of Canada, 20%; and Norsk Hydro Aluminium of Norway, 20%.

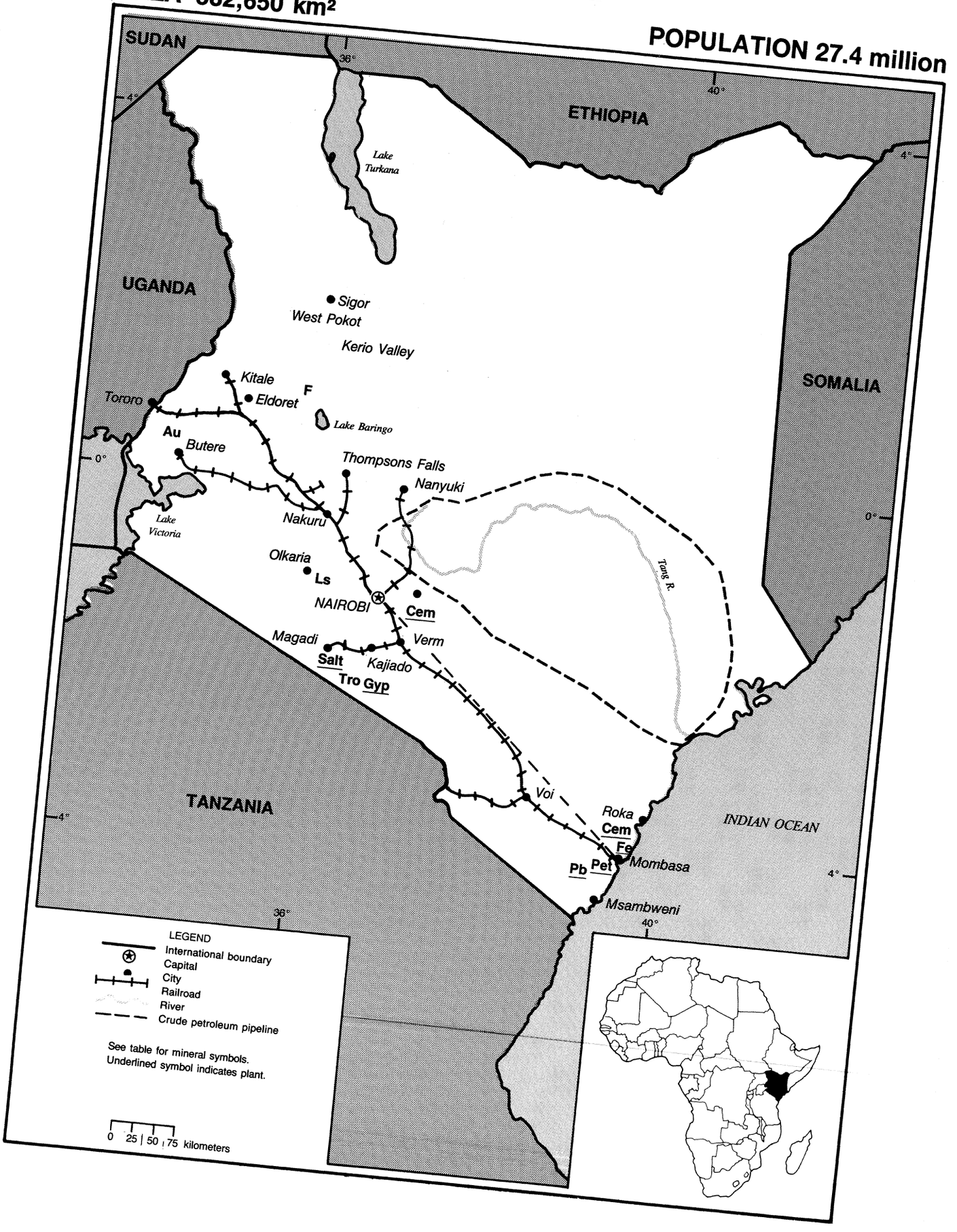
[3]"Aredor" is an acronym for Association pour la Recherche l'Exploitation du Diamants et de l'Or. Aredor Holdings Ltd. was a consortium of Australian companies Bridge Oil Ltd., 79.2%; and Bankers Trust Australia (U.K.) Ltd., 3.52%; Industrial Diamond Co. (Holdings) Ltd. (United Kingdom), 6%; and the International Finance Corporation, 11.28%. However, since Bridge Oil pulled out, Aredor is Government operated.

[4]The Koron Mine were closed in August 1992, and new contracts to reopen the mine was signed in 1993 with Golden Shamrock Mining Ltd. Also, a second contract were signed for the new mine to be developed in the Mandiana region by Cyprus-Amax of the United States.

KENYA

AREA 582,650 km²

POPULATION 27.4 million



THE MINERAL INDUSTRY OF

KENYA[1]

By David Izon

Kenya's mineral resources are limited. Mineral production consists mainly of cement, fluorspar, gemstones, salt, and soda ash. The country depends largely on agricultural exports and tourism. The mineral industry accounted for about 1.3% of the country's estimated gross domestic product (GDP) of $8.3 billion[2] in 1993.

The Government of Kenya initiated programs that are aimed at encouraging investment in the newly discovered resources such as gold. The new investment code permitted several European and Canadian mining groups to prospect for gold and other mineral resources. The outlook for prospects indicated that gold deposits could be commercially viable and could be mined by open pit methods.

GOVERNMENT POLICIES AND PROGRAMS

The Government encouraged firms to invest in the mineral industry by instituting new regulations that have reinstated confidence in the business community. Over the past 2 years, reform activities have triggered a wave of new investments in Kenya. The new regulations also have encouraged local manufacturers to take advantage of the devalued shilling to export to neighboring countries. The country's financial institutions were to be restructured to provide assistance in management and finance to small-scale businesses. Fiscal policies were geared toward relocation of industries and commercial activities from urban areas to smaller towns.

Several western donor countries provided financial assistance for the Government to restructure its parastatals. Under this program the Government also phased out subsidies, removed political interference, and established a modern stock exchange. The Government continued with policies that allowed investors to deduct all foreign exchange losses on their investments. Investors in large cities were allowed an investment tax credit allowance of 35% on plants, machinery, and buildings. Rural investors were allowed 85% and manufacturers were allowed 100% investment allowance.

ENVIRONMENTAL ISSUES

The Government of Kenya established some policies in coordinating and developing strategies for sound environmental management. Among such policies was the National Environmental Action Plan (NEAP), which is aimed at finding effective solutions to developmental problems and providing a framework for dealing with policy and institutional changes. NEAP also provides a data base for use in identifying environmental danger signals, which may be immediately acted upon to prevent or correct eminent disaster.

PRODUCTION

Major minerals and mineral materials produced in 1993 were cement, fluorspar, gemstones, salt, and soda ash. Gold production was solely artisanal. Both fluorspar and soda ash production declined in 1993 owing to falling prices on international markets. Artisanal gold production increased significantly because sales to the purchasing company were remarkably up. *(See table 1.)*

TRADE

The total export earnings for the country in 1993 were estimated at about $1.2 billion, of which export earnings from nonfuel minerals accounted for 1.3% of the country's GDP. Nonfuel export earnings were from cement, $55 million; gold, $35 million; soda ash, $14 million; and fluorspar, $9 million. Petroleum products were a source of major export earnings, most of which were in turn used to import oil from the Middle East for the country's refinery at Mombasa. Petroleum products were mainly exported to neighboring east and southern African countries, particularly Rwanda, Uganda, and Zaire.

Kenya's trading partners were France, Germany, Italy, Japan, the United Kingdom, the United States, and neighboring African countries. Imports from the United States were mainly iron and steel, medicinal and pharmaceutical products, machinery and transport equipment, phosphate rock, and processed nonferrous minerals.

STRUCTURE OF THE MINERAL INDUSTRY

The Government owned at least 51% of all mining companies, including the cement plants and the oil refinery. Magadi Soda Co. Plc, which was acquired by Penrice Soda Products of Australia in June 1991, operated as Magadi Soda Ash in 1992. Under the new agreement, Magadi Soda Ash maintained its interest and the new parent company retained all employees. *(See table 2.)*

COMMODITY REVIEW

Metals

Gold production was mainly artisanal

from aluvial opencast mines. There is no commercial gold production in Kenya. The known registered gold trading company is Goldenberg Co., which purchases gold from artisanal miners. Goldenberg is also known to buy gold from smuggled sources, particularly from neighboring countries.

Industrial Minerals

Cement.—Combined output from the country's two cement plants, Bamburi Portland Cement Co. Ltd. and the East African Portland Cement Co., was 1.42 Mmt in 1993. The two plants also were responsible for production of all limestone. Gypsum was produced by Athi River Mining Ltd. High-quality gypsum was sometimes imported to supplement local production. Klinker and magnetite also were produced locally. The Government's policy of decontrolling cement prices was a significant factor in the improved profitability of the cement industry. Planning for the construction of a third cement plant by Lonrho PLC continued at Koru about 30 km southeast of Kisumu in the Nyaza Province of western Kenya. About 20% of all cement produced in 1993 was sold to neighboring countries.

Fluorspar.—Fluorspar is Kenya's second most important mineral after soda ash. It is produced from an open pit mine at Cheberen in the Kerio Valley near Eldoret. The ore is crushed and ground prior to a floatation stage involving six stages of cleaning. After filtration, the final product contains only 10% moisture. Production of and export earnings from the acid-grade fluorspar declined because international prices were driven down by more inexpensive fluorspar produced in China.

Soda Ash.—Soda ash, the most important mineral commodity produced in Kenya, earned the country about $14 million in foreign exchange in 1993. The soda ash industry experienced a decline owing to poor international prices and rising industry costs. Plans were under way to increase output to about 300,000 mt/a by 1995. The new owner of Magadi Soda Co. PLC, Penrice of Australia, embarked on a program to modernize its production process and reduce pollution. The latter involved fitting oil traps to drains at the power station to prevent oil spillage into the lake and fitting dust extractors and scrubbers at rail-loading points to remove dust during loading. The Magadi operation was also Kenya's largest source of crude salt.

Mineral Fuels

Kenya does not produce crude petroleum but has a petroleum refinery. Proceeds from petroleum products refined at the Mombasa refinery made up a sizable share of Government revenues. Plans to upgrade the existing refinery and build a second refinery at the port of Mombasa may be shelved owing to the unwillingness of international firms to provide necessary funding. Plans considered included increasing the refinery capacity and making improvements in the refining process, particularly in the cracking process, to increase the range of petroleum products produced.

Reserves

There were no officially reported reserve data.

INFRASTRUCTURE

The railroad enters the country from the west 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 is primarily by pipeline. Extension of the pipeline to Kissumu and Eldoret is under construction.

OUTLOOK

Kenya's stable political climate should be a plus for investors who are considering development projects in the country. Long-term industrial energy conservation programs coupled with the implementation of favorable investment codes could prove beneficial to the country in the future. Development of the port in Mombasa to world class status that could handle a large volume of cargo and freight should increase Kenya's revenue base. Government policies that are directed toward projects that will improve mineral production, increase foreign earnings, and reduce the deficit, also are expected to continue.

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[1]Text prepared June 1994.

[2]Where necessary, values have been converted from Kenyan shillings (KSh) to U.S. dollars at the average rate of KSh58.00=US$1.00 for 1993 and KSh40.52=$1.00 for 1992.

OTHER SOURCES OF INFORMATION

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

Mines and Geological Department
Ministry of Environment and Natural Resources
Nairobi, Kenya

TABLE 1

KENYA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Barite		210	105	e100	e100	14	110
Carbon dioxide gas, natural	tons	5,231	5,622	4,156	4,802	5,910	6,000
Cement, hydraulic	thousand tons	1,216	1,512	1,423	1,508	1,417	1,500
Clays, kaolin		—	—	—	21	7	25
Diatomite		783	944	787	507	829	500
Feldspar[e]		[3]1,112	[3]1,290	1,200	1,200	1,200	1,300
Fluorspar (acid grade)		95,181	112,295	77,402	80,630	78,725	100,000
Gemstones, precious and semiprecious:							
Amethyst	kilograms	(4)	(4)	(4)	(4)	303	350
Aquamarine	do.	99	117	110	100	43	120
Cordierite (iolite)[e]	do.	10	10	10	10	[3]14	15
Garnet	do.	127	90	90	90	[3]31	90
Ruby	do.	36	201	e200	[3]123	e120	120
Sapphire	do.	[3]37	20	20	20	[3]2,314	20
Tourmaline	do.	1	9	10	10	229	10
Gold, mine output, Au content	do.	15	25	20	20	154	200
Gypsum and anhydrite[e]		36,478	36,000	36,000	36,000	36,000	36,500
Lead ore		—	—	—	—	396	400
Iron and steel:[e] Steel, crude	thousand tons	19	20	20	20	20	20
Lime		32,167	13,941	r11,757	12,000	12,000	12,500
Petroleum refinery products:							
Liquefied petroleum gas	thousand 42-gallon barrels	[3]320	[3]330	300	300	300	300
Gasoline	do.	[3]3,087	[3]2,856	2,850	2,800	2,800	2,800
Jet fuel and kerosene	do.	[3]3,587	[3]3,391	3,300	3,300	3,300	3,300
Distillate fuel oil	do.	[3]4,190	[3]4,202	4,200	4,200	4,200	4,200
Residual fuel oil	do.	[3]4,201	[3]4,422	4,400	4,400	4,400	4,400
Other[5]	do.	[3]766	[3]956	950	950	950	1,000
Total, including refinery fuel and losses	do.	[3]16,151	[3]16,157	16,000	15,950	15,950	16,000
Salt, crude, rock	tons	103,220	102,100	e102,000	e102,000	74,669	75,000
Sodium compounds, n.e.s.:							
Soda ash		240,880	244,480	245,000	186,038	144,850	145,000
Stone, sand and gravel:							
Calcareous:							
Coral[e]	thousand tons	[3]1,427	[3]1,650	1,600	1,600	1,600	1,700
Limestone	do.	16	18	20	12	13	20
Sand, industrial (glass)		[3]10,841	[3]12,344	12,300	12,300	12,300	13,000
Shale[e]		[3]118,459	115,000	115,000	115,000	115,000	116,000
Vermiculite		2,436	2,655	2,600	2,291	1,961	2,000
Wollastonite[e]		142	97	100	100	100	150

[e]Estimated. [r]Revised.

[1]Includes data available through May 24, 1994.

[2]In 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.

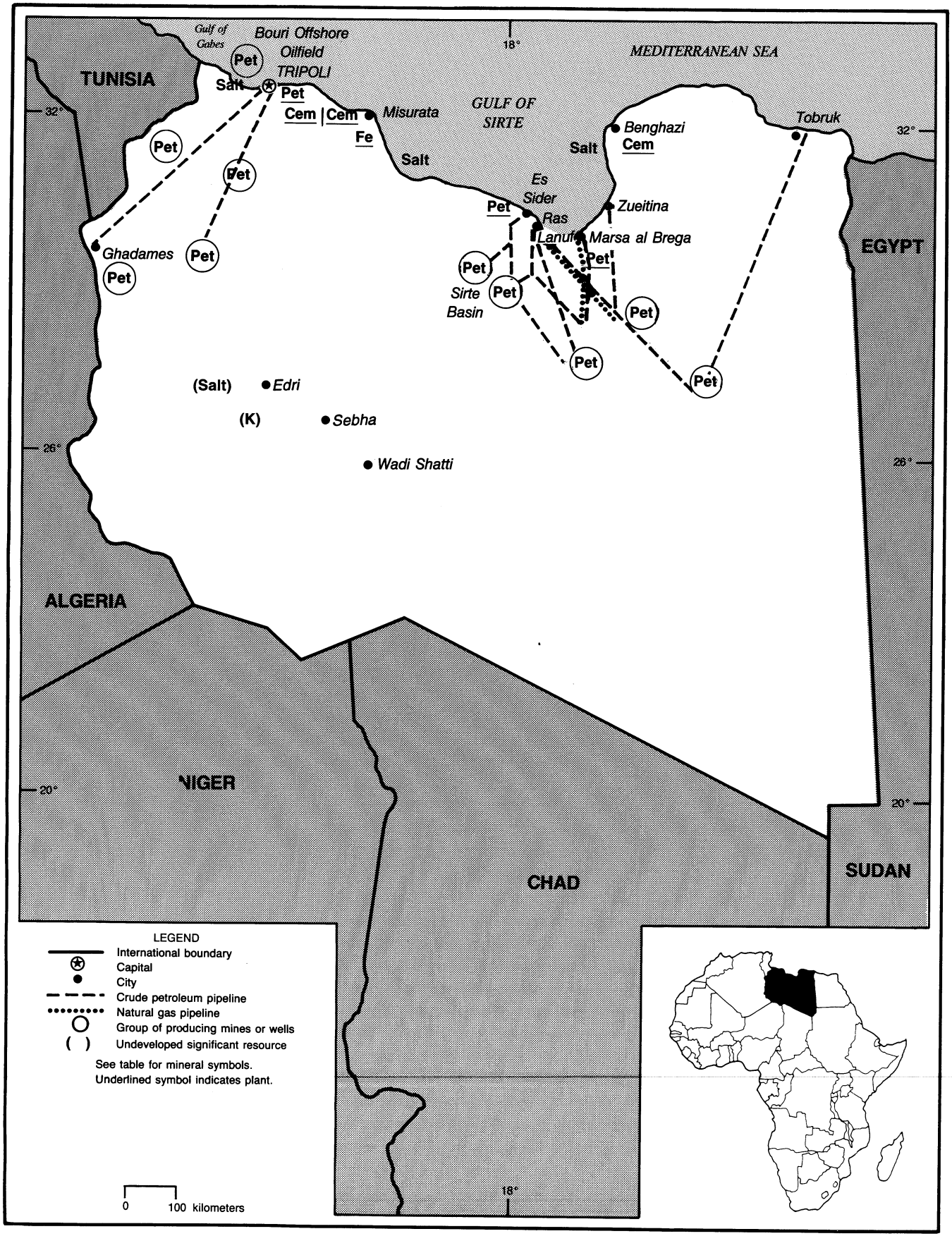
[3]Reported.

[4]Less than 1/2 unit.

[5]Refinery fuel losses were as follows, in thousand barrels: 1987—625; 1988—470; 1989—653; 1990—700; 1991—700; 1992—700; and 1993—700.

LIBYA

AREA 1,759,540 km² **POPULATION 4.9 million**



THE MINERAL INDUSTRY OF

LIBYA

By Thomas P. Dolley

Production of crude petroleum in Libya, that country's single most important source of revenue, declined in 1993. The crude oil production decrease represents the second consecutive year of such declines. The decline is due, at least in part, to the continuing United Nations (UN) trade embargo, precipitated by the 1988 airliner bombing over Lockerbie, Scotland. Being dependent on petroleum revenues, the global fall in oil prices also has had a detrimental effect on Libyan petroleum production. Petroleum production figures for 1993 were slightly below the Organization of Petroleum Exporting Countries (OPEC) quota of 1.39 Mbbl/d. Libya is a member of OPEC. Generally, Libyan oil production accounts for nearly 50% of the nation's gross domestic product (GDP). The estimated GDP for 1992, the last year available, was $26.1 billion.[1]

In 1993, Libya remained the second largest crude oil producer in Africa following Nigeria. Libya's petroleum reserves are the largest hydrocarbon resource on the African continent, but remain underexploited. The nonfuel sector of the Libyan mining industry was not significant on a global scale.

Owing to the Government's reluctance to comply with the UN on the Lockerbie affair, the international isolation of Libya became more pronounced during the year. Resolutions against Libya, adopted on November 11, 1993, by the UN Security Council fell short of a comprehensive oil embargo. European nations such as Italy, Germany, and Spain do not support a total oil embargo owing to their heavy dependence on Libyan crude oil. In the absence of a multilateral agreement, the UN resolutions called for the banning of sales to Libya of equipment used at oil and natural gas export terminals and refineries, and freezing of Libyan funds with the exception of revenue derived from oil and gas sales. These oil revenues were to be paid into special accounts authorized by central banks. Additional sanctions are to restrict Libyan civil aviation and to curtail Libyan imports of arms and military equipment.

GOVERNMENT POLICIES AND PROGRAMS

The Libyan legal system is based on Italian civil law and Islamic law. The Libyan National Oil Corp. (NOC) maintained complete control of Libyan oilfields and related investments, including marketing all the petroleum that is produced.

As of yearend 1993, the Government had not complied with the UN Security Council's request to extradite Libyan suspects in the Lockerbie bombing to either the United Kingdom or the United States. As a result, UN Security Council Resolution 883 went into effect on December 1, 1993. The U.S. sanctions of 1986 against the Government of Libya were renewed in 1993.

ENVIRONMENTAL ISSUES

Scant information exists on environmental issues or problems in Libya. Information on the environmental effects, if any, caused by Libya's largest infrastructure project, the Great Manmade River (GMR), a $25 billion scheme to divert water from interior desert artesian fields in the Fezzan region to agricultural areas in coastal Libya, is not readily available. As of yearend 1993, the environmental effects of petroleum production and exploration in Libya were unknown.

PRODUCTION

Apart from hydrocarbons, mineral production in Libya is negligible. Petrochemical and refining infrastructure development continues in Libya, but at a reduced pace. Mining activity included salt harvesting from coastal pans; quarrying of clays, gypsum, and limestone; cement production; and ammonia production. Iron and steel production remained at a level that was less than design capacity. Heavily subsidized by the Government, iron and steel production relied upon imported feed materials. *(See table 1.)*

TRADE

Crude oil accounts for more than 95% of total Libyan exports. Petroleum export revenues were estimated to be $9.2 billion in 1993, with Italy, Germany, and Spain being the main importers. Total crude oil exports from Libya to Europe amounted to 1.18 Mbbl/d in 1992, the last year for which data were available. Libyan marketing strategy for its benchmark Es Sider low-sulfur crude oil has been preferentially reserved for its joint-venture customers for the past few years. The result of this strategy is that virtually no Es Sider crude is now available on the global spot market.

Over the past several years, the Libyan parastatal Oilinvest, registered in the Netherlands Antilles, has incorporated a variety of petroleum retail outlets and additional refining capacity in Europe. To circumvent the UN embargo in 1993, Libya relinquished its majority equity control in Oilinvest by selling its share to the Italian business groups Armani, Montanari, Triboldi, and the German independent oil distributor Eggert. As of

yearend 1993, Libya maintained a 45% interest in Oilinvest and 55% equity went to the foreign partners. Additionally, Oilinvest petroleum outlets grew to about 2,800 units in 1993.

STRUCTURE OF THE MINERAL INDUSTRY

Libya possesses a predominantly state-run, socialist economy, and the mineral sector is no exception. Hydrocarbon legislation in Libya dated back to the 1955 Petroleum Law. In 1969, some foreign petroleum operators were nationalized following the Libyan Revolution. Generally, petroleum exploration and production sharing, along with any proposed mining activities, were based on the Fiscal Provisions, Revenue and Financial Law of July 1, 1977. As a result of the global petroleum market downturn of 1980, prior legislation was amended. This new legislation was known as EPSA-2. The EPSA-2 production-sharing terms were based on the following criteria: 85% to 15% in the Government's favor for highly significant hydrocarbon prospects, 81% to 19% for moderately significant oil prospects, and 75% to 25% for less significant oil prospects. These criteria were intended for foreign companies that wanted to pursue a more aggressive exploration program. Initially, the changes led to success in the oil sector; however, more foreign investment was desired by the Government. This policy led to the EPSA-3 agreements in 1988. EPSA-3's revised terms called for exploration costs to be recovered from output with development costs to be equally split between the foreign operator and NOC. Additionally, the terms called for production output to be shared between the contractor and NOC on a sliding scale, to include tax and royalty exemption for the contractor.

NOC was the parastatal created by the Government in 1970 to oversee petroleum and natural gas exploration, production, and marketing. Italy's Azienda Generali Italiana Petroli S.p.A. (AGIP) remains the largest petroleum producer in Libya by virtue of its Bouri offshore oilfield production, but other significant foreign operators included France's Société National Elf Aquitaine and Germany's Veba AG and Wintershall AG. Libya continued to rely on foreign expertise and technical personnel to develop its petroleum and mineral industry. *(See table 2.)*

COMMODITY REVIEW

Metals

In early 1993, the Libyan Iron & Steel Co. (Lisco) awarded a $224 million contract to a European consortium headed by Austria's Voest Alpine Industrieanlagenbau for the expansion of the Misurata iron and steel complex. The Misurata expansion project calls for the installation of a new direct reduction plant with a production capacity of 650 kmt/a of hot-briquetted iron. The majority of the new production after the expansion project is completed will be exported to Italy and Spain. Currently, most production is exported, some to neighboring Egypt. The 3-year expansion project will bring the Misurata steel plant's capacity up to 2 Mmt/a. Installation of the third direct reduction module will greatly augment storage capacity on-site at Misurata and allow full utilization of capacity at the steel melting shops. In the past decade, Voest Alpine was in charge of the installation of the two extant direct reduction modules at Misurata.

Mineral Fuels

Petroleum.—There were some significant developments in the Libyan crude oil sector in 1993, despite the UN sanctions. AGIP had a significant discovery in late 1993. The wildcat discovery, 900 km southeast of Tripoli in the Sahara desert, flowed at a rate of 5,000 bbl/d. Additionally, the discovery is adjacent to AGIP's Bu Attifel Field, and further production and transport of the crude oil can utilize AGIP's existing Bu Attifel oil and natural gas infrastructure. Libya's offshore Bouri Oilfield contains the largest hydrocarbon reserves and the largest offshore platform in the Mediterranean. AGIP manages the Bouri Oilfield with further development underway.

Total of France initiated the first phase of development of the Mabrouk Field, which utilizes water injection. In the western Sirte Basin, the field has an estimated reserve of 2 billion bbl of crude oil but is heavily fractured, thus requiring water injection for improved recovery.

The NOC and Tunisia's Enterprise Tunisienne d'Activités Pétrolières (ETAP) formed a joint-venture company, Société de Recherches et d'Exploration Commune et de Services Pétroliers (Joint Oil), in 1989. Joint Oil's mission was to conduct seismic surveys of the offshore 7th November petroleum concession that sits astride the maritime boundary between Tunisia and Libya. The three geologic structures there are estimated to contain recoverable reserves of 1.6 to 3.7 billion bbl of crude oil and 132 to 328 billion m^3 of natural gas. However, in early 1994, ETAP withdrew funding from the project and was seeking a third partner.

Refining.—Total throughput domestic refining capacity in Libya is 342 kbbl/d via five refineries. Oilinvest's overseas throughput refining capacity totaled about 70.7 Mbbl in 1992.

Reserves

Libya possesses the largest hydrocarbon reserves in Africa, estimated at about 23 billion bbl by international analysts. Contrastingly, the NOC estimates proven crude oil reserves at 45 billion bbl, based on a recovery rate of 35% of 130 billion bbl in situ. The Bouri offshore oilfield alone contains 5 billion bbl, of which 650 Mbbl is recoverable along with associated natural gas. Total natural gas reserves in Libya are estimated at 1.2 trillion m^3.

Libya possesses other industrial mineral resources, including gypsum, magnetite, phosphate rock, potash, sodium chloride, and sulfur, for which reserves have not been officially reported. These resources remain largely untapped

due to lack of international capital investment and ready markets along with high development costs.

INFRASTRUCTURE

Highways within Libya totaled 32,500 km, of which 24,000 km is paved. Transportation of petroleum and natural gas was primarily through a network of pipelines from wellhead to processing and shipping points that were primarily on the Mediterranean coast. Crude oil pipelines totaled 4,383 km, and natural gas pipelines totaled 1,947 km. Petroleum products traversed 443 km of pipeline. Libyan oil exports are conducted through six main terminals at Es-Sider, Marsa el-Brega, Tobruk, Ras Lanuf, Zawia, and Zueitina. Libya's General National Maritime Transport Co. (GNMTC) operates a fleet of 25 vessels, which includes 11 oil tankers with a total capacity of 1,321,700 dwt. The first phase of the GMR was virtually complete, with the final stages to include water well drilling in the Kufra region and pipeline construction. The project is to be completed at the turn of the century.

OUTLOOK

Further industrial development within Libya will inevitably depend on the perceptions and policies of the international community toward the Government. The UN embargo currently includes a ban on crude oil processing equipment, but not exploration equipment. Depending on its duration, the embargo could have long-term effects on the petroleum industry by virtually curtailing any plans to increase petroleum production capacity. Effects may be minimal in the near term owing to foreign petroleum operators in Libya having already stocked exploration and production equipment in anticipation of the UN embargo. However, a more comprehensive embargo on Libya in the future has not been ruled out by the UN. Currently, the freezing of the Government's overseas assets does not include revenues from the sale of crude oil, oil products, or natural gas. Additionally, continued austerity budgets imposed by the Government will continue to restrict development of major infrastructure projects.

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[1]Where necessary, values have been converted from Libyan dinars (LD) to U.S. dollars at the rate of LD0.3041=US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

Secretariat of Oil
P.O. Box 256
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National Oil Corp. (NOC)
P.O. Box 2655
Tripoli, Libya
Telepone: 46180 (10 lignes)
Telex: 61508-20270

Publication

Salem, M. J., and M. T. Busrewil, (eds.). The Geology of Libya, v. I, II, and III. Al-Faeh University, Tripoli, Socialist People's Libyan Arab Jamahiriya, Academic, 1980.

TABLE 1

LIBYA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Cement, hydraulic	thousand metric tons	2,700	2,700	2,369	2,300	2,300	3,900
Gas, natural:e							
Gross	million cubic meters	13,782	12,000	13,600	13,600	14,000	14,000
Marketed[3]	do.	6,452	6,500	6,500	6,500	6,500	6,500
Dry	do.	5,900	6,200	6,200	6,200	6,200	6,200
Gypsume	thousand metric tons	180	180	180	180	180	180
Iron and steel:							
Metal:							
Direct-reduced irone	do.	90	r500	r780	r850	r944	1,200
Crude steele	do.	10	r492	r718	r822	r920	1,200
Lime e	do.	260	260	260	260	260	260
Nitrogen: N content of ammonia	do.	r212	200	130	r347	350	200
Petroleum:							
Crude	thousand 42-gallon barrels	412,450	501,510	550,785	544,945	r499,685	620,500
Refinery products:							
Gasoline	do.	9,125	10,950	r15,330	15,000	15,000	15,000
Kerosene and jet fuel	do.	12,775	13,505	r13,870	13,000	13,000	13,000
Distillate fuel oil	do.	25,550	30,295	r30,660	30,000	30,000	30,000
Residual fuel oil	do.	27,740	33,215	r33,580	33,000	33,000	33,000
Other	do.	18,250	18,980	r14,600	14,000	14,000	14,000
Refinery fuel and losses	do.	3,650	4,380	r4,380	4,000	4,000	4,000
Total	do.	97,090	111,325	r112,420	109,000	109,000	109,000
Salt	thousand metric tons	12	12	12	12	12	12
Sulfur, byproduct of petroleum and natural gase	do.	14	14	14	14	14	14

eEstimated. rRevised.

[1]Table includes data available through Mar. 1994.

[2]In addition to the commodities listed, a variety of construction 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]Excludes gas reinjected into reservoirs.1

[4]Reported figure.

TABLE 2

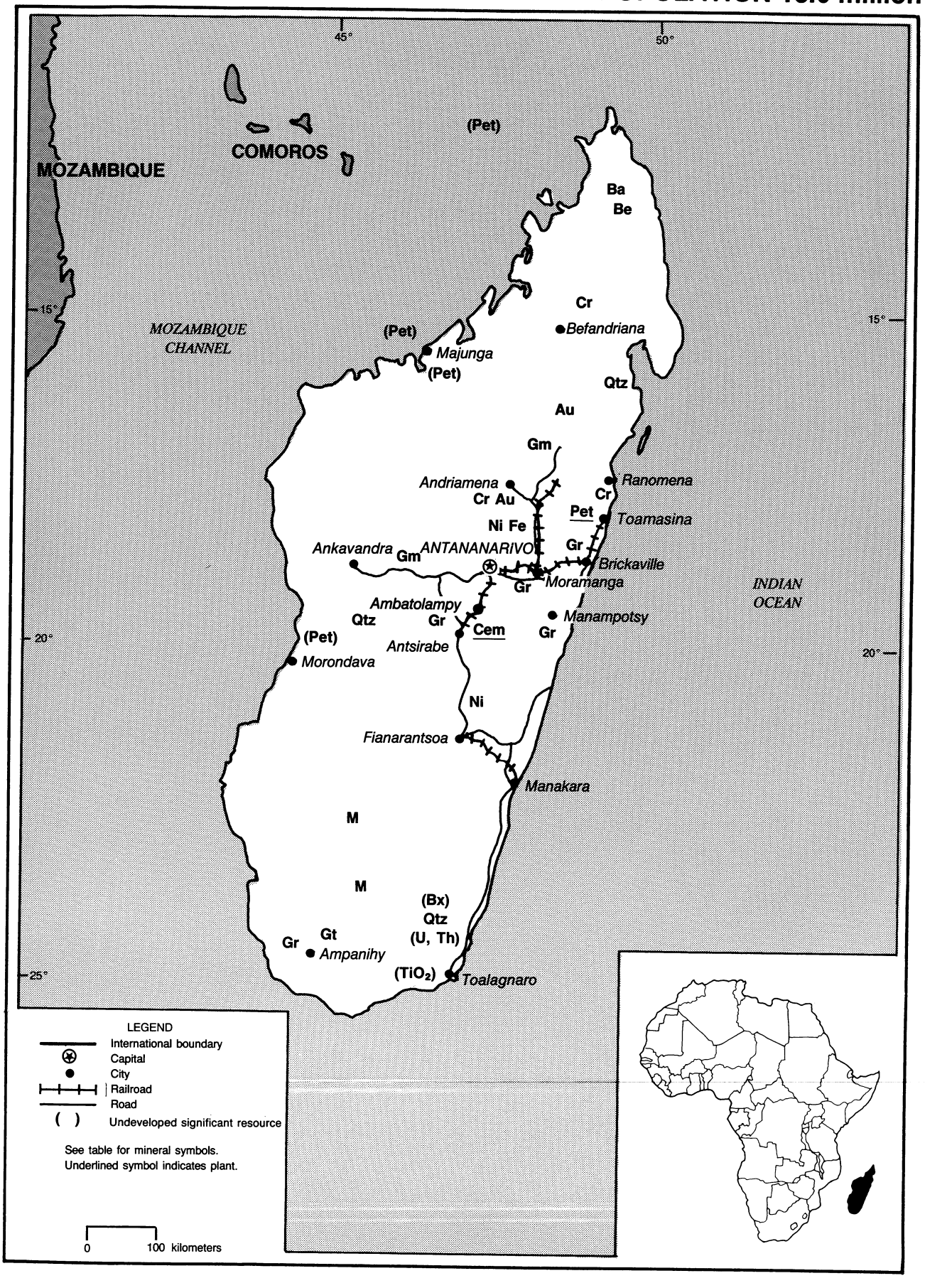
LIBYA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement		Libyan Cement Co. (Government, 100%)	Hawari, near Benghazi	1,500
Do.		National Cement and Building Materials Co. (Government, 100%)	El Margueb and Lebda	1,400
Do.		El Fataiah Cement (Government, 100%)	Derna	1,000
Iron and steel, crude		Misurata Iron and Steel Complex (Government, 100%)	Misurata	2,400
Petroleum, crude	million 42-gallon barrels	Libyan National Oil Corp. (NOC) (Government, 100%)	Mainly Sirte Basin	65.7
Do.	do.	Agip-North Africa Middle East [NOC, 85%; Azienda Generali Italiana Petroli (Agip), Italy, 15%]	Bouri offshore oilfield, Bu Attifel onshore oilfield, Rimal Katib on-shore oilfield	31, 50, 2.3
Do.	do.	Elf Aquitaine-Libya (NOC, 85%; Société Nationale Elf Aquitaine, France, 15%)	El-Meheiriga onshore oilfield	0.3
Petroleum, refining	do.	Azzawiya Oil Refining Co. (Government, 100%)	Azzawiya	44
Do.	do.	Ras Lanuf Oil and Gas Processing Co. (Government, 100%)	Ras Lanuf	73.4
Do.	do.	Sirte Oil Co. (Government, 100%)	Marsa al-Brega	3.1

MADAGASCAR

AREA 587,040 km² **POPULATION 13.0 million**



THE MINERAL INDUSTRY OF

MADAGASCAR[1]

By Thomas P. Dolley

Chromite and graphite were the most significant minerals produced in Madagascar in 1993. In addition to these minerals, the Malagasy mining industry produced some industrial mineral commodities, including a variety of semiprecious stones. Developments within the mining industry remained stagnant during the year. Mineral production was a small contributor to the overall gross domestic product (GDP), which was $2.5 billion in 1991, the last year for which data were available.[2]

In the near term, foreign investment will be needed to further develop the mining industry. A newly elected Government was officially installed at midyear.

GOVERNMENT POLICIES AND PROGRAMS

The Malagasy legal system is based on French civil law. The Government nationalized all mineral resources, with the exception of graphite and mica, in 1975. The new Mining Code, law No. 90-017 of 1990, revises and augments the earlier law No. 89/007 of December 12, 1989. The law stipulates three types of mining permits. The permits are further subdivided into exploration and exploitation permits. Type-I permits are for exploration and exploitation. Granted to individuals or groups of Malagasy nationality, type-I permits are valid for 2 years. Type-II and type-III permits are designed for small to large mining companies that have been incorporated under Malagasy law. The duration of validity of type-II and type-III exploration permits is 3 and 5 years, respectively. Under the new mining code, the maximum size of type-II and type-III exploration permits is 400 km² and 1,000 km², respectively. Type-II and type-III exploitation permits stipulate 100 km² and 200 km², respectively.

The Petroleum Code, law No. 80-001 of June 6, 1980, provides for two different types of production-sharing contracts. The first type of contract covers equity ventures between foreign oil operators and the Office Militaire National pour les Industries Stratégiques (OMNIS). The Government maintains 51% ownership, and cost and production-sharing are financed by income tax payments and royalties based on achieved rates of return.

In 1993, the Government planned privatization and reform for certain commercial ventures, including petroleum refining and distribution. These plans included restructuring Solitany Malagasy (SOLIMA), which operated the petroleum refinery at Toamasina. Currently, the Government does not appear to favor the concept of mining development within free trade zones. Canada's QIT Fer et Titane Inc. (QIT) desired to develop the ilmenite sands of Toalagnaro under the latter concept.

ENVIRONMENTAL ISSUES

By yearend 1993, QIT had made no significant progress toward exploiting the ilmenite sands near Toalagnaro. In 1990, OMNIS conducted an environmental impact study of QIT's proposed dredge mining of coastal ilmenite sands. The study concluded that the mining operation would destroy 75% of the coastal forest zone over an area of 30 km². QIT had suggested that special conservation areas be set up to limit mining damage to the environment.

The Government continued to seek multilateral and bilateral cooperation to aid in controlling the degradation of the environment incurred during the past few years. Uncontrolled slash-and-burn cultivation, deforestation, livestock overgrazing, and massive erosion threaten Madagascar's agricultural and hydroelectric potential, and the country's unique wildlife.

PRODUCTION

Official Government production figures for minerals were unavailable for 1993. However, production levels of all mineral commodities are assumed to have remained at 1992 levels. *(See table 1.)*

TRADE

Total run-of-mine chromite ore exported in 1992, the last year for which data were available, was 45,575 tons, with chromite concentrate exports at 62,600 tons. The revenues generated for ores and concentrates for Madagascar chromite exports in 1992 exceeded $7 million. Total flake and fine graphite exports for 1991 totaled 12,600 tons. Graphite exports for 1992 declined to 7,577 tons, valued at about $5.5 million. Mineral exports had to be authorized by the Ministry of Mines and Energy (MEM), with the exception of mineral samples associated with exploration. Significant amounts of gold and semiprecious stones were smuggled out of the country; this illegal trade was of concern to the Government.

Madagascar imported all of its crude petroleum and some petroleum products; this was a significant burden to the economy. In any given year, the value of petroleum imports was equivalent to 15% to 30% of the total foreign exchange earnings garnered through exports. Crude petroleum imports totaled 2.3 Mbbl for 1992, of which about 1.7 Mbbl was supplied by the Kingdom of Saudi Arabia. The balance was supplied by Iran.

STRUCTURE OF THE MINERAL INDUSTRY

The chromite industry in Madagascar was controlled by the parastatal Société Kraomita Malagasy (Kraoma). Graphite and mica production were owned and operated by foreign entities, but the Government had significent influence on these operations through taxes, royalties, and official approval of all foreign exchange transactions. OMNIS, created in 1976, was involved primarily in research, joint ventures, and promotion of Madagascar's mineral potential, including hydrocarbons, and acted as the repository of the acquired exploration data. The MEM's primary responsibility was for the energy sector. The execution of the MEMs' directives was carried out by the Directorate of Energy. The MEM also directed SOLIMA and the Electricity and Water Co. (JIRAMA). The distribution, importation, and refining of petroleum products was managed by SOLIMA. Owing to planned privatization in 1993, SOLIMA will not entirely manage the hydrocarbon sector, but will probably still keep a share in the Toamasina refinery.

COMMODITY REVIEW

Madagascar's chromite ore was mined from the area around Andriamena. Initiated in 1967, chromite production from the Andriamena district has generally remained stable in recent years. A minimum of 25 chromite lenses have been identified within the dunite host rocks of the Andriamena complex, and more lenses may yet be identified. Ore beneficiation enabled Kraoma to produce a chromite concentrate grading 29% to 34% Cr_2O_3 with 0.002% to 0.003% phosphorus; typically, crude Malagasy chromite contains 0.007% phosphorus.

Madagascar had some scattered placer and lode gold deposits, and there existed a large black market for the mining and sale of gold. During 1993, eluvial gold targets east of the coastal range in Madagascar were reported. The Government officially reports only a few kilograms of gold production annually. However, actual production varied between 2 and 3 mt/a with an annual estimated value of $25 million. The gold mining was primarily artisanal and employed approximately 5,000 to 10,000 people.

Madagascar continued to be a producer and exporter of high-quality crystalline flake graphite. Graphite was produced in Madagascar by five main companies, all headquartered in Antananarivo. Société Minière de la Grande Ile (SMGI) was the largest producer, and the other four producers were Etablissements Gallois, Société Louys, Etablissements Izouard, and Etablissements Rostaing. Three mines were operated by SMGI, with production of about 6 kmt/a of graphite with a carbon content of 90% to 95%. A joint-venture partner or new owner was being sought by SMGI.

In 1993, there were reports that geological investigations had revealed the existence of diamond deposits on the banks of certain rivers in southern Madagascar. Other precious stones such as emeralds, rubies, sapphires, and semi-precious stones were also in the area. Further studies of the area were planned.

Madagascar had no domestic crude petroleum production. The country was entirely dependent on imports of crude petroleum. Total petroleum consumption averaged about 21 Mbbl/a. During the past several years, there was a modest amount of oil exploration by foreign companies in Madagascar. As of yearend 1993, no commercial hydrocarbon finds were reported. Established in 1966, the country's sole refinery was at Toamasina with a total throughput refining capacity of 16,500 bbl/d with 2,600 bbl/d of catalytic reforming capacity.

Estimated chromite resources in Madagascar totaled 2.1 Mmt of contained chromium, or less than 1% of the world total. Graphite reserves were estimated at more than 1 Mmt. The Government stated that Madagascar had significant deposits of bastnasite, bauxite, ilmenite, and iron ore. Deposits of coal, lignite, and uranium minerals also were known from the island. Discovered in the 1940's, total minable reserves of uranium-bearing minerals remained undetermined. Some small-scale mining of uranium-bearing minerals occurred but was subsequently abandoned. Copper-nickel deposits existed, but were not considered economic. Semiprecious gemstone deposits have long been mined and exported in Madagascar; the Government desired to organize and streamline the industry to better exploit these resources.

INFRASTRUCTURE

Infrastructure development in Madagascar was inadequate for most mining development. Additional foreign aid will be needed to improve the road system and telecommunications network. The hydroelectric potential of Madagascar was estimated at 14,000 MW, but remained underexploited. Current installed hydropower capacity was 106 MW. Petroleum loading and unloading facilities existed at Toamasina, but were limited to oceangoing vessels of 50,000 dwt. The Malagasy labor force was estimated at 5.7 million.

OUTLOOK

The new Government's policy of privitization could help attract foreign investment in the mining sector. However, the lack of infrastructure, coupled with increasingly strict environmental protection policies, could forestall development in the mining sector, at least in the short term.

[1]Text prepared Feb. 1994.

[2]Where necessary, values have been converted from Madagascar francs (FMG) to U.S. dollars at the rate of FMG1,846.9=US$1.00.

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Agencies

Ministry of Industry, Energy and Mines
Geological Department
Boite Postale 322 Ampandrianomby
Antananarivo 101, Madagascar
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Publication

Ministere des Finances et du Plan, Direction de L'Institut National de la Statistique et de la Recherche Economique: Bulletin Mensuel de Statistique, monthly.

TABLE 1

MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES[1]

(Kilograms unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Beryllium: Beryl in quartz concentrates, industrial and ornamental e		r3154	r3,345	3,000	3,000	3,000	3,500
Chromium: Chromite concentrate, gross weight	metric tons	62,540	73,000	63,000	69,123	69,000	73,000
Gold, mine output, Au content e 4		r45	r216	200	200	200	200
Rare-earth minerals: e							
Bastnasite(60% REO)	metric tons	5	5	5	5	5	5
Monazite(55% REO)		100	100	100	100	100	100
INDUSTRIAL MINERALS							
Abrasives, natural (industrial only) e		10,000	10,000	10,000	10,000	10,000	10,000
Cement, hydraulic e	metric tons	60,000	60,000	60,000	60,000	60,000	60,000
Clay, kaolin	do.	1,315	485	496	756	700	1,300
Feldspar e		5,000	5,000	4,000	4,000	4,000	5,000
Gemstones:							
Amazonite		23,885	2,185	e2,000	e2,000	2,000	23,000
Amethyst:							
Gem		3	1,713	e1,700	e1,700	1,700	1,700
Geodes e		9,000	86	80	80	80	9,000
Citrine		754	50	6	e6	e6	800
Cordierite		4,051	1,556	20	7	7	4,000
Garnet		23	6,905	6,000	300	300	7,000
Tourmaline		97	54	302	257	300	2,300
Graphite, all grades	metric tons	15,863	18,036	14,079	8,910	8,000	18,000
Mica, phlogopite:							
Block	do.	7	93	90	4	4	90
Scrap	do.	899	538	500	716	700	900
Splittings and sheet	do.	162	90	90	78	70	160
Total	do.	1,068	721	680	798	774	1,150
Ornamental stones:							
Agate		9,005	4,696	9,463	5,990	5,900	13,000
Apatite		9,016	1,139	4,001	4,000	4,000	9,000
Aragonite	metric tons	2,187	786	126	120	120	2,000
Calcite	do.	1,373	3,757	1,412	1,400	1,400	3,700
Celestite		28,398	e26,000	e26,000	1,320	1,300	34,000
Jasper		30,137	23,560	11,694	68,300	68,000	30,000
Labradorite		23,015	24,000	35,010	61,654	61,000	62,000
Other gem and ornamental e	metric tons	250	250	250	250	250	250
Quartz:							
Crystal e		r40,875	32,000	32,000	32,000	32,000	41,000
Geodes e		2,700	2,700	2,500	2,500	2,500	2,700
Hematoid		5,795	3,157	560	330	e300	9,000
Piezoelectric		163	160	66,200	e66,000	e66,000	66,000
Rose quartz		64,384	10,832	4,802	27,666	27,000	360,000
Smelting e		100,000	r179,521	180,000	180,000	180,000	180,000
Other ornamental		6,578	14,360	1,267	3,600	3,000	14,000
Tourmaline		3,140	4,076	302	300	300	4,000
Salt, marine e	metric tons	30,000	30,000	30,000	30,000	30,000	30,000

See footnotes at end of table.

TABLE 1—Continued

MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES[1]

(Kilograms unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Stone:							
Calcite, industrial e	metric tons	2,000	2,000	2,000	2,000	2,000	2,000
Dimension stone e	do.	3,000	3,000	3,000	3,000	3,000	3,000
Marble, cipoline e	do.	[3]5	1	1	1	1	1
MINERAL FUELS AND RELATED MATERIALS							
Petroleum refinery products:							
Distillate fuel oil	thousand 42-gallon barrels	540	798	922	e900	900	900
Gasoline	do.	219	405	434	e400	400	450
Kerosene and jet fuel	do.	139	253	291	e290	290	300
Residual fuel oil	do.	329	504	e500	e500	500	900
Other	do.	14	26	e20	e20	20	90
Total	do.	1,241	1,986	e2,167	e2,110	2,110	2,640

e Estimated.

[1] Table includes data available through Feb. 1994.

[2] In addition to the commodities listed, modest quantitites of unlisted varieties of crude construction materials (other clays, sand and gravel, and other stone) presumably are produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

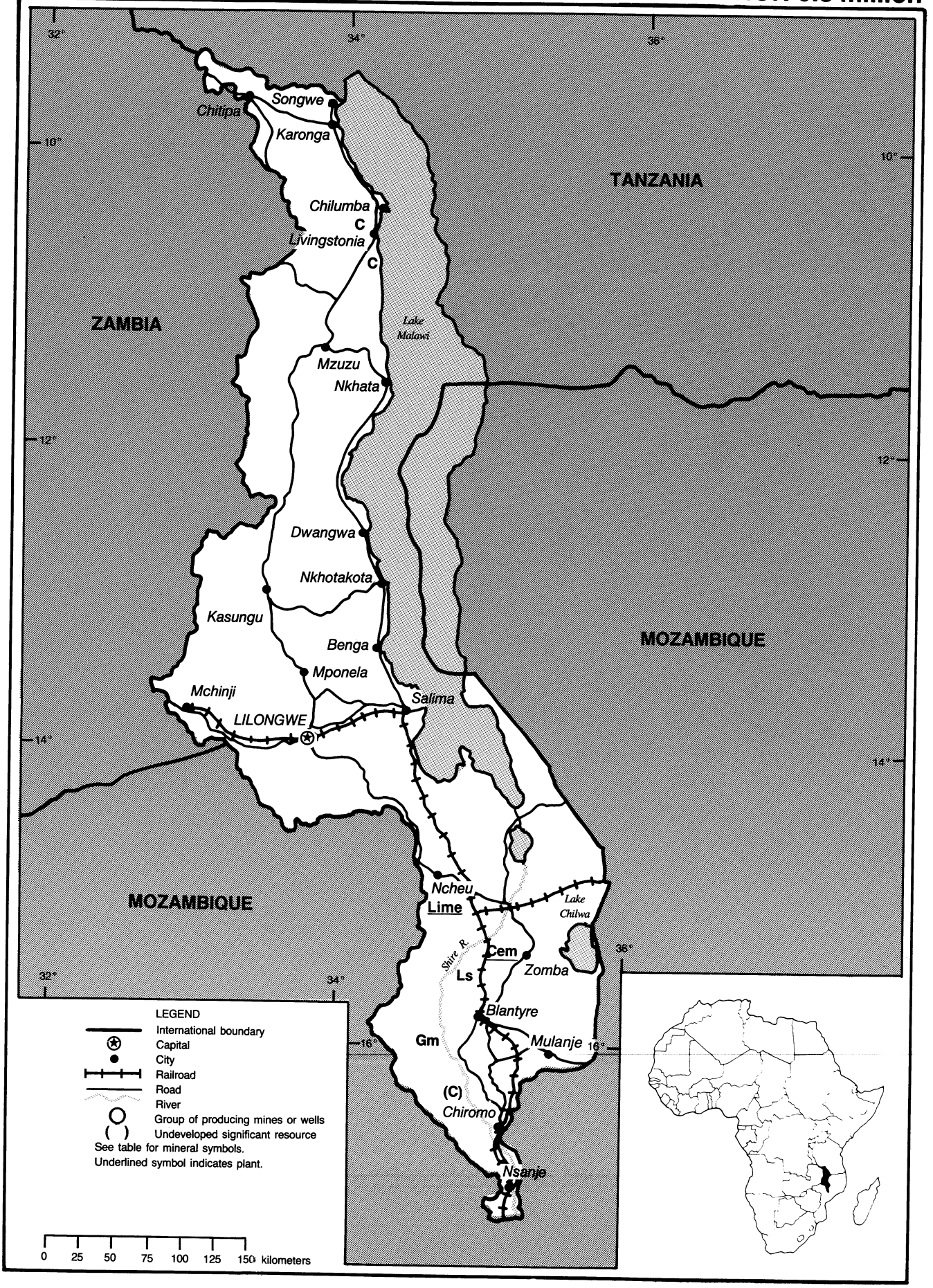
[3] Reported figure.

[4] Does not include an estimate of smuggled artisanal production.

MALAWI

AREA 118,480 km²

POPULATION 9.8 million



THE MINERAL INDUSTRY OF

MALAWI[1]

By Philip M. Mobbs

The mineral sector accounted for an estimated 1% of the gross domestic product (GDP) in 1993. Coal and limestone were the more important minerals produced, as they were used in the country's lime and cement industries.

Mineral activities were covered by the Mines and Minerals Act, 1981; the Mines and Minerals (Mineral Rights) Regulations, 1981; and the Petroleum (Exploration and Production) Act of 1983. Royalty rates, ranging from 5% on processed minerals up to 10% on rough gemstones, were being reviewed. All minerals were vested in the President on behalf of the people of Malawi. Environmental provisions in the Mines and Minerals Act included the requirement that the Department of Research and Environmental Affairs review an Environmental Impact Assessment (EIA) with each mineral rights application. The EIA should address issues such as treatment of mine wastes and plans for contouring and replanting of areas adversely affected by prospecting or mining activities.

The Ministry of Energy and Mining was authorized to negotiate incentives and benefits with investors. The Government encouraged local and foreign investment and anticipated that mining would somewhat diversify the nation's economy from its agricultural base. The Government also expected an increase in foreign exchange from export earnings, the substitution of locally produced materials for imports, and a decrease in unemployment with the expansion of the mineral industry.

Malawi was a member of the Multilateral Investment Guarantee Agency (MIGA), an affiliate of the World Bank.

Mining operations in Malawi included numerous small-scale lime producers in the Chenkumbi Hills, 36 km southeast of Ncheu, and in the Lirangwe area near Blantyre. There was extensive small-scale gemstone digging activity. Medium-scale operations consisted of limestone quarries and a 10,000-mt/a coal mine at Mchenga in the Livingstonia coal field operated by the parastatal Mining Investment and Development Corp. (Midcor). Large-scale operations included the Portland Cement Co.'s 200,000-mt/a Changalumi limestone quarry near Zomba and its 120,000-mt/a cement plant in Zomba. *(See table 1.)*

The Geological Department has completed regional geological mapping of the country. A feasibility study of the Mulanje bauxite deposits, funded by the African Development Bank, was in progress. The nation's bauxite reserves have been estimated at 28 Mmt averaging 43.9% Al_2O_3. There are 12 Karoo-aged basins in Malawi estimated to contain more than 800 Mmt of coal. Additional potentially economic mineral deposits include corundum, gemstones, glass sands, graphite, kaolin, kyanite, petroleum, phosphates, pyrite, rare-earth elements, titanium-bearing minerals, and vermiculite. The country's uranium deposits are not deemed economic at present low world prices.

Landlocked Malawi anticipates improving accessibility to the sea with the cessation of hostilities in Mozambique. The existing northern corridor uses a combination of road, lake, and railroad to transport material to the port of Dar Es Salaam, Tanzania. There is hope of re-opening of the transport routes to the ports Beira and Nacala in Mozambique.

[1]Text prepared June 1994.

OTHER SOURCES OF INFORMATION

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TABLE 1
MALAWI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic	77,000	99,349	120,000	r112,000	117,505	120,000
Coal	41,700	41,380	45,000	r39,191	52,752	55,000
Dolomite[e]	2,500	r2,483	2,500	2,500	2,000	2,500
Stone:						
Crushed for aggregate	e125,000	138,630	e200,000	420,000	380,308	500,000
Limestone for cement	r121,140	145,000	175,000	r e165,000	126,483	200,000

See footnotes at end of table.

TABLE 1—Continued

MALAWI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Gemstones: Ruby and sapphire[e]	grams	r500	500	1,000	1,000	[3]123,740	1,000
Lime[e]		3,460	4,096	4,000	4,000	[3 4]2,560	4,100

[e]Estimated. [r]Revised.

[1]Includes data available through June 13, 1994.

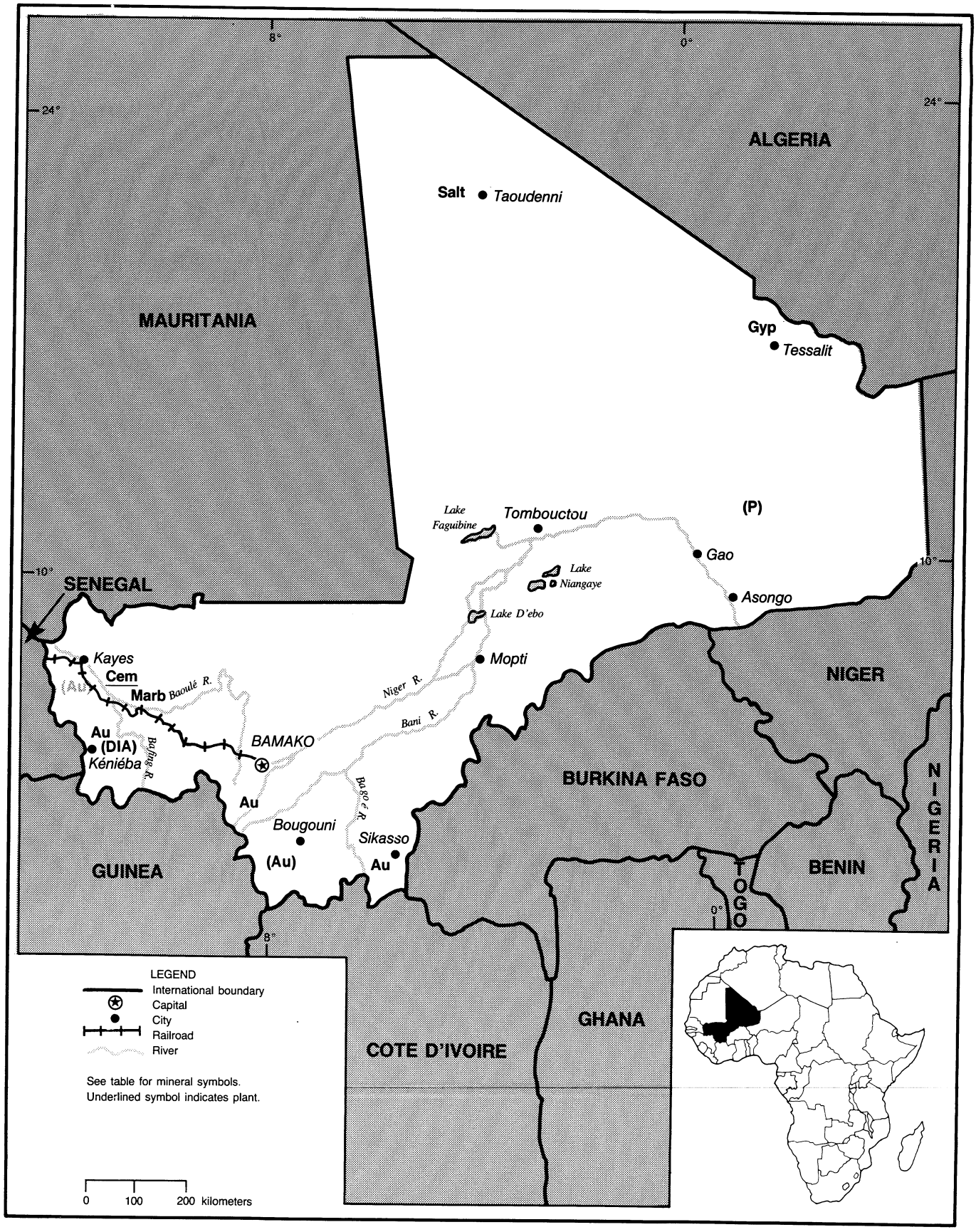
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and other stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output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

[3]Reported figure.

[4]Calcined data only.

MALI

AREA 1,241,232 km² **POPULATION 8.9 million**



THE MINERAL INDUSTRY OF

MALI[1]

By Hendrik G. van Oss

The only mining at a significant scale in Mali in 1993 was of gold. The country has a wide variety of mineral deposits, but lack of infrastructure and of local demand has precluded their development, except for a few at very small scale. Gold sales in 1993 are believed to have been worth about $63 million, about 98% of the total value of minerals produced in Mali, and of which the country's sole formal gold mine accounted for about 55%. Although but a modest component of the country's gross domestic product of $2.63 billion,[2] gold continued to be reported as Mali's most valuable export after cotton and livestock, accounting for about 19% of total exports.

Mali's geology is dominated by Precambrian rocks in the southwestern and central parts of the country and Paleozoic to Cenozoic rocks over most of the remainder. The Precambrian belts are of the greatest economic importance, particularly the Birimian Series greenstones occurring near Kéniéba, Bougouni, and Sikasso. The greenstones, as elsewhere in west Africa, host gold deposits, commonly in shear zones and quartz veins. Apart from gold, there was renewed exploration interest in diamond-bearing kimberlites near Kéniéba. Iron ore deposits also are known in this area, but are currently uneconomic, as are large but low-grade bauxite deposits. A small area of Birimian rocks south-southeast of Gao hosts a large but presently uneconomic manganese deposit. An ultramafic intrusive about 80 km southwest of Sikasso has platiniferous nickel-copper mineralization, but the potential resource there has yet to be demonstrated.

In northeast Mali near Tessalit, Precambrian granitic and volcanic rocks exposed in the Adrar des Iforas host a wide variety of minerals, including copper, gold, tin, uranium, and zinc. The remoteness of the area has made exploration difficult and would likely preclude economic exploitation of most of the deposits. Paleozoic and younger sedimentary rocks, particularly in northern and eastern Mali, host a number of industrial mineral deposits, such as gypsum, limestone, phosphate rock, and salt, some of which are or have been exploited on a small scale. The petroleum potential of Mali's sedimentary basins has attracted some small exploration interest in the past.

GOVERNMENT POLICIES AND PROGRAMS

The Government, with foreign assistance, has been upgrading and coordinating existing geological data on the country, both to attract foreign exploration and mining investment and to stimulate and make more efficient Mali's artisanal mining sector. A new mining law, Ordonnance No. 91-065/P-CTSO, was signed into law in 1991. 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.

The Government was committed to a privatization program, including that of the Kalana gold mine, which ceased production in 1991, but which was said to have remained fully staffed since. Although the Government has the right to a 10% equity share in all new mining ventures and the option to purchase a further 10%, its preference appears to be for the higher holding. The Government had a 20% share of the Syama Mine, the country's remaining formal gold producer, as well as 20% shares in various gold and diamond reconnaissance exploration and advanced projects. Mining is overseen by the Direction Nationale de Géologie et des Mines (DNGM), which is part of the Ministry of Industry, Hydraulics, and Energy.

ENVIRONMENTAL ISSUES

Although artisanal mining of gold and salt has been ongoing in Mali for centuries, the scale and methodology of the operations has not resulted in significant environmental degradation, especially by comparison with problems associated with slash-and-burn agriculture, the widespread use of firewood for energy, and overgrazing by livestock. The degree to which artisanal miners in Mali use mercury to amalgamate gold is in dispute; certainly, any use would appear to be far less widespread than in such countries as Ghana. To date, the formal gold mines in Mali have recycled or neutralized their cyanide. Although not required by formal legislation, the sulfide ore roaster being constructed at the Syama Mine is designed to eliminate most sulfur emissions.

PRODUCTION

Data were unavailable on the 1993 production of most mineral commodities, but output was believed to be largely unchanged from 1992 levels (*see table 1*). The Syama Mine's gold output was 3,066 kg in 1993, 5% less than that in 1992 owing to declining grades of the oxide ore mined in the fourth quarter. The remainder of Mali's gold production was

from artisanal production.

TRADE

Mali's mineral commodity trade in 1993 was dominated by exports of gold and by imports of petroleum products, cement, and fertilizers. There was likely significant smuggling of gold into Mali, particularly from Burkina Faso, but data on this commerce were not available. 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. There continued to be no significant mineral trade between the United States and Mali.

Exports of minerals in 1993 amounted to about $65 million, almost all gold. Total exports of goods amounted to $327 million. The 4.6% increase in 1993 of the average gold price offset a comparable decrease in output from the Syama Mine, but overall gold exports can only be estimated because of the large component of artisanal production. Although data for 1993 were unavailable, mineral commodity imports have traditionally been dominated in value by refined petroleum products; these were worth about $53 million in 1992 and are estimated to have been at a similar level in 1993. Total imports of goods into Mali in 1993 reportedly amounted to $654 million.

STRUCTURE OF THE MINERAL INDUSTRY

Mali's formal mining sector in 1993 was dominated by gold production from a single gold mine; there was also gold production by artisanal miners. Gypsum and salt were produced in limited quantities by one mine each. A number of small operations produced construction materials, such as sand and gravel and stone. The formal mining and related industries employed approximately 2,000 persons, of whom about 600 were employed by the gold mines, including 1 that was idle during the year. Estimates of the number of artisanal miners have ranged widely from 50,000 to 100,000 persons, many of whom, however, work only part-time and/or on a seasonal basis and derive their primary income from agriculture.

COMMODITY REVIEW

Mali's only operating formal gold mine in 1993 was at Syama, 75 km southwest of Sikasso. Ownership of the Syama Mine changed late in 1993 as a result of negotiations to bring the mine into its Phase-II operations by mid-1994. Under the new arrangement, ownership was BHP International Minerals, 65%; Government, 20%; and the International Finance Corp., 15%. Throughout 1993, Phase-I open pit mining of oxide ore reserves continued, but oxide reserves were expected to be exhausted by August 1994. Gold output for the year fell 5% to 3,066 kg as a result of declining oxide ore grades and the need to mine (for stockpile) some sulfide ore. Phase-II operations will exploit, again by open pit, refractory sulfide ore reserves. The sulfide ore is to be processed using a whole-ore fluidized bed roaster and a dry-grinding circuit, both of which were under construction and were expected to be operational by midyear 1994. The sulfide ore was reported by BHP to contain sufficient calcium and magnesium to eliminate 75% to 85% of all sulfur oxide emissions without the use of a flue gas scrubber. The roaster will be equipped with an electrostatic precipitator to enhance gold recoveries and to reduce dust emissions. According to the BHP annual report, gold output under Phase-II is targeted to increase to a rate of 6,000 kg/a.

Apart from BHP, a number of companies were exploring for gold in Mali during the year. A significant discovery was announced in November by the Canadian company International African Mining Gold Corp. (IAMGOLD), of the Sadiola deposit about 60 km southwest of Kayes. The deposit is held by Anglo American Corp. (AAC) of South Africa, 40%; IAMGOLD, 40%; and the Government, 20%. Reserve delineation and the feasibility study had been conducted by AAC, and the property was targeted to commence production by late 1996 or in 1997. Gold production was anticipated to be about 10,000 kg/a.

A number of gold intercepts were announced for a preliminary gold exploration drilling program on the 400-km² Niaouleni concession, about 125 km south of Bamako. The concession was held by Mink Mineral Resources Inc., of Canada, and work was continuing on the property, on an earn-in basis, by the Canadian company Viceroy Resources. In November, it was announced that the Canadian companies had reached an agreement with France's Bureau de Recherches Géologiques et Minières (BRGM) to explore the latter's 180-km² Kobada concession. This property is surrounded by the Niaouleni concession. BHP was continuing to explore the Loulo gold deposit near Kéniéba.

Mink Minerals announced that it had an agreement to acquire, on an earn-in basis, up to 65% of Syndicat Diamant Mali, a joint venture between the BRGM and the Government that held an approximately 16,000-km² diamond concession near Kéniéba. Work by the BRGM had, so far, delineated 21 kimberlite pipes, a variety of geophysical and mineralogical anomalies prospective of more pipes, and had found a number of placer diamonds scattered over a wide area. An economic deposit had yet to be demonstrated. Mink was to do additional exploration work on the concession and was seeking additional partners for this effort.

Although Mali is a well-mineralized country, mineral exploration and development have been severely constrained by the lack of infrastructure, and reserves have been delineated only for a few gold deposits and some deposits of industrial and construction minerals. In addition, resources have been delineated for bauxite, iron, and manganese.

According to BHP, oxide ore reserves at the Syama Mine were expected to be exhausted by midyear 1994. The company claimed that its mining plans for Phase-II operations, which will involve open pit mining of the underlying sulfide and some mixed oxide-sulfide ores, were

somewhat flexible according to the future gold price and the performance of the whole ore fluidized-bed roaster—a new technology for the company. Depending on the detailed mining scenario used, Phase-II ore reserves were said to range from about 7 Mmt grading about 6.5 g/mt gold to 12 Mmt at 4 g/mt.

Original reserves for the Kalana-I deposit, upon which the existing mine was based, were about 1.5 Mmt grading 14.78 g/mt gold. Less than 15% of this inventory had been mined at the time of the mine's closure in 1991, but ore reserves accessible by the existing workings had been virtually exhausted and had proven to have grades generally well below those originally determined. Another deposit nearby, Kalana-II, was drilled by the Soviets but never exploited. It is generally agreed that both deposits need to be reevaluated. The open pit potential of the Kalana concession has not been determined.

Various announcements in late 1993 of the Sadiola gold deposit discovery claimed a minable inventory of about 50 Mmt grading about 2 g/mt gold and a total inventory of about 116,000 kg of gold. 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 Mmt grading 4.38 g/mt of gold. 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 Compagnie Française de Mines of France, 49%, was formed to exploit the property. The economic viability of the deposit had not been announced as of yearend 1993, but additional drilling was to be conducted by BHP International Minerals.

Mali has a number of other metal deposits and deposits of industrial minerals; some of the latter are or have been exploited on a small scale. According to the Government,[3] none of the deposits is large by world standards, and lack of infrastructure makes the exploitation of most of them uncertain.

OUTLOOK

Limited local markets and a general lack of infrastructure will continue to hamper the development of most of Mali's mineral resources, with the major exceptions of gold and, potentially, diamonds. Gold will likely continue to dominate the country's mineral economy, and the discovery potential for additional deposits is considered high. There appears to be significant potential for Mali becoming a modest producer of diamonds.

[1]Text prepared Mar. 1994.

[2]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF286.5=US$1.00.

[3]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, Mali

Société Nationale de Recherches et d'Exploitation des Ressources Minières du Mali
B.P. 2
Kati (Bamako), Mali

TABLE 1
MALI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic[e]		[3]20,000	20,000	20,000	20,000	20,000	20,000
Gold: Mine output, Au content[4]	kilograms	[3]3,000	5,200	4,900	5,700	5,500	5,700
Gypsum[e]		700	700	700	700	700	700
Phosphate rock[e]		10,000	10,000	—	—	—	—
Salt[e]		[3]5,000	5,000	5,000	5,000	5,000	5,000
Silver[5]	kilograms	180	270	210	200	190	200
Stone: Marble		[3]155	160	—	—	—	200

[e]Estimated.

[1]Includes data available through Mar. 11, 1994.

[2]In addition to the commodities listed, Mali produced clays, other stone, and sand and gravel for local construction purposes, but information is inadequate to make reliable estimates of output levels.

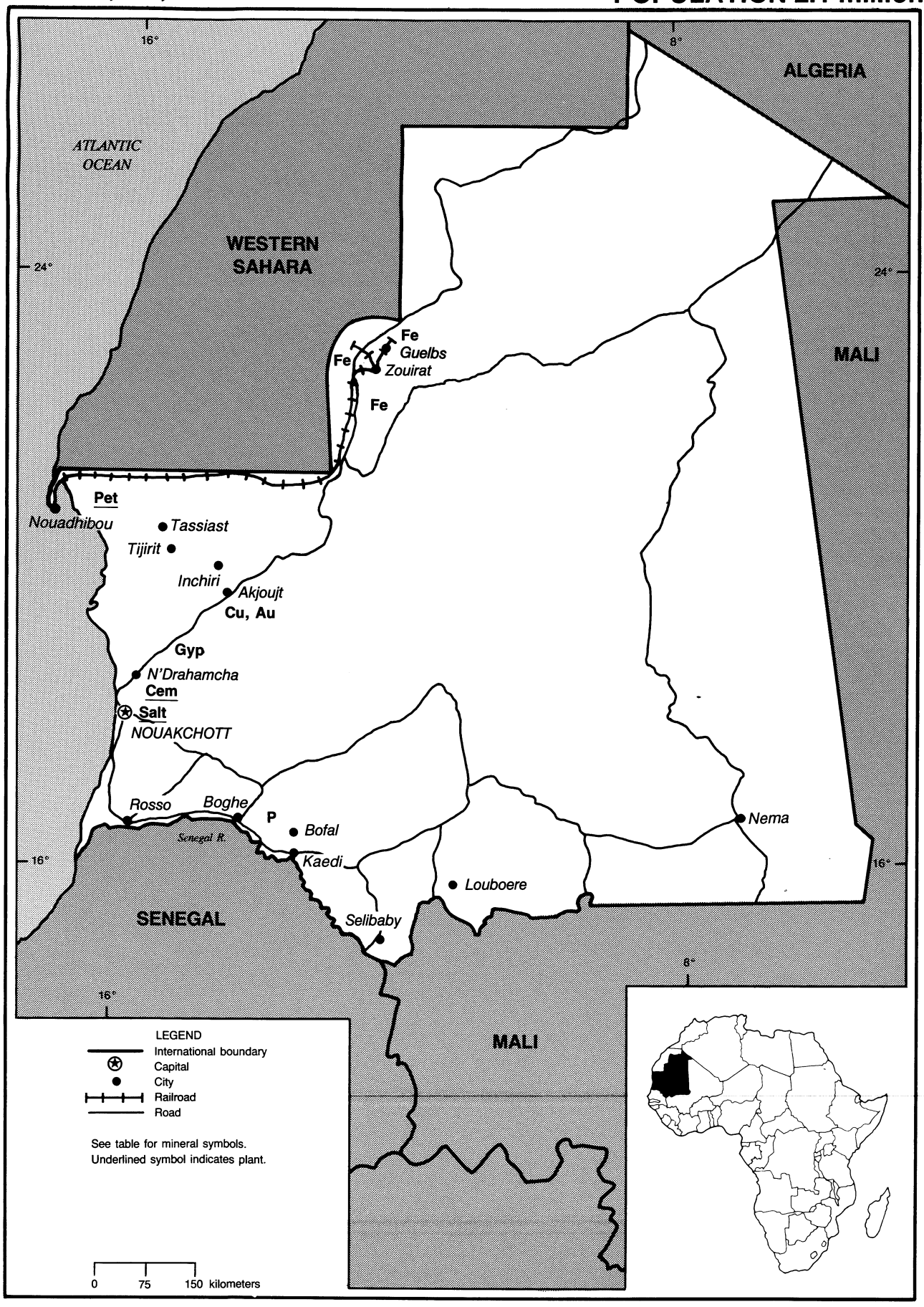
[3]Reported figure.

[4]Includes estimate (Government estimate 1989) of artisanal production and may include some gold smuggled into Mali. The Kalana Mine accounted for about 13% in 1989; 8% in 1990; about 2% in 1991; less than 1% in 1992; and nil in 1993. The Syama Mine began gold production in 1990 and accounted for about 42% of the total output that year, 49% in 1991, 57% in 1992, and 56% in 1993.

[5]Estimated silver content of doré bullion.

MAURITANIA

AREA 1,030,900 km² **POPULATION 2.1 million**



THE MINERAL INDUSTRY OF

MAURITANIA[1]

By Bernadette Michalski

Iron ore mining and beneficiation was the dominant mineral industry in Mauritania and has accounted for approximately one-third to one-half of export earnings since the mid-eighties. Gold recovery from the Akjoujt copper mine tailings continued. Cement, gypsum, and salt also were produced. The nation's sole petroleum refinery, operating on imported crude oil, supplied about one-half of the country's petroleum product requirements. Mining accounted for 12% of the gross domestic product. Public and private investment programs focused on iron ore extraction and beneficiation, gold recovery from copper mine tailings, intensified mineral exploration, and infrastructure development.

GOVERNMENT POLICIES AND PROGRAMS

In late 1992, the Government reached agreement with the World Bank and the International Monetary Fund on an economic revitalization plan that reinforced fiscal restraint, additional privatization, the restructuring of parastatals, and the liberalization of trade and exchange controls. A vital part of the agreement was the 28% devaluation of the local currency. In January 1993, Mauritania's Paris club creditors reduced the country's bilateral debt service by 50% through a combination of debt cancellation and very long-term rescheduling.

The Ministry of Industry and Mines' Office of Geological Research conducted several exploration programs during 1993. Principal activities were focused on gold exploration in the Tassiast, Tijirit, and Inchiri regions.

PRODUCTION

The extraction and beneficiation of iron ore remained the nation's leading mineral industry. *(See table 1.)* Production of iron ore has been falling between 1989 and 1992 because of declining reserves and technical difficulties at the El Rien Mine concentrator. Output should improve with the opening of the Weissat/d'Khailat Mine in 1992 and the M'Haoudat Mine opening anticipated by 1994.

Gold extraction from the Akjoujt copper mine tailings entered its second year, with the bulk of production destined for export.

TRADE

Mauritania's most vital mineral export commodity continued to be iron ore. Exports of this commodity dropped to 8.1 Mmt valued at $165 million in 1992, considerably below 1991 exports of 10.5 Mmt valued at $198 million. Leading importers in 1992 were Italy at 1.9 Mmt, France at 1.8 Mmt, Belgium-Luxembourg at 1.6 Mmt, and the United Kingdom at 1.0 Mmt. Export earnings should improve as new mines are brought into production. Other mineral exports were gold and possibly small quantities of plaster products.

Petroleum product imports in 1993 were approximately 1.5 Mbbl and accounted for almost one-half of consumption; the remainder was supplied from the refining of imported crude oil. Other mineral and related industry imports included about 125,000 mt/a of aluminum and copper semimanufactures, 3,000 mt/a of sulfuric acid, 2,000 mt/a of phosphate fertilizer, and about 12,000 mt/a of salt.

COMMODITY REVIEW

Gold was recovered from tailings by Mines d'Or d'Akjoujt (MORAK) at the Ajkoujt copper mine. Investment capital for the gold recovery project included a $3 million loan from the International Finance Corp. matched by $3 million from MORAK shareholders in proportion to their equity. According to MORAK, the mine tailings totaled 2 Mmt with an average gold content of 3.1 g/mt.

Iron ore mining operations were conducted by Société Nationale Industrielle et Minière (SNIM) in northwestern Mauritania. The Weissat/d'Khailat surface mine, 8 km southeast of the Tazadit pit, was brought into production in 1992 with output in 1993, the first full year of production, approaching 2 Mmt. According to SNIM, the 30-Mmt ore body contains 64% to 67% Fe. The proximity of the Tazadit ore crusher and rail loading equipment minimized development expenses.

The first production from the M'Haoudat deposit, 60 km northeast of Zouirat and 30 km from the existing railway at El Rhein, is expected in 1994, and peak output from this ore body is planned at 6 Mmt/a.

The Alexandria National Iron & Steel Co. and the Holding Co. for Metallurgical Industries, both of Egypt, along with Enterprise Nationale de Siderurgie and Ferphos, both of Algeria, have joined SNIM in signing a protocol agreement on the construction of an iron ore pelletizing plant to satisfy demands of direct reduction plants in several Arab countries, including an Algerian plant that is proposed to come on-stream in 1995. The pelletizing plant's capacity is planned at 5 Mmt/a of 68% Fe pellets. The project involves mining and beneficiation at Ayouj, 30 km north of F'Derik and 650 km from the port of Nouadhibou.

Mining is anticipated at the rate of 11 Mmt/a.

Industrial mineral production was limited to gypsum and salt extracted by Société Arabe des Industries Metallurgiques Mauritano-Koweitiennes (SAMIA). Gypsum is extracted from the N'Drahamcha quarry, 50 km northeast of Nouakchott. Salt is recovered from coastal areas near Nouakchott. Gypsum output satisfies local demand. Salt production, however, does not meet the fishing industry's heavy requirements; as a result, about 12,000 tons of salt is imported annually.

Although promising phosphate rock deposits have been discovered in remote regions of southern Mauritania, their development would require high infrastructure costs. Exploitation of the deposits for direct application to soils remains, however, under consideration.

Mauritania's sole petroleum refinery, Nouadhibou, is owned by the Société Mauritanienne d'Industrie de Raffinage (SOMIR) and operates under the technical management of Naftal, an Algerian oil corporation. The 20,000-bbl/d-capacity refinery, operating entirely on imported crude oil, supplies about one-half of Mauritania's demand for refined products.

Iron ore reserves, according to SNIM, are 155 Mmt of hematite ore ranging from 60% to 68% Fe and 531 Mmt of magnetite ore ranging from 36% to 40% Fe. In addition to these proven reserves, probable iron ore reserves in the western Guelbs amounted to 980 Mmt. According to MORAK, copper ore reserves amounted to 100 Mmt averaging 2.25% copper and have a gold content averaging 1.17 g/mt. Adjoujt Mine tailings are reported at 2 Mmt averaging 3.1 g/mt of gold.

INFRASTRUCTURE

A major barrier toward investment and development was the limited infrastructure, rendering all but the largest mineral deposits uneconomic. There were four paved roads in Mauritania: from the port of Nouakchott to the copper deposits at Akjoujt in the north, from Nouakchott to Nema in the east, from Nouakchott to Rosso in the south, and from Boghe to Kaedi on the southern border. The sole railroad in Mauritania is owned and operated by SNIM for the transport of iron ore from the mines to the export terminal. The 1.435-m standard-gauge railroad extends more than 700 km from M'Haoudat to the port at Nouadhibou.

OUTLOOK

Existing and proposed mining operations suggest an improved outlook for the nation's economy. Favorable results, however, are largely dependent on the successful development of the M'Haoudat iron ore project, which would ensure continued mining for the next 20 years. However, the ultimate success of this project is dependent also on favorable world iron ore prices. The EC provided $3.5 million for a prospecting program focusing on identifying gold and silver deposits that can be slated for private investment and development.

Factors bearing on the availability of financial support for the mineral economy include the border disputes between the Governments of Senegal and Mauritania, the nation's heavy external debt burden, and significant fiscal balance of payments deficits. Although gold exports have commenced, the small scale of the Akjoudt gold recovery project, valued at about $8 million, will not seriously impact on Government revenues or the balance of trade, but it does represent new foreign in6vestment and a diversification of the country's exports.

[1]Text prepared Feb. 1994.

[2]Where necessary, values have been converted from Mauritanian ouguiya (UM) to U.S. dollars at the rate of UM113.1=US$1.00.

OTHER SOURCES OF INFORMATION

Mauritanian Office for Geological Research (OMRG)
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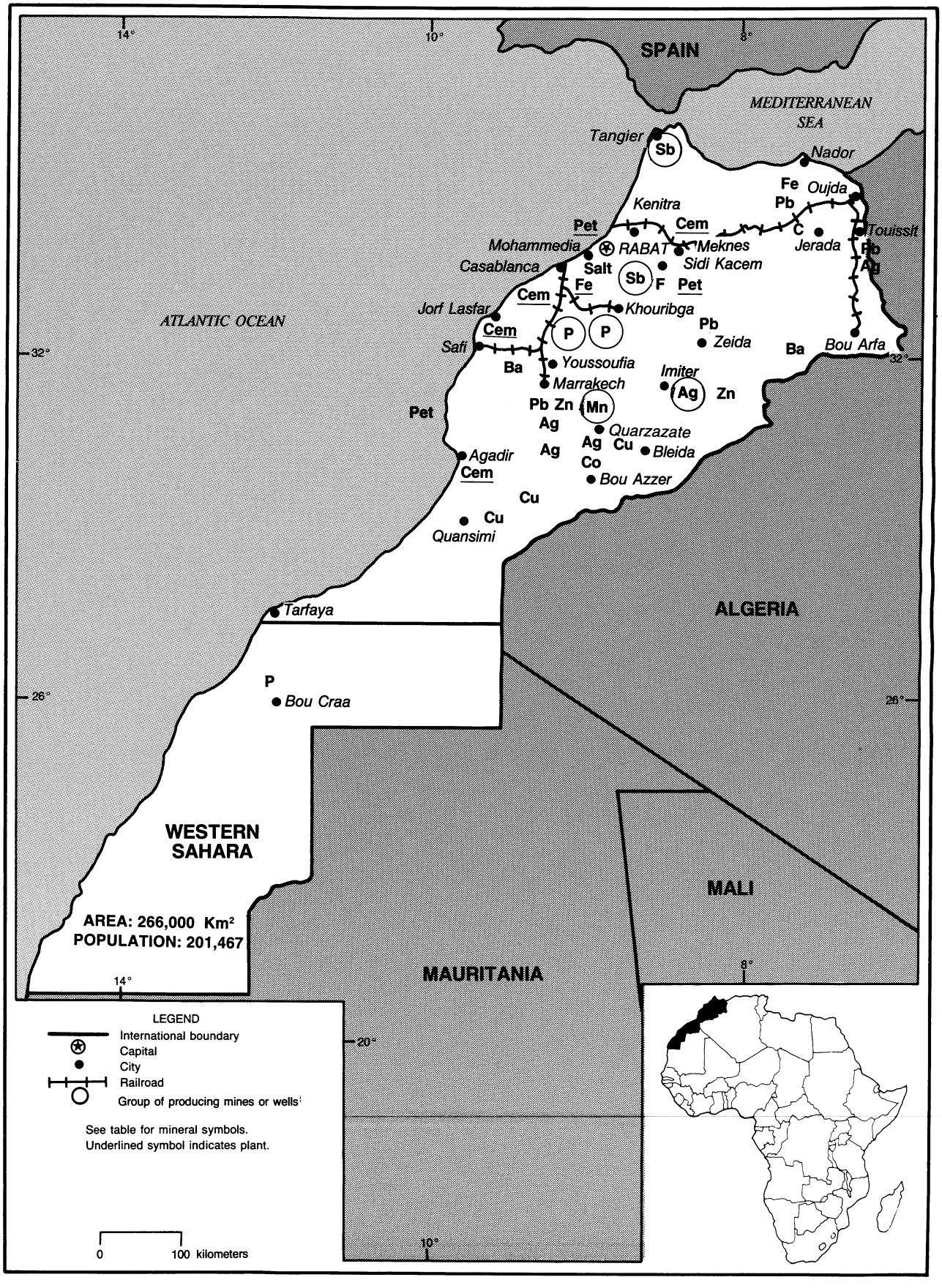
TABLE 1
MAURITANIA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Cement e	metric tons	90,000	90,000	90,000	90,000	90,000	100,000
Gold	kilograms	—	—	—	826	1,300	1,500
Gypsum[3]	metric tons	6,400	8,000	2,839	3,084	3,000	3,000
Iron and steel: Iron ore:							
Gross weight	thousand tons	12,110	11,590	10,246	8,202	[4]9,300	15,000
Iron content e	do.	7,150	6,800	6,500	5,330	5,700	5,700
Petroleum refinery products	thousand 42-gallon barrels	1,515	2,000	1,800	2,000	2,000	2,000
Salt e	metric tons	5,500	5,500	5,500	5,500	5,500	5,500

eEstimated.
[1]Table includes data available through Feb. 15, 1994.
[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]May include about 3,000 tons of plaster in 1989-90.
[4]Reported figure.

MOROCCO AND WESTERN SAHARA

AREA 446,550 km² **POPULATION 28 million**



THE MINERAL INDUSTRIES OF

MOROCCO AND WESTERN SAHARA

By Thomas P. Dolley

MOROCCO

Morocco remained the largest producer of nonfuel minerals among North African nations in 1993. Phosphate mining accounted for 94% of a mining sector that produced a variety of minerals. Morocco is a significant producer of antimony, barite, copper, fluorspar, iron ore, lead, manganese, salt, silver, and zinc. The sector remained committed to substantial self-investment, despite some global downturns or oversupply in certain mineral commodities. Mining is Morocco's largest foreign exchange earner and usually accounts for 3.5% of the gross domestic product (GDP). It accounts for more than 9% of GDP if downstream products of the mineral industry are included. The GDP for 1993 was $27.8 billion.[1]

GOVERNMENT POLICIES AND PROGRAMS

Current mining legislation in Morocco is based on Mining Code Bill No. 1-73-412 of August 13, 1973. This legislative series is also known as the 1973 Law on Maroccanization, which had sections repealed in 1990 and 1992. In 1990, the mining law was revised so that the Government was required to respond within 2 months to any foreign investment proposal and, if not, the contract presumably would be null and void. Generally, any mining law revisions were intended to expedite the bureaucratic process. Additionally, under the revisions, if a foreign mining company determined that a deposit under investigation is uneconomic, it could withdraw from Morocco under no penalty.

Regulations concerning the management of petroleum and natural gas resources were revised in June 1991 to provide further incentives for international companies. The revised law reduced the Government's share in agreements with international operators from 50% to 35%. Additionally, the law provided for corporate tax relief. Exploration activity will be fully deductible for more than 10 years for newcomer contracts and more than 3 years for preexisting operators in Morocco. Upon the discovery of a commercial hydrocarbon resource, concessionary fees for the corporation are not required for the first 28 Mbbl of oil or natural gas produced. Furthermore, the petroleum tax is waived covering the initial 3 years of production. To complement these new measures, exploration permit sizes were reduced to 2,000 km^2 from 5,000 km^2, and the minimum duration of an agreement was reduced from 15 years to 8 years. In 1992, the Government abrogated the 1974 Maroccanization Law, which pertained to petroleum refining and distribution. These latter legal changes were designed to allow foreign companies to participate in the privatization of parastatals in the petroleum sector. The Moroccan mining laws stipulate the conditions for investment for a foreign operator, which in general have become more liberal with the more recent amendments.

ENVIRONMENTAL ISSUES

Environmental issues currently being addressed in Morocco are the offshore dumping of phosphogypsum waste on the western coast of Morocco. The Government has a reforestation program for mining operations currently in force.

PRODUCTION

Mineral production in 1993 remained at or near 1992 levels. Though a depressed market existed for base metals at the beginning of the year, there were notable increases in lead, silver, and zinc production and refining due to increased global demand at yearend 1993. Morocco continued to expand nonferrous metal production capacity during the year, particularly the Douar Hajar polymetallic mine, which is compensating for depleted production from other Moroccan base metal operations. Morocco is a major base metal producer in the Mediterranean basin. It remained a major world producer of phosphate rock and fertilizers, including phosphoric acid, diammonium phosphate (DAP), and triple superphosphate (TSP). Total fertilizer production for 1993 was 2.6 Mmt. *(See table 1.)*

TRADE

Moroccan phosphate exports declined in 1993 to 8.4 Mmt from 9.1 Mmt in 1992 owing to a shortfall in global demand. Total phosphoric acid exported in 1993 was 1.4 Mmt, 458 kmt of TSP, and 1.7 Mmt of DAP. The largest recipient of phosphate rock was Spain at 1.2 Mmt. Reduced demand in Western Europe and Latin America accounted for the greatest loss of sales. Recovery in demand was noted for Central Europe and Asia in 1993 and should continue in 1994.

In 1993, Morocco imported $988 million worth of crude oil and derivative products. The United States remained the most important supplier of coal to Morocco, delivering 765,491 tons in 1992, the last year for which data were

available.

STRUCTURE OF THE MINERAL INDUSTRY

The mining industry of Morocco is controlled by the Government, specifically the Directorate of Mines, which is a department of the Ministry of Energy and Mines. The Directorate of Mines is charged with the elaboration and application of the national mining policy. It drafts and applies legislation and regulations pertaining to mining activities. The Directorate of Mines also controls the various parastatals and public companies involved in the mining industry, including the promotion of mining. Additionally, the Directorate of Mines manages mining properties, labor concerns, commercialization, and studies in mining, mineralogy, and metallurgy. Geographic administration is designed so that 15 different mining districts exist within Morocco. In total, the mining industry employed about 60,000 people, including 6,800 engineers and technicians. Approximately 12,000 laborers were involved in artisanal mining.

Established in 1928, the Bureau de Recherches et de Participations Minières (BRPM) is an autonomous public corporation involved directly or indirectly in the majority of all Moroccan mining enterprises, excluding hydrocarbons and phosphates. BRPM employs about 1,330 people, including 150 engineers. Founded in 1920, the parastatal Office Cherifien des Phosphates (OCP) manages and controls phosphate mining and is the world's largest producer of phosphate rock. OCP controls all aspects of the phosphate industry, including research, exploitation, and the production of derivative products, such as fertilizers. OCP employs 30,000 people, including 700 engineers and technicians. Created in 1960, La Centrale d'Achat et de Développement de la Région Minière de Tafilalet et de Figuig (CADETAF) promotes the working of artisanal mines of barite, lead, and zinc in the regions of Tafilalet and Figuig. CADETAF provides technical, commercial, and social assistance to the artisanal miners. The Government parastatal that controls hydrocarbon exploration and production is the Office National de Recherches & d'Exploitations Petrolieres (Onarep).

Omnium Nord Africain (ONA) is the largest private company in Morocco. Additionally, ONA was one of the largest private African companies outside of the Republic of South Africa. The company is active in four areas: agricultural distribution, finance, mining, and high technology. ONA's mining subsidiary, Pole Mines, is involved in four significant Moroccan mining ventures. Pole Mines' equity ventures include the polymetallic Douar Hajar Mine with Cie. Minière de Guemassa (CMG); the Bleida copper mine with Société Minière de Bou-Gaffer (SOMIFER); the world's only primary cobalt mine at Bou Azzer operated by Cie. de Tifnout Tiranimine (CTT); and the El Hammam fluorspar mine operated by Société Anonyme de Entreprises Minières (SAMINE). All of the latter joint ventures are with BRPM. The only other joint venture in which Pole Mines is not the sole operator is the silver mine at Imiter, operated by Société Metallurgique d'Imiter (SMI) with equity ownership by BRPM. Pole Mines also is involved in chemicals, engineering, contracting, mineral exploration, and transport.

The privatization program in Morocco is an ambitious one. Approximately 112 companies valued at $2 billion are expected to be privatized by yearend 1995. Cimenterie de l'Oriental and Société des Ciments Artificiels de Meknes were offered for privatization during the year. OCP was suggested for privatization during the year. *(See table 2.)*

COMMODITY REVIEW

Geologically, Morocco is divided into four main provinces: (1) the Anti-Atlas and Saharan Province is dominated by Precambrian basement rocks associated with Precambrian through Paleozoic sediments; (2) the Atlantic Meseta Province is dominated by deformed Paleozoic rocks; (3) the Atlas Province is dominated by the Atlas Mountain range, deformed by the Alpine orogeny; and (4) the Rif Province is composed of rocks tectonically influenced by the Sole and Alpine orogenies and continuous with the Betic Cordillera of Spain. This last province covers the entire northern part of Morocco and is representative of the Alpine orogeny at its most western extent in the Mediterranean.

Metals

Lead and Zinc.—By May 1993, Belgium's Union Miniere closed the Djebel Aouam Mine in central Morocco. Union Miniere said the mine was uneconomic, based on falling lead prices at yearend 1992. Moroccan labor unions protested the decision owing to job losses. Union Miniere stated that the mine could be reopened with updated equipment, but at a reduced staff. Reserves at the mine are 2.2 Mmt of ore grading 8.8% lead, 1.3% zinc, and 145 g/mt silver.

Manganese.—The Imini manganese mine, 160 km south of Marrakech, is operated by Société Anonyme Cherifienne d'Etudes Minières (SACEM). BRPM is a joint-equity owner of SACEM at 43%. SACEM's marketing strategy is directed at mining ultrafine manganese grades of 70% to 92% MnO_2 due to fast depletion of Imini's ore reserve. SACEM stated that reserves were sufficient for 15 years. SACEM exports the majority of its manganese production to western Europe.

Industrial Minerals

The Khouribga region, in west-central Morocco, was the area most extensively mined for phosphate in the country. Globally, the phosphate rock and derivative fertilizer industry experienced a decline in demand in 1993. Despite the decline in production and exports, OCP planned a variety of developmental projects, such as Moroc Phosphore V and VI. These two large phosphate product plants would be built at the existing site at Jorf Lasfar. However, these projects

currently suffer from a lack of funding.

Mineral Fuels

Morocco is not self-sufficient in hydrocarbon resources. Domestic crude oil production is negligible when compared to a 1993 domestic consumption rate of 41.3 Mbbl/a, which is steadily rising. Therefore, an overwhelming amount of crude petroleum is imported. The refineries at Mohammedia and Sidi Kacem processed about 44.8 Mbbl of petroleum products in 1993.

Reserves

The Government's estimated reserve of phosphate rock was approximately 22 billion tons, or about 75% of the world's known reserves. Estimated proved crude oil reserves total 2.1 Mbbl, although this figure could fluctuate as hydrocarbon exploration continues. Proven natural gas reserves total 1.2 billion m^3. Sufficient reserves existed to sustain base metal production into the 21st century.

INFRASTRUCTURE

The railroad network in Morocco totaled 1,893 km of 1.435-m standard-gauge single track. The highway infrastructure totaled 59,198 km, of which 27,740 km was paved. Crude oil pipelines totaled 362 km, and natural gas pipelines totaled 241 km. Morocco's merchant marine fleet was comprised of 51 ships totaling 487,479 dwt. Of these ships, there were 3 petroleum tankers and 11 chemical tankers. Major Moroccan ports are at Agadir, Casablanca, Jorf Lasfar, Kenitra, Mohammedia, Nador, Safi, and Tangier. The nation's electrical generation capacity was 2,384,000 kW.

OUTLOOK

Moroccan mineral industry development is affected by global commodity prices, particlarly for phosphate rock and base metal production. For the near future, Morocco must diversify its manufacturing base with increased technology, expand export trade to other markets than western Europe, and further diversify foreign investment. Currently, foreign investment is dominated by France and Spain.

WESTERN SAHARA

Predominantly a hot, dry desert country, Western Sahara has a total land area of 266,000 km^2. The region has been claimed and administered by Morocco since the mid-1970's. In the Western Sahara, annual rainfall is negligible and most foodstuffs must be imported. Economic activity, including all trade, is controlled by the Moroccan Government. Fishing and phosphate mining are the main industries and sources of revenue. The most significant mineral production in the region is from the phosphate mine at Bou Craa. Production data from Bou Craa are included in total Moroccan phosphate output. Total phosphate rock production from Bou Craa was about 1.6 Mmt in 1993.

[1]Where necessary, values have been converted from Moroccan dirhams (DH) to U.S. dollars at a rate of DH9.44=US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

Association of African Geological Surveys
Association des Services Geologiques Africains
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Publications

Le Secteur Miniere Marocain Situation et Perspectives, Ministère de l'Energie et des Mines, Rabat, Morocco.

Statistique de Commerce Exterieur, Rabat, Morocco.

TABLE 1
MOROCCO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
METALS						
Antimony concentrate:						
Gross weight	316	426	374	438	400	1,000
Sb content	142	192	168	197	180	400
Chromite	1,000	300	500	500	500	1,000
Cobalt concentrate:						
Gross weight	1,144	1,830	2,953	4,194	[3]3,606	5,000
Co content	121	194	325	461	397	550
Copper:						
Concentrates, gross weight	44,033	45,332	42,220	38,114	[4]40,167	50,000
Matte, gross weight	2,126	2,322	2,492	2,177	[5]1,548	2,400
Cu content, concentrates and matte	15,988	16,411	15,838	14,317	14,000	16,000
Iron and steel:						
Iron ore:						
Gross weight	175,600	147,825	98,676	82,625	[3]66,318	175,000
Fe content	107,116	90,173	60,192	51,227	41,117	107,000
Metal:[e]						
Pig iron	15,000	15,000	15,000	15,000	15,000	15,000
Steel, crude	7,200	7,200	7,200	7,000	7,000	7,000
Lead:						
Concentrate:						
Gross weight	93,513	95,529	102,389	104,939	[3]111,896	145,000
Pb content	67,329	68,781	73,720	76,605	81,684	105,850
Cupreous matte, Pb content	553	604	648	566	402	650
Metal:						
Smelter, primary only	63,676	64,512	70,606	68,563	[3]69,114	70,000
Refined:						
Primary	[e]63,000	[e]64,000	[e]70,000	[e]68,000	69,000	70,000
Secondary[e]	2,000	2,000	2,000	2,000	2,000	2,000
Total[e]	65,000	66,000	72,000	70,000	71,000	72,000
Manganese ore, largely chemical-grade	32,000	49,450	59,255	44,320	[3]42,585	130,000
Mercury, byproduct kilograms	20,000	20,000	20,000	20,000	20,000	20,000
Silver:						
Ag content of concentrates and matte do.	50,221	53,708	91,115	69,386	[6]73,355	91,000
Ag content of mine and smelter bullion do.	186,390	187,400	204,960	143,900	[7]235,800	236,000
Total do.	236,611	241,108	296,075	213,286	309,155	327,000
Zinc concentrate:						
Gross weight	33,913	36,860	47,709	42,649	[3]125,737	130,000
Zn content[e]	18,652	18,799	24,331	22,604	65,383	67,600
INDUSTRIAL MINERALS						
Barite	370,000	363,580	433,325	401,000	[3]325,200	433,000
Cement, hydraulic thousand tons	[e]4,200	[e]4,200	5,770	6,340	6,300	6,300
Clays, crude:						
Bentonite	3,970	4,000	9,228	8,137	[3]10,212	10,200
Fuller's earth (smectite)	48,820	45,230	37,552	38,000	[3]38,680	48,000
Montmorillonite (ghassoul)	4,133	4,427	3,900	2,670	[3]2,440	4,400

See footnotes at end of table.

TABLE 1—Continued

MOROCCO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Feldspar e		1,000	1,000	1,000	1,000	1,000	1,000
Fluorspar, acid-grade		105,000	86,500	74,600	85,500	[3]70,050	105,000
Gypsum e		450,000	450,000	450,000	450,000	450,000	450,000
Mica e		1,500	1,500	1,500	1,500	1,500	1,500
Phosphate rock (includes Western Sahara)	thousand tons	18,067	21,396	17,900	19,145	[3]18,305	25,000
P_2O_5 content	do.	e5,781	e6,906	e5,700	e6,178	e5,920	8,000
Salt, rock		89,075	124,909	108,806	164,528	[3]170,000	170,000
MINERAL FUELS AND RELATED MATERIALS							
Coal, anthracite	thousand tons	504	526	551	576	[3]604	604
Gas, natural:							
Gross	million cubic meters	62	62	38	24	24	60
Dry	do.	37	37	22	14	14	37
Petroleum:							
Crude	thousand 42-gallon barrels	102	114	83	67	67	114
Refinery products: e							
Distillate fuel oil	do.	15,968	13,505	15,162	[3]16,386	16,000	16,000
Gasoline	do.	2,897	3,285	2,331	[3]3,860	3,800	3,800
Jet fuel	do.	1,684	1,825	1,461	[3]1,705	1,700	1,800
Kerosene	do.	386	365	341	[3]351	350	380
Other	do.	2,100	5,840	1,765	[3]2,698	2,600	5,800
Refinery fuel and losses	do.	1,500	1,460	688	[3]172	170	1,500
Residual fuel oil	do.	13,000	14,235	14,000	14,000	14,000	14,000
Total	do.	37,535	40,515	35,748	39,172	38,620	43,280

e Estimated.

[1] Includes data available through Mar. 1994.

[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; however, information is inadequate.

[3] Reported figure.

[4] Includes the following types of concentrates: copper (35,690 tons at 36% Cu); gold-silver-copper (4,477 tons at 9.9% Cu, 120 grams per ton Au, 870 grams per ton Ag).

[5] Cupreous matte containing 58% Cu, 26% Pb, 1,500 grams per ton Ag.

[6] Contained in copper concentrates and matte identified in footnotes 4 and 5 above and in lead concentrates (111,896 tons at 600 grams per ton Ag).

[7] Contained in a presumably mine-produced bullion: 202 tons at 99.98% Ag and lead smelter product 34 tons at 99.99% Ag.

TABLE 2

MOROCCO: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Metric tons unless otherwise specified) unless otherwise specified)

Major commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Barite	Compagnie Marocaine des Barites (COMABAR) (50% BRPM)	Near Marrakech	270,000 concentrate.
Cobalt	Compagnie Tifnout Tiranimine (CTT) (40% BRPM)	Bou Azzer	5,000 concentrate, 150,000 ore.
Copper	Société Minière de Bou Saffer (SOMIFER) (34% BRPM)	Bleida	50,000 concentrate.
Do.	Société Minière Marocaine (SOMIMA) (75% BRPM)	Quansimi	NA.
Do.	Société du Developpement du Cuivre de l'Anti-Atlas (SODECAT) (99% BRPM)	Near Quansimi	NA.

TABLE 2—Continued

MOROCCO: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

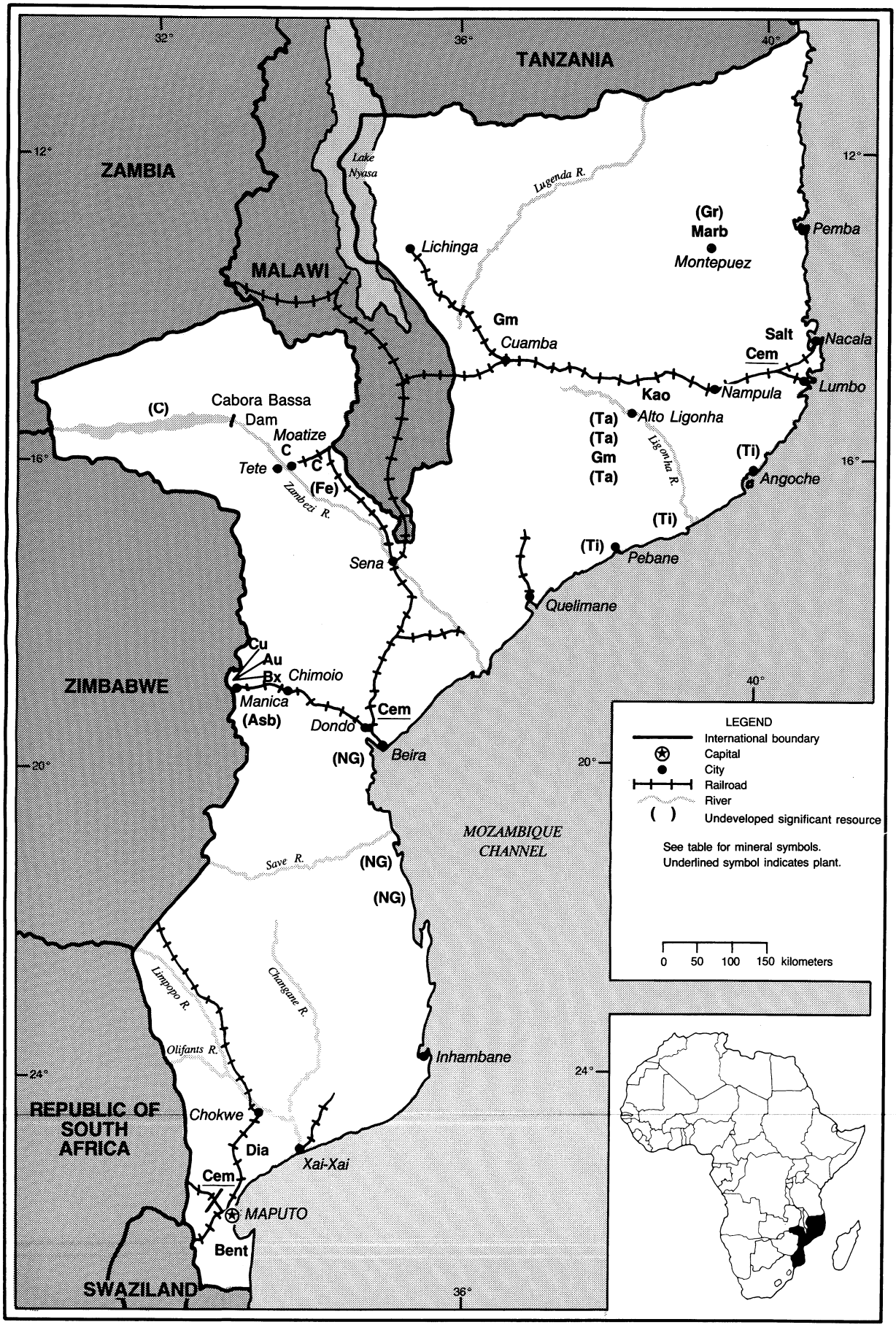
(Metric tons unless otherwise specified) unless otherwise specified)

Major commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Fluorspar		Société Anonyme de Entreprises Minières (SAMINE) (35% BRPM)	Near Khouribga	70,000 concentrate.
Lead		Compagnie Minière de Guemassa (CMG) (74% ONA, 26% BRPM)	Near Marrakech	130,000 Zn concentrate, 32,000 Pb concentrate, 12,000 Cu concentrate.
Do.		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	million metric tons	Office Cherifien des Phosphates OCP) (Government, 100%)	Khouribga and Youssoufia	25 concentrate.
Silver		Société Metallurgique D'Imiter (SMI) (BRPM, 69%, ONA, 31%)	Near Quarzazate	73,000 ore.

NA Not available.

MOZAMBIQUE

AREA 801,590 km² **POPULATION 16.3 million**



THE MINERAL INDUSTRY OF

MOZAMBIQUE[1]

By Hendrik G. van Oss

Mozambique has a wide variety of mineral deposits although few have been exploited other than on a small scale. Much of the country's mineral economy has been destroyed or damaged by almost two decades of civil unrest. However, given the fact that the peace accord signed late in 1992 between the Government and opposition forces, excepting a few incidents, held throughout 1993, there was optimism that the industry could be rebuilt. Improved security conditions aided in the rehabilitation of the country's important railing and port infrastructure and attracted investors in the mining and related industries. A new gold mine was reported to have started production, a graphite mine was in development, and rehabilitation programs were underway at the bentonite and marble operations. Two major titaniferous sands projects were underway. These developments notwithstanding, mineral output in 1993 was generally only at a modest scale. Mozambique's economy remained dominated by agriculture, which benefited during the year from adequate rains and by the return of many thousands of refugees to their farms.

Primary mineral commodity sales are estimated to have been worth about $5 million to $6 million, somewhat lower than those in 1992. Most of this value was in gold and cut gemstones. Although 1993 and 1992 data for cement were not available, sales revenues for these years are estimated to have been only about 25% of the $8.4 million reported for 1991. Most of the mineral commodity production, other than cement, was exported. The country's gross domestic product in 1993 was estimated to have been about the same as that in 1992, or about $1.75 billion.

Mozambique's ports and railways have traditionally been major components of the trade infrastructure of southern Africa. The transshipment of goods, particularly mineral commodities, to and from the country's inland neighbors has been an important source of foreign exchange, averaging about $25 million per year in recent years. About one-third of these revenues was believed to have been from mineral commodities.

Wages in the Mozambique mineral and mineral transshipment industry are estimated to have totaled about $5 million in 1993. More important was the economic contribution of Mozambique workers employed by mines in the Republic of South Africa. In 1992, the latest year for which data were available, these workers numbered about 50,000, of which 44,000 worked in gold or coal mines. Officially repatriated wages from these miners totaled $56.3 million in 1992, and it is likely that a similar amount was unofficially repatriated. It is estimated that mining wages supported about 300,000 persons in Mozambique.

Mozambique has a wide variety of mineral deposits, many of which occur in the Precambrian granitic terrane that makes up much of the northern one-half of the country. Near Alto Ligonha are pegmatite-hosted deposits of tantalum with associated subordinate columbium, antimony, and bismuth, as well as rare-earth element minerals, lithium minerals, industrial and gem grades of quartz and beryl, and tourmalines. Granitic gneisses in the north host important graphite deposits, and metasedimentary inliers to this crystalline terrane host some deposits of marble and garnet. Metasedimentary rocks near Manica host stratabound and vein gold deposits and some copper deposits. Small deposits of bauxite and iron also occur in this area; however, the iron deposits are not of economic grade. Large low-grade iron-titanium deposits occur in gabbroic rocks near Tete. Permian (Karoo) rocks in this area host major coal deposits. Quaternary sands along the Indian Ocean coast north of Quelimane host potentially economic deposits of titaniferous minerals (ilmenite and rutile), zircon, and monazite, derived from the Precambrian granitic hinterland.

The southern half of the country is made up, dominantly, of Cretaceous and younger sedimentary rocks. These host a number of deposits of industrial minerals, especially clays and diatomite. The coastal area near Beira has structural basins that are prospective for petroleum. The country's natural gas reserves also are in this area.

GOVERNMENT POLICIES AND PROGRAMS

The Government was seeking foreign investment in the mining, power generation, and transportation sectors, all of which were seen as having significant growth potential. Although there was some concern that peace negotiations and preparations to multiparty elections were progressing more slowly than anticipated, investor interest in Mozambique continued throughout 1993. Thanks to improved security conditions and the nearly completed multiyear rehabilitation programs, much of the country's railroad and port infrastructure was operational during the year. Administrative delays at the ports and railroads, and reports of pilferage of goods during transport, have led to pressure on the Government to privatize the management of this infrastructure. Toward this end, a contract was signed early in 1993 to

provide for private management of the Matola coal port terminal near Maputo.

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. A new mining investment law was being drafted. 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).

ENVIRONMENTAL ISSUES

Environmental issues in Mozambique are largely related to the myriad problems associated with the country's recent history of civil unrest, including the mass displacement of perhaps 40% of the country's population, excessive wood cutting, uncontrolled hunting (for food) of wildlife, destruction of sanitation and other infrastructure, and the widespread occurrence of as yet unexploded land mines. By comparison, and given the very small size, and in some cases, moribund status, of Mozambique's mineral operations and the country's lack of smelters, environmental problems related to mining appear insignificant. There might be some mercury contamination of streams related to artisanal gold mining near Manica and near the Tanzania border. The country's cement plants may lack emissions controls, but this will probably be rectified as the facilities are rehabilitated.

PRODUCTION

Except for some gemstones, marble, and graphite, output of mineral commodities fell in 1993 (*see table 1*). Probably the most significant change was in coal, mining of which was reported to have ceased early in the year because of flooding problems from the 1992-93 rainy season. Output was not expected to be restored until pumps and various other equipment could be obtained, probably not until 1994. There was pilot-scale production of graphite concentrates from a deposit expected to go into commercial operation late in 1994. Cement was produced only by one (the smallest) of the country's three plants; output remained dependent on imported clinker. Although gold was produced by two operations, one was experiencing technical difficulties and the other had yet to reach full output levels.

TRADE

Few data were available for 1993 for the value of trade. Overall exports are believed to have been about $160 million. Exports to the United States in 1993 amounted to $8.7 million. Between 3% and 4% of Mozambique's total exports were of mineral commodities; these were dominated by gold, gemstones, bauxite, and marble. Mineral trade with the United States was essentially nil. Full year data for 1993 on mineral transshipments were unavailable, but in 1992, the major minerals transiting Mozambique were coal from the Republic of South Africa and Swaziland (about 250,000 tons) through Maputo-Matola, and from Zimbabwe (about 11,000 tons) through Beira, and granite from Zimbabwe (about 34,000 tons). Coal transshipments from South Africa through Matola in the first half of 1993 were reported to have been nil, but to have resumed following the privatization of the port's management and the reduction of combined railing and port fees to rates competitive with South African ports. It was hoped that combined South African and Swazi coal shipments through Matola would reach 2 Mmt/a by 1995 or 1996 and about 5 Mmt/a thereafter. The once important exports of South African and Zimbabwean ferrochromium and asbestos through Maputo are believed to have remained at insignificant levels in 1993, as in 1992, owing to poor world market conditions for both commodities and, for Zimbabwean ferrochromium, power shortages in Zimbabwe. About 8.5 Mbbl/a of refined petroleum products is offloaded at Beira for transshipment by pipeline to Zimbabwe.

Mozambique's imports in 1993 totaled an estimated $1 billion, of which mineral commodity imports, not counting those for transshipment, accounted for about 13%. Petroleum products accounted for an estimated 75% of mineral imports, clinker imports for cement about $1 million, and fertilizers most of the rest. Electricity imports, all from South Africa, are estimated to have been worth about $15 million. Imports from the United States in 1993 totaled $39.5 million, but did not involve mineral commodities.

STRUCTURE OF THE MINERAL INDUSTRY

Most mineral commodities in Mozambique were produced in 1993 by small, single operations. The Government, through the public Companhia de Desenvolvimento Miniero, controlled a number of operations, but the degree of Government participation in the mining sector overall was falling. Foreign companies controlled the country's production of bauxite, gold, and much of its gemstones. Anticipated near-term new or additional production of bentonite, coal, diatomite, graphite, gold, and titaniferous sands was expected to be without significant Government equity participation.

COMMODITY REVIEW

The Chua placer gold mine near Manica was operated by Benicon Earthworks & Mining (Pty.) Ltd. (South Africa) under a royalty agreement with Lonrho Plc, the owner. Output in 1993 was reported to have declined 56% to 129 kg, owing to technical difficulties. Mincor Ltd. commenced open pit mining during the year at the old Monarch Mine, near Manica. The deposit is of auriferous quartzites and had been worked in the 1940's and 1950's as an underground operation. Production of gold for the year totaled 20 kg. There was some artisanal production of gold in the Manica and Tete areas, as well as near Lake Nyasa near the Tanzania border. Data for this production were unavailable.

BHP International Minerals had a 4-year option from Kenmare Resources Plc of Ireland to acquire up to a 75% equity stake in the Congolone titaniferous sands concession near Angoche. Reserves already delineated by Kenmare were reported to be adequate for an annual production of about 450,000 tons of heavy-mineral concentrates, mostly ilmenite, but BHP was hoping to significantly increase the mineral inventory. On the Pebane titaniferous sand concession farther south, Genmin of the Republic of South Africa was involved in reserve delineation drilling, as part of an earn-in agreement with Edlow Resources Ltd. of the United States.

Emeralds were being produced from the Niame and Maria III Mines by Niame-Companhia Miniera Lda.—an Israeli-backed company. Both mines are near Alto Ligonha.

Following an accord signed with the Government at yearend 1992, PIDICO Bentonite de Moçambique, Ltd. began rehabilitation and expansion of the Luzinda bentonite mine near Maputo. Production, however, showed little improvement in 1993. As in recent years, the bentonite was exported to Zimbabwe.

Mozambique's cement plants are at Matola, Dondo, and Nacala, but local limestone quarries supplying the plants have been closed since the early 1980's, owing to security conditions. Deprived of local feed, the plants have had to operate on imported clinker. Funds for these imports have been limited, allowing, at best, only low levels of cement production. Following the closure in 1991 of the Matola plant, only the Nacala plant remained in operation. All three plants were being privatized; reportedly several Portuguese and Scandinavian cement companies were submitting bids for the mills.

Funding for the development of the Ancuabe graphite deposit, north of Montepuez, was approved during 1993. The operating company is Grafites de Ancuabe, a joint venture among Kenmare Resources Plc of Ireland, 65%; the Government, 25%; and the Commonwealth Development Corp., 10%. A small amount of graphite concentrates, for marketing purposes, was produced from a pilot plant during the year. Commercial production was to start in early or mid-1994 at a rate of about 5,000 mt/a of concentrates for the first year, about two-thirds of capacity.

Mozambique is a mineralogically diverse country; deposits that are or have been exploited include asbestos, bauxite, various clays, coal, copper, fluorspar, gemstones, gold, graphite, marble, rare earths, and tantalum. Output has generally been from small deposits, and reserve data are unavailable for most of these commodities.

Mozambique has large coal reserves, mostly in the Tete area. 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 exploitable resources of the Moatize and similar sedimentary basins in the region amount to at least 2 billion tons. Resurrection of the small existing mines at Moatize is economically questionable, but the reserves and the large-scale mining potential of the region have attracted a great deal of attention from international coal companies in recent years, among them Brazil's Companhia Vale do Rio Doce (CVRD). A recent prefeasibility study by CVRD established that reserves were adequate to support a long-term coal output of 22 Mmt/a (9 Mmt/a salable), but that extensive (and expensive) new railing and port coal-loading infrastructure would be required to support open pit coal mining on such a scale.

Mozambique's total resources of titaniferous sands have yet to be established but are believed to be large. This is based on the results of the two exploration programs completed in 1990, the areal extent of the country's exposed granitic terrane, and the long coastline receiving sediment input from that terrane. Proven reserves for Kenmare's Congolone deposit were announced toward yearend 1989 as 166.8 Mmt of dredgeable ore grading 3.25% heavy minerals. The 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. Resource estimates for Edlow's Pebane concession, based on prefeasibility work completed in 1990, were about 250 Mmt grading 5% heavy minerals, mostly ilmenite. Both projects have attracted international mining company joint-venture partners, who are working to define reserves and expand the resource base.

According to Kenmare Resources, total resources of graphite at the Ancuabe deposit are on the order of 24 Mmt grading from 3% to 11% graphite. The mine being developed is based on proven reserves of weathered ore in one zone amounting to about 1 Mmt grading 11% graphite, most of it coarse flake.

To date, economic crude petroleum resources have yet to be discovered. Mozambique has significant natural gas resources, most notably in the Pande Field. ENH claims that its recent work has confirmed recoverable reserves of gas in the Pande Field near Beira of 40 billion m^3 and hopes to prove much higher reserves.

INFRASTRUCTURE

Mozambique has 3,140 km of 1.067-m-gauge railroads and 148 km of 0.762-m narrow gauge. Excepting spur lines to plantations and factories, the country's railroads are in six routes or "corridors." These are, from north to south: the Nacala Corridor, linking Nacala to Malawi; the Sena Corridor, linking Beira, via Dondo and Sena, to the coalfields at Moatize and to Malawi; the Beira Corridor, linking Beira to Zimbabwe; the Limpopo Corridor, linking Maputo with Zimbabwe; the Ressano Garcia line, linking Maputo to the Republic of South Africa; and the Goba line, linking Maputo to Swaziland.

Rehabilitation work on the railroads was largely complete in 1993 on all the routes except for part of the Nacala corridor near the Malawi border, and the Sena Corridor, particularly the line to the Moatize coalfields.

Much of the rehabilitation and

expansion work at the port facilities at Maputo-Matola and at Beira also had been completed in 1993. Problems with the ports were perceived now to be more with pilferage and with management. A significant development in 1993 was the signing of a 5-year management contract with South African company CMR Engineers and Project Managers to run the Matola coal terminal. By reducing total railing and port charges for coal from South Africa's Witbank coalfields to about $11.50/mt, CMR was hoping to lure business away from the comparably priced Richards Bay Coal Terminal and the more expensive facilities at Durban, both ports in the Republic of South Africa.

In 1993, Mozambique's installed electrical generating capacity remained unchanged at about 2,300 MW, of which 2,040 MW was accounted for by the Cabora Bassa hydroelectric plant. About 40% of the 900-km powerline to the Republic of South Africa remained damaged, owing to the past sabotage of about 1,800 pylons. Accordingly, electricity generation by Cabora Bassa was only about 95 GW • h, feeding a low-capacity line to the cities of Tete, Quelimane, and Nampula. About $125 million in loans was being arranged to rebuild the pylons to South Africa, and eventually, a connection is to be made with Zimbabwe. Purchases by South Africa and Zimbabwe would nearly fully utilize Cabora Bassa's capacity, but the dam has room for the addition of turbines to significantly increase its capacity. This potential has attracted the interest of at least one major international aluminum company, which has discussed with the Government the possibility of building an aluminum smelter on the coast, probably near Beira.

OUTLOOK

There is considerable international interest in Mozambique's mineral potential, but large-scale investment in the mining sector is dependent on political developments, including the perception of long-term improved security conditions. It is likely that Mozambique could become a significant producer of titanium minerals and a modest producer of gemstones, gold, and graphite, and, possibly, tantalum. It appears unlikely that significant improvement in coal output will be forthcoming, at least from the current mines, given their condition and the need to rehabilitate the servicing railroad. Large-scale development of coal in Mozambique would necessitate a large investment in rail and port infrastructure, and funding for this is uncertain. Cement production could greatly increase once the plants regain access to local limestone for the manufacture of clinker. Another long-term development would be large-scale exploitation of the country's natural gas resources, probably via pipeline to South Africa.

Transport sector rehabilitation could significantly increase the volume of goods transshipped through Mozambique and the revenues derived therefrom. Competition for this trade from South African transportation routes could be keen, but itself depends on political developments in that country. The effects of upcoming political changes in South Africa on that country's mining industry was of concern, especially the effect of such changes on the migrant Mozambique miners employed there.

[1]Text prepared Apr. 1994.

OTHER SOURCES OF INFORMATION

Ministério dos Recursos Minerais
Direcção Nacional de Minas
C.P. 2904, Maputo, Mozambique
Telephone: 258-1-427-121/420-024
Fax: 258-1-429-046

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

TABLE 1

MOZAMBIQUE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Bauxite		5,501	7,186	7,760	[r]8,336	5,995	8,500
Cement, hydraulic	thousand tons	75	79	[r e]80	[e]30	[e]20	[3]90
Clays, bentonite		126	—	[r]664	[r]20	[e]100	6,000
Coal, bituminous		62,010	40,411	50,832	[r]12,618	663	60,000
Copper:							
Ore, gross weight[e]		6,500	[4]—	—	—	—	—
Concentrate:							
Gross weight		420	[4]133	—	—	—	—
Cu content[e]		88	28	—	—	—	—
Gemstones:							
Cut stones, all types	carats	19,766	13,385	12,906	8,447	7,693	NA
Aquamarine	grams	—	[r 5]—	[r 5]—	[5]—	180,730	NA
Beryl, morganite	do.	913	[5]NA	[5]NA	[e]5,000	[e]5,000	NA
Emerald	do.	36	[5 r]—	—	75,000	33,750	NA
Dumortierite		—	—	73	[r]—	34	NA
Garnet[6]	kilograms	1,966	[r]2,562	1,281	[r]588	273	3,000
Tourmaline	grams	966	[5]—	[5]—	[r]—	35,160	NA
Gold[7]	kilograms	—	68	394	296	149	500
Graphite, concentrates		—	—	—	—	[8]10	NA
Marble, block	cubic meters	687	488	[r]279	919	[9]1,382	1,500
Salt, marine[e]		40,000	40,000	40,000	40,000	40,000	40,000
Tantalum, microlite concentrates	kilograms	—	—	266	[r]—	—	NA

[e]Estimated. [r]Revised. NA Not available.

[1]Data available through May 4, 1994.

[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, as is a small amount of natural gas. For these commodities output is not reported quantitatively and information is inadequate to make reliable estimates of output levels.

[3]Reported, for Nacala plant only. The Dondo and Matola plants have a combined installed capacity of 900,000 tons but are closed and are believed to require rehabilitation to attain this output level.

[4]No mining occurred at the Mundonguara Mine, the country's sole copper producer, during 1990. Copper concentrate was produced from stockpiled ore.

[5]Production was reported as nil or as not available. It is surmised that some artisanal production, perhaps from dump material or from placer deposits, took place. Information is inadequate to make reliable estimates of output levels.

[6]Facet-grade. In addition, there was waste garnet production, in kilograms, as follows: 1989—8,211; 1990—4,786; 1991—2,400 (estimated); 1992—1,000; 1993—600 (estimated).

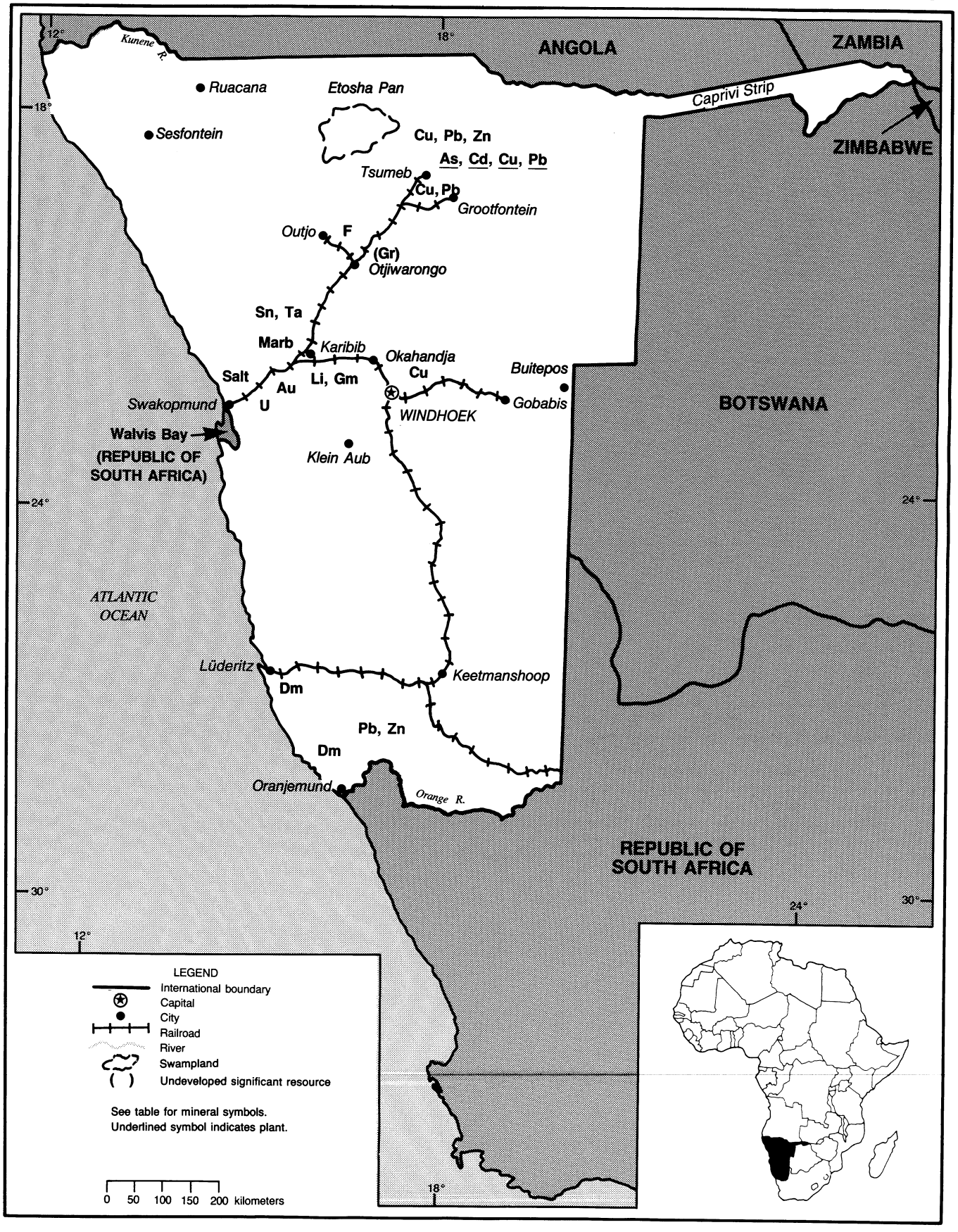
[7]Does not include artisanal gold production, for which there were no data.

[8]Pilot plant production only. Main production, at approximately 5,000 mt/a, is to commence in 1994.

[9]There was also 34 square meters of slab marble production.

NAMIBIA

AREA 824,290 km² **POPULATION 1.5 million**



THE MINERAL INDUSTRY OF

NAMIBIA[1]

By Michael M. Heydari

Namibia produced about 30 different minerals in 1993, the most important, in order of value, being diamond, uranium, copper, silver, lead, zinc, gold, pyrite, and salt. There were 45 active mines in 1993. Demand for Namibia's main mineral exports, diamonds, uranium, and precious and base metals, was generally weaker in 1993 compared with that in 1992. The main adverse factor was the reduced diamond export quota, with a matching 25% cut in Namibia production implemented at the beginning of 1993. However, with an easing in the quota to 85% of normal deliveries by midyear, output capacity was partially reinstated through expansion in marine diamond recoveries.

Mainly as a result of the lower output value of mining, Namibia's gross domestic product (GDP) contracted by an estimated 3.3% in real terms during 1993, compared with 3.5% positive growth recorded in 1992. The mining industry accounted for about 20% of the GDP at a factor cost of about $2 billion—surpassing all other sectors in relative share of the GDP—and about 57% of foreign exchange earnings.[2] The industry was the largest taxpayer, its capital investment was second only to that of the Government, and it was the largest employer after the Government and agriculture. In 1993, the mineral sector employed more than 12,000 workers, about 6% of the formal-sector work force. However, mining's contribution to the GDP, foreign exchange earnings, and employment levels has decreased steadily from that of 1980. This is because exploration has not been conducted on a sufficient scale to ensure that new mineral deposits are discovered and developed to replace production as the older mines close.

A conference on mining investment in Namibia was held in Windhoek in March 1993 to focus attention on Namibia's mineral potential and to promote foreign participation in the Namibian mining sector. Eleven U.S. firms were represented in the conference. During the conference the Government and European Community (EC) signed a financing agreement for a $47 million mining sector grant to Namibia. The grant was approved by the European Development Fund Committee, under a package called "Sysmin," to stimulate, restructure, and broaden the country's depressed mining sector. A total of $34 million is for concessional loans to finance private-sector exploration and mine development efforts. About $10 million is to be used by the Namibian Geological Survey to pay for high-resolution regional aeromagnetic and electromagnetic surveys of northern, central, and eastern Namibia.

In early 1994, Namibia and the Republic of South Africa signed a treaty transferring ownership of Walvis Bay, the principal deepwater port, to Namibia. A free trade zone was established in Walvis Bay to attract foreign investors and spur economic expansion.

GOVERNMENT POLICIES AND PROGRAMS

In December 1992, the National Assembly approved the new Minerals (Mining and Exploration) Act, No. 33 of 1992. The Minerals Act replaces South African colonial legislation covering the mining sector. It provides for a standard licensing regime with special provisions to promote investment by foreign and domestic enterprises in minerals exploration and extraction. An accompanying Mining (Taxation) Act sets out revised fiscal provisions for the industry. The main innovation is a provision for royalty payments by producers to the Government. The act provides that (1) the old Diamond Export Duty of 10% be changed to a royalty at the same rate; (2) a royalty of 5% of market value be levied on all dimension stone and semiprecious stones exported in unbeneficiated form; and (3) a maximum royalty of 5% of market value be levied on all other minerals that can be beneficiated locally. The new legislation, which is expected to come into force in July 1993, has not stipulated compulsory state participation in mining ventures, although the Government may seek a minority equity interest in new projects.

With regard to mining activities, excluding petroleum and diamond mines, the 1992 act allows that all exploration expenditure incurred before the startup be written off in the first year of production and subsequent exploration expenditure in the year in which they are incurred. In addition, the definition of exploration expenditure with regard to a specific mining company is now construed in a way that it includes any area in Namibia. The Government hopes that this will inspire mining companies to step up their exploration activities. In the case of development expenditure, however, the new act stipulates that only one-third can be written off in the year in which it is incurred and one-third in each of the 2 ensuing years. The new progressive tax rates applicable to nondiamond and nonpetroleum mining companies vary from 25% to 55%, with most companies' rates falling in the range of 25% to 40%.

The system of taxation on diamond mining consists of three separate taxes, namely income tax, diamond profits tax,

and diamond export duty. The latter is now replaced by a royalty at the rate of 10%. Income tax on diamond mining companies is levied at the rate of 50% of taxable profits, plus a surcharge of 10%. A diamond profits tax is levied at the rate of 15% of the taxable profits as specified in the Diamond Taxation Proclamation, No. 16 of 1941, as amended. The Income Tax Act provides that the amount paid as diamond profits tax be credited against the income tax payable by diamond mines.

The fiscal regime for oil exploration companies consists of three principal elements, namely an income tax and an Additional Profits Tax (APT), both levied in terms of the Petroleum (Taxation) Act, No. 3 of 1991, and thirdly, a royalty, levied in terms of the Petroleum (Exploration and Production) Act, No. 2 of 1991. In regard to income tax, the applicable tax rate is 42% of taxable income. The APT is a tax on profits above a level necessary to earn a reasonable rate of return on investment. A three-tier incremental APT scheme is provided in the new legislation. The first-tier APT rate is at 25% when the net rate of return reaches 15%. The second- and third-tier incremental APT rates are negotiated between the Government and the oil company. As in the case of the petroleum income tax, the APT is applied on a license or contract area basis. This means that expenditures incurred on different oilfields within the same license area are not ring-fenced. The Petroleum (Exploration and Production) Act, No. 2 of 1991, provides that the holder of a production license for petroleum shall pay, to the State Revenue Fund, a royalty of 12.5% of the market value of petroleum produced. However, the act provides that the Minister of Mines and Energy may, in concurrence with the Minister of Finance, remit wholly or partly any royalty payable, or defer payment of any such royalty with the intention to assist any marginal oilfield development.

The Foreign Investment Act of 1990 offers prospective investors a fairly attractive package of incentives such as repatriation of profits, security of title and tenure, availability of foreign exchange, international arbitration, and fair compensation in case of expropriation.

The Ministry of Mines and Energy had responsibility for making and enforcing policies related to minerals and energy. Within the Ministry and attached to the Permanent Secretary were the Diamond Board, the Mining Advisory Board, and the National Energy Council, all of which had both Government and private-sector representation. The Namibia Petroleum Co. and the Namibia Electricity Development Co. also are part of the Ministry. Four main directorates in the Ministry were the Geological Survey, Mining, Energy, and Administration and Finance.

The Geological Survey of Namibia initiated a program of geophysical activity to enhance the existing data base with the aim of promoting and stimulating mineral exploration in the country. The activity includes the reprocessing of existing data and the acquisition of high resolution airborne geophysical data over selected areas. The first phase of the program of high resolution surveys, to start during 1994, is financed through the EC's Sysmin package within the framework of a support program to the mining sector of Namibia.

During 1993, the Ministry of Mines and Energy approved 25 exclusive prospecting grants with 20 more under consideration compared with a total of 41 approved in 1992. In addition, 818 claims were registered and 676 prospecting licenses were issued in 1993.

ENVIRONMENTAL ISSUES

Environmental control, waste management, and rehabilitation have long been regarded as part of mining by most large-scale operations in Namibia. The new mining act requires the submission of an Environmental Management Program Report (EMPR) for all current and planned mining operations. This means documenting the full range of environmental impacts and describing how they are to be addressed during the life of the mine and after closure. The report is to cover every aspect of operations, what remedial action will be undertaken, and how it will be funded. There is a legal requirement that sufficient funds be put aside during the life of a mine to cover all future rehabilitation costs. This applies to existing as well as planned operations.

The South African-based Regional Resources Ltd., which had plans to develop an alluvial diamond mine at its Purros claim in Namibia's Kunene Province, decided not to proceed with exploration in the face of opposition by the Ovahimba cattle-herding community and the Wildlife Society of Namibia. Conservationalists demanded a full environmental impact study.

A comprehensive report published in early 1993 by the International Atomic Energy Authority (IAEA) largely commended the practices of Namibia's Rossing Uranium Ltd. with regard to current radiological and occupational safety procedures. However, it highlighted the need for closer monitoring of possible long-term environmental contamination problems. The IAEA concluded that health and safety practices at Rossing met or exceeded internationally accepted norms for the uranium industry and that the data provided by the mine management on external radiation, including radon and thoron daughters, were acceptable and reliable. Alleged excessive previous exposure to radiation was one of the main charges made in the 1992 publication "Past Exposure" by the Namibia Support Committee. A representative of the Mineworkers Union of Namibia (MUN) participated in each of the IAEA team's working groups, but the union rejected the preliminary findings and maintained that a number of its concerns needed further investigation, including the possibility that cancer deaths of past employees may have been due to radiation exposure.

PRODUCTION

In 1993, the mining industry struggled to remain profitable by trimming production costs and improving workers'

productivity. Diamond production by Consolidated Diamond Mines (CDM), a wholly owned subsidiary of De Beers Centenary, dropped by 26% from the record set in 1992. Output of uranium from the Rössing Mine dropped slightly.

Production of precious and base metals decreased across the board. Dimension stone mining did not have a good year. As demand was almost exclusively for white and black marble, only a few quarries were fully active in 1993. *(See table 1.)*

TRADE

Namibia's total exports amounted to about $1.2 billion in 1993, with diamond, manufactures (including processed fish and meat), and uranium as the main export products. Total mineral exports were estimated at about $680 million, down from $741 million in 1992, and included diamond, $410 million, down from $453 million in 1992; base metals, about $120 million; gold, $30 million; and others, including uranium, $125 million. Imports were valued at about $1.2 billion with food and beverages, machinery and electrical goods, vehicles and transport equipment, and mineral fuels and lubricant as the main imports.

Namibia's main trading partners, in order of importance, were the Republic of South Africa, Germany, Switzerland, the United Kingdom, Japan, the United States, and Belgium. As a member of Southern African Customs Union (SACU), Namibia's products have duty-free access to the markets of Botswana, Lesotho, the Republic of South Africa, and Swaziland. Namibia's products also have duty-free and quota-free access to the EC under the Lome Convention. On September 15, 1992, Namibia became the 105th contracting party of Generate Figurement on Tariffs and Trade (GATT).

According to the U.S. Department of Commerce's International Trade Administration, Namibia's exports to the United States were $22 million in 1993, down from $23.1 million in 1992. Industrial inorganic chemicals accounted for $6.3 million, and petroleum refinery products made up about $2.7 million of Namibia's exports to the United States. Namibia's total imports from the United States were $34.2 million in 1992 and $19.7 million in 1993. Construction machinery accounted for $14.9 million and $1.7 million of Namibia's imports from the United States in 1992 and 1993, respectively.

STRUCTURE OF THE MINERAL INDUSTRY

Ownership of mining companies operating in Namibia was primarily private. Government participation remained limited to only a few entities, and it has generally functioned in a regulatory fashion.

Two Namibian mining companies can be considered significant by world standards, CDM and Rössing Uranium Ltd. Together these account for about 75% of the production value of the mining sector. CDM ranks sixth in terms of production volume of near-gem and gem diamond worldwide. Rössing ranks fifth in Western World uranium production with a share of about 9%.

The five other largest Namibian operations are all metal mines, of which four are base metal properties. The five are Tsumeb Mine, Kombat Mine, Otjihase Mine, Rosh Pinah Mine, and the Navachab gold mine. They may be joined by the Okanjande graphite deposit, which is currently at final feasibility and pilot plant state. There are three medium-sized mines with a labor force of more than 100 persons. These are the Rubicon Mine of SWA Lithium Mines; the base metal property Namib Lead and Zinc of Lead Namibia Ltd.; and the Okurusu fluorspar mine. The small-scale category comprises about 35 properties, each employing a work force of between 5 and 75 persons on a regular schedule. With the exception of a copper and a gold-silver mine, the small mines extract nonmetallic minerals. *(See table 2.)*

Namibia has very little investment in smelters, refineries, or processing plants. Tsumeb has a copper and a lead smelter with blister copper and refined lead being produced. All other concentrate leaves the country for treatment and processing either in the Republic of South Africa or overseas.

The Chamber of Mines of Namibia reported that the total number of employees at its member mines, as of December 31, 1993, was 9,854, down from 11,441 in 1992 and less than 50% of its 1980 level. Mine wages are on par with those in the Republic of South Africa but are higher than those in other African countries. This has led to rationalization and more capital-intensive mining practices.

MUN, a member of the ruling party-affiliated National Union of Namibian Workers (NUNW), which is recognized by all of the mining company members of the Chamber of Mines of Namibia, was involved in three work stoppages at two mines, CDM's operations and Navachab gold mine, during 1993. The number of mine employees injured in reportable accidents dropped from 37 in 1992 to 30 in 1993.

Two institutions of higher education provide mineral sector-related training in Namibia. The Namibian Institute of Mining and Technology, financed by Rössing, is providing technician level training in geology, mining, mineral processing, metallurgy, surveying, and chemistry. The new University of Namibia (UNAM), which came into existence in early 1993, will have seven colleges. Two of these-Natural Sciences and Social and Economic Sciences-are to cover mineral sector-related disciplines at undergraduate and graduate levels, although at this stage no mining courses are proposed. In addition, UNAM is establishing a Multidisciplinary Research Center (MRC) and will coordinate with other universities in Africa and overseas to provide research and training opportunities in mineral-related areas for Namibian students.

COMMODITY REVIEW

Metals

Exploration for gold and base metals increased during 1993, especially in the northwestern Kunene region where 75%

of the surface area in the Kaokoveld and western Ovamboland districts is covered by prospecting grants. Total exploration expenditures in 1993 were $11.7 million, about 75% more than that of the preceding year. Prospecting was mainly by existing local exploration companies, with most interest shown by overseas companies being concentrated on offshore diamonds. The Metal Mining Agency of Japan (MMAJ) signed its first agreement on a mineral exploration project in Namibia. The target areas have a high potential for rare-earth mineralization in carbonatite.

Copper.—The weaker copper price during 1993 adversely affected the operations of Tsumeb Corp. Ltd., the country's major base metals producer. Blister copper output was 7% less than that in 1992, reflecting reduced output from the main Tsumeb Mine as it nears the end of its economic life. The Tsumeb Mine is expected to close by the end of 1994 owing to falling grades in the remaining deep ore. As the main Tsumeb Mine's production declined, development work continued at Tsumeb Corp.'s Tschudi Mine, 30 km west of Tsumeb. Tschudi's copper ore is of relatively low grade. The mine will have a life of 15 years. The Tschudi Mine will be a successor to the main Tsumeb Mine.

Gold.—The Navachab Mine produced 1,790 kg of Namibia's total gold output of 1,954 kg in 1993, with the remainder coming from the Tsumeb Mine smelter. Although both production and grade declined from the previous year's levels, this was compensated by a high treatment rate, high recoveries, successful cost control, and a significant improvement in the rand gold price. As a result, total revenue rose to a record $20 million. A project has been started to prove additional reserves and examine the feasibility of an underground operation in the longer term, funded by the Sysmin facility.

Manganese.—Plans by privately owned Purity Manganese for the production of high-grade manganese ore at Otjosondu, 160 km northeast of Windhoek, are reported to be on course, with the first output expected in July 1994. Otjosondu will be the only mine to produce manganese in Namibia since Johannesburg Consolidated Investment Co. Ltd. (JCI) of South Africa ceased operations there in 1960's. The Otjosondu ore body is generally continuous over an area of about 35 km^2, and the proposed operation is to recover nodules of manganese from beneath a shallow overburden averaging only 1.5 m in depth. Based on the known reserves of the nodules, production is initially aimed at 120,000 mt/a.

Uranium.—Rio Tinto Zinc (RTZ) increased its stake in the Rossing uranium mine to 41% from a controlling 51%. The additional 10% equity interest was purchased from France's Compagnie Francaise des Pétroles, a part of the Total group.

With the spot price recovering slightly, 1993 saw a slight improvement in the world uranium market. Despite this market improvement, production at Namibia's only uranium mine, owned and operated by Rössing Uranium Ltd., declined slightly to 1,966 tons of uranium oxide. A 10% increase in production is planned during 1994 to meet higher anticipated sales commitments. This includes deliveries under a long-term contract to supply Electricité de France with a total of 5,200 tons of uranium oxide. This would increase output to about 2,200 mt/a, about 70% of Rossing's reduced production capacity of 3,000 mt/a, and should also enable the mine to return to profitability.

Zinc.—Production of zinc from the Rosh Pinah lead-zinc underground mine, 80 km northeast of Oranjemund, dropped by more than 20% in 1993. Operations at the Rosh Pinah Mine resumed in January 1994 after production was halted in October 1993 owing to low metal prices. Iscor Ltd. of South Africa, the majority shareholder in Imcor Zinc (Pty.), the operating company, has put the property up for sale.

Industrial Minerals

Diamond.—Diamond is Namibia's most important mineral, accounting for more than one-half of the value of mineral exports. Total production was about 1.14 million carats compared with 1.55 million carats in 1992 and 1.19 million carats in 1991. The 1992 peak output was a result of higher production levels in the main onshore mining area, combined with the first full year of production from CDM's Elizabeth Bay near Lüderitz, and further progress with the offshore marine operations. However, production in 1993 declined as the Central Selling Organization (CSO), De Beers' marketing arm, reduced contract deliveries from all producers, including CDM, by 25% from September 1992. CDM decided it was not in a position to stockpile diamond and cut production from the beginning of 1993 in line with the reduction in sales to the CSO.

Production by CDM amounted to 1,138,998 carats in 1993. Offshore recoveries by De Beers Marine (DBM), which mines under contract to CDM, increased by 18% to 302,754 carats, contributing 27% of the combined onshore and offshore output, up from a 17% share in 1992.

At CDM, as part of the cost containment process, production was reduced by 410,000 carats, with cutbacks concentrating on the lower value diamond sources. Overburden stripping was reduced by 22% to 30.8 Mmt in 1993, while tonnage treated onshore was reduced by 34%; the average onshore recovery grade was 5.6 carats per 100 tons in 1993, down slightly from 5.9 carats per 100 tons in 1992. In Mining Area No. 1, north of Oranjemund, operations were restricted to the Nos. 2 and 3 plant areas with seven sectors mined along 3,700 m of shoreline up to 200 m seaward of the original high-water mark. Mining of aeolian grits continued at Elizabeth Bay, while inland on the Orange River's northbank at Auchas, 2.9 Mmt of overburden was stripped and

930,000 tons of diamondiferous gravel mined compared with 3.7 Mmt of overburden stripped in 1992. A similar large low-grade, paleoalluvial deposit has now been defined nearby at Daberas. Shallow water and bench area recoveries by seven contracted operators rose by 4% to 62,000 carats in 1993.

In mid-1993, DBM brought back into service one of its three mining ships that had been laid up at the start of the year. A fourth vessel, acquired early in 1993, was due to enter service in August 1994 and will utilize a larger rotating-drill mining system with increased production capacity, while a fifth is awaiting conversion in due course. De Beers states that new technology developed by DBM enables the newer vessels to recover diamonds more efficiently and operate in heavier sea swells, thus increasing overall fleet productivity. The seabed area mined during 1993 was 41% higher than in the preceding year.

The commercial and technical success achieved by DBM in its large-scale offshore mining operations has now attracted the interest of new investors, with the potential for a further significant increase in Namibia's marine diamond output in coming years. Geological experts estimate that the Atlantic Ocean floor contains about 1 billion carats deposited through 100 million years of erosion along a 1,400-km stretch offshore southern Namibia and northern South Africa. The average gem content is calculated at 93%, with resources contained in multiple submerged beaches along the continental shelf.

Namibian Minerals Corp. (Namco), of Vancouver, Canada, was granted two diamond concessions in 1993, the first granted by the Namibian Government since independence, offshore Luderitz port and Hottentots Bay, covering 920 km^2. Namco was floated on the Vancouver stock exchange in October 1993. The $10 million proceeds are to be used initially for geophysical surveying and bulk sampling. The company completed its initial geophysical survey in March 1994; diamond reserves are currently estimated at 49 million carats in Luderitz and 21 million carats in Hottentots Bay. A bulk sampling program was expected to produce sufficient information for a formal production decision to be made by the end of 1994, with commercial-scale mining expected to start during 1995.

Canada's Diamond Field Resources (DFR) purchased a 100% interest in a 600-km^2 concession extending 12 km offshore Luderitz from a local firm in 1993 and plans to expend operations from shallow into deeper waters. It subsequently entered into a joint-venture agreement with BHP Minerals and its partner, South Africa's Benguela Concessions Ltd. (BCL), whereby BHP-BCL can earn a 50.1% interest entitling it to all deep-water operations and up to 50% of those in waters of less than 40 m in depth. A third company, Ocean Diamond Mining (ODM) of South Africa, mines around the offshore islands, along Namibia's coastline, which were returned to Namibian sovereignty along with the port of Walvis Bay on March 1, 1994. It was listed on the Namibian Stock Exchange (NSE) in January 1994 and also plans to expand its operations into deeper waters.

Dimension Stone.—Dimension stone mining did not enjoy a good year. Because demand was almost exclusively for white and black marble, only a few quarries were fully active during 1993, including one near Karibib and the other south of Aus. However, Namibia has huge potential within this sector, and increased added value will be provided with the installation of a granite-tile cutting plant at the Mamorwerke Karibib factory, where a marble processing works already exists. Quarrying of high-quality blue sodalite blocks near Swartbooisdrif in Kunene Province also is expanding under a new joint venture, Namibia Blue Sodalite (NBS), formed by the existing local operator, Naso, and Germany's Kies & Natursteinwerke Leipzig (KNL), at the end of 1992. About $2.5 million has been invested in new facilities and more sophisticated techniques, and NBS plans to establish a processing plant, probably at Walvis Bay.

Fluorspar.—In financial terms, fluorspar is the second most important mineral produced in Namibia. The main fluorspar operation is centered around Okorusu, 48 km north of Otjiwarongo. Okorusu Fluorspar (Pty.) Ltd.'s main markets are, in order of importance, Germany, the United States, and the United Kingdom. In 1993, the company became the first beneficiary of the EC's $47 million aid program for Namibia's mining industry. The loan, at an annual interest rate of 6% and repayable over 13 years, will enable Okorusu to maintain its current capital expenditure program on expanding and developing the plant in anticipation of a recovery in fluorspar demand in 1994.

Mineral Fuels

Namibia produced neither crude oil nor natural gas and had no crude oil refining capacity. It had no proven crude oil reserves and only limited gas reserves, at the Kudu Gasfield, 200 km west of Oranjemund off Namibia's southern coast, generally estimated at between 150 to 500 billion m^3.

Norsk Hydro SA of Norway drilled its first well, a dry hole, off Namibia under the country's recent licensing round. The hole was drilled to 4,554 m. Hydro is committed to drill two more wells during the 4-year license period ending in April 1996.

Reserves

Reserve data reported by the Chamber of Mines and operating companies in Namibia indicated reserves of about 1 billion carats of diamond, about 3 Mmt of contained copper, 100,000 tons of contained uranium oxide, 20 tons of gold, 36 Mmt of graphite ore grading 4.3% carbon, 70 Mmt of ore grading 0.135% tin, 6 Mmt of trona-rich and sulfate-rich salts, 2.9 Mmt of fluorspar ore grading 61% CaF_2, and 29,000 tons of wollastonite.

INFRASTRUCTURE

Namibia has two principal ports,

Walvis Bay and Lüderitz. Walvis Bay has container and bulk mineral handling facilities, and oil storage tanks. More than 1 Mmt/a of freight is handled at Walvis Bay, compared with 50,000 mt/a at Lüderitz.

Namibia has a well-developed and maintained road transport system, with a railway network that links the principal centers of population to the coast and to the Republic of South Africa. The country has about 40,000 km of roads, of which about 4,500 km is surfaced. There is a principal north-south axial road linking southern Angola with the Republic of South Africa and east-west routes connect the coastal ports of Walvis Bay, Swakopmund, and Lüderitz with the Republic of South Africa and Botswana, respectively. The Botswana route will assume even greater importance once the Trans-Kalahari Highway is completed, reducing the journey between Windhoek and Johannesburg by more than 400 km. In the northeast, work is under way on upgrading the road through the Caprivi Strip to link Namibia with southeast Angola, Botswana, Zambia, and Zimbabwe.

The 2,400-km-long rail network is operated by TransNamib. The rail fleet consists of 100 diesel-electric locomotives and 2,400 wagons. Namibia's railways carry about 2 Mmt/a of freight and 480,000 passengers per year, approximately 10 times the traffic transported annually on scheduled road services.

Electricity throughout the country is provided by, the national power utility. Principal power stations include the 120-MW Van Eck coal-burning plant in Windhoek and the 240-MW Ruacana hydroelectric station on the Kunene River. The SWAWEK network interconnects with the Republic of South Africa's grid. Planning is currently under way for a second hydroelectric station to be built on the Kunene River. The proposed Epupa plant would have an installed capacity of 450 MW.

OUTLOOK

The health of the industry will remain important to the country's overall economy because mineral exports are the main source of foreign exchange earnings. The new mining and investment legislations approved by the National Assembly in 1992-scheduled to come in force on April 1, 1994-are expected to provide incentives and guarantees to foreign participation in the Namibian mining sector. In its recent publication, "Strategy for African Mining," the World Bank ranked Namibia as one of three African countries in top category, namely countries in which in excess of $100 million should be spent on exploration during the next 5 years.

Uranium production at Rossing is expected to rise in 1994 as sales contract expands, and diamond production could also rise. Improvement also is expected in the copper and zinc sectors.

Onshore diamond mining is expected to end in 10 years. Unless a replacement is found, Namibia will suffer a substantial decline in export earnings and employment in the mining sector. CDM has begun to develop offshore diamond mining. However, because of political uncertainties during the past 10 years, there has been little prospecting for other minerals in Namibia, with the result that few new mines have been developed. Given the long lead time between the prospecting and development stage of a mine, even with an increase in exploration, there is likely to be a gap in revenue from mining as the old mines close before the new ones come on-stream.

The mining companies will likely concentrate their exploration activities around areas that already have a well-developed infrastructure. Because of the high cost of exploration and mine development, large international mining companies are likely to remain dominant in Namibia's mining industry. However, there is potential to develop small mines using a minimum amount of capital.

The future of Namibia's mineral sector may lie in applying new cost-effective mining and extraction techniques to the country's wide variety of low-grade mineral deposits. Considering the country's general political stability, Namibia is a viable market for technology transfer, mining equipment, and investment for U.S. mining firms.

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[1]Text prepared July 1994.

[2]Where necessary, values have been converted from the South African rand (R) to U.S. dollars at the rate of R3.27=US$1.00 for 1993 and R2.85=US$1.00 for 1992. Although rand is still used, the Government introduced its own currency, the Namibian dollar (ND), in 1993. The ND is linked to the rand at the rate of ND1.00=R1.00.

OTHER SOURCES OF INFORMATION

Agencies

Association of Prospectors and Miners of Namibia
P.O. Box 5059
Windhoek, Namibia
Telephone: (264) 61 34978
Fax: (264) 61 32809

The Chamber of Mines of Namibia
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Windhoek, Namibia
Telephone: (264) 61 37925/6
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First National Development Corp.
Private Bag 13252
Windhoek, Namibia
Telephone: (264) 61 306911
Fax: (264) 61 33943

Geological Survey of Namibia
Private Bag 2168
Windhoek, Namibia
Telephone: (264) 61 37240
Fax: (264) 61 228324

Ministry of Mines and Energy
Private Bag 13297
Windhoek, Namibia
Telephone: (264) 61 226571
Fax: (264) 61 38643

Ministry of Trade and Industry
Private Bag 13340
Windhoek, Namibia
Telephone: (264) 61 2989111
Fax: (264) 61 220148

Namibia National Small Miners Association
P.O. Box 7289
Windhoek, Namibia
Telephone: (264) 61 31088
Fax: (264) 61 31188

U.S. Embassy
P.O. Box 12029
Windhoek, Namibia
Telephone: (264) 61 221601
Fax: (264) 61 229792

Publications

Chamber of Mines of Namibia Annual Report.
Mineral Investment in Namibia, Mining Journal Research services in cooperation with the Ministry of Mines and Energy, Namibia, Mar. 1993, 107 pp.

TABLE 1
NAMIBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
METALS							
Antimony, sodium antimonate (47% Sb):							
Gross weight		73	5	21	r13	13	75
Sb content		34	2	10	r6	8	35
Arsenic, white, 99% arsenic trioxide		2,399	1,636	1,804	2,456	2,290	2,500
Beryl concentrate		—	25	6	e10	15	25
Cadmium metal, refined		88	69	67	r33	13	100
Cesium, pollucite, gross weight		—	3	5	e5	e5	5
Columbium and tantalum, tantalite concentrate:[e]							
Gross weight	kilograms	25,730	23,678	200	200	—	6,000
Cb content	do.	2630	2550	30	30	—	700
Ta content	do.	2630	2550	30	30	—	700
Copper:							
Mine output, concentrate (29% to 30% Cu):							
Gross weight		109,305	108,331	116,842	115,178	110,324	150,000
Cu content[e]		32,800	32,500	233,884	234,553	33,100	44,000
Metal, blister[3]		37,978	33,190	32,929	r37,531	34,788	58,000
Gold	kilograms	336	1,605	1,857	r2,025	1,954	2,500
Lead:							
Mine output, concentrate (30% Pb):							
Gross weight		79,854	61,758	50,585	r49,582	35,476	80,000
Pb content[e]		223,710	18,000	15,000	15,000	11,000	25,000
Metal, refined, primary[3]		44,183	35,129	33,367	31,655	31,236	45,000
Silver, mine output, Ag content of concentrate	kilograms	108,247	92,072	91,293	r e89,000	e72,000	110,000
Tin, mine output, concentrate (61% to 67% Sn):							
Gross weight		1,683	1,390	17	r18	6	2,000
Sn content		1,120	900	11	r11	4	1,200
Uranium, U_3O_8 content of concentrate		r3,631	r3,786	2,889	1,986	1,966	3,000
Zinc, mine output, concentrate (49% to 53% Zn):							
Gross weight		79,805	72,480	68,098	r68,337	53,995	80,000
Zn content		41,675	37,719	33,150	r36,053	28,380	42,000
INDUSTRIAL MINERALS							
Aragonite[e]		—	—	219	20	20	30
Diamond:							
Gem[e]	thousand carats	910	750	1,170	r1,520	1,120	1,600
Industrial[e]	do.	20	15	20	r30	20	50
Total[4]	do.	927	763	1,187	r1,549	1,141	1,650
Fluorspar, concentrate, acid grade (98% CaF_2)[5]		25,679	27,107	34,565	37,176	42,249	50,000
Graphite[e]		—	—	200	200	—	200

See footnotes at end of table.

TABLE 1—Continued

NAMIBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Gypsum		—	—	—	380	e400	500
Lithium minerals:							
Amblygonite		131	54	20	r5	5	150
Lepidolite		41	80	33	r93	88	100
Petalite		1,226	1,134	1,139	r1,064	649	1,300
Total[4]		1,398	1,268	1,192	r1,162	742	1,550
Mica		—	—	—	2	e2	3
Quartz		—	107	e100	e100	358	400
Salt		142,102	157,224	141,368	r114,625	116,375	160,000
Semiprecious stones:							
Agate		93	72	53	e100	76	100
Amethyst		161	110	110	e120	176	200
Beryl	kilograms	—	e3,000	6	e10	e10	1,000
Chrysocolla	do.	8,000	900	5,382	e6,482	e6,500	9,000
Dioptase	do.	190	109	52	r35	e50	200
Quartz, crystal		7	20	11	e50	e50	70
Rose quartz		302	605	314	r124	166	700
Sodalite[e]		2,50	50	50	100	546	600
Tourmaline	kilograms	968	1,117	1,216	r638	e600	1,300
Stone, sand, and gravel:							
Granite		9,154	5,437	7,890	r7,313	1,270	8,000
Marble		12,573	12,882	10,031	r12,289	17,047	18,000
Sulfur, pyrite concentrate:							
Gross weight (49% to 51% S)		196,531	138,925	127,119	164,191	113,704	200,000
S content[e]		100,000	70,000	65,000	r 2,80,946	2,56,056	100,000
Wollastonite		—	—	305	r549	721	1,500

[e]Estimated. [r]Revised.

[1]Table includes data available through Apr. 15, 1994.

[2]Reported figure.

[3]Products of imported concentrate included.

[4]Data may not add to totals shown because of independent rounding.

[5]The figure for 1988 is revised to 3,989 tons.

TABLE 2

NAMIBIA: STRUCTURE OF THE MINDERAL INDUSTRY FOR 1993

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper		Tsumeb Corp. Ltd. (Gold Fields Namibia Ltd., 100%)	Tsumeb	15,500 Cu in concentrate, 58,000 blister copper.
Do.		do.	Kombat, 50 kilometers south of Tsumeb	12,000 Cu in concentrate.
Do.		Otjihase Mine (Tsumeb Corp. Ltd., 70%; Johannesburg Consolidated Investment Co. Tsumeb Ltd., 30%	Otjihase, near Tsumeb	16,500 Cu in concentrate.
Diamond	million carats	CDM (Pty.) Ltd. (De Beers Centenary AG, 100%)	Mines near Oranjemund, Elizabeth Bay Mine, 25 kilometers south of Luderitz, and marine operations	1.6.

TABLE 2—Continued

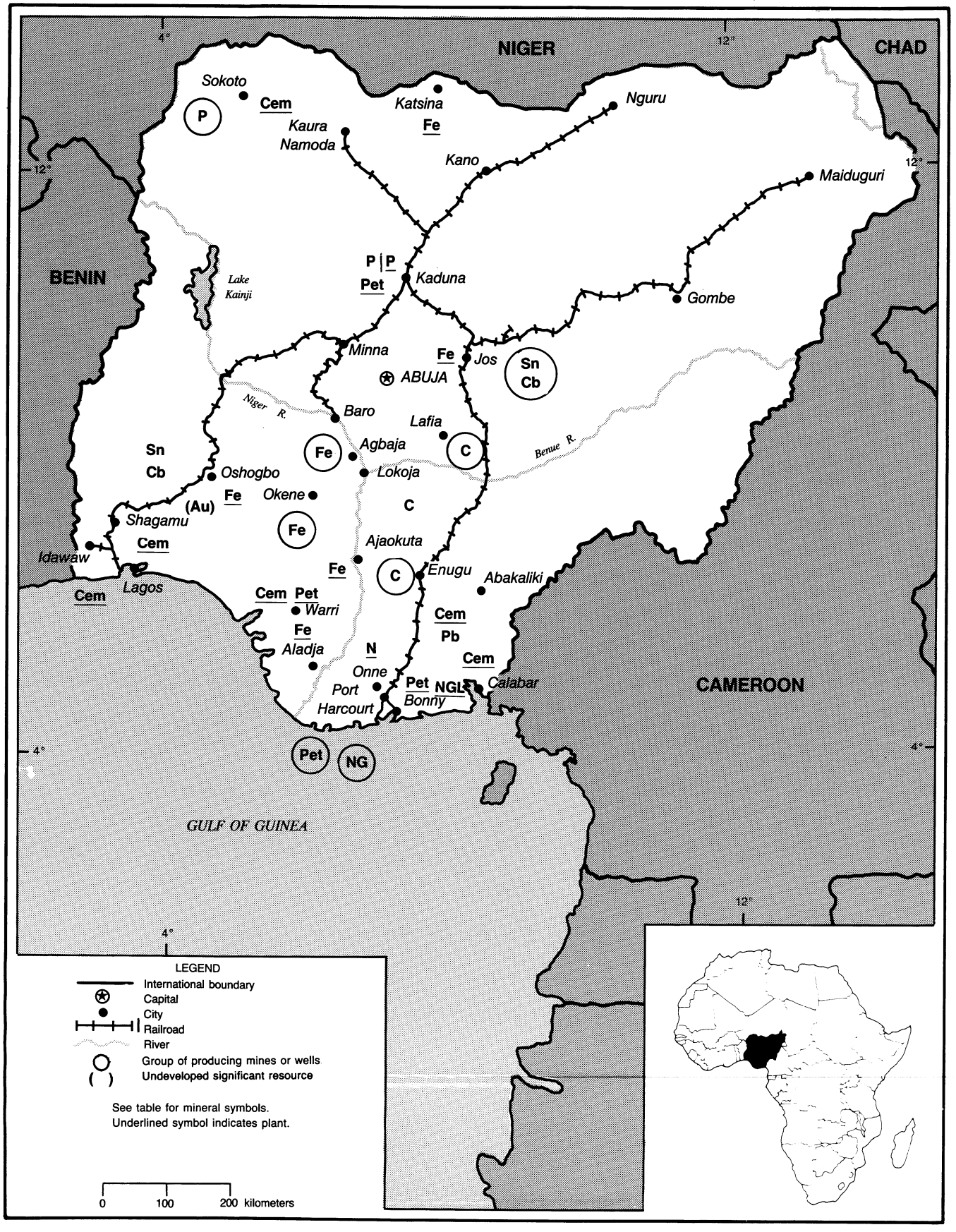
NAMIBIA: STRUCTURE OF THE MINDERAL INDUSTRY FOR 1993

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Fluorspar	Okorusu Fluorspar (Pty.) Ltd. (Iscor Ltd., 26%; Okorusu Holdings)	Okorusu, 48 kilometers north of Otjiwaroungo	50,000, 98% calcium fluoride.
Gold	Navachab Gold Mine Co. (Erongo Mining and Exploration Co. Ltd., 70%; Metall Mining Corp., 20%; Rand Mines Ltd., 10%)	Navachab near Karibib	2 Au.
Lithium	SWA Lithium Mines (Pty.) Ltd. (Klockner; Matramco)	30 kilometers south of Karibib	1,500 concentrate.
Marble cubic meters	Karibib Mining and Construction Co. (Namibia) Ltd. (private, 100%)	Karibib	2,500 marble, 600 granite.
Salt	Salt Co. (Pty.) Ltd. (private, 100%)	Swakopmund	150,000.
Uranium	Rossing Uranium Ltd. (RTZ Corp. plc, 51.4%; Industrial Development Corp. of South Africa, 10%; Rio Algom, Canada, 8%; Urangesellschaft mbH, 5%; Government of Namibia, 3.5%; Gencor Ltd., 2.3%)	Rossing, 30 kilometers east of Swakopmund	4,000 uranium oxide.
Zinc	Imcor Zinc (Pty.) Ltd. (Iscor) Ltd., 51%; Moly Copper Mining and Exploration Co.)	Rosh Pinah Mine, 80 kilometers	40,000.

NIGERIA

AREA 923,770 km² **POPULATION 95.1 million**



THE MINERAL INDUSTRY OF

NIGERIA

By David Izon

Nigeria, Africa's largest oil producer, ranked 10th in world production of crude oil. Nigeria accounted for about 3% of world production and about 8% of the Organization for Petroleum Exporting Countries's (OPEC) total production. The hydrocarbon sector remained the mainstay of the economy, accounting for about 35% of a gross domestic product (GDP) of about $35 billion.[1] The oil sector accounted for 82% of total Government revenues in 1993 and about 96% of the country's total export earnings. The value of exports from the oil sector amounted to about $10 billion in 1993. The country has considerable mineral wealth and potential for diversified development of the mineral industry. Natural gas reserves in the range of 6,000 billion m^3 were barely exploited. However, efforts to increase crude oil reserves to about 25 billion bbl by 1995 was emphasized with the country giving concessions to several companies for prospecting. Though there was some diversification in the oil and gas industries, the nation's economy still reflected the dominance of a single product, crude petroleum.

The country's nonfuel mineral resources base of barite, gold, iron ore, lead, and zinc could help diversify the economy. To this end the Raw Materials Research and Development Council (RMRDC) started a rigorous campaign to attract investors to explore and develop the known resources. The ongoing revision of the mining laws and investment codes should provide adequate incentives for prospective investors. The country has an adequate work force and resources to build a stable minerals industry.

GOVERNMENT POLICIES AND PROGRAMS

In 1993, the Military Government abolished policies and programs instituted under the Structural Adjustment Program. Minerals policy is governed by the Mineral Act and Regulations of 1946 and the Quarries Act and Regulations of 1969. The country's ongoing revision of the mineral laws received assistance from the U.S. Government. The Government is determined to attract enough foreign investors and oil companies to develop new fields both onshore and offshore, start a liquefied natural gas (LNG) project, introduce sustainable domestic fuel prices, privatize the distribution of fuel and gas in Nigeria, and export natural gas via pipeline to neighboring west African countries. Hence, the Government negotiated the construction of the Nigeria-Ghana natural gas pipeline and reduced the amount of royalties payable on solid minerals. Government policy was directed at revitalization of existing companies that produce minerals such as barite, kaolin, gold, marble, and tin. The Federal Ministry of Petroleum and Natural Resources announced an intention to permit 100% private or foreign ownership of some downstream oil sector ventures such as refineries and petrochemical plants.

ENVIRONMENTAL ISSUES

The Federal Environmental Protection Agency (FEPA) Act was promulgated in 1988, following the Koko incident when toxic waste from Italy was dumped at the fishing port of Koko, near Warri. The FEPA Act gave FEPA overriding authority for the protection and development of the environment and environmental technology. FEPA's wide range of powers included giving grants, entering into agreements that would permit it to fulfill its duties, and providing technical assistance where necessary. FEPA also could search premises, seize items, and make arrests without warrant to enforce the provisions of the FEPA Act or any subsidiary regulations.

Several specific regulations or guidelines were issued since the 1988 FEPA Act. These guidelines or regulations provide specific standards for industrywide operations in the country. They include the Pollution Control Guidelines of 1991, the Pollution Abatement Regulations of 1991, the Solid and Hazardous Waste Regulations of 1991, the Effluent Limitation Regulations of 1991, and the Harmful Waste Act of 1992.

PRODUCTION

The oil and gas industry remained stable in spite of the apparent worsening political climate and continued to experience growth as more crude oil reserves were found. In other sectors, pilot projects to produce industrial minerals continued, and the Raw Materials Research Development Council advertised for investors to explore and develop several mineral deposits. *(See table 1.)*

TRADE

Nigeria's oil revenues for 1993 were about $10 billion, accounting for about 96% of foreign exchange and about 80% of total Government revenues. Major mineral exports included coal, crude oil, steel billets, tin, some industrial minerals,

and agricultural produce.

The United States continued to be the largest importer of Nigerian crudes, accounting for about 57% of the country's oil exports. In 1993, U.S. imports from Nigeria totaled about $5.3 billion. Other major consumers of Nigerian crude were the Netherlands, Spain, and west African Economic Community of West African States (ECOWAS) member countries. The United States was Nigeria's major export market, accounting for about 40% of total exports in 1993. Germany and Spain were the second and third most important export markets, respectively.

Nigerian imports consisted mainly of manufactured goods. Machinery and transport equipment accounted for the largest share of total imports, followed by chemicals and other manufactured products. Germany and the United Kingdom were the most important sources of imports, each accounting for about 14% of total imports, followed by the United States with about 12%. Other sources of imports include France, 9%; and Southeast Asian countries as a group, about 15%.

Major factors affecting the trade imbalance in Nigeria were inflation, shortage of raw materials for manufacture of goods, low credit markets due to large government fiscal deficits, and an external debt of about $29 billion.

STRUCTURE OF THE MINERAL INDUSTRY

The Government had a 51% to 60% controlling interest in all foreign mineral companies operating in the country. In an effort to privatize its parastatal companies, Nigeria restructured its largest corporation, Nigerian National Petroleum Corp. (NNPC), into 10 subsidiary companies. They were run on a profit-and-loss basis without Government intervention. Other principal mineral agencies of the country included the Nigerian Mining Corp., Nigerian Coal Corp., and the Nigerian Steel Development Authority. All important minerals such as coal, tin, and columbite were mined by State-owned companies or joint-venture and/or partnership companies. *(See table 2.)*

COMMODITY REVIEW

Metals

The 180,000-ton aluminum plant being built at Ikot Abasi in Cross Rivers State, southeastern Nigeria, was reported to be progressing slowly. The initial production capacity of 45,000 tons was planned to come on-stream in 1995. The Government intends to use locally produced bauxite and some imports from neighboring west African countries at the plant. New gold deposits in Niger, Oshun, and Sokoto States were reported in 1993. Other reported metallic minerals with reserves of commercial quantity were iron ore and lead and zinc. The RMRDC made efforts at attracting investors for the development of these deposits.

Gold.—The Nigerian Mining Corp. (NMC) announced the discovery of new gold deposits in Niger, Oshun, and Sokoto States. The extent of the discoveries surprised NMC so much that the Government set aside large tracks of the country for prospecting under special exclusive licenses. The recent find prompted the Government to reactivate an old State-owned mine at Iperindo near Ilesha. Production at the mine declined from 1,244 g/month to 124 g/month in 1992.

Iron and Steel.—The Ajaokuta complex was operational as of December 1993, but continued to have problems with workers rioting at the plant because of fiscal problems in payment of employee salaries. The Ajaokuta complex comprised 1.3 Mmt/a of light sections, bars, and rods, a central workshop, and a thermal powerplant. The complex's total combined capacity of billets and rolled products was 2 Mmt/a.

The National Iron Ore Mining Co. (NIOMC) continued to stockpile iron ore that is required to serve the Ajaokuta Steel Plant and the Delta Steel Co. The same reasons of inadequate maintenance of mining equipment, frequent theft, and inefficient management accounted for the continued poor performance. A progress report on work on the beneficiation plant was good as were the rail links from Itakpe to Ajaokuta and from Port Harcourt to Ajaokuta.

Tin.—Production of tin in 1993 remained low but much higher than in recent years at about 580 mt/a in 1993. The tin industry continued to experience a shortage of spare parts, mine flooding, and low prices. The Makeri tin smelter, which produced about 160 mt/a, exported about 75% of its production and retained the remaining for domestic consumption. However, because only refined tin could be exported from Nigeria and local miners prefer selling to smugglers for dollars, it was difficult for the smelter to produce at its installed capacity. Smuggling had flourished so much that the Government was considering the legal exportation of tin concentrates. Major reason for the weak domestic tin industry also could be attributed to the depletion of minable reserves and a world decrease in demand for tin. External factors contributed to the weak industry, including production and exports from China and the former U.S.S.R.

Industrial Minerals

The RMRDC has enumerated a number of mineral commodities that have proven reserves or adequate resources for industrial development. Among minerals identified in commercial quantities for investor consideration were asbestos, barite, bauxite, bentonite, clays, kaolin, fire clay, diatomite, dolomite, feldspar, fluorspar, graphite, gypsum, ilmenite, kyanite, limestone, phosphate, salt, soda ash, sulfur, and talc. Other industrial minerals that occur in commercial quantities were gemstones that included amethyst, aquamarine, sapphire, topaz, and tourmaline.

The RMRDC's pilot plants produced and processed 20,000 mt/a of kaolin at Katsina, 15,000 mt/a of phosphate rock at

Katsina, 3,000 mt/a of soda ash at Maiduguri, and 3,000 mt/a of talc at Maiduguri in 1993.

Fertilizers.—Nigeria has two fertilizer plants, the National Fertilizer Co. of Nigeria (NAFCON) in Onne, which was the sole producer of ammonia and urea, and the Federal Superphosphate Fertilizer Co. in Kaduna. The average capacity utilization at the plants in 1993 was 96%. The Ministry of Agriculture and Natural Resources buys fertilizer from NAFCON on commercial terms and distributes it to State government stations and other authorized customers. Fertilizer smuggling is widespread because the Government sells fertilizer at subsidized prices.

In June 1993, the foundation for the $450 million NAFCON II was laid next to the existing plant. At completion the plant would produce 1,000 mt/d of ammonia, 1,500 mt/d of urea, and 50 mt/d of methanol. The plant's equity sharing partners would be the Federal Government Nigeria, 62%; NNPC, 30%; and M. W. Kellogg, 8%. Financing for the project was not finalized in 1993.

Mineral Fuels

Coal.—Coal production at the Onyeama Mines in Enugu was minimal owing to flooding of the mine, which kept the mine closed for most of 1993. Export levels remained at 1992 levels because of stockpiles and continued mining in other areas.

Variable qualities of coal are found in the Enugu Coalfields, from the high sulfur/high ash coals of the Upper Cretaceous to the low sulfur/low ash, noncoking subbituminous coals of the Lower Cretaceous. Coal seams were not usually very thick, ranging from less than 1 m to 2.3 m.

The Government continued to pursue its efforts to divest by inviting private investors to participate in development of the coal industry. Terra Explorations Nigeria Ltd., a joint-venture partnership between the Government of Nigeria and South Africa's Terra Explorations Co., reopened some dormant mines in the Enugu Coalfields. Production in 1993 was estimated at about 30,000 Mmt and is expected to be increased to 50,000 mt/a, which is the maximum tonnage the Port Harcourt port could handle. Terra is expected to handle the operations of the mines via a South African company under contract to Terra and also construct rail links and improve other handling facilities at the port.

Production at the Onyeama Mines is expected to be increased to between 400,000 tons and 500,000 tons by 1995. Reserves at the Onyeama Mines were reported at 254 Mmt.

Natural Gas.—Nigeria ranks 5th in the world with natural gas reserves of more than 3 trillion m^3. Most of the natural gas produced was associated gas, of which about 79% was flared and 9% marketed, while another 9% is reinjected. The remainder is used in the field for energy generation. Nigeria also has probable reserves of about 2.8 trillion m^3.

The Government actively encouraged local consumption and the reinjection of gas into reservoirs for enhanced oil recovery. Only the Nigerian Gas Co. (NGC) bought gas from producing joint ventures and sold to local customers. NGC sold 69% of its gas to five powerplants, four of which were near the gas wells. The fifth powerplant, Egbin, served the Lagos area and is connected by a 357-km Egbin-Lagos pipeline that is to be extended to Kaduna via Ajaokuta and Abuja. The pipeline has a capacity to carry about 27 Mm^3/d of natural gas to Lagos for industrial use and to Kaduna through Ajaokuta, where the steel complex would be a major consumer, and to the Federal Capital Territory. The other main customer was NAFCON, which uses natural gas as a feedstock. Future customers include the LNG plant, the Eleme petrochemical plant, the aluminum smelter, and NAFCON phase 2. Other noteworthy projects involving natural gas were Mobil Oil Co.'s Oso condensate project, Chevron's proposed natural gas liquids extraction project, and the NNPC/NGC's compressed natural gas project, for use as automotive fuel.

The Nigerian Liquefied Natural Gas (NLNG) board agreed in 1993 to build a 5.3-Mmt/a LNG liquefaction plant using the U.S. "Air Process." The $4.5 billion, two-train LNG plant was a joint venture between Nigerian LNG Ltd., a subsidiary of NNPC (49%), Shell Oil Co. of the United States (24%), ELF Aquitaine Oil Co. of France (15%), AGIP Oil of Italy (10%), and International Finance Corp. (2%). The plant is to be built at Finima in Rivers State, a village near Bonny. The cost of the project included the cost of five LNG tankers and more than 200 km of pipelines. The NLNG is under agreement to transport and market the LNG through a subsidiary, Bonny Gas Transport Ltd. NLNG has already purchased four LNG tankers, which are currently for hire on the world market. The company is expected to buy the fifth tanker before the plant comes on-stream.

Petroleum.—Production of crude petroleum remained stable even though the country was suffering from strikes and unrest following the removal of petroleum subsidies in the last half of 1993. Production of crude oil was from small fields and many wells. Wells produced between 500 and 5,000 bbl/d. About 65% of all oil produced in Nigeria was light, sweet crude with an API gravity of 35^0 or higher. Also, about 65% of output was onshore in the Niger Delta areas, with nearly all the rest produced from offshore wells in the shallow continental shelf. The Government continued to pursue its agenda of increasing the country's oil reserves to 25 billion bbl by 1995. Hence, successful bidders on deepwater concessions, equity partners with NNPC, began exploration and development work in 1993. The result was an addition of about 1.5 Mbbl to the proven reserves. Production of crude petroleum in 1993 averaged 1.9 Mbbl/d, of which about 1.865 Mbbl/d was exported, meeting Nigeria's OPEC quota. The balance of production was used locally for manufacture of petroleum products.

Nigeria has four oil refineries, one in Kaduna, two in Port Harcourt, and one in Warri, with a combined capacity of

445,000 bbl/d. Most of the petroleum products refined in the country were intended for domestic consumption, but the heavier products were exported. Nigeria also exchanged about 50,000 bbl/d of light crude with Saudi Arabian heavy crude for production of base oil and lubricants at the Kaduna refinery. The Kaduna refinery was closed in July 1993 owing to a fire in the refinery's fluid catalytic cracking unit. The Warri refinery was also under repairs in 1993, leaving only one of the Port Harcourt refineries operational because the old Port Harcourt refinery also was undergoing repairs.

Reserves

Nigeria's proven oil reserves at yearend 1993 were about 20 billion bbls. Known natural gas reserves were about 3 trillion m^3 ranking Nigeria fifth in the world in natural gas reserves. Nearly 70% of the oil and gas reserves are onshore and in the Niger River Delta area.

The total in situ reserves of Nigerian coal were reported 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 250 Mmt.

Total iron ore resources were estimated at about 2.5 billion tons with an average iron content of 37%. About 2 billion tons of the total iron ore reserves is at Agbaja with an average iron content of 45% to 47%.

INFRASTRUCTURE

The Nigerian railway system, the fifth largest in Africa, consists of 3,510 km of 1.067-m-gauge track. The two main north-south lines, from Lagos to Kano at 1,126 km, and from Port Harcourt to Maiduguri at 1,443 km, are connected by a 179-km east-west line from Kaduna to Kafanchan about 100 km southeast of Jos. These lines are used to transport goods and mineral commodities to the ports such as the Ajaokuta-Port Harcourt line. Roads totaled about 120,000 km, of which 35,000 km was paved. Inland waterways of about 9,000 km consisted mainly of the Niger and Benue Rivers. These also serve as routes for commodity transport.

The Kainji dam and powerplant, with a capacity of about 11,500 MW, was the major source of hydroelectric power for the country. Major ports included Lagos, Port Harcourt, and Koko near Warri.

OUTLOOK

The Government's fiscal and financial incentive programs designed to attract local and foreign investors into new investments and developments in the mineral industry is expected to continue. Petroleum and natural gas are expected to continue dominating the economy for the foreseeable future. Major changes in policy and programs owing to the political situation in the country could affect industrial development, particularly the nonfuel minerals industry. Development of the steel industry could enhance the growth of heavy equipment and metalworking industries and could provide jobs for the available large labor force.

Revitalization of the coal industry could add to reserves and provide an additional source of foreign exchange when fully exploited. Joint-venture agreements signed with foreign investors should increase production of coal and reduce importation of coal.

The mineral industry as a whole should continue to enjoy considerable growth because of increasing activity in the mineral fuels sector. The planned output of 2.5 Mbbl/d of crude oil by 1995 is achievable if the political situation does not deteriorate beyond its present state. The abundance of natural gas should provide a new energy source and feedstock for the chemical and petrochemical industries. Completion of the Nigeria-Ghana pipeline would provide additional revenue.

Development of other nonfuel minerals would broaden the country's industrial base, particularly with favorable mining and investment codes, which are under review.

[1]Where necessary, values have been converted from Nigerian naira (N) to U.S. dollars at N22.00=US$1.00 in 1993, the official rate. Parallel markets' conversion was at N48.00=US$1.00 in 1993.

OTHER SOURCES OF INFORMATION

Federal Ministry of Mines and Power
Six Storey Building
Lagos, Nigeria
Nigerian National Petroleum Corporation
NNPC Building Falomo
Lagos, Nigeria
Federal Ministry of Petroleum and Natural Resources
Federal Secretariat Building
Ikoyi, Lagos
Nigeria

TABLE 1

NIGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Columbium and tantalum concentrates:							
Gross weight		46	44	36	40	40	40
Columbium content e		20	19	15	17	17	17
Iron and steel:							
Iron ore, gross weight	thousand tons	e300	374	398	e400	400	400
Steel, crude	do.	r213	220	250	e200	150	200
Lead:							
Mine output, Pb content e		2—	2106	100	100	100	100
Tin:							
Mine output, cassiterite concentrate:							
Gross weight		350	200	350	568	600	700
Sn content		255	145	255	415	400	500
Metal, smelter		229	130	230	370	350	400
INDUSTRIAL MINERALS							
Cement, hydraulic e	thousand tons	3,500	3,500	3,500	3,500	3,500	3,500
Clays:							
Kaolin e		500	21,356	1,300	1,300	1,300	1,300
Unspecifed e		213,341	260,113	60,100	60,100	60,100	60,100
Feldspar e		2945	2714	700	700	700	700
Nitrogen:							
N content of ammonia	thousand tons	364	405	367	337	350	365
N content of urea	do.	522	573	373	486	400	400
Stone:							
Limestone	do.	1,315	1,136	1,436	1,400	1,400	1,400
Marble		1,377	1,605	e1,600	e1600	1,600	1,600
Shale e	thousand tons	238	267	70	70	70	70
MINERAL FUELS AND RELATED MATERIALS							
Coal, bituminous	thousand tons	28	78	138	140	140	140
Gas, natural:							
Gross	million cubic meters	24,831	r27,593	31,286	31,973	31,300	31,300
Dry	do.	3,833	r3,233	2,568	2,897	2,600	2,600
Petroleum:							
Crude	thousand 42-gallon barrels	626,489	r660,462	688,500	714,900	714,900	730,000
Refinery products:							
Gasoline	do.	23,337	30,706	30,818	33,235	30,800	31,000
Jet fuel e	do.	500	700	900	900	500	900
Kerosene	do.	11,873	14,521	14,760	14,552	14,500	15,000
Distillate fuel oil	do.	17,591	17,366	26,464	15,983	15,500	16,000
Residual fuel oil	do.	19,254	23,935	13,468	877	800	1,000
Unspecified	do.	2,274	3,806	1,615	1,600	1,000	1,100
Total	do.	74,829	91,034	88,025	67,147	63,100	65,000

eEstimated. rRevised.

[1]Includes data available through Sept. 9, 1994.

[2]Reported figure.

TABLE 2

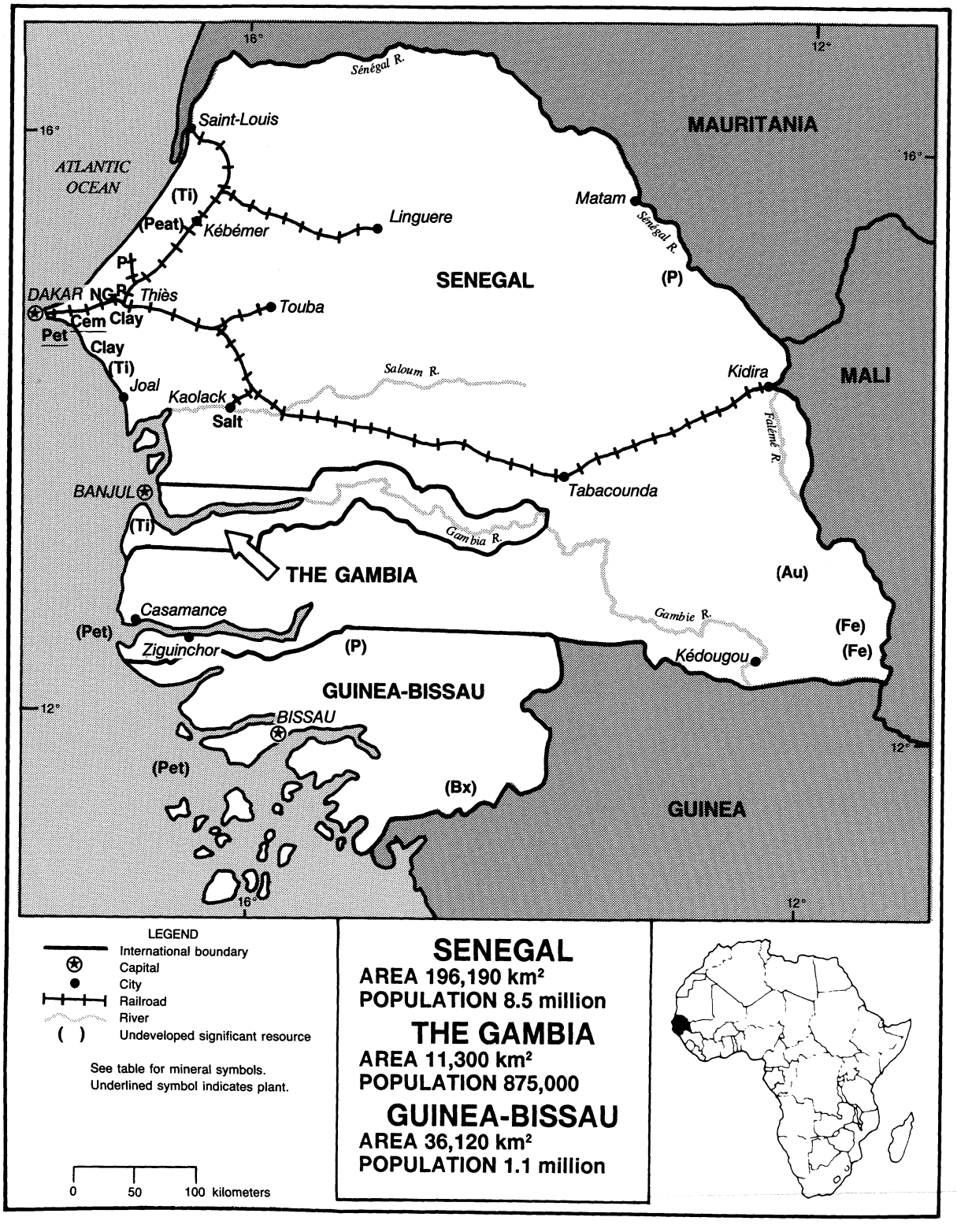
NIGERIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Million metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Coal	thousand metric tons	Nigerian Coal Corp. (Government, 100%)	Enugu	150.
Iron ore		National Iron Ore Mining Co. (Government, 100%)	Itakpe, near Okene	325.e
Iron and steel		Ajaokuta Steel Co. Ltd. (Government, 100%)	Ajaokuta City	1.3, .7 (rolled steel).
Do.		Delta Steel Co. Ltd. (Government, 100%)	Aladja	1.00 (liquid steel), .32 (rolled steel).
Do.		Jos Steel Rolling Co. Ltd. (Government, 100%)	Jos	.21.
Do.		Katsina Steel Rolling Co. Ltd. (Government, 100%)	Katsina	.21.
Do.		Oshogbo Steel Rolling Co. Ltd. (Government, 100%)	Oshogbo	.21.
Nitrogen	thousand metric tons	National Fertilizer Co. of Nigeria (Government, 63%; M.W. Kellog, 37%)	Onne	548 N content of ammonia, 360 N content of urea.
Petroleum, crude	million barrels	Nigerian National Petroleum Corp. (Government, 60%; private, 40%)	Lagos	695.
Petroleum refinery products	thousand barrels	Kaduna refinery (Government, 100%)	Kaduna	40.
Do.	do.	Warri refinery (Government, 100%)	Warri	46.
Do.	do.	New Port Harcourt refinery (Government, 100%)	Port Harcourt	55.
Do.	do.	Old Port Harcourt refinery (Goverment, 100%)	do.	22.
Tin	thousand metric tons	Makeri Smelting Co. Ltd. (Government, 100%)	Jos	1.

eEstimated.

SENEGAL, THE GAMBIA, GUINEA-BISSAU



THE MINERAL INDUSTRIES OF

SENEGAL, THE GAMBIA, AND GUINEA-BISSAU[1]

By Thomas P. Dolley

SENEGAL

Though accounting for less than 2% of the gross domestic product (GDP), Senegal's mining industry greatly contributes to the country's export earnings. Senegal's estimated GDP for 1993 was about $5 billion.[2] Phosphate rock, fertilizers, and phosphoric acid, together the country's fourth largest foreign exchange earner, continued to dominate mineral industry production in Senegal in 1993. Disturbing trends in the phosphate production and export sector highlighted mineral industry developments during the year. Additionally, Senegal's percentage of mineral industry investment expenditures as compared with total investment expenditures had declined from about 38.8% in the early 1980's to only 1.1% in the early 1990's.

Mining legislation in Senegal is exemplified by the Mining Code, law No. 88-06, adopted on August 26, 1988. Petroleum legislation was adopted as the Petroleum Code of 1986. The investment code, law No. 87-25 of July 30, 1987, augments the existing mining legislation.

With the exception of attapulgite, Senegal's primary mineral commodities suffered an across-the-board decline in 1993. The primary reason for a decline in phosphate production has been a global recession in phosphate demand, which has been particularly acute for Senegal. European customers have ceased purchases of Senegalese phosphate, known to contain cadmium. Additionally, mine closures in Senegal, managerial and financial problems with the Senegalese producers, and phosphate oversupply by other producing countries such as Morocco, Togo, and Jordan have exacerbated the production and sales decline.

Under a contract financed by Sysmin, BIA S.A. of Belgium initiated research on a process to remove cadmium from Senegalese phosphate. Followup research also will be conducted on increasing mining productivity to cover the cost of cadmium removal. Additionally, construction of a pilot plant for cadmium removal is being considered.

An unreported but modest amount of gold is produced in Senegal by artisanal miners. Australia's Paget Mining Ltd. paid $250,000 in late 1993 to take a major option in the Sabodala gold prospect in Senegal. Under an agreement with France's Bureau de Recherches Géologiques et Minières (BRGM), Paget Mining Ltd. may acquire a 50.7% equity in Société Minérale Sabodala, the company that operates the gold concession. Paget Mining Ltd. also may acquire further options on the prospect from the Government. BRGM's prior research at Sabodala indicated a resource of more than 2.9 Mmt grading 4.36 g/mt gold. Additionally, the greenstone belt where the deposit is located, contiguous into Mali, has been a prolific gold producer over the centuries. Paget Mining Ltd. estimated the project development costs to be $18 million to sustain a 500-kmt/a mine producing 1,866 kg/a of gold.

The Government is an equity partner in virtually all mining activities. The structure of Senegal's mineral industry is dominated by four principal companies. Compagnie Sénégalaise des Phosphates de Taïba (CSPT) mines phosphate. Société Sénégalaise des Phosphates des Thiès (SSPT) produces phosphate, attapulgite, and aluminum phosphate, which is reported as clinker. Industries Chimiques du Sénégal (ICS) operates a fertilizer complex with annual production capacities of 560 kmt of sulfuric acid and 400 kmt of phosphoric acid. Société Africaine de Raffinerie is equity owned by various foreign petroleum products distributors and the Government. The sole refinery near Dakar has the monopoly on all crude oil imports and refining. Petrosen is a parastatal delegated with mineral fuel development and regulation in addition to selling a small amount of natural gas. The mining industry of Senegal employs more than 2,500 persons.

Senegal's total exports for 1993 had an estimated value of $765 million. Phosphate rock and derivative products accounted for 19% of total merchandise export earnings or $153 million in 1993. The loss of phosphate sales to European markets has not been compensated for by sales to other markets. Major customers for Senegalese phosphate are currently Canada, India, and Iran. The largest phosphate mining company in Senegal is CSPT, whose volume of exports fell from about 1 Mmt in 1992 to 864 kmt in 1993. A concomitant loss in sales also was recorded from $74 million in 1992 to $33.5 million in 1993. The total value of SSPT's exported calcium phosphate, attapulgite, and clinker in 1993 was about $8.65 million, down from $9.8 million in 1992. Senegal's imports of ammonia were about 12,300 tons in 1993.

Additional deposits of phosphate rock have been identified in northeastern Senegal with estimated reserves of 40

Mmt. These deposits will remain unexploited under current phosphate market conditions. Hydrocarbon production in Senegal is negligible; however, the petroleum geology of the country is not fully understood.

The nation's railroad infrastructure consisted of 1,034 km of 1-m-gauge track, all single line except for 70 km of double-track line from Dakar to Thiès. The major seaport is at Dakar.

THE GAMBIA

The Gambia had no significant mineral industry in 1993. The Gambian economy was dominated by agriculture and tourism. Clays for bricks, laterite, sand and gravel, and cockle shells were exploited for domestic construction needs. Other identified mineral resources in the Gambia included glass sand deposits and titaniferous sands.

GUINEA-BISSAU

Guinea-Bissau had no significant mineral industry in 1993. The country's economy was dominated by agriculture with some small-scale mining to meet domestic construction needs. Reserves of bauxite and phosphate exist in the country, but are of low grade.

[1]Text prepared June 1994.

[2]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF286.50=US$1.00.

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

TABLE 1
SENEGAL: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic	metric tons	379,793	469,537	503,317	601,071	589,820	600,000
Clays: Fuller's earth (attapulgite)	do.	98,882	114,610	129,403	112,336	119,409	119,000
Petroleum:							
Crude	thousand 42-gallon barrels	13	8	4	4	4	8
Refinery products:							
Gasoline	do.	[3]2,261	[3]2,520	[3]2,124	787	[e]780	2,500
Kerosene and jet fuel	do.	652	682	644	710	[e]710	700
Distillate fuel oil	do.	[e]2,000	2,057	1,374	3,002	[e]3,000	3,000
Residual fuel oil[e]	do.	[4]1,493	1,500	1,300	1,000	1,000	1,000
Other	do.	[e]57	[e]32	55	52	[e]50	50
Refinery fuel and losses	do.	[e]185	209	193	217	[e]210	210
Total[e]	do.	6,648	7,000	5,690	5,768	5,750	7,460
Phosphate rock and related products:							
Crude:							
Aluminum phosphate[e 5]	thousand metric tons	140	127	92	75	29	300
Calcium phosphate	do.	2,273	2,147	1,741	2,284	1,667	2,300
Manufactured:							
Aluminum phosphate, dehydrated[6]	do.	100	91	66	54	21	200
Phosphoric acid	do.	189	228	302	288	274	400
Calcium phosphate-based fertilizers	do.	117	173	171	169	160	170
Other[7]	do.	2	1	1	1	1	4
Salt	metric tons	[e]97,000	[e]92,000	102,000	110,000	117,400	160,000

[e]Estimated.

[1]Includes data available through June 1994.

[2]In addition to the commodities listed, Senegal produced clays, sand and gravel, and stone for local construction purposes, limestone for cement, minor artisanal gold, and natural gas for electricity generation. Information is inadequate to make reliable estimates of output levels, although, in 1992, gas production was reportedly in the range of 2,800 to 4,000 cubic meters per day.

[3]Includes gasohol, reported as 66% of total production in 1989, 68% in 1990, and 61% in 1991.

[4]Reported figure.

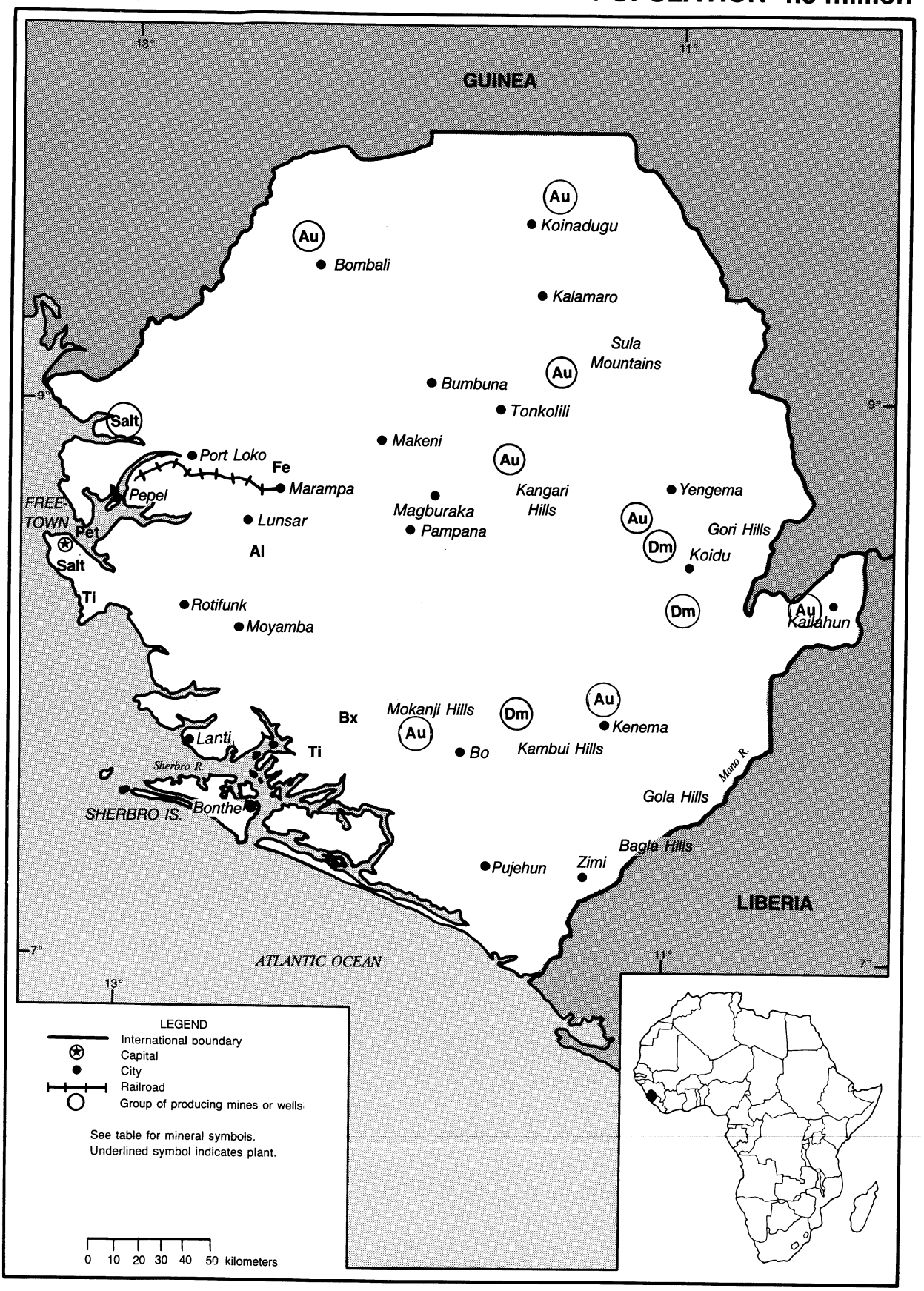
[5]Output was reported as nil. Estimate based on required usable crude output for reported clinker (dehydrated aluminum phosphate) production.

[6]Reported as "clinker"; material is derived from crude product output.

[7]Products marketed under the trade names "Balifos" and "Phospal."

SIERRA LEONE

AREA 71,740 km² **POPULATION 4.5 million**



THE MINERAL INDUSTRY OF

SIERRA LEONE[1]

By Bernadette Michalski

Sierra Leone's mineral industry was centered on the production and export of rutile and its coproducts, bauxite, diamonds, and gold, listed by order of value. A petroleum refinery, entirely dependent upon imported crude oil, was in operation. However, this facility, owned by the Sierra Leone Petroleum Refining Co. Ltd., was placed in liquidation in early 1994.

GOVERNMENT POLICIES AND PROGRAMS

The Government honored its commitment to the economic recovery program suggested by the International Monetary Fund (IMF). The overall budget deficit was reduced from 10% to 7% of the gross domestic product (GDP) between 1991 and 1993. The GDP for 1991 was estimated at $1.4 billion, $1 billion for 1992, and $0.7 billion for 1993. The rate of inflation decelerated from 115% in 1991 to 20% in 1993. Of particular concern, has been the adoption of more stringent laws relating to the mining and marketing of precious minerals. In recent years, heavy revenue losses attributed to illegal trading in diamonds and gold contributed to the country's significant trade deficits (-$37.5 million in 1993) and faltering economy. A new mining policy, in effect as of January 1994, offers more rigid requirements for licensing miners and exporters. Under the new law, higher minimum performance standards have been set and failure to achieve these targets for 3 consecutive months could result in license revocation and loss of fees. Incentives are to be provided to dealers whose performance exceeds the minimum target. The new law includes a provision for non citizens to form companies to mine precious metals by artisanal mining.

ENVIRONMENTAL ISSUES

Environment and resource management are seriously hampered by weak regulatory and enforcement capacity. Significant environmental problems are evident throughout the various sectors of the economy. Land degradation from large-scale and artisanal mining is pronounced throughout the interior of the country. Coastal mining sites have fared more favorably where Sierra Rutile, Ltd. has historically practiced land rehabilitation programs, including infrastructure development and village relocation activities. The village relocation programs have resulted in the development of planned villages containing improved housing, sanitation, water supply, and communal facilities.

PRODUCTION

Mineral output was relatively stable in 1993 with the exception of diamonds. *(See table 1.)* Official production was reduced to about one-half of the previous year's output partly because of rebel activities in the Yengema diamond mining district. Over the years, the state-controlled National Diamond Mining Co. had experienced falling grades, technical and management problems, and illicit mining. The company went into liquidation in October.

The production of iron ore remained suspended since 1985, but the reactivation of the Marampa iron ore mine was under consideration. Ore production from the mine averaged 2 Mmt/a in the 1970's. Output was reduced to 355,000 tons in 1984 and only 70,000 tons was produced in 1985 before its closure.

TRADE

The value of Sierra Leone's mineral exports was reported at $108 million in 1993, equal to approximately 90% of total exports for the year. Titanium minerals (rutile, ilmenite, and possibly zircon) continued to be the nation's principal export, valued at $62 million, with shipments destined for Western Europe and the United States. Bauxite exports earned approximately $28 million. While illicit trading of diamonds and gold continued, official diamond exports were valued at approximately $18 million.

Petroleum imports were valued at $26.6 million. Nonfuel imports were reported at $151 million.

STRUCTURE OF THE MINERAL INDUSTRY

The privatization of the Sierra Leone Petroleum Refining Co. was proposed. The mining of bauxite, rutile, and ilmenite remained open to foreign investment. In mid-1993, a 50% interest in Sierra Rutile Ltd., a subsidiary of Nord Resources Corp. of the United States, was purchased by Consolidated Rutile Ltd. of Australia. The new company is known as Sierra Rutile Holdings Ltd.

COMMODITY REVIEW

The Sierra Leone Ore and Metal Co., the nation's sole bauxite producer, operated the Mokanji Mine; ore reserves, however, were nearing depletion. A second bauxite operation and an alumina plant were under development near Port Loko, where reserves total 30 Mmt averaging 49% Al_2O_3.

Sierra Rutile Holdings Ltd., the former Sierra Rutile, Ltd., has launched an expansion and land rehabilitation program at an estimated cost of $48 million. The program includes a new

powerhouse, updated mining equipment, improvement in recovery plant operations, infrastructure development, rehabilitation of mined areas, and village relocation activities. A portion of the financing was made available through a $13 million loan from the Commonwealth Development Corp. of the United Kingdom. The International Finance Corp. has signed an agreement to provide a $15 million loan. Other financing is to be provided by the Overseas Private Investment Corp. of the United States and the German Finance Co. for Investments in Developing Countries.

The source of diamond production in 1993 was mainly from artisanal and small-scale mining. The National Diamond Mining Co. ceased mining operations in March. The company officially went into liquidation in October.

The Sunshine Mining Co. of the United States has not, as yet, been notified as to the ratification of its 1991 agreement to commence diamond mining in Sierra Leone. According to the Sunshine Mining Co., a total of 2.4 M carats of mostly gem-quality diamonds could be recovered over a 15-year period.

The parastatal Sierra Leone Petroleum Refining Co. operated a 10,000-bbl/d-capacity refinery in Freetown based on imported crude, most recently from Nigeria. The refinery operated at one-third capacity and was offered for sale to private investors in early 1994. An adequate and reliable supply of petroleum products is critical for economic stabilization.

Reserves

Proven reserves totaled 370 Mmt of ore containing 5.7 Mmt of recoverable rutile in 1993. Nearly 1 Mmt of recoverable rutile was added to proven reserves during the year as a result of exploration and ore definition work in the southern Gbangbama area and in the northern area near Sembehun.

INFRASTRUCTURE

A $48 million loan was secured from the African Development Bank to construct the Bumbuna Hydroelectric Dam on the Rokel River, which empties into the Atlantic Ocean near Pepel. The dam and powerplant will provide 50 MW of electricity in its first phase to Freetown, Makeni, Magburaka, Port Loko, and Lunsar. The second construction phase will extend capacity to more than 100 MW, and the third phase will incorporate an upriver dam to produce an additional 210 MW.

Before the closure of the Marampa Mine, the 1.067-m narrow-gauge railroad delivered iron ore to the port at Pepel, 84 km away. The line remained operable but in limited use.

The port at Freetown permits a draft of almost 10 m and services most of the country's general cargo and all of its petroleum import traffic. The Ports of Niti and Pepel are operated by private mining firms and handle bulk exports of bauxite, rutile, and, when in production, iron ore.

OUTLOOK

Sierra Leone is endowed with significant mineral potential, ample cultivable land, and exploitable fisheries. However, inadequate development and poor resource management has earned the country the world's least developed status according to the United Nations. The IMF structural adjustment program has led to exchange and trade systems being liberalized, price controls being lifted, and revenue collection and expenditure control systems being strengthened. Border security problems continue to drain resources from the economy. A significant proportion of diamond and gold mining and trading activity continues to bypass Government revenue collection channels. The resumption of international lending for mining projects in Sierra Leone offers some encouragement.

The mining of titanium-bearing sands has been the most successful mineral project in the country. Sierra Leone's rutile is of high grade with notably low radioactivity. Sierra Rutile Ltd. has been protected to some extent by its long-term sales contracts and high-quality ore during recent low world market prices but revenue per ton declined in 1993 as global economic conditions exerted downward pressure on prices. According to Nord Resources, world demand for TiO_2 pigment is expected to increase an average of 3.5% to 4% annually between 1993 and 1996. Recovering economies should be favorable to industries requiring large quantities of paint, paper, and plastic. This in turn should stimulate the demand for rutile.

[1]Text prepared May 1994.

OTHER SOURCES OF INFORMATION

Ministry of Mines
Freetown, Sierra Leone
Bank of Sierra Leone
Freetown, Sierra Leone

TABLE 1

SIERRA LEONE: PRODUCTION OF MINERAL COMMODITIES[1]

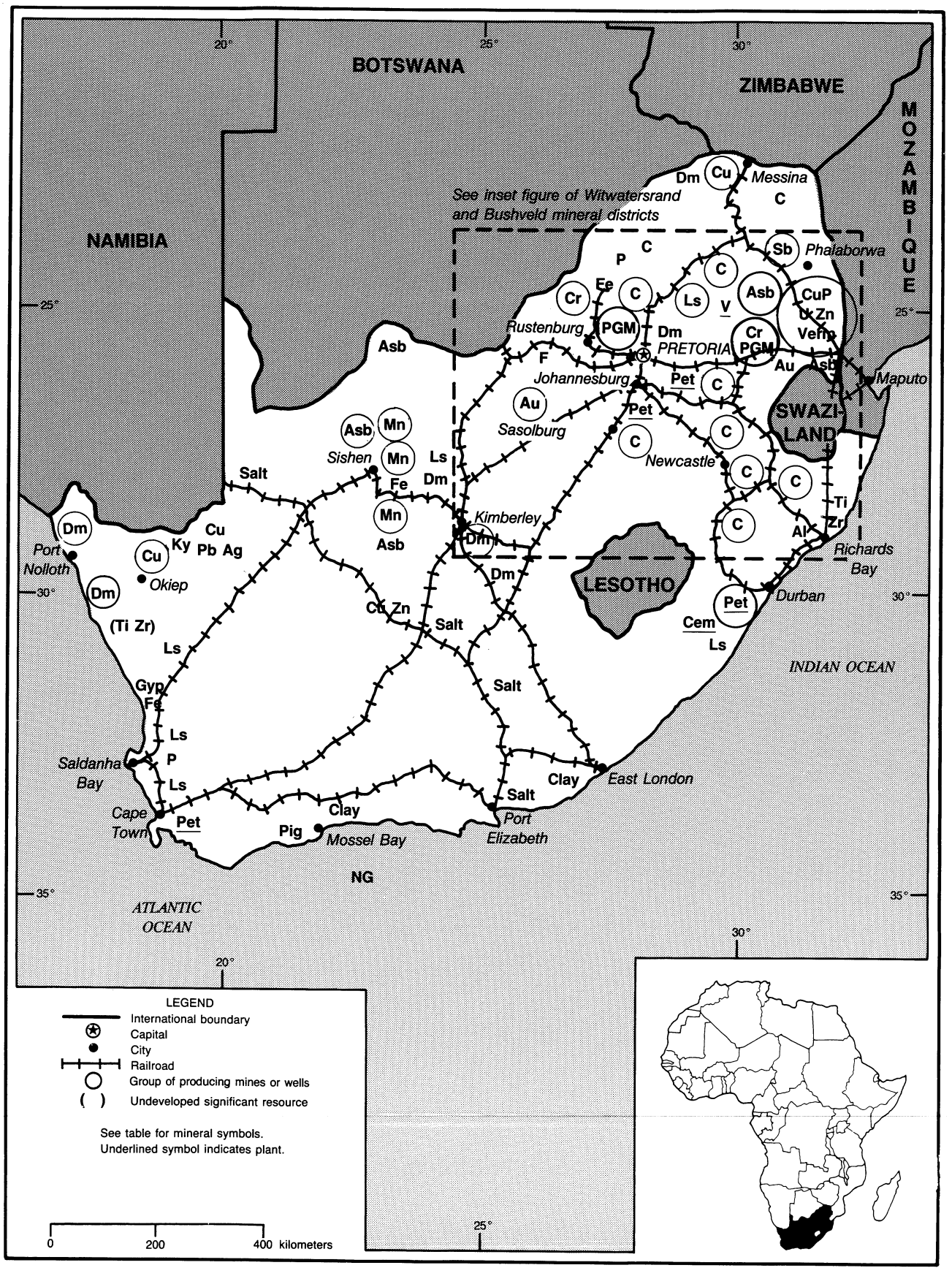
(Metric tons unless otherwise specified

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Aluminum: Bauxite, gross weight	thousand tons	1,562	1,430	1,288	1,246	[2]1,165	1,500
Diamond:							
Gem e	thousand carats	90	66	160	180	90	300
Industrial e	do.	39	12	83	116	68	200
Total[3]	do.	129	78	243	296	[2]158	500
Gold[3]	kilograms	226	32	26	92	[2]157	300
Gypsum e		4,000	4,000	4,000	4,000	4,000	4,000
Petroleum refinery products:							
Liquefied petroleum gas	thousand 42-gallon barrels	7	6	4	6	5	9
Gasoline	do.	190	180	125	200	180	250
Jet fuel	do.	100	100	100	125	100	150
Kerosene	do.	35	30	25	30	25	50
Distillate fuel oil	do.	375	375	300	350	350	500
Residual fuel oil	do.	300	300	250	300	300	500
Other	do.	1	1	1	1	1	1
Total	do.	1,008	992	805	812	961	1,460
Salt e	thousand tons	200	200	200	200	200	200
Titanium:							
Rutile ore and concentrate 96% TiO_2, gross weight		128,198	144,284	154,800	148,990	152,000	200,000
Ilmenite ore and concentrate 60% TiO_2, gross weight		62,310	54,639	60,371	60,331	[2]62,900	65,000
Zircon		—	—	1,119	1,329	—	2,000

eEstimated.
[1]Table includes data available through Mar. 15, 1994.
[2]Reported figure.
[3]Data includes only officially reported production.

REPUBLIC OF SOUTH AFRICA

AREA 1,221,040 km² **POPULATION 43 million**



THE MINERAL INDUSTRY OF

SOUTH AFRICA[1]

By Hendrik G. van Oss and Philip M. Mobbs

South Africa in 1993 was one of the world's foremost mineral producing and exporting nations. It remained by far the largest producer of gold and was among the largest producers of a number of other mineral commodities. Notable metallic mineral production included that of antimony, chromite and ferrochromium, iron ore, manganese and ferromanganese, platinum-group metals (PGM), titanium, uranium, vanadium, and zirconium. Industrial mineral output of note included andalusite, asbestos, diamonds, dimension stone, fluorspar, phosphate rock, and vermiculite. South Africa had major output and exports of bituminous coal and was the world's largest user of coal for conversion to liquid fuels and other organic chemicals.

The total sales value of crude or primary minerals in 1993, as reported by the South African Minerals Bureau, was about $14.4 billion.[2] Of this, exports accounted for almost $11.7 billion, of which $7.1 billion was from gold. South Africa also had significant production of a number of secondary or processed mineral commodities, such as ferroalloys and steel, cement, manufactured fertilizers, and refined petroleum products (from coal). Data were incomplete on the total value of secondary mineral output, but it is estimated that these totaled about $7.5 billion, including exports of about $2.5 billion. About 90% of South Africa's electricity was generated from coal and about 4% from uranium; electricity sales in 1993 amounted to $4.2 billion. By comparison, South Africa's gross domestic product in 1993 was $111.7 billion, and total exports were $24.2 billion.

The South African minerals industry is unusual in that the bulk of production is controlled by six mining houses. These houses also have major holdings in most other sectors of the South African economy. The legal and regulatory framework that favored this arrangement was expected to be reevaluated by the new Government formed in early 1994. In late 1993, proposals for a Reconstruction and Development Program were being drafted by the main opposition political party and by yearend were sent to the major mining companies and other industrial concerns for their comments. Perhaps in anticipation of political and economic changes to come, some of the major mining houses were divesting themselves of their nonmining subsidiaries—a process referred to as "unbundling" by the local press. They also were expanding their activities overseas—a process greatly aided by the rapid removal of economic sanctions against South Africa. An example of this was Gencor Ltd., which was negotiating to buy the mining assets of Billiton Ltd., a subsidiary of Royal Dutch/Shell. Anglo American Corp. of South Africa (AAC), however, resisted pressure to unbundle, stating that it would comprimise its operations' efficiency.

GOVERNMENT POLICIES AND PROGRAMS

The Ministry of Mineral and Energy Affairs' Department of Mineral and Energy Affairs (DMEA), the primary Government entity responsible for oversight of the country's mineral industry, was reorganized during 1993. Within DMEA's Mineral and Energy Management Branch were the Mineral Rights and Management Services Chief Directorate, which was responsible for liaison and information and the registration of mining titles; the Minerals Bureau Directorate, which was responsible for collecting, classifying, and analyzing mineral data; and the Energy Chief Directorate, which promoted the optimum utilization of energy resources. The Government Mining Engineer and the Mining Branch were responsible for mine health and safety issues. Nine newly created Regional Directorates issued prospecting permits, inspected mineral operations and mine rehabilitation sites, and ensured compliance with environmental regulations. A Mine Environment Control and Rehabilitation Chief Directorate was to be established in 1994.

On April 1, 1993, DMEA's liaison offices in London, Paris, Tokyo, and Washington D.C. were closed. On November 1, 1993, in accordance with the Geoscience Act, 1993, DMEA's Geological Survey Chief Directorate became the Council for Geosciences under the Ministry of Mineral and Energy Affairs.

The Council for Mineral Technology (Mintek) and the Council for Scientific and Industrial Research (CSIR) conducted minerals, mineral processing, and environmental research. The Chamber of Mines Research Organization (COMRO) was merged into CSIR in March 1993 as CSIR's mining technology division. The African National Congress (ANC)-associated Minerals and Energy Policy Centre (MEPC) was established in January to conduct research into South Africa's mineral and energy policies. However, by yearend, MEPC's long-term role was unclear as it competed with DMEA for recognition as the country's primary mineral policy establishment.

The South African mineral industry operated under a number of laws in 1993. These include the Mining Titles

Registration Act, 1967; Mining Rights Act, 1967; Central Energy Fund Act, 1977; Petroleum Products Act, 1977; Nuclear Energy Act, 1982; Diamonds Act, 1986; Electricity Act, 1987; Mineral Technology Act, 1989; Minerals Act, 1991; and Minerals Amendment Act, 1993. The Liquid Fuels and Oil Act, 1947, was repealed in February by the Liquid Fuels and Oil Repeal Act, 1993. Revisions to the Nuclear Energy Act, 1982, as amended in the Nuclear Energy Act, 1993, were to come into effect during 1994.

Under the new Minerals Act, all mines had to reapply for mining permits by January 1994. In early 1993, the Government appointed an independent commission of inquiry into mine safety, health, and compensation to study existing regulations following a number of fatalities in accidents at a number of coal and gold mines.

Historically, the energy crises of the 1970's and the effect of international sanctions on South Africa's supply of imported crude oil had resulted in Government involvement in most aspects of the oil and gas industry, particularly in efforts to achieve energy self-sufficiency. Oil companies were obliged to buy all of Sasol Mining (Pty.) Ltd.'s synthetic fuel (synfuels) production, and prices of fuels and some petroleum products were controlled. Deregulation of the industry was being considered by the Government in 1993. Of particular concern was the disposition of the synfuels production of Sasol and the Mossel Bay Gas Project (Mossgas), and the Atomic Energy Corp.'s (AEC) Z-plant at Pelindaba. The Z-plant produced enriched uranium at nearly twice the world market price.

ENVIRONMENTAL ISSUES

The new Minerals Act introduced strict environmental laws requiring the preparation of reclamation plans and environmental impact statements for mineral operations. The Minerals Amendment Act increased environmental planning requirements for new mines and increased the responsibility of mine owners to rehabilitate environmental damage. Emissions were being reduced at the country's smelters. A number of gold mines' tailings piles were being reprocessed and/or rehabilitated. Feasibility studies were underway to install scrubbers at the country's many large coal-fired powerplants, although the cost of such retrofits was expected to be prohibitive. New mining projects were under increased environmental scrutiny. Underground development was being considered for the Gamsburg zinc deposit that could more economically be mined as an open pit. An independent committee recommended against the issuance of a mining permit for the St. Lucia titaniferous sands project in an environmentally sensitive part of the northern Natal coastline.

PRODUCTION

South Africa continued to be one of the world's major and most diverse producers of mineral commodities. As shown in table 1, production of mineral commodities in 1993 was mixed. Most increases were in response to, and constrained by, export market conditions; domestic sales in general declined except where sales were directed toward downstream processing for export. Overall, the metallics sector fared better than did that of industrial minerals. Important increases were seen in the output of precious metals, particularly gold and PGM's. This was a result of mining higher grade gold ores and opening of a new PGM mine. Among ferrous metal commodities, chromite ore output continued to decline owing to lackluster world demand, but ferrochromium production increased significantly. Notwithstanding the increase in PGM production, cobalt output—a byproduct of PGM mining—fell. However, nickel—another byproduct—increased. Driven by strong export demand, a modest increase was seen in the output of iron ore; however, weak domestic demand constrained the production of both crude iron and steel. Conversion of some ferrochromium capacity to ferromanaganese led to an increase in domestic demand and overall output of both manganese commodities. Owing to reduced availability of Chinese material on the world market and hence higher antimony prices, South Africa's antimony output rose—the first increase in several years. Mine closures, technical problems, and increased stripping ratios led to an overall decrease in the output of copper ore; the lack of toll concentrates at one smelter resulted in a reduced output of blister copper. However, production efficiencies resulted in an increased output of refined copper.

With a few exceptions, such as diamonds and vermiculite, the output of industrial minerals declined in 1993. Coal output increased modestly, driven by improved export demand.

TRADE

The bulk of South Africa's crude mineral production was exported. To an increasing degree, a number of commodities, notably chromite, iron and crude steel, diamond, dimension stone, gold, and manganese, were being processed into higher value-added products prior to export.

Export revenues in 1993 were affected adversely by poor world market conditions for many of the primary mineral commodities produced in South Africa. This largely offset the gains seen in export volumes and prices of certain high-unit-value minerals, notably diamonds, gold, and PGM. Overall, the value of crude mineral exports increased only 0.8% to $11.7 billion.

Gold was once again the mineral industry's leading export revenue earner with total sales of $7.1 billion, followed by PGM at $1.6 billion, and coal at $1.4 billion. South Africa was the world's leading exporter of gold and PGM and the third largest coal exporter. Export revenues also increased for dimension stone, iron ore, pyrophyllite, titanium, uranium, vermiculite, and zirconium. However, exports of other ferrous and industrial minerals fell. Overall, primary mineral exports accounted for about 48% of the country's total export earnings. However, if the value of processed mineral products, such as refined base

metals, ferroalloys, iron and steel, and refinery products produced from coal, is included, about 58% of South Africa's total 1993 export revenues would come from mineral-based products.

Data for 1993 were not available, but in 1992, the United States had direct imports of about $400 million worth of mineral commodities from South Africa. The bulk of the value was in various ferrous metals and ferroalloys, diamonds, and uranium. These data, however, exclude imports of South African mineral commodities shipped via third countries, and thus significantly understate the U.S. imports of some South African commodities, such as diamonds, gold, and some ferroalloys. With the removal of trade sanctions, trade likely increased significantly in 1993.

South Africa was the largest export market for U.S. products and services in sub-Saharan Africa. In 1992, U.S. mineral exports to South Africa were about $150 million, primarily steel and steel scrap, refined petroleum products, and coking coal. The United States also had significant sales to South Africa of mining and milling machinery.

STRUCTURE OF THE MINERAL INDUSTRY

The South African mining industry continued to be dominated by six major mining investment groups: Anglo American Corp. (AAC), Anglovaal Ltd.; Gencor; Gold Fields of South Africa Ltd. (GFSA); Johannesburg Consolidated Investment Co. Ltd. (JCI); and Rand Mines Ltd., a subsidiary of Barlow Ltd. *(See table 2.)* The groups, often referred to as mining houses, are members of the Chamber of Mines of South Africa.

Other Chamber of Mines members include the majority of gold and coal mines and a number of producers of other mineral commodities. The Chamber of Mines is responsible for a variety of advisory and service functions. One of the main activities of the Chamber is the annual wage negotiations between member mines and the National Union of Mineworkers (NUM). The Rand Refinery, the largest gold refinery in the world, is a subsidiary company of the Chamber.

According to an analysis released in 1993,[3] AAC (including De Beers) was the Western World's largest mining company in 1991, the period of the study, and likely remained so in 1993. In 1991, AAC controlled 8.3% of the total value of the entire Western World's nonfuel primary minerals production, nearly double the 4.6% share of its nearest rival, RTZ Corp. Plc. (RTZ) of the United Kingdom. In 1991, Gencor had 1.2% of the Western World's value of all nonfuel primary mining commodities produced and placed 12th in the world. Rand Mines was 25th and Anglovaal was 27th.

The South African mineral industry was dynamic, with numerous changes in corporate ownership and joint ventures and active trading on the Johannesburg Stock Exchange. Gencor unbundled its consumer products, energy, forest products, and investment divisions. AAC proposed to divest its 39.7% interest in JCI after appropriate tax law changes, anticipated by late 1994. During 1993, Sumitomo Corp. of Japan secured 1% interest in Associated Manganese Mines, the base metals and ferroalloys producer, for about $2.8 million. Barlow Ltd. continued its restructuring program in 1993, selling its 27.5% stake in Randgold to Banque Paribas. Barlow's (formerly Barlow Rand) mining interests included coal mining (Randcoal), which Barlow has put up for sale, and gold reprocessing (Rand Mines Properties).

The largest foreign-owned mining group operating in South Africa was RTZ, which jointly owned, with AAC, the Palabora copper mine in northeastern Transvaal, one of the largest copper mines in the world. RTZ is also a 50% shareholder in Richards Bay Minerals Ltd. (RBM), a major world producer of mineral sands, with operations in the coastal areas of Natal Province.

Rock bursts and ground falls were the major cause of the 8,532 reportable injuries and 578 deaths from mining accidents in 1993. Of the 578 fatalities in 1993, gold operations had 418 and 90 were at coal mines; a methane explosion at one coal mine alone accounted for 53 fatalities.

The mineral industry continued to reduce the number of its employees. An average of 617,647 workers were employed in the mining and quarrying industry in 1993, compared with 665,458 in 1992. Data by the Chamber of Mines for its members' gold and coal mines showed an average of 366,248 workers employed by the gold mines in 1993 and 34,243 by the coal mines (data for SASOL not included). Overall, this was a 7% decline from Chamber staffing levels in 1992. Since 1986, the South African mining industry has cut almost 216,000 jobs.

The Employment Bureau of Africa (TEBA) continued to recruit unskilled and semiskilled workers throughout southern Africa for members of the Chamber of Mines. Of the 167,444 non-South African workers thus employed in 1993, the gold mines employed 88%, the coal mines 3%, and other Chamber mines, the remainder. As much as 60% of the total wages earned by foreign migrant mineworkers in South Africa was remitted by TEBA to the home countries; additional sums were sent home by the workers on a voluntary basis.

COMMODITY REVIEW

Metals

Aluminum.—Primary aluminum production was entirely by Aluminum South Africa (Pty.) Ltd. (Alusaf) and increased slightly over the level in 1992. Notwithstanding some labor problems at the construction site, the company was on schedule with its development of the Hillside smelter, which was scheduled to come on-stream in mid-1995, and was to be a two-potline facility with a total output capacity of 466,000 mt/a (hot metal). Full capacity output was anticipated to be reached in 1996. Alumina feed for the new smelter was to be obtained on the world market, although if majority Alusaf shareholder Gencor succeeded in purchasing the Billiton mining assets of Royal Dutch/Shell, it would then own adequate

alumina refinery capacity to supply the smelter.

South Africa had a growing domestic market for aluminum, and the country had five secondary aluminum manufacturers. Rheem South Africa (Pty.) Ltd., a Highveld Steel and Vanadium Corp. Ltd. subsidiary, began aluminum beverage can production in August 1993. The country's largest aluminum reroller, Hulett Aluminium Ltd., was planning to triple the rolling capacity of its Pietermaritzburg plant to 150,000 mt/a in anticipation of the increased aluminum capacity at Alusaf-Hillside. Hulett expects to use about 30% of the Hillside smelter's output.

Antimony.—South Africa's sole producer of antimony sulfide concentrate, Consolidated Murchison Ltd., reported a modest increase in production. Local and export sales of antimony trioxide increased significantly in 1993, particularly in the last quarter of the year. The improvement in 1993 sales was attributed to the absence of the Chinese material that had glutted the world market in 1992. However, the company was not fully able to take advantage of the improved antimony market because in recent years, to survive, it has shifted the bulk of its operations to more gold-rich parts of its mines. The stibnite content of these ores is relatively low.

Chromite.—South Africa's production and exports of chromite continued to fall because of weak international demand; exports declined 16% to 983,656 tons.

South Africa's largest chromite producer remained Samancor Ltd., a Gencor subsidiary, with a production capacity of approximately 3.6 Mmt/a. The company controls about 80% of South Africa's chromite reserves, which are the largest in the world.

In 1993, a drop in demand for chrome ore for use in the production of ferrochrome at Consolidated Metallurgical Industries' (CMI) Rustenburg Plant led to more ore becoming available for export from Purity Chrome Ltd.'s chrome mine. Ore exports to Japan and the United States rose by 83% and 103%, respectively. Purity, a wholly owned subsidiary of CMI and one of the lowest-cost producers of chrome ore in South Africa, produced chromite fines for domestic ferrochrome production and exported a portion of its less than 1-mm (grain size) product (concentrates) to the chemical and metallurgical markets.

Copper.—South Africa's copper mine and smelter output fell slightly in 1993, largely owing to declines in output from some of the copper mines in northern Cape Province and the January closure of the Messina Mine.

The Palabora Mine was by far the largest copper producer in the country. Mine output was 28.5 Mmt of ore, very slightly below the level, but at the same grade, as that in 1992. Mill output was slightly higher (about 370,000 tons of concentrate) than that in 1992, but the grade of concentrate fell slightly; copper in concentrate was 2% lower in 1993 at 126,401 tons. A severe problem for the mill was the increasing content of titaniferous magnetite in the ore; magnetite production in 1993 increased by two-thirds to about 150,000 tons. Recent process control upgrades to the mill were improving throughput and allowed the mill to handle the higher magnetite levels. Owing to debottlenecking procedures late in the year, overall smelter performance improved in 1993 and anode production increased 6% to 111,876 tons. Refinery output rose 5% to 109,650 tons of copper cathode. Palabora also produced badelleyite, nickel sulfate, uranium, and vermiculite. Sulfuric acid is produced for sale; acid production rose significantly as a result of modifications at the smelter to enhance the recovery of sulfur dioxide emissions. Refinery tankhouse slimes are sold for recovery of precious metals (gold, silver, platinum, and palladium).

The Palabora Mine claimed that its remaining open pit reserves were sufficient for mining through the year 2002. The company was studying the feasibility of developing an underground mine and smelter capacity increases to carry on beyond that time. The results of the study were expected to be known by mid-1994.

Following 2 years of negotiations with the NUM and the South Africa Boilermakers Society, Palabora was granted Government permission to mine on Sundays. Previously, only the mill ran 7 days per week.

Blister copper also was produced by O'Okiep Copper Co. Ltd. at its Nababeep smelter. Production fell from 24,668 tons to 22,452 tons in 1993 as a result of lower mine production and the limited availability of toll concentrates. O'Okiep's copper concentrate production fell to 21,323 tons in 1993 from 23,290 tons owing to the 1992 collapse of a stope at the Carolusberg Deep Mine. The company also suspended mining at the Hoits Mine. The Messina copper mine ceased production during January 1993.

Gold.—South Africa continued to be the world's largest gold producer. Output in 1993 was the highest since 1986, although only slightly higher than that in 1992, and represented about 27% of total world production. Members of the Chamber of Mines accounted for 95% of total South African gold output, including byproduct gold. Most of the Chamber's output was from about 30 mines on the Witwatersrand. The average grade of ore milled by Chamber members in 1993 was 5.56 g/mt gold. Although this continued a rising grade trend since 1989 (4.99 g/mt), and itself was the highest grade milled since 1986, the 1993 grade was still only 42% to 68% of the grades milled in the 1970's.

Because gold export sales were denominated in dollars but working costs in rands, South Africa's gold mines benefitted from the significantly higher average dollar gold price in 1993, as well as the continued devaluation of the rand against the dollar. Mitigating these benefits, however, were higher working costs related to the general high level of inflation in South Africa and the extraordinary technical difficulties of mining at extreme depths. Increasing labor costs were of major concern given the still labor-intensive character of the

mines. Cost escalation has caused the average grade pay limits to rise steadily since 1985. With falling grades, the gap between pay limits and recovery grades has declined significantly. The recent rising grade trend noted represents an effort by the mines to combat cost or grade pay limit increases by reducing the milling of low-grade ores. It does not represent an overall increase in the reserves of higher grade material. Indeed, if cost escalation cannot be constrained and/or gold prices do not increase significantly, much of the remaining low-grade ore may be "sterilized"—rendered permanently uneconomic. Also of concern is the viability of developing recently discovered goldfields on the Witwatersrand—much of the mineralization in these fields is exceedingly deep.

The Witwatersrand gold mines vary considerably in size, grade, and profitability. Largest of all is AAC's Free State Consolidated, which milled 28.3 Mmt of ore in 1993 to recover 116,450 kg of gold (average mill gold grade was 4.61 g/mt). Except for Gencor's Bracken Mine, which milled a mere 11,000 tons of ore to recover 486 kg of gold (mill gold grade of 42.71 g/mt), the highest grade operation was GFSA's Kloof Mine, which milled 2.2 Mmt of ore to recover 30,622 kg of gold (mill grade 14.18 g/mt).

A number of gold mines were considered marginal; two closed during the year. The Bracken Mine's output was a last gesture prior to its closure. In its 30-year life, it produced 232,231 kg of gold from about 35 Mmt of ore. The Marievale Mine managed only 15,000 tons of ore and 44.5 kg of gold in 1993 prior to its shutdown. Other mines were considering merging with adjacent properties to reduce costs through the more efficient use of facilities. For example, a working face in one mine could be closer to another mine's hoisting facilities and thus the time and cost to move workers and material to/from the face could be reduced by using the closer shaft. Costs savings also could be achieved by eliminating the ban on mining (blasting) on Sundays. Currently, only marginal gold mines are granted exemptions to this rule.

In 1993, AAC announced that because of a 30,000-mt/month increase in hoisting capacity (to 1.8 Mmt/month) at the Vaal Reefs No. 11 shaft, it would be able to bring on-stream its Moab extension to Vaal Reefs a year earlier than previously expected. AAC was proceeding with sinking the Western Deep Levels' subvertical shaft. Anglovaal was proceeding with the Target project adjacent to its Loraine Mine. JCI in 1993 continued its underground exploration program on its South Deep Project adjoining its Western Areas Mine. GFSA continued to evaluate its Sand River Project in the Orange Free State.

A number of marginal producers, such as the Loraine Mine and JCI's H.J. Joel Mine, were mentioned as candidates for merger with other mines or possible closure. Dump reclamation at Genmin's Buffelsfontein Mine is projected to extend the life of the mine by an estimated 13 years.

Randgold's 98-year-old East Rand Proprietary Mines' (EPRM) management and finances were restructured during 1993 in an attempt to rescue the mine from closure. EPRM also began a 7-day workweek; however, production difficulties continued. Randgold's Durban Roodeport Deep Mine announced that underground operations would be halted if mine economics did not improve. Production at GFSA's Kloof Mine was reduced in the last quarter of the year owing to an accident in the No. 3 shaft and a later earthquake-related rock fall.

Fearing possible tax changes following the expected formation of a new Government in early 1994, South African citizens increased their purchases of Krugerrand gold coins. The minting of these coins substantially increased the amount of gold beneficiated in-country for the year. In 1993, the Jewel City Complex, incorporating the South African Diamond Centre, opened in downtown Johannesburg. The center processed both diamonds and gold. The Africa Gold jewelry factory was proposed for Welkom in the Orange Free State. The factory is projected to process 20 mt/a of gold.

Iron and Steel.—Iron Ore.—Despite reduced domestic sales for steel in 1993, output of iron ore increased modestly because of strong export demand. About 19 Mmt of iron ore was exported, compared with about 15 Mmt in 1992.

Iscor Ltd.'s two iron mines, Sishen and Thabazimbi, accounted for 78% of the total. Iscor continued work on a direct-reduced iron ore plant at Sishen. The company was investing in a major iron ore port in China as part of a deal to secure large, long-term export contracts with that country. One possibility being explored was to have the Chinese Government acquire a 60% equity holding in the Sishen Mine.

Steel.—South Africa continued to be the largest producer of steel in Africa. Imported steel accounted only for about 5% of the South African market, which was dominated by Iscor and Highveld. A preliminary study by Iscor concluded that a Corex steel plant at Saldanha Bay would be economically viable. Results from the final feasibility study for the project were expected early in 1995. The study will determine the design of the plant and metallurgical processes and will involve an environmental impact assessment. The proposed plant's 650,000-mt/a capacity would be twice the capacity of Iscor's Pretoria Steel Plant. Output would be hot-rolled coil. Iscor opted for minimill technology, which has been the basis for the recent success of American and Far Eastern steelmakers. However, Iscor plans to use its own iron ore instead of ferrous scrap.

Iscor was spending $12.5 million on converting the tin-free steel (chrome coating) line at its Vanderbijlpark Plant to a tinning line. The new line would have a product capacity of 130,000 mt/a to 180,000 mt/a and would meet local demand for beverage can stock. The tinning line also will replace imports of tinplate, estimated at 45,000 mt/a.

Iscor proposed closing its 125,000-mt/a Durban Steelworks because of the high cost of local steel scrap feed as well as the low prices received for the plant's billet product. Other factors that

influenced the decision were the high cost of electricity and complaints from local residents about pollution from the plant.

Most of South Africa's smaller steelmaking operations and foundries were totally dependent on ferrous scrap. Local scrap availability was reduced as scrap merchants bypassed local consumers in favor of the higher priced export market. The Department of Trade and Industry had yet to restrict scrap export permits.

About 30% of the Columbus Stainless Steel expansion project was completed by yearend. The project, a joint venture among Samancor, Highveld, and the IDC (33.3% each), would have a capacity of 500,000 mt/a. Startup was expected in 1995 and would include higher quality grades of stainless steel than are currently produced at the existing plant. Current production is about 160,000 mt/a. The expansion project would make Columbus Stainless the world's sixth largest producer of stainless steel and its largest single-site producer.

***Ferroalloys.*—Ferrochrome.**—Despite a significant increase in production, South Africa's ferrochrome producers continued to operate below capacity in 1993. Samancor reduced its ferrochrome operating capacity by converting some of its ferrochrome furnaces to production of ferromanganese and silicomanganese. The industry continued to face severe competition on the export market from members of the countries of the former U.S.S.R. and China. Exports fell to 589,500 tons in 1993 from 736,600 tons in 1992. Major customers included France, Germany, Japan, and the United States.

Samancor's chrome division concluded a 50-50 joint venture with Nippon Denko Corp. (NDC) of Japan under which NDC's traditional customers would be supplied from Samancor's Tubatse No. 5 furnace. The joint venture is initially expected to produce 55,000 mt/a of ferrochromium to replace production that was lost at NDC's Hokuriku Plant when its No. 73 furnace was closed.

JCI's Consolidated Metallurgical Industries (CMI) reduced output at its Lydenburg plant by 50%, but benefitted from sharply reduced operating and distribution costs. Cost savings are inherent to the plant's prereduction technology, in part because of lower power requirements and the ability to use relatively low-cost chromite fines as feed. Savings were enhanced by operating at higher loads during off-peak hours to take advantage of lower electricity rates.

Ferrosilicon.—South African production of ferrosilicon increased substantially in 1993. Exports increased to 31,921 tons, from 25,488 tons in 1992. Antidumping duties of between 35% and 47% levied by the European Union on imports of South African ferrosilicon had minimal effect on Samancor and Highveld's Rand Carbide division, which sold most of their ferrosilicon to local steel producers. As a result of increased demand, Samancor switched two of its ferrochrome smelters to ferrosilicon production.

The Siltech plant in Newcastle, which has had technical problems since starting production in December 1992, announced that it would suspend operations at the 55,000-mt/a facility. Siltech sold more than 95% of its output on the export market, mainly to the United States. The company was considering restarting production on a smaller scale.

Ferromanganese.—South Africa's production of high and medium carbon ferromanganese increased significantly in 1993. Exports increased 70% to 405,137 tons. This led to conversion of some ferrochromium furnaces in South Africa to ferromanganese production—Samancor so converted 5 of its 19 ferrochromium furnaces.

Manganese.—In 1993, total South African manganese ore exports fell to 1.2 Mmt from 1.4 Mmt in 1992. The bulk of South Africa's production of manganese ore was of metallurgical grade, with a manganese content of more than 48%. Most of the ore was mined by Samancor and Associated Manganese. Chemical-grade ore was produced near Zeerust in the western Transvaal by Klipveld Manganese Mine (Pty.) Ltd., by Metmin, and by Samancor's Mamatwan Mine in the Kalahari Field.

Union Mines Ltd. hoped to export manganese from its Postmasburg-area deposit in northern Cape Province. Resources have been estimated at about 1.6 Mmt of combined detrital and in situ ore, grading 36% to more than 50% manganese, and with generally low iron content.

Nickel.—South Africa's nickel output is mostly a byproduct of PGM production. Production increased modestly owing to the startup of the Potgietersrust PGM mine during the year. Columbus Stainless Steel was the dominant nickel consumer in South Africa. Exports of nickel amounted to 16,442 tons in 1993. Nickel production was of various forms: Rustenburg Base Metal Refiners (Pty.) Ltd. produced electrowon cathode from concentrate from its mines as well as the mines of Lebowa Platinum Mines Ltd. Impala Platinum Ltd. produced nickel in briquettes and powder from concentrate supplied by four of its mines. Nickel-cobalt sulfate was produced by Western Platinum Ltd., and Northam Platinum Ltd. made a 22% Ni nickel sulfate. Nickel was also a byproduct of PMC's copper mine; output was as nickel sulfate hexahydrate.

Anglovaal began a 3-year feasibility study of the Slaaihoek Farm in the eastern Transvaal. Reportedly, AAC has shelved plans to develop its Uitkomst nickel and copper prospect, pending improved prices.

Platinum-Group Metals.—South Africa is the world's largest primary producer of PGM and has almost 90% of world reserves. Combined PGM production was up sharply owing to production from GFSA's Northam Mine, which came on-stream at yearend 1992, and to the May 1993 opening of the Potgietersrust Platinums Ltd. PGM mine. The Potgietersrust operation is near Potgietersrus and exploits the so-called Platreef. The Platreef had been a source

of PGM in the past, but in recent years all South African production has been from the Merensky and, to a limited degree, UG2 reefs. The Platreef differs from these in that it is much thicker and is of highly variable and generally lower grade. Past assessments of the Platreef were negative but had been based on underground mining models. Although it may go underground in the future, the Potgietersrust Mine was developed as an open pit, with a mill designed to produce concentrates to be smelted at Rustenburg. The mine produced its first PGM concentrates in May 1993 and reached full capacity in July. Milling capacity is nominally 2.4 Mmt/a of ore with a PGM output (in concentrate) of about 9,700 kg/a (about 49% palladium, 48% platinum, 3% rhodium). The same concentrate would contain about 575 kg/a of gold.

Myriad geotechnical and grade control problems plagued the Northam Mine, largely owing to a greater than expected incidence of so-called pothole structures in the Merensky Reef. Production was only about 50% of expected levels. GFSA was reviewing the economics of keeping the mine in operation.

Tin.—Following an October announcement, Rooiberg Tin Ltd., South Africa's last tin producer, shut down its mine and smelter in December 1993—a casualty of continued low international tin prices. The mine had been in operation for 85 years.

Titanium and Zirconium.—Richard Bay Minerals' Tisand (Pty.) Ltd. (RBM) produced ilmenite, rutile, and zircon from beach sands north of Richards Bay. Richards Bay Iron and Titanium (Pty.) Ltd. produced an 85% titanium dioxide slag from ilmenite concentrates at the Richards Bay smelter, as well as low-manganese pig iron. Titaniferous magnetite also was recovered at the Palabora and Foskor Mines as a byproduct of copper and phosphate rock production, respectively.

At yearend, an independent review panel recommended against RBM's mining the St. Lucia titanium-bearing sands for environmental reasons. The panel's recommendation was forwarded to the Government for a final decision.

The zircon mineral baddeleyite was recovered by Foskor and PMC from their copper and phosphate mines at Phalaborwa.

Iscor began a 2-year feasibility study of titanium processing. The company acquired mineral rights to the titanium reserves on Shell South Africa's Natal Mineral Sands prospect in Kwazulu-Natal and Rhombus Exploration's Wavecrest property in Transkei. Iscor proposed to develop a 200,000-mt/a smelter near Richards Bay to produce titanium slag.

Anglo American continued with development of the Namakwa Sands project, about 220 km north of Saldanha Bay, with the aim of starting recovery of titaniferous sands about midyear 1994. Ilmenite would be stockpiled pending completion of a smelter to produce high titania slag and pig iron. The project also would produce rutile and zircon.

Uranium.—South Africa's uranium production (as U_3O_8) increased slightly in 1993. Almost all of the uranium was recovered as a byproduct by several Witwatersrand gold mines, but PMC recovered a small amount (93 tons of calcined oxide) from its copper mine at Phalaborwa. Production from Witwatersrand ores was processed and packed at a central plant owned and operated by the industry's uranium marketing arm, Nuclear Fuels Corp. of South Africa (Pty.) Ltd. (NUFCOR). Uranium output is sold by NUFCOR to nuclear power stations, including South Africa's only nuclear power station, Koeberg, near Cape Town.

The Atomic Energy Corp. suggested that the stockpiles of highly enriched uranium (HEU) left over from the nation's abandoned weapons program could be used to produce industrial and medical isotopes or downgraded to power reactor levels. The company patented a process to downgrade HEU to low-enriched uranium.

Vanadium.—Vanadium is produced from titaniferous magnetites mined from the Bushveld Complex. The producers were Highveld; Vametco Minerals Corp., which is owned by the U.S. company Strategic Metals Corp.; and Vanadium Technology Ltd. (Vantech), a subsidiary of Chromecorp Technology Group. A fourth producer, Rhombus Vanadium Holdings Ltd. (Rhovan) was entering the market. Exports of vanadium pentoxide (V_2O_5) equivalent dropped to 21,344 tons in 1993 compared with 28,054 tons in 1992. South Africa also exported vanadium chemicals and Nitrovan.

Highveld, the world's largest V_2O_5 producer, had almost 50% of world capacity. However, it operated at about 70% of capacity during the year. Much of Highveld's production was slag containing about 25% V_2O_5, generated as a byproduct of steelmaking. The balance was produced by the company's Vantra plant in the form of V_2O_5 flake directly from vanadiferous magnetite ore from the Mapochs Mine; output was, however, suspended because of low prices. Highveld's slag traditionally has been sold to customers in Europe, where it is smelted into ferrovanadium. But with European smelter capacity being reduced, and with the closure of Highveld's subsidiary Transvaal Alloys, Highveld began processing more of its slag into vanadium chemicals.

Vametco was South Africa's second largest V_2O_5 producer. In July 1993, the company completed an expansion program that increased its production capacity of its product Nitrovan to 2,000 mt/a and output of ferrovanadium to 1,000 mt/a. Vantech, a relatively low-cost producer, produced vanadium products at its Steelpoort plant, adjacent to its mine. Vantech mines the highest-grade vanadium deposit in the world. According to the company, the mine has an estimated 15 years of reserves remaining. Although the company increased V_2O_5 production for the year, output had declined to 300 mt/month at yearend 1993; it had peaked at about 350 mt/month earlier in the year.

Rhovan commissioned its 6,000-mt/a V_2O_5 (equivalent) plant project to process

magnetite from the Ba-Mapoga Mine near Brits in the Transvaal. Production was slated for yearend 1994. Rhovan was studying the feasibility of producing ferrovanadium rather than V_2O_5.

Zinc.—Zinc concentrate production was by GFSA's Black Mountain Mineral Development Co. (Pty.) Ltd., Shell South Africa (Pty.) Ltd.'s Pering Mine Services (Pty.) Ltd., and Metores (Pty.) Ltd.'s Maranda Mining Co. Zinc concentrate exports resumed in 1993, with a total of 9,770 tons shipped during the year.

Output of electrolytic zinc by Zinc Corp. of South Africa Ltd. (Zincor), the country's only zinc metal producer, increased by almost 16%. Exports more than doubled to 7,407 tons in 1993. Zincor's byproduct sulfuric acid was sold locally.

GFSA continued with its feasibility study to develop an underground mine on the Gamsberg zinc deposit. Underground mining, rather than open pit, was favored for environmental reasons. Because the Gamsberg ore body has a high manganese content, standard electrolytic recovery processes will not be used. GFSA planned an integrated smelting/mining operation.

Industrial Minerals

Asbestos.—South Africa's production of asbestos decreased in response to continued low world demand for amosite and crocidolite; exports declined to 110,080 tons compared with 131,109 tons in 1992.

Because of large stockpiles, the Griqualand Exploration and Finance Co. Ltd. (Gefco) operated its Merencor/Cortesi crocidolite mine, in the Kuruman district of the northern Cape Province, at minimal production levels. Amosite stockpiles at the company's closed Penge Mine were depleted during the year. However, Msauli Ltd., a subsidiary of Hanova Corp., operated its Kangwane Mine in the eastern Transvaal at full capacity owing to continued demand from traditional customers for the mine's high-quality chrysotile fiber.

South Africa continued rehabilitating asbestos mine dumps. Although total rehabilitation was expected to take another 30 years, almost one-half of the targeted sites were planted with inedible vegetation and several closed mines had been completely rehabilitated as of yearend.

Cement.—Cement was produced by Pretoria Portland Cement Co. Ltd. (PPC), Anglo Alpha Cement, and Blue Circle Cement (Pty.) Lyd. The three companies had equal interest in Natal Portland Cement Co. (Pty.) Ltd. (NPC), which served much of the Natal market. Cement production in 1993 registered only a slight increase over that in 1992, and the mills operated at only about 60% of capacity. The lackluster output level was in response to a continued recession in the domestic construction sector, which consumes almost two-thirds of the cement production. The cement industry did benefit toward yearend from increased orders related to the ALUSAF aluminum smelter expansion project and the Lesotho Highlands Water Project. With the anticipated change in Government in 1994, it was expected that domestic construction demand for cement would increase as new rural housing programs were implemented.

Diamond.—South Africa's rough diamond production increased slightly in 1993 owing to increased output from De Beers' Venetia Mine. De Beers dominated the South African diamond sector with about 95% of total production. Both De Beers' local sales and exports improved, particularly in the first half of the year, and together with a marked improvement in unit values, led to a major improvement in revenue.

Total diamond production from De Beers' mines in South Africa increased 2% to 9,826,615 carats. This was entirely due to a 166% increase in output (to 4,969,400 carats) from the Venetia Mine, near Messina. The mine had its first full year of operation in 1993, and was run at a full-capacity test rate at midyear. De Beers anticipated a lower output from Venetia in 1994, in part because it expected to commence mining from a lower grade satellite pipe. Reported recovery grade for the Venetia Mine in 1993 was 137.5 carats per 100 tons, a 16% improvement from the previous year and much higher than the company's next richest South African mine (Finsch—75.1 carats per 100 tons).

Diamond output from De Beers' older operations (Finsch, Kimberley, Koffiefontein, Namaqualand, and Premier) was severely curtailed, partly in line with quotas from De Beers' Central Selling Organization (CSO). Output in 1993 from these mines was just 4,857,215 carats—37% lower than that in 1992. However, this was a better performance than might have been expected given that the total ore tonnage treated in 1993 by these mines was 46% lower than that in 1992. The 1993 diamond output reflects a significant increase in the grade of ore treated and, in the case of the Premier Mine, the almost complete cessation of retreatment of low-grade tailings. At the Finsch Mine, output was aggravated by heavy rainfalls that caused ground handling problems underground and in the plant. Production reductions at the older mines involved reduction of workshifts to two per day and overall reductions in staffing.

Apart from De Beers, there were several other companies with diamond operations in South Africa. Most of these were relatively small alluvial workings, either onshore or offshore the Atlantic coast north of Saldanha Bay, but particularly near the Namibian border around Alexander Bay and along the Orange River. One of the larger of these companies is Trans Hex Group Ltd. Apart from its coastal alluvial operations, the company was recovering diamonds through retreatment of kimberlite mine tailings from three former mines near Kimberley.

Toward yearend, Canadian company Diamond Field Resources Inc. obtained an option to acquire a two-thirds share of two active open pit diamond mines near Kimberley—this being made possible by the lifting of economic sanctions. The purchase was subject to an independent

due diligence review. The company already had diamond properties in Namibia. A number of other companies were exploring alluvial diamond concessions along the Atlantic coast or were looking at old mines in the Kimberley area, either with a view to reopening them or to retreating their tailings.

Fluorspar.—Increased recycling of hydrofluoric acid by world steelmakers contributed to reduced demand for fluorspar and a decrease in South African output. Facing increasing production costs and the near exhaustion of its reserves, Gencor ceased production from the Buffalo Mine in November, while readying the mine for closure in early 1994. The mine continued to meet its sales obligations from stockpiles. It was anticipated that the country's other fluorspar producers would be able in time to increase output to compensate for the loss of the Buffalo Mine's production.

Phosphate.—South Africa was one of the world's largest producers of phosphate rock. The number of phosphate rock producers in the country was reduced to two early in March when Chemfos Ltd., a subsidiary of Samancor Ltd., closed its Langebaan phosphate mine northwest of Cape Town. In June, it was announced that the closure would be permanent. The mine had produced small quantities of a relatively low-grade phosphate concentrate for the domestic market, but sales had declined owing to continued drought-induced low fertilizer demand. At closure, the mine had remaining ore stockpiles sufficient to supply customers for several months.

The closure of Langebaan left Foskor Ltd. and PMC, both at Phalaborwa, as South Africa's only phosphate mining companies.

Foskor mines phosphates hosted by pyroxenite; the ore is processed to recover both phosphates and byproduct copper concentrates. It supplies the copper concentrates to neighboring PMC, which in turn supplies Foskor with phosphate-rich tailings from PMC's copper mine and mill complex. Owing to poor world demand, Foskor reduced its output during the year.

Salt.—Domestic production declined in part because of poor production at the Walvis Bay solar operations of Salt & Chemicals (Pty.) Ltd., South Africa's largest producer. With the planned transfer of sovereignty over Walvis Bay to Namibia in early 1994, output of this operation no longer will be credited to South Africa. This automatic decline is expected partly to be offset by the planned startup of new evaporative operations on South Africa's Atlantic Coast. However, the long-term domestic and export market prognosis was not good given increased substitution of natural soda ash (including that from Botswana) for synthetic soda ash and efforts by major domestic customers in the paper and pulp industries to reduce their consumption of chlorine-based chemicals.

Mineral Fuels

South Africa produces no crude oil and has limited resources of gas. Most of the country's primary energy needs were supplied by coal; most electricity was generated by coal-fired power stations, and coal was also the basic raw material for South Africa's production of synthetic fuels.

The Southern Oil Exploration Co. (Soekor), the state-owned petroleum exploration company, controlled all offshore oil and gas prospects. During 1993, Soekor drilled eight holes in the Bredasdorp Basin, 90 km off the southwest coast.

Coal.—South Africa was the sixth largest coal-producing country in the world. Bituminous coal accounted for more than 98% of South African production. Four companies, Anglo American Coal Corp. Ltd. (Amcoal), Trans-Natal Coal Corp. Ltd., Randcoal, and Sasol Mining (Pty.) Ltd., accounted for more than 80% of the country's coal production. Other producers included Iscor Ltd., which mined coal for its own use; GFSA; and numerous independent medium to small coal companies. Although the 76 coal operations within the 19 coalfields of South Africa were spread over an area of 300,000 km^2, the main coal-producing area was the Witbank Basin, which accounted for approximately 42% of the country's output. About 65% of the coal was produced from underground mining operations, with the remainder coming from open pit mines. Most open pit mines were less than 70 m deep.

The largest domestic consumer of coal continued to be Eskom, followed by Sasol. Eskom used slightly less than 40% of the coal produced in South Africa for power generation. Sasol's oil-from-coal plants consumed about 21% of the country's coal production. Other significant domestic users were Iscor's metallurgical plants, the cement industry, and large municipalities. Approximately 28% of South Africa's coal production was exported in 1993, with about 92% going through Richards Bay Coal Terminal, 7% through Durban, and very small quantities through Port Elizabeth, Cape Town, and Maputo-Matola in Mozambique. South Africa ranked third in world coal exports after Australia and the United States.

The major mining houses continued coal exploration and reserve development programs. Randcoal commissioned a new shaft at the Umgala Colliery and ceased anthracite production from its Natal operations. Amcoal inaugurated a new open pit mine at the Landau colliery in June. Foreign companies, too, were involved in South African coal. Duiker Exploration, a Lonrho Plc. subsidiary, purchased Agipcoal S.A.

Coalex (the Red Terminal), a second terminal proposed for Richards Bay, remained under consideration.

Natural Gas.—Mossgas, South Africa's first oil-from-gas project, began commercial production in January 1993. There was much debate over the project's economics, especially in light of elimination of trade sanctions. Engen announced that it would not proceed with

the acquisition of one-third interest in Mossgas and that it would also withdraw from Mossgas management. Soekor's contract to operated the Mossgas offshore production platform expired in October.

Petroleum, Refining.—Sasol was converting more of its synfuel capacity to the production of higher value petrochemicals in response to the reduction of trade sanctions on crude petroleum. Four domestic refineries processed imported crude oil—Gencor's Genref and Shell and British Petroleum's Sapref in Durban, Caltex in Cape Town, and Sasol's Natref in Secunda. They were all in the process of expanding and/or upgrading their facilities. The total design capacity of the four refineries was estimated at 433,500 bbl/d, and they were operating at or near full capacity.

Reserves

South Africa's mineral reserves are large and diverse and reflect the country's complex geology. South Africa has a wide variety of sedimentary, igneous, and metamorphic rocks. Ages range from some of the world's oldest Archean rocks (some in excess of 3.6 Ga) to the Quaternary. In terms of economic geology, the northern third of the country is mineralogically the most important. It is predominantly an Archean granite-greenstone basement terrane, in places intensely deformed, overlain by Archean and Proterozoic sedimentary rocks, and into which has intruded the Bushveld Igneous Complex (BIC), dated at about 2 Ga. Although the Archean greenstone belts contain some important ore deposits (notably antimony in the Murchison Belt near Phalaborwa, and asbestos and gold in the Barberton Belt rimming the northeast Swaziland border), it is from some of the overlying Precambrian sedimentary rocks, and the BIC, that the vast bulk of South Africa's mineral revenues have been derived. Of greatest importance are the late Archean quartz conglomerates of the Witwatersrand Supergroup. These occur in a basin near Johannesburg and form the world's largest goldfield in terms of past and present output and remaining reserves. The Witwatersrand also is a major world source of uranium and has significant byproduct production of PGM and silver. The BIC, largely made up of cumulate mafic rocks, is mined extensively for, and contains the world's largest known reserves of, PGM, chromite, and vanadium. Significant amounts of cobalt and nickel are recovered as byproducts to the PGM mining, as is a small amount of gold. Granites forming the upper part of the BIC host tin and fluorite deposits; fluorite also is mined, as is andalusite, within the BIC's contact metamorphic aureole in the Proterozoic Transvaal Sequence sedimentary rocks. Deposits associated with the Witwatersrand and the BIC, and some unrelated deposits nearby, are shown in figure 1. One of the most important of these other mineral districts is at Phalaborwa, where a pyroxenite-carbonatite complex is mined for copper, phosphate rock, vermiculite, badelleyite (a zirconium mineral), and uranium. Except for uranium, the complex is the country's largest resource of these minerals.

Near Sishen, Transvaal Sequence sedimentary rocks host large iron ore reserves and what are considered the world's largest reserves of manganese ore. Farther west, near Okiep, Precambrian rocks host historically important deposits of copper, lead, and zinc.

Overlying parts of the Precambrian terrane noted earlier and covering much of the rest of the country are Paleozoic and Mesozoic sedimentary rocks. These sedimentary rocks are sources of a variety of industrial and construction minerals. In the Transvaal and to a lesser extent in Natal, late Paleozoic sedimentary rocks within the Karoo Sequence host South Africa's large coal reserves.

South Africa has a number of both primary and secondary diamond deposits. Most of the primary or kimberlite pipe deposits are near Kimberley, but important pipes also occur near Pretoria and west of Messina. The secondary or alluvial deposits are found along the Atlantic coast, especially near the Namibia border. Large reserves of titaniferous sands (with zircon) are found near Richards Bay and about midway up the country's Atlantic coast.

Table 3 gives the reserve base for a number of South Africa's major minerals; diamond reserve data are unavailable. Although data are incomplete for the world, for many of the minerals shown South Africa's reserves appears to rank among the top five countries and would rank first in the world for andalusite, chromite, gold, manganese, PGM, and vanadium.

INFRASTRUCTURE

The country had a well-developed and extensive road and railroad infrastructure, serving not only South Africa but also southern Africa. A number of ports handle minerals, notably Cape Town, Durban, Richards Bay, Port Elizabeth, Mossel Bay, East London, and Saldanha Bay.

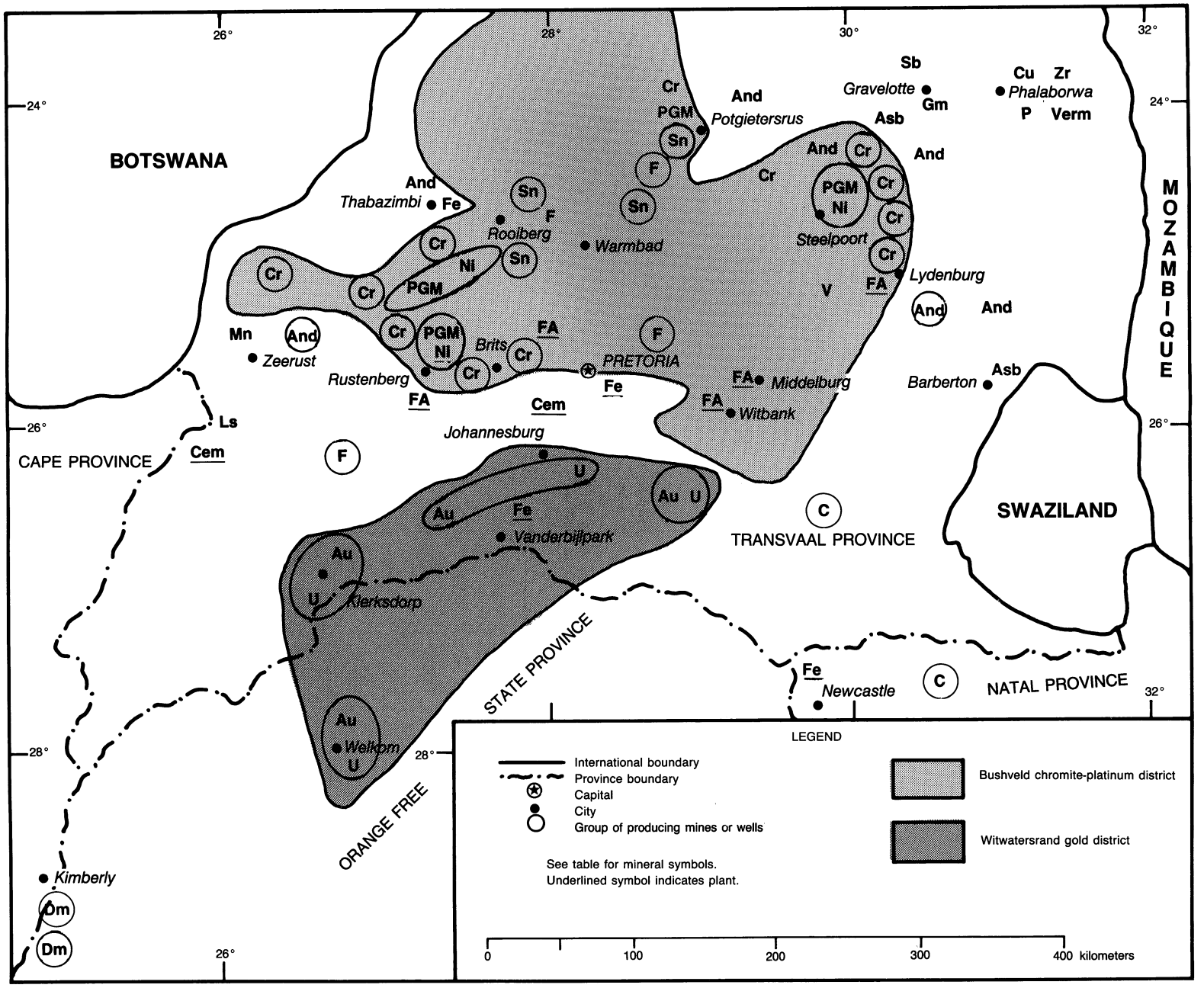
Richards Bay handled the greatest volume of cargo among African ports. Richards Bay Coal Terminal (RBCT) has a coal export capacity of 55 Mmt/a. Coal exports through Durban were only a fraction of those through RBCT. Durban's port facilities are designed mainly for small consignments of high-quality-sized bituminous coal and anthracite that cannot be accommodated at Richards Bay and have a coal export capacity of 3.5 Mmt/a. An upgrading program, which would increase capacity to 5 Mmt/a, is in progress.

In addition to fulfilling the requirements of South Africa itself, the country's ports also served as outlets for landlocked countries such as Botswana, Lesotho, Swaziland, Zaire, Zambia, and Zimbabwe. Walvis Bay handled most of Namibia's imports and exports; this port was transferred to Namibia sovereignty in early 1994. South Africa also is a regional supplier of electricity and petroleum products, two of a number of examples of the dependence of neighboring countries on South Africa's infrastructure and transportation networks.

Eskom, one of the largest utilities in

FIGURE 1

SOUTH AFRICA: WITWATERSRAND AND BUSHVELD MINERAL DISTRICT



the world with a nominal capacity of 39,746 MW (31,585 MW in active plants), generated 154,260 GW•h of electricity in 1993—almost 98% of the country's total electricity. Coal-fired powerplants accounted for 94.3% of Eskom's total output. Eskom's Koeberg nuclear powerplant supplied 4.7% of the total. The mining industry consumed 22% of Eskom's electricity in 1993. By commodity, the biggest mining consumers were gold, 67%; PGM, 15%; coal, 7%; copper, 4%; and diamonds, 2%. Data for mineral processing industries was within that for total industry (other than mining), which took about 26% of Eskom's 1993 output. Of total nonmining industry consumption, iron and steel accounted for 30%.

OUTLOOK

The removal of economic sanctions should allow South Africa to better compete on the world mineral market. The long-term outlook is favorable for increased production of many South African mineral commodities. However, the short-term major production increases predicted for commodities such as chromite, ferroalloys, manganese, and vanadium could be constrained by increased supplies from countries of the former U.S.S.R. and from China. The anticipated political transformation of South Africa could result in increased trade and development opportunities for minerals among South Africa's neighbors. Many southern African countries are likely to continue to rely on South Africa's transportation infrastructure, and this could encourage increased South African regional investments in mining and other economic sectors.

The political transformation is expected to result in new Government emphasis on low income housing construction and other rural development, including electrification. This is expected to greatly increase domestic demand for a number of mineral commodities, such as cement and other construction materials, steel, and coal. Emphasis is expected to be given to encouraging the development of more value-added or mineral processing industries, although such could be expensive.

It is likely that political changes in South Africa will increase production costs, particularly as trade unions seek larger reductions in wage disparities and as the country's monetary policies are reevaluated. Labor cost increases in particular could have serious consequences for the viability of existing marginal gold and other mines. Barring major technological innovations, labor cost increases augur poorly for the development of new, ultradeep gold resources. Overall employment levels in the mining sector could decline significantly over the long term.

It is expected that increased attention will be given to environmental issues, and these issues also will be a factor in projects for which financing is sought from international lending institutions.

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[1]Unless otherwise specified, reference to South Africa includes Bophuthatswana, Ciskei, Transkei, and Venda, as well as the 10 tribal homelands, all within the boundary of South Africa.

[2]Where necessary, values have been converted from South African rands (R) to U.S. dollars at the rate of R3.27=US$1.00 for 1993 and R2.85=US$1.00 for 1992.

[3]Raw Materials Group RMG AB, Stockholm, Sweden. Who Owns Who in Mining 1993. Roskill Information Services Ltd., London, 1993.

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TABLE 1

SOUTH AFRICA: OUTPUT OF MINERAL COMMODITIES[1]

Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
METALS							
Aluminum metal, primary		165,900	159,489	169,390	172,795	174,700	175,000
Antimony concentrate:[2]							
Gross weight		8,838	8,113	7,533	6,465	7,182	9,500
Sb content		5,201	4,815	4,485	3,779	4,111	5,600
Cadmium, Cd content of cadmium cake		r50	r57	r103	r60	e65	120
Chromite, gross weight:							
More than 48% Cr_2O_3	thousand tons	54	47	70	18	4	70
44% to 48% Cr_2O_3	do.	2,583	2,383	2,673	1,904	1,808	3,000
Less than 44% Cr_2O_3	do.	2,314	2,188	2,367	1,441	1,014	2,500
Total[3]	do.	4,951	4,618	5,110	3,363	2,827	5,600
Cobalt:							
Mine output, Co content[e]		300	350	300	350	300	400
Refinery output:							
Metal, powder[e]		60	70	60	65	48	700
Sulfate, contained cobalt[e]		140	180	150	170	124	180
Total[3 4]		199	249	209	234	172	250
Columbium and tantalum:							
Columbite-tantalite concentrate:							
Gross weight	kilograms	20	6	14	31	—	50
Cb content[e]	do.	7	2	5	11	—	18
Ta content[e]	do.	5	2	4	9	—	15
Copper:							
Mine (company output), Cu content		181,854	178,704	184,556	176,074	166,348	185,000
Metal:							
Smelter		184,800	176,000	164,700	152,800	148,140	185,000
Refined, primary		144,200	133,000	127,000	120,100	127,900	150,000
Gold, primary	kilograms	607,460	605,100	601,110	614,071	619,201	630,000
Iron and steel:							
Ore and concentrate:							
Gross weight	thousand tons	29,958	30,291	28,958	28,226	29,385	32,000
Fe content	do.	19,461	19,689	18,819	r18,347	e19,100	20,000
Metal:							
Pig iron	do.	6,543	6,257	6,968	6,498	6,107	7,000
Direct-reduced iron	do.	772	882	863	854	833	900
Ferroalloys, electric arc furnace:							
Chromium ferroalloys	do.	1,050	1,022	r1,149	r771	834	1,680
Ferromanganese	do.	394	404	r260	r270	393	400
Silicomanganese	do.	298r	r269	r270	r267	268	375
Ferrosilicon	do.	93	78	68	64	99	90
Silicon metal	do.	36	36	40	35	38	40
Ferrovanadium[e]	do.	2	1	1	1	1	2
Total[e 3]	do.	1,873	1,810	1,788	1,408	1,633	2,587
Crude steel	do.	9,337	8,619	9,358	9,061	8,726	9,500

See footnotes at end of table.

TABLE 1—Continued

SOUTH AFRICA: OUTPUT OF MINERAL COMMODITIES[1]

Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Metals—Continued							
Lead:							
Concentrate, Pb content		78,171	69,417	76,262	75,806	100,171	100,000
Smelter, secondary		36,900	31,200	32,200	29,000	31,800	30,000
Manganese:							
Ore and concentrate, gross weight:							
Metallurgical:							
More than 48% Mn	thousand tons	1,228	2,102	1,637	1,331	1,239	2,100
45% to 48% Mn	do.	1,357	610	181	279	237	600
40% to 45% Mn	do.	702	689	628	273	299	700
30% to 40% Mn	do.	1,518	917	653	491	665	1,500
Total[3]	do.	4,805	4,318	3,100	2,375	2,440	4,900
Chemical:							
More than 65% MnO_2	do.	1	6	1	16	—	25
35% to 65% MnO_2	do.	77	69	45	73	67	75
Less than 35% MnO_2	do.	—	9	—	—	—	—
Total	do.	79	84	46	89	67	100
Grand total[3]	do.	4,884	4,402	3,146	2,464	2,507	5,000
Metal, electrolytic	do.	40	35	35	35	35	35
Nickel:							
Mine output, concentrate, Ni content		28,900	29,000	27,700	28,400	e30,000	32,000
Metal, electrolytic		28,100	28,200	26,863	27,621	29,868	30,000
Platinum-group metals, metal content of concentrate, matte, refinery products	kilograms	133,684	141,913	142,861	152,891	176,167	180,000
Silver, mine output, Ag content	do.	179,829	161,003	170,832	182,723	192,418	200,000
Thorium, monazite concentrate, gross weight (e55% rare-earth oxides)[e]		1,200	[3]1,317	1,300	1,300	1,300	1,300
Tin:							
Cassiterite concentrate:							
Gross weight[e]		3,350	2,800	2,600	1,500	1,200	—
Sn content		1,306	1,140	1,042	582	452	—
Metal:							
Primary[5]		1,306	1,140	1,042	592	e450	1,300
Secondary[e]		80	70	70	60	50	80
Titanium:[e]							
Rutile concentrate		60,000	[4]64,056	75,000	75,000	100,000	130,000
Titaniferous slag	thousand tons	725	840	[3]808	[3]884	1,000	1,000
Uranium oxide (U_3O_8)		3,456	2,875	2,039	2,222	2,008	4,000
Vanadium:							
Vanadiferous slag, gross weight[e]		80,000	70,000	60,000	55,000	60,000	100,000
V content:							
Of vanadiferous slag[e]		11,300	10,000	8,460	7,730	8,400	14,000
Of V_2O_5 and vanadate products[e]		7,270	7,100	6,500	6,300	6,650	16,000
Total[e] [3]		18,567	17,106	14,962	r14,034	15,051	30,000

See footnotes at end of table.

TABLE 1—Continued

SOUTH AFRICA: OUTPUT OF MINERAL COMMODITIES[1]

Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Metals—Continued							
Zinc:							
Concentrate:							
Gross weight		145,452	139,266	e127,000	133,892	e140,000	215,000
Zn content		77,334	74,792	64,425	71,928	77,096	115,000
Metal, smelter		84,997	91,900	91,659	83,208	96,154	95,000
Zirconium concentrate (baddeleyite and zircon)[e]		150,000	r151,536	230,000	230,000	230,000	325,000
INDUSTRIAL MINERALS							
Aluminosilicates:							
Andalusite		284,617	283,677	209,824	230,333	187,708	300,000
Sillimanite		170	256	422	632	569	800
Asbestos							
Amosite		26,124	26,570	27,325	5,132	—	30,000
Chrysotile		115,420	103,410	101,650	103,660	92,380	120,000
Crocidolite		15,050	15,820	19,550	24,476	11,614	25,000
Total[3]		156,594	145,791	148,525	133,268	103,994	175,000
Barite		8,570	2,490	4,790	3,570	2,000	10,000
Beryl concentrate (11% to 12% BeO)	kilograms	—	1,000	103	—	—	500
Calcite		—	—	2,556	13,764	14,094	20,000
Cement, hydraulic	thousand tons	8,030	7,811	r7,427	r7,028	7,356	12,600
Clays:							
Attapulgite		6,609	7,628	8,109	8,235	7,032	8,500
Bentonite		62,987	66,059	64,600	43,977	50,441	70,000
Fire clay		282,885	232,393	132,813	86,195	91,839	200,000
Flint clay, raw and calcined		128,586	130,174	123,849	123,721	89,352	140,000
Kaolin		139,711	132,421	134,485	131,765	147,349	150,000
Brick clay, local sales	thousand tons	1,870	2,062	1,260	1,072	1,028	3,000
Corundum, natural		2	e2	—	—	—	2
Diamond, natural:							
Gem[e]	thousand carats	4,000	3,900	3,800	4,600	4,600	5,400
Industrial[e]	do.	5,120	4,810	4,630	5,556	5,724	6,600
Total[3 4]	do.	9,116	8,708	8,431	10,166	10,324	12,000
Diatomite		133	2,798	2,352	576	—	3,000
Feldspar		52,964	56,124	70,324	49,425	56,761	75,000
Fluorspar:							
Acid-grade[e]		310,000	262,000	240,000	r231,000	195,000	400,000
Ceramic-grade[e]		9,000	7,500	6,000	r6,000	3,800	25,000
Metallurgical-grade[e]		49,340	41,530	24,340	r23,000	19,000	100,000
Total[3 4]		368,340	311,032	270,341	r259,790	217,778	525,000
Gemstones, semiprecious:							
Rose quartz	kilograms	47,210	17,842	41,206	100,834	85,500	100,000
Tiger's eye	do.	279,617	550,245	467,260	620,827	548,386	600,000

See footnotes at end of table.

TABLE 1—Continued

SOUTH AFRICA: OUTPUT OF MINERAL COMMODITIES[1]

Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Gypsum, crude		406,743	390,765	420,146	333,771	284,389	500,000
Industrial sand and gravel (quartz, glass sand)	thousands tons	2,182	1,986	2,068	1,750	1,738	2,000
Lime[5]	do.	1,939	1,830	1,765	1,686	1,599	2,000
Magnesite, crude		75,695	114,182	92,634	60,085	67,403	120,000
Mica, scrap and ground		1,708	1,765	1,883	r2,079	1,991	2,000
Nitrogen: N content of ammonia		455,200	456,200	457,000	540,500	e607,000	550,000
Perlite		1,950	200	41	97	328	2,000
Phosphate rock:							
Gross weight	thousand tons	2,963	3,165	3,050	3,051	2,496	3,200
P_2O_5 content	do.	1,111	1,190	e1,150	e1,150	e940	1,225
Pigments, mineral, natural:							
Ochers		1,180e	2,710e	999	890	1,175	3,000
Oxides		e150	e200	123	224	11	250
Total[3]		1,327	2,909	1,122	1,114	1,186	3,250
Salt		692,391	728,110	664,624	701,991	613,301	800,000
Silcrete[5]		4,079	1,244	—	—	—	—
Sodium sulfate, natural		15	e20	—	37,169	36,380	50,000
Stone, n.e.s.:							
Dimension:							
Granite and norite		626,800	692,400	806,100	600,019	528,310	800,000
Marble[6]		6,000	11,500	12,100	17,200	20,600	25,000
Slate		33,900	29,400	26,282	26,344	22,019	50,000
Crushed and broken:							
Limestone and dolomite	thousand tons	18,903	19,946	19,971	19,782	18,215	20,000
Nepheline syenite		141	e200	20,966	174,864	—	200,000
Quartzite[5]		290	113	977	235	274	1,000
Shale		398,374	386,286	391,108	300,836	331,394	500,000
Aggregate and sand, n.e.s.	thousand tons	47,016	38,654	34,455	31,141	27,142	70,000
Sulfur:							
S content of pyrite	thousand tons	461	452	293	384	323	500
Byproduct:							
Metallurgy[e]	do.	100	110	105	100	145	150
Petroleum[e]	do.	120	120	120	120	120	120
Total[3 4]	do.	682	683	517	605	588	770
Talc and related materials:							
Talc		11,596	11,179	8,235	13,882	8,798	15,000
Pyrophyllite (wonderstone)		3,942	2,759	4,448	3,053	4,287	5,000
Vermiculite		224,500	220,311	214,656	170,399	211,143	230,000
MINERAL FUELS AND RELATED MATERIALS							
Coal:							
Anthracite	thousand tons	4,208	3,622	2,689	3,345	3,246	4,000
Bituminous	do.	172,075	171,161	175,507	r171,047	178,980	200,000
Total[3]	do.	176,283	174,784	178,196	174,392	182,226	204,000

See footnotes at end of table.

TABLE 1—Continued

SOUTH AFRICA: OUTPUT OF MINERAL COMMODITIES[1]

Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
MINERAL FUELS AND RELATED MATERIALS—Continued							
Petroleum refinery products:							
Liquefied petroleum gases	thousand 42-gallon barrels	r1,554	r1,508	r1,543	r1,543	2,460	2,500
Gasoline	do.	r49,793	r51,595	r54,587	r54,545	57,446	60,000
Jet fuel	do.	r5,440	r5,584	r5,600	r6,480	6,346	6,500
Kerosene	do.	r3,674	r3,883	r3,813	r3,906	4,678	4,800
Distillate fuel oil	do.	r51,213	r35,510	r34,428	r33,943	31,136	40,000
Residual fuel oil	do.	r12,960	r13,307	r13,626	r15,884	e16,000	20,000
Lubricants (including greases)	do.	r2,520	r2,394	r2,310	r2,240	2,503	2,550
Bitumen	do.	2,151	1,963	1,673	1,739	1,784	2,200
Other[7]	do.	r931	r819	r812	r686	e700	1,000
Total[8]	do.	r126,290	r129,575	r116,849	r119,423	e120,593	137,050

[e]Estimated. [r]Revised.

[1]Table includes data available through Feb. 4, 1994.

[2]Data are for the year ending June 30 of that stated.

[3]Data may not add to totals shown because of independent rounding.

[4]Reported figure.

[5]Domestic sales plus exports.

[6]Converted from reported cubic meters (m^3) figure using 1 m^3=2.7 tons.

[7]Includes naphthas, paraffin wax, petroleum coke, petrochemical feedstocks, unfinished oils, white spirits, and blending components.

[8]Excludes refinery fuel and losses, amounting an estimated 7 to 8 million 42-gallon barrels per year.

TABLE 2

SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners[1]	Location of main facilities	Annual capacity
Aluminum	Aluminium South Africa (Pty.) Ltd. (Alusaf) (Gencor, 48%; IDC, 34%; Other, 18%)	Alusaf aluminum smelter at Richards Bay	170.
Andalusite	Rhino Andalusite Mines (Pty.) Ltd. (Anglovaal Ltd., 77%)	Timeball Mine, near Thabazimbi	120.
Do.	Damrec of France (private, 100%)	Annesley Mine at Penge, 50 kilometers north of Steelpoort	75.
Do.	do.	Andafrax Mine at Groot Marico, 60 kilometers west of Rustenburg	12.
Do.	Cullinan Minerals Ltd. (South African Mutual Life Insurance, Insurance, 44%; Fermain Nom Ltd., 8%; AAC)	Krugerspost Mine, near Lydenburg	50.
Do.	Verref Mining (Pty.) Ltd. (AAC)	Havercroft Mine at Penge, 50 kilometers north of Steelpoort	36.
Do.	Hoogenoeg Andalusite (Pty.) Ltd.	Hoogenoeg Mine, 60 kilometers northeast of Potgietersrus	15.
Antimony	Consolidated Murchison Ltd. (JCI, 24.1%; Middle Witwatersrand, 5.5%; Anglovaal Ltd., 2.4%)	50 kilometers west of Phalaborwa	9.5 Sb concentrate.
Asbestos	Gencor Ltd. (Gencor Beherend Bpk, 54.8%; AAC, 0.9%)	Penge Mine, 50 kilometers north of Steelpoort	48 (amosite).
Do.	do.	Klipfontein Mine near Sishen	NA (crocidolite).
Do.	Anglo Dutch Exploration & Mining Co. (Pty.) Ltd.	Stella Mine, 25 kilometers east of Barberton	NA (chrysotile).
Cement	Anglo Alpha Ltd. (AAL)	Dudfield plant near Lichtenburg	1,830.
Do.	do.	Ulco plant 60 kilomerters northwest of Kimberley	1,241.
Do.	Blue Circle Cement (Pty.) Ltd. (BCC)	Plant at Lichtenburg	2,000.
Do.	Natal Portland Cement Co. (Pty.) Ltd. (AAL, 33.3%; BCC, 33.3%; Pretoria Portland Cement, 33.3%)	Simumu plant, 125 kilometers southwest of Durban	580.
Do.	Pretoria Portland Cement Co. Ltd. (Barlow Rand Group, 60.3%)	De Hoek, Herculese, Jupiter, Slurry, Riebeeck West, and Port Elizabeth	4.59 Mmt (combined), clinker.
Chromite	Samancor Ltd. (Gencor, 41%; Delauney Ltd., 24.9%; De Beers, 8.7%; Genbel Investments Corp. Ltd., 1.6%; ASA Ltd., 0.3%)	Winterveld Mine at Steelpoort	1,000 ore.
Do.	do.	Henry Gould, 30 kilometers east of Rustenburg	640 ore.
Do.	do.	Mooinooi Mine, 30 kilometers west of Brits	456 ore.
Do.	do.	Millsell Mine, 8 kilometers east of Rustenburg	90 ore.
Do.	do.	Grasvally Mine, near Potgietersrus	1,000 ore.e
Do.	Consolidated Metallurgical Industries (Pty.) Ltd. (JCI, 49.9%; AAC, 26.4%)	Purity Mine, near Rustenburg	360 ore, 252 concentrate.
Do.	Lavino South Africa (Pty.) Ltd. (Anglovaal Ltd., 51%; Middle Witwatersrand, 49%)	Grootboom Mine, near Lydenburg	500 ore.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners[1]	Location of main facilities	Annual capacity
Chromite—Continued:		Dilokong Chrome Mine (Pty.) Ltd. (Mining Corp. Ltd., 100%)	Dilokong Mine, near Lydenburg	480 ore.
Do.		Chromecorp Technology (Pty.) Ltd. (CI Chromeinvest AG, Germany, 50%; Investinox AG, Germany, 50%)	Chroombronne Mine near Rustenburg	576 ore; 432 concentrate.
Coal		Anglo American Coal Corp. Ltd. (AAC, 51.4%; ASA Ltd., 2.2%)	13 collieries in eastern Transvaal and Natal	46,000 anthracite and bituminous.
Do.		Trans-Natal Coal Corp. Ltd. (Gencor, 44%; Genbel Investments Corp. Ltd., 10.8%)	12 collieries in eastern Transvaal and Natal	40,000 anthracite and bituminous.
Do.		Duvha Opencast Services (Pty.) Ltd. (Rand Mines Ltd., 71%)	Duvha Colliery, 18 kilometers southeast of Witbank	11,000 bituminous.
Do.		Rietspruit Opencast Services (Pty.) Ltd. (Rand Mines Ltd., 50%; Shell S.A., 50%)	Rietspruit Colliery, 30 kilometers southeast of Witbank	9,000 bituminous.
Do.		Sasol Mining (Pty.) Ltd.	Sigma Mine, 75 kilometers south of Johannesburg	7,000 bituminous.
Do.		do.	Secunda Collieries, 75 kilometers south of Witbank	31,000 bituminous.
Do.		Iscor Ltd. (De Beers, 3.4%; AAC, 0.7%)	Grootegeluk Mine, 120 kilometers north of Thabazimbi	6,300 bituminous; 1,700 coking coal.
Do.		do.	Durnacol Mine at Dannhauser, 40 kilometers south of Newcastle	1,200 coking coal.
Do.		do.	Hlobane Mine, 100 kilometers east of Newcastle	700 coking coal.
Do.		do.	Tshikondeni Mine in Venda, about 100 kilometers southeast of Messina	200 coking coal.
Copper		Palabora Mining Co. Ltd. (Rio Tinto Zinc Corp. plc, 38.9%; AAC, 19.1%; De Beers, 9.5%; Middle Witwatersrand, 0.4%)	Palabora Mine and plant at Phalaborwa	130 metal.
Do.		O'Okiep Copper Co. Ltd. (GFSA, 82%; Mellon Securities Trust Co., 18%)	O'Okiep copper mine, 20 kilometers north of Okiep	40.
Do.		Black Mountain Mineral Development Co. (Pty.) Ltd. (GFSA, 55.4%; Phelps Dodge Corp., U.S.A., 44.6%)	Black Mountain Mine, 100 kilometers northwest of Okiep	2.5 Cu in concentrate.
Diamond	million carats	De Beers (Anglo American Investment Trust Ltd., 25.8%; AAC, 6.9%; ASA Ltd., 0.3%)	Finsch Mine, 100 kilometers west of Kimberley	4.6.
Do.	do.	do.	Kimberley Mines, Kimberley	.8.
Do.	do.	do.	Koffiefontein Mine, 70 kilometers south of Kimberley	.2.
Do.	do.	do.	Namaqualand Mines, 50 kilometers north of Port Nolloth	1.0.
Do.	do.	do.	Premier Mine, 70 kilometers east of Pretoria	2.3.
Do.	do.	do.	Venetia Mine, 150 kilometers north of Potgietersrus	.3.

See footnotes at end of table.

TABLE 2—Continued

SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners[1]	Location of main facilities	Annual capacity
Fluorspar		Transvaal Mining and Finance Co. Ltd. (Gencor, 100%)	Buffalo Mine, 110 kilometers northeast of Pretoria	— (closed).
Do.		Vergenoeg Mining Corp. (Pty.) Ltd. (Bayer AG, Germany, 100%)	Vergenoeg Mine, 90 kilometers east of Pretoria	200 acid- and metallurgical-grade fluorspar.e
Do.		Phelps Dodge Mining (Pty.) Ltd. (Phelps Dodge Corp., U.S., 100%)	Witkop Mine, 130 kilometers west of Johannesburg	75 acid-grade fluorspar.e
Do.		Van Den Heever Vloeispaat Werke	Van Den Heever Mine, 120 kilometers west of Johannesburg	50.e
Gold	tons	AAC (De Beers, 38.7%; ASA Ltd., 0.1%)	Freegold near Welkom, Vaal Reefs near Klerksdorp, Western Deep Levels, 70 kilometers southwest of Johannesburg	260 Au.
Do.	do.	GFSA (GFSA Holdings Ltd., 43%; Anglo American Gold Investment Co., 10.8%; AAC, AAC, 8.9%; De Beers, 1.3%)	East Driefontein and West Driefontein, 65 kilometers southwest of Johannesburg; Kloof, 55 kilometers southwest of Johannesburg; and others	125 Au.
Do.	do.	(Gencor Beherend Bpk, 54.8%; AAC, 0.9%)	Buffelsfontein near Klerksdorp; Beatrix, 35 kilometers southeast of Welkom, Winkelhaak, 120 kilometers southeast of Johannesburg; and others	90 Au.
Do.	do.	Rand Mines Ltd. Barlow Rand Ltd., 74%)	Harmony Mine, 20 kilometers southeast of Welkom and others	55 Au.
Do.	do.	Anglovaal Ltd. (Anglovaal Holdings Ltd., 49.7%; South African Mutual Life Insurance, 10.7%; Middle Witwatersrand, 2.9%; De Beers, 2.8%)	Hartebeestfontein Mine near Klerksdorp and others	45 Au.
Do.	do.	JACI (AAC, 39.8%; South African Mutual Life Insurance, 8.9%; De Beers, 8.4%)	Randfontein Mine, 20 Kilometers west of Johannesburg; Western Areas Mine, 30 kilometers southwest of Johannesburg; and others	41 Au.
Iron and steel:				
Iron ore		Iscor Ltd. (De Beers, 3.4%; AAC, 0.7%)	Sishen Mine at Sishen	21,500 ore.
Do.		do.	Thabazimbi Mine at Thabazimbi	2,500 ore.
Do.		Highveld Steel and Vanadium Corp. Ltd. (Anglo American Industrial Corp. Ltd., 51.8%; De Beers, 3.8%)	Mapochs Mine at Roossenekal, 60 kilometers west of Lydenburg	3,000 titaniferous magnetite ore.
Ferroalloys		Ferrometals Ltd. (Samancor Ltd., 100%)	Witbank	320 ferrochromium.
Do.		Tubatse Ferrochrome (Pty.) Ltd. (Samancor Ltd., 100%)	Steelpoort	300 ferrochromium.
Do.		Batlhako Ferrochrome (Pty.) Ltd. (Samancor Ltd., 100%)	Ruighoek Mine site, 80 kilometers southwest of Thabazimbi	20 ferrochromium.
Do.		Samancor Ltd. (Gencor, 41%; Delauney Ltd., 24.9%; De Beers, 8.7%; Genbel Investments Corp. Ltd., 1.6%; ASA Ltd., 0.3%)	Middelburg	300 ferrochromium.
Do.		do.	Krugersdorp, 30 kilometers west of Johannesburg	120 ferrochromium.
Do.		Consolidated Metallurgical Industries (Pty.) Ltd. (JCI, 49.9%; AAC, 26.4%)	Lydenburg	210 ferrochromium.

See footnotes at end of table.

TABLE 2—Continued

SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners[1]	Location of main facilities	Annual capacity
Ferroalloys—Continued:	do.	Purity in Rustenburg	120 ferrochromium.
Do.	Chromecorp Technology (Pty.) Ltd. (CI Chromeinvest AG, Germany, 50%; Investinox AG, Germany, 50%)	Rustenburg Machadadorp, 80 kilometers east of Middelburg	180 ferrochromium.
Do.	Feralloys Ltd. (Associated Manganese Mines of South Africa Ltd., 100%)		110 ferrochromium.
Do.	do.	Cato Ridge, 75 kilometers west of Durban	130 high-carbon ferromanganese.
Do.	Samancor Ltd. (Gencor, 41%; Delauney Ltd., 24.9%; De Beers, 8.7%; Genbel Investments Corp. Ltd., 1.6%; ASA Ltd., 0.3%)	Meyerton plant, 50 kilometers south of Johannesburg	240 high-carbon ferromanganese; 200 silicomanganese.
Do.	Transvaal Alloys Pty. Ltd., (Highveld Steel and Vanadium Corp., 100%)	Witbank	20 low-carbon ferromanganese; 175 silicomanganese.
Steel	Iscor Ltd. (De Beers, 3.4%; AAC, 0.7%)	Vanderbijlpark plant, 70 kilometers southwest of Johannesburg	4,300.
Do.	do.	Newcastle plant	2,000.
Do.	do.	Pretoria plant	800.
Do.	do.	Cisco plant near Cape Town	150.
Do.	do.	Corex plant in Pretoria	300.
Do.	do.	Ex-Usko plant in Vereeniging, 60 kilometers south of Johannesburg	450.e
Do.	Highveld Steel and Vanadium Corp. Ltd. (Anglo American Industrial Corp. Ltd., 51.8%; De Beers, 3.8%)	Witbank	1,000.
Do.	Columbus Stainless, Ltd. (AAC and De Beers, 33.3%; Gencor, 33.3%; IDC, 33.3%)	Middelburg stainless steel plant	120 stainless steel.e
Manganese	Associated Manganese Mines of South Africa Ltd. (Associated Ore and Metal Corp. Ltd., 45%; Anglovaal Ltd., 44%; Middle Witwatersrand, 6.9%)	Blackrock, Gloria, N'Chwaning Mines near Hotazel, 70 kilometers north of Sishen	1,500 ore.
Do.	Samancor Ltd. (Gencor, 41%; Delauney Ltd., 24.9%; De Beers, 8.7%; Genbel Investments Corp. Ltd., 1.6%; ASA Ltd., 0.3%)	Mamatwan and Wessels Mines near Hotazel, 70 kilometers north of Sishen	3,000 ore.
Petroleum products million 42-gallon barrels	Shell and British Petroleum South Africa Petroleum Refineries Pty. Ltd. (Shell South Africa, 50%; British Petroleum Co., 50%)	Sanref refinery in Durban	73 crude.
Do. do.	Caltex Oil SA Pty. Ltd. (Private, 100%)	Refinery in Cape Town	33 crude.
Do. do.	National Petroleum Refiners of South Africa Pty. Ltd.(Sasol, 100%)	Refinery in Secunda, 100 kilometers southeast of Johannesburg	28 crude.
Do. do.	Genref (Engen Ltd., 62%)	Refinery in Durban	24 crude.

See footnotes at end of table.

TABLE 2—Continued

SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners[1]	Location of main facilities	Annual capacity
Phosphate		Phosphate Development Corp. Ltd. (Foskor Ltd.) (IDC, 100%)	Foskor Mine at Phalaborwa	3,800 gross weight of phosphate rock.e
Platinum-group metals	tons	Rustenburg Platinum Mines Ltd. (JCI, 32.6%; AAC, 23.9%; Lydenburg Platinum Ltd., 8.3%; ASA Ltd., 0.8%)	Rustenburg Mine near Rustenburg, Union and Amandelbult Mines near Northam, 50 kilometers south of Thabazimbi	70 PGM.e
Do.	do.	Lebowa Platinum Mines Ltd. (Rustenburg Platinum Holdings, 21.5%; JCI, 20.1%; Lydenburg Platinum Ltd., 20.1%; AAC, 14.4%; Lebowa Homeland, 9%)	Atok Mine, 70 kilometers east of Potgietersrus	10 PGM.e
Do.	do.	Potgietersrust Platinums Ltd. (JCI, 30.23%; AAC, 22.65%; Lydenburg Platinum Ltd., 7.85%)	Open pit mine near Potgietersrus	10 PGM (in concentrates).
Do.	do.	Impala Platinum Ltd. (Gencor, 40.7%; Genbel Investments Corp. Ltd., 10.8%; ASA Ltd., 0.4%; Rand Mines, Ltd., 0.4%)	Bafokeng North and Bafokeng South Mines, Wildebeestfontein North and Wildebeestfontein South Mines, about 20 kilometers north of Rustenburg	40 PGM.e
Do.	do.	Eastern Platinum Ltd. (Lonhro plc, United Kingdom, 73%; Impala Platinum Holdings Ltd., 27%)	40 kilometers northeast of Rustenburg	3 PGM.e
Do.	do.	Western Platinum Ltd. (Lonhro plc, United Kingdom, 73%; Impala Platinum Holdings Ltd., 27%)	20 kilometers east of Rustenburg	10 PGM.e
Do.	do.	do.	Karee Mine, 25 kilometers northeast of Rustenburg	5 PGM.e
Do.	do.	Barplats Investments Ltd. (Impala Platinum Holdings Ltd., 38%; Rand Mines Ltd., 30.6%; Vansa Vanadium, 3.2%)	Crocodile River Mine near Brits	10 PGM.
Do.	do.	Northam Platinum Ltd. (GFSA, 63%; New Wits Ltd., 3.1%)	Northeast of Northam, 20 kilometers south of Thabazimbi	10 PGM.e
Pyrophyllite		Wonderstone 1937 Ltd. (Associated Ore and Metal Co. Ltd., 100%)	Gestoptefontein Wonderstone Quarry near Ottosdal, 70 kilometers west of Klerksdorp	4.e
Titanium concentrate		Tisand (Pty.) Ltd./Richards Bay Minerals (Rio Tinto Zinc Corp. Plc., 50%; Gencor, 50%)	Opencast operations near Richards Bay	125 rutile concentrate; 1,280 ilmenite.
Titanium slag		Richards Bay Iron and Titanium Corp.e Richards Bay Minerals (Rio Tinto Zinc Corp. plc, 50%; Gencor, 50%)	Smelter at Richards Bay	1,000 slag.
Uranium	tons	Vaal Reefs Exploration and Mining Co. Ltd. (Anglo American Gold Investment Co., 16.8%; AAC 10.8%; ASA Ltd., 3.1%; Genbel Investments Corp. Ltd., 1.3%; Middle Witwatersrand, 0.9%; New Wits Ltd., 0.4%)	Mine and plant near Klerksdorp	2,000 uranium oxide.e

See footnotes at end of table.

TABLE 2—Continued

SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners[1]	Location of main facilities	Annual capacity
Uranium—Continued:	tons	Buffelsfontein Gold Mining Co. Ltd. (Anglo American Gold Investment Co., 20.2%; AAC, 8.7%; Gengold Ltd., 8.6%)	Mine and plant, 15 kilometers southwest of Klerksdorp	400 uranium oxide.e
Do.	do.	Hartebeestfontein Gold Mining Co. Ltd. (Zandpan Gold Mining Co. Ltd., 19.6%; Anglo American Gold Investment Co., 15.5%; AAC, 7.5%; Anglovaal Ltd., 4.6%; Middle Witwatersrand, 2.8%; ASA Ltd., 2.2%)	Mine and plant, 5 kilometers southeast of Klerksdorp	400 uranium oxide.e
Do.	do.	Western Areas Gold Mining Co. Ltd. (Elsburg Gold Mining Co. Ltd., 48.7%; JCI, 6.5%; Anglo American Gold Investment Co., 2.5%; AAC, 2.2%)	Western Areas Mine, 30 kilometers southwest of Johannesburg	500 uranium oxide.e
Do.	do.	Free State Consolidated Gold Mines Ltd. (Freegold) (Orange Free State Investments Ltd., 49.9%; Anglo American Gold Investment Co., 6.5%; Welkom Gold Mining Co. Ltd., 5.2%; AAC, 3.2%; Middle Witwatersrand, 0.3%)	Mine and plant near Welkom	500 uranium oxide.e
Do.	do.	Palabora Mining Co. Ltd. (Rio Tinto Zinc Corp. plc, 38.9%; AAC, 19.1%; De Beers, 9.5%; Middle Witwatersrand, 0.4%)	Palabora Mine and plant at Phalaborwa	200 uranium oxide.e
Vanadium	tons	Highveld Steel and Vanadium Corp. Ltd. (Anglo American Industrial Corp. Ltd., 51.8%; De Beers, 3.8%)	Mapochs Mine near Lydenburg	25,000 vanadium pentoxide.e
Do.	do.	do.	Highveld slag plant in Witbank	17,000 vanadium pentoxide.
Do.	do.	do.	Highveld Vantra plant in Witbank	8,000 vanadium pentoxide.
Do.	do.	Vametco Minerals Corp. (Strategic Metals Corp., U.S.A., 100%)	Krokodilkraal Mine and plant near Brits	5,000 vanadium pentoxide.e
Do.	do.	Transvaal Alloys Pty. Ltd., (Highveld Steel and Vanadium Corp., 100%)	Wapadskloof Mine and plant near Witbank	2,250 vanadium pentoxide.e
Do.	do.	Vanadium Technology Ltd. (Vantech) (Chromecorp Technology (Pty.) Ltd., 100%)	Kennedy's Vale (ex Vansa Vanadium) Mine and plant near Lydenburg	3,600 vanadium pentoxide.
Do.	do.	Rhombus Vanadium Holdings Ltd. (Rhombus Exploration Ltd., 50%; Usko Ltd., 50%)	Ba-Mogopa Mine and Usko plant near Brits	7,500 vanadium pentoxide.e
Vermiculite		Palabora Mining Co. Ltd. (Rio Tinto Zinc Corp. plc, 38.9%; AAC, 19.1%; De Beers, 9.5%; Middle Witwatersrand, 0.4%)	Palabora Mine and plant at Phalaborwa	230.e
Zinc		Zinc Corp. of South Africa Ltd. (GFSA, 56%; Iscor Ltd., 35%; New Wits Ltd., 9%)	Struisbult Springs Works in Springs, 35 kilometers southeast of Johannesburg	90 Zn.

See footnotes at end of table.

TABLE 2—Continued

SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners[1]	Location of main facilities	Annual capacity
Zinc—Continued:	Black Mountain Mineral Development Co. (Pty.) Ltd. (GFSA, 55.4%; Phelps Dodge Corp., U.S.A., 44.6%)	Black Mountain Mine near Aggeneys, 100 kilometers northeast of Okiep	26 Zn in concentrate.
Zircon	Tisand (Pty.) Ltd./Richards Bay Minerals (Rio Tinto Zinc Corp. plc, 50%; Gencor, 50%)	Opencast operations near Richards Bay	300 zircon concentrate.
Do.	Palabora Mining Co. Ltd. (Rio Tinto Zinc Corp. plc, 38.9%; AAC, 19.1%; De Beers, 9.5%; Middle Witwatersrand, 0.4%)	Palabora Mine and plant at Phalaborwa	13.2 baddeleyite.e
Do.	Phosphate Development Corp. Ltd. (Foskor Ltd.) (IDC, 100%)	do.	12.5 baddeleyite.e

eEstimated.

[1]Abbreviations of company names used are as follows: Anglo American Corp. of South Africa Ltd. (AAC); De Beers Consolidated Mines Ltd. (De Beers); General Mining, Metals and Minerals Ltd. (Gencor); Gold Fields of South Africa Ltd. (GFSA); Investment Development Corp. of South Africa (IDC); and Johannesburg Consolidated Investment Co. Ltd. (JCI).

TABLE 3

SOUTH AFRICA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1993

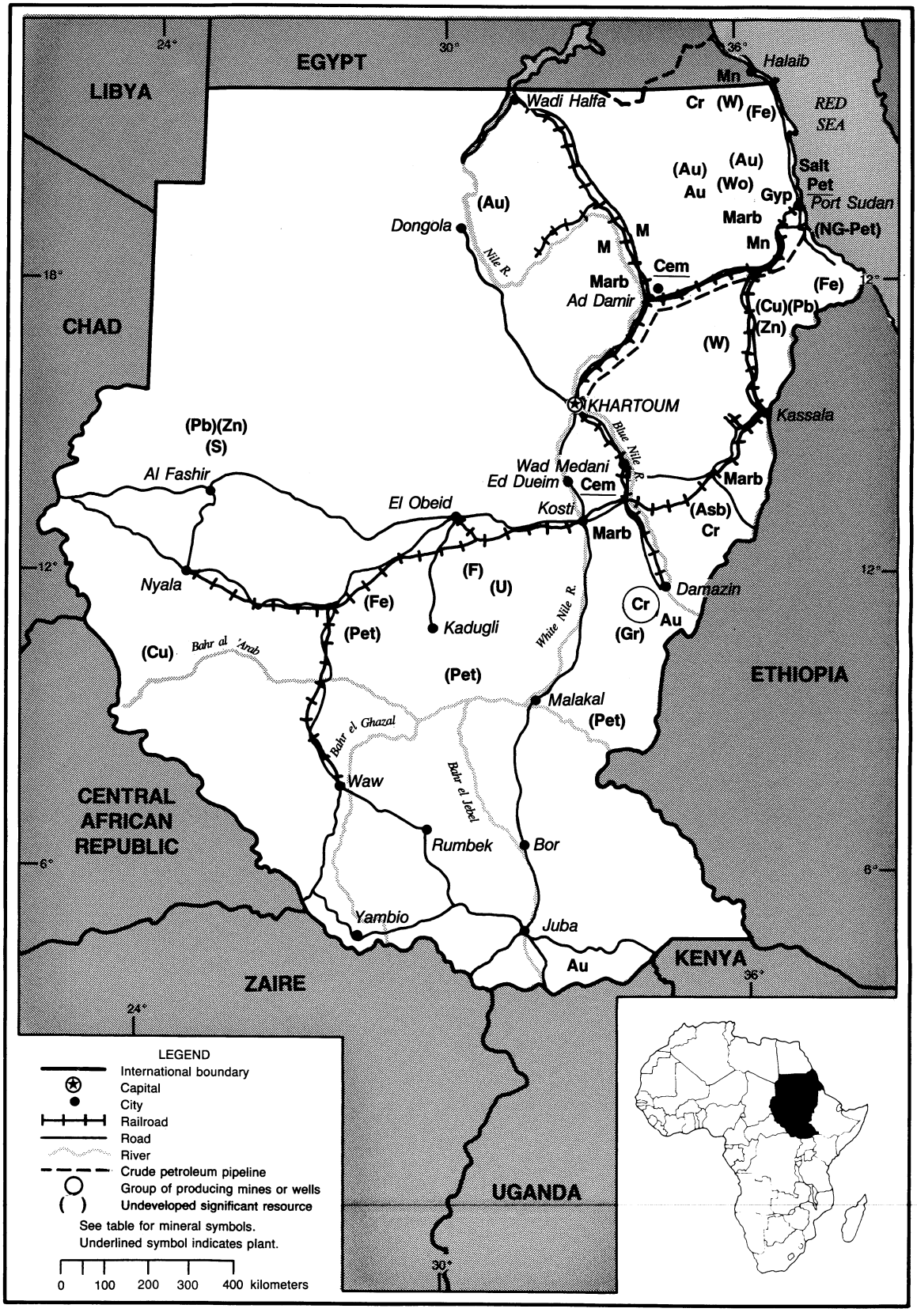
(Million metric tons unless otherwise specified)

Commodity		Reserve base[1]
Andalusite[2]		50.
Antimony	thousand tons	250.
Asbestos		8.2.
Chromium		3,200 (ore).
Coal		55,300.
Cobalt	thousand tons	15.
Copper		13.
Fluorspar		36.
Gold	thousand tons	18.[3]
Iron ore		5,900.
Lead		5.
Manganese		3,992.
Nickel		11.8.
Phosphate rock		2,310 concentrate.
Platinum-group metals	thousand tons	58.9.
Silver	do.	10.
Titanium		45.
Uranium	thousand tons	179.1.[4]
Vanadium		12.5.
Vermiculite		80.
Zinc		15.
Zirconium		15.3.

[1]Metallic minerals are contained metal.
[2]Includes sillimanite.
[3]Mine leases only. The Economic Geology Research Unit of the University of the Witwatersrand estimates a reserve base, including that of undeveloped fields, of 40,000 tons of gold.
[4]Recoverable at a cost of less than $80/kilogram.

SUDAN

AREA 2,505,810 km² **POPULATION 28.7 million**



THE MINERAL INDUSTRY OF

SUDAN[1]

By Lloyd E. Antonides

The principal minerals produced in Africa's largest country, more than one-fourth the size of the United States, included cement, chromite, gold, gypsum, limestone, petroleum refinery products, and salt. A very small amount of crude oil for domestic use also was produced in 1993. The country had a larger potential for oil and gas, gold, and chromite as well as for manganese ores and several industrial minerals. Nevertheless, the mineral industry contributed very little to Sudan's gross domestic product (GDP). Chromite, gold, and salt were the main mineral exports but provided less than 1% of export revenues. However, imports of petroleum refinery products and crude oil were very significant factors of trade.

The economy, with a GDP nominally about $6 billion in 1993, again showed some growth primarily attributed to favorable agriculture conditions in the eastern half of the country. The agriculture sector typically contributed nearly 40% to GDP, employed about 80% of the work force, and provided almost all of the exports, more than 50% of which was cotton. But inflation rates of more than 100% and high deficits in the Government budget and the balance of trade persisted. Also, unemployment remained high, about 30%, and per capita GDP remained low, about $200. The ambitious 3-year economic liberalization program instituted in January 1990 had met certain commercial goals and was renewed, but it had neither cut inflation or stabilized the exchange rate nor attracted much foreign investment, and a number of reforms were reversed during 1993. Failure to repay debts and proceed with reforms led to serious difficulties with the World Bank and International Monetary Fund.

The costly unresolved 10-year-old civil war in the south was a major fiscal problem involving the largest army in the sub-Sahara other than the Republic of South Africa. There were other obstacles to an improved economy as well: agricultural problems; a stagnant industrial sector; high population growth rate of about 3%; and a large displaced population requiring humanitarian assistance.

Politically, besides the civil war, which had some religious aspects, a more widespread religious controversy continued to be a major problem for the military Government established by coup in 1989. A dispute continued with Egypt over mineral rights in the triangular zone along Sudan's border with Egypt and the Red Sea known as the Halaib area.

GOVERNMENT POLICIES AND PROGRAMS

The Government continued to declare a policy of encouraging foreign investments, especially in minerals, as it had even before the Investment Encouragement Act of 1980. However, the commercial climate continued to be considered less than favorable by some observers because of ramifications of Islamic law imposed in 1991 over the northern half of the country; problems with lengthy bureaucratic procedures; some political favoritism in issuance of business licenses; regulations that discouraged new inflows of foreign exchange to banks; and other remaining subsidies and price controls.

The Government nationalized private industries, including mining, in 1971. But in 1979, Sudanese nationals regained their control of at least certain companies, and thereafter the Government had no further involvement with such local firms. However, the Government apparently usually held equity in any foreign company venture and Government entities were reported to account for more than 70% of new investment in 1993.

A new Minister of Energy and Mining was appointed in January 1993. The Geology and Mineral Resource Department of the Ministry continued to develop geologic maps and investigate potentially economic mineral occurrences.

PRODUCTION

Information on mineral output was very limited and generally considered of doubtful reliability. Probably the significant events for 1993 were a continuation of the steady increase in gold production, an apparently short-lived production of crude oil, and presumably a reduced output of petroleum refinery products.

The principal additional gold was reported from the Hassai Mine operated by the French Bureau de Recherches Geologiques et Minieres (BRGM). The crude oil came from one or more of the most western fields, around Abu Gabra near Muglad, about 750 km southwest of Khartoum. It was refined locally in a topping refinery. Ownership of the concessions and plant were unclear. Reportedly, the wells began producing only salt water rather early in 1993, and the refinery products were poor grade. Press reports indicated the Port Sudan refinery doubled its normal output in 1991 but had difficulties in securing crude supplies in 1992 and 1993. One estimate was that in 1992 and 1993 the plant ran at perhaps 65% of 1991's rate.

TRADE

Mineral exports had little significance in value or volume to overall trade figures, but normally included chromite, gold, salt, and frequently manganese ore. Mineral commodity imports were significant to trade values and volumes, with petroleum refinery products and crude oil being the major components. Fertilizer as well as structural steel imports also were significant. In terms of value of all exports, mostly agricultural, the destinations were typically Western Europe for almost 50%, Arab countries for more than 15%, and the United States for less than 5%. Sources of imports typically included about one-third from Western Europe, one-third from Arab countries, and 15% from the United States.

Press reports stated that during 1992 Iran had entered into trade and infrastructure assistance agreements with Sudan and was supplying crude oil and products as well as military equipment and supplies. However, early in 1994 the Finance Minister said that since early 1993 all oil and petroleum products were being purchased on the spot market, presumably for cash. Agricultural trade and cooperation agreements were signed with Iraq to which Sudan was shipping meat.

STRUCTURE OF THE MINERAL INDUSTRY

State-owned companies were a major factor in the mineral industry of Sudan starting in the early 1970's. Although private firms also began operating in 1979, the Government apparently held some equity ownership in any production ventures that had foreign participation, with the possible exception of crude oil.

COMMODITY REVIEW

Metals

Gold.—The Ariab Mining Co., owned 45% by BRGM and 55% by the Government's Sudanese Mining Co., planned to raise its output of gold doré bullion to 2,200 kg in 1994 and eventually to 3,000 kg/a, as compared to 1,600 kg in 1993, according to local press reports in mid-1994. Ariab was reported as having been formed in 1990, although a joint venture of the same parties had been reported in 1981. BRGM, operator of the venture, started work in the so-called Ariab Basin area, centered about 200 km west of Port Sudan, in about 1987. A 150-mt/d ore open pit was opened at the Hassai Mine site in 1989. In late 1991, existing heap-leaching facilities, presumably used for feasibility tests, were rehabilitated, and doré-bullion was poured in December 1991. At that time plans were to increase output to 100 kg/month by October 1992. Further increases presumably continued to be made. Press reports in early 1994 said the company also planned to increase its concession area. A group of five expatriates and six Sudanese were killed in a takeoff crash at Ariab's mine airport in June 1993.

Two other gold ventures that started up in the past few years, one by Minex (Greenwich Resources) and the other by Kenmare Resources, apparently remained closed since 1990. Both of these were in the Red Sea Hills in the quadrant northwest of Port Sudan, roughly centered about 600 km northeast of Khartoum. Early in 1993, the Government was reportedly negotiating with a number of international companies over prospecting licenses for gold in that area as well as for areas in the north (just east of the Nile south of Wadi Halfa, about 600 km north of Khartoum), and in the south at several places near the borders with Ethiopia and Uganda.

Manganese.—Egyptian plans to mine manganese ore in the Halaib Triangle area in the northeast on the Red Sea coast continued to raise objections from the Sudan Government. Apparently, since 1899 during the British colonial period when the 22° parallel was established as the international boundary, the area was considered to be Egyptian territory, but according to an agreement in 1902 the population and activities remained under the administration of Sudan authorities. A bilateral agreement in 1956 was said to have confirmed that status. Early in 1993, the Egyptian Government announced a broad geological investigation program in the area and was said to have already sent technical and political administrative personnel into the field. A petroleum concession along the coast granted in 1991 by Sudan and declared illegal by Egypt apparently precipitated the controversy that was unresolved as of mid-1994.

Industrial Minerals

Cement.—Expansions at Sudan's two cement plants, which were owned by the Government, were expected to raise total output about 15% in 1994, according to the Arab Union for Cement and Building Materials. The Atbara Cement Co. Ltd. operation was about 275 km northeast of Khartoum and the Nile Cement Co. facility was about 250 km south of Khartoum at Rabak. Annual capacities for finished cement in 1990 before expansions started were estimated respectively at 150,000 tons and 100,000 tons. In the Cembureau's 1991 Directory, the Atbara plant was slated for expansion of capacity to 375,000 mt/a burning (clinker) and 500,000 mt/a grinding by 1991, and the Rabak plant was projected to increase capacity to 300,000 mt/a, presumably of finished cement, in the early 1990's.

Mineral Fuels

Natural Gas.—International Petroleum Corp. (IPC) of Canada delayed a planned 1993 appraisal well aimed at following up a promising 1992 seismic survey of the Suakin gas/condensate field in the so-called Delta Tokar block that is onshore and offshore southeast of Port Sudan on the Red Sea just north of Eritrea. Although its 6-year concession began in December 1991, probably owing to work requirements, IPC reportedly had only until June 1994 to complete the well and in early 1994 was still trying to find a farm-out partner. Discovered by

Chevron with a drillhole in 1976, the field was indicated by IPC's seismic work to be more extensive with the structural crest at a different location. The planned hole was to be 5 km southeast of the discovery hole. In case of production, the concession would be extended to at least 25 years.

Work on IPC's other oil and gas concession to the north on the coast in the Haliab area was delayed pending resolution of the sovereignty dispute between Sudan and Egypt.

Petroleum.—Production of up to 1,000 bbl/d of crude oil continued for at least part of 1993 from at least one well in the Abu Gabra area just south of Muglad, about 750 km southwest of Khartoum. However, press reports in July 1993 said the field eventually produced only saltwater. This first commercial crude production in Sudan started late in 1992 from the country's first discovery well originally drilled in 1979 by Chevron. Chevron reliquished its rights on that and other adjacent fields to the Government in 1990. The output was processed in a nearby 2,500-bbl/d-capacity topping plant that started production in December 1992. At yearend 1993, the products were reported to have been of poor quality and caused equipment breakdowns in Khartoum user plants.

Ownership of the operations was unclear. Some reports referred to a Government venture that had some help, at least initially, from the Romanian company, Rompetrol. Other reports attributed the facilities to a Sudanese company, Concorp International, Ltd. Concorp was the company to which, in June 1992, Chevron sold its last remaining interests. These consisted mostly of two large blocks, known as Muglad and Melut, after nearby communities, totaling 170,000 km² extending from east of Abu Gabra almost to the Ethiopian border. Although terms of sale were not fully disclosed in the press, one report at the time mentioned $25 million, a tiny fraction of nearly $1 billion spent by Chevron over much of the country from 1974 to 1990. In July 1992, Concorp announced plans to start production when a 2,500-bbl/d topping plant was completed in a few months at Abu Gabra and eventually raising output to supply a proposed 40,000-bbl/d refinery. However, within a few months Concorp was said to have sold the concessions to the Government.

Arakis Energy Corp., an independent oil investment company headquartered in Vancouver, Canada, subsequently acquired certain rights to the former Chevron/Concorp concessions in an arrangement that involved State Petroleum Corp., reported as also being a Vancouver-based company as well as a private Sudanese firm. In December 1992, State announced reaching some understandings with the Government regarding development rights and with Arakis regarding being taken over by Arakis if a concession was conclusively granted. Arakis/State then proceeded to arrange for technical support and to search for financing. The venture developed several proposed programs of progressively smaller scope and consequently lower cost until State finally concluded a production-sharing agreement with the Government and/or Government-owned General Petroleum Corp. in late August 1993. Various terms mentioned by different sources included: a 25-year concession, a $1 million signature bonus payment by State, and a net revenue split allowing State 70% until "payout" and 40% thereafter. As best can be deduced from press reports, the agreement was firm for a permit on only 48,600 km². This covered the Heglig, Unity, and Kaikang Fields in the northern part of the Muglad block that had estimated recoverable reserves of 260 Mbbl mostly at 1,500 m to 2,500 m depth. It also gave a 1-year option of some kind on the remaining 122,000 km² and 40 Mbbl of such reserves in that and the Melut blocks. An option on an even larger area also was mentioned in some press reports.

The development plan announced by Arakis at that time called for three phases: 25,000 bbl/d from Heglig by December 1995 to supply a refinery at Muglad for an investment of $140,000; an additional 40,000 bbl/d from Unity to supply a new refinery near Khartoum; and eventual buildup to an additional 200,000 bbl/d. Timeframes and costs for the latter two phases were not given. Substantial plan revisions followed in the next few months.

Apparently first-year drilling requirements for the first area actually meant only reentering and testing 5 of 34 Chevron holes said to have production potential on the Helig and Unity Fields. That work was done in April and May 1994 prior to start of the June to September rain season and gave combined flows of 15,000 bbl/d of light crude having low sulfur, low metals, and 29° to 43° gravity. Later in 1994 after the rains, at least nine additional holes were to be opened and production capacity progressively increased. In November 1993, contractors had been identified as Roll'n Well Service of Canada for work on existing wells and Parker Drilling Co. of the United States for new exploration drilling. As production facilities were installed, output was to be delivered to topping facilities at Abu Gabra/Muglad.

In March 1994, Arakis announced having secured some additional equity financing for first-phase work, the cost of which was estimated at $88 million to produce 65,000 bbl/d from Heglig and Unity by December 1995. This was after many months of trying for loans and investment quarantees without success, partly because of the Sudan Government's loan delinquencies. A subsidiary of Susquehanna Investment Group, based in Philadelphia, was identified as the source of funds. It was to purchase $40 million of shares over 18 months. Shortly thereafter, State became a 100% subsidiary of Arakis and work started.

About that time, Arakis formed wholly owned State Petroleum Pipelines Ltd. to be majority owner in building and operating an 85,000-bbl/d, 1,500-km pipeline with minimal loadout facilities at Port Sudan. Estimated cost was $300 million. An early report said Arakis would retain only 10% to 20% equity in the venture, which would involve a consortium of companies, at least some of which were to be Sudanese. Later reports mention only loans being arranged by

Strand Partners in London. The Government had previously agreed in principle to the plans and subsequently was reported to have granted exclusivity and rights of way for the project.

At mid-1994, Arakis was planning for 65,000-bbl/d production from the Heglig and Unity Fields by December 1995 to feed a then completed 85,000-bbl/d-capacity pipeline to Port Sudan. An additional 20,000 bbl/d was expected in 1996 from new drilling in the Kaikang Field. Further expansion, up to 300,000 bbl/d in 3 to 5 years, was considered possible depending on infrastructure expansions. Costs estimated by Arakis were: $17 million for reopening the first 14 wells included in a total of $88 million for facilities to produce 65,000 bbl/d from 32 to 36 existing wells on the Heglig and Unity Fields by December 1995; $60 million for work on Kaikang; and $300 million for the pipeline and port facilities. However, one report also cited an expenditure of $230 million through 1996 or 1997, not including the Kaikang work or the pipeline.

Total, a major French oil company, continued to raise concerns early in 1994 about safety of personnel and property if it was to restart work on its three exploration blocks in the midsouth near Malakal. Because of civil war hostilities, work stopped in 1985, and the Government had allowed a force majeure moratorium until November 1993 when control of the area had been considered regained for almost 1 year. The permits were renewable annually each summer. In early 1994, the Government was urging Total and a French canal contractor to return to work and to help clear widespread landmines in the area.

Elf Aquitaine, another French oil major, was approached in mid-1993 by Government representatives to take up some of Chevron's former permits. French officials indicated some interest in western Sudan because of Elf's work in Chad.

Refinery.—A 2,500-bbl/d-capacity topping plant near the Abu Gabra Oilfield started up in December 1992, and in May 1993 a Government official said it was operating at 1,000 bbl/d. Ownership was unclear but most likely was by the Government. However, it probably was shut down shortly thereafter because the original supply wells were reported producing only water in July 1993. There were also reports of poor product quality.

A refinery study costing $180,000 was reported early in 1994 to have been contracted with Arthur D. Little (London) by the Government. The project was to be based on oil from the southern fields discovered by Chevron in the 1980's and to cost less than $200 million, including a pipeline. The cost parameter was said to indicate a small and/or simple installation. No relationship with the Arakis venture was cited. The Government had previously considered building refineries of 60,000 bbl/d at Kosti, 40,000 bbl/d at Khartoum, and 25,000 bbl/d at Muglad-Abu Gabra. In mid-1994, a press report said the Kosti facility plan had been dropped in favor of smaller plants along a pipeline. Inadequate transportation was cited as the reason. Domestic consumption was about 85,000 bbl/d.

The Port Sudan refinery, started in 1984 by owners Royal Dutch/Shell Oil Co. and British Petroleum Corp. but wholly owned by the Government since 1991, apparently continued to operate but at much less than its design capacity of 24,000 bbl/d. Some reports indicated throughput was never more than one-half that figure. It was variously stated that this resulted from equipment limitations, personnel shortcomings, and/or the lack of crude. Crude suppliers were reluctant to commit because of the Government's arrears on payment for previous shipments.

INFRASTRUCTURE

Sudan's transport system was considered inadequate for the country's size and terrain, which includes large desert and swamp areas. Roads were the primary transportation mode and were badly in need of repair. According to World Bank information, there was only 20,000 km of roads, of which about 10% was paved and another 30% improved. 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 operated much below capacity and more fuel was carried by tanker trucks. There also was about 3,000 km of waterways, mostly connected to the Nile, but that least expensive mode of transportation was little used. Airports were scattered throughout the country, about 10 of which had permanent surface runways. Port Sudan was a deepwater port on the Red Sea that had regular scheduled shipping services. 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. The United Nations funded some work by the Government Energy Research Institute on solar power for rural areas in the west.

Telecommunications were reported barely adequate, and foreign funding was sought for improvements.

OUTLOOK

Other than the promising oil production development, which still faced difficult financial hurdles, continued political and economic instability appeared to deter serious consideration of further exploiting the mineral potential of Sudan for some time. The generally poor infrastructure also would be an obstacle to any significant mineral production increases.

[1]Text prepared July 1994.

OTHER SOURCES OF INFORMATION

Agency

Ministry of Energy and Mining
Republic of the Sudan

P.O. Box 2087
Khartoum, Sudan
Telephone: 755-95 Telex: 22256

Publication

Arab Oil & Gas Directory 1994,
Arab Petroleum Research Center,
7 Avenue Ingres,75016 Paris, France.

TABLE 1
SUDAN: PRODUCTION OF MINERAL COMMODITIES[e] [1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic		150,000	[3]166,538	170,000	250,000	250,000	300,000
Chromium: Chromite, mine output, gross weight (e48% Cr_2O_3)		[3]25,000	[3]12,500	10,000	10,000	10,000	25,000
Gold, mine output, Au content	kilograms	500	100	50	r1,000	1,600	1,800
Gypsum and anhydrite, crude		[3]10,000	5,000	7,000	10,000	10,000	15,000
Petroleum:							
Crude (including lease condensate)	thousand 42-gallon barrels	—	—	—	110	360	2,500
Refinery products:[4]							
Liquefied petroleum gas	do.	100	[3]90	200	r100	100	200
Gasoline	do.	1,100	810	1,400	r900	900	1,500
Jet fuel	do.	400	[3]330	600	r400	400	600
Kerosene	do.	100	100	100	r100	100	100
Distillate fuel oil	do.	1,500	1,380	2,400	r1,600	1,600	2,500
Residual fuel oil	do.	1,200	1,190	2,800	r1,800	1,800	2,800
Other	do.	150	150	300	r200	200	300
Total		4,550	4,050	7,800	r5,100	5,100	8,000
Salt		[3]91,000	[3]68,262	75,000	75,000	75,000	100,000

eEstimated. rRevised.

[1]Includes data available through July 1, 1994.

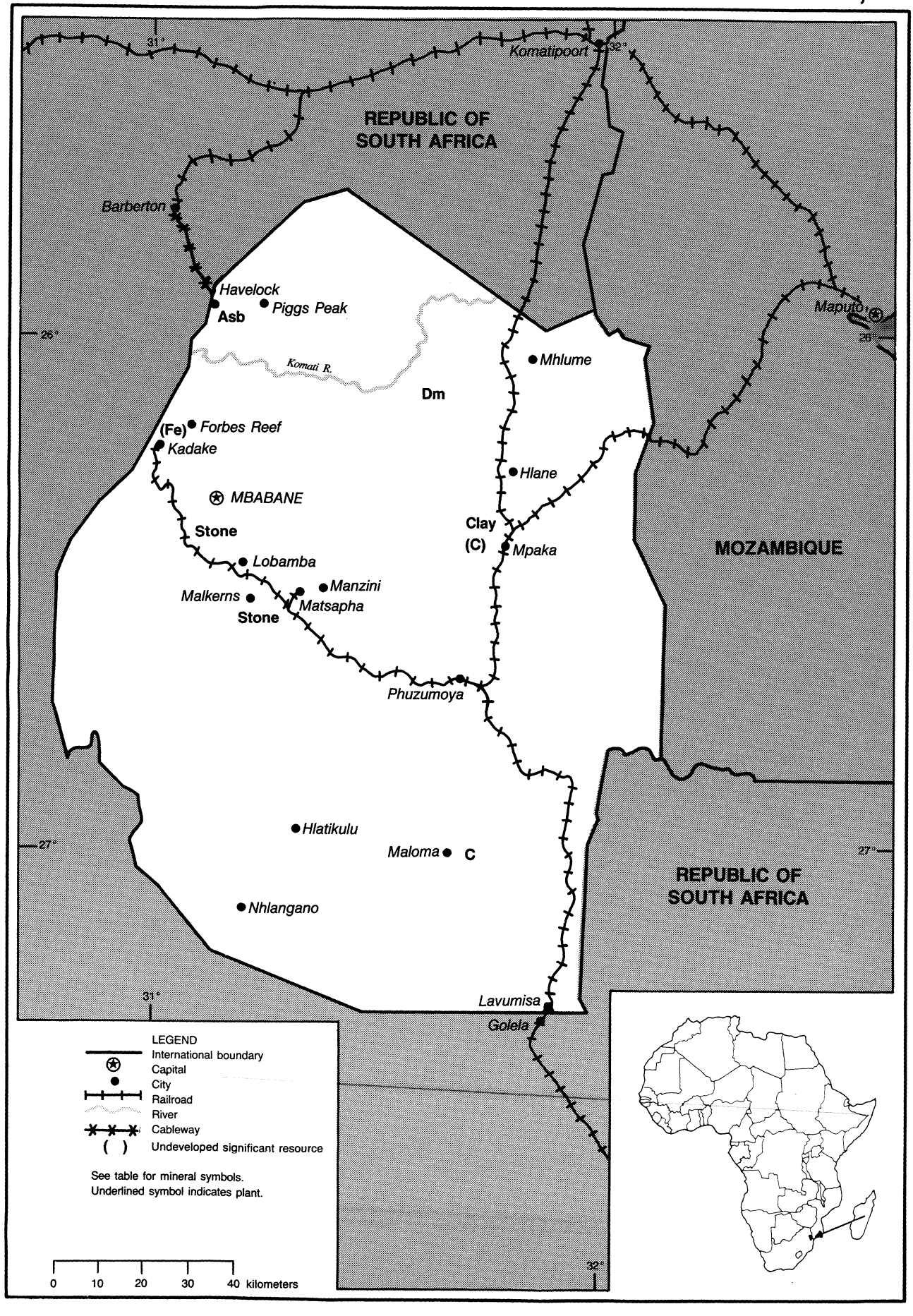
[2]In addition to the commodities listed, the following are presumably produced but available information is inadequate to reliably estimate output: limestone for cement manufacture (at least 1.25 tons per ton of finished cement), as well as for agriculture, lime manufacture, and construction aggregate and fill; clay and/or shale for cement manufacture (normally about 0.4 ton per ton of cement); and other locally used construction materials (clays, sand and gravel, stone, et al.). Also production of manganese ore (48% to 50% Mn) was reported for 1989 at 1,100 metric tons and 1990 at 60,000 metric tons.

[3]Reported figure.

[4]Refinery fuel and losses are included in output of individual products. Capacities of individual products were estimated by inspection of recent annual production data and balanced to fit total.

SWAZILAND

AREA 17,360 km² **POPULATION 907,000**



THE MINERAL INDUSTRY OF

SWAZILAND[1]

By Hendrik G. van Oss

Swaziland in 1993 was a modest, but significant regional producer of asbestos, coal, and diamonds. In years past it has also been a producer of gold, iron ore, tin, and certain industrial minerals such as barite, fluorspar, and pyrophyllite. Among these commodities, coal, gold, and industrial minerals have attracted recent exploration interest.

Mining revenues in 1993 were reported as about $28 million,[2] slightly below the levels in 1992; *the* decline was largely due to a reduced output of coal (*see table 1*). To this could be added an estimated $5 million for the value of brick clay (as brick), but data for this commodity have been unavailable for several years. It is estimated that about 20,000 Swazis were employed in the minerals industry—about 1,000 in Swaziland and the rest in the Republic of South Africa. Although data are incomplete and are primarily for 1992, total wages earned in 1993 by these miners are estimated to have exceeded $100 million. About 10% of Swaziland's population was directly dependent on this income. Mineral commodity industries were thus of economic significance to the country, the gross domestic product of which in 1993 was $995.4 million. Virtually all of Swaziland's mineral production except stone and some brick clay was exported.

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 deposits. Along the northwest Swaziland border is part of an Archean greenstone belt known as the Barberton Mountain Land. This terrane in Swaziland has hosted asbestos, barite, gold, and iron deposits. In east-central Swaziland, a 20-km-wide north-south belt of Karoo sedimentary rocks hosts Swaziland's large coal reserves and some occurrences of industrial minerals. The eastern one-third of the country is made up of a largely economically barren north-south belt of volcanic rocks forming the Lubombo Plateau.

GOVERNMENT POLICIES AND PROGRAMS

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 all mining matters. 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. TTN's free equity share in mining ventures is commonly on the order of 40% to 50%. However, 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.

Because of mining's importance to, particularly, the rural economy, the Government in recent years has acted as an intermediary in mine labor negotiations and has made loans to at least one mine to prevent its closure.

ENVIRONMENTAL ISSUES

Swaziland's mineral industries are relatively small and have yet to attract significant attention in terms of environmental matters. The country lacks smelters or large thermal powerplants, and most of the mines are not mineralogically conducive to problems such as severe acid mine drainage and heavy-metal contamination of water. Dumps at the asbestos mine at Bulembu are a source of local asbestos contamination, and health problems have been noted among asbestos miners there, particularly in the past. The Ngwenya iron mine (now closed) at times was the source of extra sediment input to the local watershed. Locally, it may be presumed that the country's rock and crushed stone quarries, and perhaps the coal mines, have similar problems, especially during periods of high rainfall. Overall, however, the environmental impact of mining in Swaziland appears to have been minor.

PRODUCTION

Output of mineral commodities increased in 1993, with the exception of coal. A new coal mine near Maloma opened during the year, and at yearend was reported to have reached a production rate of about 15,000 mt/month. This initial output, however, did not substantially offset the loss of production from the mine at Mpaka, which closed in 1992. Diamond production increased modestly, but the mine continued to experience technical problems. A continuing program of road building has led to a strong demand for,

and hence production of, crushed stone.

TRADE

Along with Botswana, Lesotho, Namibia, and the Republic of South Africa, Swaziland is a member of the Southern African Customs Union, which provides for duty-free internal shipping, a common external tariff, and access to a market of about 45 million persons. The Republic of South Africa dominates the Customs Union, and, as in years past, perhaps 75% of Swazi exports were sold to or transshipped through that country. Almost 90% of Swaziland's imports either originate in or transit the Republic of South Africa. Trade with the United States generally has been minor and has not involved a significant quantity of mineral commodities.

Detailed trade data for 1993 were unavailable but are likely to have been similar to those for 1992. In 1992, mineral commodity exports were reported to have been worth almost $27.5 million, or about 4% of total exports of $702 million. In addition, it is estimated that clay exports (as brick) were worth about $3 million. Swaziland's coal exports traditionally have been mostly to Kenya and have been exported through Maputo, Mozambique, and/or through South Africa. Asbestos exports are by aerial cableway to Barberton in South Africa, and thence to world markets.

Mineral commodity import data were last available for 1991, but are believed to be representitive of the trade levels in 1993. On this basis, it can be estimated that total mineral commodity imports amounted to about $150 million, of which about $125 million was for refined petroleum products, $5 million for bituminous coal, and the remainder largely for fertilizers. Total imports, by comparison, amounted to about $827 million for the year. These imports were virtually all from the Republic of South Africa. Electricity imports from South Africa in 1993, based on 1991 data from the South African power utility ESKOM, likely were worth about $10 million.

STRUCTURE OF THE MINERAL INDUSTRY

Except for stone quarries, of which there are several, output of Swaziland's major mineral commodities is by a single operation each. Some of the stone quarries operate on an intermittent basis and are geared to local road-building requirements. There are no significant value-added mineral industries, such as smelters, in the country.

Mines in Swaziland employed about 1,000 workers in 1993, but this work force was dwarfed by the approximately 19,000 Swazis who were employed by mines in the Republic of South Africa. According to 1992 data from the Chamber of Mines of South Africa, about 15,000 of these workers were employed by gold mines.

COMMODITY REVIEW

The most significant development in the Swazi mineral industry in 1993 was the opening about midyear of a new coal (anthracite) mine, at Maloma. The operating company, Maloma Colliery Ltd., is 50% owned by Carbonex Co. of Denmark, and the remaining equity is with the Government. Output is to reach a rate of 250,000 to 300,000 mt/a, but did not reach this rate during the year. Although details were not available, it was expected that the new mine would employ at least some of the 220 workers made available by the closure of the Emaswati coal mine near Mpaka in 1992.

The asbestos mine at Bulembu, under new ownership and management since 1991, continued to operate near capacity levels. Notwithsatnding a significant increase in output, a number of technical difficulties were reported for the country's sole diamond mine, at Dvokolwako, northwest of Hlane. According to Trans Hex Group Ltd. of South Africa, the operator and 50% owner of the mine, problems were experienced with water seepage, comminution of the mixed soft clay-rich and hard kimberlite ore, and increasingly marginal grades. In line with its increased production costs and generally lackluster diamond prices, the company reported that it was renegotiating its royalty rate to the Government.

INFRASTRUCTURE

Swaziland's road and railroad network is considered to be generally adequate to serve the mining industry. Asbestos mining is an exception. The asbestos mine, located in mountainous terrain, ships its ore by aerial cableway to South Africa (Barberton). Swaziland's first railroad, from Kadake to the Mozambique border, was built to export ore from the now closed iron mine northwest of Mbabane. In recent years, part of the same line has served to export coal when security conditions in Mozambique permitted. A more recent north-south railroad was built to allow the rapid transportation of South African goods, including minerals, through Swaziland, chiefly to the South African ports of Richards Bay and Durban.

Swaziland's electrical generation capacity and grid have been a problem for industrial development. The generation capacity totals about 60 MW, installed in a number of coal and diesel and/or fuel oil thermal plants. The coal-fired plants are designed for imported South African bituminous coal rather than the harder-to-ignite Swaziland anthracite. However, projects have been mooted to build anthracite-burning plants on the Swaziland coalfields. Swaziland typically imports about $10 million in electricity (about 357 GW • h in 1991) annually from Eskom in South Africa, and plans were being made to build additional power lines from that country.

OUTLOOK

Barring the delineation of new reserves, asbestos production in Swaziland is expected to wind down about 1996. The country's sole diamond mine is facing economic difficulties and its future viability is in some doubt. No significant discoveries have yet to be announced resulting from recent gold exploration programs in northern and

northwestern Swaziland, although there remains the possibility of development of gold mining on a small scale. Swaziland has a number of deposits of industrial minerals and some of these may yet be developed on a modest scale. Coal appears to be the most promising commodity for sustained and/or increased output over the long term. Although still something of a problem, constraints on the export of coal through Mozambique should diminish as security conditions in that country improve and as rehabilitation of the coal terminal at Matola (Maputo) is completed. Exports through South Africa could increase as the coal terminals at Richards Bay are expanded.

Of concern to Swaziland, economically tied to and three-quarters surrounded by the Republic of South Africa, are the economic, political, and social uncertainties pertaining to the April 1994 elections in South Africa. For example, it is as yet unclear if the Southern African Customs Union, which has benefitted Swaziland to a significant degree, will be maintained. The future of migrant labor in South African mines (and hence of wages repatriated to Swaziland), and of the mines themselves, was in question. Various proposals were being made in South Africa in early 1994 pertaining to migrant labor—these included elimination of this employment, maintaining the status quo, and offering South African citizenship to at least long-term labor contract holders.

[1]Text prepared Mar. 1994.

[2]Where necessary, values have been converted from Swazi emalangeni (E) to U.S. dollars at the rate for 1993 of E3.26=US$1.00. The conversion rate for 1992 was E2.85=US$1.00.

OTHER SOURCE OF INFORMATION

Geological Survey and Mines Department
P.O. Box 9
Mbabane, Swaziland
Telephone: 268-42411
Fax: 268-45215

TABLE 1
SWAZILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Asbestos, chrysotile fiber		27,291	35,938	13,888	32,301	33,860	40,000
Coal, anthracite		165,122	150,967	122,502	100,220	19,550	300,000
Diamond	carats	55,264	42,484	57,420	50,546	61,686	60,000
Stone: Quarry product	cubic meters	128,463	155,347	128,759	232,860	257,866	350,000

[e]Estimated.

[1]Includes data available through Apr. 1, 1994.

[2]In addition to the commodities listed, modest quantities of crude construction materials (brick clay and sand and gravel) are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.

TANZANIA

AREA 945,090 km² **POPULATION 27.3 million**

THE MINERAL INDUSTRY OF

TANZANIA[1]

By David Izon

Tanzania has a variety of mineral resources, though they have not been fully explored or developed. Gold and diamonds are the mainstay of the country's mineral production. Mineral production accounted for the major share of export earnings and 13% of a gross domestic product (GDP) of $7 billion.[2] Diamonds contributed about 85% of total mineral export earnings. Major minerals produced, in order of value and foreign exchange earnings, were diamond, gold, gemstones, phosphates, salt, and tin. Tanzania's gem diamonds are of very high quality. Recent exploration and investment activities in the minerals sector provide potential opportunities for growth in the mineral economy of the country. Crude petroleum is the major mineral import for the energy dependent country.

GOVERNMENT POLICIES AND PROGRAMS

Investment in the mining and petroleum sectors was governed by the provisions of the 1979 Mining Act and the 1980 Petroleum (Exploration and Production) Act, respectively. The incorporation of the 1988 minerals trade policies into the 1979 Act and the establishment of the National Investment Promotion Center (IPC) helped to create a favorable environment for foreign investment. Prospectors must obtain exploration and development licenses through the IPC. Exploration licenses were issued for a period of 1 year and could be renewed yearly. These cover specific areas and minerals. Mining licenses, when issued, give exclusive rights to investors to prospect, produce, and sell the minerals recovered. The mining licenses expire after 25 years or at the end of the estimated life of the deposit, whichever was shorter, and were renewable for a further 15 years.

The Government's recent liberalization measures have attracted private mining investors from Australia, Canada, Japan, South Africa, the United Kingdom, and the United States. Some of these measures included simplification of the tax system.

ENVIRONMENTAL ISSUES

The 1979 Mining Act required that prospectors provide environmental statements with applications for permit before a license was issued. The National Environment Management Act of 1983 covers environmental matters and authorized a National Environmental Council to regulate environmental activities. Mining is not permitted in National Parks or in the Ngorongoro Conservation area, but is allowed by special permits in game reserves.

PRODUCTION

There was a decline in diamond output owing to depletion of higher grades of ore at Mwadui and equipment failure. Gold production is believed to be significantly underreported owing to lack of regulations governing the large number of small-scale miners and the inefficient Government purchasing procedures for gold by the Bank of Tanzania. *(See table 1.)*

TRADE

Major minerals traded included diamonds and gold, which accounted for about 85% of foreign exchange earnings. Other minerals of importance were gemstones and phosphate.

The country's main trading partners remained the Federal Republic of Germany, Italy, the Netherlands, the United Kingdom, and neighboring east African countries.

Major imports from the United States were manufactured goods, machinery and transport equipment, and spare parts.

STRUCTURE OF THE MINERAL INDUSTRY

The state has owned all mineral rights in the country since 1964. The National Development Corp., formed in 1966, took over most of the private enterprises. The State Mining Corp. (STAMICO) controlled the mineral industry and operated most mines and plants. The Mining Act of 1979 applied to investments that deal directly with mining. Foreign participants in mining ventures are now allowed to have more than 50% of the shares. Development of any new remote mineralized areas would have to provide for infrastructure development. *(See table 2.)*

COMMODITY REVIEW

Metals

Tanzania's base metals deposits have been well studied in the past few years. Mineral exploration continued to identify new deposits and reserves. There was notable production of copper and lead from the Mukwamba Mine in Mpanda district. However, cobalt, copper, lead and zinc, and nickel occur widely in the country. Other deposits include iron ore at Liganga and Njombe. Proven resources were about 45 Mmt at Liganga grading 52% iron. Nonproduction of iron ore may

be due to the remoteness of Liganga.

Gold.—In 1993, there were three semimechanized small-scale gold mining operations in the country. They include TANCAN Gold Ltd., at Matinjie near Nzega; Mans Mining Ltd.'s Sengambi Mine near Lupa; and the Rubble Mine at Suza in the Lupa District. STAMICO's Buckreef Mine remained closed as negotiations continued between the Government and East Africa Mines Ltd., a subsidiary of Portman Mining Co. of Australia, for a takeover and development of the Buckreef property by the latter. Gold output decreased in 1993 by about 1 ton. The gold purchase price by the Bank of Tanzania failed to meet the market price, thereby encouraging a flourishing parallel market system often used by artisanal miners. Small-scale miners were well organized in their mining efforts by local village authorities, and actual labor may be about 20,000 workers. The value of gold sales in 1993 was about $32 million. However, based on estimates of smuggled gold, total sales may exceed $200 million.

A Canadian-based company, Tan Range Explorations, acquired a gold concession covering 207 km^2 in the Kahama District. The company began exploration in early 1993. The Bulyanhulu deposits in the Kahama District had reported reserves of about 4.3 Mmt, grading about 11 g/mt gold, 12.05 g/mt silver, and 0.66% copper. Other companies exploring for gold and evaluating potential targets in the country include Tan Range's Tanzanian subsidiary, Tan Can Mining of Canada, East African Gold Mines of Australia, SAMAX Ltd of the United Kingdom, and Skeat Mining of South Africa.

Nickel.—Exploration activities by Sutton Resources and Romanex International of Canada continued at two concessions in northwest Tanzania for cobalt, lead, nickel, and platinum-group metals. BHP Minerals International held a 52% share in the project, and funded the exploration work. Kabanga Nickel Co. and Kagera Mining Co., subsidiaries of the Sutton Resources and Romanex International of Canada, work the concessions. The total reserves estimated at yearend 1992 were about 80 Mmt at the Kabanga-Kagera concessions. Based on the preliminary results, Sutton Resources envisaged a 15,000-mt/d open pit operation lasting about 20 years.

Industrial Minerals

Tanzania's industrial minerals include bentonite, graphite, gypsum, and phosphate. Large reserves of bentonite occurred at Lake Manyara, Mount Gelai, and Sinya. Tanzania has rich deposits of gemstones, including diamond, emerald, rhodolite, ruby, sapphire, tanzanite, and tourmaline.

Decline in production of diamond at the Mwadui Mines continued in 1993 owing to aging of plant and equipment. European Ventures Corp., a Vancouver-based company, acquired 50% interest in Tan Range Exploration Corp.'s shares with an intent to explore for diamonds. According to the agreement, European would fund $100,000 and $200,000 of the exploration costs in the first and second years, respectively, and issue 100,000 common shares to Tan Range. European acquired and would explore 60 km^2 of the Shinyanga region. Tanex Ltd., a subsidiary of De Beers Centenary, explored an area covering 23,000 km^2 in the Mwanza, Shinyanga, and Tabora regions. Other parties that showed interest in diamond concessions were Reunion Mining Co. and RTZ Corp., who submitted applications for diamond prospecting.

Mineral Fuels

Tanzania possesses a considerable resource of low-sulfur coal that is only exploited on a small scale. The active mines are the Kiwira and Ilima Mines, northeast of the Kipengere range. The mines produced about 39,000 mt/a, all processed for local consumption. The estimated output capacity of the mines was 150,000 mt/a, which was planned to be raised to 180,000 mt/a by 1995. The continued shortage of equipment and adequate funds resulted in limited output. Coalfields of importance are the Songwe-Kiwira and the Ruhuhu, both in southwest Tanzania. The Ruhuhu Coalfield contains the largest and best quality coal resource. Reserves were estimated to be about 1.2 billion tons.

The development of the Songo Songo natural gas fields continued on schedule, and funding is being provided by Ocelot International Inc. of Canada.

Reserves

Tanzania's estimated reserves of natural gas are 41 billion m^3 in the offshore-Songo Songo Field 300 km 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. Estimated iron ore resources were 45 Mmt with an average iron content of 52% Fe. Gold reserves at the Bulyanhulu deposits were 10 Mmt of ore. Estimated diamond reserves were 3.8 million carats. Phosphate reserves were 10 Mmt. Nickel-cobalt-copper ore resources were about 80 Mmt. There were no officially reported reserve figures for tin and other minerals.

INFRASTRUCTURE

Most mining projects and mineral deposits are in remote areas where the infrastructure is extremely poor. The Kiwira Mine in the Songwe-Kiwira Coalfields is near the Tanzania-Zambia Railway Authority (TAZARA) and Lake Nyasa. The Ruhuhu Coalfield lies in a remote area. TAZARA is used to transport goods mainly for Zambia and Malawi. Dar Es Salaam is the ocean terminus of the railway to the inland ports of Kigoma at Lake Tangayika and to Mwanza at Lake Victoria. Major ocean ports are at Dar Es Salaam, Mtwara, Tanga, and Zanzibar.

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 and gold should continue to dominate the mineral economy of Tanzania for the near future. Development of key mineral resources such as coal, cobalt, diamond, gold, graphite, and nickel would increase sources of revenue and foreign exchange for the country.

The Government's economic recovery program should continue to improve Tanzania's ability to attract investors and promote industrial growth. Road and rail improvement projects being implemented or studied would help to alleviate transportation problems now barring the efficient distribution of commodities. Toll roads, when installed in the country, could raise funds for construction of additional infrastructure needed for remote areas.

[1]Text prepared Aug. 1994.

[2]Where necessary, values have been converted from Tanzanian shilling (Tsh) to U.S. dollars at Tsh475=US$1.00 in 1993.

OTHER SOURCE OF INFORMATION

Ministry Water, Energy and Minerals
Dar Es Salaam, Tanzania

TABLE 1
TANZANIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Cement, hydraulic e		540,000	540,000	540,000	540,000	540,000	540,000
Clays:							
Bentonite e		75	75	75	70	70	1,400
Kaolin		1,554	2,021	1,739	1,360	1,300	2,500
Coal, bituminous		46,000	51,569	33,213	38,580	38,500	150,000
Diamond[3]	carats	e150,000	84,598	99,763	67,309	40,847	150,000
Gemstones, precious and semiprecious excluding diamond[4]	kilograms	11,398	38,700	59,630	59,600	32,979	60,000
Gold, refined e	do.	3,500	3,500	4,200	5,210	3,370	7,000
Gypsum and anhydrite, crude		5,895	36,155	35,263	35,200	17,600	40,000
Lime, calcined and hydrated e		2,505	1,466	870	1,806	1,800	2,500
Limestone, crushed		986,537	861,253	553,436	553,400	990,480	1,000,000
Mica, sheet		(5)	(5)	(5)	(5)	(5)	NA
Petroleum refinery products:							
Liquefied petroleum gas	thousand 42-gallon barrels	49	e50	35	33	30	50
Gasoline	do.	835	e800	858	855	850	900
Kerosene	do.	321	e300	437	432	400	450
Jet fuel	do.	107	e100	237	262	250	300
Distillate fuel oil	do.	1,097	e1,000	820	820	800	900
Residual fuel oil	do.	1,543	e1,500	1,568	1,562	1,500	2,000
Other	do.	321	e300	470	450	450	500
Total including refinery fuel and losses	do.	4,273	e4,050	4,425	4,414	4,280	5,100
Phosphate minerals:							
Apatite		4,657	25,066	22,419	22,400	7,162	30,000
P_2O_5 content e [6]		1,444	7,771	6,950	6,940	2,219	3,000
Salt, all types		20,010	39,315	64,419	64,400	64,000	80,000
Sand, glass		13,101	6,365	4,263	4,200	4,200	14,000
Soda ash e		300	300	300	300	300	300
Tin, mine output, Sn content e		15	15	6	8	12	20

eEstimated. NA Not available.

[1]Includes data available through Aug. 9, 1994.

[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.

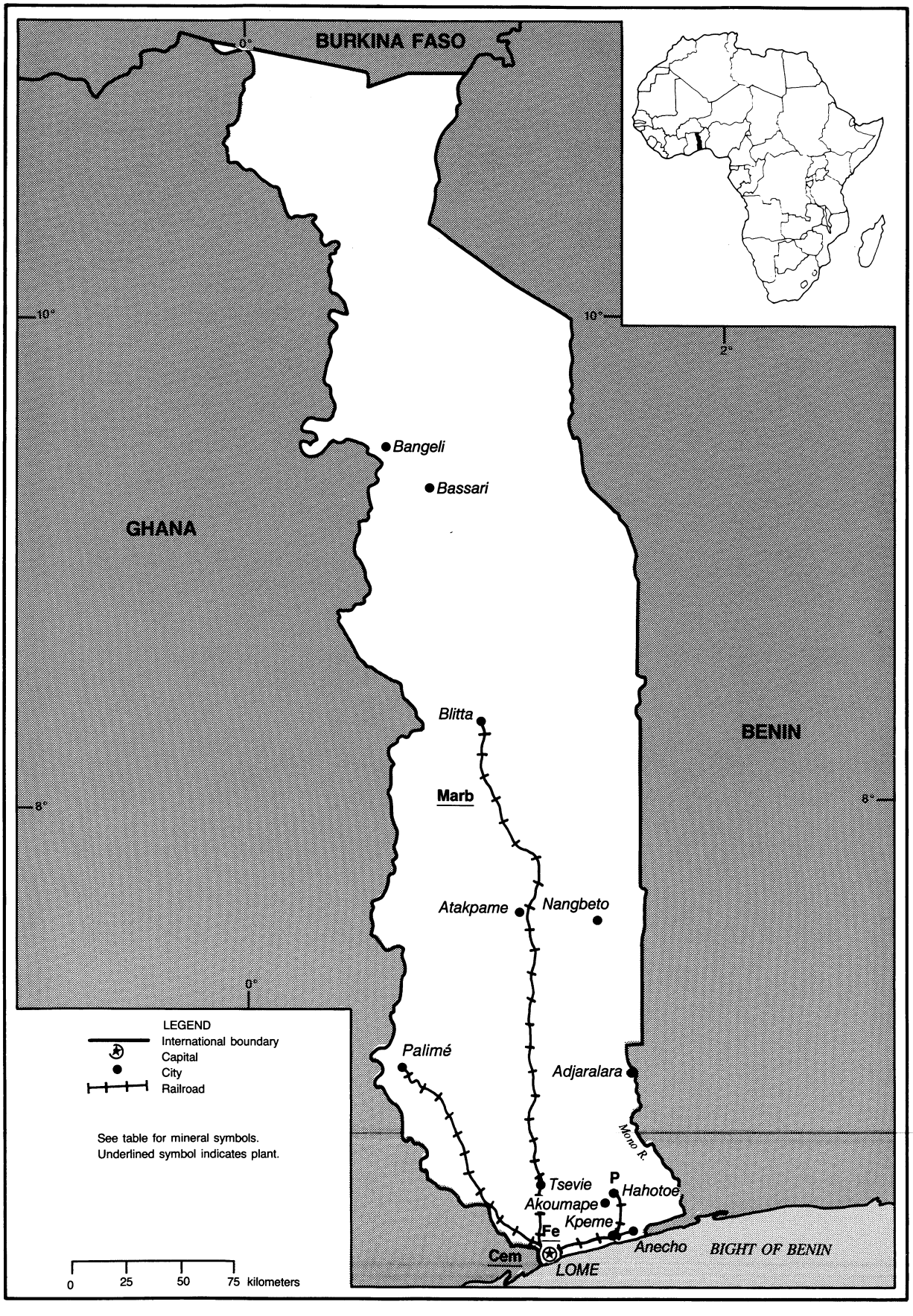
[4]Exports.

[5]Less than 1/2 unit.

[6]P_2O_5 figures are estimated to represent 31% of apatite ($3Ca_4P_2O8C_n$). Consideration is given for impurities.

TOGO

AREA 57,000 km² **POPULATION 4.1 million**



THE MINERAL INDUSTRY OF

TOGO[1]

By Philip M. Mobbs

A number of internal and external factors combined to make 1993 a poor year for the Togolese economy. The disruptive general strike, which began in November 1992, extended into 1993. Togo's mineral production and mineral exploration program were interrupted by the nationwide unrest. *(See table 1.)*

Togo's mineral industry was dominated by the Government-owned phosphate producer, Office Togolaise des Phosphates (OTP). OTP operated phosphate mines clustered around the cities of Hahotoe and Akoumape, about 30 km from the company's treatment plant and export terminal at Kpeme. Phosphate rock remained Togo's principle source of foreign exchange. However, OTP's production of phosphate rock dropped sharply in 1993 and Togo's share of world phosphate exports dropped slightly as international demand for Togolese phosphate weakened. Exports were shiped primarily to Canada and South Africa.[2]

In recent years, OTP has experienced a decline in phosphate rock exports to its traditional Western European and North American markets. This was due in part to customers' concerns over liability perceived to be associated with the relatively high cadmium content of the country's exceptionally high-grade phosphate ore. Togo's phosphate ore contains 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. Cadmium removal procedures were being studied as was the development of lower grade phosphate deposits with cadmium values within current international tolerances. The new mining areas are downdip of the current workings.

Existing phosphate pits contained about 10 years of reserves at 1993 levels of mining. Industry sources estimated that Togo's total phosphate reserves were about 260 Mmt of commercial-grade ore. Togo also had deposits of lower grade carbonate phosphates around Bassar, about 150 km north of the rail terminus.

Apart from phosphate rock and small quantities of limestone, exploitation of minerals in Togo was negligible. Cimtogo, a joint venture between the Government and Scancem ANS, a Norwegian company, operated a 600,000-mt/a cement factory in Lomé. The Société Togolaise de Siderurgie, owned by private U.S. interests, had closed its 20,000-mt/a steel plant in Lomé in 1991. The 90,000-m^2/a marble plant operated by the Government's Nouvelle Société Togolaise de Marbre et de Materiaux also closed in 1991. Royal Dutch Shell was using the Complex Petrolier facilities near Lomé as a petroleum product storage depot. The 7.3-Mbbl/a refinery has been closed since 1981.

A number of mineral deposits were known, but development awaited more detailed exploration and infrastructural improvements. A relatively large deposit of iron ore, estimated to total 95 Mmt, occurs near Bassar. The deposit, which averages more than 40% iron, mainly as magnetite, has been studied periodically by the local Bureau National de Recherches Minières (BNRM) and most recently in conjunction with France's Bureau de Recherches Géologiques et Minières (BRGM). The BNRM and BRGM exploration team discovered a zone of gold anomalies about 60 km east of Bassar as well as diamond indications on the d'Akposso Plateau and in the surrounding alluvial basins, about 50 km north of Palimé. The exploration team also located chromite, rutile, and uranium mineralization in the northwestern part of the country.

Most of the nation's mineral requirements were imported through the port at Lomé. Togo had long been a regional trade center, and its highway network facilitated trade between Lomé and Benin, Burkina Faso, and Ghana. Phosphate was shipped through the port of Kpeme.

All of the developed mineral deposits accessed the approximately 515-km single-track railway that connected Lomé with the cities of Anecho, Blitta, and Palimé. Exploitation of the iron and manganese deposits in the northern part of the country would require transportation improvements.

Togo's mineral economy should continue to be dominated by the phosphate industry well into the next century. New industry attracted to the country by the Government's economic policies should provide an important economic buffer during periods of low phosphate prices. However, even with optimistic growth projections, the industrial sector is not diverse enough to isolate Togo from economic slowdowns when commodity prices are low. The recent trend toward civil unrest and strikes could reduce anticipated international investment.

[1]Text prepared Aug. 1994.

[2]Mining Journal Ltd. (London). Mining Annual Review 1994, 240 pp.

TABLE 1

TOGO: PRODUCTION OF MINERAL COMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
Cement[3]		389,070	398,530	388,000	350,000	350,000	600,000
Iron and steel, semimanufactures[4]		6,197	8,400	e6,000	—	—	—
Phosphate rock, beneficiated product:							
Gross weight	thousand metric tons	3,355	2,314	2,965	r2,083	1,750	3,600
P_2O_5 content[e]	do.	1,270	840	1,076	760	635	NA
Stone, marble:							
Dimension	square meters	11,206	6,500	—	—	—	—
Blocks		354	357	e250	—	—	—
Crushed		977	912	e600	—	—	—

[e]Estimated. [r]Revised. NA Not applicable.

[1]Includes data available through Aug. 22, 1994.

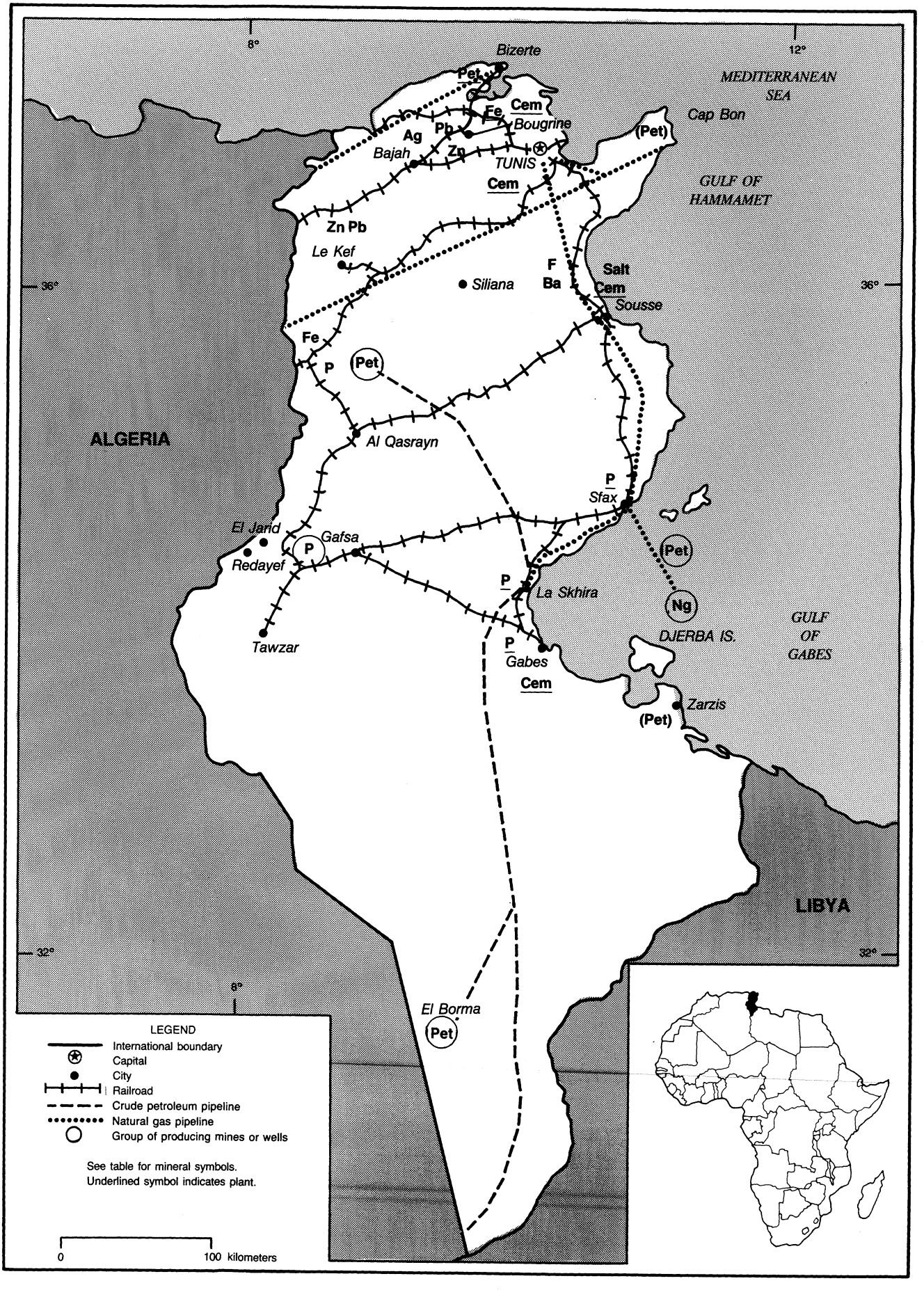
[2]In addition to the commodities listed, Togo presumably produced a variety of crude construction materials (clays, sand and gravel, and other stone) but output is not reported, and available information is inadequate to make reliable estimates of output levels.

[3]Produced from imported clinker.

[4]Iron rod production from semifinished metal.

TUNISIA

AREA 164,000 km² **POPULATION 8.6 million**



THE MINERAL INDUSTRY OF

TUNISIA[1]

By Thomas P. Dolley

In 1993 Tunisia's mineral industry experienced declines in its two most important mineral commdities, phosphate and crude oil. Nonetheless, it possesses one of the more stable economies in north Africa. Hydrocarbon production in Tunisia usually accounts for about 12% of the gross domestic product (GDP). The estimated GDP for Tunisia in 1993 was $14.8 billion.[2]

Juxtaposed with these primarily market-driven declines in mineral production are favorable trade relations with the European Community (EC) and successful economic structural adjustment sponsored by the International Monetary Fund and the World Bank. These have enabled the Tunisian economy to grow in the past several years. Privatization, or some facsimile thereof, has been suggested by the Government for the cement, phosphate, refining, and shipping industries.

GOVERNMENT POLICIES AND PROGRAMS

The Tunisian legal system is based on French civil law and Islamic law. Basic investment codes covering mining legislation in Tunisia were based on law No. 72-38 of 1972, concerning industries producing for the export market, and law No. 74-74 of 1974, concerning domestic industries. A unified investment code was introduced in November 1993 to help facilitate foreign investment in the mineral industry.

The most recent amendment to laws governing hydrocarbon exploration and production was passed on June 12, 1990, by the Tunisian Parliament. This amendment, law No. 90-55, was designed to encourage foreign companies to operate in Tunisia. Additionally, further changes are planned for 1994 in the hydrocarbons law to simplify investment procedures. Currently, hydrocarbon exploration agreements take three primary forms: an exploration license that allows the operator to undertake geological investigations before making a full commitment; an exploration permit allowing the operator the right to conduct seismic geophysical investigation with options for full prospection; and, a prospecting permit that allows the operator to carry out geological exploration and drilling for up to 5 years. If a hydrocarbon resource is to be developed, a joint-venture agreement is signed with the Tunisian parastatal Enterprise Tunisienne d'Activities Petrolieres (ETAP). The law obligates ETAP to cover its share of expenses if it chooses to participate.

ENVIRONMENTAL ISSUES

In Tunisia the task of environmental management resides with the Ministry of Environment and Land Planning through its subsidiaries Agence Nationale de la Protection de l'Environnement and Office National de l'Assainissement. The most serious environmental concern for Tunisia is the pollution of the Mediterranean Sea from a variety of sources. Pollution from industrial effluent, urban sewage, ships' discharges of oily ballast, and accidental oil spills are seriously affecting the southwestern Mediterranean Sea and coastline. World oil traffic using the major routes of Bizerte-Cap Bon in Tunisia and the Gibraltar Strait place additional stress on the area. The Government was formulating an institutional and legal template to allow for responsible environmental management. According to the World Bank, the Government's plan includes: (1) a 10-year action plan for water and soil conservation; (2) a forestry program; (3) a national strategy to combat desertification; and (4) a national action program for environmental protection that aims to combat pollution, preserve the quality of life of urban and rural populations, protect the marine environment and beaches, and preserve the country's archeological heritage. By yearend 1993, the World Bank was considering a $5.8 million loan to assist Tunisia's environmental efforts.

PRODUCTION

Tunisia is an important producer of industrial minerals and mineral fuels in the north African region. However, production of the two main mineral commodities, phosphate and crude oil, experienced declines in 1993. Tunisia remained a small-scale metals producer in support of the steel industry along with continued production of nonferrous metals. Fluorspar production ceased in 1992. *(See table 1.)*

TRADE

The EC dominates Tunisian trade, accounting for more than 75% of imports and exports. France is Tunisia's main trading partner with more than 30% of total trade. French imports of Tunisian crude oil were about 1.4 Mbbl for 1993. For 1993, total merchandise imports were valued at $6.2 billion with total merchandise exports valued at $3.8 billion. Hydrocarbon exports typically account for about 15% of total Tunisian export revenues. Phosphate rock exports rose to about 1.1 Mmt in 1993, reflecting the aggressive pursuit of new markets by

Compagnie des Phosphates de Gafsa (CPG). Preparation of a building site for the country's first free trade zone began in October 1993 at Bizerte. *(See tables 2 and 3.)*

STRUCTURE OF THE MINERAL INDUSTRY

Phosphate rock production in Tunisia was entirely controlled and operated by the Government parastatal CPG, founded in 1896. CPG is the largest company in Tunisia in both number of employees and capital investment. CPG directly employs 9,000 people and indirectly employs more than 200,000 people. Le Groupe Chimique Tunisien (GCT) controls phosphate processing through its Tunisian-owned Société Industrielle d'Acide Phosphorique et d'Engrais (SIAPE) and Société Arabe des Engrais Phosphates et Azotes (SAEPA). In 1989, GCT absorbed Industries Chimiques Maghrebines and Société Engrais de Gabes, both companies being producers of phosphoric acid. Société Minière du Nord-Ouest (COMINO) operates three mines; a lead-zinc-barite operation at Boujabeur, zinc at Hassine, and lead-zinc at Lakhouat Boukhil. The parastatal Société du Djebel Djerissa produces iron ore from the underground mine at Djerissa and the open pit operation at Tamera Douaria. Hydrocarbon exploration and production was overseen with a series of production-sharing agreements between foreign operators and the Tunisian Government-controlled ETAP, usually with ETAP a 45% to 50% equity partner.

COMMODITY REVIEW

In the nonferrous metals arena, the zinc-lead mine at Bougrine was scheduled to commence production by mid-1994. Bougrine is approximately 170 km southwest of Tunis. Anticipating the employment of about 300 people, including many Tunisian professionals, the operation will be an underground mine utilizing drift and fill and sublevel mining. The operator of the mine, Société Miniere de Bougrine (SMB), is 45% owned by Canada's Metall Mining Corp., which is in turn a subsidiary of Germany's Metallgesellschaft AG. The remaining equity ownership is by the Tunisian parastatal Office National des Mines along with the Tunisian banks Société Tuniso Seoudienne d'Investissement (STUSID), Banque Tuniso Koweitienne de Developpement (BTKD), and Banque de Developpement Economique de Tunisie (BDET). Bougrine is the only private-sector mining project in Tunisia with total development costs estimated at $78 million. Construction of the mine, to include two mine entrances and twin declines, underground drifts and raises, installation of fixed mining equipment, underground explosives magazine and electrical facilities, was essentially completed by yearend 1993. Completion of the 350 kmt/a mill is expected for 1994. SMG estimated the productive life of the mine to be 15 years. Additionally, Metall Mining Corp. continued exploration for other carbonate or sediment-hosted zinc-lead deposits similar to Bougrine in a joint venture with the Government.

Tunisian phosphate rock is mined primarily in the Gafsa region from a variety of open pit and underground sources. CPG's newest open pit operation is at Kef Eddour. Additionally, CPG engineered and commissioned a 1.8-Mmt/a washing plant in 1993. CPG processed about 80% of its phosphate output in Tunisia at plants in Gabes, M'Dilla, Sfax, Skhira, and Tunis with technology developed in country. Marketable phosphate comes in three main categories; phosphate used in the manufacture of phosphoric acid and fertilizers with a 65% to 68% bone phosphate of lime (BPL), 60% to 62% BPL phosphate that can be directly applied agriculturally, and a third metallurgical grade of phosphate. Additionally, CPG proposed the development of another open pit mine at Moulares by 1996 at an estimated cost of $22 million.

Increased domestic consumption and declining output from larger oilfields has put stress on the Tunisian hydrocarbon sector. Despite these apparent shortfalls, new exploration and development continues unabated in Tunisia. The country is a preferred exploration target among foreign operators. Foreign investments in the energy sector increased from $322 million in 1992 to about $643 million in 1993. The latter figure largely represents the United Kingdom's British Gas Tunisia investment in the offshore Miskar natural gas field and a doubling of capacity of the Algeria-Italy or Transmed pipeline. Miskar is scheduled to go on-stream in late 1995, with initial production of 1.5 billion m^3/a of natural gas. Miskar represents the largest foreign investment project in Tunisia to date.

Though declining in production, the El-Borma Field remained Tunisia's largest crude oil producer and is operated by Italy's Azienda Generali Italiana Petroli (Agip). The offshore Ashtart Field accounts for more than 20% of Tunisia's total crude oil production. In yearend 1993, 38 exploration agreements were awarded and an anticipated 20 wildcat wells were to be drilled into 1994 by a variety of foreign operators.

Reserves

The African Development Bank estimated Tunisian phosphate rock reserves at 3.5 to 4 billion tons, which was approximately 5% of the global reserve of phosphate rock. Crude petroleum reserves have been estimated at 1.7 billion bbl; however, this figure will fluctuate based on the extensive exploration program currently under way. Metall Mining Corp. estimated minable reserves at Bougrine to be 5.3 Mmt grading 11.7% zinc and 2.6% lead. Total estimated reserves of natural gas are 85 billion m^3. Recoverable natural gas reserves at the offshore Miskar Field alone is estimated at 22.7 billion m^3 to 28 billion m^3.

INFRASTRUCTURE

A total of 2,115 km of railway was the primary mode of transportation of phosphate rock to chemical plants and seaports. Highways within Tunisia total 17,700 km. Crude oil pipelines are 797 km long, and natural gas pipelines total

742 km. Tunisia has an electrical generation capacity of about 1.5 MkW. Combined cycle power stations, which generate electricity from natural gas, remained a construction priority in Tunisia.

Additional infrastructure capacity has been built for the Bougrine Mine to include a short railway offshoot from the main railway line to transport mineral concentrates to the port of Tunis. At the port of Tunis, a 15,000-ton concentrate storage and handling facility was being constructed. Soft ground conditions at the port required the use of about 100 concrete piles to adequately support the facility.

OUTLOOK

Tunisia already enjoys excellent trade relations with the EC; this trend should continue in the near term. The mineral industry is an integral part of the country's economic future as evidenced by the phosphate and hydrocarbon sectors. Improvement in the global markets of these mineral commodities, continued commitment to economic structural adjustment and environmental concerns, and proposed free trade relations with Europe bode well for Tunisia.

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[1]Text prepared July 1994.

[2]Where necessary, values have been converted from Tunisian dinars (D) to U.S. dollars at a rate of D1.039=US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

National Office of Mines
Department de Geologie
95 Avenue Mohamed V
1002 Tunis Le Belvedere, Tunisia
Compagnie des Phosphate de Gafsa
Cité Bayech
Gafsa 2100
Tunisia
Telephone: 06 22 022
Société Tunisienne d'Expansion Minière
(SOTEMI)
Rue Mongi Slim
Le Kef, Tunisia
Telephone: 20388

TABLE 1

TUNISIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Iron and steel:							
Iron ore and concentrate, gross weight	thousand tons	280	291	295	291	[3]299	300
Fe content	do.	e148	e154	e156	e151	153	150
Metal:							
Pig iron e	do.	140	140	140	140	140	140
Steel, crude	do.	187	177	193	181	190	190
Lead:							
Mine output, Pb content		2,702	2,966	1,285	1,362	[3]863	2,900
Metal: e							
Primary[4]		2,200	2,200	750	913	900	2,200
Secondary		500	500	250	250	250	500
Total		2,700	2,700	1,000	1,163	1,150	2,700
Silver metal, primary	kilograms	933	930	e900	e900	900	900
Zinc, mine output, Zn content		10,000	7,000	5,000	4,090	[3]2,389	10,000
INDUSTRIAL MINERALS							
Barite		33,104	30,885	22,366	30,179	[3]15,289	33,000
Cement, hydraulic e	thousand tons	3,228	3,300	3,300	3,300	3,300	3,300
Clays, construction e	do.	350	350	350	350	350	350
Fluorspar, acid grade		53,575	40,974	37,580	13,750	[5]—	53,000
Gypsum e		100,000	100,000	100,000	100,000	100,000	100,000
Lime e	thousand tons	650	650	650	600	600	650
Phosphate rock:							
Gross weight	do.	6,610	6,258	6,352	6,400	[3]5,500	6,600
P_2O_5 content	do.	e1,963	e1,858	e1,880	e1,894	e1,628	1,900
Salt, marine	do.	480	402	441	460	[3]435	480
MINERAL FUELS AND RELATED MATERIALS							
Gas, natural:							
Gross e	million cubic meters	388	374	236	200	200	380
Dry	do.	190	200	200	150	150	200
Petroleum:							
Crude	thousand 42-gallon barrels	37,595	36,500	38,690	40,259	[3]35,770	40,000
Refinery products:							
Gasoline e	do.	1,800	[3]2,200	[3]2,293	2,200	2,200	2,200
Kerosene e	do.	2,400	[3]2,400	[3]1,163	1,100	1,100	2,400
Distillate fuel oil e	do.	3,000	[3]4,042	[3]3,897	3,800	3,800	4,000
Other e	do.	400	[3]400	400	400	400	400
Refinery fuel and losses e	do.	200	[3]111	[3]232	200	200	200
Residual fuel oil e	do.	4,000	[3]3,857	[3]3,511	3,500	3,500	4,000
Total e	do.	11,800	13,010	11,496	11,200	11,200	13,200

eEstimated.

[1]Table includes data available through Mar. 1994.

[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.

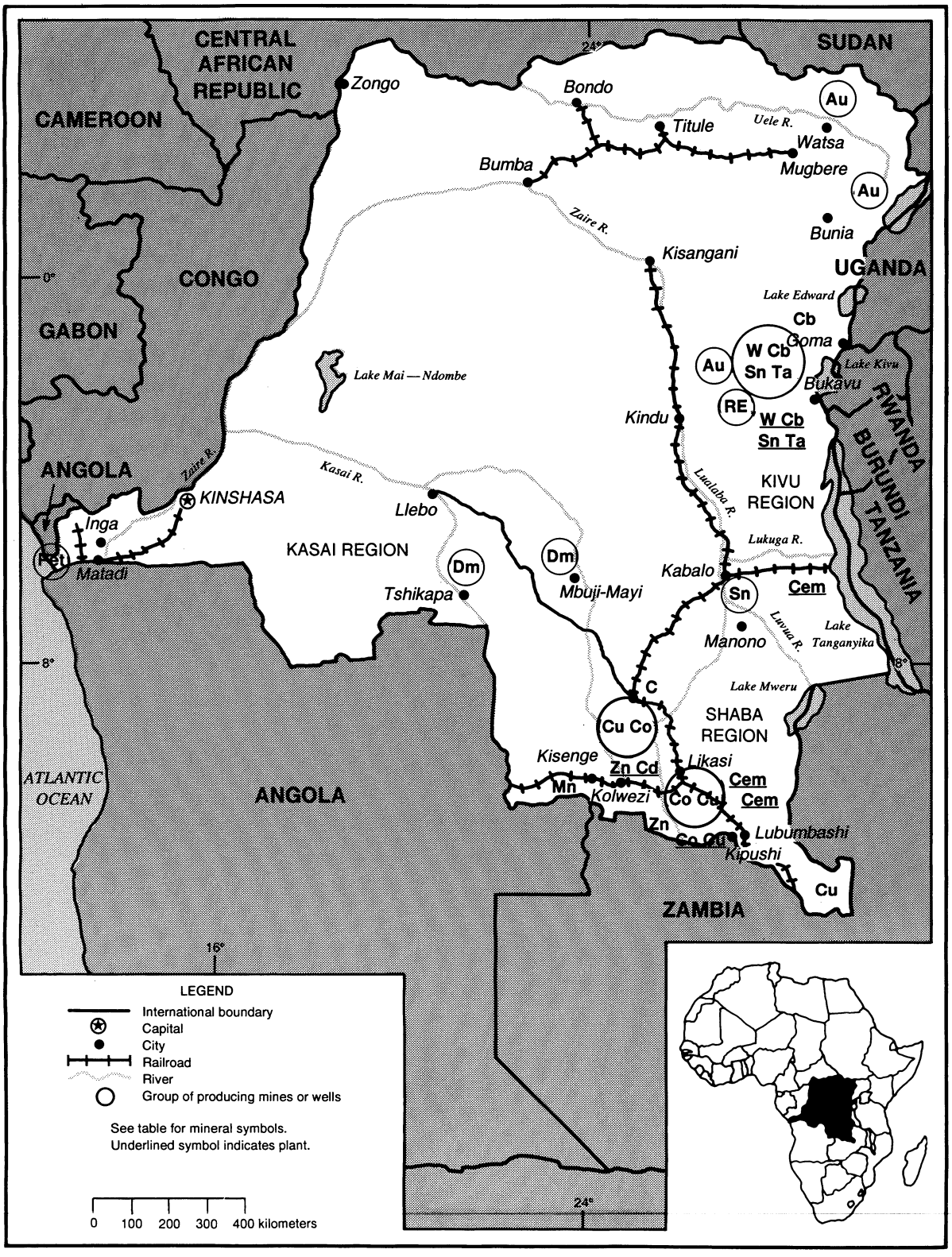
[3]Reported figure.

[4]From domestic and imported ores.

[5]Mine closed in 1992.

ZAIRE

AREA 2,345,410 km² **POPULATION 41.3 million**



THE MINERAL INDUSTRY OF

ZAÏRE

By Philip M. Mobbs

The overall decline of Zaïre's mining industry continued in 1993 as production of copper and cobalt, formerly the foundation of the nation's foreign currency earnings, continued its precipitous slide. Finished copper production declined 66% in 1993, following a 39% decline in 1992 and a 34% decline in 1991. Cobalt metal output fell an estimated 68% in 1993, following a 23% decline in 1992 and a 14% drop in 1991. Cadmium, coal, gold, crude petroleum, silver, and zinc production also declined. With this virtual collapse of Zaïre's metal mining sector, diamond exports became Zaïre's most important source of foreign exchange.

Historically, the mining industry accounted for 25% of Zaïre's gross domestic product and about three-quarters of total export revenues. However, depressed production and sales of cobalt and copper resulted in another significant drop in revenues for La Générale des Carrières et des Mines (Gécamines), the parastatal mining company responsible for most of Zaïre's copper and all of its cadmium, coal, cobalt, and zinc. The drop in export revenues further aggravated the company's already weak cash-flow situation and adversely affected the Zairian economy. Gécamines had difficulty meeting its payroll obligations as well as making payments to a number of suppliers and contractors. Until recently, the company was a significant source of Government revenues. However, in 1993, it was again unable to make tax payments to the Government.

Shaba Province declared its autonomy from the nation in December.[1] Metal sales regulations were liberalized and native-born Katanganese were authorized to enter Gécamines' installations to recover scrap metals. The local government expected that the economy would be augmented by the sales of previously unrecovered metal; however, the ensuing scavenging of slag, scrap, and unsecured equipment from the Lubumbashi smelter reinforced the shutdown of the Gécamines facility. People stripped powerlines of the public electric company of their copper, which affected the regional supply of electric power.

GOVERNMENT POLICIES AND PROGRAMS

The country was in political and economic chaos because it had two governments and two rival Prime Ministers.[2] Prices were pushed to record levels and wages failed to keep pace with the hyperinflation, which reached an estimated annual rate of 12,000%.[3]

The de facto Federal Government introduced several measures during the last quarter that influenced the mineral industry. In late October, the Federal Government banned international air flights from Provincial capitals in an attempt to restore some Government control over the trade in precious minerals.[4] Also during October, the national currency, the zaire, was replaced by the new zaire at a rate of 1 new zaire to 3 million zaires. The Federal Government required that all diamond purchases be made with the new zaire. This mandate effectively paralyzed legal diamond purchases in East Kasai as residents of Mbuji-Mayi boycotted the new currency. Illegal sales on the U.S. dollar-based black market probably continued. In November, the Federal Government announced that legal residence status of all expatriates living in the mining districts was to be verified. Diamond sales were disrupted during the 2 weeks of inspection and did not recover to pre-October levels during the remainder of the year.

PRODUCTION

Gécamines faced multiple crises in production, transportation, and finance, placing the company on the verge of collapse. Grounds for Gécamines' most recent poor performance included aging equipment; loss of credit lines; lack of domestic and international investment; insufficient equipment maintenance; lack of spare parts; fuel, lubricants, and sulfuric acid shortages; ore and finished product transportation problems; theft of finished products; flooding of open pit mines; and personnel disruptions, including the forced departure of Kasai engineers and technicians from Shaba-based Gécamines after the outbreak of tribal violence and the departure of expatriate staff after another destructive rampage by the army. *(See table 1.)*

Proposed funding of new equipment by the World Bank and International Monetary Fund was postponed.[5] The World Bank suggested a privatization scheme for Gécamines to raise money for modernization and make the company more competitive. The proposal suggested that new investment be made in the viable core business and nonprofitable services and operations be eliminated.

TRADE

In 1993, diamond exports value and carat volume were up compared with those of 1992; however, diamond export numbers dropped sharply at yearend in an unexpected response to changes in Federal Government mineral policy. Exports of other traditional mineral commodities dropped in 1993.

The more significant mineral commodities exported from Zaïre were cobalt, copper, diamond, gold, crude petroleum, and zinc. In addition to

official exports, it was estimated that 2,000 tons of unreported cobalt production and 6,000 tons of copper were unofficially exported to Zambia. Significant volumes of diamonds and gold also were smuggled out of the country.

Zaïre's main trading partners, in order of importance, were Belgium, the United States, Japan, France, Germany, and the Republic of South Africa. Imports by the United States from Zaïre consisted mainly of cobalt, refined copper cathode, gem diamond, crude petroleum, tantalum ore and concentrate, and unwrought zinc.

STRUCTURE OF THE MINERAL INDUSTRY

Zaïre's Government maintained at least part ownership, and generally majority ownership, of nearly all the productive and service sectors of the economy. Gécamines, the principal parastatal company, operated on its own fiscal regime. Its holdings included subsidiary companies that produced coal, cement, and other materials required for its primary mineral interests. Gécamines staff dropped from 35,000 to 26,000 employees since 1992.[6]

Legislation exists relating to all aspects of the mineral industry. Article 10 of the Constitution states that the soil and subsoil belong to the state. Prospecting and exploration, and exploitation in the mineral sector is regulated by Ordinance No. 81-013 of April 2, 1981. All such undertakings require permits from the Ministry of Mines and Energy. *(See table 2.)*

COMMODITY REVIEW

Metals

Cobalt.—Zaïre's total cobalt production plunged an estimated 68% from its 1992 level to 2,098 tons. For many years Gécamines precipitated excess cobalt as hydrate from its hydrometallurgical plants' cobalt leach circuits and stockpiled this material for later use. It is estimated that there are sufficient cobalt hydrates stockpiled to maintain the current cobalt production level through 1995. Cobalt production in 1993 from the available stockpiled cobalt hydrates was lower than expected, owing in part to transport equipment problems.

Because Gécamines produces cobalt as a byproduct of its copper operation, the company proposed to high-grade plant feed by mining cobalt-rich seams, in addition to reprocessing concentrator waste and slags.[7] The company placed more emphasis on cobalt flake and granules as its primary foreign currency earner, as part of its "survival plan." However, in 1993, white alloy and cobalt-nickel matte accounted for more than 50% of total cobalt production.

Zairian cobalt was trucked to South African ports for export to European, Japanese, and North American destinations. Several incidents of theft or diversion of cobalt by local officials were reported during the year.

Cobalt prices ranged from $13 to $15/lb during 1993, despite Zaïre's production crisis. Prices eventually reached $11 to $12/lb for 99.9%-grade material in November, before moving sharply upward to $18 to $19/lb at yearend. Prices were stabilized initially in part by the U.S. Defense Logistics Agency's continued auction of cobalt from its strategic stockpile and the general lack of demand by the specialty steel industry.

Copper.—Owing to numerous difficulties, including a lack of production from the Kamoto underground mine, which suffered a major cave-in September 1990, Gécamines' copper production dropped to less than 10% of its 1989 level. Most of the copper ore was produced in 1993 by the Kamoto underground mine and the Kamoto open pit. Additional ore volume came from the Kakanda Mine, the Kambove Mine, the Kipushi Mine, and the Sodimiza pits (Musoshi-Kinsenda). The Dikulwe-Mashamba open pit is expected to be dewatered and contributing in 1994.

The Lubumbashi smelter resumed operations in May, 3 months into a proposed 2-month shutdown. The smelter was shut down again in July and remained off-line for the rest of the year. Reduced volumes of coal from Luena and ores from Kipushi and Sodimiza contributed to the smelter stoppages. Complications associated with the reduced plant feed were compounded by difficulties in obtaining imported coke and general technical problems.

The new Luilu electrorefining facility continued to have problems. The refinery had broken down, owing to technical problems, shortly after the official startup.[8]

Gold.—Gold production is in part by medium-sized companies and in part by artisanal miners. The former include Sominki and the Office des Mines d'Or de Kilomoto (Okimo). It is difficult to estimate the quantity of artisanal production, most of which is smuggled across the eastern and northeastern borders. Zaïre's formal gold output continued a downward trend, largely owing to obsolete equipment and lack of new development work at the mines. Sominki gold came primarily from two operations, the Mobale underground mine at Kamituga, 100 km southwest of Bukavu, and the Lugushwa alluvial operation. Okimo was allegedly obstructed from resuming operations at a number of production sites by Government security personnel originally called in during a 1992 strike.

Zinc.—Electrolytic zinc metal production fell from 18,833 tons in 1992 to 3,703 tons in 1993. Gécamines' Kolwezi plant's cadmium and zinc outputs were byproducts of ore from the Kipushi Mine, west of Lubumbashi. The Kipushi Mine's production dropped to very low levels owing to the water level in the mine and shortages of spare parts and hydraulic fluid for the drilling equipment.

Industrial Minerals

The Société Minière de Bakwanga (MIBA) remained the major official diamond producer in Zaïre. It sold its predominately industrial diamond output to a subsidiary of the De Beers Con-

solidated Mines group. MIBA's 1993 production increased to about 4.7 million carats worth $52 million from 4.3 million carats worth $46 million in 1992.

The balance of diamond output was by artisanal workers who have historically accounted for the largest portion of diamond production in Zaïre. Output by artisanal workers is purchased by buyers and/or trading posts known as "comptoirs." The ratio of gem to industrial diamond recovered by artisanal workers is higher than that for MIBA, but their level of recovery is lower. An additional undocumented volume of stones was smuggled in from Angola and exported as Zairian.

In 1993, the dozen registered diamond trading houses produced about $260 million worth of diamond. However, the "unregistered" trade in diamonds has been estimated to be as high as two times the official amount, most of it smuggled out through under-invoicing of legally recorded diamonds on their way to the principal diamond cutting center in Antwerp, Belgium.

Wye Resources Corp., a Canadian company, holds interest in four contiguous diamond placer concessions on the Kansadisadi River near the Angolan border with the Mohawk Mining Co., a Zairian firm. The venture completed a preliminary study during 1993 and proceeded with plans for conducting a detailed geological and hydrological evaluation of the concessions.

Mineral Fuels

Coal production from the Luena Mine was significantly reduced as a result of ethnic conflicts in Shaba.

During the year, Petrofina discontinued its exploration program around Lake Albert. Zaïre Gulf Co., the country's sole offshore oil operator, produced at an average level of 24,000 bbl/d throughout 1993.[9] The company continued Motoba Field development with the No. 10 well.

Reserves

Zaïre's major mineral reserves are considered sufficient for many years of production, although reserves of high-grade ores are limited. However, inadequate financing for transportation, mine development, and maintenance of mining operations will inevitably extend the life of the reserves as an artifact of reduced levels of exploitation.

INFRASTRUCTURE

Zaïre is an essentially landlocked country, with a small coastal area on the Atlantic Ocean. The 2-Mmt/a Port of Matadi suffered from endemic looting, and the 160-km river approach to the seaport was subject to periodic Angolan rebel attacks.[10]

Zaïre utilizes a combination of railroad, road, and riverboat transport to move equipment, food, and other supplies into the mining and mineral processing regions and to convey ores, concentrates, and finished mineral products out. Much of this transport network is in varying degrees of disrepair. Locomotive and railroad car shortages continue to limit the availability of ore at the mills, as well as limiting the quantity of finished products available for export. The major companies involved in transportation are Government-owned; small, private trucking and riverboat companies provide limited local service. Mineral products are shipped on the Voie Nationale to the Matadi seaport, the only transport route entirely within Zaïre, as well as to Dar es Salaam in Tanzania and to ports in the Republic of South Africa. It takes 45 days to get copper seaborne by rail transport, either south via Zambia and Zimbabwe or eastward along the Tazara railway. Owing to rail and river transport problems, most cobalt and copper wirebar products were shipped via truck convoy to the Port of Durban in the Republic of South Africa. High-value diamonds and gold were flown out of the country.

A portion of the electricity consumed in the Shaba region, site of most of the country's mining activity, is delivered by the 1,800-km Inga-Shaba transmission line. Gécamines is also dependent on imported coke and petroleum refinery products for its mine and metallurgical operations.

OUTLOOK

The short-term economic prospects for Zaïre are poor. The continued decline of copper and cobalt production has led to the deterioration of the country's most important company, Gécamines. Despite predictions of Gécamines operations coming to a "grinding halt" owing to its multitude of problems, the company continues to operate, albeit at minimal capacity.

Demand for U.S. mining and materials handling equipment is expected to resume in the long run. Gécamines had bought heavily from U.S. suppliers but is currently having difficulty paying its debts. The MIBA diamond mines and Kilomoto gold mines are also good potential customers.

Because of its size and wealth of resources, Zaïre's long-term potential is more promising and the country could remain an important supplier of copper, cobalt, and diamond for years. Much of Zaïre's future mineral output will depend on the availability of financing. Zaïre's prospects depend on its ability to achieve political and economic stability, mobilize its resources, control Government spending, and renew multilateral and bilateral aid programs.

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[9]Oil and Gas Journal. Worldwide Crude Oil and Gas Production. V. 92, No. 11, Mar. 14, 1994, p. 87.

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TABLE 1
ZAÏRE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Cadmium, smelter		224	127	65	84	[2]12	200
Cobalt:							
Mine output:							
Ore milled:							
Gross weight	thousand tons	13,324	11,898	8,415	5,641	1,850	13,000
Co content		37,700	39,500	20,900	13,300	5,058	40,000
Concentrate produced:							
Gross weight	thousand tons	1,464	1,290	902	631	208	1,500
Co content		18,400	19,000	9,900	5,700	2,459	19,000
Refinery input, Co content:							
Concentrate e		18,400	19,000	9,900	5,700	2,459	19,000
Hydrates		—	3,194	5,483	4,106	1,000	5,500
Scrap		27	49	517	1,113	180	1,200
Total e [3]		18,427	22,243	15,900	10,919	[2]3,639	25,700
Metal, Co content:[4]							
Luilu cathodes		4,814	3,474	2,989	2,629	107	3,000
Shituru refinery:							
Cathodes		3,492	3,117	2,439	1,837	263	3,000
Granules[5]		1,005	3,356	2,686	583	461	3,000
White alloy, matte		—	34	506	1,580	1,267	1,600
Total[3 6]		9,311	9,981	8,620	6,628	[2]2,098	10,600
Columbium and tantalum:							
Columbite-tantalite concentrate:							
Gross weight	kilograms	48,020	r35,830	57,000	29,000	20,000	57,000
Cb content e	do.	12,500	r9,100	15,000	7,500	5,000	15,000
Ta content e	do.	13,400	10,000	16,000	8,000	5,700	16,000
Pyrochlore concentrate:							
Gross weight	do.	711,000	900,000	e1,000,000	1,048,050	1,000,000	1,000,000
Cb content e	do.	320,000	400,000	450,000	450,000	450,000	450,000

See footnotes at end of table.

TABLE 1—CONTINUED
ZAÏRE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Copper:							
Mine output by company:[7]							
Ore mined:							
Gross weight:							
Gecamines	thousand tons	11,510	12,115	7,936	6,892	1,200	11,000
Sodimiza	do.	946	769	684	558	150	1,000
Total[3]	do.	12,456	12,885	8,620	7,450	1,350	12,000
Cu content:							
Gecamines	do.	504	489	292	261	52	380
Sodimiza	do.	20	21	18	14	4	20
Total[3]	do.	524	509	310	275	[2]56	400
Concentrate:							
Gross weight:							
Gecamines	thousands tons	1,591	1,403	992	631	190	950
Sodimiza	do.	40	38	31	23	5	50
Total[3]	do.	1,630	1,441	1,023	654	195	1,000
Cu content:							
Gecamines	do.	455	396	252	159	47	253
Sodimiza	do.	17	17	13	9	2	17
Total[3]	do.	472	413	265	168	[2]49	270
Metal:							
Intermediate products:							
Electrowon cathode		280,800	229,100	e180,000	r111,000	33,000	255,000
Smelter:[8]							
Black copper		15,000	9,500	e5,000	e2,000	[2]300	5,000
Blister		153,380	117,174	52,536	19,898	[2]6,997	40,000
Total[3]		449,180	355,774	e237,536	r e132,900	45,297	300,000
Finished products:[4]							
Blister		153,380	117,174	52,536	19,898	6,997	20,000
Electrowon cathode[9]		87,242	80,566	65,569	67,240	5,243	80,000
Refined, wirebar		181,570	140,868	103,992	47,503	31,107	160,000
Other		—	—	—	539	1,954	—
Total		422,192	338,608	222,097	135,180	[2]45,301	260,000
Gold e	kilograms	10,600	9,300	8,800	7,000	6,000	10,000
Silver e	do.	70,000	84,000	80,000	60,000	50,000	85,000
Thorium:							
Monazite concentrate, gross weight (e55% rare earth oxides)		175	124	e120	e50	50	175
Tin:							
Mine output, Sn content		2,346	2,221	1,522	1,020	700	2,400
Smelter, primary e		100	90	70	50	50	100
Tungsten, mine output, W content		16	17	e15	—	—	—

See footnotes at end of table.

TABLE 1—CONTINUED
ZAÏRE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
METALS—Continued							
Zinc:							
Mine output:							
Ore milled:							
Gross weight	thousand tons	1,297	1,340	1,042	619	200	1,400
Metal content		127,700	114,700	81,400	45,900	15,000	115,000
Concentrate:							
Gross weight		156,400	144,600	99,300	53,600	17,000	160,000
Metal content		72,800	61,800	42,400	22,300	6,500	85,000
Metal, primary, electrolytic		54,043	38,206	28,321	18,833	[2]3,702	75,000
INDUSTRIAL MINERALS							
Cement, hydraulic		[e]460,000	460,581	[e]250,000	174,052	[2]149,428	460,000
Diamond:							
Gem	thousand carats	2,663	2,914	[e]3,000	8,934	2,006	10,000
Industrial	do.	15,092	16,513	[e]14,814	4,567	13,620	15,000
Total[2]	do.	17,755	19,427	17,814	13,501	[2]15,626	25,000
Lime		100,208	92,011	82,933	64,593	50,000	100,000
Stone, crushed[e]		475,000	450,000	360,000	280,000	200,000	500,000
Sulfur:							
Byproduct of metallurgy, S content of sulfuric acid from sphalerite[e]		29,000	23,500	16,000	11,000	2,000	29,000
Sulfuric acid, gross weight:							
From sphalerite		87,478	70,736	48,596	33,158	6,000	90,000
From imported sulfur		60,932	61,445	50,545	36,259	10,000	60,000
Total		148,410	132,181	99,141	69,417	16,000	150,000
MINERAL FUELS AND RELATED MATERIALS							
Coal, bituminous[e]	thousand tons	130	100	60	61	[2]14	130
Petroleum:							
Crude	thousand 42-gallon barrels	10,119	10,597	9,955	8,698	[2]8,308	12,000
Refinery products:							
Liquefied petroleum gas	do.	5	4	4	3	4	NA
Gasoline	do.	578	687	375	201	350	NA
Kerosene and jet fuel	do.	613	756	468	199	500	NA
Distillate fuel oil	do.	1,027	1,541	714	317	700	NA
Residual fuel oil	do.	867	1,182	383	193	350	NA
Refinery fuel and losses	do.	222	150	111	56	96	NA
Total[2]	do.	3,312	4,320	2,055	969	2,000	6,200

[e]Estimated. [r]Revised. NA Not available.

[1]Table includes data available through Aug. 6, 1994.

[2]Reported figure.

[3]Data may not add up to totals shown because of independent rounding.

[4]Products shown are primarily salable products.

[5]Granules are produced from cathode produced primarily at Shituru and are not double counted.

[6]In the U.S. Bureau of Mines' Cobalt World Refinery Production Table, the refinery production of cobalt in Zaire excludes white alloy and matte, which require further processing.

[7]In the U.S. Bureau of Mines' Copper World Mine Production Table, the mine production of copper in Zaire is the sum of (1) blister, black copper, and Sodimiza concentrate copper content (by concentration or cementation), and (2) electrowon cathode (by leaching).

[8]In the U.S. Bureau of Mines' Copper World Smelter Production Table, the smelter production of copper in Zaire is the sum of blister, black copper, and electrowon cathode.

[9]Includes the portion of electrowon cathode that is exportable for further processing. This may include high-purity cathode.

TABLE 2

ZAÏRE: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

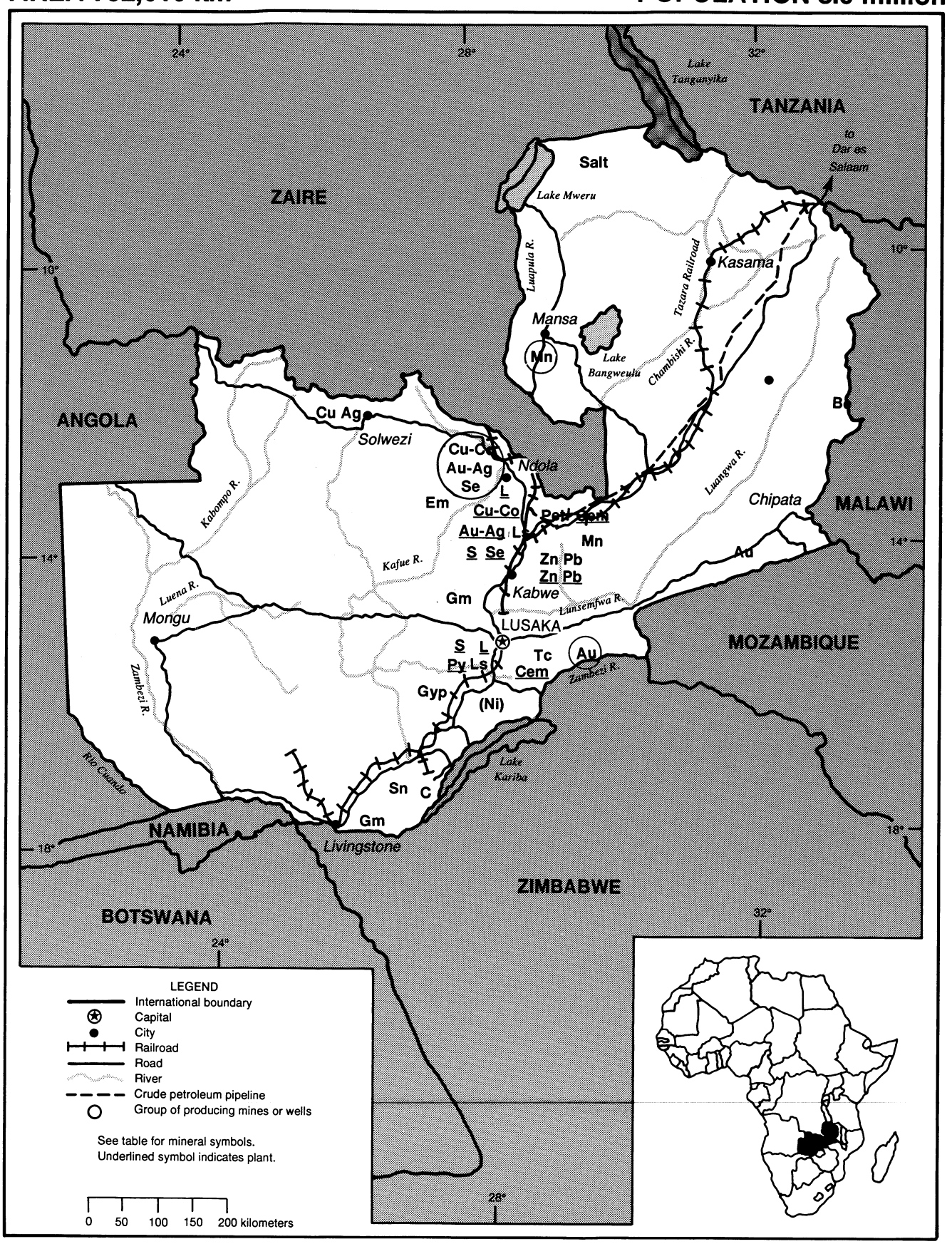
(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cobalt	Générale des Carrières et des Mines du Zaïre (Government, 100%)	Shituru at Likasi	9,000 Cu as granules.
Do.	do.	Luilu at Kolwezi	9,000 Cu as flakes.
Columbium-tantalum	Société Minière du Kivu (Geselleschaft für Elektro-metallurgie, Gmbh, Germany, 70%; Government, 20%; Sominki, 10%)	Lueshe, 70 kilometers north of Goma	1,000 pyrochlore concentrate.
Do.	Société Minière et Industrielle de Kivu (Sominki) (Lencourt Ltd., 71.7%; Government, 28.3%)	Northern Kivu region	60 concentrate.
Copper	Générale des Carrières et des Mines du Zaïre (Government, 100%)	Lubumbashi	165,000 blister Cu.
Do.	do.	Shituru at Likasi	250,000 refined Cu.
Diamond million carats	Société Minière de Bakwanga (Government, 80%; Sibeka, 20%)	Mbuji Mayi	9.2.
Do. do.	Artisanal miners (Private, 100%)	Tshikapa	15.
Gold kilograms	Société Minière et Industrielle de Kivu (Sominki) (Lencourt Ltd., 71.7%; Government, 28.3%)	Eastern Zaïre	3,000.e
Do. do.	Office des Mines d'Or de Kilomoto (Okimo) (Government, 100%)	do.	3,000.e
Do. do.	Artisanal miners (Private, 100%)	Eastern and northeastern Zaïre	4,000.e
Tin	Société Minière et Industrielle de Kivu (Sominki) (Lencourt Ltd., 71.7%; Government, 28.3%)	Kalima, Kindu	2,400 Sn in concentrate.
Zinc	Générale des Carrières et des Mines du Zaïre (Government, 100%)	Kipushi	85,000 Zn in concentrate.
Do. do.	do.	Kolwezi	75,000 refined Zn.

eEstimated.

ZAMBIA

AREA 752,610 km² **POPULATION 8.9 million**



THE MINERAL INDUSTRY OF

ZAMBIA

By Lloyd E. Antonides

Minerals continued to be the source of about 90% of Zambia's almost $1 billion foreign exchange earnings in 1993.[1] Copper accounted for more than 75% and its byproduct cobalt for more than 10%. Gemstones, mostly emeralds, were also a significant contributor but a large portion was not recorded because of illicit dealings. Mineral commodities production, predominately copper, were estimated to contribute 8% to 20% to gross domestic product (GDP), according to various sources, and to employ about 15% of the country's wage-earning work force of about 400,000. The minerals sector was also the major source of Government revenue even though agriculture accounted for about 20% of GDP and manufacturing, 25%.

The landlocked country was among the world's four largest producers of copper ore and six largest of refined primary copper, as well as single largest of refined cobalt and reputedly the single largest in volume (40%) of emeralds. More limited values of a number of other metals and metal ore and concentrates also were produced, as well as industrial minerals and coal. Many additional occurrences of a variety of potentially valuable minerals were widespread geographically in the Texas-sized country. However, few were definitively explored, particularly if they were not within 100 km of the so called "line of rail" running roughly north-south on the more developed and populated 1,000-m-high, gently rolling, central plateau.

The eastern part of the country has generally higher, rougher terrain and the southwestern part is generally lower in elevation with sandy flats and marshes. In the northwest, the elevated continental divide of drainage to the Indian and Atlantic Oceans is the border with Zaire and continues into the northeast lobe, forming a central spine of increasingly higher ground up to the Tanzanian border. The Zambezi River along much of the southern border, mostly with Zimbabwe, drains a large part of the country—all that is south of the continental divide. Despite the tropical latitudes, the moderate elevation provides a subtropical climate that is pleasantly mild, somewhat similar to southern California but subject to distinct wet and dry seasons. About one-half of the country is covered by forest consisting mostly of second growth savanna woodland and about one-half by cropland and pasture.

The geological background consists of Precambrian sedimentary and metamorphic rocks with some igneous formations of localized granitic basement and a few small basic intrusions over most of the eastern and north-central areas, generally under moderate soil cover. Within those areas, Younger Karoo sedimentary rocks with an occasional basaltic flow commonly are exposed in the several rift valleys as well as underlying normally eroded river valleys. Karoo formations also underlie a thick cover of more recent Kalahari windblown sands in the western third of the country. The north-central copper-cobalt deposits are in Proterozoic sediments of the Katanga group, mostly carbonaceous marine shales and graywackes.

GOVERNMENT POLICIES AND PROGRAMS

Zambia's economy was dependent on one commodity, copper, even for several decades prior to independence from the United Kingdom in 1964. As a consequence of nationalization of the mines in 1970 and subsequent increased usage of mineral earnings by the one party, socialistic Government with little regard to the need for reinvestment, domestic copper output in 1993 was less than 400,000 tons, after having peaked at almost 700,000 tons in 1976. Following a peaceful, multiparty election of a new market-oriented Government in October 1991, a very stringent economic reform program previously agreed upon with the World Bank and International Monetary Fund was more rigorously pursued. Some of the Government actions included adoption of a free market in currency and interest rates, removal of price and import controls, and reduction of subsidies and trade barriers. Also, it allowed retention of foreign currency earnings and repatriation of all aftertax profits and lowered business taxes. Early in 1994 the World Bank staff stated that good progress had been made in the relatively brief time the program was in effect. Reduction in the inflation rate, a principal concern in the program, was showing considerable success during the last half of 1993 and into early 1994. Among the economic problems that observers felt required long-term effort to resolve were a bloated bureaucracy of limited capability, a generally unskilled population lacking self reliance, very unequal distribution of income, and heavy foreign debt.

As part of the economic reform program and transition to a market economy, the new Government began taking steps early to privatize most of the more than 100 parastatal companies. It listed more than 50 firms for sale and completed negotiations or actual privatization on 14 by yearend 1993. Most of the others were expected to be at that stage by yearend 1994. In the minerals sector, the Government made its share (60% or more) of Chilanga Cement

Ltd. available to the public late in 1993, but no resolution was reached at mid-1994 as to the precise form of privatization of Zambia Consolidated Copper Mines Ltd. (ZCCM).

The Government continued to promote actively the private sector and seek foreign investment. It participated in a number of investment conferences starting in the early 1990's and including an African Mining Investment Conference in Denver in June 1994, organized by the World Bank's Multilateral Investment Guarantee Agency. A concise paper reviewing current production, geology, prospects, and legal matters was presented by Zambia's Ministry of Mines and Mineral Development. The Ministry was an organizer of a Southern African Development Community (SADC) European Union (EU) Mining Forum in Lusaka in December 1994 aimed at promoting investment.

New mining legislation expected to be presented to the parliament in late 1994 aimed at attracting risk capital, technology, and entrepreneurial efforts to the mining sector. It resulted from several outside studies and World Bank and consultant reviews, as well as long and somewhat contentious intra-Government discussion. Its intent was to be comprehensive and to improve the economic and operating environment for mining companies. The law was to have its own investment provisions paralleling those in the latest revision of the general investment law as well as incorporating changes already made to other existing Zambian legislation. It also was designed to reflect successful legislation in other countries of SADC. All mineral commodities were to be covered. Large-scale, small-scale, and artisanal operations were each to be treated separately as to mineral rights (prospecting and mining authorizations) and taxation. Among the provisions reported are: specified taxes, not requiring negotiation, oriented toward profits actually generated and responsive to different economic conditions as they develop; exemption from import duties and sales taxes on material, at least for an initial period of exploration and development; royalty on net back at mine starting at a maximum of 3% but apparently decreasing to zero dependent on value added in processing; and income tax somehow tied to market prices starting with a reasonably low base rate with deductions allowed for capital redemption, royalty, and any indirect taxes.

A World Bank-financed technical assistance project to the Ministry of Mines and Mineral Development got underway in June 1993. It included components covering: additional geological mapping; improving assaying and mineral processing test facilities; setting up a database of mining titles and resources; as well as studies on small-scale mining assistance, mining policy, and restructuring the Ministry.

Expatriate mining consultants, as well as physicians and university lecturers, were particularly cited as being among those whose work permit applications continued to be rejected by the Labour Ministry at midyear 1994. The Ministry denied more than 660 applications in the previous 7 months on grounds that there were sufficient qualified Zambians available.

ENVIRONMENTAL ISSUES

Government concern had grown for a number of years regarding the environmental effect of industrial activities, including mining and mineral processing, as well as of a growing population's use of land, water, and especially forests. This led to an act of parliament entitled the Environmental Protection and Pollution Control Act (No. 12) of 1990 (EPPCA). The legislation formed the basis for a Ministry of Environment and Natural Resources and also an Environmental Council of Zambia. The act formally came into full force in February 1992 and gave the Ministry overall responsibility for protecting the environment. The council was formed with representatives from mining, manufacturing, forestry, agriculture, academia, government, and the public. Its first task was to establish standards and limits for discharges of all kinds for inclusion in legally binding regulations.

ZCCM had followed a self-regulatory approach to environmental protection for some time. It established standards based on limits elsewhere in the world. After the EPPCA came into full force, ZCCM put into place an appropriate management structure with the help of consultants under a World Bank Technical Assistance package. It was among the major companies of the 25 that comprised the nongovernmental International Council on Metals and the Environment founded in 1991 to promote sound environmental and health practices. That Council was coordinator and cosponsor with two United Nations units and the World Bank of a Conference on Development, Environment and Mining in Washington, DC in June 1994. In April 1994, ZCCM commenced a more intensive 2-year program of personnel education, discharge measuring, formal reporting, mass balance studies, monitoring stations installation, and conceptual rehabilitation planning.

PRODUCTION

Detailed production data for 1993 were not available as of mid-1994. However, press reports indicated a general downward trend except for officially reported gemstones. Some attributed the return to a downward trend in copper and cobalt output to efforts to raise profitability in view of low prices; others cited lower production in mining and lower recovery rates in processing. Lead and zinc production also dropped, and the operations were reported closed at midyear 1994 owing to continued operating losses. Coal output decreased because of equipment problems as well as reduced purchases by a major customer, Nitrogen Chemicals of Zambia Ltd., an ammonia producer. The rise in recorded gemstone production was attributed to the decontrol of the kwacha and consequential decline in illicit trading. *(See table 1.)*

TRADE

Copper, cobalt, zinc, and lead, in order of value, were usually considered the major mineral exports. However, gemstones were said to have been very significant in export value for some time, possibly second to copper, despite absence of official records. Although official published trade data were unclear, based on ZCCM sales of cobalt, copper, lead, and zinc, the EU was the leading destination for exports for a number of years, with Japan a close second. Cobalt and copper were also among the major exports to the United States, not a significant trading partner otherwise.

Petroleum, including crude and refined products, was by far the major import. Fertilizer components were the second largest import, particularly phosphorus and potassium, because only some nitrogen compounds were made domestically. Structural steel was another important import of mineral origin. The Arabian Gulf States were a principal source of imports because of oil purchases. The Republic of South Africa was also a principal source of imports, at least partly because of transshipments from overseas sources. Mining equipment was normally the largest import from the United States.

STRUCTURE OF THE MINERAL INDUSTRY

The Government still dominated the industry. The state-owned Zambia Industrial and Mining Corp. Ltd. (ZIMCO), which was scheduled for phaseout in 1994, held a majority interest in all principal commercial and industrial ventures other than those privatized. ZCCM, the largest entity in the minerals sector, was owned 60.3% by ZIMCO, 27.3% by Zambia Copper Investments Ltd. (owned 50% by Minorco S.A., in turn, owned more than 60% by the Anglo American Corp.-DeBeers Centenary AG group), and 12.4% by the public, including institutions. One division of ZCCM produced zinc, lead, and pyrite (for sulfuric acid), and a Small Mines Development Unit supported at least one mine for gemstones in Eastern Province and one for gold as well as one for copper in Western Province. Other units also produced lime and marble, and ZCCM also owned shares in several ventures not related to minerals. Divestiture of noncore businesses began in 1992.

The Government's privatization program and new investment and mining acts were expected to result in the formation of a number of new private companies. Among companies that demonstrated some interest in Zambia's mineral sector, especially privatization of ZCCM or its components, were five of the world's eight largest private mining organizations: RTZ Corp. PLC of the United Kingdom; Anglo American Corp. of South Africa Ltd. (AAC), Broken Hill Pty. Co. Ltd. (BHP) of Australia, Phelps Dodge Corp. (PD) of the United States, and Gencor Ltd. of South Africa. But at mid-1994, after studies by various consultants, the Government had not yet concluded how much of its interest in ZCCM to sell and whether to sell as a single integrated unit or several separate operating companies.

ZIMCO also had a Mineral Exploration Department (MINEX) that worked in areas other than ZCCM's properties and also provided services to other subsidiaries. Other ZIMCO subsidiaries in the minerals sector included: wholly owned Reserved Minerals Corp. which in turn owned 100% of Mindeco Small Mines Ltd. (producer of several industrial minerals) and 55% of Kagem Mining Ltd. (reportedly the country's largest gemstone producer, 45% of which was owned by the Hagura organization, a private partnership); Chilanga Cement Co., 60% or more owned through Indeco Ltd., another wholly owned subsidiary of ZIMCO; wholly owned Nitrogen Chemicals of Zambia Ltd., producer of ammonia and compounder of fertilizers and explosives; wholly owned Maamba Collieries Ltd., the country's sole coal producer; and Indeni Petroleum Refinery Co. Ltd., 50% owned through Indeco Ltd. with at least some portion believed owned by Agip SpA. of Italy, the operating manager. Additionally, among more than 100 companies, ZIMCO also had majority or full ownership of some minerals-related businesses, such as: crushed stone, glass, and ceramics firms; Metal Marketing Corp. of Zambia, a minerals and metals trading firm; as well as Tazama Pipelines Ltd. (the crude oil pipeline from Dar es Salaam), Zambia Railways Ltd., domestic and international airlines, and electric utilities.

Private entities operated a number of small mines on which little information was available. More than 20 such mines were producing gemstones. Others produced rather limited quantities of gold, apparently mostly from alluvial deposits, as well as tin and a great variety of industrial minerals.

COMMODITY REVIEW

Significant exploration was being carried out throughout the country at mid-1994. Nearly 50 separate licenses were in effect covering very large areas, especially the northwest and much of the areas surrounding ZCCM's mine sites. In addition to copper-cobalt and lead-zinc ores, the companies targeted gold and nickel minerals, diamonds and other gemstones, fluorspar, and phosphate. A number of international mining groups were involved such as: BHP and Western Mining Corp. Ltd. from Australia; SouthernEra Resources Ltd. from Canada; Billiton International Metals BV from the Netherlands (acquired by RSA's Gencor Ltd. in mid-1994); AAC, Gencor, Johannesburg Investment Co. Ltd. (JCI), and Trans Hex Group Ltd. from the Republic of South Africa; RTZ Crop. PLC from the United Kingdom; and Phelps Dodge Corp. of the United States.

Recovery of cobalt, copper, lead, and zinc from tailings and slag dumps on ZCCM and other properties were of interest to several companies.

Metals

Cobalt.—Despite a small decrease in production in 1993, ZCCM became the world's largest single producer of cobalt

as a result of the drastic 60% drop in output from Zaire. The planned expansion in output by ZCCM appeared doubtful in the near term and a further reduction in 1994 was predicted by some observers. Because cobalt was primarily a byproduct of copper mining, the lower volume of copper ore together with lower grades of cobalt were said to be the reasons. Recovery of cobalt from ZCCM copper smelter slag was planned by a Zambian company that reportedly obtained the rights from ZCCM. Caledonia Mining Corp. of Toronto, Canada, applied for prospecting permits for cobalt in three areas.

Copper.—ZCCM experienced a shortfall in copper, to 392,000 tons for the year ending in March 1994 (year 1993 in table 1), according to a company announcement. That production presumably was finished copper of company origin, and tolled production (40,000 tons in 1993) was not identified. Nevertheless, output was well below plans and expectations. Reasons cited included bad mining conditions at Mufulira combined with low metallurgical recoveries at the Nchanga concentrator and Nkana smelter, as well as cost-reduction efforts. Nevertheless, continuing steps toward greater efficiency, including significant manpower cuts, closing of Luanshya copper smelter (since the Nkana smelter was upgraded) and other unprofitable operations, and disposal of noncore units, were expected to result in an increase in profits and production for the year ending March 1995.

Privatization of ZCCM was of major interest to everyone in the industry. The total cost of fully revitalizing the entire company to reach and maintain the desired 450,000-mt/a production level, which at mid-1994 had risen to an estimate of more than $3 billion over a 15-year period, was an important factor in determining the format for returning the company to the private sector. The possibility of joint ventures with outside firms on specific divisional projects was also a consideration.

Development of deeper ore at the Konkola Mine at the northwestern end of the Zambian Copper Belt was the focus of immediate attention. A 1,470-m-deep shaft would allow mining several hundred million tons grading more than 3% copper. It was crucial to the survival of ZCCM because it was needed to replace the reserves nearing depletion at the Nchanga open pit. The cost to develop a 6-Mmt/a production was given as about $650 million.

ZCCM offered the Chambishi and Kansanshi Mines for sale about mid-1994. Chambishi, on the Copper Belt, had published resources of 136 Mmt at 2.4% copper. Kansanshi, near Solwezi northwest of the Copper Belt, with resources of more than 26 Mmt at 2.9% copper with significant gold, was operated as a training facility and to provide jobs for employees considered excess at other operations.

The Lumwana deposit, about 250 km west of the Copper Belt center of Kitwe, became an exploration project of Phelps Dodge Corp. of the United States. Prior indicated mineralization was more than 1 billion tons averaging 0.7% copper.

Nickel.—The Munali nickel sulfide deposit, about 50 km south of Lusaka, was revived as a project early in 1994 by the concession-holder Appolo Mining (Pty) Ltd., a private Zambian company, and its partner Claims Minerals NL of Australia. Reserves were given as 10.4 Mmt at 1.1% nickel.

The Kalumbila deposit, about 460 km northwest of Lusaka (50 km west of Lumwana), came under investigation by Anglo American. Earlier studies gave resources as 8 Mmt at 0.55% nickel.

Zinc.—At ZCCM's Kawabe lead-zinc mine, about 110 km north of Lusaka, the ore types in the remaining reserves were changing from sulfides to oxides. As a consequence, the zinc leach plant was rehabilitated and reopened in early 1993 with an annual capacity reported as 10,000 tons of zinc and the Imperial Smelting furnace was to be closed. However, after the expenditure of more than $3.5 million, the operation lost $16 million in the year ending March 1994. Following a difficult closure decision and reconsideration because of social consequences, it apparently was finally closed and available for purchase at the end of September 1994.

Industrial Minerals

Cement.—Plants operated by Chilanga Cement Ltd. were at Lusaka, originally started up in 1951, and at Ndola on the Copper Belt, started up in 1969. Both were subsequently enlarged, and capacities in 1992 were rated at 200,000 mt/a and 300,000 mt/a, respectively. Output went primarily to domestic customers, but the latest information available indicated that in 1991 20% was exported, mostly to Burundi. Reportedly having little debt and being marginally profitable, the company was to be privatized late in 1993 with the Government's 60% or greater share being sold to the public, including an allotment for of some kind for company employees.

Diamonds.—Alluvial diamonds, known for some time to occur in the Musondweji river basin about 400 km west-northwest of Lusaka, were to be explored by Caledonia Mining Corp. of Toronto, Canada. Locating the source was of special interest. A De Beers unit was working on diamond exploration in western Zambia in late 1992.

Fluorspar.—A unit of Agip SpA., of Italy, continued to discuss with the Government the possible development of a fluorspar deposit about 120 km south of Lusaka. Significant infrastructure costs were a restraint on exploitation.

Gemstones.—The Ministry of Mines and Mineral Development continued to implement the 1991 law that liberalized the sector. Dealership licenses were available permitting purchases and sales with a requirement to report activity. This replaced a Government trading organization that had driven sales underground. The Government estimated sales at about $100 million of which only

$30 million was reported. The Government believed sales could be increased 50% with little new investment and implemented an active program to develop the sector with training and other assistance and believed the sector should be attractive to foreign investment in mining, processing, and marketing.

Emeralds, mostly produced about 200 km north of Lusaka (Ndola rural area), were estimated to normally comprise about 80% of total gemstone production in value. But in volume, amethyst output, mostly from a location about 300 km south-southwest of Lusaka (Kalomo area), usually was the largest reported. Additionally, there was production of aquamarine and tourmaline, mostly from a location about 600 km northeast of Lusaka (Lundazi area), as well as garnet, agate, and other gemstones at a number of locations. Of the 30 to 40 registered gemstone operations reported, 2 were larger size, mechanized mines that were joint ventures with the Government. From 200 to several thousand small, unregistered mining operations were estimated to be operational.

Nitrogen.—Nitrogen Chemicals of Zambia Ltd. signed an agreement early in 1993 to import 1,000 mt/month of nitrogen from South Africa for making fertilizers. In the late 1980's, a World Bank- supported project to improve operations included rehabilitation of two coal-based ammonia plants originally commissioned in 1970 and 1981. However, in a 1993 report the Bank concluded that the project was not very successful and the company needed a substantial capital injection and a major financial restructuring.

Talc.—Talc Zambia Ltd., formed in 1989, worked the Mushishi deposit identified as being near Ndola on the Copper Belt. Reserves were given as 2 Mmt containing 33% steatite. The initial output rate was about 30,000 mt/a of several grades, for sale domestically as well as to buyers in Zimbabwe and the Republic of South Africa.

Government-owned Crushed Stone Sales Ltd. mined the Lilayi talc deposit, just south of Lusaka. It was listed for privatization early in 1992 because operations were not very efficient.

Mineral Fuels

Coal.—Maamba Collieries Ltd.'s strip mine in southern Zambia continued to have unidentified difficulties. Results were not yet announced regarding a World Bank-funded study to determine the long-term viability of the mine before committing major funds. John T. Boyd Co. of Pennsylvania began the study in October 1992. Lack of coal orders late in 1992 caused problems because it necessitated increasing the plant's idle time.

Petroleum.—The World Bank's International Development Association (IDA) approved a $30 million credit toward a $48 million petroleum sector restructuring project. A major portion, $20 million, was for rehabilitating the Tazama pipeline from the port of Dar es Salaam, Tanzania, to the Indeni refinery at Ndola on the Zambian Copper Belt.

Reserves

Copper ore reserves of ZCCM were ample for at least 15 years of continued full-scale operation at 450,000 mt/a of finished copper, according to ZCCM officials. ZCCM's Annual Report for the year ending March 31, 1993, gave total ore reserves at seven mines of 330 Mmt averaging 3.0% copper. Additional mineral resources of ZCCM were huge, 1.22 billion tons at 2.5% copper. A number of other known copper deposits outside of ZCCM's license area were known as well. The major deposit was Lumwana with resources of more than 1 billion tons at 0.7% copper.

Cobalt reserves associated with the copper ore were substantial.

Gold ore resources were being studied by several groups and appeared to be rather extensive. Many occurrences were located throughout the country, some around and to the east of Lusaka.

Lead-zinc reserves at existing operations were limited, but additional resources were known at several locations. Resources projected at Kabwe were more than 50 Mmt at 3.8% zinc and 1.7% lead, including some waste material, but most were low grade or not immediately accessible.

Nickel resources at the Munali sulfide deposit were put at 10.4 Mmt at 1.1% nickel with minor copper, gold, silver, and platinum-group metal content. The Kalumbila deposit had resources estimated at 8 Mmt at 0.55% nickel. Neither deposit was fully defined, and extensions were to be explored. Additional resources are projected at other sites.

A large variety of other metallic minerals deposits also were known but needed further exploration. Most work appeared to have been done on iron, molybdenum, and tin-tantalum.

Of the many industrial mineral resources that were being exploited or studied by commercial groups, gemstones were of the most value, but others included: clays for brick and tile, and for refractories; fluorspar; gypsum; limestone for cement and lime manufacture; magnetite for special purposes; marble; phyllite probably for cement manufacture; silica, mostly for glassmaking; and talc. Phosphate resources were known, but only of low grade, one of which was a carbonatite in the northeast, the subject of continuing studies by Government agencies.

Mineral fuel resources were reported as 250 Mmt of bituminous coal but details of the classification were not available. Petroleum resources remained conjectural with no work known or planned after some surveys in 1990 along the Zambesi River east of Victoria Falls to Mozambique.

INFRASTRUCTURE

A fairly extensive truck road and railway network existed within the country and externally for access to ocean and lake ports for international trade. Major highways generally paralleled the rail lines. The World Bank's affiliated

International Development Association (IDA) considered the road system was neglected for many years and that improvement was essential to economic growth. It approved an $8.5 million credit to reform Government policy, institutions, and financing as well as to begin planning for rehabilitation.

The principal rail routes were: northeast to and from Dar es Salaam, Tanzania—nearly 2,000 km from Ndola in the Copper Belt—mostly on the Tanzania Zambia Railways Authority (Tazara) line; and south through Zimbabwe to and from South African ports—more than 2,500 km from Ndola—using the Zambia Railways Ltd. line in Zambia. The roughly 2,000-km rail link southeast to Beira, Mozambique, through Zimbabwe, became generally available after a long hiatus due to civil war in the port country; but ocean ship availability apparently was limited. The more than 2,200-km rail link north into Zaire and west to Lobito, Angola, remained unavailable because of political unrest in the port country. A southeasterly route involving trucks to Grootfontein in Namibia and then rail to the port at Walvis Bay on the South Atlantic Ocean was tested with copper shipments starting in 1990. Despite appearing to be of limited advantage, it continued to be of interest to the Government. In general, the railroad system still had rolling stock shortages, and track maintenance on internal routes was of concern. However, equipment rentals and donor aid programs were helping to improve the situation.

A crude oil pipeline ran from Dar es Salaam about 1,700 km southeast to a refinery in Ndola. It was owned and operated by Tazama Pipelines Ltd., a joint venture of the Zambian and Tanzanian Governments.

International and domestic air transport were generally considered excellent.

Electric power capacity was adequate, furnished about 70% from hydroelectric, 20% from oil, and 10% from coal plants, but the expansion of hydro sources was planned. The 1992 drought resulted in some limitation on consumption but Zaire furnished some extra power needed in the Copper Belt during that year. The energy source for mobile equipment continued to be petroleum, a significant amount of which was from imported crude refined in the state-owned facility at Ndola. Other needs were met by imports of appropriate products. The household energy source was wood, which thus continued to be the country's largest single source of energy.

Telecommunications also were considered very good, both internally and externally.

OUTLOOK

Zambia's economic difficulties could remain a problem for some time because of the many impediments to the reform program that was so essential to eventual resolution of the difficulties. But much promise of success could be found in the availability of good agricultural, mineral, and water resources; the open political environment; and a market-oriented Government, together with the continued reasonable personnel and financial assistance from international sources. With political stability and improved investment and mining policies, the international mining community could be expected to act on the opportunities. A number of minerals appeared ripe for development. Although copper-cobalt output in the short term is likely to decrease owing to restructuring, improved efficiency and reinvestment of earnings could bring a turnaround. However, production can be expected to again decrease in the longer term unless there is some substantial outside financing in the next few years.

[1]Where necessary, values have been converted from Zambia kwachas (K) to U.S. dollars at the rate of K434=US$1.00 for 1993 values and K156=US$1.00 for 1992 values, the official year averages quoted by the Bank of Zambia. Yearend rates quoted for 1993 and 1992 were K500 and K357, respectively.

OTHER SOURCES OF INFORMATION

Agencies

Ministry of Mines and Minerals Development
P.O. Box 31969
Lusaka, Zambia
Telephone: 260-1-227-653
Facsimile: 260-1-254-281

Mines Development Department
P.O. Box 31969
Lusaka, Zambia
Telephone: 260-1-251-288
Facsimile: 260-1-252-095

Geological Survey Department
P.O. Box 50135
Lusaka, Zambia
Telephone: 260-1-250-174
Facsimile: 260-1-251-973

Publications

Investment Opportunities in the Mineral Sector of Zambia, Ministry of Mines and Mineral Development, Lusaka, Zambia. (Paper presented at African Mining Investment Conference, June 6-8, 1994, Denver, Colorado) Multilateral Investment Guarantee Agency of the World Bank, Washington, DC, 1994.

TABLE 1

ZAMBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
METALS							
Beryllium: Beryl	kilograms	880	1,633	836	504	[3]178	1,500
Cobalt:[4]							
Mine output:							
Ore milled:[5]							
Gross weight	thousand tons	6,596	6,505	6,311	[r]6,630	5,700	6,600
Co content		10,590	10,870	10,970	[r]11,370	8,700	11,000
Concentrate:							
Gross weight		274,989	258,698	243,504	[r]226,150	225,000	275,000
Co content		7,255	6,999	6,994	[r]6,910	5,300	7,300
Metal:							
Materials treated:							
Gross weight		299,811	261,608	282,927	[r]259,515	255,000	300,000
Co content		7,075	6,666	7,104	[r]6,968	6,400	7,500
Refined electrolytic cathode		4,447	4,674	4,741	4,797	3,700	5,000
Copper:[4]							
Mine output:[6]							
Ore milled:							
Gross weight	thousand tons	23,640	22,952	21,502	[r]22,746	21,000	25,000
Cu content		538,115	519,400	475,870	[r]537,903	470,000	550,000
Concentrate:							
Gross weight	thousand tons	1,488	1,344	1,102	[r]1,099	1,200	1,500
Cu content		419,080	400,221	343,647	[r]367,491	360,000	425,000
Metal:							
Electrowon:							
From tailings leachate		78,716	67,774	70,614	80,371	72,000	100,000
From copper concentrate leachate		16,857	12,418	11,108	—	—	20,000
From cobalt concentrate leachate		25,233	24,379	28,214	27,321	25,000	30,000
Total electrowon		120,806	104,571	109,936	107,692	97,000	150,000
Smelter output, blister/anode[7]		345,478	331,739	300,329	356,367	320,000	350,000
Total electrowon and blister		466,284	436,310	410,265	464,059	417,000	500,000
Refined:							
Electrorefined[8]		342,735	334,878	314,125	376,059	338,000	375,000
Shapes[9]		75,383	50,546	42,938	52,436	47,000	50,000
Subtotal		418,118	385,424	357,063	428,495	385,000	425,000
Electrowon[10]		45,444	52,660	45,390	43,712	40,000	50,000
Total refined grade		463,562	438,084	402,453	472,207	425,000	475,000
Gold[4 11]	kilograms	129	129	136	271	250	275
Lead:[4]							
Mine output, ore milled:							
Gross weight		111,000	158,000	177,000	[r]114,000	100,000	100,000
Pb content		8,807	9,638	9,084	[r]4,446	5,000	5,000
Metal:							
Smelter bullion, gross weight		6,912	5,339	4,999	[r]3,950	3,500	7,500
Refined, gross weight[12]		3,653	3,670	2,637	3,033	2,600	5,500
Manganese concentrate (°48% Mn), gross weight		351	712	662	292	300	750

See footnotes at end of table.

TABLE 1—Continued

ZAMBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS—Continued							
Selenium, refined, gross weight[4 13]	kilograms	20,861	21,692	21,858	31,785	28,500	30,000
Silver[4 11]	do.	19,719	17,031	13,657	20,972	18,800	25,000
Tin concentrate:							
Gross weight (65% to 72% Sn)		2	2	9	3	3	10
Sn content		1	1	6	2	2	7
Zinc:[4 14]							
Mine output, Zn content of ore milled		22,853	32,074	19,825	r14,706	13,500	13,500
Metal, refined, gross weight[15]		12,351	9,717	6,339	7,288	6,500	15,000
INDUSTRIAL MINERALS							
Cement, hydraulic		385,937	437,421	366,914	e347,000	350,000	500,000
Clays:							
Brick[16]		5,126	3,732	2,817	e3,000	3,000	5,000
Building, not further specified e		2,000	2,000	2,000	2,000	2,000	2,000
China and ball		e350	e250	120	e200	200	400
Feldspar		20	60	e70	113	100	150
Gemstones:							
Amethyst	kilograms	6,275	18,130	168,220	479,252	3397,964	200,000
Aquamarine	do.	89	166	65	254	374	200
Emerald	do.	334	619	265	453	3138	1,000
Gypsum e [17]		15,000	14,000	14,000	e13,000	13,000	20,000
Lime, hydrated and quick	thousand tons	230	214	184	212	200	250
Limestone (cement and lime) e [18]	do.	980	860	750	770	750	1,000
Magnetite, gross weight[19]		318	576	400	417	400	500
Nitrogen: N content of ammonia		11,700	3,900	4,700	e7,000	10,200	12,000
Sand and gravel, construction e	thousand tons	3226	500	500	500	500	1,000
Stone, construction:							
Limestone, crushed aggregate	do.	775	772	739	e750	750	1,000
Other e	do.	1,000	700	700	700	700	1,500
Sulfur:[4]							
Pyrite concentrate:							
Gross weight (e42% S)		70,828	72,060	73,483	r78,202	76,000	80,000
S content e		29,700	3e30,200	3e30,600	31,000	32,000	34,000
In sulfuric acid: e							
From pyrite roaster gas, S content		18,000	15,000	20,000	20,000	20,000	25,000
From smelter gas, S content		78,000	71,000	69,000	75,000	75,000	85,000
Total, S content		96,000	86,000	89,000	95,000	95,000	110,000
Talc		114	160	89	366	350	400
MINERAL FUELS AND RELATED MATERIALS							
Coal, bituminous	thousand tons	395	382	345	422	450	500
Petroleum, refinery products:[4]							
Liquefied petroleum gas	thousand 42-gallon barrels	43	e100	e100	e100	100	100
Motor gasoline	do.	1,237	e1,300	e1,300	e1,300	1,300	1,400
Jet fuel e	do.	540	500	500	500	500	600
Kerosene e	do.	323	300	300	300	300	400
Distillate fuel oil	do.	2,071	e2,000	e2,000	e2,000	2,000	2,200

See footnotes at end of table.

TABLE 1—Continued

ZAMBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
MINERALS FUELS AND RELATED MATERIALS—Continued							
Petroleum, refinery products—Continued:							
Residual fuel oil	do.	623	e700	e700	e700	700	800
Other, including refinery fuel and losses	do.	431	e400	e400	e400	400	500
Total	do.	5,268	e5,300	e5,300	e5,300	5,300	6,000

eEstimated. rRevised.

[1]Table includes data available through Oct. 1, 1994.

[2]In addition to commodities listed, the following were probably produced but information is inadequate to reliably estimate output: fluorspar (reported in 1989 at 99 metric tons and in 1990 at 35 metric tons); tourmaline (reported for 1990-92 as at least 1 kilogram per year); additional crude construction materials at artisanal operations (clays for brick and tile; sand, gravel, and stone for agggregate and fill; dimension stone; et al.); and clay and/or shale normally used for cement manufacture (about 0.4 ton per ton of finished cement). Some "industrial sand" and minor amounts of "phyllite" and "silicate" production also was reported but not further defined.

[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 were produced.

[6]Includes ore and concentrate shown under "Cobalt" entry above, all of which contain copper that was recovered; but separate quantitative data on copper content of cobalt concentrates are not available. In the Copper Annual Report in V. I of the USBM Minerals Yearbook, copper content of mine production is considered to be the sum of the following entries from this table: "Smelter output" plus "Total electrowon" less any metal derived from imported ore included in either entry.

[7]Includes the following quantity of blister anodes produced on toll by Zambia Consolidated Copper Co. Ltd. (ZCCM) from Zairean (1989-92), South African (1991-92), and Indonesian (1992) concentrates, in metric tons: 1989—r15,295; 1990—16,182; 1991—19,678; and 1992—34,569. In the Copper Annual Report of the USBM Minerals Yearbook, "smelter production" is considered to be the sum of the following entries from this table: "Smelter output" plus "Total electrowon" less "Refined: Electrowon."

[8]Includes the following quantity of electrolytic cathodes (presumably refined grade) produced on toll by ZCCM from blister smelted from Zairean (1989-92), South African (1991-92), and Indonesian (1992) concentrates, in metric tons: 1989—15,094; 1990—16,494; 1991—15,691; and 1992—40,001.

[9]Reported by ZCCM as "finished production, refined shapes," presumably billets and/or wirebars of refined grade produced from lower grade electrowon cathodes and/or blister anodes that were furnace- or fire-refined; although high-grade electrowon cathodes or even electrorefined cathodes could possibly have been used as well.

[10]Presumed to meet refined-grade specifications although reported by ZCCM only as "finished production, leach cathodes," apparently a portion of the total electrowon cathodes that were not further refined.

[11]From copper and cobalt refinery residue produced by ZCCM only. Additional production probably came from artisanal operations but information is inadequate to reliably estimate output. However, for calendar year 1992, total production, presumably from artisanal as well as ZCCM operations, was reported as 218 kilograms of gold and 18,264 kilograms of silver. In year ending Mar. 31, 1993, up to 250 kilograms of silver may have come from imported copper concentrates processed on toll.

[12]Reported by ZCCM as "finished production." Presumed to be primary in the absence of any reported use of scrap by ZCCM.

[13]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 to reliably estimate content.

[14]Gross weight of ore milled shown in "Lead" above.

[15]Includes output of both Imperial smelter and electrolytic zinc plant reported as "finished production" by ZCCM.

[16]Presumably weight of finished brick.

[17]Estimated for cement manufacture only, assuming no imports. Available information is inadequate to reliably estimate additional output for other uses (e.g., plaster). Only production officially reported was 82 metric tons for 1992.

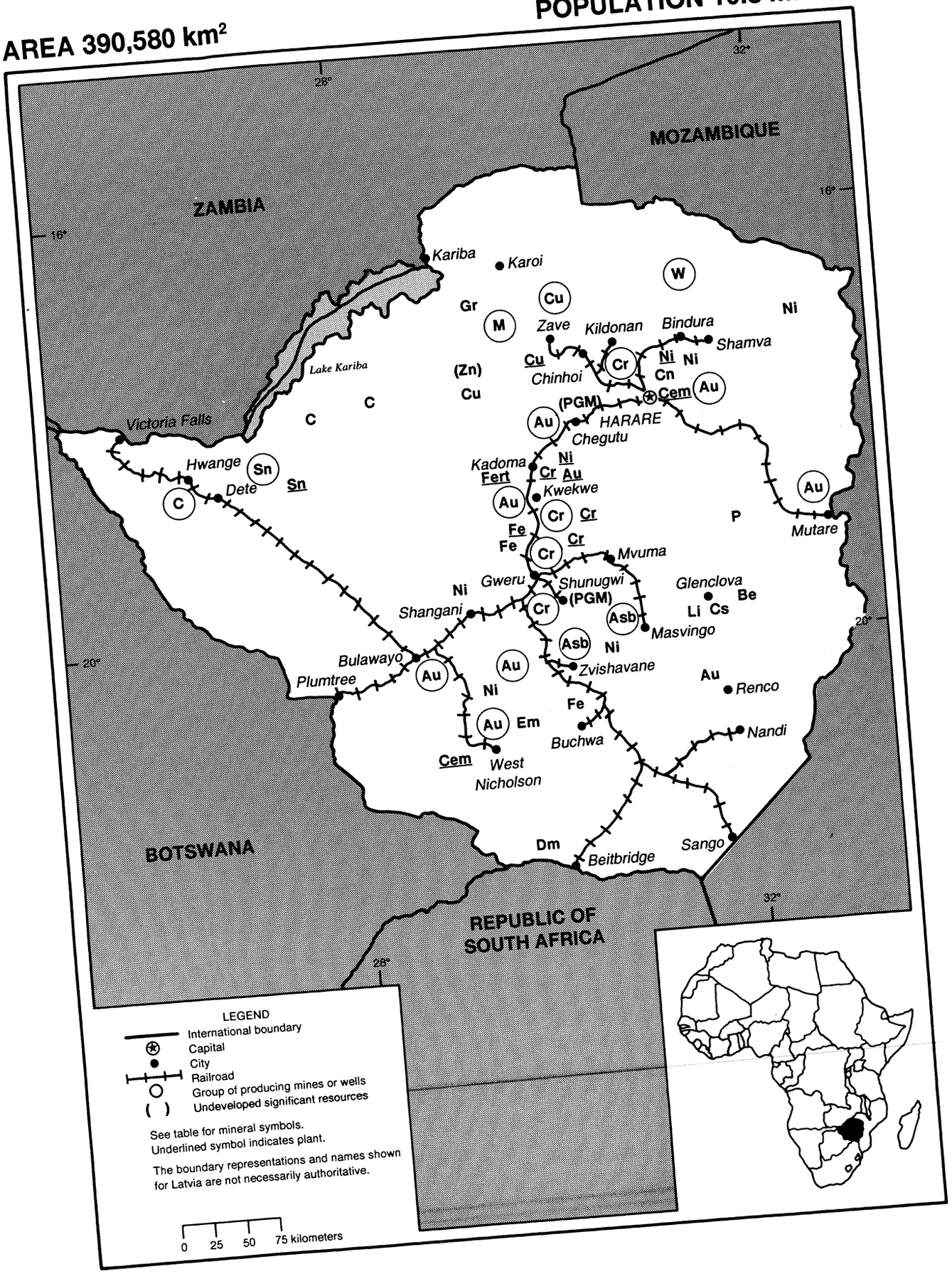
[18]Estimated for cement and lime manufacture only. Also see "Stone, construction: Limestone, crushed aggregate."

[19]Presumably for cement manufacture, dense media, electronic, or other special uses. Estimated at 65% to 70% Fe.

ZIMBABWE

AREA 390,580 km²

POPULATION 10.8 million



LEGEND

- International boundary
- Capital
- City
- Railroad
- Group of producing mines or wells
- ( ) Undeveloped significant resources

See table for mineral symbols.
Underlined symbol indicates plant.

The boundary representations and names shown for Latvia are not necessarily authoritative.

0 25 50 75 kilometers

THE MINERAL INDUSTRY OF

ZIMBABWE

By Philip M. Mobbs

Zimbabwe played a major role in world supply of ferrochromium, chrysotile asbestos, and lithium minerals. More than one-half of the world's known reserves of high-grade chromium ore was in Zimbabwe. Zimbabwe is self-sufficient in most minerals, with more than 50 different mineral commodities being produced. Gold production remained the country's leading mineral sector in 1993. The extractive industry accounted for about 7% of the gross domestic product at factor cost.

The mineral industry of Zimbabwe is in transformation. Changes range from Harare offices switching telephone numbers as the telephone system is upgraded to the interest in operating new mines as worksites only, thus eliminating the expense of the traditional mining town infrastructure. The nation's nucleus of asbestos, chromite, copper, gold, and nickel mining activity is rapidly diversifying with the recent successful diamond exploration. Foreign investment attention also focused on heap-leachable gold projects and coalbed methane prospects. The platinum potential of the Great Dyke could soon be realized as encouraging feasibility studies for both BHP Zimbabwe Inc. (BHP) and Delta Gold NL's Hartley Prospect and Union Carbide Zimbabwe's (Pvt.) Ltd. Mimosa Prospect were completed.

The increasing optimism of the mineral industry was fostered by the continuing recovery from the water and power shortages associated with the 1991-92 drought and increasing availability of foreign exchange. However, liquidity problems associated with the weak international commodity market, high interest rates, and increased energy costs tempered the enthusiasm. A yearend Central Statistical Office survey indicated that 86% of mining companies contacted were still operating at less than full capacity.[1]

GOVERNMENT POLICIES AND PROGRAMS

Increased availability of foreign exchange through the Minerals Marketing Corp. of Zimbabwe (MMCZ) loan program was one effect that the Government's 1991 Economic Structural Adjustment Program (Esap) had on the mining industry in 1993. The third loan (MMCZ3 facility), a foreign exchange allocation of $30 million, was offered during the year. The availability of another source of financing, the Sysmin facility, was announced in November. Sysmin was restricted to companies that had recently exported mineral products to the European Union.

In April, the Government also increased the percentage of foreign exchange that exporters were allowed to keep under the Export Retention Scheme from 35% to 50%.

The Gold Trade Act gave the Reserve Bank of Zimbabwe the monopoly on buying and selling all produced gold. During 1993, the Government permitted gold producers to coordinate forward sales of gold with the Reserve Bank. It also allowed 15% of gold production to be hedged and authorized miners to finance expansion with gold loans. The Reserve Bank authorized one gold loan at yearend, but the expected industry enthusiasm for the program has not materialized.

The Government's 5% drought levy on companies expired in September. However, a 10% tax on services, such as consulting services, was initiated in November.[2]

The Zimbabwe Investment Center assisted investors with permits and licenses. The 1993 Zimbabwe Investment Center Act accelerated the investment project sanctioning process. The commission was moving toward being more of a national investment promotion center.

ENVIRONMENTAL ISSUES

The Ministry of Environment and Tourism proposed that interim environmental impact assessments be required by 1994.[3] However, administration of existing environmental protection and pollution control legislation historically has been hampered by limited funding available for the Government's enforcement efforts as well as the adverse effect it would have on the nation's many economically marginal mining operations.

The Ministry of Mines is responsible, under the provisions of the Mines and Minerals Act, for verifying that exploration and development operations have minimal long-term environmental impact. The Ministry of Lands, Agriculture, and Water Development monitors water pollution under the Water Act, as does the Ministry of Environment and Tourism's Department of Natural Resources under the Natural Resources Amendment Act. City councils also maintain water quality standards. The Ministry of Health is responsible for air quality under the Atmospheric Pollution Prevention Act.

International finance organizations increasingly specify environmental standards when considering development projects.[4]

PRODUCTION

The value of mineral production in 1993 exceeded $437.8 million.[5] The country's most significant minerals produced in 1993 were, in order of percent of total mineral value, gold (46.1%), asbestos (15.7%), coal (13.4%), nickel (12.2%), copper (2.9%), chromite (1.8%), iron ore (1.3%), phosphate (1.0%), granite (0.9%), and limestone (0.8%). In only its 2d year of production, diamond jumped to Zimbabwe's 12th most valuable mineral produced. Many commodities posted lower production in 1993 than in 1992. (*See table 1.*)

TRADE

Most of the country's mineral industries were export oriented and thus exposed to world market fluctuations. Many exports were processed, in accordance with the Government's strategy of increasing value-added natural resource exports.

During 1992, the most recent year for which trade data are available, exports were valued at $1,466 million. The main export commodities, in order of percent of export value, were tobacco (35%), gold (13%), ferroalloys (9%), nickel (6%), and cotton (2%). Zimbabwe's leading buyers were South Africa (14%), the United Kingdom (11%), Germany (7%), Japan (6%), and Botswana (5%). Principal mineral exports to the United States were ferrochromium and nickel. Exports, except gold, were handled by the MMCZ, which charged a 0.875% commission.

The most significant imports in 1992, in percent of total import value, were machinery and transport equipment (36%), fuel (12%), and chemicals (12%). Notable sources for the $2,264 million of imports were South Africa (24%), the United Kingdom (12%), the United States (9%), Germany (6%), Japan (5%), and Botswana (1%).[6]

STRUCTURE OF THE MINERAL INDUSTRY

Large multinationals such as Anglo American Corp. Svc. Ltd. (Anglo), Lonrho Zimbabwe Ltd., Rio Tinto Zimbabwe Ltd. (RTZ), and Union Carbide Zimbabwe historically have maintained a significant presence in the nation's mining industry. Recently, the nation's exploration potential attracted the interest of a number of foreign companies. International junior mining corporations spent much of the year negotiating and exercising exploration options and performing geological and geophysical work.

The Government's mining company, Zimbabwe Mining Development Corp. (ZMDC), had interest in a number of mining operations. Refractory ores containing gold were treated at the state's oldest parastatal, The Roasting Plant. Doré was delivered to Fidelity Printers and Refiners (Pvt.) Ltd., the subsidiary of the Reserve Bank of Zimbabwe that purchased all gold produced in the country. The state's Industrial Development Corp. of Zimbabwe Ltd. had a number of subsidiary companies operating in the industrial minerals sector. *(See table 2.)* Exports were usually shipped out of the country aboard the state-owned National Railways of Zimbabwe.

Approximately 50,000 people were employed in medium- and large-scale mining operations, including about 3,000 people with the industry's 46 mining cooperatives. An estimated 10,000 people worked the nation's small mines, and the Ministry of Mines estimated that between 40,000 and 50,000 people were involved in informal gold panning.

During 1993, a total of 24 fatal mining accidents were reported.[7] The mining work force was threatened by AIDS and a cholera epidemic. There were an estimated 80 AIDS-related deaths in the formal mining community.

COMMODITY REVIEW

The number of Exclusive Prospecting Orders granted by the Mining Affairs Board increased to 120 in 1993, from 62 in 1992 and 74 in 1991. Diamond is now the most popular exploration target.[8]

Metals

Copper.—Mhangura Copper Mines Ltd. continued production at reduced levels in 1993. The smelter and refinery suffered from insufficient feed despite imported concentrate, because the supplemental feed source also was disrupted. The company obtained an $8 million loan from the Government to partially satisfy creditor and supplier demands.[9] The collapsed Miriam shaft was successfully refurbishing from 487 m back to bottom (732 m).

Reunion Mining (Zimbabwe) Ltd. will develop the oxides of the Sanyati copper deposit.[10] However, sulfuric acid availability may initially be a problem. The deposit's reserves were estimated by the Government to be 60 Mmt of copper, lead, and zinc oxides. Reunion optioned three other base metal properties to Argonaut Mining.[11]

Ferrochrome.—Union Carbide Zimbabwe's Zimbabwe Mining and Smelting Co. (Pvt.) Ltd. (Zimasco) and Anglo's Zimbabwe Alloys Ltd. (Zimalloys) reduced production because of poor ferrochrome markets.

Connecticut-based Union Carbide Corp. continued its attempt to divest itself of Union Carbide Zimbabwe, its only mining subsidiary. By mid-1993, Union Carbide Zimbabwe was turning things around. Zimasco had cut back on its mining operations, allowing contractor mining co-operatives to remain in operation at reduced levels. The metal from slag (MFS) plant next to the Kwekwe smelter was reprocessing the facility's slag dumps, which contain up to 10% ferrochrome. MFS material was mixed with unmarketable fines and remelted.

Zimasco shut down its six high-carbon ferrochrome furnaces in December 1992 for 2 months. Zimasco was restarting the fifth furnace when Union Carbide Corp. announced that a Harare-based management group would administer

Union Carbide Zimbabwe as a joint-partnership operation.[12]

Zimalloys reduced chromite production from its mines owing to the reduced refinery requirements. Netherburn Mine was closed and Inyala Mine was put on care-and-maintenance status in September. Production from the Great Dyke Mine and purchase of ore from contractors were also drastically cut back. The Gweru smelter's A3 furnace produced all output after the A2 furnace was shut down in August.

Gold.—Most of the new gold operations were based on the application of new technology to old operations.

Alluvial gold panning was one of Zimbabwe's fastest growing industry areas, as the rural alternative to subsistence farming. However, most panning was illegal, and much of the production was smuggled out of the country. The resultant tax avoidance and extensive environmental damage due to riverbank erosion and stream siltation resulted in increased official awareness of the area.

Cluff Resources Zimbabwe Ltd. finished production in the Rebecca open pit. The adjacent Freda pit is expected to last another 5 years. An underground feasibility study was positive, and Cluff began preliminary stopping on the hanging wall and room-and-pillar test work at the base of the Rebecca pit. It began a decline in the hanging wall and expects first ore production from the underground mine in 1994. At yearend, Cluff received a 1,617-kg gold loan to finance underground development.[13]

During 1993, the Sabi gold mine joint venture of ZMDC and African Gold Zimbabwe (Pvt.) Ltd. was dissolved. Masasa Mines finished surface exploration at its Makaha gold prospect in September, while Antares Mining and Exploration Corp. continued exploration on its Lady Lina property with an underground evaluation program. Reunion entered into joint ventures with Blanket Mine Ltd., a subsidiary of Falconbridge Gold, and with Blue Falcon Mines Ltd. During the year, Kinross Gold purchased majority interest in Falconbridge Gold, which was drilling delineation wells at the Golden Kopje Mine.

The Roasting Plant was studying pressure oxidation and bioleach processes to replace the older of its Edwards roasters. The Roasting Plant expects to increase its customer base with the new technology because refractory ores comprise an estimated 30% of Zimbabwe's proven gold reserves.[14]

Iron and Steel.—Zimbabwe Iron and Steel Co.'s (Zisco) blast furnace No. 4 was shut down for approximately 18 months for a reline early in the year. Zisco's other blast furnace normally heats less than 40% of annual production. Construction continued on the 2-Mmt/a sinter plant at Redcliff to process the ore from the new mine at Ripple Creek.[15] Except for stockpiled fines, the iron ore mine at Buchwa will be exhausted shortly. Zisco's rehabilitation was delayed for a number of years because of continuing financial problems stemming in part from depressed domestic and international steel markets. The Government changed the company's top management in April.

Zisco had recently commissioned 2 new 25-oven coke batteries at Redcliff. At the end of August, the company suffered through a crisis when Wankie Colliery stopped supplying coking coal to Zisco for 20 days owing to nonpayment.[16]

Nickel.—Earlier this year, Bindura Smelter & Refinery's (BSR) smelter was taken down for 10 weeks for a total rebuild of the 15-MW furnace. It was back on-line by mid-June. The refinery was also shut down for a 6-week maintenance program. The concentrators at Trojan Nickel Mines' Trojan, Shangani, Madziwa, and Epoch operations were shut down during the same period for scheduled maintenance. During the shutdown, BSR erected a cobalt drier building to decrease cobalt hydroxide cake handling time.

BSR uses an Outokumpu leach process. As part of its continuing facilities upgrade, BSR planned to add a Sherrit Gordon pressure leach line and a small Sirosmelt furnace to the Bindura facility. The additions, which could be on-line in 1995, would improve base metal recovery rates slightly and boost the byproduct platinum-group metals (PGM) recovery rate from 30% to almost 95%.

RTZ's Empress nickel refinery had toll refined matte from BCL's Selebi Phikwe smelter in Botswana since reopening in 1985. Empress' proposed expansion to 10,000 mt/a from 6,500 mt/a was postponed as Tati Nickel Mining Co. delayed development of the Phoenix Mine in Botswana.

By yearend, Empress' Sirosmelt smelter, which had been installed in June 1992, was operating at near capacity. The Sirosmelt smelter treats the residue remaining after leaching matte. Empress formerly shipped about 7,300 mt/a of leach residue to BCL for further treatment.[17]

Platinum-Group Metals.—BHP concluded a 30-month evaluation of the Hartley Platinum Project at Selous, about 80 km from Harare, in April. During the evaluation, BHP drilled 40,000 m of core and trial mined a 610-m haulage drift along strike and two 1.5-m stopes. The feasibility study was submitted in July 1993 and approved by the head office in December. BHP planned to negotiate appropriate investment conditions with the Zimbabwean Government.[18]

Hartley is shallow compared to South African platinum operations. BHP has proposed a decline in the footwall with conveyor belts to bring out ore and a 2- to 3-year timeframe to get to full production. In addition to the expected 4-mt/a PGM output, BHP will recover copper, gold, and nickel from Hartley.

Conflicting reports of the status of Union Carbide Zimbabwe's Mimosa platinum project were published during June and July, after the completion of a 3-year feasibility study.[19] The management changes at Union Carbide Zimbabwe most likely delayed the project although a company vice president indicated that the new management "will also explore new possibilities for developing Union Carbide Zimbabwe's

platinum project at Mimosa."[20]

Delta Gold acquired the right to earn 24% in the Mhondoro Prospect joint venture of RTZ (38%) and Valley Exploration and Mining Co. (38%), an Anglo subsidiary. The joint venture was evaluating the ore body. Core drilling was completed at midyear, and the results of the Zinca trial mine on the Mhondoro prospect were being examined. A decision to go ahead could be made as early as 1994. Mhondoro was just south of the Hartley platinum prospect.

Tin.—Underground mining operations were shut down, slightly improving the economic prospects of the remaining Kamativi open pit tin operations. Feed for the smelter was made up of concentrate from Kamativi and the Kigali area in Rwanda.[21] ZMDC has continued tin operations at Kamativi since 1986 despite losses and anticipated that the operation could be salvaged.

Uranium.—Inter-Uran GmbH terminated work on the Kanyemba uranium prospect in December 1992 owing to low world prices.[22]

Industrial Minerals

Cement.—Circle Cement Ltd. increased production capacity from 110,000 mt/a to 292,000 mt/a with the commissioning of a new plant outside Harare.

Emerald.—Northbrooke Investments received Government approval to purchase RTZ's Sandawana emerald mine.

Diamond.—Redaurum Red Lake Mines Ltd. bought Cornerstone Investments, thus becoming a 50% partner in the River Ranch Mine.[23] The River Ranch operation was upgraded in 1993 with the purchase of a recently decommissioned heavy-media separation plant from RTZ Corp.'s Mafeking, South Africa, operation. The separator should boost capacity from 50,000 carats/a to 180,000 carats/a. Current production is reported to be 60% gem quality.[24]

A number of companies announced the discovery of kimberlites during the year. RTZ began ground work for its diamond exploration program in October. Reunion entered into diamond exploration agreements with Novennial, an Australian company, and with Argosy Mining Corp. In November, Argosy discovered two new kimberlites on the Mlibizi property. At yearend, Reunion was drilling the kimberlite pipes on the Quest property.

Fertilizer.—Sable Chemical Industries Ltd., 17 km north of Kwekwe, the country's only nitrogenous fertilizer plant, produces 240,000 tons of ammonium nitrate. Sable also provides oxygen to Zisco and Zimasco, and some of the plant's ammonium nitrate is trucked across the highway to Nitro Nobel's explosives plant. Because electric power accounts for 90% of the plant's expenses, the company was a potential customer for the low cost energy as well as the ammonia production predicted from the coalbed methane projects.

The Institute of Mining Research began a 2-year project with Dorowa Minerals; the Ministry of Lands, Agriculture, and Water Development; the University of Guelph, Ontario, Canada; and Zimbabwe Phosphate Industries to develop a low cost phosphate fertilizer from apatite rock.

Vermiculite.—Dinidza Vermiculite Mining Co. (Pvt) Ltd. opened a 10,000-mt/a vermiculite mine in the Dorowa area.

Mineral Fuels

Coal.—A lack of spares attributed to cash-flow problems caused by late customer payments resulted in a number of operations failures. However, Wankie Colliery Co. Ltd. continued production despite a drastic drop in demand by local ferrochrome plants, the collapse of Zairian coke demand, and at yearend, the loss of the Zambian market. During the year, Wankie Colliery obtained supplementary overburden stripping equipment with a $10 million International Finance Corp. loan.

RTZ placed its Sengwa coal mine on care and maintenance in May. As part of a 3-year pilot project, RTZ trial mined at the Sengwa coalfield and studied the economics of the metallurgical coal market. Zimasco did not need the coal because of the downturn in the ferrochrome market. RTZ was contemplating a feasibility study on the development of a 400-MW coal-fired power station at the mine mouth.

Shangani Energy Exploration was seeking funding for a nine-well pilot study to establish production rates from its special grant area near Lupane. Shangani was owned by Union Carbide Zimbabwe (80%) and Maralex International Inc. (20%).

Trotter Exploration and British-based Afpenn Resources Ltd. formed a joint venture to explore for coalbed methane in the southeast.

Zimchem Refineries Private Ltd. is now scheduled to begin operations at Redcliff in 1994. The plant is to refine the coke-oven byproduct stream into benzene, road tar, and toluene.

INFRASTRUCTURE

Because of improved generation capability of the hydroelectric plants and the Hwange Power Station and increased imports, the Zimbabwe Electric Supply Authority (ZESA) increased mineral industry consumers electricity allocation from 80% of normal consumption to 90% at the beginning of the year. Power rates were again increased in September, the fourth increase in 17 months.

ZESA proposed a 6-year development program to meet future demand. In May, ZESA agreed to a 500-MW interconnection with the Matimba power station in South Africa's Transvaal. Construction of the powerline through Botswana should be completed by the end of 1995. Another 500-MW interconnection with the Cabora Bassa Dam in Mozambique also was being pursued.[25] ZESA implemented a 5% surcharge in December to finance the development program.[26]

Most of Zimbabwe's bulk commodities were moved by rail, the backbone of the country's agricultural and industrial development. All major cities and industrial centers were linked by the National Railways of Zimbabwe's 4,304 km of track.

The 203-km Mutare-Harare pipeline was completed. Petroleum products were trucked and railed in from the Beria pipeline terminal at Feruka, near Mutare.

OUTLOOK

Zimbabwe will recover from its recent history of foreign exchange and price controls and strict regulation of private investment. Increased availability of foreign exchange should enable the mineral industry to replace aging plants and obsolete equipment. Given the intensity of exploration, new mineral deposits were likely to be discovered. However, many of the country's marginal mineral operations will continue to be adversely affected by poor economic conditions.

Asbestos, coal, ferroalloys, gold, and nickel should remain the mainstays of the Zimbabwean mineral economy through the turn of the century, joined soon by diamonds and PGM's. Updated investment regulations, developed and maintained infrastructure, and new exploration techniques should encourage further local and foreign participation in the mineral industry.

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OTHER SOURCES OF INFORMATION

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TABLE 1

ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
METALS							
Antimony, mine output, concentrate, Sb content		210	101	160	254	95	260
Beryllium: Beryl concentrate, gross weight		46	28	29	23	23	50
Chromium: Chromite, gross weight		627,424	r573,013	563,634	522,013	2252,033	650,000
Cobalt:[3]							
Mine output, Co content e		90	102	105	80	90	105
Metal (hydroxide)		112	127	130	100	2113	150
Columbium and tantalum: Tantalite concentrate:							
Gross weight	kilograms	32,000	35,000	r111,000	94,000	48,000	111,000
Cb content e	do.	4,800	5,200	r16,650	14,100	7,000	16,700
Ta content e	do.	11,200	12,200	r38,850	32,900	41,000	39,000
Copper:							
Mine output, concentrate, Cu content e		16,400	14,698	14,420	10,100	9,000	7,000
Metal:							
Smelter output, blister—anode, primary e [4]		15,800	14,100	13,830	9,690	8,200	44,000
Refinery output, refined—cathode, primary		15,659	14,080	13,811	9,673	28,187	28,000
Gold	kilograms	16,003	16,900	17,820	18,278	218,916	21,000
Iron and steel:							
Mine output, iron ore:							
Gross weight	thousand tons	1,143	1,259	1,136	1,179	375	1,400
Fe content e	do.	686	730	660	710	225	850
Metal:							
Pig iron e	do.	520	521	r535	507	211	540
Steel, crude	do.	650	580	r581	547	221	1,000
Ferroalloys:							
Ferrochromium		173,000	222,102	186,774	190,994	123,985	213,000
Ferrosilicon chromium		25,000	16,612	27,755	20,282	30,158	28,000
Ferromanganese		—	—	—	—	2,151	2,500
Total		198,000	238,714	214,529	211,276	156,294	243,500
Nickel:							
Mine output, concentrate, Ni content e		13,600	13,490	12,371	11,300	212,769	17,000
Refinery output, refined metal[5]		11,633	11,426	11,297	10,349	211,097	25,000
Platinum-group metals:							
Palladium	kilograms	43	31	30	19	11	45
Platinum	do.	25	21	19	9	4	25
Total	do.	68	52	49	28	15	70
Selenium	do.	e3,000	e2,300	2,549	1,736	1,113	3,000
Silver	do.	22,305	21,221	19,380	16,930	12,004	22,000
Tin:							
Mine output, Sn content e		1,130	1,120	1,060	950	800	1,100
Smelter output, metal		848	838	796	716	2657	850
Tungsten, concentrate:							
Gross weight		(6)	(6)	(6)	—	—	—
W content e		1	1	1	—	—	—
INDUSTRIAL MINERALS							
Asbestos		187,006	160,861	141,697	150,158	2156,881	300,000

See footnotes at end of table

TABLE 1—Continued

ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	1991	1992	1993e	Annual capacitye (Jan. 1, 1994)
INDUSTRIAL MINERALS—Continued							
Barite		1,900	320	866	232	120	2,000
Cement, hydraulic		719,469	700,000	865,000	e900,000	1,000,000	1,000,000
Clays:							
Bentonite (montmorillonite)		104,865	99,854	e99,900	82,956	83,000	105,000
Fire clay		19,100	19,914	23,304	15,954	9,257	24,000
Kaolin		17	—	65	83	90	90
Diamond	carats	—	—	—	40,654	2 43,850	50,000
Feldspar		2,697	2,197	3,820	2,696	1,553	3,800
Gemstones, precious and semiprecious: Emerald	kilograms	r344	r822	r667	46	635	800
Graphite		18,147	16,383	12,903	12,346	2 7,142	20,000
Kyanite		1,869	160	2,463	1,990	1,000	2,000
Lithium minerals, gross weight		20,647	19,053	9,186	12,837	2 18,064	33,000
Magnesium compounds: Magnesite		33,423	32,639	23,295	8,973	2 6,276	34,000
Mica		1,471	1,301	506	495	510	1,500
Nitrogen: N content of ammonia		e61,500	62,500	r e66,000	r e67,000	70,000	82,000
Phosphate rock, marketable concentrate	thousand tons	134	148	117	142	2 153	155
Pigments, iron oxide		287	416	e400	538	550	550
Stone, sand and gravel:							
Granite		e60,000	e70,000	79,907	90,694	2 40,032	110,000
Limestone	thousand tons	1,370	1,252	1,428	1,366	2 8 1,036	1,500
Quartz[7]	do.	62	63	70	77	61	80
Sulfur							
Pyrite:							
Gross weight		47,561	66,571	69,851	66,345	72,588	70,000
S contente		20,900	29,300	30,734	29,200	30,000	31,000
Byproduct acid, metallurgical and coal process gase		5,000	5,000	5,000	4,500	5,000	5,000
Total		25,900	34,300	35,734	33,700	35,000	36,000
Talc		1,513	1,787	1,676	2,203	1,349	2,300
Vermiculite		e1,000	e1,000	2,319	4,300	5,032	5,000
MINERAL FUELS AND RELATED MATERIALS							
Coal, bituminous	thousand tons	5,111	5,505	5,616	5,547	5,285	5,600
Coke, metallurgicale 8	do.	600	565	560	500	500	600

eEstimated. rRevised.

[1]Table includes data available through Sept. 12, 1994.

[2]Reported figure.

[3]"Mine output" figures are calculated from "metal" figures. "Metal" may include metal content of compounds/salts and may include cobalt recovered from nickel-copper matte imported from Botswana for toll refining.

[4]Smelter copper includes impure cathodes produced by electrowinning in nickel processing.

[5]May include nickel content of nickel oxide.

[6]Less than 1/2 unit.

[7]Includes rough and ground quartz as well as silica sand.

[8]Data represent output by the Wankie Colliery Co. Ltd.; additional output by the Redcliff plant of Zisco Ltd. may total 250,000 metric tons per year of metallurgical coke and coke breeze.

TABLE 2

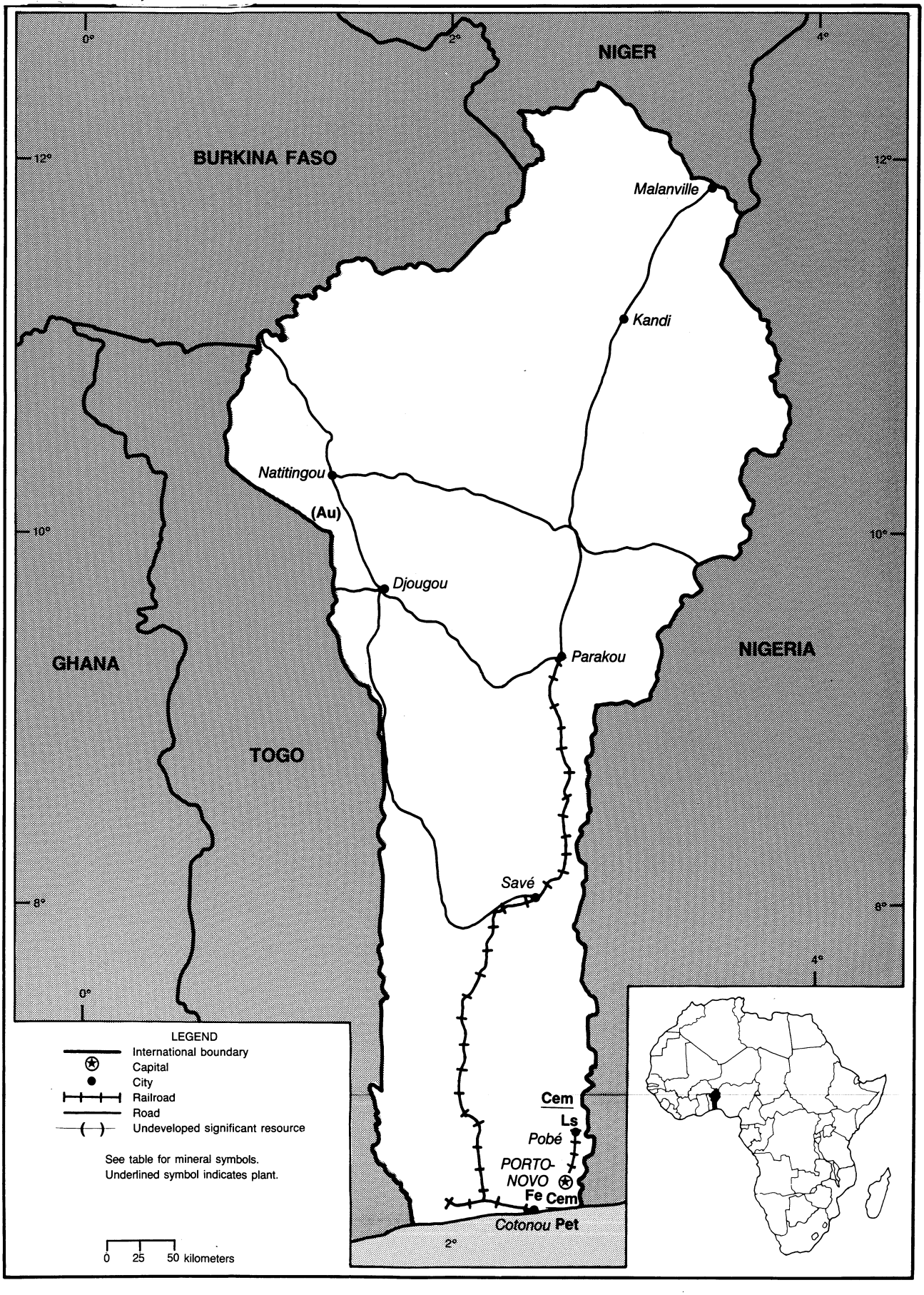
ZIMBABWE: STRUCTURE OF THE MINERAL INDUSTRY FOR 1993

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Asbestos		Shabanie and Mashaba Mines (Pvt.) Ltd. [African Associated Mines (Pvt.) Ltd., 100%]	Shabanie Mine, Zvishavane; Gaths and King Mines, Mashava	300
Coal		Wankie Colliery Co. Ltd. (Government, 40%)	Hwange	5,000
Cobalt		Bindura Nickel Corp. (Anglo American Corp., 100%)	Shangani Mine, NW of Shangani; Madziwa Mine, 50 kilometers northeast of Bindura; Trojan Mine, Bindura; Epoch Mine, Filabusi	150
Copper		Mhangura Copper Mines Ltd. [Zimbabwe Mining Development Corp. (ZMDC)]		16
Do.		do.	Smelter at Alaska	35
Do.		do.	Refinery at Alaska	28
Diamond	carats	Auridam Zimbabwe Ltd. (Auridam Consolidated NL, 50%; Redaurum Red Lake Mines Ltd., 50%)	River Ranch Mine, near Beitbridge	50,000
Gold	kilograms	Rio Tinto Zimbabwe Ltd. (RTZ Corp. plc., 56%)	Renco Mine, 75 kilometers southeast of Masvingo; Patchway Mine, Kadoma; Brompton Mine, Kadoma; and Cam and Motor dump, Kadoma	2,800
Do.	do.	Cluff Resources Zimbabwe Ltd. (Cluff Resources plc, 82.4%; private investors, 17.6%)	Freda Rebecca Mine, Bindura	2,500
Do.	do.	Independence Mining (Pvt.) Ltd. (Lonrho plc, 100%)	How Mine, Bulawayo; Athens Mine, Mvuma; Tiger Reef Mine, Kwekwe; and Anzac Mine, Kwekwe	2,000
Do.	do.	Falcon Gold Zimbabwe Ltd. (Falcon Investments S.A., 71.7%)	Dalny Mine, Chegutu; and Venice Mine, Kadoma	1,650
Do.	do.	ZMDC (Government, 100%)	Sabi Mine, south of Zvishavane and Elvington Gold Mine, near Chegutu	800
Do.	do.	Jena Mines Ltd. [ZMDC, 50%; Trillion Resources (Pvt.) Ltd. Zimbabwe, 50%]	Jena Group, Kwekwe area	400
Do.	do.	Masasa Mines (Delta Gold NL, 100%)	Giant tailings dump, near Chegutu	100
Iron and steel:				
Crude steel		Zimbabwe Iron and Steel Co. (Zisco) (Government, 92%)	Redcliff, near Gweru	1,000
Iron ore, gross weight		Buchwa Iron Mining Co (Zisco, 100%)	Buchwa West Mine, Buchwa; Ripple Creek Mine, near Redcliff	1,400
Ferroalloys:				
Ferrochromium, high-carbon		Zimbabwe Mining and Smelting Co. (Pvt.) Ltd. (Zimasco) (Union Carbide Zimbabwe, 100%)	Smelter at Kwekwe	178
Ferrochromium, low-carbon		Zimbabwe Alloys Ltd. (Zimalloys) (Anglo American Corp., 100%)	Smelter at Gweru	35
Ferrochromium -silicon		do.	do.	28
Lithium		Bikita Minerals (Pvt.) Ltd.	Bikita Mine, 60 kilometers east of Masvingo	33
Nickel		Trojan Nickel Mines (Bindura Nickel Corp., 100%)	Shangani, Madziwa, Trojan, and Epoch Mines	17
Do.		BSR Ltd. (Bindura Nickel Corp., 100%)	Smelter and refinery at Bindura	16
Do.		Rio Tinto Zimbabwe Ltd.	Empress Nickel Refinery, Eiffel Flats, northeast of Kadoma	7
Phosphate		Dorowa Minerals (Pvt.) Ltd. (Chemplex Corp. Ltd., 100%)	Dorowa Mine, 90 kilometers west of Mutare	155
Tin		Kamativi Tin Mines Ltd. (ZMDC, 91%; private, 9%)	50 kilometers north of Dete	1

BENIN

AREA 112,620 km² **POPULATION 5.0 million**



THE MINERAL INDUSTRY OF

OTHER COUNTRIES OF AFRICA

By Staff, Branch of Africa and Middle East

BENIN[1]

The production of mineral commodities was a small part of the economy of Benin in 1993. Cement and crude petroleum formed the foundation of the nation's mineral production as well as being the country's most significant mineral exports. Benin's imports of mineral commodities were dominated by refined petroleum products and clinker for cement. Benin also imported about 95% of its electricity needs from Ghana.

The Office Béninoise des Mines (OBEMINES), under the Ministry of Energy, Mining, and Hydraulics, oversees mineral developments in Benin. A new mining law, proposed in 1991, was still being considered by the Government. The country's investment regulations have been liberalized recently and the transition to a market economy has been made. The Government had also begun the privatization of state-run industries.

Production from the offshore Sèmè Field had been declining. *(See table 1.)* The Government reported recoverable oil reserves at Sèmè to be about 40 Mbbl, about 25 Mbbl of which was as condensate. An additional 4 billion m^3 of natural gas was ascribed to the field. However, production problems were expected to severely curtail the field's life. Onshore exploration rights were relinquished by Trilogy Resources Corp. of Canada.

The Government controlled a majority interest in the Société des Ciments d'Onigbolo (SCO), which was the country's largest and only integrated cement plant. Production in 1993 by SCO continued at a rate well below capacity. Reportedly, much of the plant's production was exported. The domestic market was the primary target for the production of the private cement companies Cimbenin s. a. and Société des Ciments du Benin.

There is potential for the development of additional mineral resources in Benin.[2] However, depressed local and international mineral markets have apparently adversely influenced the investment interest that the Government had anticipated in the wake of its liberalization of investment regulations. The general state of the nation's transportation infrastructure also has hampered inland industrial mineral development.

A number of gold occurrences, both placer and vein, are known in the Precambrian terrane in northwest Benin. None of the known occurrences are large, but there may be potential for the development of small-scale gold mining in that region. Significant reserves of limestone occur near the cement facility at Onigbolo, sufficient to supply the plant at design capacity for more than a century. Other mineral extraction opportunities identified by OBEMINES include a number of deposits of brick and china clay along the coastal plain, the marble deposits at Idadjo, peat deposits adjacent to the Togo frontier, silica sand along the coast south of Porto Novo, and in the north, the Mékrou phosphate deposit and the Loumbou-Loumbouiron-bearing deposit.

OTHER SOURCES OF INFORMATION

Ministere de l'Energie, des Mines et de l'Hydraulique
Office Béninoise des Mines
P.O. Box 363
Cotonou, Benin

TABLE 1
BENIN: PRODUCTION OF MINERAL COMMODITIES[1]

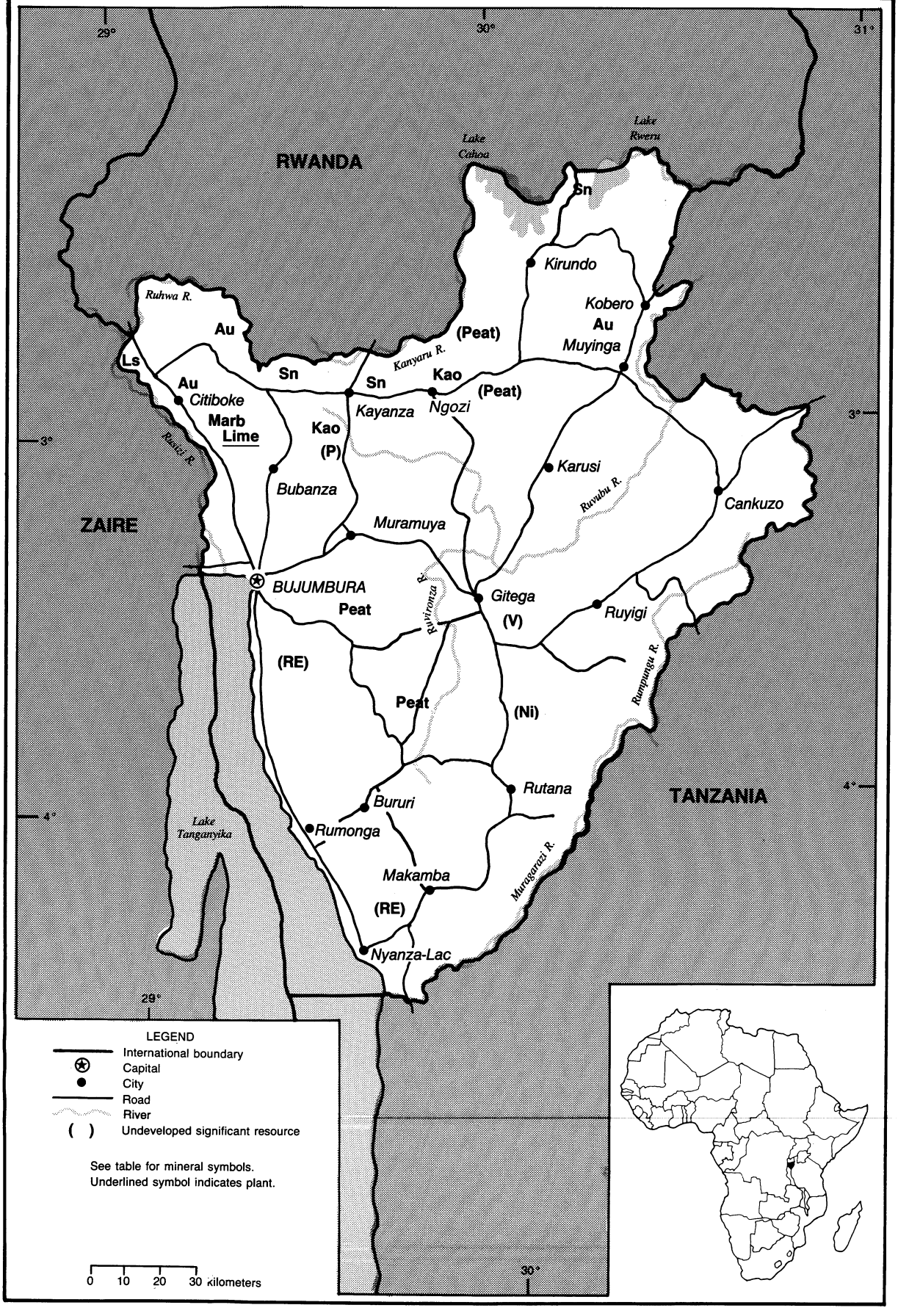
(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Cement, hydraulic e		250,000	300,000	320,000	370,000	380,000	380,000
Iron and steel: Steel, crude e		2,000	8,000	8,000	8,000	8,000	11,000
Petroleum, crude	thousand 42-gallon barrels	1,460	r,3 1,416	r,3 1,353	3 931	1,000	1,400
Salt, marine e		100	100	100	100	100	100

eEstimated. rRevised.
[1]Includes data available through Feb. 28, 1994.
[2]In addition to the commodities listed, unreported quantities of clay, sand and gravel, and stone are believed to be produced, but information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

BURUNDI

AREA 27,830 km² **POPULATION 6.0 million**



BURUNDI[3]

Minerals commodity production continued to be a very small sector in Burundi's economy during 1993 despite the good geological potential for a substantial contribution and the Government's demonstrated interest in promoting the industry. Small quantities of gold and tin minerals, kaolin, limestone, construction stone, sand and gravel, and peat for fuel were produced. Expansion of gold production and initiating output from known deposits of nickel with associated platinum-group metals as well as a carbonatite-apatite phosphate deposit were being studied in more detail. In earlier years, columbium-tantalum, rare earths, and tungsten were contained in mineral products, and an oil and gas potential was inconclusively investigated.

The gross domestic product (GDP) of the Maryland-sized, densly populated, landlocked, hill country was estimated at slightly more than $1 billion, one of the world's lowest per capita. Typically, the agriculture sector made up more than 50% of GDP, employed more than 75% of the population, and provided more than 90% of export earnings—mostly coffee beans. A structural adjustment program, with guidance and help from the World Bank and other international groups, began in 1986 and continued to show some success.

Mineral development, and economic development in general, were severely impacted by the resurgence of historically violent ethnic conflict in the fall of 1993 that continued sporatically into 1994. After relatively calm multiparty elections in June 1993, a smooth, conciliatory transition from military control to representative democracy appeared to be well accepted by all factions. However, in October, assassination of the new President and six cabinet ministers in an unsuccessful military coup touched off huge intertribal massacres and refugee movements. Early in 1994, an interim Government was trying to maintain an uneasy peace.

Government policy, laws, and regulations, including those covering mining, were designed to attract private investment, particularly by foreign entities. A free trade (import-export tax-free) zone system covering the entire country, announced in September 1992, offered many benefits to industrial and commercial ventures. However, the application to minerals processing remained unclear early in 1994 because of an August 1993 decision by the new President that rescinded the free-trade status of a gold ore buyer-refiner. For U.S. firms, an Overseas Private Investment Corp. (OPIC) investment insurance program was available.

Gold production was of continued interest to the Government, and in April 1993 the African Development Bank approved funding for a more detailed next phase feasibility study of an operation in the northeast. A study by M.E.G.A. International Inc. of Golden, Colorado, in 1992 indicated economic viability for a 620-mt/d ore operation, but some underground exploration was recommended. Award of the new study was not yet announced.

A gold refiner in Bujumbura, identified as Affimet, began operations in April 1993 after being granted free trade zone status. However, the plant shut down in August when the export tax-free status was reversed by the newly elected Government. A return to illicit export of gold concentrate was considered possible.

Nickel exploration in the southeast by RTZ Corp. began after an agreement with the Government was concluded in April 1993. Work was suspended owing to civil disturbances after the October coup attempt. The concession reportedly covers the southern portion of a 50-km-wide mineralized belt extending along the eastern border from near Lake Tanganyika on the south, northeasterly 150 km to the Tanzania border. The belt continues across the border where Sutton Resources and Broken Hill Proprietary Co. Ltd. (BHP) were exploring a nickel occurrence. BHP was negotiating with the Burundi Government on an exploration agreement, reportedly for an area north of RTZ's, prior to the coup, after which personnel was withdrawn.

Phosphate studies by Mackay & Schnellmann were not yet finalized early in 1994 although field and process tests were reported completed.

Political instability appeared once again to have become a major obstacle to expansion of the mineral sector. Hydropower potential and abundance of water were advantages but export transportation as well as infrastructural factors in general were not favorable. Thus, the outlook for increased mineral production is limited.

OTHER SOURCES OF INFORMATION

Agencies

General Directorate of Geology and Mines
Ministry of Energy and Mines, Republic of Burundi
B.P. 745, Bujumbura, Burundi
Telephone: 257-22-2278
Facsimile: 257-22-3337

Department of Technical Cooperation for Development
Natural Resources and Energy Division, United Nations
1 UN Plaza, New York, NY 10017
Telephone: 212-963-8764
Facsimile: 212-963-4340

Publications

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

Papers, Round Table on the Development of the Mining Sector in Burundi, Ministry of Energy and Mines, Bujumbura, 1991, 185 pp.

TABLE 2

BURUNDI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Clays: Kaolin	4,305	5,281	6,682	9,688	5,000	10,000
Gold[3] kilograms	18	9	e25	e32	20	50
Lime	202	188	86	182	150	200
Peat	14,200	11,984	10,026	12,000	10,000	20,000
Tin, mine output, ore (e60% SnO_2):						
Gross weight	106	e115	124	183	100	200
Sn content e	50	54	74	110	50	100

eEstimated.

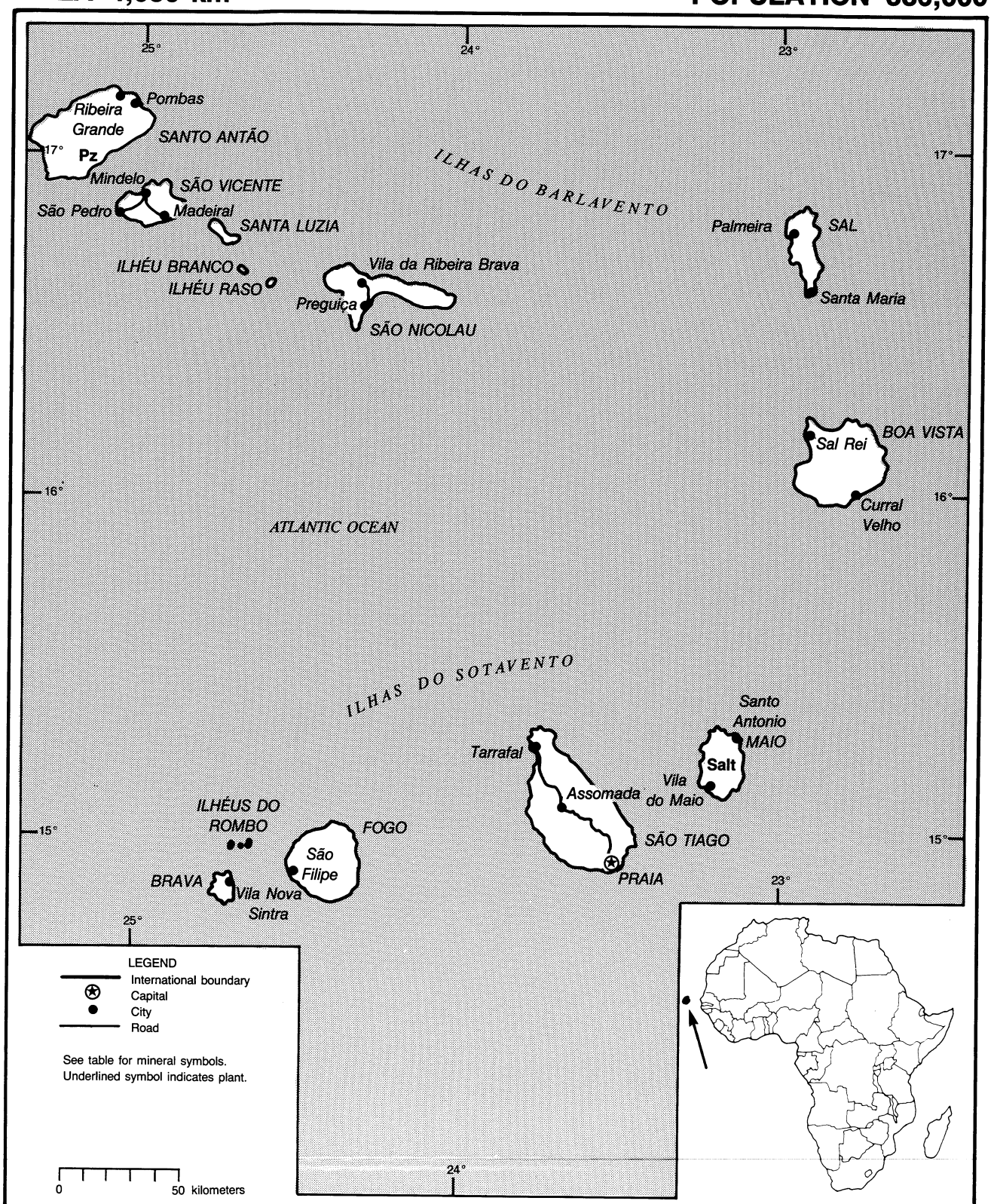
[1]Includes data available through June 1, 1994.

[2]In addition to commodities listed, the following were produced but information is inadequate to reliably estimate output: columbium-tantalum ore and concentrate officially reported as 8,527 kilograms gross weight in 1992 (last prior report was 2,100 kilograms in 1979); and mostly locally produced and used crushed stone (47,282 cubic meters known and reported in 1992), and presumably other crude construction materials (clays, sand and gravel, et al.).

[3]Prior to 1991 some additional gold production, mostly in the northwest, was illegally exported and not officially recorded, but information is inadequate to reliably estimate such output. This unrecorded production was reported to be substantial in 1990 especially. Starting in 1991 production data reported are considered realistic although only estimates because statistics are no longer obtained by Burundi Government agencies.

CAPE VERDE

AREA 4,030 km² **POPULATION 386,000**



CAPE VERDE[4]

Mining's contribution to the economy of Cape Verde in 1993 was minimal. Salt, limestone, and volcanic rock was produced for local use. *(See table 3.)* In 1990, the latest date these data were available, the mining industry employed an estimated 170 people, of which 50 worked in the salt industry and 120 in the extraction of naturally occurring building materials.

Maio Island's two salt producers were privately owned. The salt companies were Sociéte des Saline du Cap Vert, a private French company, and Companhia de Fomento, which had been shut down owing to operational difficulties. Although it directly accounted for less than 1% of Cape Verde's gross domestic product, salt was considered important because one of its main uses was to preserve a portion of Cape Verde's fish harvest. The fishing industry has accounted for about 60% of the nation's export earnings in recent years.

Output from the four pozzolana mines on Santo Antão had been curtailed earlier in the year owing to the financial condition of the operating company.

Other mineral resources found in the country include gypsum, kaolin, ornamental building stone, and pumice. Past attempts to commercialize the deposits were not economically successful. Cape Verde's construction sector's demand for locally mined building materials is expected to continue. However, most of the nation's other mineral requirements will be imported. Given Cape Verde's poor natural resources base and small market, it is not economically feasible for local companies to compete with larger foreign producers. The salt industry, which has been producing far below historical capacity, should be capable of expanding production to meet domestic demand. The availability of potable water continues to remain a major concern in a country that has suffered devastating droughts and famines approximately every 20 to 30 years throughout its history.

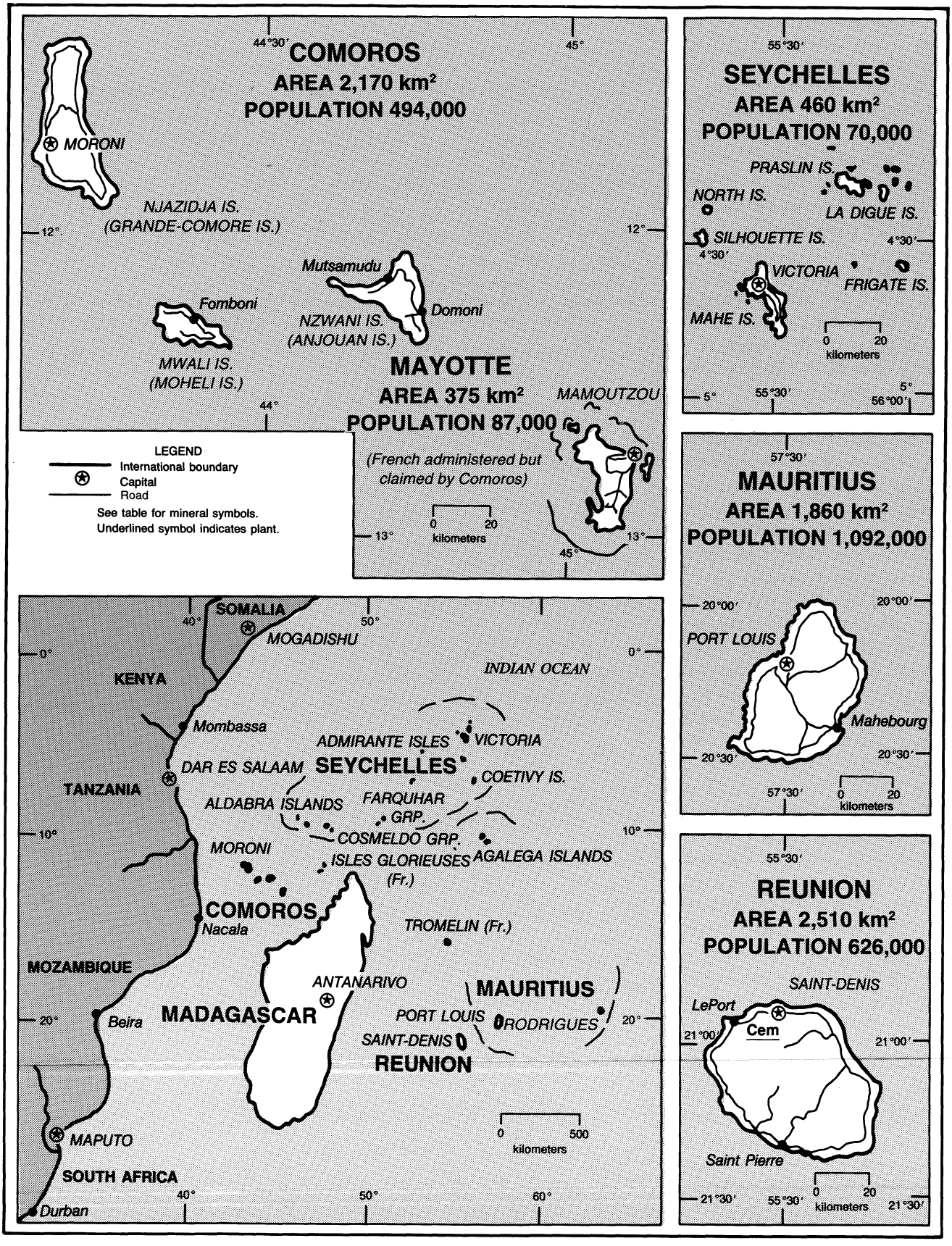
TABLE 3
CAPE VERDE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1989	1990	1991	1992	1993e	Annual capacity e (Jan. 1, 1994)
Salt	3,000	3,500	4,000	4,000	4,000	5,000
Pozzolana	53,000	53,000	53,000	53,000	25,000	53,000

eEstimated.
[1]Includes data available through Mar. 4, 1994.
[2]In addition to commodities listed, small quantities of limestone, clays, gypsum, pumice, and ornamental building stone may have been produced, but available information is inadequate to make reliable estimates of output levels.

ISLANDS OF COMOROS, MAURITIUS, REUNION, AND SEYCHELLES



COMOROS[5]

The mineral industry of Comoros remained limited to producing only common local building materials, such as clays, gravel, crushed stone, and sand during 1993. Quantities were not available but were presumably very low because there were no significant construction projects noted in the press since the early 1980's. A construction method, suitable for unskilled labor, of using lava and volcanic ash was being promoted to reduce both imports of cement and mining of coral. Such reductions would help the trade deficit and cut degradation of the environment. Geothermal energy was considered a possiblity for development. The International Development Association (IDA) unit of the World Bank announced a possible loan for consulting services to support private small-scale mining of unspecified minerals. But the outlook on minerals output was for no significant change.

MAURITIUS[5]

The mineral industry of Mauritius was a negligible factor in the economy. Historically, the output consisted of basalt construction stone, coral sand, lime, and solar-evaporated sea salt. Quantitative information was rarely available and then appeared to be inconsistent. But for 1989 through 1993, production of mineral commodities was estimated as follows: lime, 7,000 mt/a; solar-evaporated sea salt, 6,000 mt/a; coral sand, 300,000 mt/a; and basalt stone, 1,000,000 mt/a. Additional locally used crude construction materials (clays, sand, stone) presumably also were produced. Undoubtedly the bulk of the coral sand was used for construction, but in 1991 about 20% was reported as being used in industry. Presumably some was used to make lime (1.5 to 2 tons per ton of lime). Coral mining was under pressure because of environmental effects on coastal lagoons. Sand from crushing basalt rock was proposed as a substitute for construction uses.

Polymetallic nodules occurred on the ocean floor at about 4,000 m depth, from 400 km to 800 km north of Port Louis, northeast of Tromelin Island. The nodules averaged more than 15% each of iron and manganese and more than 0.3% cobalt, with an abundance averaging 2 to 6 kg/m^2.

Oil possibilities were explored inconclusively with geophysics and drilling by Texaco in the 1970's. The drilling was east of the polymetallic nodules area at shallower depths.

Steel reinforcing bars were made from imported ingot at three rolling mills. The Government continued searching for financing an oil refinery and petrochemical plant based on imported crude.

The near-term outlook on mineral-related matters was for few new developments other than a reduction in coral mining.

REUNION[5]

Mineral commodities production was only a small part of the economy of Reunion in 1993 as in prior years, even though little quantitative information was available. However, output of hydraulic cement, made by grinding imported clinker, presumably remained substantial—well above 300,000 mt/a. The plant, owned by Ciments de Bourbon S.A. at Le Port, had a capacity of 350,000 mt/a. Additionally, production of basic volcanic rock and sea coast coral undoubtedly continued to meet the needs of construction. Little change in mineral activity could be anticipated in the future.

SEYCHELLES[5]

Mineral production in Seychelles during 1993 continued to consist mostly of unspecified quantities of construction materials—clays, coral, rock, and sand. Output of guano, an organic phosphate fertilizer from bird droppings, ceased in the mid-1980's, but a 5,000-mt/a capacity remained with some occasional small production unofficially reported. There was also some potential for producing granite dimension stone from the bedrock of Mahe and nearby islands, which was done on a trial basis by an Italian firm in the early 1980's. In 1992, Gondwana Granite, a South African company, was granted a license to extract and export up to 3,000 m^3. Tile and statuary products reportedly were most likely. Production of lime and cement from the abundant coral continued to be considered, but environmentalist/preservationist opposition was raising objections to both projects.

Polymetallic nodules were known to occur on the ocean bottom near the Admirante Islands. Limited sampling was done in the mid-1980's but funds for the further planned work were not granted.

The entire Seychelles was promoted as a highly prospective frontier region for petroleum. Tar balls from subsurface seeps were known for many years to occur on the beaches of Coetivy Island, as well as on Mahe and some nearby islands. Some exploration began in 1969. In the late 1970's and into the early 1980's, Amoco's geophysical work culminated in three wells about 150 km west of Victoria. The results led to additional geophysics before the oil depression caused the company to give up its extensive acreage in 1986. In 1987, Enterprise Oil, a British firm, acquired rights in the southeastern Seychelles. Texaco and Ultramar (eventually Lasmo) took areas to the north and west. Geophysical studies resumed and tar ball studies continued. A seminar on regional oil exploration was held in Victoria in December 1990 and some technical articles were released. Early in 1994, Enterprise Oil was reported planning a $10 million drilling test in 1995 on its 10,000-km^2 offshore concession, 200 km southeast of Victoria.

The events in 1993 suggest that minerals could play a larger role in the future economy of the Seychelles.

OTHER SOURCES OF INFORMATION

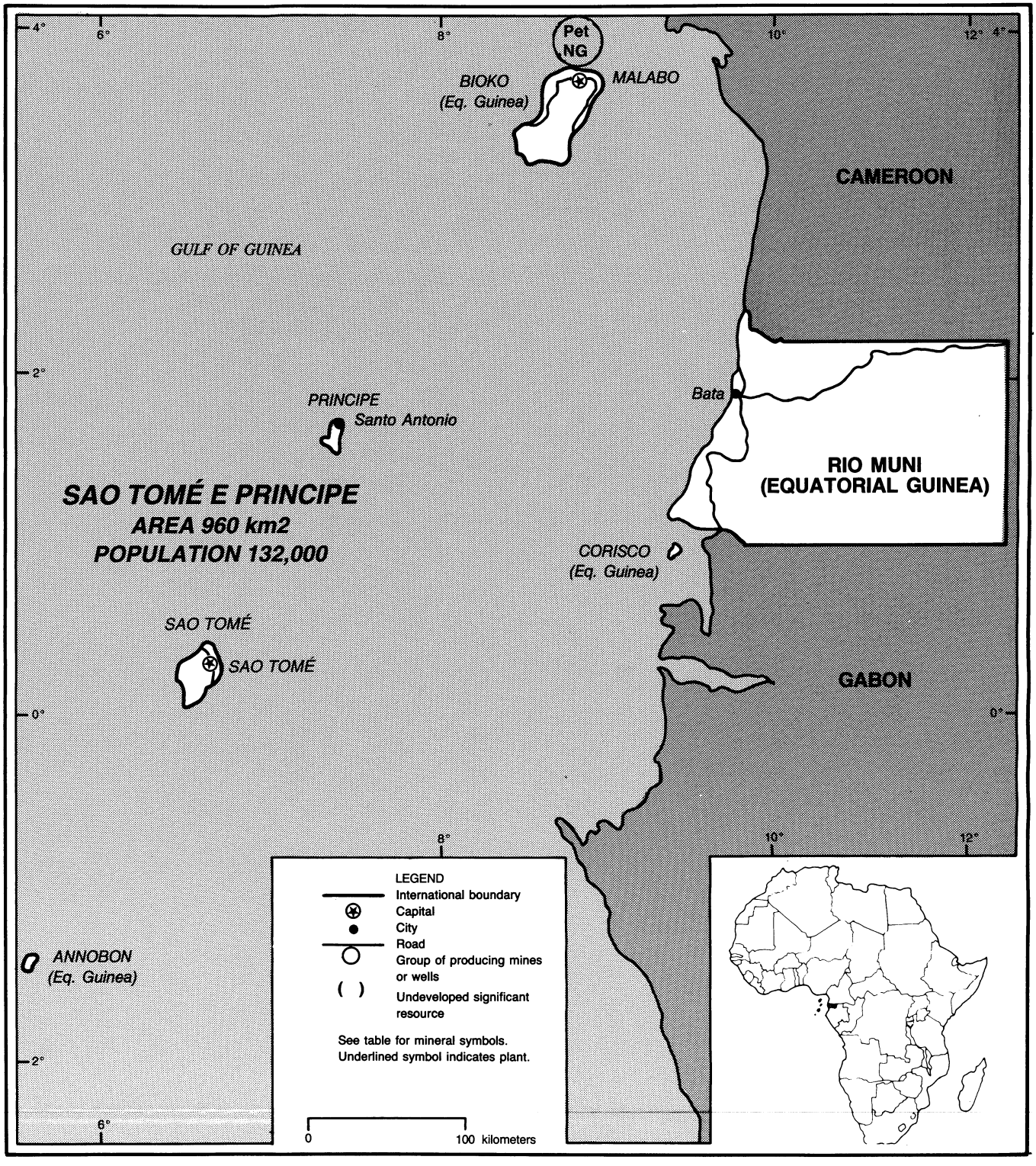
Agencies

Ministry of Economy
Government Building

Moroni, Grand-Comore Island, Comoros
Ministry of Agriculture and Natural Resources
Government House
Port Louis, Mauritius
Bureau de Recherches Géologiques et Minières
46 Bis Rue de Nice, P.B. 1206
Saint-Denis, La Reunion
Ministry for National Development
Independence House, P.O. Box 199
Victoria, Mahe, Seychelles

EQUATORIAL GUINEA AND SAO TOMÉ E PRINCIPE

AREA 28,050 km² **POPULATION 389,000**



EQUATORIAL GUINEA[6]

The Republic of Equatorial Guinea consists of two main provinces: the volcanic island of Bioko in the Gulf of Guinea and Rio Muni on the African mainland. Although Equatorial Guinea had no globally significant mineral industry in 1993, the nation continued with the development of the Alba gas-condensate field in the Gulf of Guinea 36 km offshore of Bioko, operated by Walter International of the United States. In 1993, the total condensate production from two wells at the Alba Field was at a rate of 4,000 bbl/d and should rise to 5,000 bbl/d when the field is fully developed. The estimated value of the exported gas condensate, commencing in April 1992, was about $14 million.[7] The estimated gross domestic product (GDP) for 1993 was $156 million. Petroleum exploitation and production in Equatorial Guinea was controlled by Decree Law No. 7/1981, enacted on June 16, 1981, and persuant to the earlier Hydrocarbons Law (Model of Agreement), section II, paragraph 2.8 (E). Hydrocarbon exploration in Equatorial Guinea began both onshore and offshore in the late 1960's and early 1970's. During 1993, blocks totaling 13,000 km^2 were offered for exploration, with bidding to be submitted to the Government's Ministry of Mines and Hydrocarbons. EMS Ltd. of the United Kingdom signed an agreement with the Ministry of Mines and Hydrocarbons to promote the licensing round.

The Cretaceous and Tertiary lacustrine and marine carbonates and sands in the coastal basin of Rio Muni are the major targets of current hydrocarbon exploration.[8] A total of 5,275 line km of seismic data have been recorded over the past 10 years from both onshore and offshore Rio Muni. To date, Rio Muni has had only six wells drilled both onshore and offshore and the hydrocarbon potential remains undetermined. Additionally, offshore drilling near the island of Bioko is planned for late 1994 by United Meridian International Corp. of the United States.

According to the Government's Ministry of Mines and Hydrocarbons, several mineral and geological surveys have been conducted by various foreign organizations, commencing with an air photo survey in 1962. From 1981 to 1985, France's Bureau de Recherches Géologiques et Minières identified several types of minerals in Rio Muni. The mineral occurrences included bauxite, copper, alluvial gold, ilmenite beach sands, lead, phosphates, and zinc. However, the Government indicated that further exploration was needed to determine the economic viability of these resources. Environmentally, Equatorial Guinea's plant and animal resources are threatened by deforestation of coastal regions.

SÃO TOMÉ E PRINCIPE[6]

The Democratic Republic of São Tomé e Principe had no significant mineral industry other than some small clay and stone open pit operations supplying local construction needs. The value of mineral production is insignificant. The gross domestic product (GDP) for 1991 was about $42 million.[9] The production and export of cocoa was declining. In recent years, São Tomé e Principe has been promoting tourism to stimulate the economy. The legal system of São 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.

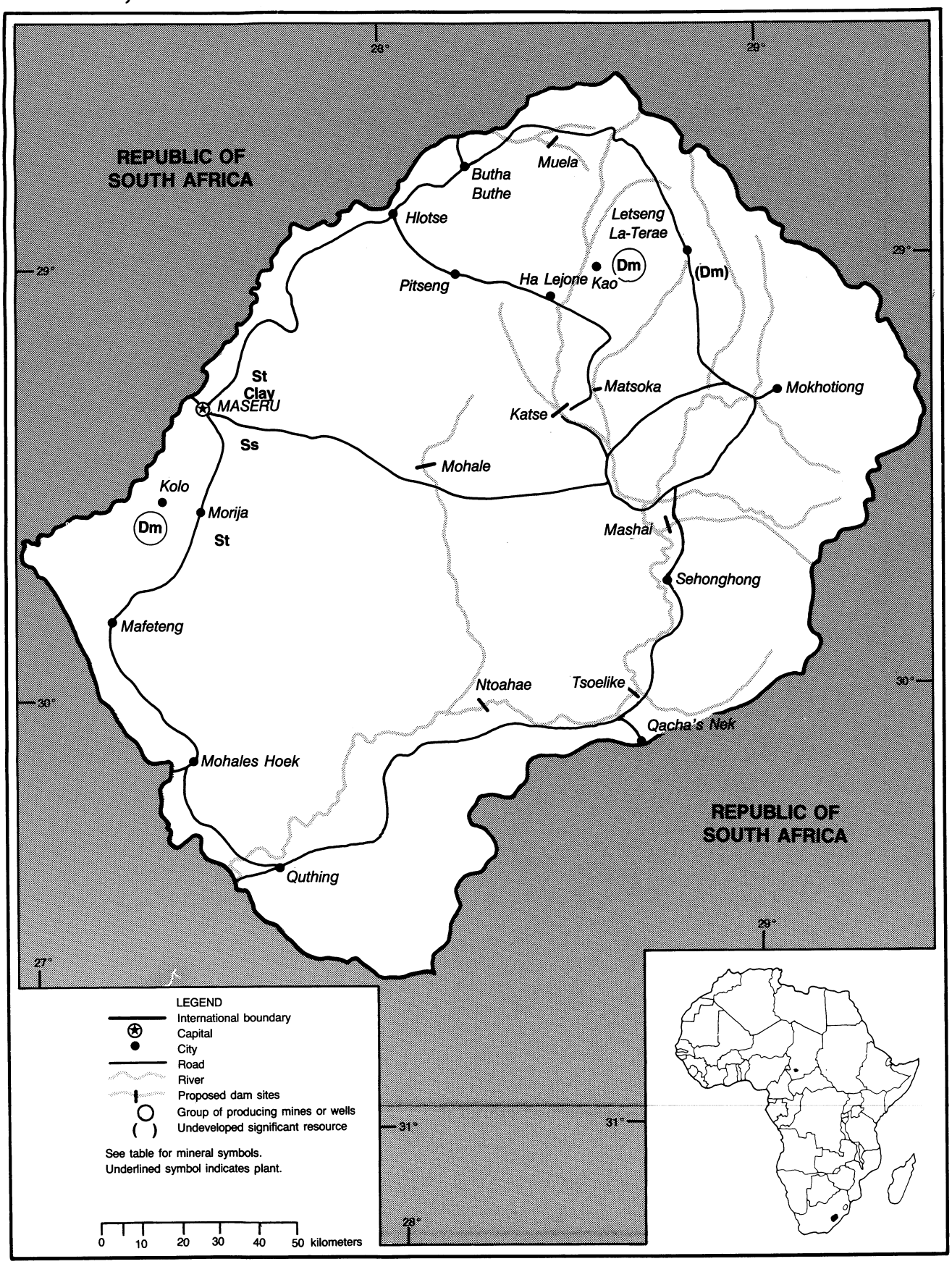
OTHER SOURCES OF INFORMATION

Agencies

U.S. Embassy
Calle de Los Ministros
P.O. Box 597
Malabo, Equatorial Guinea
U.S. Embassy
Boulevard de la Mer
B.P. 4000
Libreville, Gabon (Administers for São Tomé
e Principe)

LESOTHO

AREA 30,000 km² **POPULATION 1.8 million**



LESOTHO[10]

In 1993, the mineral output of Lesotho consisted almost entirely of clays, gravel, sand, and stone for use in the local economy. Although the domestic mineral sector was relatively insignificant, the wages earned by Basotho miners in the mines of the Republic of South Africa traditionally has been a significant source of the nation's foreign exchange.

Work on the Lesotho Highland Water Project in the Maluti Mountains continued. The estimated $4 billion project involves the construction of a series of reservoirs, tunnels, and dams to bring water to the vicinity of Johannesburg in the Republic of South Africa and to provide hydroelectric power for Lesotho. Locally produced gravel and crushed diabase are being used for the project, but cement is imported. A small, unknown quantity of gem-quality diamond is believed to have been produced by licensed diggers and was exported.

Coal, limestone, phosphate, and uranium mineralization have been identified in the country, but no development has occurred.

OTHER SOURCES OF INFORMATION

Agency

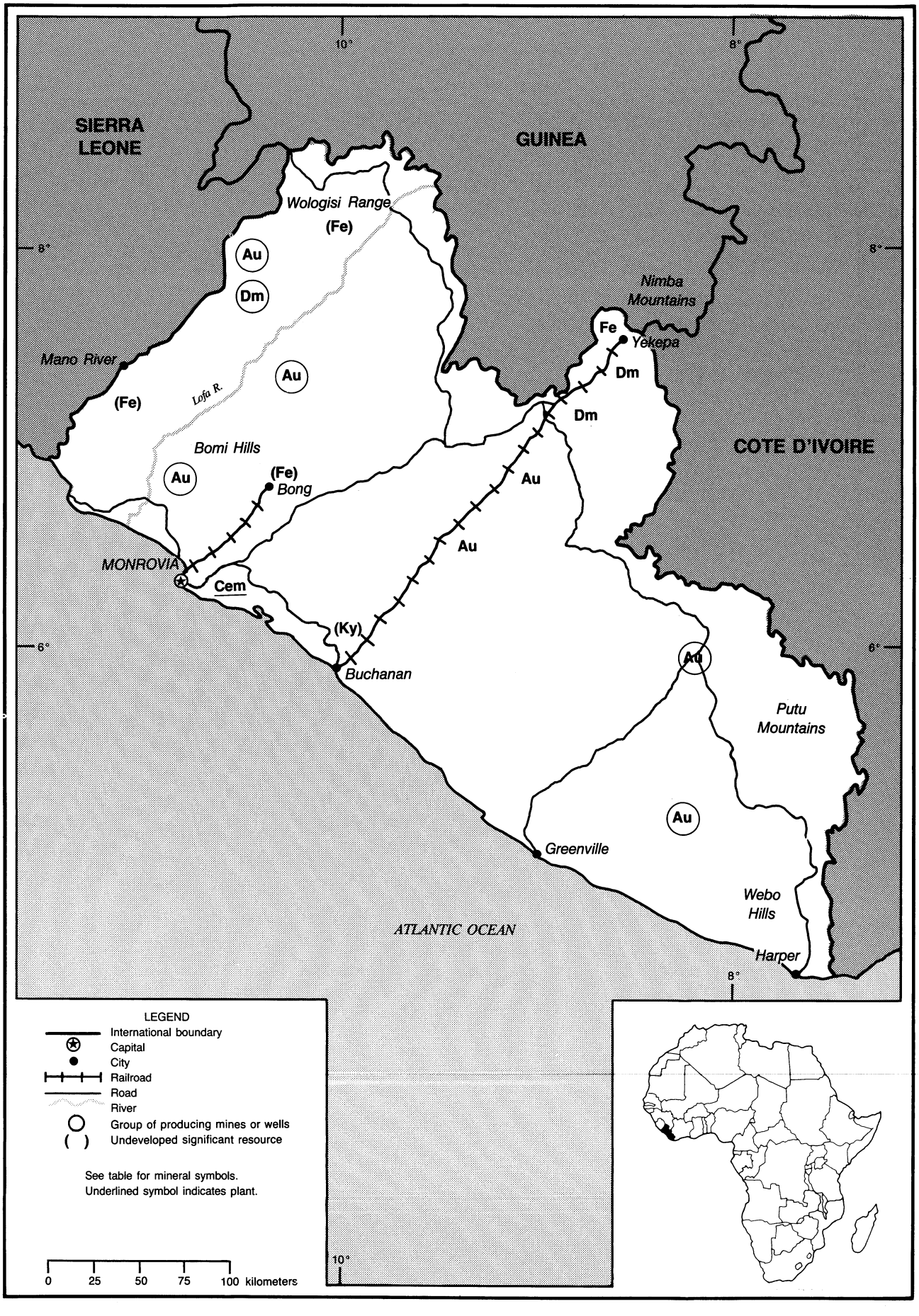
Department of Mines and Geology
Ministry of Water, Energy, and Mining
Maseru, Lesotho

Publication

Department of Mines and Geology, Maseru: Annual Report of the Department of Mines and Geology.

LIBERIA

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



LIBERIA[11]

Liberia's mineral economy in 1993 was barely functioning owing to the civil unrest that has plagued the country since yearend 1989. Mineral production before late 1992 consisted mainly of iron ore by one company, diamonds, and gold by artisanal miners. In addition, there was a small output of cement by one plant. Liberia in the early 1980's produced about 12 Mmt/a of iron ore, but more recently output has fallen owing to declining resources and security problems. Mining at Yekepa, the last mining operation, ceased in late 1992. The operator at Yekepa was evaluating the resumption of mining. Data on diamonds and gold production are incomplete owing to the reported smuggling of these commodities to and from Liberia's neighbors. Liberia-registered ships form the world's largest merchant fleet (tonnage), and license fees from these ships are an important source of revenues for the Government. The civil war prevented the Government from realizing most agricultural and mineral-related income because almost all of the mineral and agricultural industries were in the areas controlled by opposition forces. Negotiations between the opposing parties resulted in a cease-fire in 1993 and installation of a power-sharing administration in early 1994. This was to be replaced by a national Government in September 1994. The cease-fire allowed production and import-export activities of rubber and timber to resume but not of minerals. An embargo of Buchanan in November 1992 cut off the country's exports of iron ore and remained in effect throughout 1993. Reports from sources in Liberia indicated that most of the infrastructure in the mining area was undamaged. Minerals have the potential to play a significant role in Liberia's future. Mining of iron ore near Yekepa could resume when peace is restored and a stable Government is established. However, the security of mine personnel remains a vital issue that depends on the effective disarming of the rival factions. The Governments of Liberia and Guinea may resume negotiations to develop the MIFGERGUI-Nimba iron deposit just over the border in Guinea from Yekepa. An issue of concern to the Government of Guinea is the present state of the Liberian infrastructure to support the MIFERGUI-Nimba project. The project when completed would provide shipping revenues to the Liberian Government. Environmental issues related to MIFERGUI include the preservation of the forest and certain animal life; however, the potential mine site has been excluded from the World Heritage Site designated for the area.

TABLE 4
LIBERIA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity[1]		1989	1990e	1991e	1992e	1993e	Annual capacity e (Jan. 1, 1994)
Cement, hydraulic	metric tons	85,300	[3]48,838	r2,311	[3]8,282	8,300	110,000
Diamond:[2]							
Gem	thousand carats	61,822	40,000	40,000	60,000	60,000	NA
Industrial		92,732	60,000	60,000	90,000	90,000	NA
Total		154,554	100,000	100,000	150,000	150,000	NA
Gold[2]	kilograms	734	600	600	700	700	NA
Iron ore	thousand metric tons	11,700	[3]4,050	[3]1,100	[3]1,742	—	12,000
Silica sand e	metric tons	10,000	5,000	—	—	—	NA

eEstimated. rRevised. NA Not available.

[1]In addition to the commodities listed, Liberia produced a variety of crude construction materials (clays, stone, and sand and gravel), but available information is inadequate to make reliable estimates of output levels. Table includes data available through Mar. 4, 1994.

[2]Data through 1989 do not include smuggled production. Data for 1990-92 are estimates of artisanal production, likely smuggled out of Liberia, but which are comparable to that hitherto reported to the Government.

[3]Reported figure.

NIGER

AREA 1,267,000 km² **POPULATION 8.2 million**

NIGER[12]

Niger was the seventh largest producer and fourth largest exporter of uranium in the world in 1993. The country's uranium reserves were the fifth largest in the world. Niger is endowed with rich deposits of gold. The anticipated gold production potential is expected to total 100 tons of metal with a capacity of about 1 mt/a. Other commercially exploitable minerals in the country were coal, iron ore, phosphates, salt, and tin. Also, Niger has significant amounts of chromium, copper, nickel, platinum-group metals, silver, and titanium. Exploration activities for oil were under way by Niger Hunt Oil Co. in the northeastern part of the country.

New regulations in place favor foreign and domestic private investment in all aspects of the country's economy. The Government, in its effort to promote commercial production of the country's mineral resources, offered a number of incentives to potential investors. The new investment code includes an income tax holiday of 5 years to large companies, 2 years to small companies, and exemption from customs duties on equipment imported for mining or exploration. Also, foreign investors could get exemptions from value added tax in some cases and the right to remit dividends freely.

Uranium continued to dominate mineral production and export in 1993. Other mineral commodities produced included cement, clays, coal, salt, and tin. Coal production was totally for domestic consumption. *(See table 5.)*

Imports from the United States included primarily oil industry exploration equipment and technology, other industrial equipment, and manufactured goods. Niger's major trading partners were France, Japan and Nigeria.

The Government participated in equity sharing arrangements with several companies through its ministry of mines, Office Nationale des Resources Minieres (ONAREM). Uranium concentrates were produced by two companies, the Sociéte des Mines de l'Air (SOMAIR) and Compagnie Miniere d'Akouta (COMINAK). Gold is produced largely by artisanal miners. Major operating companies in the country were Societe Nigerienne de Charbon (SONICHAR) for coal and Societe Miniere du Niger (SMDN) for tin.

Production of gold is mainly from the Liptako Fields on an artisanal basis with estimated output level of 1 mt/a worth about $11 million at current world prices. Recent exploration work revealed the existence of high-quality gold bearing ore in the green stone belt of the Liptako hills northwest of Niamey, between the Niger River and the border with Burkina Faso.

Uranium remained the main commodity mined in Niger and represents a large percentage of the country's foreign exchange earnings. SOMAIR and COMINAK operated all mines on two concessions, one near the town of Arlit, 250 km northwest of Agadez, and the other at Akouta. The combined installed capacity of the two companies was 7,700 mt/a. Joint-venture operations of mines were comprised of the Government and several French, German, Japanese, and Spanish firms.

Small quantities of tin ore were mined from El Mecki, Tarouadji, Timie, Agahak, and Cuissat in the Air Mountains by private individual operators. An output of about 250 mt/a of ore was co-ordinated and marketed by the SMDN.

Industrial mineral production is limited to a few commodities such as cement, gypsum, salt, and sand and gravel. Mineral fuels production also is limited to coal with a capacity of 150,000 mt/a. There were no officially reported reserve figures for uranium in 1993.

The transportation system in Niger is inadequate, despite considerable road development. The paved roads included a 902-km all-weather road between Niamey and Zinder through Agadez. The 651-km section of the road between Arlit and Tahoua is called the "uranium road." Niger has no railways.

Uranium should remain the most important mineral commodity produced in Niger for the foreseeable future and the largest foreign exchange earner for the immediate future. Development of other resources such as gold, iron ore, petroleum, and phosphates should provide additional jobs and foreign exchange revenue for the country.

OTHER SOURCES OF INFORMATION

Office Nationale des Recherches Minieres
B.P. 734
Niamey, Niger

TABLE 5

NIGER: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1989	1990	1991	1992	1993[e]	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic	27,000	19,478	20,109	29,288	29,200	29,300
Coal, bituminous	171,434	153,913	156,542	133,525	133,500	150,000
Gypsum[e]	3,000	950	[3]1,000	[3]1,750	1,700	1,700
Molybdenum concentrate, Mo content[e]	13	10	10	10	10	10
Salt	2,824	2,740	[r]2,960	[r]2,970	3,000	3,000
Tin, mine output, Sn content	71	38	20	[e]20	20	20
Uranium, U_3O_8 content of concentrate	3,013	3,161	3,330	2,970	2,900	2,900

[e]Estimated. [r]Revised.

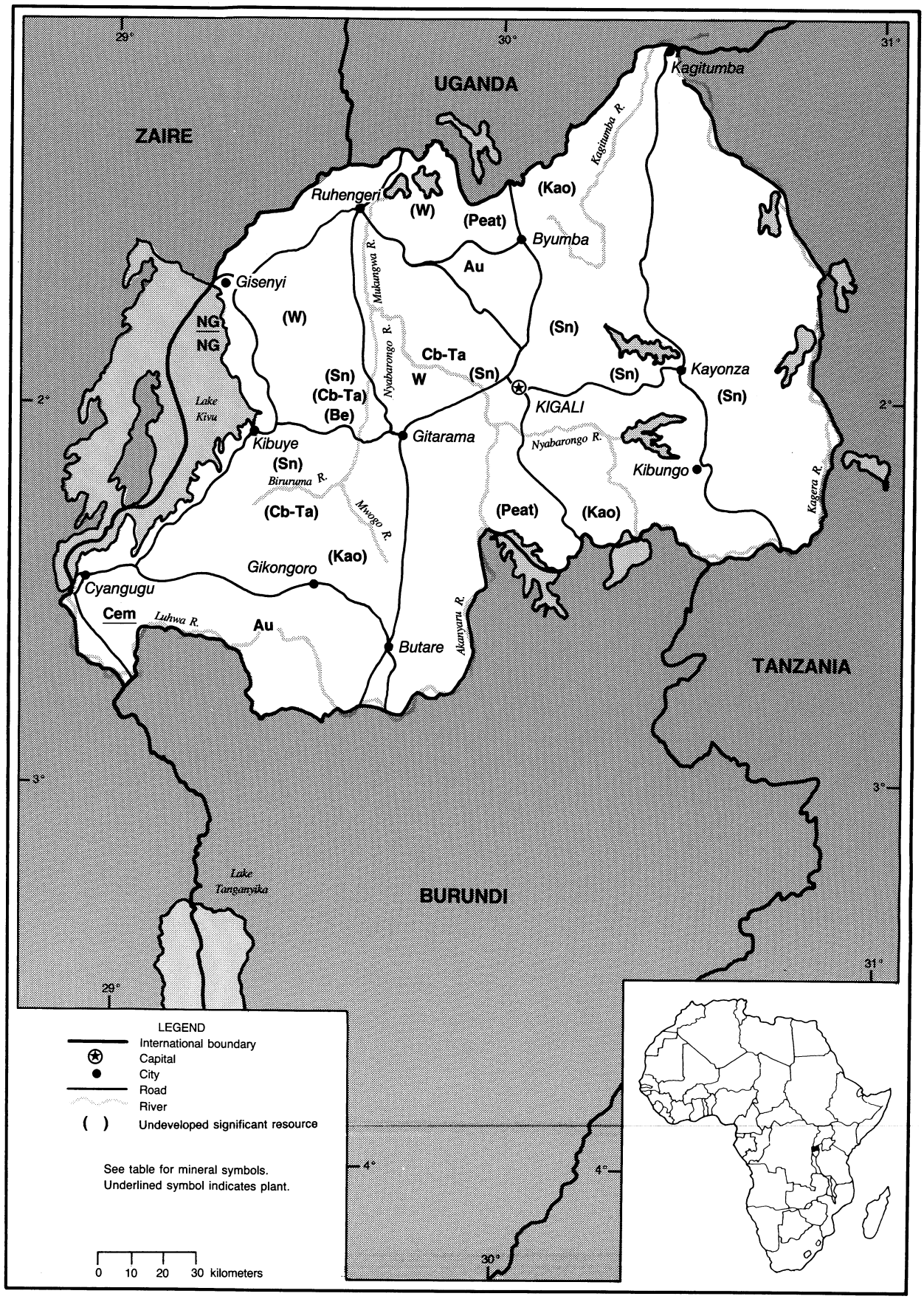
[1]Includes data available through Mar. 19, 1994.

[2]In addition to the commodities listed, Niger also produced clays, and sand and gravel for construction purposes; however, available information is inadequate to make reliable estimates of output levels.

[3]Reported figure.

RWANDA

AREA 26,340 km² **POPULATION 8.2 million**



RWANDA[13]

Rwanda's small but long existing mineral industry contributed little to the country's economy even though many occurrences of potentially valuable minerals were on record for a number of years, especially owing to United Nations efforts. Typically, all industry, almost entirely agricultural processing but including a very minor component of mineral production, contributed only slightly more than 15% to a gross domestic product (GDP) of about $2 billion. Agriculture accounted for about 50% of GDP and employed more than 90% of the labor force. Mineral commodities, including gold, provided somewhat more than 10% of export earnings, and agricultural products (70% coffee), provided more than 80%. Small cooperatives and individual artisans produced concentrates of tin, tungsten, and columbium-tantalum ores, and also some gold bullion. A small cement plant in the southwest utilized local limestone, and a brewery used natural gas from a pilot plant exploiting resources beneath northern Lake Kivu. Mineral commodities, mainly petroleum fuels and structural steel, normally comprised about 25% of imports. Trade was mostly with Europe.

The African Development Fund, an interest-free lending unit in the African Development Bank group, granted $8 million late in 1993 for developing extensive peat deposits in the south to fuel cement and other industries, and especially homes, thereby reducing oil imports and saving native forests.

Although the investment and mining laws aimed at attracting foreign investment, the impoverished, densely populated, tiny but naturally scenic highland country was again in the throes of violent, vicious tribal genocide in the spring of 1994. It rekindled the civil war that had reached a cease fire in April 1993, and consequently demolished the economic adjustment plan being pursued with the World Bank and other donors.

OTHER SOURCES OF INFORMATION

Agency

Ministry of Industry and Handicrafts
Republic of Rwanda
P.O. Box 73
Kigali, Rwanda
Telephone: (250) 75417
Fax: (250) 75465

Publication

Map of Mineral Deposits of Rwanda, Ministry of Natural Resources, Republic of Rwanda, 1982.

TABLE 6
RWANDA: PRODUCTION OF MINERAL COMMODITIES[1]

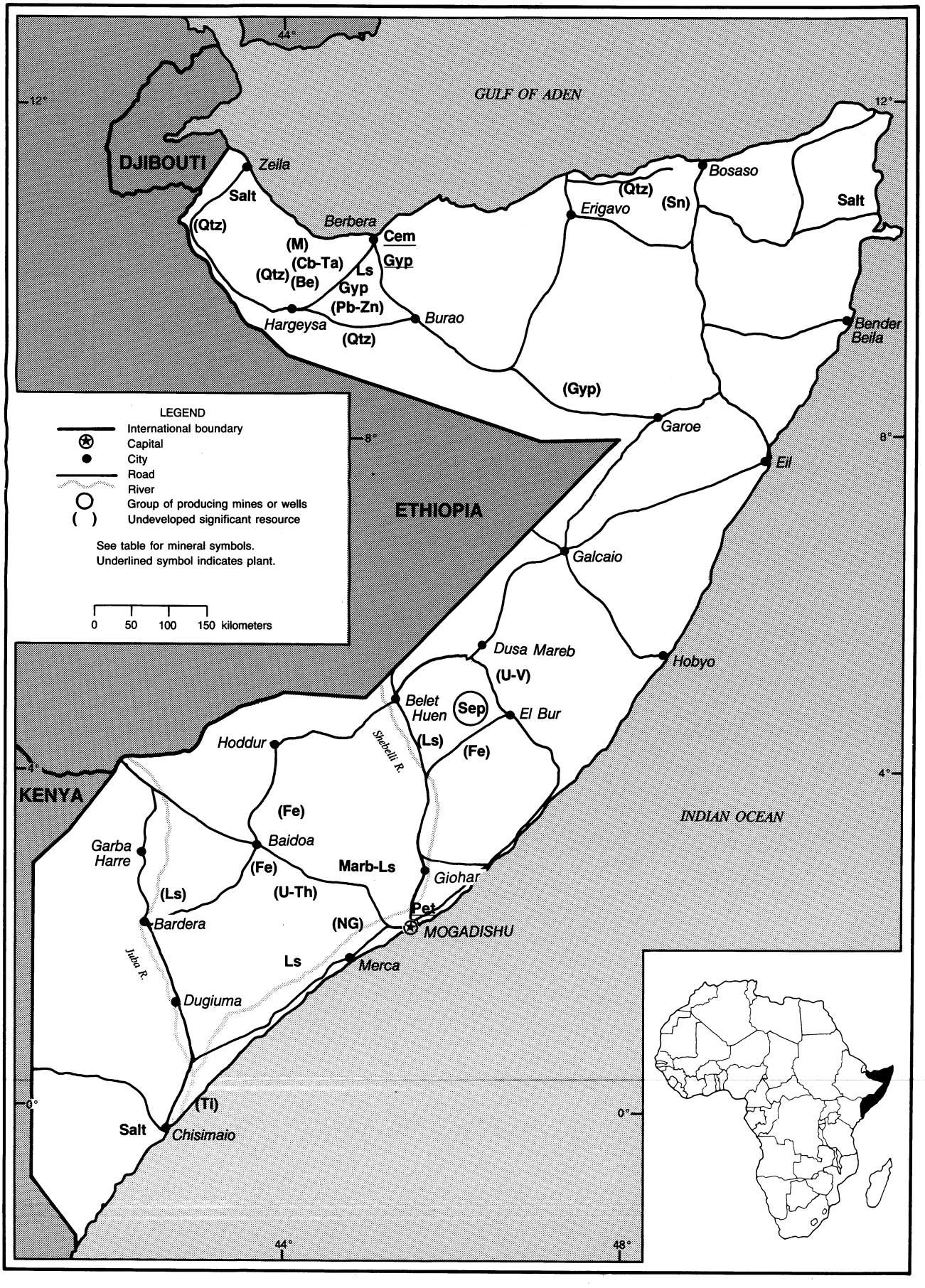
(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991e	1992e	1993e	Annual capacitye (Jan. 1, 1994)
Cement		67,706	60,339	60,000	60,000	60,000	60,000
Columbite-tantalite, ore and concentrate:							
Gross weight	kilograms	[3]64,100	[3]109,900	100,000	100,000	100,000	110,000
Cb contente	do.	19,000	33,000	30,000	30,000	30,000	35,000
Ta contente	do.	14,000	24,000	22,000	22,000	22,000	25,000
Gold, mine output, Au content	do.	[4]745	[4]2,163	1,000	1,000	1,000	1,500
Natural gas, gross	thousand cubic meters	132	973	970	970	970	1,000
Tin: Mine output, Sn content		[5]767	[5]734	730	730	730	800
Tungsten, mine output, W content		[6]105	[6]156	175	175	175	200

eEstimated.
[1]Includes data available through June 1, 1994.
[2]In addition to commodities listed, the following are produced but information is inadequate to reliably estimate output: some gemstones (sapphire and tourmaline); limestone for cement and possibly agriculture; shale and/or clay for cement; and probably crude construction materials (e.g., clays for brick and tile, sand and gravel, stone) from small local operations. Beryllium (beryllium concentrate, estimated 10% BeO) production was last reported in 1985 at 27 tons. Tin smelter output was last reported in 1985 at 800 tons metal when the smelter was reported shut down.
[3]Reported figure. Estimated to contain 22% Ta plus 30% Cb (content last reported in 1985 at 27% Ta_2O_5).
[4]Gross weight reported, estimated to contain 92% Au.
[5]Gross weight ("cassiterite") reported, estimated to contain 70% Sn.
[6]Gross weight ("wolfram") reported, estimated to contain 54% W (68% WO_3).

SOMALIA

AREA 637,660 km² **POPULATION 7.2 million**



SOMALIA[14]

Somalia's normally very small minerals industry undoubtedly remained even smaller in 1993 because of continued political instability and the resultant lack of security for persons and property, but no current statistical data and little other economic information were available. Prior to the Government overthrow early in 1991, industry, of which minerals commodity production was only a small part, typically contributed less than 10% to a gross domestic product (GDP) of less than $2 billion. In the past, production normally included crude local construction materials; cement and its component limestone, clay or shale, and gypsum; calcined gypsum (plaster); meerschaum; evaporated sea salt; refined petroleum products from imported crude; and occasionally very minor amounts of metallic ores. Meerschaum was the only noteworthy mineral export commodity. However, oil possibilities attracted international companies, and many other potentially valuable mineral occurrences were reported by surveys of international agencies. Among these were piezo-electric quartz and those of copper, iron, lead-zinc, manganese, tin, titanium, and uranium as well as others.

Prospective oil and gas areas continued to be of interest, mostly in the north and along the eastern coast. Known possibilities for other valuable minerals appeared to be associated with exposures of Precambrian rocks forming highlands near and paralleling the north coast and lower elevations 100 to 250 km west-northwest of Mogadishu. Another area of interest was in younger rocks 300 to 500 km north-northeast of Mogadishu.

OTHER SOURCES OF INFORMATION

Ministry of Mineral and Water Resources
P.O. Box 744
Mogadishu, Somalia
United Nations
Department for Development Support and Management Services Branch of Sustainable Development and Environmental Management
1 UN Plaza (Room DC1-864)
New York, NY 10017

TABLE 7
SOMALIA: PRODUCTION OF MINERAL COMMODITIES[e 1]

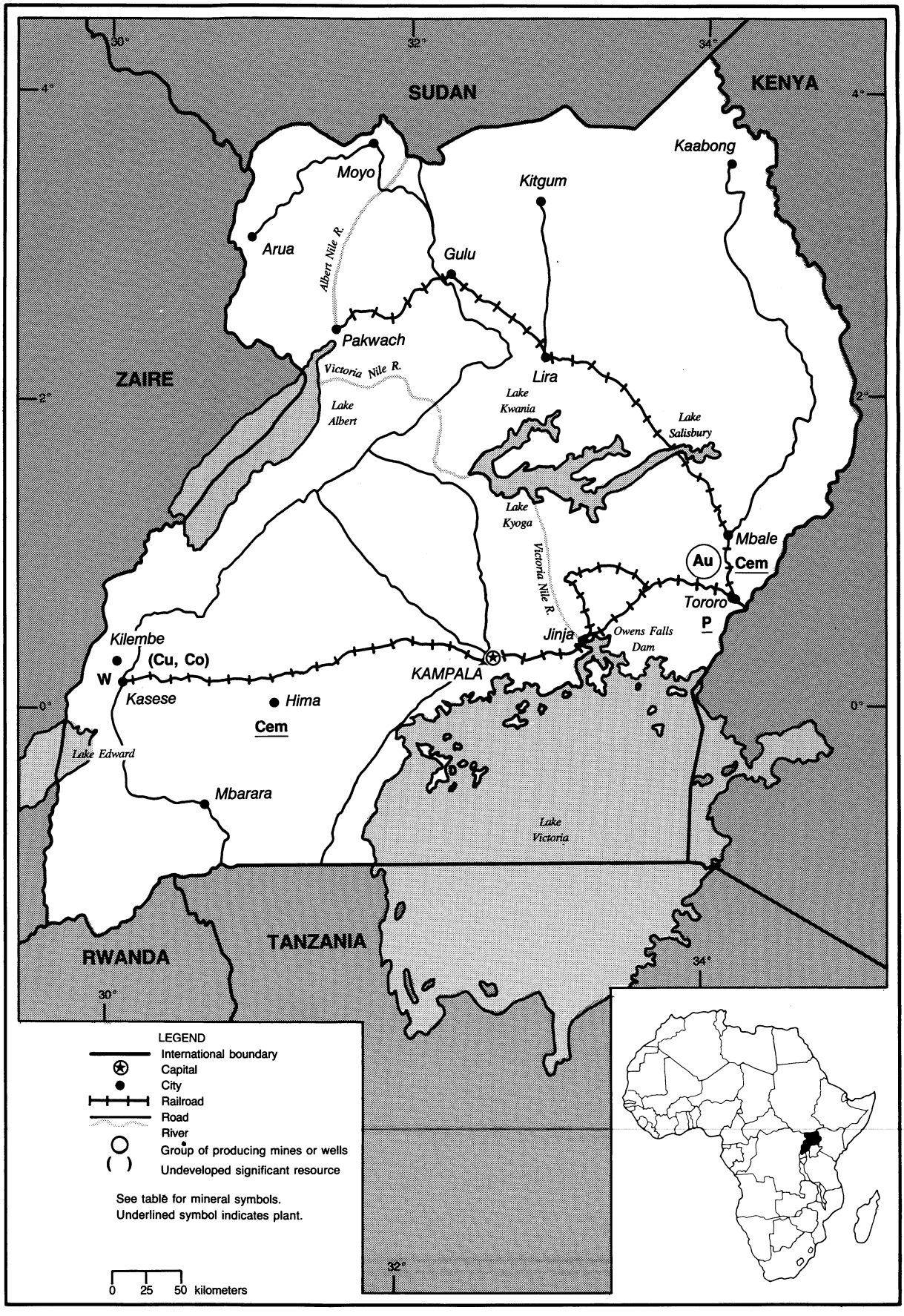
(Metric tons unless otherwise specified)

Commodity[2]		1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic		50,000	40,000	10,000	25,000	25,000	50,000
Gypsum		3,500	2,500	1,000	2,000	2,000	3,500
Limestone[3]		85,000	65,000	17,000	40,000	40,000	85,000
Petroleum refinery products:							
Gasoline[4]	42 gallon barrels	750	740	150	r—	—	500
Jet fuel	do.	160	120	30	r—	—	100
Kerosene	do.	80	60	20	r—	—	50
Distillate fuel oil	do.	610	620	120	r—	—	400
Residual fuel oil	do.	100	110	20	r—	—	70
Other[5]	do.	90	100	20	r—	—	80
Total	do.	1,790	1,750	360	—	—	1,200
Salt, marine		2,000	1,500	500	1,000	1,000	2,000
Sepiolite, (meerschaum)		20	10	4	2	5	20

[e]Estimated. [r]Revised.
[1]Includes data available through June 1, 1994.
[2]In addition to the commodities listed, various crude construction materials (e.g., clays, sand and gravel, crushed and dimension stone) and limestone for lime manufacture and/or agriculture are presumably produced; also clay and/or shale are normally produced for cement manufacture. But available information is inadequate to make reliable estimates of output. Nitrogen production (as ammonia) ceased in 1987 when plant closed.
[3]Estimated for cement manufacture only.
[4]Includes aviation and motor gasoline.
[5]Includes nonenergy products (lubricants, bitumen, and miscellaneous other) and refinery fuel and losses. Liquid petroleum gas apparently was not produced. Refinery fuel and losses were estimated as follows, in thousand barrels: 1989—40; 1990—60; and 1991—10.

UGANDA

AREA 236,040 km² **POPULATION 19.4 million**



UGANDA[15]

Uganda had no mineral production of world significance in 1993. However, minerals have the potential to play a significant role in Uganda's future. Commercial level mineral deposits include copper, iron ore, phosphate, salt, tin, and tungsten, particularly in southwestern Uganda. The other mineral commodities of importance were cobalt as a byproduct of copper and gold.

A feasibility study conducted in 1993 recommended that a combined biological oxidation, solvent extraction and electrowining plant be built to recover 1,000 mt/a of cobalt from the copper pyrites tailings at the old Kilembe copper mine near Kilembe in southwestern Uganda. A pilot plant incorporating a 65-m^3 bioleach tank was constructed and has operated at Kasese since mid-1993. This was designed to assist with engineering design of the actual full-scale cobalt recovery plant and training of plant operators. The Ugandan Government has a 45% stake in the cobalt recovery project. The latter is estimated to cost about $45 million.[16] The production of cobalt from copper tailings at the Kilembe Mine on a pilot basis is scheduled to begin in 1995.

Uganda is mainly an agricultural state, with about 98% of export earnings coming from agricultural products. In 1993, coffee accounted for 70% of foreign exchange earnings. The Ugandan Government through the International Development Association received about $650 million of financing for several projects in 1993. Such projects included a pipeline between Nairobi in Kenya and Kampala, the infrastructure improvement project, and the rehabilitation of the Owen Falls hydroelectric power station.

Uganda's major export products, in order of importance, were coffee, salt, sugar, and tea. Its major trading partners were France, Germany, Kenya, the United Kingdom, and the United States. The country imported machinery, parts, and clothing, mainly from Germany, the United Kingdom, and the United States, and petroleum products from Kenya.

Mineral production is expected to attain its full potential after the turn of the century. The Government is concentrating on reviving its mining industry. The International Monetary Fund-prescribed structural adjustment program adopted by the Government has resulted in increased foreign investment in the energy and mining sectors. Additional financing and technical assistance for reconstruction and rehabilitation of old mining equipment and facilities is being sought from Western donors. *(See table 8.)*

The Government continued work on phosphate extraction research at the Tororo apatite deposits. There were no officially reported reserve figures for minerals. The country's continued effort to revive its mining industry and improve its infrastructure should lead to growth of the mineral industry and economic expansion. The Kilembe cobalt project under way, if implemented and managed properly, could stimulate foreign investors' confidence in the economy. Also, the completion of the Tororo phosphate mine and fertilizer plant could enhance production of food crops and provide additional export commodities. Additional gold and iron ore export should increase the country's foreign exchange revenues.

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[1]Text prepared Mar. 1994, by Philip M. Mobbs.
[2]Ministry of Energy, Mining, and Hydraulics. Benin Mining Resources, 1992, 23 pp.
[3]Text prepared July 1994, by Lloyd E. Antonides.
[4]Text prepared Mar. 1994, by Philip M. Mobbs.
[5]Text prepared May 1994, by Lloyd E. Antonides.
[6]Text prepared Apr. 1994, by Thomas P. Dolley.
[7]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF295.22=US$1.00.
[8]Ross, D. Geology, Hydrocarbon Potential of Rio Muni Area, Equatorial Guinea. Oil and Gas J., Aug. 30, 1993, pp. 96-100.
[9]Where necessary, values have been converted from São Toméan dobras (STD) to U.S. dollars at the rate of STD239.59=US$1.00.
[10]Text prepared May 1994, by Philip M. Mobbs.
[11]Text prepared Mar. 1994, by David Izon.
[12]Text prepared Apr. 1994, by David Izon.
[13]Text prepared June 1994, by Lloyd E. Antonides.
[14]Text prepared June 1994, by Lloyd E. Antonides.
[15]Text prepared Apr. 1994, by David Izon.
[16]Where necessary, values have been converted from Ugandan shillings to U.S. dollars at USH1,131.00=US$1.00 in 1993.

TABLE 8
UGANDA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1989	1990	1991	1992	1993	Annual capacity[e] (Jan. 1, 1994)
Cement, hydraulic	13,755	26,920	e50,000	e50,000	50,000	50,000
Gold kilograms	—	—	—	1,800	1,800	2,000
Iron ore	—	—	—	132	130	130
Lime, hydrated and quick[e]	500	1,500	2,000	[3]1,500	1,500	1,500
Phosphate minerals: Apatite[e]	100	100	100	100	100	100
Salt, evaporated[e]	5,000	5,000	5,000	5,000	5,000	5,000
Tin, mine output, Sn content[e]	10	25	25	[3]30	30	30
Tungsten, mine output, W content[e]	4	4	4	[3]66	60	60

[e]Estimated.
[1]Includes data available through Apr. 6, 1994.
[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.

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/beryl	Be
Bismuth	Bi
Bitumen (natural)	Bit
Boron	B
Bromine	Br
Cadmium	Cd
Calcium/calcite	Ca
Carbon black	CBl
Cement	Cem
Cesium	Cs
Chromite	Cr
Clays	Clay
Coal	C
Cobalt	Co
Columbium (niobium)	Cb
Copper	Cu
Corundum	Cn
Cryolite	Cry
Diamond	Dm
Diatomite	Dia
Dolomite	Ds
Emerald	Em
Emery	E
Feldspar	Feld
Ferroalloys	FA
Ferrochrome	FeCr
Ferromanganese	FeMn
Ferronickel	FeNi
Ferrosilicon	FeSi
Fertilizer	Fz
Fluorspar	F
Gallium	Ga
Garnet	Gt
Gemstones	Gm
Germanium	Ge
Gold	Au
Graphite	Gr
Gypsum	Gyp
Indium	In
Iron and steel	Fe
Iron ore	Fe
Jade	J
Kaolin	Kao
Kyanite	Ky
Lapis lazuli	Laz
Lead	Pb
Lignite	Lig
Lime	Lime
Limestone	Ls
Liquefied natural gas	LNG
Liquefied petroleum gas	LPG
Lithium	Li
Magnesite	Mag
Magnesium	Mg
Manganese	Mn
Marble and alabaster	Marb
Marl	Ma
Mercury	Hg
Mica	M
Molybdenum	Mo
Natural gas	NG
Natural gas liquids	NGL
Nepheline syenite	Neph
Nickel	Ni
Nitrates	Nit
Nitrogen (ammonia plants)	N
Ochre	Oc
Oil sands	OSs
Oil shale	OSh
Olivine	Ol
Opal	Opal
Peat	Peat
Perlite	Per
Petroleum, crude	Pet
Petroleum refinery products	Pet
Phosphate	P
Pig iron	Pig
Pigments, iron	Pigm
Platinum-group metals	PGM
Potash	K
Pozzolana	Pz
Pumice	Pum
Pyrite	Py
Pyrophyllite	Pyrp
Quartz or quartzite	Qtz
Rare earths	RE
Rhenium	Re
Salt	Salt
Sand and gravel	S/Gvl
Sandstone	Ss
Selenium	Se
Sepiolite, meerschaum	Sep
Serpentine	Serp
Shale	Sh
Silicon	Si
Sillimanite	Slm
Silver	Ag
Soapstone	So
Soda ash, trona	NaAsh
Sodium sulfate	$NaSO_4$
Stone	St
Strontium	Sr
Sulfur	S
Talc	Tc
Tantalum	Ta
Tellurium	Te
Thorium	Th
Tin	Sn
Titanium (rutile or ilmenite)	Ti
Titanium dioxide (processed)	TiO_2
Tungsten	W
Umber	Um
Uranium	U
Vanadium	V
Vermiculite	Vm
Wollastonite	Wo
Yttrium	Y
Zinc	Zn
Zircon	Zr

MAP LEGEND

Symbol = Mine, including beneficiation plants, wells

Circled Symbol = Group of producing mines or wells

Underlined Symbol = Processing plant or oil refinery, including smelters and metal refineries

(Symbol) = Undeveloped significant resource

UNITS OF MEASURE AND ABBREVIATIONS

Unit of Measure	Symbol
American Petroleum Institute gravity	°API
barrel(s)	bbl
calorie(s)	cal
centi (prefix)	c
centimeter(s)	cm
cubic meter(s)	m^3
day(s)	d
ton(s), deadweight	dwt
giga (prefix)	G
gigawatt(s)	GW
gigawatt hours(s)	GW•h
gram(s)	g
gram(s) per metric ton	g/mt
hectare(s)	ha
thousand	k
kilocalorie(s)	kcal
kilogram(s)	kg
kiloliter(s)	kL
kilometer(s)	km
square kilometer(s)	km^2
thousand metric ton(s)	kmt
kilovolt(s)	kV
kilowatt(s)	kW
kilowatt hour(s)	kW•h
liter(s)	L
mega (prefix)	M
megawatt(s)	MW
megawatt hour(s)	MW•h
meter(s)	m
million	M
million metric ton(s)	Mmt
square meter(s)	m^2
ton(s), metric	mt
standard coal equivalent	SCE
volt	V
watt	W
watt hour	W•h
year	a

Name or Term	Abbreviation
African Development Bank	ADB
American Petroleum Institute	API
European Community	EC
European Free Trade Association	EFTA
Free Trade Agreement	FTA
General Agreement on Tariffs and Trade	GATT
gross domestic product	GDP
gross national product	GNP
liquefied natural gas (methane)	LNG
liquefied petroleum gas (propane-butane)	LPG
Organization for Economic Cooperation and Development	OECD
Organization of Petroleum Exporting Countries	OPEC
Southern Africa Development Conference	SADC
United Nations	UN
United Nations Development Program	UNDP