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MINERAL INDUSTRIES OF

AFRICA

U.S.
DEPARTMENT
OF THE
INTERIOR

BUREAU
OF
MINES

1991

UNITED STATES DEPARTMENT OF THE INTERIOR • Bruce Babbitt, Secretary

BUREAU OF MINES

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Preface

This edition of the Minerals Yearbook records the performance of the worldwide minerals industry during 1991 and provides background information to assist in interpreting that performance. Content of the individual Yearbook volumes follows:

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

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

Volume III, Area Reports: International, contains the latest available mineral data on more than 160 foreign countries and discusses the importance of minerals to the economies of these nations. Volume III 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. This year's reports incorporate location maps, industry structure tables, and an outlook section previously incorporated in our Mineral Perspectives Series quinquennial regional books, which have been discontinued. The U.S. Bureau of Mines continually strives to improve the value of its publications to users. Constructive comments and suggestions by readers of the Yearbook are welcomed.

Acknowledgments

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

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

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

George J. Coakley
Chief, Division of International Minerals

Contents

Tables

Vitae

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THE MINERAL INDUSTRIES OF

AFRICA

By George A. Morgan and Staff, Branch of Africa and Middle East

INTRODUCTION

The 53 countries that constituted Africa in 1991 accounted for a significant portion of total world output of a number of mineral commodities. However, total output for the continent declined for many major mineral commodities produced compared with that of 1990. Also, Africa's share of total world output of these commodities generally declined. (*See tables 1 and 2.*)

The most conspicuous declines were for cobalt and copper owing to mining and metal processing difficulties experienced by the world's two largest cobalt producers, Zaire and Zambia. Phosphate rock output declined primarily owing to a sharp fall in production from Morocco, also a leading world producer. Morocco's state corporation for phosphate production experienced marketing problems, leading to the decline.

A significant bright spot in Africa was gold production from 24 countries. Gold recovery showed continued growth as new producers started and several existing major producers expanded output. This was despite a decline in output of almost 7 tons by the world's leading producer, the Republic of South Africa. Ghana was the second largest gold producer in Africa at 26.3 tons, followed by Zimbabwe at 17.8 tons.

Liberalization of investment and mining laws continued, as the poor economics of most state-run mining enterprises became evident. Privatization of many of these enterprises was under way. In Zambia, the state corporation responsible for output of copper and cobalt as well as lesser commodities was being privatized.

Among the most significant mineral commodities produced in Africa were andalusite, antimony, asbestos, bauxite, chromite, coal, cobalt, copper, diamond, fluorspar, gold, lithium minerals, manganese, phosphate, platinum-group metals, the titanium minerals—ilmenite and rutile—vanadium, vermiculite, uranium, and zircon. Several of these, chromite, cobalt, diamond, and manganese, were not produced in the United States.

U.S. imports in 1991 from African nations were mainly raw materials. U.S. restrictions on imports from the Republic of South Africa for coal, gold, iron and steel, and uranium were lifted in July 1991. They had been in effect since October 1986. Of $1.7 billion imported from the Republic of South Africa in 1991, almost $1.6 billion was for mineral commodities. Ten African 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; the Republic of South Africa for andalusite, antimony, asbestos, chromium, diamond, fluorspar, gemstones, manganese, platinum-group metals, pyrophyllite, vanadium, and vermiculite; Zaire for cobalt, copper, and diamond; Zambia for cobalt; and Zimbabwe for chromium and lithium. U.S. exports to Africa were mainly food, equipment and machinery, computers, and aircraft. The Republic of South Africa was the largest market for U.S. products and services in Subequatorial Africa in 1991. U.S. exports to the country were mainly mining equipment, chemicals, aircraft and parts, and other equipment.

Research by the Branch of Africa and Middle East indicates that in 1991 there was activity at 24 mineral industry projects in Africa that involved U.S. corporate or banking interests. Of these, 15 projects involved development of crude petroleum, petroleum refinery products or natural gas facilities, or pipeline construction. Nonfuel projects with U.S. interests included an aluminum plant appraisal in Cameroon, mercury decontamination and sulfur exploration in Egypt, diamond and gold joint ventures in Ghana, titanium and zirconium prefeasibility work in Mozambique, diamond production in Sierra Leone, and closure of a small steel mill in Togo.

Despite the underdevelopment of much of Africa, mineral raw materials play a very important part in the national economies of many of its countries. 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, gold in Ghana, bauxite in Guinea, uranium in Niger, phosphate in Senegal and Togo, and copper and cobalt in Zaire and Zambia.

In terms of percentage of export earnings, minerals clearly were the lifeblood of a number of countries throughout the continent. In 12 countries, minerals accounted for more than 50% of foreign exchange earnings. These centers of mineral exports developed years ago, and with the exception of petroleum, nearly all the hard-rock mines opened during the colonial period. Some, such as gold in Ghana, have recently been reactivated. In Botswana, Gabon, Namibia, the Republic of South Africa, and Zimbabwe, relatively successful diversification has grown from the central

core of mineral development and its attendant infrastructure. In recent years, African countries have expanded or improved their mining, investment, and tax laws to further such activity. Privatization of Government-held mining enterprises continued in 1991. The move toward mineral development is happening despite the time lag for development and initial capital requirements for opening mines. The advantages of developing an economic mineral resource base in those countries with such identified 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 the Republic of South Africa, Zaire, Zambia, Morocco, Zimbabwe, and Namibia. Also important in terms of value of mineral production from several high-valued minerals or those produced in large volume, such as bauxite, diamond, gold, manganese, phosphate rock, and uranium, were Botswana, Gabon, Ghana, Guinea, Niger, and Togo.

In terms of mineral fuels, Nigeria and Libya were the largest producers of crude petroleum, followed by Egypt and Algeria. However, the western coast of Africa remained an exploration target for additional oil and gas resources. West coast countries currently producing crude petroleum were Angola, Benin, Cameroon, Congo, Côte d'Ivoire, Gabon, Morocco, Nigeria, Senegal, and Zaire. Areas of Equatorial Guinea, Namibia, Niger, and the Republic of South Africa were explored for natural gas or crude petroleum. Coal was produced by only a few countries, although reserves were quite large in southern Africa. The main producers, in order of importance, were the Republic of South Africa, which was also the world's third largest exporter of coal, Zimbabwe, and Botswana.

The Republic of South Africa had the highest value of nonfuel mineral production in Africa and ranked among the top five world producers in value of nonfuel minerals. It is estimated that total sales of crude minerals and processed mineral products, such as cement, ferroalloys, iron and steel, and petroleum refinery products, were $30 billion in 1991. It was among the top world producers of andalusite, chromite, diamond, fluorspar, gold, manganese, platinum-group metals, pyrophyllite, titanium, uranium, vanadium, vermiculite, and zircon.

The total land area of Africa is about 3.2 times that of the United States. Exclusive of the mineral commodities aforementioned for which there was no U.S. production or which were unique to Africa in terms of dominating world markets, U.S. production of most mineral commodities exceeded that for all of Africa. Two major exceptions were gold and uranium, for which Africa remains a major world supplier.

Although Africa has been a source of minerals for centuries, large areas are under thick vegetative or sand and unconsolidated alluvium cover, which impede exploration. Other large areas are subject to internal strife or legislation prohibitive to risk investment, which have set back the pace of mineral industry development and even exploration. Africa has large reserves of a number of minerals, most of which are in south and central regions of the continent. Among these are antimony, asbestos, bauxite, cesium, chromite, cobalt, copper, diamond, fluorspar, gold, hafnium, ilmenite, kyanite, manganese, phosphate, platinum-group metals, tantalum, vanadium, vermiculite, and zirconium. 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. 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. Most precious metals, such as gold and platinum, and precious and semiprecious stones such as diamond, are more likely to be produced, particularly if found in alluvial or eluvial deposits.

The population of Africa is about 700 million compared with 255 million for the United States. However, Africa's labor force consists for the most part of unskilled or semiskilled labor. Lack of skilled labor remains a significant factor in the slow pace of mineral project development throughout much of Africa. The combined gross domestic product (GDP) of the countries of Africa is about $449 billion and is vastly outweighed by the $5,673 billion GDP of the United States. The Republic of South Africa had the highest GDP at $104 billion, followed by Algeria at $54 billion and Nigeria at $30 billion. African countries have some of the lowest per capita GDP in the world and vary from about $120 for Mozambique to $6,800 for Libya, compared with $22,470 for the United States. Average per capita GDP for the region is $642. All tons are metric in this report unless otherwise specified.

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

SELECTED GENERAL SOURCES OF REGIONAL INFORMATION

Africa Economic Digest London.

British Sulphur Corp. Ltd., London:
Nitrogen, bimonthly.
Phosphorus and Potassium, bimonthly.
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Mining Magazine, monthly.
Mining Journal, weekly.
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Penn Well Publishing Co., Tulsa, OK:
International Petroleum Encyclopedia.

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Economic Geology (and Bulletin), bimonthly.

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Mineral Perspectives, International Strategic Minerals Inventory Summary Report: A Regional Assessment of Selected Mineral Commodities in Subequatorial Africa

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World Bank, Washington, DC: Bank news releases.

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World Metal Statistics, monthly.

TABLE 1

AFRICA: PRODUCTION OF SELECTED MINERAL COMMODITIES FOR 1991

(Thousand metric tons unless otherwise specified)

	Aluminum	Cement	Chromite	Cobalt, mine (tons)	Copper, mine	Diamond (thousand carats)	Gold (kilograms)	Iron ore (gross weight)	Lead, mine	Manganese ore	Petroleum crude (thousand barrels)	Phosphate rock	Steel, raw	Uranium, (tons)	Zinc, mine
Algeria	—	6,319	—	—	—	—	—	2,344	1	—	203,852	1,090	838	—	3
Angola	—	1,000	—	—	—	1,245	—	—	—	—	167,000	—	10	—	—
Benin	—	275	—	—	—	—	—	—	—	—	1,353	—	8	—	—
Botswana	—	—	—	207	27	15,252	66	—	—	—	—	—	—	—	—
Burkina Faso	—	—	—	—	—	—	8,000	—	—	—	—	3	—	—	—
Burundi	—	—	—	—	—	—	15	—	—	—	—	—	—	—	—
Cameroon	83	622	—	—	—	—	8	—	—	—	55,480	—	—	—	—
Central African Republic	—	—	—	—	—	379	176	—	—	—	—	—	—	—	—
Congo	—	103	—	—	—	—	12	—	—	—	56,575	—	—	—	—
Côte d'Ivoirè	—	500	—	—	—	15	1,100	—	—	—	730	—	—	—	—
Egypt	178	15,000	—	—	—	—	—	2,400	—	—	320,470	1,100	2,100	—	—
Ethiopia	—	290	—	—	—	—	2,000	—	—	—	—	—	—	—	—
Gabon	—	117	—	—	—	1	51	—	—	2,013	109,500	—	—	594	—
Ghana	175	750	—	—	—	700	26,311	—	—	320	—	—	25	—	—
Guinea	—	—	—	—	—	113	4,453	—	—	—	—	—	—	—	—
Kenya	—	1,500	—	—	—	—	20	—	—	—	—	—	(1)	—	—
Liberia	—	—	—	—	—	100	600	1,100	—	—	—	—	—	—	—
Libya	—	2,700	—	—	—	—	—	—	—	—	541,295	—	500	—	—
Madagascar	—	60	63	—	—	—	200	—	—	—	—	—	—	—	—
Malwai	—	120	—	—	—	—	—	—	—	—	—	—	—	—	—
Mali	—	20	—	—	—	—	5,500	—	—	—	—	10	—	—	—
Mauritania	—	90	—	—	—	—	—	10,246	—	—	—	—	—	—	—
Morocco	—	4,200	1	525	14	—	—	97	73	59	114	17,900	7	—	35
Mozambique	—	30	—	—	—	—	—	—	—	—	—	—	—	—	—
Namibia	—	—	—	—	30	1,194	1,857	—	12	—	—	—	—	2,707	33
Niger	—	20	—	—	—	—	—	—	—	—	—	—	—	3,330	—
Nigeria	—	3,500	—	—	—	—	—	398	(1)	—	689,800	—	137	—	—
Rwanda	—	60	—	—	—	—	700	—	—	—	—	—	—	—	—
Senegal	—	503	—	—	—	—	—	—	—	—	3	1,833	—	—	—
Sierra Leone	—	—	—	—	—	243	26	—	—	—	—	—	—	—	—
Somalia	—	10	—	—	—	—	—	—	—	—	—	—	—	—	—
South Africa, Republic of	170	8,000	4,618	350	179	8,714	605,452	30,291	70	4,402	—	3,165	8,600	2,951	75
Sudan	—	170	10	—	—	—	50	—	—	—	—	—	—	—	—
Swaziland	—	—	—	—	—	57	—	—	—	—	—	—	—	—	—
Tanzania	—	540	—	—	—	100	2,799	—	—	—	—	22	—	—	—
Togo	—	388	—	—	—	—	—	—	—	—	—	2,965	—	—	—
Tunisia	—	3,300	—	—	—	—	—	295	1	—	38,690	6,400	200	—	9
Uganda	—	50	—	—	—	—	—	—	—	—	—	(1)	—	—	—
Zaire	—	250	—	9,900	266	17,814	8,800	—	—	—	9,955	—	—	—	42
Zambia	—	367	—	6,991	346	—	136	(1)	9	1	—	—	—	—	22
Zimbabwe	—	865	564	105	14	—	17,820	1,136	—	—	—	117	580	—	—
Total Africa	606	51,719	5,256	18,078	876	45,927	686,152	48,307	166	6,795	2,194,817	34,605	13,005	9,582	219
Share of world Total, percent	3.4	4.1	44.8	76.2	13.1	47.9	33.1	6.6	5.1	27.6	9.3	25.2	1.5	26.8	4.9
United States	4,030	72,200	—	—	1,498	—	265,500	59,000	419	—	2,778,745	49,817	97,900	6,210	288

[1]Less than 1/2 unit.

TABLE 2

AFRICA: PRODUCTION OF SELECTED MINERAL COMMODITIES FOR 1990-REVISED

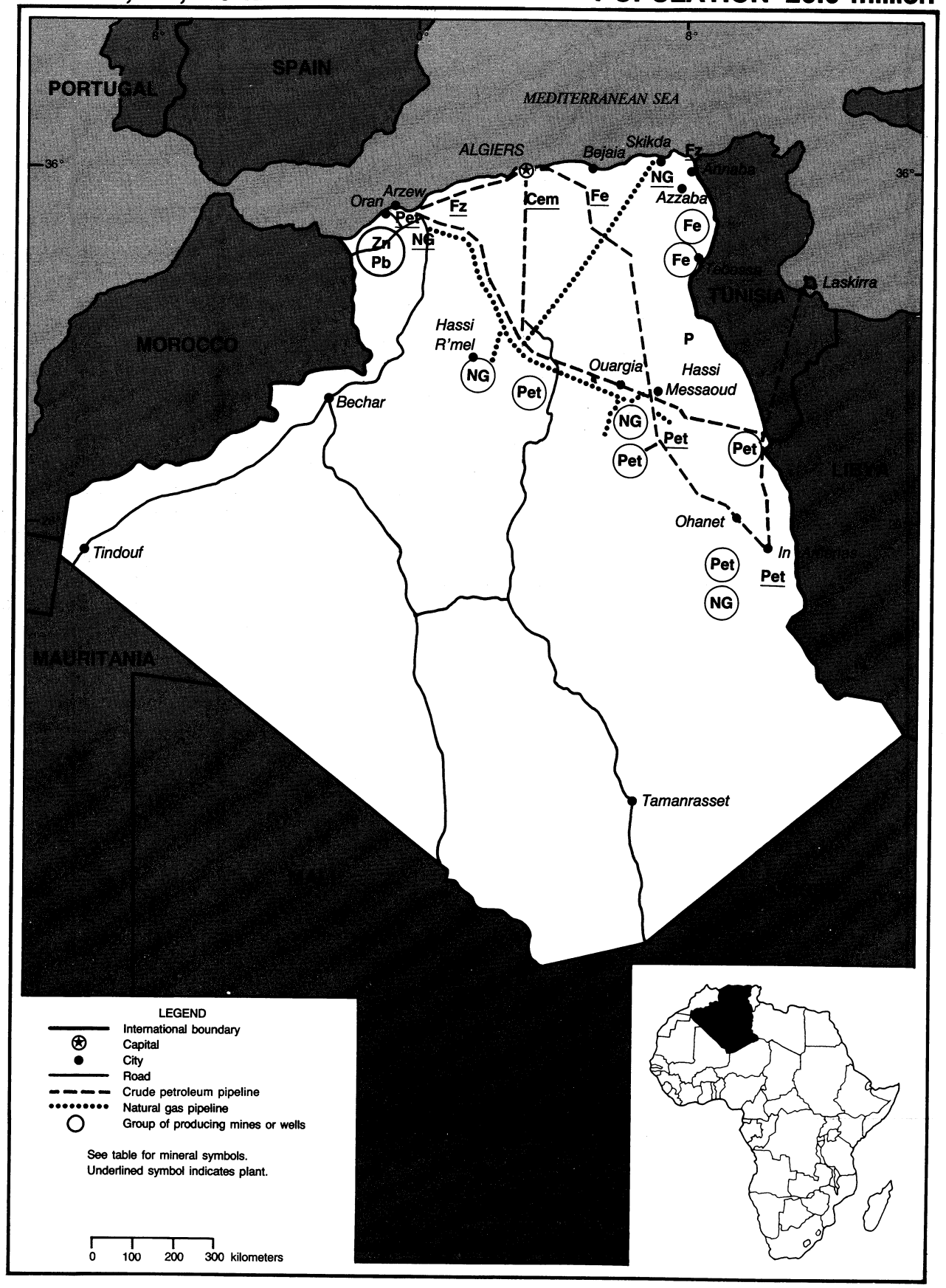
(Thousand metric tons unless otherwise specified)

	Aluminum metal	Cement	Chromite	Cobalt, mine (tons), Co content	Copper, mine, Cu content	Diamond (thousand carats)	Gold (kilograms)	Iron ore (gross weight)	Lead, mine, Pb content	Manganese ore	Petroleum crude (thousand barrels)	Phosphate rock, (gross weight)	Steel, crude	Uranium, (tons)	Zinc, mine, Zn content
Algeria	—	6,337	—	—	—	—	—	2,941	1	—	290,175	1,128	836	—	4
Angola	—	1,000	—	—	—	1,300	—	—	—	—	174,000	—	10	—	—
Benin	—	275	—	—	—	—	—	—	—	—	1,416	—	8	—	—
Botswana	—	—	—	206	25	17,352	50	—	—	—	—	—	—	—	—
Burkina Faso	—	—	—	—	—	—	7,800	—	—	—	—	3	—	—	—
Burundi	—	—	—	—	—	—	9	—	—	—	—	—	—	—	—
Cameroon	93	624	—	—	—	—	8	—	—	—	64,605	—	—	—	—
Central African Republic	—	—	—	—	—	381	241	—	—	—	—	—	—	—	—
Congo	—	90	—	—	—	—	7	—	—	—	58,765	—	—	—	—
Côte d'Ivoirè	—	500	—	—	—	12	20	—	—	—	770	—	—	—	—
Egypt	179	15,299	—	—	—	—		2,405	—	—	319,375	1,143	2,100	—	—
Ethiopia	—	340	—	—	—	—	848	—	—	—	—	—	—	—	—
Gabon	—	115	—	—	—	1	80	—	—	2,423	100,000	—	—	704	—
Ghana	174	675	—	—	—	650	16,840	—	—	247	—	—	26	—	—
Guinea	—	—	—	—	—	127	6,340	—	—	—	—	—	—	—	—
Kenya	—	1,512	—	—	—	—	25	—	—	—	—	—	(1)	—	—
Liberia	—	50	—	—	—	100	600	4,050	—	—	—	—	—	—	—
Libya	—	2,700	—	—	—	—	—	—	—	—	501,510	—	500	—	—
Madagascar	—	60	73	—	—	—	216	—	—	—	—	—	—	—	—
Malwai	—	99	—	—	—	—	—	—	—	—	—	—	—	—	—
Mali	—	20	—	—	—	—	5,200	—	—	—	—	10	—	—	—
Mauritania	—	90	—	—	—	—	—	11,590	—	—	—	—	—	—	—
Morocco	—	4,200	(1)	194	16	—		148	69	49	114	21,396	7	—	19
Mozambique	—	79	—	—	(1)	—	63	—	—	—	—	—	—	—	—
Namibia	—	—	—	—	26	748	1,624	—	21	—	—	—	—	3,485	38
Niger	—	19	—	—	—	—	—	—	—	—	—	—	—	3,161	—
Nigeria	—	3,500	—	—	—	—		374	(1)	—	660,462	—	133	—	—
Rwanda	—	60	—	—	—	—	700	—	—	—	—	—	—	—	—
Senegal	—	470	—	—	—	—		—	—	—	8	2,274	—	—	—
Sierra Leone	—	—	—	—	—	78	32	—	—	—	—	—	—	—	—
Somalia	—	40	—	—	—	—		—	—	—	—	—	—	—	—
South Africa, Republic of	166	8,700	4,951	300	182	9,116	607,500	29,958	78	4,884	—	2,963	8,973	3,472	97
Sudan	—	167	13	—	—	—	100	—	—	—	—	—	—	—	—
Swaziland	—	—	—	—	—	42		—	—	—	—	—	—	—	—
Tanzania	—	540	—	—	—	85	1,629	—	—	—	—	25	—	—	—
Togo	—	399	—	—	—	—		—	—	—	—	2,314	—	—	—
Tunisia	—	3,300	—	—	—	—	—	291	3	—	36,500	6,258	184	—	7
Uganda	—	27	—	—	—	—		—	—	—	—	(1)	—	—	—
Zaire	—	461	—	19,000	413	19,427	9,300	—	—	—	10,597	—	—	—	62
Zambia	—	375	—	7,086	400	—	129	1	10	1	—	—	—	—	32
Zimbabwe	—	700	643	102	15	—	16,900	1,259	—	—	—	148	580	—	—
Total Africa	612	52,823	5,680	26,888	1,077	48,099	676,261	53,017	182	7,604	2,218,297	37,662	13,357	10,822	259
Share of world Total, percent	3.5	4.7	44.2	75.1	11.9	48.5	33.2	5.7	5.5	32.6	10.4	27.8	1.7	—	3.4
United States	4,048	71,310	—	—	1,587	—	266,000	56,408	495	—	2,664,000	46,343	89,726	e6,000	543

[1]Less than 1/2 unit.

ALGERIA

AREA 2,381,740 km² **POPULATION 26.0 million**



THE MINERAL INDUSTRY OF

ALGERIA

By Bernadette Michalski

Algeria's mineral industry includes a diverse but modest production of metals; however, hydrocarbons are by a wide margin the leading mineral sector, accounting for the bulk of export earnings. The Government launched an aggressive policy to further develop and market hydrocarbons. The most striking aspect of the policy was the offer to foreign companies to buy into existing oilfields and gasfields. Included in the Government's priority list was the refurbishing and expansion of natural gas gathering and processing facilities and the negotiation of long-term natural gas export contracts.

Recent economic and financial reforms have moved Algeria's centrally planned economy closer to a market-based economy. The International Monetary Fund has endorsed Algeria's monetary policies and its move toward a market economy as evidenced by the approval of a 9-month standby credit for $404 million[1] on May 30, 1991. The standby agreement also provided contingency funds against a sharp fall in oil prices, raising confidence among creditors.

GOVERNMENT POLICIES AND PROGRAMS

The national 5-year plan covering 1990-94 emphasizes international cooperation in energy development and the removal of limitations on foreign equity. 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 has been relaxed in exploration agreements. The initial license under the new program was awarded to Total CFP for the Hamra Sud-Est and Djebel Bottene perimeter. Additional licenses were awarded in 1991 and early 1992 to Occidental Petroleum, Atlantic Refining Co., Mobil, British Petroleum, Phillips Petroleum, and others.

The Government has given foreign companies a new role in enhanced recovery operations, gas production, and other sectors from which they were previously excluded.

On August 26, 1991, the National People's Assembly adopted a provision amending article 39 of 1986 law No. 86-14 concerning hydrocarbons. It permitted foreign companies to be given fiscal status in Algeria, which enabled the companies to avoid double taxation by their own countries and by Algeria. Additional legislation was passed by the Assembly on November 30, 1991. The resulting act, law No. 91-21 of December 4, 1991, was announced. The major points of this law are summarized as follows:

- Foreign firms have the right to participate up to a 49% equity in existing oilfields with SONATRACH retaining 51%,
- Natural gas is now subject to the same regulations as oil. Previously, SONATRACH alone was permitted to develop and operate gasfields—Algeria's principal exchange earner,
- Disputes between foreign contractors and Government authorities are to be resolved by international arbitration, and
- Transportation no longer remains a SONATRACH monopoly.

The Government plans to open at least 10 fields, including the giant Hassi Messaoud Field. Foreign expertise in secondary and tertiary recovery was being sought for existing fields. In addition, companies awarded exploration rights have the option to choose any of the four following contract types: production-sharing; a partnership; a joint-stock company agreement; or a service contract.

The Energy Ministry projected $14 billion in new foreign investments through exploration and development of existing fields. Up to $7 billion is anticipated in front-end bonuses and $2.5 billion annually in oil and gas export revenues by 1996 and eventually rising to $5 to $6 billion by the year 2000.

The Government announced that among its chief priorities is an improved recovery rate of reserves in place, expanded hydrocarbon production transport and export capacities, and a maintained overall level of Algerian liquid hydrocarbon exports at 1.8 Mbbl/d in the immediate future and 2.5 Mbbl/d by the start of the next century. A major shift in oil policy was revealed in 1991 when 30 international companies were invited to participate in 10 existing oilfields, including the offer to foreign companies to purchase 25% equity in the Hassi Messaoud Field.

Plans to form a common market with the five north African states of the Arab Maghreb Union have been postponed. The free trade zone, a single market, and several integrated economic projects have been held up by domestic problems in several participating countries.

PRODUCTION

A significant natural gas producer, Algeria ranked among the top five world producers. Although petroleum

production remains significant, the nation's more mature wells required water or gas injections to maintain pressures. Algeria ranked 15th among world oil producers.

A variety of nonfuel minerals was 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. Mercury was produced entirely for export as was phosphate rock.

The decline in lead and zinc production was attributed to the temporary closure of the Kherzet Youcef Mine where shaft deepening operations were underway. *(See table 1.)*

TRADE

Although liquid fuels and natural gas accounted for $11,900 million or about 94% of Algeria's export earnings, crude oil contributed only 17% to the total hydrocarbon exports for 1991. Crude oil exports are expected to increase in mid-decade as a result of the application of enhanced recovery technology; however, exports of condensate are expected to decline from the 1991 level of 390,000 bbl/d to 320,000 bbl/d by 1995. Associated natural gas will become increasingly dry as the growing proportion of production will be from reinjected dry gas from which the natural gas liquids have already been stripped.

Western Europe absorbed more than 90% of Algeria's crude oil exports in 1991. Italy alone imported 30% of Algeria's crude oil shipments. The average monthly spot price for Algerian Saharan Blend crude oil ranged from a low of $18.74 per bbl in June to a high of $25.00 per bbl in October. The annual average was $21 per bbl compared with an annual average of $24.22 per bbl in 1990 and $18.52 per bbl in 1989.

Depleting oil reserves in mature fields diverted marketing attention to natural gas, condensates, and refined products. Natural gas exports in 1991 were estimated at 33.7 billion m^3, including 18.8 billion m^3 of liquefied natural gas LNG. This volume represented a 7.5% increase above the 1990 level. Algeria's adoption of a more flexible pricing system that linked the price of natural gas to the price of crude oil improved marketability. The bulk of natural gas exports was delivered to Western Europe. The largest consumer was Italy, which imported 12.4 billion m^3. Others included France at 9.2 m^3 billion, Belgium at 4.2 billion m^3, Spain at 3.5 billion m^3, and the United States at 1.8 billion m^3. Algeria plans to export 40 billion m^3 in 1992 and 50 billion m^3 by 1995.

Other exports, by order of value, are metals and metal products, phosphates, and iron ore.

STRUCTURE OF THE MINERAL INDUSTRY

The Algerian Government has traditionally controlled all mining and mineral processing industries. However, private capital is being encouraged as SONATRACH'S majority participation in all hydrocarbon production contracts is no longer pursued. Government policy was reversed in 1991 when international companies were not only invited to participate in exploration contracts but also to buy into existing oilfields and gasfields.

The nation's chronic cement shortages prompted the Government's invitation to private investors to enter the state-dominated cement industry. The 1990-94 plan was to be modified by legislation liberalizing private participation. *(See table 2.)*

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 was to be secured through purchase agreements.

Gold.—Mining is scheduled to commence at the Tirek and Amesmessa deposits in the eastern Hoggar Mountains of southeastern Algeria. The deposits are reported to contain 540 kg and 1,740 kg of gold, respectively.

Iron Ore.—The bulk of Algeria's iron ore output was extracted from the mine at Ouenza. Production exceeded 2 Mmt of hematite ranging from 53% to 60% iron content. Iron ore was also mined at Bou Khadra and shipped with Ouenza ore by rail to the El Hadjar processing plant, near Bejaia, a distance of 170 km. Both mines are operated by Entreprise Nationale de Fer et de Phosphates.

Iron and Steel.—Raw steel was produced at the Entreprise Nationale de Siderurgie's El Hadjar steel complex. Metal-Sider, the nation's first private steelmaker, will begin operation near Arbaa in mid-1993 with an 80-ton electric furnace and a continuous billet castor, in a plant with two rolling mills producing 200,000 mt/a of rebar and 100,000 mt/a of merchant bar. The mill will save the country about $300 million per year in merchant bar imports. Current rebar production from the El Hadjar complex is less than 300,000 mt/a while demand averages 1.4 Mmt/a. A second electric furnace is planned for mid-decade with a 500,000-mt/a rod mill and a second 500,000-mt/a rebar mill.

Algeria is seeking partners for a hot-briquetted iron project at the port of Jenjen, which can accommodate ore carriers of up to 180,000 dwt. Plans include the installation of two furnaces with a combined capacity of 1.5 Mmt/a of hot-briquetted iron. About one-half of the output will be consumed by Algerian electric furnaces at two-private sector mills and at the state-owned El Hadjar steel complex.

Lead and Zinc.—The El Abed Mine near the Algerian-Moroccan border remained in production, after Algeria's only other lead-zinc mine, Kherzet Youcef, was closed to permit further mine construction at deeper levels.

Mercury.—Algeria was a significant world producer of mercury, supplying almost 10% of the world's total production. Output fluctuates with the world price, which is often at or below Algeria's production cost for mercury. Entreprise Nationale des Nonferreur et Substances Utiles reported the average production cost of mercury in Algeria at $300 per flask.

Industrial Minerals

Cement.—Although the state has traditionally controlled the cement industry, private-sector investors in the Oran region were authorized to purchase up to five cement plants for $200 million. The International Finance Corp. was to assist in identifying the plants and mobilize finance. Algerian cement demand was reported at 13.8 Mmt in 1991. Supply was reported at 7.9 Mmt, including about 1.5 Mmt of imported cement. Only 57% of the national demand was met. Local cement plants are working well below capacity of 11.2 Mmt/a. In November 1991, international bids were invited to participate in the construction of a 200,000-mt/a-capacity white cement plant at Beni-Saf.

Clays.—El Milia, 20 km north of Tamazert, was selected as the site of a 50,000-mt/a-capacity kaolin plant. About one-half of the plant's output will be utilized for sanitaryware, with the remainder divided between the manufacture of tableware and the newspaper industry. Most of the plant's output will be directed to the domestic market. Plant construction was contracted to a consortium of Neyrtec SA, Kaolins d'Arvor of France, and the Gilco Group of Italy.

Phosphate Rock.—Production was derived from the Djebel Onk open pit mine 330 km south of Annaba and 22 km from the Tunisian border. Operated by Entreprise Nationale de Fer et de Phosphates, the deposit site covers 2,100 km^2 and produced more than 1 Mmt of processed phosphate. About one-third of the output was utilized at the Annaba fertilizer complex, and the remainder was exported, principally to France and Spain.

Mineral Fuels

Natural Gas.—Gross production of natural gas was about 140 billion m^3, and about one-half of production was reinjected to maintain petroleum reservoir pressure. Liquefaction of natural gas for the export market averaged 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 the Bechtel Corp. and the M. W. Kellogg Co. of the United States and the U.S. subsidiary of Sofregas of France. Loan agreements guaranteed by the Export-Import Bank will provide $348 million for work by Bechtel, $172 million for M. W. Kellogg, and $53 million for Sofregas US. These guarantees have a 4-year drawdown period. The loans are underwritten by Citicorp with participation by the Arab Petroleum Investments Corp. at $140 million. Sufficient credits are in place to allow the expansion to proceed. The upgrading of the GL1-Z and GL2-Z plants at Bethioua near Arzew were awarded to Bechtel Corp. and the M. W. Kellogg Co. of the United States. The plants are currently operating at 60% and 85% of their respective capacities of 10,580 Mm^3 and 10,700 Mm^3.

On December 31, 1991, a $228 million credit agreement was signed between SONATRACH and French banking interests covering France's share of financing for renovation of the GL1-K gas liquefaction plant at Skikda. The plant was operating at about 55% of its 8,500-Mm^3 capacity. Renovation should continue through 1994.

Restoration on GL4-Z, currently operating at 90% of its 1,400 Mm^3 capacity, is to be carried out by Sofregaz and SONATRACH. An audit of the plant was in progress in 1991.

A gas processing plant is proposed for construction in the Hamra Field in south Algeria. Construction is expected to take 40 months. Hamra development is expected to cost $500 million with production anticipated at 5 billion m^3/a by 1995.

Construction commenced on a helium plant at Arzew for the Helios Co., a joint venture with SONATRACH involving Air Products of the United States (APCI) and L'Air Liquide of France. The plant will process helium-rich waste gas from Sonatrach's natural gas facilities. The plant cost is projected at $96.2 million. Upon completion, the plant is to produce 16 Mm^3/a of liquid helium, which would represent 20% of world output, and 33,000 mt/a of liquid and gaseous nitrogen. The plant site will be in the GL2-Z natural gas liquefaction complex in Bethious, near Arzew. Construction commenced in 1991 and should be completed by 1994. The plant will use APCI's production process and will also retreat, by cooling and distillation, the residual gas produced by the GL2-Z liquefaction complex. This gas contains on average 10% helium and 45% nitrogen. As Algeria enjoys the proximity of the European market, almost all helium produced will be exported to Europe. The nitrogen will be sold in Algeria and other north African markets.

Natural gas exports to Eastern Europe were anticipated by May 1992 via the trans-Mediterranean pipeline to Slovenia. Liftings for 1992 were projected at 150 Mm^3 rising to 600 Mm^3 annually until the year 2007.

Financing for a second natural gas pipeline across the Mediterranean Sea was partially secured. The section of the trans-Mediterranean (Transmed 2) pipeline covering the distance between Tunisia through Sicily to the Italian mainland had been secured at $260 million. Financing for the $400 million Algerian section was expected by the close of 1992. The Algerian portion of Transmed 2 begins at Hassi R'Mel and continues for 530 km to the Moroccan border. Included in the design are two terminals, five interrupter stations, and other facilities.

The Hassi R'Mel gasfield is to be linked with Spain via Morocco and the Strait of Gibraltar by 1995. The delivery of 6 billion Mm^3/a of natural gas to Spain and up to 1 billion Mm^3/a to Morocco should commence by October 1995. In the second phase of construction, the pipeline will be extended to provide access to Portugal, France, and Germany.

Petroleum.—**Exploration.**—Most of the exploration activity remains under SONATRACH, which holds the license for exploration on more than 600,000 km^2. In 1991, SONATRACH drilled 25 exploration or extension wells. Sixteen wells were completed. Five new discoveries were announced, adding about 400 Mbbl of oil and 46 billion m^3 of natural gas to reserves in place. One of the major discoveries occurred in May at Oued Tourhar, 100 km southeast of Adrar. The discovery was at a depth of 900 m in the Cambro-Ordovician formation. Geophysical studies indicated that the structure covered an area of 20 km^2 containing reserves in place estimated at 240 Mbbl of 40° API crude oil.

Total CFP entered into a new exploration agreement on May 12, 1991, covering 6,458 km^2. The agreement covers the 4,509-km^2 Jebel Bottene block and the 1,949-km^2 Hamra Sud-Est perimeter. The agreements required Total to carry out seismic surveys and to drill at least six wells during an initial exploration period of 5 years.

The International Petroleum Corp. (IPC) signed a 12-month exploration agreement with SONATRACH in June 1991 covering an 8,600-km^2 area north of the town of Bechar in western Algeria. The agreement required IPC to carry out geological and geophysical studies and process existing seismic data.

On June 9, 1991, the Occidental Petroleum Corp. signed an exploration agreement with SONATRACH for a 23,000-km^2 area east of Hassi R'Mel. During the initial 5-year period, Occidental was committed to drilling 10 wells.

The Japan National Oil Corp. (JNOC) entered into a 2-year agreement with SONATRACH on August 18, 1991, requiring JNOC to log and process 2,700 km of seismic lines and to reprocess 2,500 line km of existing seismic data from a region covering 33,00 km^2 about 50 km southwest of Reggane.

Encor and Norcen Energy Resources signed an oil exploration agreement with SONATRACH on October 8, 1991, covering the 13,500-km^2 Mehaiguene region north of Hassi R'Mel. The contract calls for the minimum expenditure of $60 million on exploration operations, including interpreting 2,500 km of seismic lines and drilling 10 wildcats.

A new hydrocarbon exploration agreement was signed between Agip of Italy and SONATRACH on December 17, 1991, for 6,800 km^2 in the Zotti Est region. Agip is required to undertake extensive geological and geophysical studies utilizing existing data available from SONATRACH, as well as logging 700 km of seismic lines and drilling one exploration well that will be succeeded by two additional exploration wells if the first strikes hydrocarbons. The new exploration agreement followed Agip's oil discovery 220 km southeast of Hassi Messaoud in November, marking Agip's third find in as many years.

Anadarko Petroleum of the United States signed a contract on January 25, 1992, for the 3,377-km area known as Ahara about 200 km northwest of In Amenas. Anadarko is to reprocess existing seismic data and undertake additional seismic surveys.

Atlantic Richfield Co. of the United States entered into exploration agreements on May 10, 1992, covering a 9,952-km^2 area in the Oued Mya basin east of Hassi R'Mel and a 4,945-km^2 area in the Ghadames basin structure. ARCO estimates exploration costs at $65 million if extended over a 10-year period. The agreement falls under the revised hydrocarbons law, which permits ARCO to benefit from any production if the exploration yields positive results.

Production.—Crude oil production averaged 558,500 bbl/d. Most of the production was derived from Hassi Messaoud-Haoud el Hamra Fields in the Sahara, the Zarzaitine-Edjeleh Field near Ohanet, and In Amenas near the Libyan border. Field condensate production averaged 415,000 bbl/d. The Government offered foreign companies equity interest 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. The opening of these properties to international participation was made possible by the December 1991 amendment.

Petroleum production from Algeria's mature fields has reached capacity; however, further augmentation is possible with a major enhanced recovery program. SONATRACH has installed water injection systems at 13 fields. Natural gas injection systems at the Hassi Messaoud Field have a capacity of 50 Mm^3/d. To implement this volume of natural gas injections, natural gathering installations must be expanded. Additional facilities both to recover flared gas at the field itself and to transport natural gas from the Nezla, Hassi Touareg, and Gassi Touil Fields via pipeline would be required to provide sufficient gas to the injection systems at Hassi Messaoud.

A natural gas reinjection system with a capacity of 4 Mm^3/d was installed at the Gassi Touil Field, and similar projects are under consideration for the Ait-Kheir and Masdor Fields.

Refining.—Algeria's five refineries have a combined distillation capacity of 474,500 bbl/d and a catalytic reforming capacity of 56,000 bbl/d. Output was running near capacity levels. The Skikda refinery was the nation's largest facility with capacity reported at 323,000 bbl/d.

Petrochemicals.—Growing global demand for methyl tertiary butyl ether (MTBE), an unleaded fuel additive, prompted a feasibility study on construction of a 600,000-mt/a-capacity MTBE plant at Arzew. Partners in the $400 million project with SONATRACH are Total of France and Ecofuel of Italy.

Entreprise Nationale de le Petrochimie (ENIP) plans to increase capacity of a low-density polyethylene plant (LDPE) at the Skikda petrochemicals complex from 48,000 mt/a to 65,000 mt/a.

A contract for the engineering work on a high-density polyethylene (HDPE) plant at Skikda was awarded to a Spanish consortium. The plant's total cost is estimated at $120 million. The 130,000-mt/a-capacity plant will start production in 1992.

Reserves

Algeria possesses enormous sedimentary basins that very likely contain larger reserves of crude oil than present reserve estimates suggest. Improved geochemical, petrophysical, and reservoir studies and the installation of enhanced recovery systems would enable probable reserves to be reclassified as proven reserves. Natural gas reserves, however, as reported by the Ministry of Mines and Industry at the close of 1991, were 3.63 trillion m^3. 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 has seven sea ports for the export of hydrocarbons: Algiers, Annaba, Oran, Arzew-Bethious, Skikda and Bejaia in Algeria, and the port of La Skhirra in Tunisia. The Arzew-Bethious and Skikda ports include loading facilities for LNG. All condensate exports and about 40% of all remaining hydrocarbon exports are shipped through the Arzew-Bethious terminal.

Algeria utilizes 20 major crude oil pipelines. The principal crude oil export lines are the 34-inch-diameter, 633-km-long Haoud El Hamra to Skikda pipeline, the 28-inch-diameter, 800 km-long Haoud El Hamra to Arzew pipeline, the 24-inch diameter, 646-km-long Hassi Messaoud to Bejaia pipeline, and the 24-inch diameter, 770-km-long In Amenas to La Skhirra pipeline.

Natural gas was pumped from Hassi R'Mel by pipeline to the Mediterranean ports of Arzew and Skikda. Nine lines carried dry gas; four lines carried condensates and NGL. Port capacity at Skikda was limited to 90,000-m^3 natural gas carriers. Consideration is being given to the expansion of the port to accommodate 125,000-m^3 natural gas carriers. The Algerian fleet consists of one 22,300-dwt oil tanker, three NGL carriers with a combined capacity of 18,500 m^3 and six LNG tankers with a combined capacity of 677,900 m^3.

Algeria's railroads, principally in the northern regions of the country, totaled 4,146 km of track. The nation's road system consists of 80,000 km. Of this total, 60,000 km is concrete or bituminous surfaced and the remaining 20,000 km is surfaced with gravel, crushed stone, or unimproved earth.

OUTLOOK

Effecting the most dramatic change in oil policy since nationalization took place in 1971, the Algerian Government has offered for sale a portion of equity rights in oilfields and gasfields currently in production. This action should eventually aid the balance of payments and make optimum use of Algeria's energy reserves. The immediate sale of 25% of Hassi Messaoud Field for about $6 billion is intended to service Algeria's short-term debt. Over the next 6 years, the debt service is projected to absorb at least 60% of the nation's foreign currency earnings. Additional equity sales in existing fields could considerably ease this debt servicing burden.

The outlook for Algerian natural gas exports in the coming decade represents a radical reversal of the situation in the 1980's when major markets were lost to competitors largely due to pricing practices. Expansion of the trans-Mediterranean pipeline alone should open markets in Austria, Czechoslovakia, Hungary, and Yugoslavia. The current infrastructure would prove inadequate to satisfy demand within a few years. If Algeria is able to raise sufficient foreign capital to refurbish the natural gas extraction and processing facilities, as well as the transport infrastructure, the country should be positioned to take full advantage of anticipated price increases. Therefore, top priorities centered on revamping and expanding natural gas processing and export facilities both for gaseous natural gas and LNG to attain the goal of exporting 60 billion m^3 by the year 2000.

Increased political instability evidenced in mid-1992 could jeopardize Algerian plans to refinance its $23.4 billion external debt. About $5 billion of the external debt is owed to commercial banks. While the injections of funds into the economy remains urgent, investors will be hesitant as long as the political situation remains unclear. Political uncertainty threatening Algeria comes at an inopportune time for the natural gas industry. A major competitor, the fragmented former U.S.S.R., faces political and commercial problems and will require some time to stabilize natural gas exports.

[1]Where necessary, values have been converted from Algerian dinars (AD) to U.S. dollars at the rate of AD13.58=US$1.00.

OTHER SOURCES OF INFORMATION

Ministry of Mines
80 Avenue Ahmed Ghermoul
Algiers, Algeria

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

Société Nationale des Matriaux de Construction
90 Rue Didouche Mourad
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Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures

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TABLE 1

ALGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991e
METALS						
Cadmium, refined		102	55	46	65	[3]78
Iron and steel:						
Iron ore, gross weight	thousand tons	3,380	3,118	2,748	2,941	[3]2,344
Metal:						
Pig iron	do.	1,478	1,500	1,300	1,037	[3]877
Steel, crude	do.	1,378	1,300	943	r836	[3]838
Lead:						
Concentrate, Pb content e		1,600	1,900	1,400	r1,100	900
Refined		r3,200	r3,900	r2,700	r4,500	4,500
Mercury		758	662	587	637	[3]431
Silver e	kilograms	3,700	3,000	2,800	2,500	2,500
Zinc:						
Concentrate, Zn content		8,892	6,348	6,263	r4,160	[3]2,610
Metal, smelter output		21,000	r37,000	r28,000	r23,600	[3]24,917
INDUSTRIAL MINERALS						
Barite, crude		45,000	43,000	49,000	53,078	[3]44,361
Cement, hydraulic	thousand tons	7,541	7,195	6,819	6,337	[3]6,319
Clays:						
Bentonite		24,600	25,600	r39,200	33,700	[3]25,803
Fuller's earth e		3,500	3,500	3,500	e4,000	[3]4,526
Kaolin		16,000	17,800	18,000	18,000	[3]21,460
Diatomite		3,300	3,087	4,400	4,156	[3]3,629
Gypsum e [4]	thousand tons	275	275	275	250	[3]152
Lime, hydraulic		r40,700	r32,000	r27,000	r32,000	[3]61,345
Nitrogen: N content of ammonia		r174,200	r196,900	r131,500	e150,000	150,000
Phosphate rock	thousand tons	1,073	1,332	1,124	1,128	[3]1,090
Salt	do.	233	237	229	r222	[3]211
Sodium compounds: Caustic soda e		700	700	700	700	700
Strontium minerals: Celestite, gross weight e		5,400	5,400	5,400	5,400	5,400
Sulfur, elemental e		20,000	20,000	20,000	20,000	20,000
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross	million cubic meters	110,910	109,903	108,000	110,000	140,000
Dry[5]	do.	43,180	44,900	48,400	48,500	56,000
Natural gas plant liquids	thousand 42-gallon barrels	45,750	55,400	56,492	56,000	57,000
Petroleum:						
Crude	do.	239,200	236,800	253,675	290,175	[3]203,852
Condensate	do.	170,000	175,000	170,000	r154,075	[3]151,575
Refinery products:						
Gasoline	do.	17,360	15,610	17,760	r18,604	18,600
Kerosene and jet fuel	do.	4,530	4,058	3,903	r3,850	3,850
Distillate fuel oil	do.	54,400	60,105	57,233	r57,546	57,500
Residual fuel oil	do.	36,100	40,050	37,660	r38,235	38,200

See footnotes at end of table.

TABLE 1--Continued

ALGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum—Continued						
Refinery products—Continued						
Lubricants	thousand 42-gallon barrels	917	735	959	r840	835
Other[e]	do.	43,425	47,100	47,300	47,000	47,000
Total	do.	156,732	167,658	164,815	166,075	165,985

[e]Estimated. [r]Revised.

[1]Table includes data available through Aug. 31, 1992.

[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.

TABLE 2

ALGERIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	Enterprise des Ciments et Derives de L'Est (Government, 100%)	Setif, near Bejaia	1,200.
		Batna, 60 kilometers south of Skikda	1,000.
		Constantine, west of Skikda	1,200.
Do.	Enterprise des Ciments et Derives de L'Ouest (Government, 100%)	3 plants at Oran	2,900.
Do.	Cimenterie de Oued Sly (Government, 100%)	El-Asnam, 80 kilometers west of Algiers	2,000.
		Djelfa	500.
Do.	Entreprise des Ciments et Derives du Centre (Government, 100%)	Blida, 5 kilometers southwest of Algiers	1,200.
		Bouira, near Algiers	1,000.
		Algiers	500.
Fertilizer	Entreprise Nationale des Engrais (ASMIDAL) (Government, 100%)	Arzew	495 ammonium nitrate, 660 ammonia, 132 urea, 395 nitric acid.
Do.	do.	Annaba	330 ammonium nitrate, 330 ammonia, 254 nitric acid, 495 sulfuric acid, 165 phosphoric acid, 550 compound fertilizers.
Iron ore	Entreprise Nationale de Fer et de Phosphates (Government, 100%)	Ouenza and Bou Khadra	4,000.
Iron and steel	Entreprise Nationale de Siderurgie (Government, 100%).	El Hadjar, near Bejaia	1,500.
Mercury tons	Entreprise Nationale des Nonferrous et Substances Utiles (Government, 100%)	Azzaba	800.
Natural gas million cubic meters	Societe Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures (Government, 100%)	Hassi R'Mel and Hassi Messaoud natural gas gathering center	112,000.
		Liquefaction plants at Arzew	22,900.
		Liquefaction plant at Skikda	7,900.
Natural gas liquids million barrels	do.	Hassi R'Mel	200.
Petroleum, crude do.	do.	Hassi-Messaoud and others (Al Agreb, Amassak, Tabankort, Nezla North, Haoud Berkaoui, Zemlet Ennous, Zarzaitine, Rhourde El Baguel, Edjeleh, Tin-Fouye and others)	440.
Do. do.	Total, Compagnie Francaise des Petroles (French Government, 34.1%; Abu Dhabi Investment Authority, 8.4%; Caisse des Depots et Consignations, 5.2%; other diverse shareholders, 52.3%)	Mereksen	2.

See footnotes at end of table.

TABLE 2—Continued

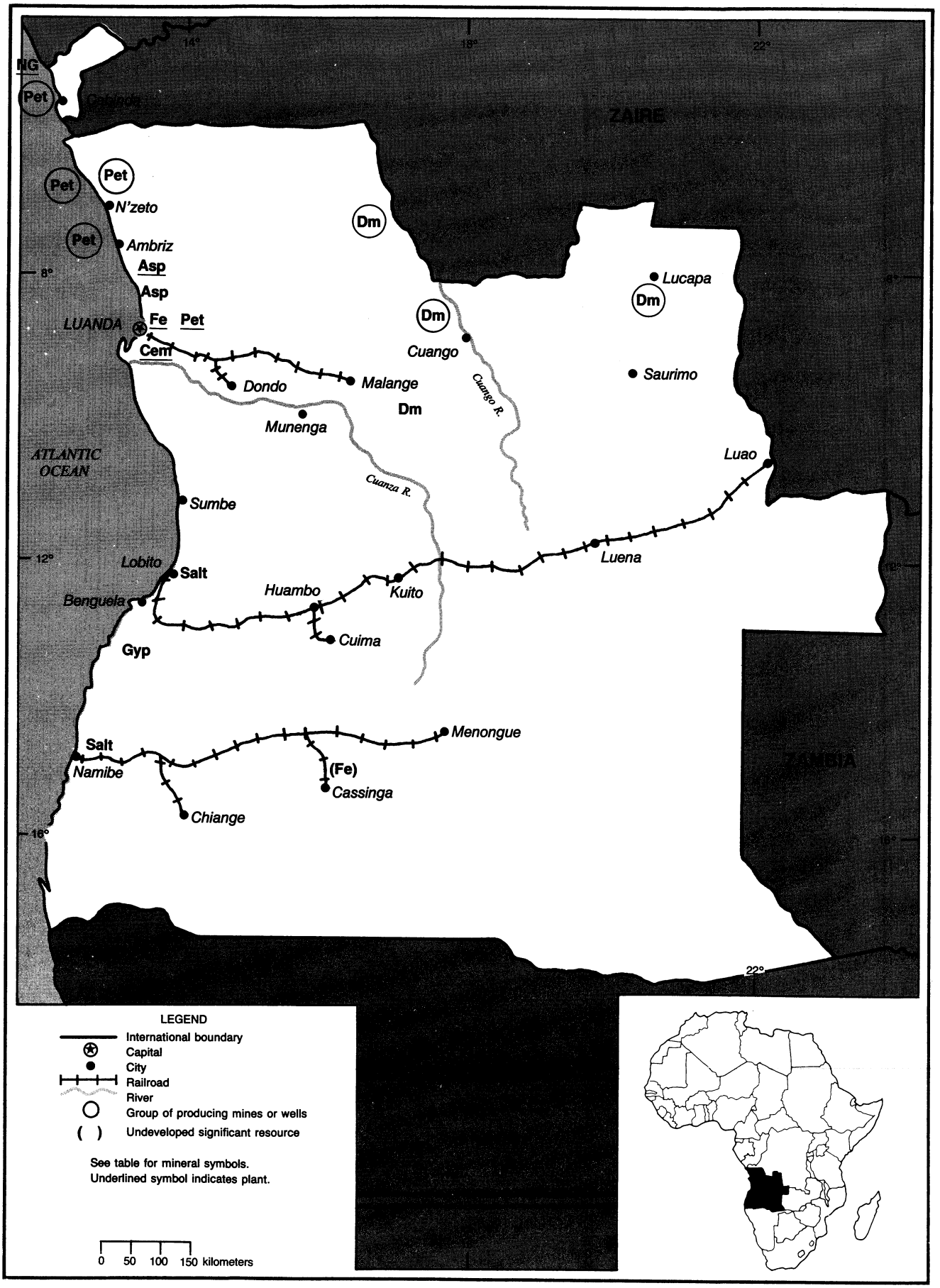
ALGERIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Petroleum, products	million barrels	Enterprise Nationale de Raffinage des Produits Petroliers (Government, 100%)	Refinery at Skikda	118.
			Refinery at Arzew	22.
			Refinery at El Harrach, near Algiers	22.
			Refinery at Hassi Messaoud	10.
			Refinery at In Amenas	2.

ANGOLA

AREA 1,246,700 km² **POPULATION 8.8 million**



LEGEND

- International boundary
- Capital
- City
- Railroad
- River
- Group of producing mines or wells
- ( ) Undeveloped significant resource

See table for mineral symbols.
Underlined symbol indicates plant.

0 50 100 150 kilometers

THE MINERAL INDUSTRY OF

ANGOLA

By Audie L. King

While the mineral industry continued to play a key role in Angola's economy, the bulk of its earnings came from only two commodities, petroleum and diamond. A historic peace treaty was signed between Government and opposition leaders in May 1991 that ended the 16-year-long civil war and renewed hopes that Angola would finally begin to develop its rich and varied mineral resources. The civil war, however, ruined the country's infrastructure, and it will be many years before the country will be in a position to significantly diversify its mineral industry. In 1991, crude oil production was the country's most lucrative endeavor. The petroleum industry generated about $3,900 million[1] and accounted for almost 45% of Angola's GDP and about 95% of the mineral sector's revenues. In 1989, the last year for which data were available, about 92% of total export earnings was generated from the petroleum sector. More than 50% of Government revenues was derived from the state's participation in the petroleum industry, and the taxation of foreign oil companies continued to be the Angolan Government's principal source of foreign exchange.

Revenues from official diamond mining accounted for about 2% of the GDP and about 4% of total export earnings. According to figures provided by Empressa Naçional de Diamantes de Angola (Endiama), the state diamond mining company, official production of diamond decreased during 1991 to 960,558 carats from 1,132,851 carats in 1990. This was only about two-thirds of the production level achieved in 1974. Angola's longstanding problem with illegal small-scale diamond mining got much worse following the end of the 16-year-long civil war. The ranks of illegal miners and smugglers swelled once it was perceived to be relatively safe to move about the countryside. Two to three times as much diamond may have been smuggled out of the country as in 1990 when an estimated 500,000 carats was smuggled across the border to Zaire. Endiama signed an agreement in January 1991 with De Beers Centenary AG to reestablish its marketing relationship. The deal would provide the Angolan state company with a $50 million loan to increase production from the Cuango area. In return, Endiama agreed to sell its entire production from the area to De Beers' Central Selling Organization (CSO). De Beers also agreed to spend at least $50 million on the evaluation of the Camutue kimberlite in northeastern Angola and to prospect for new primary diamond sources.

GOVERNMENT POLICIES AND PROGRAMS

During the first few months of the year, governmental efforts were focused on negotiations that led to the signing of peace accords in May 1991 that signaled the end of Angola's 16-year-long civil war. Free multiparty elections were scheduled for September 1992, and a plan was worked out under which the Government and rebel forces would be combined into a single army. Meanwhile, the Government continued to implement economic reforms aimed at converting to a free market economy. Its ambitious plans led to Angola becoming a member of the International Monetary Fund (IMF) and the World Bank in September 1990. An eventual goal of the reforms was to privatize many of the country's small- and medium-sized parastatal companies. Angola's Finance Minister identified 17 public enterprises that could be privatized. Enterprises such as the Benguela railroad and the Angolan airlines would only sell a part of their holdings. Plans called for the Government to maintain a majority status in any company that holds a monopoly status.

Angola's mining law was revised during 1991. The new document continued to consider all mineral resources the property of the state, but allowed foreign companies to participate in exploration and mining. Provisions in the previous law that required majority ownership by Angolan nationals were repealed. It was implied that parastatal mining companies would be given greater autonomy. The law would effectively allow the mining industry to enjoy the same freedom of operations that the highly successful petroleum industry had enjoyed for many years. A newly formed Ministry of Geology and Mines would oversee the changes in the mining laws. Since Angola's independence, the Geological Survey Department and the National Department of Mines, the latter of which controlled the state mining companies, had been under the Ministry of Industry. The Government had plans to create an environmental protection department to deal with ecological problems caused by petroleum exploration. The new department would fall under the jurisdiction of the Angolan Oil Minister.

The Office of Foreign Investment was established to centralize and speed up the Government's approval of new foreign investment projects. Foreign companies were guaranteed the right to repatriate profits.

Government austerity measures included tax reforms designed to increase Government revenue and measures to cut state expenditures by 15%. The People's Assembly approved a law that abolished duty-free and foreign exchange shops and eliminated the system of paying Government employees with goods instead of cash. Duty on certain items such as cars and alcohol was increased by between 30% and 100%. Tax incentives were offered for certain projects that were deemed necessary for the rebuilding of the infrastructure or training the labor force. In September 1991, the kwanza was devaluated from 29.92 to 60 kwanza's to the dollar, and in November it was devaluated a further 50% to 90 kwanza's to the dollar. A minimum wage of 12,000 kwanzas was set, and the income tax rate was reduced from 40% to 15%.

PRODUCTION

Crude oil production increased during 1991 as major operators proceeded with plans to bring numerous new oilfields into production. Petroleum production in 1991 increased by 5.7% compared with a 4.2% rise in 1990. Diamond production fell for the second consecutive year, apparently because diamond reserves in the area Endiama had been operating were nearing exhaustion. Ironically, this decline in production came as illegal production in the same general area near Cuango skyrocketed. The Minister of Geology and Mines emphasized the need for the Government to engage in exploration for new diamond reserves, an activity that had been neglected for many years primarily because of the civil war.

Clay, granite, marble, and crushed stone were reportedly mined at a number of localities throughout the country, but information on production and mine locations was sparse and unreliable. *(See table 1.)*

TRADE

Petroleum products accounted for about 94% of Angola's export earnings. Diamond exports accounted for most of the rest of the country's exports. Angola also exported minor quantities of coffee and timber. In 1990, the last year these data were available, about 50% of Angola's exports went to the United States. Other recipients of Angolan exports included Brazil, Cuba, France, Portugal, Spain, the United Kingdom, and the U.S.S.R. During 1991, an agreement was signed under which petroleum exports to Portugal would increase by 30%. The Republic of South Africa was also negotiating a barter agreement to receive significant quantities of Angolan fishmeal.

Angola's principal imports were food, clothing, instruments and optical goods, paper, minerals, chemicals, plastics, metals, and electrical and transport equipment. The main suppliers were Brazil, Cuba, France, Portugal, the United States, and the U.S.S.R. For the first time in many years products from the Republic of South Africa were reaching Angola in significant quantities.

STRUCTURE OF THE MINERAL INDUSTRY

During 1991, the Angolan industrial sector, with the significant exception of the petroleum industry, was dominated by state enterprises. In most cases, private foreign oil companies operated on the basis of joint ventures or production-sharing agreements with Sociedade Nacional de Combustiveis de Angola (Sonangol), the state-run oil company. Diamonds were mined by the state-run company, Endiama, which like the petroleum companies, was considered an enclave enterprise. Enclave enterprises were free from most Government oversight and regulation. All other minerals were mined or processed by Government enterprises. Additional state companies were responsible for mineral deposits that were not currently being mined but were potentially valuable. For example, Companhia de Fosfatos de Angola (Fosfang) was accountable for a large phosphate deposit in northwestern Angola. Companhia de Ferro de Angola (Ferrangol) managed the Cassala-Kitunga iron ore deposit near Cassinga and oversaw numerous other iron and manganese prospects.

While the Government moved ahead with plans to privatize many state-run enterprises, the future status of Angola's mining companies was uncertain. Recent agreements between Endiama and De Beers, for example, suggest that the Government intends to retain control of the nation's diamond deposits while contracting out certain aspects of its operations. The Government announced that it intended to modify existing laws to allow private Angolans and foreign companies to own the right to exploit mineral deposits. It was still uncertain if mineral rights would be made salable or in any way transferable. Companies considered by the Government to be strategic public monopolies would remain under state control, but would be made autonomous and decentralized. Nonviable public enterprises would be required to present a program for closing down and liquidating their assets. *(See table 2.)*

COMMODITY REVIEW

Metals

Gold.—Anglo American Corp. Ltd., of the Republic of South Africa, was granted exploration rights for a 25,000-km^2 area in the southwestern part of Angola that was reportedly free of land mines. The company plans to prospect for gold and other precious metals in the area's Precambrian greenstone belt from its base in Namibia.

Gold has reportedly been mined off and on by small-scale operations in seven of Angola's Provinces, mainly from alluvial deposits, quartz veins, and possibly from greenstones.

Iron.—The head of Angola's Geology and Mining Service said that following the signing of the peace agreement, there was an avalanche of inquiries from foreign companies concerning the possible rehabilitation of the Cassinga iron ore mine, which was closed in 1975. Ferrangol, the state iron ore mining

company, produced a very minor quantity of ore in 1988, but has shown no output since. Further exploitation awaits infrastructural renovation and probably a firming of world markets. Nevertheless, Ferrangol has plans to install a 1.1-Mmt/a-capacity concentrator.

Industrial Minerals

Diamond.—In July, Endiama formally reestablished its relationship with De Beers. After 5 years of marketing its own diamond output, Endiama agreed to sell all of its current diamond output from the Cuango area, amounting to about 80% of its total production, through the CSO. In exchange for diamond marketing rights, De Beers would supply Endiama with a $50 million loan to increase placer production in the Cuango area and build and equip a diamond sorting operation in Luanda. De Beers would lend an additional $50 million over 5 years to develop other diamond deposits, including some very large kimberlites in the Lucapa area. To date, all of Angola's diamond production has come from alluvial deposits. Production from the kimberlite deposits was not expected to start until the mid-1990's.

Endiama and Sociedade Portuguesa de Empreendimentos (SPE), the Portuguese state mining company, proceeded with plans to mine and prospect for alluvial diamond in a 700-km^2 area in the Lucapa region.

Brazil's Construtora Norbeto Odebrecht (Odebrecht), under contract with Endiama, proceeded with a very ambitious diamond exploration and mining scheme. Much of De Beers' $50 million loan is being spent on a high-tech, self-sufficient operational headquarters that is being constructed at the remote site of Lussamba, in the Cuango River Valley about 15 km south of Cuango. The "Lussamba Project" will be the center of gravity for all exploration in the region.

Although RST International, a subsidiary of Zambia Consolidated Copper Mines, is still mining diamond in the Cuango area under a contract signed with Endiama in 1986, its operations had almost ground to a halt owing to the exhaustion of its deposits. Endiama and Odebrecht began to establish a new mining area. A deal was closed with the Barlow Equipment Co. of the United Kingdom for the purchase of $26 million worth of mining equipment for the major new alluvial diamond mining operation at Lussamba. It was expected to generate about $1.6 billion worth of diamond over a 7-year period. Van Eckand Lurie (VEL), a Republic of South African company, was also awarded a $500,000 contract by Odebrecht, on behalf of Endiama, for the supply of a modular diamond recovery plant.

Portugal's Sociedade Portuguesa de Investimentos (SPI) and the private Zairian group Saicam began prospecting for diamond in the Cuango River Valley near the Zairian border.

An oversupply of rough diamond and low sales levels were disrupting the world market normally controlled by the CSO. From the end of the Angolan civil war in mid-1991 to mid-1992, more than 50,000 small-scale diamond miners, or garimpéiros, illegally descended on a remote 150-km-long stretch of the Cuango River between Cuango and the Zairian border. This unprecedented surge in illicit mining activity was encouraged by a reversal of a law that had made it illegal for Angolan citizens to hold and trade diamonds. The new ruling was intended to allow the Government to derive some benefit by taxing the sale of diamond already held by Angolans to the central bank. Instead, it encouraged unlicensed small-scale mining and the smuggling of diamond to buyers in Antwerp, Israel, and Republic of South Africa. The situation along the Cuango River had degenerated to where it might be difficult for the Government to regain control. Among the ranks of the illegal diamond diggers and contributing to the extremely dangerous conditions in the digging areas were at least 5,000 heavily armed soldiers who were demobilized following the end of the Angolan civil war in May 1991. The Government remained confident that it could reoccupy the areas being mined illegally from its base being set up in Lussamba. To quickly correct the problem, great emphasis was being placed on finding foreign investors and restructuring the industry.

Widespread illegal mining could damage Angola's chances of becoming a long-term diamond producer. Such small-scale operations concentrate on removing only the highest grade diamonds, leaving behind subeconomic tailings. Low water levels in the Cuango River and its tributaries, caused by the prolonged southern African drought, had assisted the garimpéiros in their search by exposing diamond-rich alluvial gravel. If the trend continues, industry sources estimate that more than $500 million worth of high-quality gem diamond, more than double the value of the country's official production, would be smuggled out of Angola during 1992.

Granite.—A number of new companies and joint ventures were formed to exploit dimension stone in southwestern Angola. Prior to 1975, the area produced significant quantities of high-quality building stone that was referred to as black granite but was probably anorthosite. It was used for building facades and for interior flooring and wall cladding. The last reported production from the area occurred in 1978 when 500 tons of black granite was exported from the port of Namibe to Japan.

Quajja Co. Ltd., a Namibian company, was granted a 70% interest in a 1-year concession to prospect and mine ornamental stone in a 10,800-km^2 area in southwestern Angola. Under the agreement, the Angolan Government would retain a 30% interest in the concession. The company will reportedly pay a 5% royalty on its stone production in addition to a 65% corporate tax.

Angola Granite Ltd. will engage in geological prospecting, mining of ornamental stone, and domestic and international marketing from its base in Lubango. The new joint-venture company was formed in mid-1991 by Roremina Ltd., the Angolan state ornamental stone company, and International Granite Ltd. of Namibia.

The European Investment Bank (EBI) was planning to provide funds to a new company, Angorochas LDA, a joint venture to be formed between Roremina and an as yet unnamed European company. This would be the first EIB financing involving a private European investor in Angola. The funds were to be used to set up a quarry and export black granite to Europe, Japan, and the United States.

Kaolin.—A number of projects were approved at the ninth meeting of the Southern African Development Coordination Conference (SADCC) held in Luanda on May 20, 1991. A project approved at the SADCC Ministers of Mines meeting called for kaolinite exploration at Quihita, near Lubango in the Province of Huíla at a cost of $253,000. The proposed exploration project would take 12 months to complete.

Quartz.—Dunes Ltd., a South African-British group, was reportedly considering a joint-venture contract with Minaquartzo, the Angolan state quartz mining company, to mine high-quality quartz from the Conda-Pocarica Mine. It estimated that an investment of $3 million would be required to restore the quartz deposit to its previous level of production of about 2,000 mt/a. The Conda-Pocarica Mine, near Sumbe in Cuanaza Sul Province, has been closed since 1979, shortly after Minaquartzo was formed to oversee the operation. Angola's product compared favorably with similar high-purity products from Brazil, Madagascar, and Sri Lanka.

Mineral Fuels

As of 1991, the Government had divided Angola's offshore area into 31 petroleum exploration concessions. Of these, 14 were near shore, shallow water concessions defined as being less than 152 m (500 feet) in depth. These occupied a 20- to 50-km-wide strip along the entire Angolan coast. Paralleling the shallow water concessions were 17 deepwater concessions, defined as occupying depths from 152 m to 609 m (500 to 2,000 feet). The shallow water concessions comprised, from north to south, blocks 1 through 13 and the offshore Cabindan Concession. The deepwater concessions were similarly designated blocks 14 through 30. Blocks 1 through 3, occupying the shallow water area between the Zaire River and N'zeto, are, however, labeled anomalously. Block 2 occupied a 120-km stretch about 25 km wide nearest the coast, while blocks 1 and 3 occupied the rest of the shallow water area further offshore.

The Cabindan Concession and blocks 2 and 3 were producing crude oil, while blocks 1, 4, and 5 were under exploration. Block 7 was recently awarded to Elf Aquitaine Angola (Elf), and blocks 6 and 8 were awarded to Conoco Inc. Sonangol was offering blocks 9 through 13 under a similar production-sharing agreement used for the Cabindan Concession and other blocks. Interest in these blocks was high because of geological similarities of the area to the oil-rich Campos Basin in Brazil. Braspetro S.A., the overseas subsidiary of the parastatal Brazilian oil company Petrobras S.A., was negotiating to become the operator in a consortium that would explore block 9. Negotiations were also under way by British Petroleum Exploration Co., Occidental Petroleum Corp., and Petrofina S.A. (Fina) for the north, central, and south onshore areas in Cabinda. Many oil and gas finds were made in this area before Angola's independence, when the area was last explored.

Sonangol recently put up all of the country's 17 virtually unexplored deepwater concessions for bid. Shell was awarded block 16, and Elf secured block 17. Details of license terms were being negotiated with Sonangol, and partners were being discussed. Authorities were in the process of selecting operators for deepwater block 14, offshore Cabinda, and block 15, the northern most deepwater block off the mainland Angolan shore. Contracts for the deepwater tracts would be on production-sharing terms similar to those that Angola used to open up its near-shore blocks 20 years ago. A contractor would be called upon to pay for all exploration expenses, with recovery of these expenses paid for from a "cost oil" share of production from successful finds. The remaining "profit oil" would go largely to the Government, its share starting at 70% and rising to 95% in line with cumulative production. A controversial aspect of the existing agreement has been the price cap that has prevented oil companies from benefiting from oil price rises after an exploration contract is signed. This cap would likely be omitted in consideration of the higher risks of deepwater work.

Elf continued to develop some of its numerous block 3 discoveries. Production was recently established at the Palanca, Pacassa, Bufalo, and Impala Southeast Fields, with oil piped to offshore loading facilities. The Impala and Cobo Fields were under development, and nine more fields were lined up for development during the next 3 to 4 years, raising production to 185,000 bbl/d by 1996 from 161,800 bbl/d in 1991. Two gas condensate fields are not included in current development plans. It is possible that they will be part of a gas injection program later in the 1990's.

During 1991, Chevron concentrated development work on the 3 largest of its 14 active fields, the Takula, Numbi, and Wamba, which together accounted for 70% of the production of the offshore Cabinda Concession. Cabindan production increased to 287,000 bbl/d from 267,000 bbl/d in 1991 owing to the completion of projects in the Wamba and Numbi Fields where more wellhead platforms were installed. Another development project in the Takula Field was scheduled for completion in 1992. Future plans called for the development of the Bomboco and Kokongo Fields by mid-1994. Then the Nemba and Sanha/N'Dola Fields would be developed. A midrange reserve estimate for these new fields was 635 Mbbl and could be expected to produce at a peak of about 164,000 bbl/d by 1998. Chevron Inc. was predicting that its overall production would continue to increase until the mid-1990's.

An international consortium led by Texaco Inc. made a string of new discoveries, including the Bagre, Estrela, and Savelha Fields in the northern part of block 2 and the Morsa and Califate Fields in the southern part of the block. Altogether the consortium hoped to bring 17 new fields onstream during the next 5 years, boosting production to 66,000 bbl/d by 1997 from 46,100 bbl/d in 1991. Braspetro, one of the partners, decided not to participate in the development of these new fields, leaving the other partners in the consortium to renegotiate the license, possibly with new partners. Braspetro planned instead to bring another new find, the Espadarte Field, into production by the end of 1991.

Agip Angola, the operator for block 1, has been testing the feasibility of developing the small Safueiro Field as a satellite of Texaco's Essungo Field in adjoining block 2.

Petrofina SA (Fina) reopened the Cabeca Daad Cobra Field that was sabotaged in 1990. It also planned to reopen the Galinda Field that was shut down in 1984 when rebel attacks destroyed its tank farm. Production from Fina's onshore fields, which averaged 28,965 bbl/d in 1991, was expected to decline. Secondary recovery programs could slow but not reverse the long-term downward trend. Two discoveries in block 4 with combined reserves of about 30 Mbbl, where Ranger Oil Co. had the management services contract together with Sonangol, could be producing about 17,000 bbl/d in 1996.

Reserves

Sonangol reported proven petroleum reserves of about 2,000 Mbbl and estimated resources of about 5,000 Mbbl. Proven natural gas reserves were reported to be almost 60,000 Mm^3. It was estimated that natural gas resources exceeded 140,000 Mm^3.

According to the Government, Angola had proven diamond resources of about 82 million carats in deposits grading a minimum of 0.6 carats/m^3. About two-thirds of these diamonds was in kimberlites as yet unmined. Estimates of the resource base range from 220 to 350 million carats.

The Cassinga iron ore deposit had resources of 100 Mmt, grading more than 63% iron, when it closed in 1975. An additional 1 billion tons of material, grading between 35% and 63% iron, was indicated. Ferrangol also claimed to have extensive iron deposits 70 km northeast of Dondo and a potentially economic manganese deposit about 150 km east of Dondo.

There was reportedly about 10 Mmt of commercial-grade phosphate ore at Kindonacaxa near N'zeto. In a 1981 test, using a 15,000-mt/a pilot plant, it was shown that crushed phosphate produced from the deposit was suitable for domestic consumption. The possibility of using the ore to produce phosphoric acid was still being investigated by Fosfang. The deposit has yet to be exploited on a commercial basis because of war-related transport difficulties. There are also large phosphate deposits at Mongo-Tando, about 45 km north of Cabinda.

Other known resources included natural asphalt, barite, bauxite, beryllium, coal, copper, gold, granite, gypsum, kaolin, lead, marble, mica, quartz, rare earths, sulfur, talc, tungsten, uranium, and zinc.

INFRASTRUCTURE

The basic transportation infrastructure in Angola was developed before independence in 1975. Surface transport infrastructure consisted of three east-west-trending rail-port systems. There was the northern Luanda Railroad, the central Benguela Railroad, and southern Namibe Railroad, as well as a mostly north-south-trending feeder road network. The rail-system consisted of 2,879 km of 1.067-m-gauge and 310 km of 0.600-m-gauge track. Most of the routes were damaged during the civil war, and the railroad's physical assets fell into disrepair or were destroyed. As a result, by 1991, freight shipments had fallen to a small fraction of what they were before Independence. The flow of goods also reversed, with imports currently dominating the freight business. After having been shut down since 1988, irregular freight-traffic on the Benguela Railway between Lobito and Huambo resumed in mid-1991. Most early rehabilitation efforts concentrated on a stretch of track between Lobito and Huambo. By mid-1992, normal passenger traffic resumed from Lobito to Ganda, about halfway to Huambo from the coast. East of Ganda, however, the route was barely passable. The full extent of the damage was yet to be fully accessed but initial surveys showed the damage to be extensive, with at least 75 bridges badly in need of repair.

SADCC failed to obtain international funding for its plan to rehabilitate the entire 1,350 km of track of the Benguela Railroad. While the prospect of restoring the Benguela Railroad to its former status as a major transport link in southern Africa was appealing, representatives from the major international donor organizations felt that the estimated $600 million cost over a period of more than a decade could not be justified. Proponents of the project contended that it would be especially important to Zaire, a leading producer of cobalt and copper. Zaire once transported one-half of its trade on the Benguela line. Detractors felt that by the time the project could be completed, in the late 1990's, the value of exports, including cobalt and coppper mined in Zaire and Zambia, would not justify the cost of reconstruction. When it became apparent that a full-scale rehabilitation project was not an option, SADCC adopted a bare-bones plan focusing on 584 km of track from Lobito to Kuito at an estimated cost of $17 million over 3 years. Work on the rest of the rail line could be undertaken following the completion of this initial phase in 1995. A comprehensive survey, funded by the World Bank, of the work required to fully restore the line began in January 1992.

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

nation's roads would take 30 years to complete.

A Portuguese consortium signed a $11.5 million agreement to repair some of the Angolan railway and port installations damaged during the war. The agreement covered repair work on cargo moving equipment at Luanda and Lobito ports and renovation of the main workshops at Huambo for the Benguela rail line.

The Italian Government was planning to sponsor the construction of a sea terminal in Cabinda Province. It also financed the construction of the Lobito sea terminal, completed in 1986.

The total installed capacity of Angola's electrical supply system was about 506 MW in 1989, the last year for which data were available. Of this total, only 60% was available because much of the system had fallen into disrepair since 1974, when Angola's power generation peaked at 1,029 GW•h. Following Independence, the nation's demand for power fell dramatically, but has since recovered to about 770 GW•h. In 1986, Angola generated 754 GW•h of electricity, 97.6% of which was from hydroelectric plants. More recently, however, Angola's hydroelectric power distribution network had come under increasingly frequent rebel attacks. For example, between 1984 and 1990, rebels destroyed 217 pylons on the powerlines that supply Luanda. As a result, Angola was forced to increasingly rely on more expensive thermal plants. Angola was set to begin rebuilding its power sector with the help of a $33.5 million credit from the International Development Agency. The credit would help Angola create a legal and institutional framework for its electric power sector from which it could proceed to carry out rehabilitation work.

Work on the 110-m-high, 1,120-m-wide Capanda Dam was delayed by financial problems. Work at the dam site 148 km southeast of Luanda began in December 1986 and was originally scheduled for completion during 1991. Plans to bring the first turbine of the associated 520-MW hydroelectric plant on-line in December 1992, followed by three other turbines in 1994, would probably also be delayed. The $920 million project experienced monetary difficulties when the Banco do Brazil canceled $75 million worth of credit because it believed the project's risk was unacceptable. Brazil's Construtora Norbeto Odebrecht was the main contractor for the Capanda scheme. The company was the lead partner in Consortio Capanda, a joint venture also including Technopromoexport of the U.S.S.R. and Furnas Centrais Electricas (FCE) of Brazil. In November 1991, the Standing Commission of the Council of Ministers met to discuss the project's financial problems. It recommended that all agencies responsible for managing the project, as well as foreign enterprises taking part in the project, meet to discuss the project's financial problems while taking into account Angola's limited monetary resources.

OUTLOOK

Petroleum should continue to dominate Angola's economy for the foreseeable future. The stagnating minerals industry can be expected to revive once transportation and security problems are resolved. These improvements will come slowly, however, and at great cost. Recent changes in the Angolan Government's attitude toward free market economics and a move toward multiparty politics may help stabilize the economy. Little investment, however, is likely to occur in the mineral industry until elections in November 1992. If the political situation were then stabilized and appropriate mining policies were firmly established, renewed mineral exploration would follow. Within a few years, new commodities such as gold, iron ore, kaolin, and phosphate rock could be added to Angola's list of export commodities. Even under ideal conditions, however, there would still be substantial infrastructural problems, and a generally weak world market for many of Angola's most promising mineral products such as iron ore and phosphate rock.

The prospect of mining the country's massive kimberlite deposits opened up the potential of Angola becoming one of the world's top diamond producers in terms of both value and volume.

[1]Where necessary, values have been converted from Angolan kwanzas (AK) to U.S. dollars at the rate of AK90=US$1.00.

TABLE 1
ANGOLA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1987	1988	1989	1990	1991
Asphalt and bitumen, natural[e]	metric tons	11,000	13,000	13,000	13,000	13,000
Cement, hydraulic[e]	thousand metric tons	350	1,000	1,000	1,000	1,000
Diamond:[e 3]						
Gem	thousand carats	675	950	1,165	r1,060	899
Industrial	do.	75	50	80	r73	62
Total	do.	750	1,000	1,245	r 41,133	4961
Gas, natural:[e]						
Gross[5]	million cubic meters	r 42,760	r2,790	r 42,820	2,850	2,870
Dry	do.	4455	4512	4427	430	430
Gypsum[e]	metric tons	20,000	57,000	57,000	57,000	57,000
Iron and steel: Steel, crude[e]	do.	10,000	10,000	10,000	10,000	10,000
Natural gas plant liquids, propane and butane[e]	thousand 42-gallon barrels	2,320	2,790	2,480	2,500	2,500
Petroleum:						
Crude	do.	131,190	165,000	167,000	174,000	184,000
Refinery products	do.	9,490	9,855	10,800	11,700	e12,000
Salt[e]	metric tons	60,000	70,000	70,000	70,000	70,000

[e]Estimated. [r]Revised.
[1]Table includes data available through Nov. 27, 1992.
[2]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and crushed stone) presumably is produced for local consumption, but information is inadequate to make reliable estimates of output levels.
[3]Does not include smuggled artisanal production.
[4]Reported figure.
[5]Angola has no natural gas distribution system, most gas is vented except for a small fraction from which natural gas liquids are processed. Propane and butane canisters are filled at the well site. See "Natural gas plant liquids, propane and butane" in table.

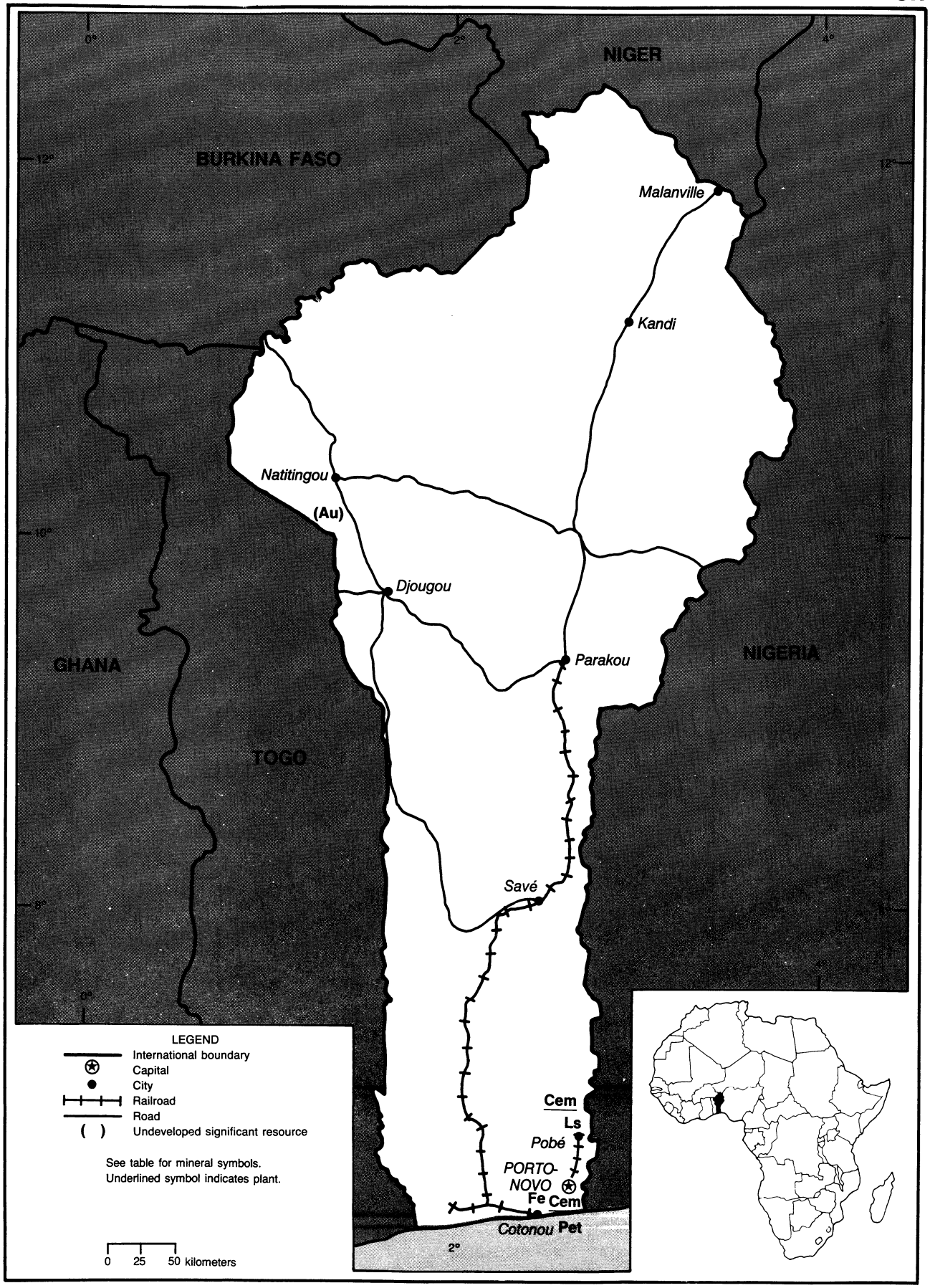
TABLE 2
ANGOLA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

Major commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	thousand metric tons	Empresa de Cimento de Angola (Cimangola) (Empresa Nacional de Cimentos, 55%; Hjgaard Schultz, 45%)	Luanda	700
Do.		Empresa Nacional de Cimento, (Encime) (Government, 100%)	Lobito	200
Diamond	thousand carats	Empresa Nacional dos Diamantes (Endiama) (Government, 100%)	Luanda Norte Province, Kuango and Lucapa areas	e1,300
Petroleum, crude	million barrels	Cabinda Concession [Chevron-operator, United States, 39.2%; Sociedade Nacional de Combustiveis (Sonangol), Angola, 51%; Agip S.p.A., Italy, 9.8%]	Offshore Cabinda	e75
Do.		Block 2 Concession (Texaco-operator, United States, 20%; Sonangol, Angola, 25%; Total CFP, France, 27.5%; Petrobras, Brazil, 27.5%)	Offshore Zaire Province between the Zairian border and N'zeto	e15
Do.		Block 3 Concession [Societe National ELF Aquitaine (Elf)-operator, France, 50%; Mitsubishi, Japan, 25%; Agip S.p.A., Italy, 15%; NA-Naftaplin, Yugoslavia, 5%; Naftagas, Yugoslavia, 5%]	30 kilometers off the coast, near N'zeto	e45
Do.		Block B Concession [Petrofina S.A (Fina)-operator, Belgium, 49%; Sonangol, Angola, 51%; Texaco, United States, 16.4%]	Onshore, about 50 kilometers south of the Zairian border, near the coast	e15
Petroleum, refined	million barrels	Fina Petroleos de Angola (FPA). [Petrofina S.A. (Fina), Belgium, 40%; Government, 60%]	Luanda	12
Iron and steel	thousand metric tons	Siderurgia Nacional (Government, 100%)	do.	30

[e]Estimated.

BENIN

AREA 112,620 km² **POPULATION 4.8 million**



THE MINERAL INDUSTRY OF

BENIN

By Hendrik G. van Oss

Crude petroleum and cement were the dominant mineral commodities produced by Benin in 1991. There was also modest production of steel semimanufactures and of salt. Sales of mineral commodities in 1991 were essentially unchanged from those of 1990 and are estimated to have amounted to about 3% of the country's GDP of about $1.91 billion.[1] The 1991 GDP, too, was essentially unchanged from that of 1990 (revised). Crude petroleum sales were worth almost $23.8 million and made up virtually all of Benin's exports of primary minerals and an estimated 87% of total mineral commodity exports. Cement sales are estimated to have been worth about $28 million, of which only about 2% represented exports. Overall, exports of mineral commodities are estimated to have accounted for 9.5% of Benin's estimated total 1991 exports of $291.4 million. Benin's economy remained dominated by agriculture; about 35% of GDP was from that sector. Approximately 50% of Government revenues continued to be derived from taxes on the legal transshipment of goods to Nigeria; however, smuggled trade with that country remained a problem.

Imports of refined petroleum products amounted to almost $55 million or 11% of Benin's total 1991 goods imports. Except for clinker, imports of which in 1991 were estimated at $6.5 million, Benin's other mineral commodity imports are negligible. Benin relies on electricity imports, all from Ghana, to meet almost 90% of its electricity needs. Electricity imports were estimated at $10 million in 1991.

The Government continued to enact the World Bank structural adjustment program adopted in 1987. This has resulted in a liberalization of the country's investment regulations and, in conjunction with major political changes at yearend 1989, the adoption of a market economy. A major goal of the structural adjustment program is the privatization of state-run industries, especially the country's largest cement company. Investors for this enterprise were sought in 1991. The Office Béninoise des Mines (OBEMINES), under the Ministry of Industry, Mines, and Energy, oversees mineral developments in Benin. Efforts were underway in 1991, with UN assistance, to draft a new mining law.

Output of crude oil was all from the Sèmè Field, about 15 km south of Cotonou. Production in 1991 fell slightly despite the bringing of an eighth well into production in 1990. Recoverable reserves at Sèmè, about 20% of the measured resources, were reported by the Government to be about 41 Mbbl, of which 25 Mbbl is condensate. Onshore exploration rights covering about 4,350 km^2 in southern Benin were controlled by Trilogy Resources Corp. of Canada. Trilogy conducted a 100-line-km seismic survey of the ground in the first half of 1991. The company had an option to drill an exploration well in 1992 and was seeking financing for this and additional wells in 1993. Offshore exploration rights covering 2,960 km^2 were held by a joint venture between International Petroleum Corp. of Canada and Hardy Oil and Gas Co. of the United Kingdom. A seismic survey was conducted to follow up work done in 1990 on the reprocessing and reinterpretation of about 500-line-km of existing seismic data. The venture had a commitment to drill an exploration well in 1992.

Benin's three cement plants continued to operate well below capacity during the year. The largest, Société des Ciments d'Onigbolo (SCO), is a joint venture largely between the Governments of Benin and Nigeria and is the only integrated plant in the country. The plant, far larger than can be accommodated by the domestic market, was constructed to sell into the much larger Nigerian market. Reportedly, the plant has never produced in excess of 200,000 mt/a, and cement sales to Nigeria have been minor. As a result, the plant has competed on the Benin market to a larger degree than had been anticipated, and this has hurt the cement sales of the country's other two mills. These other cement mills import their clinker, despite below-capacity utilization by SCO of its own calcining facilities. The two clinker-grinding plants were recently privatized, but the Government continued to have trouble finding buyers for its share in SCO, largely because of the joint ownership with the Government of Nigeria. SCO controls limestone reserves reported by the Government to be adequate for at least 100 years of operation of the cement mill at full capacity. *(See tables 1 and 2.)*

A small steel mill was operated by Société Béninoise de Siderurgie. The mill, which remelts scrap steel to produce rebar, wire, and roofing iron, was inaugurated in 1989. Original capacity was in two production lines of 4,000-mt/a and 7,000-mt/a capacity, respectively.

Benin has the potential for the development of significant additional reserves of oil and of natural gas. The country has large reserves of limestone near the cement facility at Onigbolo, north of Cotonou. A number of gold occurrences are known in Precambrian terrane in northwest Benin. None of the known occurrences is large, but there may be potential for the development of small-scale gold mining in that region.

Benin has deposits of brick and china clay near the Nigerian border; development of the clay deposits would likely depend on market conditions in Nigeria.

[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF282.11=US$1.00.

OTIIER SOURCES OF INFORMATION

Office Béninoise des Mines
P.O. Box 363
Cotonou, Benin
Telephone: 229-31-29-24;
229-31-35-95
Fax: 229-30-11-38

TABLE 1
BENIN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1987	1988	1989	1990e	1991e
Cement, hydraulic e	300,000	200,000	250,000	275,000	275,000
Iron and steel: Steel, crude e	—	—	2,000	8,000	8,000
Petroleum, crude thousand 42-gallon barrels	2,555	1,825	1,460	r 3 1,416	3 1,353
Salt, marine e	100	100	100	100	100

eEstimated. rRevised.
[1]Includes data available through Jan. 20, 1992.
[2]In addition to the commodities listed, unreported quantities of stone and sand and gravel are believed to be produced, but information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

TABLE 2
BENIN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

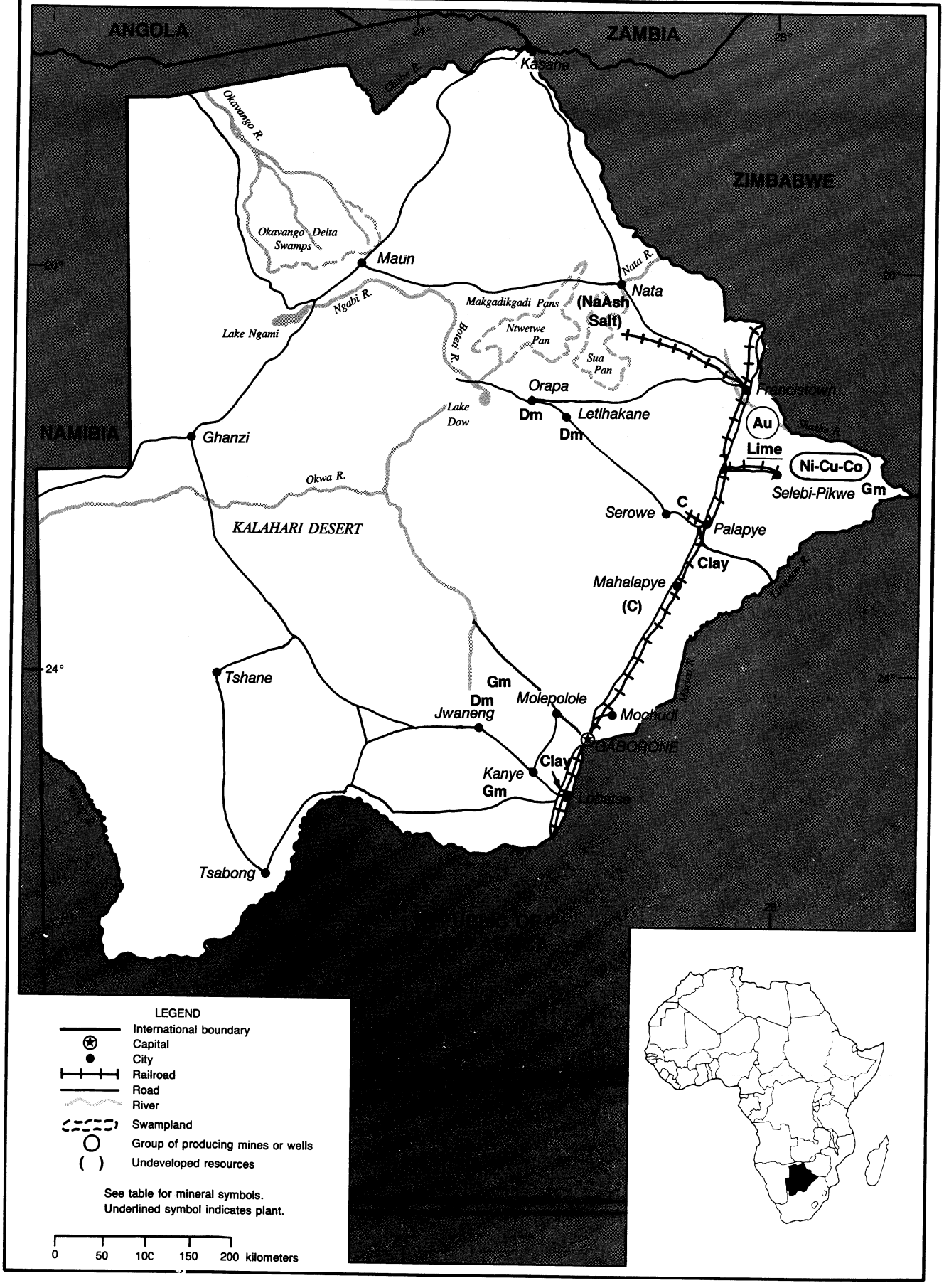
(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	CIMBENIN (private)	Clinker-grinding plant near Cotonou	200,000 cement.
Do.	Société des Ciments du Bénin (private)	do.	150,000 cement.
Do.	Société des Ciments d'Onigbolo (Government of Benin, 51%; Government of Nigeria, 43%; other, 6%)	Integrated cement plant and limestone quarry about 80 kilometers north of Porto Novo	500,000 cement.
Petroleum, crude thousand barrels	Williams Bros. Engineering Co. of United States (field owned by Government, 100%)	Sigma Field, 15 kilometers offshore Cotonou	1,460.
Salt, marine	Artisanal producers only	Various coastal sites	NA.
Steel	Société Béninoise de Siderurgie (private American investor)	Remelting plant in Cotonou	14,000 rebar and roofing iron.

NA Not available.

BOTSWANA

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



THE MINERAL INDUSTRY OF

BOTSWANA

By Lloyd E. Antonides

Minerals completely dominated the economy of Botswana in 1991, as was the case for more than a decade. Primarily because of diamonds, of which it is the world's leading producer by value, the country enjoyed the benefits of a high per capita GDP and a surplus in balance of payments. Nickel and copper also played a significant though smaller role in the economy. Mining and mineral commodities provided about 60% of Government revenue, more than 50% of a GDP estimated at more than $3 billion,[1] and almost 90% of almost $2 billion exports. Yet mining employed less than 10% of the working population as compared to agriculture's 80%.

Botswana's mineral resources remained largely unexplored. Principal areas of interest for metals were said to be: the northeast for copper, nickel, and precious metals; the northwest for copper and silver; and the south for base and precious metals. Many areas with potential for precious stones were open to prospecting, and other industrial mineral deposits were available for leasing. Huge coal reserves were also known in the east and central regions, and a petroleum potential in the west remained to be explored. However, in general, there were infrastructure restraints on exploration, particularly road access and water supply, and especially in the west. Another restraint in the western half of the country was the frequently thick cover of Kalahari Desert sand. Some companies also reported that a shortage of sufficiently capable local and expatriate employees was restraining their exploration efforts.

GOVERNMENT POLICIES AND PROGRAMS

A stable political environment and the Government's flexibility and fairness in dealing with mineral investors provided a basis for continued confidence in Botswana's mining industry according to a representative of the Department of Mines.

Private-sector growth and job creation, especially in manufacturing and agriculture, were emphasized as development objectives by the Government. It recognized and actively promoted the existence of a very attractive mineral potential. At the same time there was a desire for diversification away from the economy's heavy dependence on diamonds.

Botswana encouraged foreign investment. There were no restrictions on reinvestments or repatriation of earnings and capital, and exchange controls were liberal. Botswana had 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.

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. Planned infrastructure improvements were being implemented in transportation, power, communication, and water supply. Also, increased availability of capital was expected from the expansion of Botswana Development Corp.'s role. Being especially aware of the adverse impact that lack of infrastructure had on potential mineral projects, the Government stated its willingness to assist on securing funding for such work.

The Ministry of Mineral Resources and Water Affairs had responsibility for the mining sector. Subunits of the Ministry granted prospecting licenses and negotiated mining leases. 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 a 5% royalty on gold sales.

PRODUCTION

Botswana's dominant mineral commodity, diamonds, declined in carat volume production about 5% in 1991 as compared to that of 1990. *(See table 1.)* But 1990 included recovery of 1.1 million carats of fine diamonds from material mined and stockpiled during 1989 and 1990. The total value of output increased more than 9%. Quantity and value of gold and gemstones produced declined significantly for the second year. Although several gold operations closed down in 1991, a new gold operation started late in the year. It was expected to boost the country's current gold production by several times. Mine output of nickel-copper-cobalt smelter matte was Botswana's next most valuable mineral commodity after diamond. It showed little change in volume or value but was facing lower sales prices and ore grades together with rising costs. New production of soda ash and salt at Sua Pan began slowly with some difficulties. Late in the year there

also was the startup of a major addition to brick and tile clay production. Construction stone and sand also had significant increases in output due to a construction boom.

TRADE

Exports continued to be mainly mineral commodities. Of total export value, almost 80% was diamonds. Nickel, copper, and cobalt content in smelter matte normally made up more than 10% of total export value. Europe usually was the principal final destination of exports.

Early in 1992, reports indicated that for 1991 diamonds earned about $1.5 billion, which was 12% more in pula or 4% more in U.S. dollars as compared to that of 1990. Export earnings from diamonds in 1990 were 1% lower than those in 1989. This had been of considerable concern to the Government because it was in such sharp contrast to the 40% average annual increase in the previous 7 years, according to the Bank of Botswana. And although nickel-coper-cobalt in matte earned only $124 million, about 10% less in dollars, values of total mineral exports and of total exports were higher than those in 1990.

Imports were mostly foodstuffs followed by manufactured goods and petroleum products. Zimbabwe was a major source of food.

For 1990, the latest data available, total exports were $1.768 billion f.o.b., and total imports were almost the same, $1.769 billion c.i.f.

Botswana continued to be a member of the South African Customs Union, which includes Lesotho, Namibia, the Republic of South Africa, and Swaziland.

STRUCTURE OF THE MINERAL INDUSTRY

The Government and Anglo American Corp. of South Africa Ltd. (AAC) were very significant participants in Botswana's mineral industry. *(See table 2.)* Although the Government had the right to negotiate a free grant of a 15% to 25% equity in ventures when issuing mining leases, it often ended up with more. It held only a 15% share of BCL Ltd. (BCL), the major nickel-copper-cobalt producer. It also held 15% of Shase Mines Ltd., owner of a mining lease on the closed Map Nora gold mine near Francistown. This had been expected to be the country's largest gold producer when opened in 1989 by the 85%-owner, Phelps Dodge (Africa) (Pty.) Ltd. However, the Government directly owned 50% of the diamond company, Debswana Diamond Co. (Debswana), plus a small additional interest resulting from an agreement in 1987 when Debswana was apparently given a 5% share of the other 50% owner, De Beers Consolidated Mines Ltd. (De Beers). The 1987 agreement also gave Debswana two seats on De Beers' board of directors, with the Government gaining the right to make the appointments. Later the seats additionally applied to De Beers Centenary AG, a unit formed during restructuring by De Beers in 1990 and to which De Beers tranferred its ownership of Debswana.

In Soda Ash Botswana (Pty.) Ltd. (SAB), the Government had a 48% equity share. But a substantial portion was actually a financial investment and it was searching for a buyer of at least a portion of its share.

The Botswana Development Corp. (BDC), a Government agency, also provided funding and guidance to small, nascent private enterprises. It was seeking to expand its role in mining.

AAC had substantial, financially beneficial interests and often controlling or management interests in all the principal Botswana mining operations. As a point of interest, according to an analysis released early in 1992,[2] in 1990 AAC controlled the largest share of the total value of nonfuel minerals produced in the entire Western World, as compared to any other company or Government. The share, estimated at 8.5%, was almost double the next largest.

In Botswana, besides its interest in SAB and BCL, AAC in 1991 acquired a 51% share of Tati Nickel Mining Co. (TNMC), the only other producer of nickel-copper-cobalt ores. Francistown Mining & Smelting held the remaining interest. BCL was the contract operator of TNMC's mine, Selkirk, about 80 km (mapline) north of Selebi-Phikwe. Started in 1989, it produced about 50,000 mt/a of high-grade ore (about 2% nickel plus 2% copper) that was trucked to BCL's plant for direct smelting on toll.

Several gold operations other than the Map Nora and Monarch Mines had some production during at least part of 1991. Only Shamrock (Pty.) Ltd.'s work on tailings was reported to be very successful. It produced 15 kg of bullion. All the operations were near Francistown.

Some smaller mining ventures were reported to be planning to open mines in the next year. Thakudu Mining (Pty.) Ltd. was to produce copper and silver in the Masitama copper district, about 75 km west-northwest of Francistown. A Falconbridge unit, the original lease holder, transferred the lease to Thakudu in return for a royalty. Thakudu was a subsidiary of a South African mining consulting firm, G.S.E. Mining. Jacomar Manganese (Pty.) Ltd. planned to reopen a mine near Kgwakgwe, about 75 km southwest of Gaborone, and to start shipments of manganese ore to the Republic of South Africa.

The gemstone segment of the industry consisted of many small individual miners but only two licensed dealers and one active company producing polished stones. Agates were the principal product.

More than a dozen rock quarries and several sand and gravel pits operated in various parts of the country.

Total employment in the mining sector in 1991 was more than 13,000. The industry included the country's largest private-sector employers: Debswana with about 6,000 employees, including those in related units doing sorting, cutting, polishing, and other downstream work connected with diamonds; and BCL with more than 5,000 working in nickel-copper-cobalt production. Soda Ash Botswana Ltd. (SAB) employed almost 1,000, which was expected to drop to about 600 after full production was achieved. Morupule Colliery (Pty.) Ltd. employed more than 350. Gold operations had more than 200 workers and the clay mines and rock quarries almost 500.

About 1,000 expatriates were working in the mineral sector. Citizen labor at the major mines, except SAB, was unionized.

COMMODITY REVIEW

Metals

Copper.—Thakudu Mining continued work on developing about 8 Mmt of 3.5% copper ore containing some silver on leases in the Matsitama District. The annual production rate of the plant, planned for solvent extraction/electrowin to conserve acid, was to be 6,000 tons of copper and 2,000 kg of silver. Falconbridge continued exploration further north in the area, including work at the old Bushman Mine.

AAC had a rather extensive prospecting effort under way in the north in an area covered by Kalahari sand. Presumably it was related to the previously known copper mineralization near Lake Ngami, about 600 km northwest of Gaborone. That mineralization was similar to the Zambian copper belt.

Gold.—Several small local companies, mostly working old tailings in the vicinity of Francistown, had difficulties with water shortage, erratic ore occurence, and improper processing methods. Only Shamrock continued to operate throughout the year, reprocessing old tails. A new plant started up at the reopened Monarch Mine in November. The production goal was 300 kg/a of gold from 7,000 mt/month of ore. Falconbridge was reported still hopeful for its Signal Hill prospect southeast of Francistown. Phelps Dodge also continued work in that area, apparently not completely discouraged after having to close its Shashe property a second time in 1991 owing to technical reasons as well as higher costs and lower gold prices than were predicted.

Nickel-Copper-Cobalt.—The European Community and Government of Botswana signed a $26 million loan agreement to support BCL's operations. The goal was to extend the life of the operations and also promote economic diversification of the local area. BCL suffered further deterioration of its financial position in 1991 owing to declining metal prices and ore grades, and increasing costs. Access to higher grade ores and deeper ores, improved ventilation, and access to ore at Selebi North were the objectives of major work at the Selebi-Phikwe mining operations. Selebi North began producing in June. Repairs and improvements to electrostatic precipitators were accomplished at the smelter. The Falconbridge refinery in Norway received 29,101 tons of metal in matte, and 9,587 tons went to Zimbabwe for refining.

The Phoenix Mine of TNMC, 15 km north of its Selkirk Mine being operated by BCL, was the subject of a feasibility study completed in 1991. Subsequent negotiations with the Government on some tax incentives that would encourage further tests apparently were successful. In March 1992, a South African company, Basil Read Mining, was awarded a contract for delivering 154,000 tons of nickel-copper ore for metallurgical testing. For that sample, the resultant open pit would be 40 m deep and have required stripping 1.1 Mmt of overburden.

Platinum-Group Metals.—Local units of Goldfields of South Africa Ltd. and Inco Ltd. were to participate in exploration for platinum-group metals in southeastern Botswana. Each separately agreed with a subsidiary of Molopo Australia Ltd. to investigate certain of Molopo's licensed areas. Inco was actually entering phase 2 of a joint program started earlier. Goldfields reportedly also held licensed properties of its own in the vicinity. Grades of 1 g/mt of combined platinum-group metals were reported previously. Latest work indicated the area was not an extension of rocks similar to the nearby Bushveld Complex in the Republic of South Africa.

Industrial Minerals

Cement.—BDC was said to have contracted for a feasibility study and to be searching for a foreign, technical, 30% partner on a new cement plant. Presumably this was the 250,000-mt/a plant mentioned in 1990, to be at Morupule and to use up to 25% fly ash from the nearby powerplant.

Clays.—The Lobatse brick plant began operations in November. It was a joint venture of Interkiln Corp. of the United States and the BDC. Source material was the Woodhall clay deposit at Lobatse, about 70 km south-southwest of Gaborone. Plant capacity was in excess of 24 million bricks per year.

Makoro Brick and Tile (Pty.) Ltd. started production in 1989 from a clay deposit about 250 km north-northeast of Gaborone and produced 8 million bricks in 1991.

Diamond.—A number of companies were active in prospecting for diamonds, mostly in the central and southern regions. Among them was Gold Fields Botswana (Pty.) Ltd. It planned to finance some diamond exploration on kimberlite prospects held by a Molopo Australia Ltd. subsidiary. The property was southwest of Jwaneng.

Debswana's Jwaneng Mine produced 9.437 M carats from treating 6.016 Mmt of ore and stripping 13.475 Mmt of overburden. The Jwaneng recrush plant for processing main plant tails started up in July 1990 and reached full capacity about midyear 1991, but diamond output was less than expected. Therefore, higher grade ore was mined that more than offset the deficit. A grease plant was commissioned that increased recovery of fine diamonds over the previous X-ray process. Water consumption for the year was 6.0 Mm^3.

Orapa's output was 6.105 M carats from 7.357 Mmt treated and Letlhakane's was 0.964 M carats from 2.942 Mmt treated. Waste stripped totaled 8.362 Mmt. At Orapa, 1.836 Mmt of untreatable ore was stockpiled. Pit bottoms were approaching 120 m below the surface. Water consumption in 1991 was 5.01 Mm^3. Orapa's metallurgical test plant, started up in 1989, continued to perform primary liberation tests.

A new cutting and polishing factory to be established at Serowe, about 270 km north-northeast of Gaborone, was agreed upon by the Government and other Debswana principals in October 1990. It was organized as the Teemane Manufacturing Co. (Pty.) Ltd. Ownership and funding were apparently shared by the Government as a 50% owner of Debswana. Construction of the building and training of personnel began in 1991. It was expected to open late in 1992 and eventually have 500 employees.

Lazare Kaplan International Inc. was also preparing to open a cutting-polishing facility. Located at Molepolole, 50 km north of Gaborone, it was licensed in 1990 and was scheduled to open in early 1993.

A sales agreement between Debswana and the Central Selling Organization was renewed in November to run to yearend 1995. Apparently it provided for a number of new arrangements. The company name changed from De Beers Botswana Mining Co. to Debswana Diamond Co., and its own separate head office was established in Gaborone. A new chief executive was selected who was formerly a Government official and a De Beers board appointee. Studies aimed at increasing throughput at Jwaneng by 33% were initiated.

Soda Ash.—SAB was reported to have encountered technical problems, in brine supply as well as mechanical and electrical areas, in bringing its soda ash (sodium carbonate) plant up to capacity. Soda ash production started at the end of March 1991, but only at yearend did rates begin to climb. Apparently, additional capital investment was required. The first coarse washed salt was produced in July but the rate of deposition was slower than planned and the thin salt floors could not support harvesting equipment.

Mineral Fuels

Coal.—Morupule Colliery was certified at the beginning of the year to have a capacity of 1 Mmt/a, as compared with its previous capacity of 800,000 mt/a. A major part of the increase was needed to meet the needs of SAB.

The 250,000-MW electric generating project for export power, considered for location at a mine in the Mmamabula Coalfield about 140 km north-northeast of Gaborone, continued to be studied. A Bechtel unit completed a prefeasibility study. A comparison with the Kgaswe Field west of Morupule, studied by Shell Oil in the early 1980's, was being considered.

Early in 1992 Amoco Oil was investigating the possibility of extracting methane from Botswana coalbeds.

Reserves

Coal reserves considered proven and indicated were estimated at 17 billion tons. Diamond reserves were reported by the Government to be equivalent to 20 years of current production or about 300 M carats. Nickel-copper ore reserves as of the end of 1991 were stated by BCL as 95 Mmt at 0.68% nickel and 0.71% copper. Soda ash reserves are stated as being sufficient for 1,000 years at current plant capacity.

INFRASTRUCTURE

Transportation facilities, both highway and railroad, were fairly adequate in the eastern fringe of the country. To the northeast the main routes entered Zimbabwe. To the south the main routes led into the Republic of South Africa. A main highway ran northwest across the country from Francistown in the northeast to Zambia on the north. The main north-south rail line of Botswana Railways had a new 165-km spur completed in 1991, running northwesterly from Francistown to Sua Pan. Its cost was $45 million. Construction was by an Italian firm. Work continued on improving roads to and in the western regions. A road west to Namibia across the Kalahari Desert was started.

Electric generating capacity of the Botswana Power Corp. was more than ample for the demand although cost to consumers was considered relatively high. The Morupule coal-fired plant had a capacity of 132 MW. A station at Selebi-Phikwe was rated at 60 MW. About 15 MW of this capacity used waste steam from BCL, and the balance was coal-fired. SAB had a 22-MW generating plant using steam from its coal-fired boilers needed for producing soda ash. However, about 6% of Botswana's electricity needs were imported from the Republic of South Africa at relatively lower cost. Some electric power was exported to Zimbabwe. Concessionary rates were extended to BCL to maintain mining operations. About two-thirds of BPC's sales was to the mining industry, of which two-thirds went to BCL and one-third to Debswana.

Main airports were at Gaborone, Francistown, Selebi-Phikwe, and Maun. Air Botswana was the major airline. Charter companies provided service in and out of the Gaborone hub.

Telecommunications were considered very good and expanding.

Water availability was a major issue in Botswana even though perennial rivers were along most of the southern and eastern borders and on the north. The mining sector used both mine water and drilled wells for its water needs. A number of studies had been made or were under way to assess supply and demand for water.

OUTLOOK

The economic outlook was clouded. At the beginning of 1991 the Bank of Botswana predicted slower economic growth and coincident problems with inflation, balance of payments, Government revenues, and unemployment over the next several years. The basis for the prediction was the leveling off of diamond production and sales. Debswana had announced plans to stabilize diamond output at about 15 m carats per year.

In any case, with such high value and substantial reserves, diamonds were expected to continue to make the minerals sector the dominant factor in Botswana's economy for some time. BCL's nickel-copper-cobalt operations appeared to be facing some difficult economic times. This was due to a combination of existing

debt load and the normal need for reinvestment, as well as lower market prices. But production probably would be continued with some Government concessions to maintain employment.

Continued exploration activity was expected, and this gave promise of new mineral ventures. The basis was Botswana's very high ranking among all developing countries in regard to private-sector exploration interest, according to a 1990 worldwide survey of prominent mining companies.[3] Geologic environment and mineral investment climate were considered. In investment climate alone, considering political and economic factors, Botswana was ranked first in Africa. Nevertheless, consideration of conditions in landlocked Botswana's neighboring countries would probably affect any decision.

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[1]Where necessary, values have been converted from Botswana pula (P) to U.S. dollars at the rate of P2.0725=US$1 for 1991 and P1.8713=US$1 for 1990. These were Bank of Botswana official rates at yearend.

[2]Raw Materials Group RMG AB, Stockholm, Sweden. Who Owns Who in Mining 1992. Roskill Information Services Ltd., London, 1992, 327 pp.

[3]Johnson, C. J. Ranking Countries for Minerals Exploration, Natural Resources Forum, Aug. 1990, pp. 178-186. Butterworth-Heinemann Ltd. Guilford, Surrey, United Kingdom.

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Ministry of Mineral Resources and
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Gaborone, Botswana
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Mines Department
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Geological Survey Department
P.O. Box 0014
Lobatse, Botswana
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TABLE 1

BOTSWANA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991
Coal, bituminous		579,409	612,873	663,045	r794,041	783,873
Cobalt: Smelter output, Co content of matte[3 4]		181	291	r215	r205	208
Copper:						
Mine output, Cu content of ore milled		r27,900	27,300	r24,700	r25,300	24,800
Smelter output, Cu content of matte[3 4]		18,933	24,428	21,709	r20,612	20,576
Diamond:						
Gem and near gem[e]	thousand carats	r9,370	10,660	r10,680	r12,150	11,550
Industrial stones[e]	do.	3,840	r4,570	r4,570	r5,200	4,950
Total[5]	do.	13,208	15,229	15,252	17,352	16,506
Gemstones, semiprecious, rough[6]	kilograms	r40,100	38,600	146,000	r500	205
Gold[e 7]	do.	31	21	66	r45	20
Lime		325	226	—	r55	6
Nickel:						
Mine output, ore milled, gross weight	thousand tons	3,281	3,330	3,338	3,369	3,451
Mine output, Ni content of ore milled		r25,900	r26,000	r23,700	r23,200	23,500
Smelter output, matte, gross weight[3]		43,238	57,530	49,754	r47,959	48,319
Smelter output, Ni content of matte[4]		16,528	22,539	19,759	r19,022	19,294
Salt[8]		—	—	—	—	2,600
Sand, construction[9]	cubic meters	122,203	179,936	147,300	r164,978	340,825
Soda ash, natural[8]		—	—	—	—	62,000
Stone, crushed, not further described	cubic meters	225,362	337,677	458,900	r589,999	783,487

[e]Estimated. [r]Revised.

[1]Table includes data available through Dec. 1, 1992.

[2]In addition to commodities listed, silver (estimated about 2% of output reported as gold bullion) and clay for brick and tile were produced but information was inadequate to reliably estimate output.

[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]Total reported assumed to contain 70% gem and near gem. Detail may not add to total owing to independent rounding.

[6]Sales, principally agates and carnelians. Reported as rough through 1989 and as polished thereafter. Only cut or polished stones could be legally exported after 1989.

[7]Reported bullion less silver content estimated at 2% Ag.

[8]From natural soda ash production commenced June 1991.

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

TABLE 2
BOTSWANA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

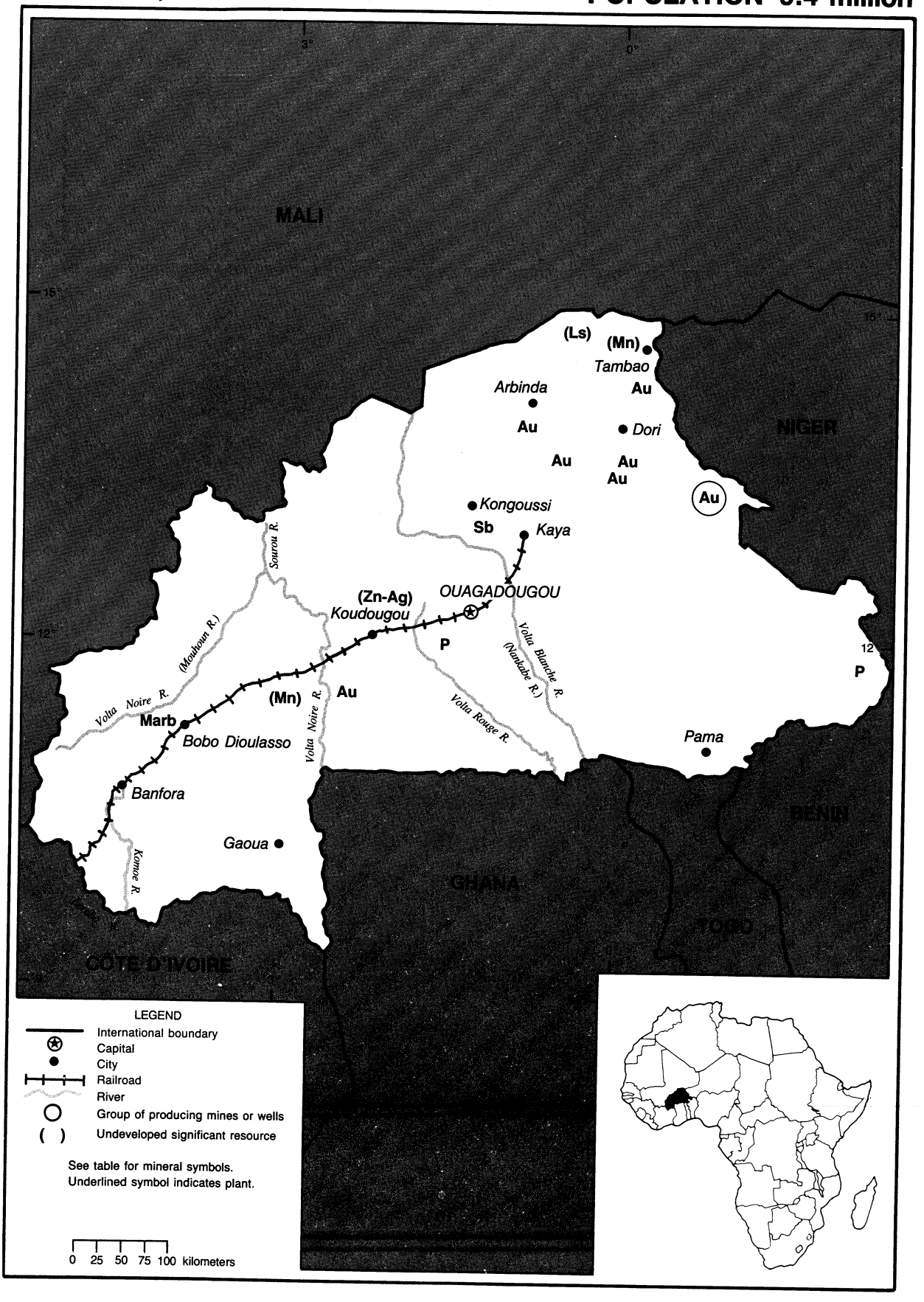
(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Coal		Morupule Colliery (Pty.) Ltd. (Anglo American Corp. of South Africa Ltd. (AAC) and related firms, at least 90%)	Morupule, 270 kilometers north-northeast of Gaborone	1,000,000.
Cobalt		BCL Ltd. (Government, 15%; Botswana RST Ltd., 85%, itself owned by AAC and related firms, at least 20%, and AMAX Inc., 29.8%)	Selebi-Phikwe, 350 kilometers northeast of Gaborone	e300, content of matte.
Copper		BCL Ltd. (Government, 15%; Botswana RST Ltd., 85%)	do.	20,000, content of matte.
Diamond	million carats	Debswana Diamond Co. (Pty.) Ltd. (Government, 50%; De Beers Centenary AG, 50%, itself owned by AAC and related firms, at least 40%.)	Orapa, Letlhakane, and Jwaneng, respectively 375 kilometers north, and 115 kilometers west of Gaborone	e17.5.
Gold	kilograms	Mining and Development (Pty.) Ltd.[1] (NA)	Monarch Mine, just north of Francistown, 420 kilometers north-northeast of Gaborone	300 bullion.[2]
Nickel		BCL Ltd. (Government, 15%; Botswana RST Ltd., 85%)	Selebi-Phikwe, 350 kilometers northeast of Gaborone	22,000, content of matte.
Salt		Soda Ash Botswana (Pty.) Ltd.[3] (Government, 48%; AECI Chlor-Plastics Ltd., 26.5%, itself owned by AAC and related firms, at least 25%, and by Imperial Chemical Industries PLC, at least 20%; AAC, 12.75%; De Beers Centenary AG, 12.75%, itself owned by AAC and related firms, at least 40%)	Sua Pan, 450 kilometers north of Gaborone	650,000.
Soda ash		Soda Ash Botswana (Pty). Ltd.[3] (Government, 48%; AECI Chlor-Plastics Ltd., 26.5%; AAC, 12.75%; De Beers Centenary AG, 12.75%)	do.	300,000.

eEstimated. NA Not available.
[1]Production started Nov. 1991.
[2]Botswana bullion typically had silver content estimated at 2% of output reported.
[3]Production started Mar. 1991.

BURKINA FASO

AREA 274,200 km² **POPULATION 9.4 million**



THE MINERAL INDUSTRY OF

BURKINA FASO

By Hendrik G. van Oss

Burkina Faso's mining sector is dominated by gold, derived from one formal operation and numerous artisanal miners. In recent years, it is estimated that only 40% to 50% of the artisanal gold production has been sold through legal channels; the rest has been smuggled out of the country. Estimates of the value of this smuggled trade vary, but are on the order of $30 million, roughly equal to the value of legal gold sales. Including the estimate of smuggled gold, the total sales value of domestic mineral production appears to have been equivalent to about 2% of Burkina Faso's 1991 GDP of about $3.3 billion.[1] Gold was virtually the only mineral commodity exported in 1991; legal sales accounted for about 8.5% of the country's total exports (of goods and services) of about $365 million, and were second in export importance only to cotton.

Mineral commodity imports are estimated to have amounted to about $110 million, of which petroleum products accounted for about 64%. Cement and fertilizers made up most of the remaining mineral commodity imports. Total 1991 imports of goods and services amounted to almost $870 million.

Formal gold production in 1991 was all from the Poura Mine, southwest of Ouagadougou. The mine was owned and operated by Société de Recherches et d'Exploitation Minières du Burkina, a joint venture of the Government, 60%; the Islamic Development Bank, 20%; and Compagnie Française des Mines, 20%. Following extensive repairs to the mine in 1989, and an almost 50% reduction in staff to about 1,000 workers, the mine output increased somewhat to 1,164 kg/a (fine gold) in 1990 and 1,067 kg in 1991. The operation was reported to be in debt. Reserves at yearend 1989 for Poura were listed by the Government as 1.4 Mmt grading 7.6 g/mt. In line with the general World Bank structural adjustment program adopted in March 1991, the Government was seeking to sell its share of the mine. Total artisanal output of gold in Burkina Faso is estimated to have declined significantly in 1991, largely owing to the exhaustion of much of the easily accessible surface ore. Artisanal and semi-industrial sales of gold to the Government fell 33% in 1991. Gold exploration was ongoing during the year in several parts of the country. *(See table 1.)*

Besides gold, the country's most significant mineral resources are the unexploited Perkoa zinc and Tambao manganese deposits. Boliden International Mining of Sweden was working to bring into production by 1994 or 1995 the Perkoa massive sulfide deposit north of Koudougou. Reserves were believed adequate for 10 to 12 years of production, with output averaging at least 130,000 mt/a of concentrate grading 55% zinc and 170 g/mt silver. Boliden continued to study the problem of ore transport; the nearby Ouagadougou-Abidjan (Côte d'Ivoire) railroad is in poor condition.

In August, the Government announced that it had signed an agreement with InterStar Mining Group of Canada to develop the Tambao manganese deposit in the extreme northern part of the country. Tambao has a potentially economic resource of about 15 Mmt grading 51% manganese; the ore, however, is rather high in phosphorus (0.15% P). The main hindrance to development of the deposit is the lack of infrastructure, the nearest railhead being at Kaya, about 250 km away. InterStar was studying various

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

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991
Gold[3]	kilograms	7,000	9,300	7,600	5,300	5,300
Phosphate rock	thousand metric tons	3	3	3	3	3
Pumice and related volcanic materials	metric tons	10,000	10,000	10,000	10,000	10,000
Salt	do.	6,500	6,500	6,500	6,500	6,500
Stone: Marble	thousand metric tons	100	100	100	100	100

[1]Includes data available through May 8, 1992.
[2]In addition to the commodities listed, Burkina Faso produced clay, and sand and gravel for local constructional uses. There has been a small, erratic output of antimony from one operation since 1980. Information is inadequate to make reliable estimates of output levels.
[3]Estimate based on reported formal and legal artisanal production and estimated smuggled artisanal output.

transportation options, and indicated that it would begin trial operations, at a rate of about 75,000 Mmt/a, in 1993.

[1]Where necessary, values for Burkina Faso have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF282.11=US$1.00.

OTHER SOURCES OF INFORMATION

Bureau des Mines et de la Géologie du
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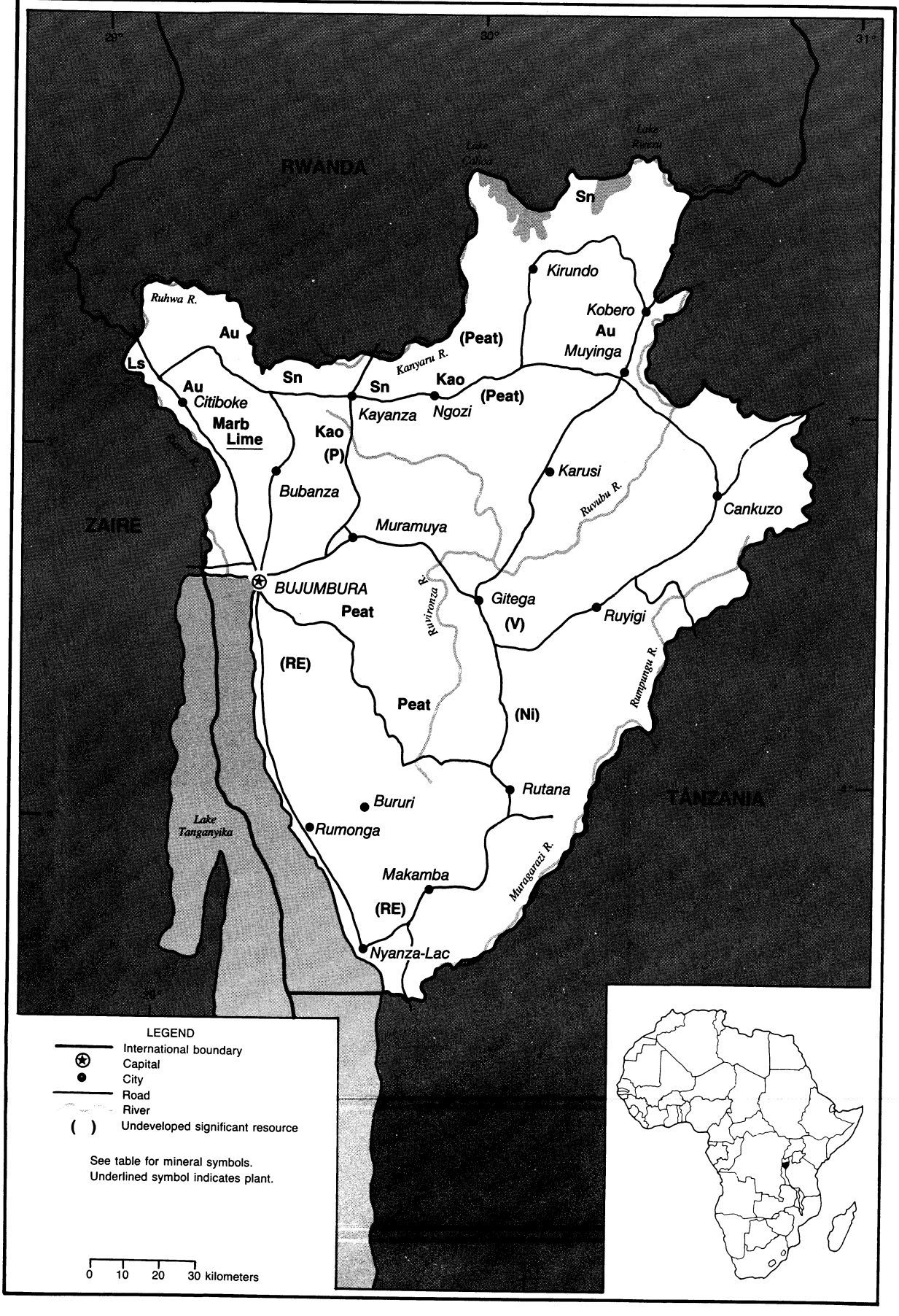
BURUNDI

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



THE MINERAL INDUSTRY OF

BURUNDI

By Lloyd E. Antonides

Although in even the best past years minerals contributed less than 1% to Burundi's GDP, the potential for a much larger role continued to be an important focus of the Government in 1991.

A round table on the development of the mining sector was held in November. It was organized by the Ministry for Energy and Mines in collaboration with UN agencies. The 2-day session in Bujumbura outlined the geology and main mineral deposits and reviewed infrastructure and Government policies, regulations, and services offered. Subsequently, there were 2 days of visits to the most significant deposits. Among these were deposits of gold, kaolin (china clay), limestone for cement, nickel, phosphate, platinum-group metals, rare-earth metals, and vanadium. Round table papers were published and made available by the Ministry.

Phosphate production feasibility was being studied in detail by Mackay and Schnellmann Ltd. (United Kingdom) under a contract with the Ministry and the African Development Bank. Completion was scheduled for early in 1992. The study considered apatite mineralization associated with the Matongo carbonatite deposit, about 45 km northeast of Bujumbura. The deposit was to be further core drilled and samples subjected to beneficiation tests.

Gold mining in the northeast was the subject of a multiphase project on which proposals were invited by the Director-General of Geology and Mines about midyear. An award was expected early in 1992. Further details were not known. Field work in that general area was started by Burundi Mining Co.(Buminco) in 1989. That company was originally announced as being 25% Government-funded with major financing by Middle Eastern investors. The latter suspended further funding after the Gulf Crisis started. But apparently the Government continued to fund the work.

Nickel laterite, especially the Musongati deposit about 90 km southeast of Bujumbura, reportedly was the center of interest in negotiations on a mining concession between the Government and at least one large mining company. Discussions apparently started late in the year and were continuing early in 1992. Early in 1991 the Government was looking for financing of a final feasibility study estimated to cost about $5 million.[1]

The pace of mineral industry activity seemed to be picking up in 1991 and, if maintained, should eventually result in increased production. Additional small, simple operations by local businessmen might start the growth. But to achieve any significant mineral output will probably require attracting foreign participation and a few years of effort. Shortages of trained personnel and difficult export routes will remain obstacles.

[1]Where necessary, values have been converted from Burundi francs (BF) to U.S. dollars at the rate of BF181.51=US$1 in 1991.

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Agencies

General Directorate of Geology and Mines
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Natural Resources and Energy Division, United Nations
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Fax: 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 1

BURUNDI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1987	1988	1989	1990	1991
Clays: Kaolin	5,290	4,021	4,305	5,281	6,682
Gold[3] kilograms	26	14	18	9	25
Lime	137	96	202	188	86
Peat	17,000	17,589	14,200	11,984	10,026
Tin, mine output, ore (e/60% SnO_2):					
Gross weight	5	50	106	r e115	124
Sn content e	2	24	50	54	74

eEstimated. rRevised.

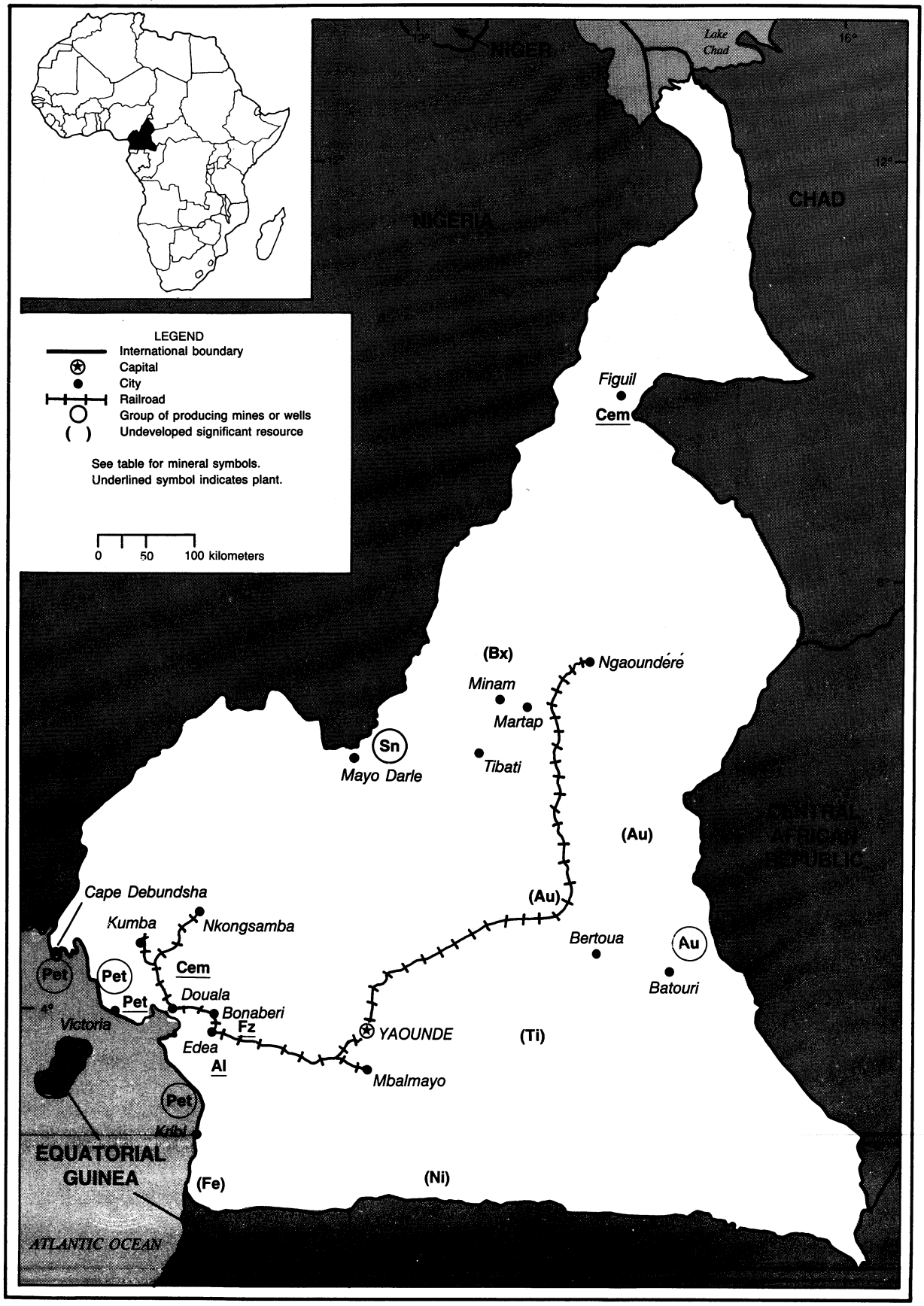
[1]Includes data available through July 1, 1992.

[2]In addition to commodities listed, crushed stone and presumably other crude construction materials (clays, sand and gravel, et al.) are produced, but information is inadequate for making reliable estimates of output levels.

[3]Some additional gold production, mostly in the northwest, was illegally exported and not officially recorded; but information is inadequate for reliably estimating such output. This unrecorded production was reported to be substantial in 1990 especially but the 1991 production reported is considered realistic.

CAMEROON

AREA 475,440 km² **POPULATION 11.4 million**



THE MINERAL INDUSTRY OF

CAMEROON

By Thomas P. Dolley

The Republic of Cameroon's sagging economy was buoyed to a limited extent by higher global petroleum prices in 1991, owing to the Persian Gulf War. During the year, petroleum production and export continued to dominate the mineral industry of Cameroon. Since May 1989, in the face of declining production and reserves of crude petroleum, the Government has offered tax and royalty incentives toward foreign petroleum operators. These measures have met with some success in 1991 and early 1992.

Cameroon's crude oil revenues stood at $789,944,000 in 1987 and dropped to $601,862,000 in 1989. Increased global petroleum prices have caused petroleum industry analysts to estimate that revenues from the Cameroonian petroleum sector would reach $1 billion in 1991.[1]

Declines in nonpetroleum income were attributed to heightened tax evasion and smuggling. Cameroon's external debt is estimated at $5 billion. The estimated GDP for 1991 was $12.4 billion.

GOVERNMENT POLICIES AND PROGRAMS

Cameroon gained independence from France on January 1, 1960. The legal system of Cameroon is, therefore, based on 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.

By yearend 1991, the revised troleum code was successful in racting foreign operators to Cameroon's petroleum arena. In May 1990, the decree regulating oil companies was altered by the Government's Ministry of Mines, Water Resources and Power. The changes in the law were to allow foreign petroleum exploration companies greater operational freedom, thus stimulating increased investment in Cameroon's oil exploration sector. Formerly, the law provided for production-sharing guidelines stipulating 30% of the output to the foreign operator and 70% of the output to Cameroon's Société Nationale des Hydrocarbures (SNH). Additionally, the Government took 87% of net profits in the form of fees and taxes. However, the new agreements mandate that reimbursable exploration and production costs rise from 20% to 30%. Guaranteed aftertax mining allowances also rise from 22% to 33%. Crude petroleum reserved for SNH has also been reduced to 60%.

As a prerequisite for further financial aid from the International Monetary Fund, a Structural Adjustment Program (SAP) was implemented by the Government. The SAP has had a limited effect on the economy. However, the SAP is implementing such measures as privitization of parastatals, curbing salary increases, cutting various subsidies, and restructuring the public sector. The economic retrenchments that the SAP has caused have led to popular discontent and demonstrations. Meanwhile, the Government attempted to attract foreign financial assistance and formulate a more democratic government.

PRODUCTION

The primary mineral commodities produced in Cameroon were crude petroleum, aluminum metal, and tin ore and concentrate. Cameroon's production of tin is not significant on a global scale, but tin has been mined in modest amounts since 1933. Additionally, limestone is quarried for use in the cement industry.

Due to financial difficulties, the Government's Ministry of Plan and Regional Development has along with the Ministry of Mines, Water Resources, and Power, been unable to provide comprehensive statistics on mineral production. *(See table 1.)*

TRADE

Generally, crude petroleum accounts for approximately 50% of Cameroon's exports and most of the nation's foreign exchange. Conversely, an estimated 60% of imported goods is brought into Cameroon without payment of customs duties, in violation of the existing laws.

The Ministry of Trade and Industry reported that revenues from the Port of Douala dropped from $89.3 million in 1985 to $36.5 million in 1990, the last year for which data were available. However, there was no concomitant drop in port traffic.

Cameroon imported 12,216 tons of cement in 1991, valued at about $1.2 million, according to the Department of Statistics and National Accounts. Cameroonian exports of cement were 39,470 tons in 1991, valued at $3.1 million. Cameroon did not trade in pozzolana or building stone in 1991.

STRUCTURE OF THE MINERAL INDUSTRY

The primary mining organization in Cameroon is the Government's Ministry of Mines, Water Resources and Power. The Government actively promotes

investment in the mining sector, and foreign operators are usually involved in joint ventures with Cameroonian partners.

SNH is the state-owned company involved in hydrocarbon exploitation. SNH consults with the Ministry of Mines, Water Resources and Power in the awarding of exploration permits and production concessions. 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. *(See table 2.)*

COMMODITY REVIEW

Metals

Aluminum.—By June 1992, Kaiser Aluminum of the United States was expressing interest in building a $1 billion aluminum plant in Cameroon. The proposed plant would have a bauxite treating capacity of 250 kmt/a, making it one of the largest in Africa. Additionally, the plant would be built in an area set aside as a free trade zone. Electrical power for the facility would necessitate the construction of a dam. The bauxite resource that would be exploited to feed the plant would probably be Minim-Martap. Bureau de Recherches Géologiques et Minières (BRGM) of France and Société des Bauxites du Caméroun (Sebacam) had previously surveyed the Minim-Martap deposits in the 1960's. Reserve estimates were 1 billion tons of ore grading 43% alumina and 3.4% silica.

The existing aluminum smelter at Edea is managed by Alucam and has a production capacity of 85 kmt/a. Alucam's equity ownership is by Pechiney of France (58%) and the Government (42%). The plant utilizes alumina imported from Guinea.

Gold.—The Ministry of Mines, Water Resources and Power has estimated its gold production in the past, due to its dominant position in the trade of this mineral. However, Cameroon's gold production and trade is insignificant on a world scale. Since 1989, the Ministry of Mines has been unable to monitor gold transactions or purchase gold because of financial difficulties. Therefore, in the past 3 years, no reliable statistics exist for gold production in Cameroon.

Titanium.—The parastatal Société d'Etudes de Rutile d'Akonolinga (Serak) was created as a joint venture between the Government and BRGM. Serak's mission was to determine the feasibility of mining rutile in the Akonolinga region 140 km east of Yaounde. The study determined a resource potential of 300 kmt of rutile in the region. Subsequently, in 1991, Consolidated Rutile Ltd. (CRL) of Australia signed a joint-venture agreement with Serak. Under the terms of the agreement, CRL retains the right to a 40% share in any future development of mineral sands in the area. Reportedly, the deposit can support a 50-kmt/a operation for 10 years. Some industry analysts remain skeptical of this mining plan, owing to the current reserve estimate of 300 kmt for Akonolinga.

Mineral Fuels

Declining petroleum reserves remain a cause for concern in the mineral industry. However, the petroleum industry in Cameroon received a boost during 1991 as a result of international petroleum operators acquiring several exploration and production concessions. Major foreign players in Cameroon included France's Société Nationale Elf Aquitaine (Elf) and Pecten International Co. (Pecten), a subsidiary of Shell Petroleum of the United States. These companies expect to be active in petroleum exploration and development in Cameroon through 1994-95. Additionally, onshore acreage in the Douala Basin is the exploration target of Esso Exploration and Production Five, subsidiaries of Exxon Corp. of the United States.

In 1991, Pecten acquired 16,000 km of three-dimensional seismic data for exploration on its PH 59 tract within the Rio del Rey basin. The Rio del Rey basin is offshore and north of Victoria. Additionally, Elf acquired 7,500 km of three-dimensional seismic data on its PH 48 exploration permit within the Rio del Rey basin. Pecten and Elf are each 25% equity owners, with SNH at 50% on eight exploration permits. Most of these permits are on the offshore Rio del Rey basin. Vigorous exploration continued into 1992 in the Rio del Rey basin. Exploration acreage was also held by these operators in northern Cameroon, near Lake Chad. However, current activity in the Lake Chad area is minimal.

Within the Rio del Rey basin are the producing oilfields of Itindi, Kole, Lipenja, and Mokoko-Abana. Rio del Rey is the most prolific petroleum producer in Cameroon; the major operaters are Pecten and Elf in cooperation with SNH. Their combined production amounted to 135 kbbl/d from six production concessions covering 72,000 hectares. Well into the mid-1990's, the Rio del Rey basin will remain a target for development for foreign operators.

Pecten is producing from 90 wells at the Mokoko-Abana concession. This oilfield went into production and has produced 100 Mbbl of crude oil to date. Reserves are declining however, in spite of secondary recovery efforts. Production from the Mokoko-Abana oilfields and adjacent fields travels through subsea pipelines to permanently anchored offshore storage vessels. These offshore storage vessels are at the Kole and Moudi export terminals. The crude oil is transshipped to market via oceangoing tankers.

In late 1990, Sofregaz, a subsidiary of France's Gaz de France and Beicip of the French Pétrole Institute, was awarded a contract for exploration and development of natural gas resources in Cameroon. The contract will extend into 1993.

Reserves

Cameroon hosts a variety of mineral deposits, but few have been commercially exploited. Cameroon reportedly has large reserves of liquid petroleum gas (LPG) that are relatively untapped. The development of a viable mineral indus

in Cameroon is difficult owing to inadequate infrastructure and lack of electrical power and financial investment.

INFRASTRUCTURE

Cameroon's National Energy Plan is an attempt to prepare for petroleum shortfalls in the future. A pivotal part of this plan is the proposed construction of the Nachtigal Power Station. Hydro-Quebec of Canada has conducted a feasibility study of the project. The project calls for the construction of a 280-MW power station on the Senegal River, north of Yaounde.

Total installed electrical generation capacity is 801 MW. The electrical distribution network is 6,491 km. Railroads total 1,003 km of track, of which 858 km is 1-m-gauge track, with the remainder being 0.6-m-gauge track. Highways total approximately 65,000 km, 50% of which is unpaved. The major seaport is at Douala.

OUTLOOK

The Government must attract foreign investment to forestall becoming a net petroleum importer by 1995. In the short term, this task is particularly daunting given the Government's effort to convert to a more efficient market economy country.

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[1]Where necessary, values have been converted from Communauté Financíere Africaine francs (CFAF) to U.S. dollars at the rate of CFAF282.11 = US$1.00.

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Department of Mines and Geology
B.P. 70
Yaounde, Cameroon

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Ministry of Commerce and Development
B.P. 1004
Yaounde, Cameroon

TABLE 1
CAMEROON: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1987	1988	1989	1990	1991e
Aluminum metal, primary	metric tons	79,008	86,513	91,716	93,284	[3]82,516
Cement, hydraulic	do.	718,869	584,523	614,000	624,229	622,000
Gold, mine output, Au content	kilograms	8	8	8	8	8
Petroleum, crude[e]	thousand 42-gallon barrels	63,500	62,780	[3]58,648	[3]64,605	[3]55,480
Pozzolana	metric tons	128,574	130,490	e130,000	e130,000	130,000
Stone:						
Limestone	do.	42,443	57,369	e57,000	e57,000	57,000
Marble	do.	209	e200	200	200	200
Tin ore and concentrate:						
Gross weight	kilograms	7,685	4,894	4,800	4,300	4,300
Sn content[e]	do.	5,533	3,400	3,400	3,050	3,050

eEstimated.
[1]Includes data available through Mar. 1992.
[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.

TABLE 2
CAMEROON: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

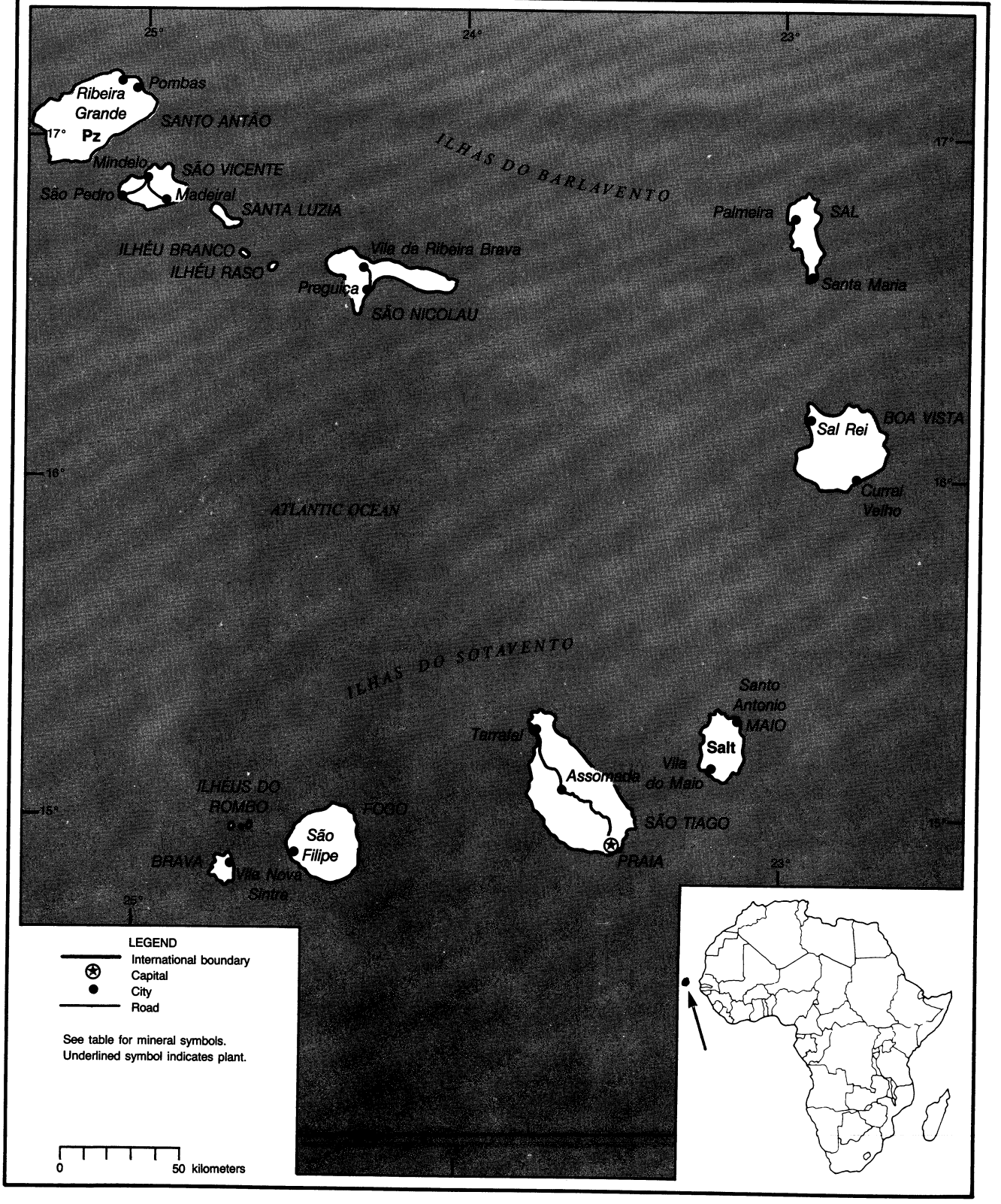
(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum		Compagnie Camerounaise de l'Aluminium (Pechiney, France, 58%; Government, 42%)	Edea, south of Douala	85.
Cement		Société des Cimenteries du Cameroun (Government, 100%)	Bonaberi Figuil	900. 100.
Fertilizer		Société Camerounaise des Engraise (Government, 100%)	Bonaberi	58 ammonium, 36 sulfate, 66 sulfuric acid.
Gold		Artisanal workings	Batouri	NA.
Petroleum, crude	million barrels	Société Nationale des Hydrocarbures (Elf, France, 40%; Government, 35.5%; Pecten, United States, 24.5%)	Rio Del Rey oilfields (offshore and North of Victoria)	49.
Petroleum,	do.	Société Nationale de Raffinage des Hydrocarbures (Government, 66%; Total-Cie., France, 10%; Elf, France, 8%; Mobil and Shell, United States, 8% each)	Limbe	15.
Tin		Artisanal workings	Mayo Darle	NA.

NA Not available.

CAPE VERDE

AREA 4,030 km² **POPULATION 386,000**



THE MINERAL INDUSTRY OF

CAPE VERDE

By Audie L. King

Mining was virtually unchanged as a very small contributor to Cape Verde's economy in 1991. Productive activity was mostly concentrated in the agricultural sector and in services. Production consisted of minor quantities of salt and pozzolana, whose combined value was less than 0.2% of the GDP. Gypsum, kaolin, limestone, ornamental building stone, and pumice have been either mined or identified as possible resources. Importation of cement was less expensive than the estimated cost of domestic production.

The economy expanded by an estimated 3.2% during 1988, the latest year such data were available, continuing a growth trend that continued throughout the 1980's. Real GDP increased at an average rate of 6% per year between 1980 and 1987. This strong economic performance was partially due to the Government's conservative economic policies. Nevertheless, the country remains strongly dependent on foreign aid and emigrant remittances.

In 1989, the latest year for which such data were available, Cape Verde had a trade deficit of $96.9 million[1] ($107.8 million in imports and $10.9 million in exports).

In February 1991, Cape Verde held its first multiparty elections since independence. The African Party for Independence of Cape Verde (PAICV) lost control of the presidency and the People's National Assembly to the Movement for Democracy (MPD).

GOVERNMENT POLICIES AND PROGRAMS

In recent years, the Government began to realign the economy to deal with chronic unemployment and a poor natural resource base. Legislators focused on ways to utilize Cape Verde's strategic geographical position to promote exports and economic growth. The development of the country's tourist, fishing, and offshore banking concerns were dealt with specifically. New economic policies emphasized labor-intensive activities in the manufacturing and service sectors.

In December 1988, the Cape Verdean Constitution was amended to provide for private banking and insurance companies. In 1989, a duty-free warehousing system was established under which most goods could be stored for up to 4 years without the payment of duties. The Government expected new warehousing laws to facilitate the importation of raw, semifinished, or finished materials that would be used in Cape Verde's export industries.

A new investment code that favors foreign investment did not stipulate minimum local ownership for joint venturers. The investment code also provided for the repatriation of profits in foreign currency provided that a portion of profits were reinvested.

PRODUCTION

Small quantities of salt and pozzolana were mined for domestic consumption. Salt production decreased markedly since 1985 owing to technical problems. During the same period of time, high demand from the construction industry caused pozzolana production to more than double. Output was estimated to have increased again in 1991. *(See table 1.)*

TRADE

Cape Verde's main export items, bananas, tuna, lobster, leather products, and textiles, were shipped primarily to Portugal, Angola, Algeria, France, and Brazil. Net salt and pozzolana exports stopped in the early 1980's as domestic demand for construction materials outstripped production capacity and salt output fell below domestic needs. In 1989, the latest date that these data were available, the total value of Cape Verdean exports was $10.9 million; this amounted to only about 10% of its $107.8 million in imports. Portugal, the Netherlands, Spain, France, Brazil, Federal Republic of Germany, and Japan continued to supply Cape Verde with most of the necessities of life, including at least 50% of its food supply.

STRUCTURE OF THE MINERAL INDUSTRY

Cape Verde's four pozzolana mines and two salt producers were all privately owned. 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. *(See table 2.)*

COMMODITY REVIEW

Industrial Minerals

Salt.—Two marine salt plants were in operation on Maio Island. The operating companies were Saline du Cap Vert (SCV), a private French company, and Companhia de Formento, which had recently shut down owing to operational

difficulties. The Government had recently studied the feasibility of building a 90,000-mt/a marine salt production facility on Maio Island. In the past, salt also was produced on Sal and Boa Vista Islands. Several price increases and a slight increase in production allowed SCV to increase its 1990 profits to about $78,000 from $31,000 in 1989. Though it directly accounted for less than 0.03% of Cape Verde's GDP, salt was considered important because one of its main uses was to preserve Cape Verde's fish harvest. The fishing industry employed more than 6,000 persons and accounted for about 60% of the nation's export earnings in recent years. Salt consumption is expected to grow with the fishing industry, whose growth potential is high considering reports that Cape Verde harvested only an estimated 25% of its renewable catch limit. Despite continued domestic demand, salt production fell sharply during the past few years, from a peak of 31,000 tons in 1977 to only 3,000 tons in 1988. The main reasons for the decline were technical problems. During the same time period, Cape Verde stopped exporting and became a net importer of salt.

Pozzolana.—Together with its value-added products, pozzolana accounted for about 90% of the value of all minerals produced for construction purposes. The industrial minerals industry had quadrupled from 1980 to 1985 and has since been growing at 10% per year. Pozzolana was mined from four mines on Santo Antão Island.

INFRASTRUCTURE

Foreign trade is served through the ports of Porto Grande, at Mindelo on São Vicente Island, and Praia on São Tiago Island. Goods arriving at these two ports were distributed to the other islands, making adequate ports on all the islands essential. The ports collectively handled 394,000 tons of freight in 1986, the latest year for which such statistics were available.

In November 1990, the International Bank for Reconstruction and Development announced that the Praia Port Project was completed on schedule. The project rehabilitated two deepwater berths at the Praia Port and increased the efficiency of port operations at Praia and Porto Grande by providing modern cargo handling and workshop equipment. The project also provided technical assistance and training in the maritime sector by establishing a training center at Mindelo. The project's funding was a joint effort by the Governments of Portugal, Cape Verde, and Norway, and of the IDA, Arab Bank for Economic Development in Africa, and the Empresa Naçional de Administracão dos Portos.

The Empresa Publica de Electricidade e Agua (Electra) operated a number of thermal powerplants; a 2.8-MW plant on Praia, a 6.5-MW plant on Mindelo, and a 1-MW plant on Sal. Local councils also operated 12 rural powerplants whose combined generating capacity was a little more than 2MW. In 1989, the latest date these data were available, Cape Verde generated 34.5 GW•h. Electra foresaw meeting future demand through an interconnected system of combined wind-diesel powerplants. Ten 30-kW wind generators were in operation on Mindelo.

The availability of water was a major concern in a country that had suffered devastating droughts and famines every 20 to 30 years throughout its history. The most recent drought started in 1968 and lasted 10 years. Only international aid and the importation of nearly all of the islands' food requirements have averted disaster. Past droughts have wiped out 15% to 40% of the population. Rainfall finally broke the latest drought in 1978, but has been erratic during most of the 1980's. In 1984, heavy rainfall caused catastrophic floods. Recent programs included reforestation, the building of rainwater dikes, water-well drilling, and irrigation to reduce some of Cape Verde's weather-related problems.

OUTLOOK

If recent Government policies succeed in attracting investment in labor-intensive industries, Cape Verde's reliance on foreign aid may decrease. For the foreseeable future, however, Cape Verde will remain highly dependent on foreign donors and remittances from its citizens living abroad. The mineral industry will continue to be of minor importance to the overall economy. The extraction of building materials will likely increase as growth in the construction sector continues. Much of the building material, such as cement, will probably still be imported because Cape Verde's small market would not allow local manufacturing companies to compete with larger foreign manufacturers. The salt industry, which has been producing far below capacity, should be capable of expanding production to meet rising domestic demand as the population grows and the fishing industry expands.

[1]Where necessary, values have been converted from Cape Verdean escudos (CVEsc) to U.S. dollars at the rate of 77.4CVEsc=US$1.00.

TABLE 1
CAPE VERDE: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons)

Commodity[2]	1987	1988	1989	1990	1991
Salt	5,000	[3]3,000	3,000	3,500	4,000
Pozzolana	43,000	53,000	53,000	53,000	53,000

[1]Includes data available through Feb. 5, 1992.
[2]In addition to commodities listed, small quantities of limestone, clay, gypsum, pumice, and ornamental building stone may have been produced, but output was not reported, and available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

TABLE 2
CAPE VERDE: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

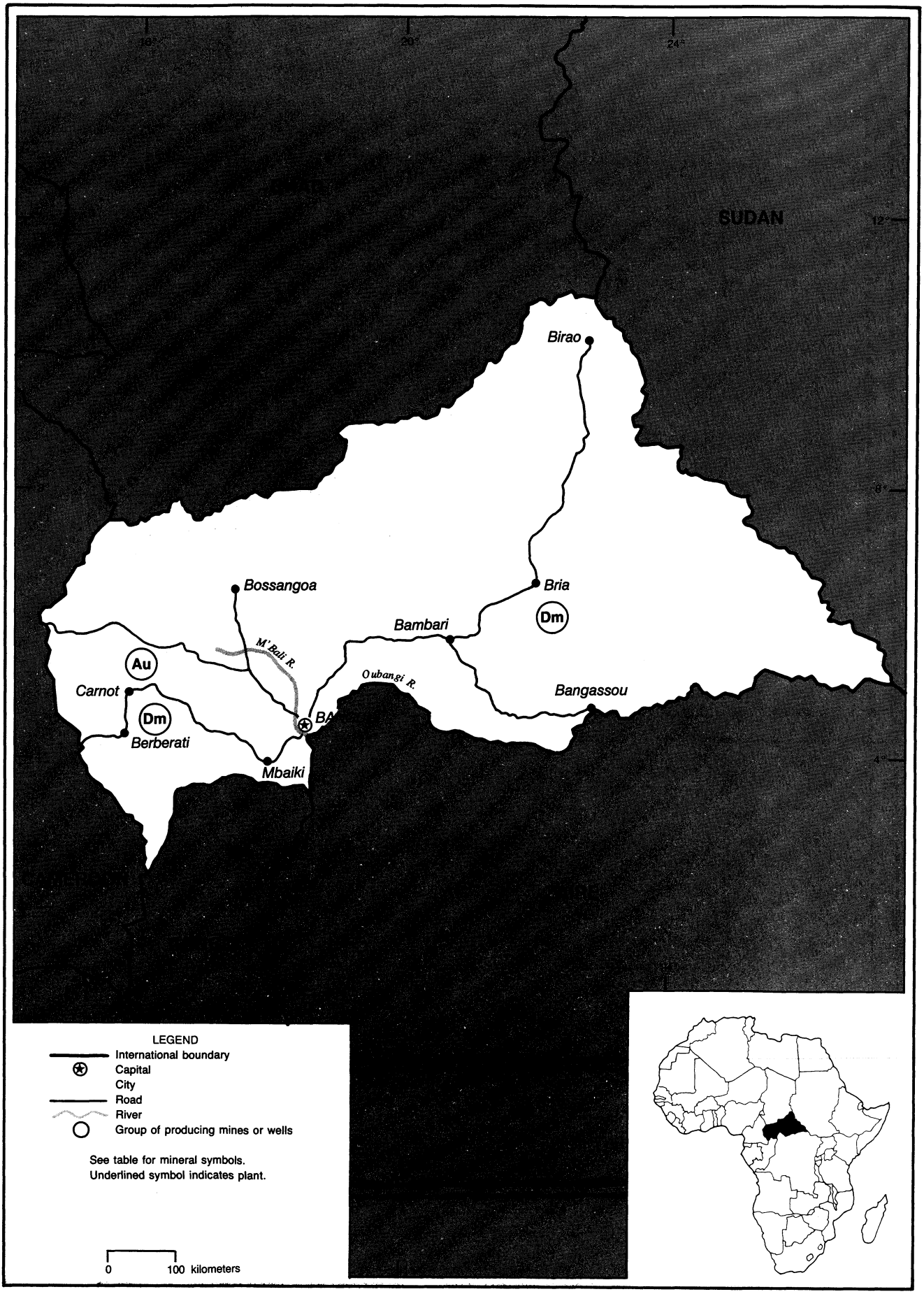
(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[1]
Salt	Societe des Salins du Cap Vert (Compagnie des Salins du Midi et des Salins de l'Est, 62.5%)	Maio Island.	45
Do.	Companhia de Fomento (private, 100%)	do.	45
Pozzolana	Four small, private companies	Santo Antão Island.	53

[1]Capacity is based on output.

CENTRAL AFRICAN REPUBLIC

AREA 622,980 km² **POPULATION 2.9 million**



THE MINERAL INDUSTRY OF THE

CENTRAL AFRICAN REPUBLIC

By Thomas P. Dolley

In 1991, the Central African Republic's mining sector remained dominated by the production and export of alluvial diamonds of gem quality. Diamonds are the most important commodity in the Central African Republic and contribute 50% of the GDP and about 46% of export earnings. A modest amount of gold is also produced in this landlocked nation. The Central African Republic has suffered from periodic drought along with recent political strife. All of these factors combined with a heavy external debt burden have contributed to the nation's underdevelopment.

The Central African Republic gained independence from France on August 13, 1960. Mining legislation was based on the Mining Code, law No. 61/208 of April 11, 1961. This law was subsequently modified, beginning in 1979. In all, 12 additional amendments have been made to the law, the latest in 1984. These amendments provide guidelines for the ownership, exploitation, possession, and marketing of gold and raw diamonds. Permission of the Ministry of Mines is required before mining or purchasing precious stones and minerals. Hydrocarbon legislation was based on the Petroleum Code, Ordinance No. 73/016, of February 10, 1973.

Accurate production and export figures for both gold and diamonds are unavailable due to widespread smuggling. Diamond production supports an artisanal labor force of about 40,000 people, primarily in the mining areas surrounding Carnot and Berberati. Scant information exists on the kimberlitic provenance of the diamond deposits. The Government reported that gem-quality diamond production generated approximately $47 million[1] in 1991. The unreported value of smuggled diamonds would probably double the reported figure. This clandestine activity was associated with unconfirmed reports of banditry in the Carnot area. Industrial-grade diamonds and bort variety diamonds accounted for an additional $12 million in revenue during the year. The Government has attempted to curb smuggling and some additional income has been achieved, despite lowered global prices for gold and diamonds.

France remained the Central African Republic's primary trading partner. However, the Oubangui River is the Central African Republic's primary trading route with other nations. The river has 1,800 km of navigable waterways south of the capital at Bangui to Brazzaville in the Congo.

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 company Petroca. However, a large percentage of petroleum supplies are smuggled and sold illegally.

Crude oil reserves have been indicated in the northern regions of the Central African Republic, but little is known of them. Previous seismic exploration activities were conducted between 1975 and 1985 by Petty Ray, Rogers, and Geosource of the United States. These seismic exploration companies were financed by a consortium of oil companies comprised of the Netherland's Royal Dutch/Shell and Exxon, Chevron, and Conoco 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 early 1992, the World Bank recommended that the Central African Republic renew petroleum exploration. Approval was still pending on a World Bank grant valued at $1.7 million for the Central African Republic's energy sector. Other minerals found in the Central African Republic include copper, iron ore, limestone, manganese, and uranium.

TABLE 1
CENTRAL AFRICAN REPUBLIC: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1987	1988	1989	1990	1991
Diamond:						
Gem	carats	303,769	284,130	334,396	302,530	296,320
Industrial	do.	108,455	59,278	80,806	78,496	82,323
Total	do.	412,224	343,408	415,202	381,026	378,643
Gold	kilograms	223	381	328	241	176

[1]Includes data available through June 1992.
[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.

Electricity is generated and distributed by Energie Electrique Centrafricaine (EEC). Total installed capacity was 35 MW. Of the electricity produced, 60% was from hydroelectric plants and 40% was from diesel plants. A new dam and power station came on-line on the M'Bali River in late 1991. This new operation is a joint project with Zaire. EEC has extensive rehabilitation plans along with the extension of existing electrical supply facilities in Bangui.

The lack of adequate transportation and industrial infrastructure, to include no railway system, continue to hinder the development of a viable mineral industry in the Central African Republic. *(See tables 1, 2, and 3).*

[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF282.11=US$1.00.

TABLE 2
CENTRAL AFRICAN REPUBLIC: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	Destinations	
			United States	Other (principal)
Aluminum: Metal including alloys, semimanufactures		8	—	All to Zaire.
Diamond, natural:				
Gem, not set or strung	value, thousands	$58,970	$41	Belgium-Luxembourg $57,647; Switzerland $977.
Industrial stones	do.	$1,691	—	Belgium-Luxembourg $1,548; France $74; Switzerland $69.
Gold: Metal including alloys, unwrought and partly wrought	kilograms	268	—	Switzerland 230; Sweden 26; France 12.
Iron and steel: Metal, scrap		31	—	All to France.
Petroleum refinery products: Gasoline	42-gallon barrels	107	—	All to Chad.
Salt and brine		14	—	Do.

[1]Comparable data not available for 1990. Table prepared by Virginia A. Woodson.

TABLE 3

CENTRAL AFRICAN REPUBLIC: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	Sources	
			United States	Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides	value, thousands	$1	—	All from France.
Metal including alloys: Unwrought		668	—	Cameroon 635; Netherlands 15.
Chromium: Oxides and hydroxides	value, thousands	$2	—	All from France.
Copper: Metal including alloys, semimanufactures		34	—	France 19; Spain 14.
Iron and steel: Metal:				
Scrap		2	—	All from France.
Pig iron, cast iron, related materials		29	—	France 33; West Germany 5.
Steel, primary forms		157	—	France 152; Italy 4.
Semimaufactures:				
Bars, rods, angles, shapes, sections		1,671	NA	France 1,181; Spain 127; Cameroon 121.
Universals, plates, sheets		257	—	Thailand 122; France 106; East Germany 21.
Hoop and strip		17	—	France 9; Italy 5.
Rails and accessories		2	—	All from West Germany.
Wire		154	—	France 66; Zimbabwe 63; China 8.
Tubes, pipes, fittings		206	—	France 130; Spain 22; Sweden 21.
Lead:				
Oxides		5	—	All from France.
Metal including alloys: Semimanufactures	value, thousands	$3	—	Mainly from Switzerland.
Tin: Metal including alloys:				
Unwrought	do.	$1	—	All from France.
Semimanufactures		1	—	Do.
Titanium: Oxides		14	—	Do.
Zinc: Metal including alloys:				
Unwrought	value, thousands	$1	—	Do.
Semimanufactures	do.	$1	—	Do.
Other: Oxides and hydroxides		43	—	Do.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones		4	—	West Germany 2; Italy 1.
Cement		41,772	—	Zaire 41,046; Cameroon 635.
Chalk		155	—	Zaire 150; France 5.
Diatomite and other infusorial earth		51	3	France 48.
Fertilizer materials: Manufactured:				
Ammonia		27	—	West Germany 20; France 7.
Nitrogenous		293	—	Italy 253; Cameroon 40.
Phosphatic		12	—	All from Netherlands.
Potassic		1,216	(2)	Belgium-Luxembourg 1,206; Cameroon 10.
Unspecified and mixed		335	—	All from Belgium-Luxembourg.
Gypsum and plaster		8	—	All from Cameroon.
Lime		95	—	Belgium-Luxembourg 50; France 26; Cameroon 19.
Pigments, mineral: Iron oxides and hydroxides, processed		11	—	All from France.
Potassium salts, crude		148	—	All from Netherlands.
Salt and brine		5,809	NA	Republic of South Africa 3,799; Cameroon 1,246; unspecified 700.

See footnotes at end of table.

TABLE 3—Continued

CENTRAL AFRICAN REPUBLIC: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	Sources	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		2	—	All from France.
Worked	value, thousands	$2	—	Mainly from Cameroon.
Dolomite, chiefly refractory-grade		70	—	Do.
Sulfur:				
Elemental:				
Crude including native and byproduct		11	—	West Germany 6; Cameroon 4; France 1.
Colloidal, precipitated, sublimed		12	—	All from France.
Sulfuric acid		18	—	France 11; Belgium-Luxembourg 6.
Talc, steatite, soapstone, pyrophyllite		1	—	All from France.
Other: Crude		1,094	—	Chad 844; Zaire 250.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		1	—	All from France.
Coal: Briquets of anthracite and bituminous coal	value, thousands	$3	—	All from United Kingdom.
Petroleum:				
Crude	barrels	274	—	All from Cameroon.
Refinery products:				
Liquefied petroleum gas	do.	2,285	545	France 974; Netherlands 510.
Gasoline	do.	46,903	NA	Cameroon 196; unspecified 46,648.
Mineral jelly and wax	do.	87	—	France 55; Netherlands 32.
Kerosene and jet fuel	do.	64,767	NA	Cameroon 628; unspecified 63,790.
Distillate fuel oil	do.	80,620	NA	NA.
Lubricants	do.	6,055	(2)	Cameroon 3,878; France 896; Nigeria 392.
Residual fuel oil	do.	18,987	NA	NA
Bitumen and other residues	do.	485	—	Côte d'Ivoire 376; France 103.
Bituminous mixtures	do.	18	—	France 12; Portugal 6.

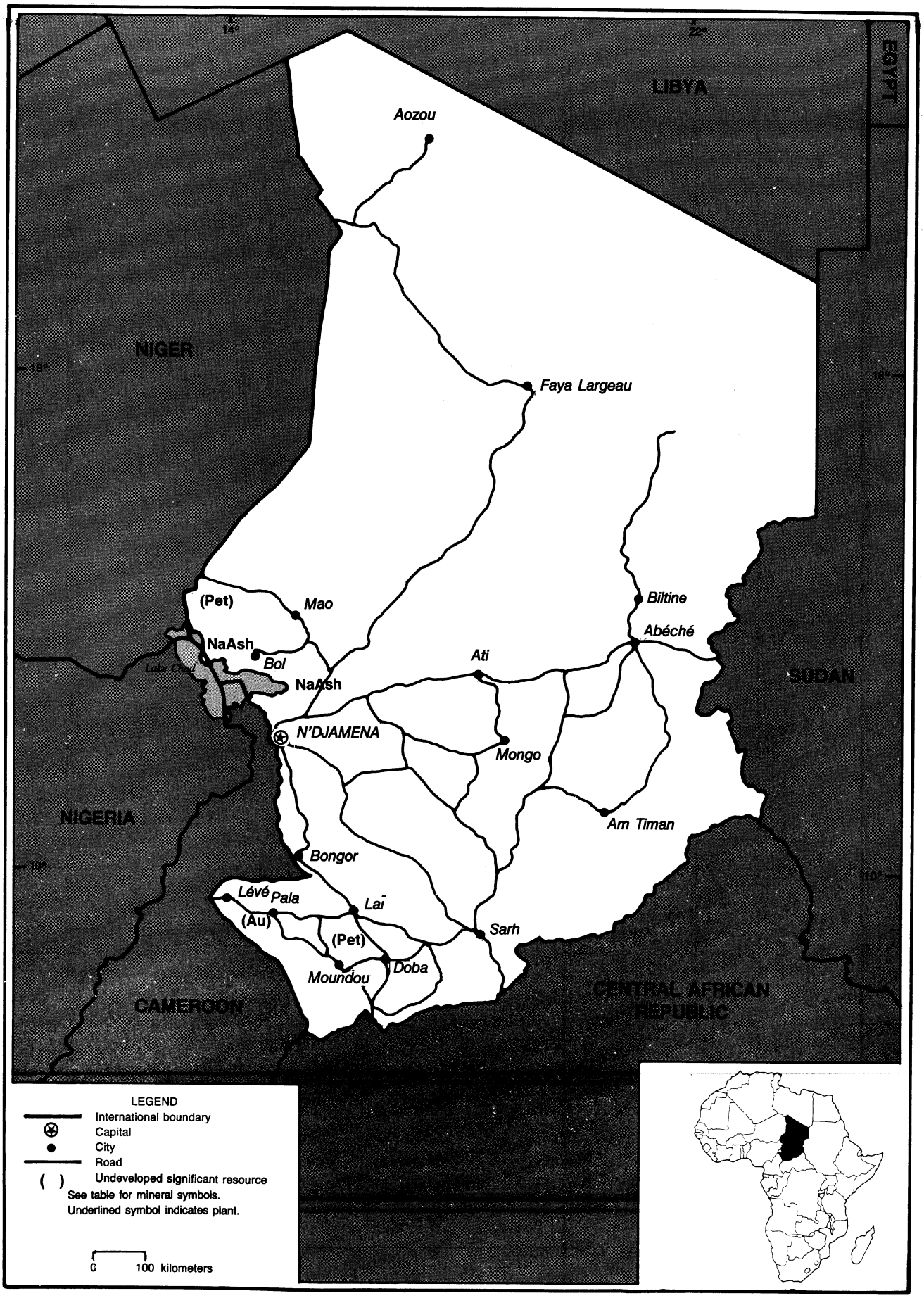
NA Not available.

[1]Comparable data not available for 1990. Table prepared by Virginia A. Woodson.

[2]Less than 1/2 unit.

CHAD

AREA 1,284,000 km² **POPULATION 5.1 million**



THE MINERAL INDUSTRY OF

CHAD

By Thomas P. Dolley

In 1991, political upheaval and poor infrastructure continued to impede the development of a mineral industry in the landlocked nation of Chad. Insufficient knowledge of Chadian geology and a lack of a technically skilled work force have also contributed to the underdevelopment. The extant mineral sector is a minimal contributor to the overall economy. Natron and salt are the only commodities that are mined and only on a small scale.

Chad remained heavily dependent on foreign financial aid. The investment budget of Chad is 100% externally financed along with 70% of public-sector spending. According to UN figures, total foreign direct investment in Chad from 1988-90 was about $30 million.[1] External debt in 1989, the last year for which data were available, amounted to about $418 million.

Chad gained independence from France on August 11, 1960. 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 continues to support a mineral policy centered on the exploration and development of domestic hydrocarbons.

Cotton is the most significant export product and accounts for about 65% of foreign capital income. Livestock is the second most important exported commodity. Total U.S. exports to Chad in 1990 were valued at about $7 million. Leading U.S. imports from Chad in 1990 were valued at $2.1 million. From January to June 1991, leading U.S. imports from Chad were valued at about $300,000.

Chad has no significant domestic energy production. Petroleum products consumed in Chad are exclusively imported from Nigeria and Cameroon. Owing to the fact that there are no railway or pipeline facilities, importation of petroleum is by trucks, which are privately owned and operated. Distribution of the majority of petroleum products is through Shell Oil Corp. and Mobil Oil Corp. of the United States and Total of France, respectively. Various imported petroleum products are mainly jet fuel, gasoline, distillate fuel oil, kerosene, lubricants, and natural asphalt.

In 1974, crude oil was discovered in Chad at Sedigi, north of Lake Chad, approximately 300 km from N'Djamena. The World Bank had previously indicated in 1989 that Esso Chad, a consortium of Shell, Chevron, and Exxon of the United States, confirmed the presence of oil with reserve estimates of 10.5 Mbbl. World Bank funding for an oil pipeline from the Sedigi Oilfields to a microrefinery in N'Djamena is still pending. Despite evacuation of personnel from the Lake Chad area resulting from the coup in late 1990 coupled with the global travel restrictions caused by the Gulf War, Esso Chad expected to return to the area. Additionally, the existence of petroleum has been postulated for the Erdis Basin in northeastern Chad. The Erdis Basin is an extension of the Kufra Basin in Libya, a prolific petroleum producer.

Though the geology of Chad has been incompletely examined, over the years some mineral resources have been identified. An alluvial gold deposit exists in the Mayo N'Dala River about 14 km northwest of the city of Pala. Recently examined by a UN-sponsored project, the gold is found in the active channel of the river and the adjoining terraces, but the resource apparently totals only a few dozen kilograms. The active channel cuts into Precambrian greenstone and Cretaceous sedimentary bedrock. The deposit does not appear to have sufficient quantities of gold to be economic beyond artisanal or semi-industrial development. Additionally, platinum has been found in a hornblendite pipe southwest of Léré.

In an effort to promote prospection of mineral resources, the UN's Department of Technical Co-operation for Development (DCTD) has provided technical assistance and for the evaluation of mineral potential in Chad since 1988. Evaluation of certain geological targets will take place along with the training of Chadian technicians.

Diesel generators with imported fuel produce all electrical power utilized in Chad. Total installed generating capacity amounted to 38 MW managed by Société Tchadienne d'Energie Electrique. Only the major cities of N'Djamena, Moundou, and Abeche possess electric power and are not interconnected. Communications network infrastructure is not sufficient. Chad possessed no railroad or river port facilities. Roadways totaled 31,322 km, with 200 km of roadway being paved with asphalt.

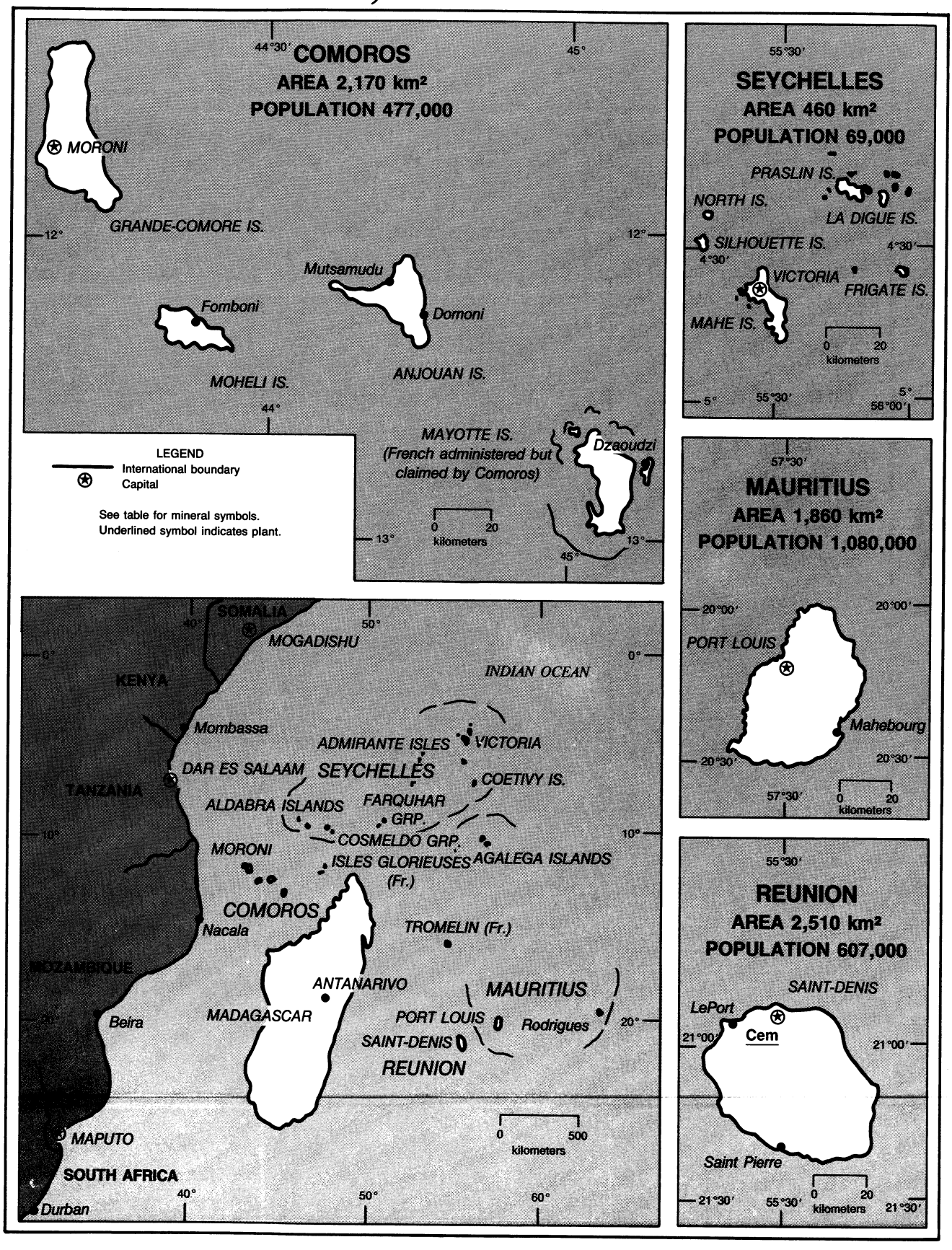
Environmental concerns in Chad have been exacerbated by the depletion of water in Lake Chad. Representing an important resource for people in the area, Lake Chad provides fish and natron. Lake Chad has shrunk from its earlier extent of 25,000 km² to the current 500 km².

For the foreseeable future, landlocked geography coupled with undeveloped infrastructure will delay progress in forming a viable mineral industry and export market in Chad. A short-term strategy for mineral development in Chad

should address commodities that can be initially utilized for domestic needs.

[1]Where necessary, values have been converted from Communauté Financfere Africaine francs (CFAF) to U.S. dollars at the rate of CFAF282.11=US$1.00.

ISLANDS OF COMOROS, MAURITIUS, REUNION, AND SEYCHELLES



THE MINERAL INDUSTRIES OF

COMOROS MAURITIUS, REUNION, AND SEYCHELLES

By Lloyd E. Antonides and Audie King

COMOROS

The mineral industry of Comoros continued to be very limited in 1991, producing only common building materials, such as sand, gravel, and crushed stone. Output quantities were not available but were presumably lower than in the early 1980's when several public works projects were completed. Promotion of a new construction method based on use of lava and volcanic ash by unskilled labor was expected to reduce imports of cement and mining of coral. Such reductions would, respectively, help the trade deficit and cut degradation of the environment.

The independent Islamic Republic consists of a chain of three main islands spaced roughly equally along a northwesterly axis about 180 km long. They are centered about 500 km west of the northern tip of Madagascar, halfway to mainland Africa. Total land area is about two-thirds that of Rhode Island, of which Grand Comore is 60%. The islands, volcanic mounts rising from 3,000-m depths, have hilly to mountainous terrain. One 2,500-m high volcanic vent was still active on Grand Comore. The climate is tropical. More than 40% of the land was cultivable and almost 25%, meadow or woodland. Population growth was high, at 3.5%. Arab, African, and East Indian are the main ethnic groups. Official languages are French and Arabic. Adult literacy was more than 50%.

With a GDP estimated at less than $250 million[1] for 1991, or less than $525 per capita, Comoros was among the poorest countries of the world. The GDP real growth rate was estimated at between 1% and 2%. A young, fast-increasing population of a generally low educational level, together with a land having few natural resources, was the cause of low economic activity and growth and dependence on foreign aid. Agriculture, including fishing and forestry, contributed about 40% to GDP, employed about 80% of the labor force, and provided essentially all exports. Tourism contributed about 25% to GDP. Estimates indicated inflation in consumer prices was a low, single-digit figure but unemployment was in the high teens.

Exports in 1990, the last available data, were estimated to be about $16 million—mostly vanilla, cloves, ylang-ylang (a perfume oil), and copra. The United States took more than 50% of exports and France more than 40%. Comoros was the world's major source for ylang-ylang and the second largest producer of vanilla. Imports of about $40 million were mostly rice and other foodstuffs, cement, and petroleum products. More than 20% came from France and about 40% from other European nations.

Roads, totaling 750 km, all of stone or gravel with 210 km bituminous topped, gave somewhat limited access on the rugged islands. There were no railroads. Principal ports were Mutsamudu and Moroni. An international airport was near Moroni, the capital, and each other island had smaller strips. All had permanent surfaces. Utilities provided by Electricité et Eaux des Comoros included 16 MW installed, all diesel power except 1 MW of hydroelectric power.

The outlook for the economy and minerals output was for little change, at least in the near term. Benefits are expected to result from improved regional cooperation and development through Comoros' membership in the Indian Ocean Commission (IOC). Other members included Madagascar, Mauritius, Seychelles, and France, the latter representing Reunion. The social-economic unrest that surfaced early in 1992 was not expected to achieve much or to become a major upheaval.

Mayotte Island, the fourth major island in the Comoros archipelago, is about 100 km further east and is claimed by Comoros. However, when the other islands voted for independence from France in 1975, Mayotte did not. It was designated a territorial collectivity of France in 1976.

With a land area of 375 km^2, about twice that of the District of Columbia, it had a population estimated at 75,000 with a high growth rate of almost 4% per year. Some limited production of construction stone and sand was presumed to be the extent of minerals activity. Its economy was similar to its neighbor: very poor, based on agriculture but not self-sufficent in food, and dependent on external financial assistance, mostly French in the past. Exports were less than $5 million, principally ylang-ylang and

vanilla, mostly to France. Imports, about $20 million, were principally building materials and food, mostly from France. Roads totaled 42 km, one-half bituminous. The airfield was paved.

MAURITIUS

Mauritius has a small minerals industry that historically produces basalt construction stone, coral sand, and solar-evaporated sea salt. *(See table 1.)* By far, the bulk of the coral sand was used for construction but about one-fifth was reported being used in industry. Apparently only a small portion of the latter was made into lime, of which a small fraction was made into paint pigment. However, coral mining was under pressure to be discontinued because of the environmentally detrimental effects on coastal lagoons. One news report stated about 600,000 tons of coral sand was being produced each year. Sand from crushing basalt rock was proposed as a substitute for construction uses.

Polymetallic nodules were known for some time to occur in a 500-km-wide zone from 400 km to 800 km north of the main island. Marine Mining, October-December 1991, reported a 1987 reconnaisance sampling of a 12,000-km^2 area at about a 4,000-m depth 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 inconclusively explored with geophysics and drilling by Texaco in the 1970's, in the same general area as contains the polymetallic nodules.

Steel reinforcing bars for construction were made from imported ingot at three rolling mills. They satisfied about 75% of the approximate 40,000-ton annual demand, and an additional mill was planned. The Government was searching for financing of a planned oil refinery and a petrochemical plant to be based on imported crude but no progress was yet announced.

The nation embraces a number of volcanic islands in the western Indian Ocean dispersed over an area 900 km to 1,600 km east of Madagascar and extending about 1,200 km north-south. Geologically, they were associated with the submerged Mascarene Plateau and related ridges and outliers. Claims to some additional islands to the northeast and one to the west were disputed. Almost all the land area and population is concentrated in the most southerly island after which the country was named. About 700 km to the east, Rodrigues Island, 40 km^2, had more than 30,000 inhabitants; 1200 km to the north, the two Agalega Islands, totaling less than 40 km^2, had less than 500 residents; and the other islands were unpopulated. The main island is less than two-thirds the size of Rhode Island, consisting essentially of a large central plateau, probably an old caldera, edged by mountains and encircled by a narrower coastal plain fringed with coral reefs. The climate is subtropical. More than one-half of the land is cultivable, with sugarcane grown on almost 90%. About 35% of the land is meadow or woodland. Population growth rate was less than 1% per year. Principal ethnic groups were Indo-Mauritian, 68%, and Creole, 27%. English was the official language. Adult literacy was more than 90%.

In March 1992, the form of government changed to an independent republic with a president, having been an independent parlimentary democracy whose head of state was the British Monarch since 1968.

GDP was calculated as $2.69 billion[1] in 1991 or about $2,500 per capita, rather high for the region. Although GDP at constant prices grew almost 5% in the year, it was lower than the average growth of more than 6% during the previous decade—causing concern among business and government circles. GDP accounts indicated contributions of industrial production at about 25%, agriculture at slightly more than 10%, and tourism at about 3%. An Export Processing Zone (EPZ), which was established in 1970 and boomed in the 1980's, was the key to the economy's growth. Although EPZ enterprises were diverse, including jewelry and gemstone finishing among others, clothing and textile manufacturing provided more than 90% of the EPZ employment. The clothing and textile share was more than 15% of GDP, 40% of export earnings, and 35% of employment. Sugar, including processing and byproducts, which formerly had been the singular base of the economy, still was about 10% of GDP, 30% of export earnings, and 15% of employment. Tourism had a small direct share of GDP but earned 16% of total foreign exchange and was a major employer. Inflation was estimated as 7%, comparing the International Monetary Fund (IMF) average consumer prices index for 1991 versus 1990. Unemployment was reported as slightly more than 2%.

Exports in 1991 were $1.734 billion and imports were $1.855, according to IMF data. Exports were principally textiles and sugar but in recent years small amounts of some mineral commodities, presumably reexports, were included: polished diamonds and other gemstones, metal scrap, and fertilizers. About 75% of total exports went to France, the United Kingdom, and Germany and 15% to the United States. Imports were mostly manufactured goods, equipment, and foodstuffs but in recent years included such mineral commodities as cement, clays, coal, fertilizers, iron and steel, LPG, and other petroleum products. For the most part imports came from the EC, United States, and Republic of South Africa.

Roads, totaling 1,800 km, more than 90% paved, radiated out from Port Louis and also encircled the island. There were no railroads. Port Louis was the principal port. The main airport was near Mahebourg, with a paved runway suitable for heavier international traffic. Additional runways were available on other islands. Electric power generating capacity, controlled by the Central Electricity Board, was 233 MW in 1989, according to the latest data available. Two diesel and six hyroelectric plants were in the system. Sugar operations owned another 15 MW of capacity in thermal plants, from which the Board bought about 10% of power it sold. Bagasse, sugarcane residue, was a commonly used fuel. The Board had an

additional hydroelectric project underway and was reportedly planning a bagasse-fired plant.

The outlook on mineral commodity-related matters was for little change other than a reduction in coral mining. On the economy in general, the EPZ manufacturing sector was expected to suffer through some adjustments as labor costs increased and markets changed. More capital and technologically intensive industries as well as financial services will probably be attracted to the island if labor accepts training in new skills. As a founding member of the IOC, Mauritius look forward to mutual benefits from the regional cooperation efforts.

REUNION

Mineral commodities production did not play a very large role in the economy of Reunion during 1991 or historically, although 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.

Reunion, an overseas department of France, consists of a volcanic island slightly more than three-fourths the size of Rhode Island, in the Indian Ocean about 700 km east of Madagascar and 200 km southwest of Mauritius Island. It is the top of a large peak whose base is more than 4,000 m below sea level, off the southwestern end of the submerged Mascarene Plateau. The terrain is rugged and mountainous, up to 3,000 m, with a narrow coastal plain. One volcano last erupted in 1990. The climate is tropical. Land use was reported as slightly less than 25% cultivable, with sugarcane on 80% and about 40% meadow or woodland. Population growth was 1.9% annually. Ethnic ancestry is very intermixed with French, African, and Asian groups prominently represented. French is the official language. Adult literacy was more than 75%.

The economy had a GDP estimated at more than $4 billion[1] in 1991, giving a per capita figure of more than $6,000, very high for the region. A GDP real growth rate of 9% annually in recent years was attributed to heavy financial assistance from France. Agriculture was the base of the economy and employed 30% of the labor force. Sugarcane was by far the dominate crop although perfume essences and vanilla were also considered noteworthy. Tourism was being promoted but had not yet become significant to the economy. Industrial activity, although attributed to be 25% of GDP, was essentially limited to processing of sugarcane. Inflation of consumer prices was estimated as only 1% to 2% annually. Unemployment was a major problem; more than 30% of the labor force was reported unemployed in February 1991, probably after the sugarcane harvest peak employment period.

Exports of sugar, rum, and molasses were more than 80% of the almost $200 million total estimated value. France was by far the major recipient. Imports totaled almost $2 billion, principally manufactured goods, food, and equipment, but also petroleum products. France and Bahrain were major partners.

Roadways totaled 2,200 km of paved plus 600 km of stone or stabilized earth. A main route along the coast encircled the island, and another crossed diagonally. Other roads gave only limited access into the interior owing to the rugged terrain. There were no railroads. The main shipping port was at Le Port, and an international airport with paved runways was near Saint Denis. Installed electric generating capacity was 245 MW; at least some capacity was hydroelectric for which there remained a large potential.

Little change in the economy could be anticipated in the near future. France would undoubtedly continue its financial support of the department while promoting direct investment in industrial diversification as well as regional integration and cooperation through the IOC.

SEYCHELLES

Mineral production in Seychelles during 1991, as in past years, consisted mostly of unspecified quantities of construction materials—rock, coral, and sand. Output of guano, a phosphate fertilizer, apparently ceased in the mid-1980's according to a Government source, although the 5,000-mt/a capacity remained. There was also some potential for producing granite dimension stone from the bedrock of Mahe and nearby islands, as was apparently done on a trial basis by an Italian firm in the early 1980's. More recently, production of lime and cement from the abundant coral was under consideration and offshore petroleum remained a possibility in several areas. In addition, polymetallic nodules were known to occur on the ocean bottom near the Admirante Islands, about 300 km southwest of Victoria. Limited sampling was done in the mid-1980's but funds for the further work that was planned apparently were not forthcoming.

Petroleum tar balls from underground seeps were known for many years to occur on beaches of Coetivy Island, about 300 km south of Victoria, as well as on Mahe and some nearby islands. Oil exploration began in Seychelles in 1969 and continued throughout the 1970's and early 1980's. Texaco drilled the first two exploratory wells in 1970. Amoco was active during the early 1980's and drilled three dry holes off Silhouette Island, about 30 km northwest of Victoria. Under the Ministry of National Development, a petroleum office was set up in 1981 and in 1984 Seychelles National Oil Co. (SNOC) was formed as a parastatal company with a small technical staff. After adoption of a new petroleum law in 1986, oil exploration was actively promoted.

Enterprise Oil Ltd., a British firm, signed an exploration agreement in 1987 and did preliminary seismic work. In late 1989, it had hoped to start at least one test well by yearend 1990 but apparently

was unsuccessful in attracting partners because no further information was available.

A seminar on regional oil exploration was held in Victoria in December 1990, which was expected to develop interest but no new activity was reported through mid-1992. In Oil & Gas Journal, August 31, 1992, a SNOC geophysical consultant reported that studies on the tar balls continued to give promise of a significant oil potential.

The republic of Seychelles consists of 100 to 120 islands clustered in several groups over a 400,000-km^2 area between 330 km northwest and 1,200 km northeast of the northern tip of Madagascar. Of the 455 km^2 total land area, about 2.5 times that of the District of Columbia, 145 km^2 is in one lagoon of an island in the southeast group, all coral atolls. Another 148 km^2 is on Mahe, the largest of about 40 steeply hilly, rocky granite islands with narrow coastal strips that made up the northeast group. On Mahe, elevations are up to 900 m. The group is considered to represent peaks rising from a relatively shallow submerged plateau of a continental block split off from Africa, similar to the basement rock of Madagascar. The 60 to 80 other outer islands are low and flat, formed from coral reefs around submerged remnant peaks, presumably mostly volcanic. The climate is tropical. Only slightly more than 20% of the land is cultivable, but almost 20% is rather lush forest and woodland. Conservation of fresh water is important because even brief droughts resulted in shortages.

Of the total population, more than 25% lived in Victoria and 90% elsewhwere on Mahe. Except for the three next largest islands—Praslin, La Digue, and Silhouette—the other islands had few people and most were uninhabited. Population growth was low, less than 1%. The well-mixed ethnic origins included Asians, Africans, and Europeans. English and French were official languages. Adult literacy was estimated at about 70%.

GDP was probably at least in the upper $300 million[1] for 1991, or well over $5,000 per capita. Real growth rate was between 5% and 10% per year. Tourism employed about one-third of the labor force and provided most of the foreign currency earnings. Other services were also important to the economy. Fishing, including canning, was becoming another prominent sector. Although the agriculture sector was small, it was important to export earnings and import substitution, and the Government was promoting investment for expansion. Foreign aid was a major contribution to the economy and came from many sources. The consumer price inflation was less than 2% annually. Unemployment was estimated at about 10%.

Exports totaled $47.9 million in 1991. Principal items were fish, copra, and cinnamon. Major destinations were France and countries in or bordering the Indian Ocean. Imports totaled $172.4 million. Principal items were various manufactured goods and equipment, food, and petroleum products. The other main mineral commodities imported were cement and steel. Main sources of imports were the United Kingdom, France, and the Republic of South Africa.

Roads included 160 km bituminous and 100 km crushed stone or earth, apparently all and only on Mahe. The principal port was at Victoria, and an international class airport was about 20 km south. Electric generating capacity of the Public Utilities Corp. was 24 MW from three diesel plants. Two were on Mahe and one on Praslin, which also supplied La Digue by undersea cable. Privately owned generators are fairly common, especially on other islands.

In the future, the economy is not expected to incur major changes. Tourism and other services would continue to dominate. However, fishing and agriculture, and associated activities, probably will grow as a result of Government efforts at general diversification and expansion. These efforts may benefit from the wider trade objectives of the IOC.

[1]Where necessary, values have been converted from Comoran francs (CF) to U.S. dollars at the rate of CF282.11=US$1.00 for 1991 and CF272.26=US$1.00 for 1990, Mauritian rupees (MauRs) at MauRs15.652=US$1.00 for 1991, French francs (F) at F5.64=US$1.00 for 1991 (for Reunion), and Seychelles rupees (SR) at SR5.29=US$1.00 for 1991 and SR5.34=$1.00 for 1990.

OTHER SOURCES OF INFORMATION

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
Telephone: 262-21-2214
Fax: 262-21-8696

Ministry for National Development
Independence House, P.O. Box 199
Victoria, Mahe, Seychelles

TABLE 1

MAURITIUS: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

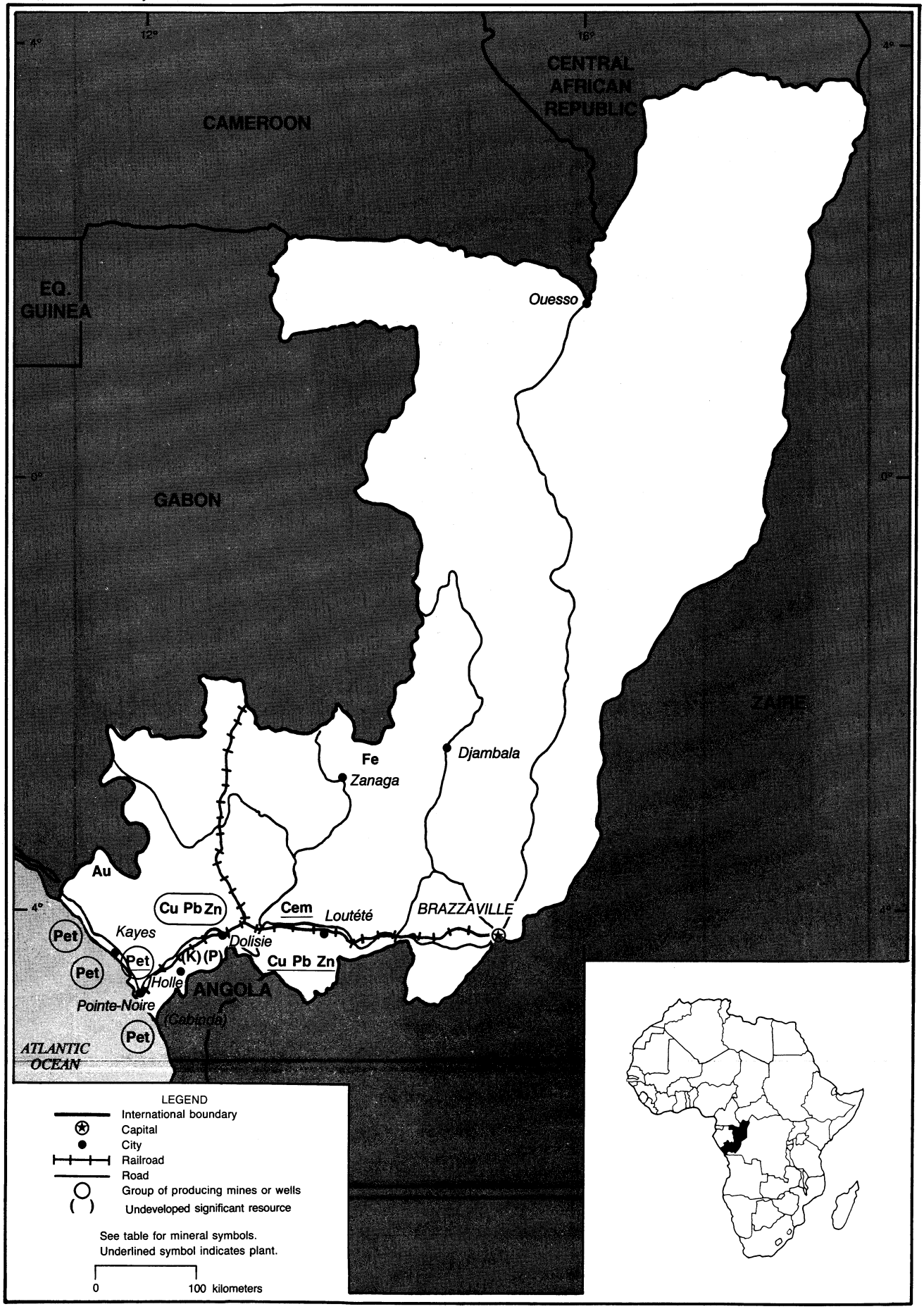
Commodity[2]	1987	1988	1989	1990	1991
Lime	7,000	7,000	7,000	7,000	7,000
Salt	6,000	6,000	6,000	6,000	6,000
Sand, coral	300,000	300,000	300,000	300,000	300,000
Stone: Basalt, not further described	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000

[1]Includes data available through Aug. 1, 1992.

[2]In addition to the commodities listed, minor quantities of crude mineral material for construction and coral for lime production presumably are produced, but information is inadequate to reliably estimate output.

CONGO

AREA 342,000 km² **POPULATION 2.3 million**



THE MINERAL INDUSTRY OF

CONGO

By Thomas P. Dolley

Production of crude petroleum and the reform of the petroleum industry remained paramount concerns for the Republic of Congo in 1991. Sales of crude petroleum in Congo accounted for about 70% of the nation's foreign exchange income. Hydrocarbon revenues in 1990 reached $160 million.[1] Petroleum revenue for 1991 was estimated at $515 million, more than four times the value for 1989.

Violence and political upheaval led to the formation of a transitional Government in early 1991. By midyear, a new Constitution was being drawn up for referendum to be followed by multiparty and presidential elections in 1992. A domestic financial crisis coupled with a bloating external debt hindered attempts at public-sector restructuring, some of which is planned for segments of the mineral industry. As a result, offers of foreign aid have remained elusive. The estimated GDP for Congo in 1991 was $2.3 billion. Direct foreign investment in Congo from 1988 to 1990 totaled about $59 million.

Congo achieved independence from France on August 15, 1960. In 1965, all mines were nationalized and continue to remain the property of the Government. 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. Created in 1979, the parastatal Société Congolaise de Recherche et d'Exploitation Minière (Socorem) is involved with the exploitation of all nonfuel ores and minerals. Created in the early 1970's, Hydro-Congo is the state-owned petroleum company.

A significant disruption of trade links occurred during the year between the Government of Congo and Gabon's Compagnie Minière de l'Ogooué (Comilog). The Congo-Ocean Railway Co. (CFCO) placed responsibility for a train wreck near Luombo on Comilog, ostensively because Comilog leased an unmaintained locomotive, resulting in brake failure. The accident occurred in September 1991 and killed 100 people. In retaliation, the Government of Gabon suspended Comilog's transshipments of manganese ore exports via Congo on September 20, 1991. Comilog's manganese ore shipments totaled about 1 Mmt in 1990 through Congo's port at Pointe-Noire. However, since 1987, Comilog has been transitioning a greater percentage of its manganese exports through Gabon's newly completed port at Owendo. Due to the suspension, CFCO could lose approximately $2.6 million per year in revenue. By yearend 1991, an official inquiry into the accident was unresolved. The United States imported about $1.7 million worth of manganese exported through Congo in 1990. Additionally, the United States is a major importer of Congolese crude petroleum. Preliminary figures indicate that U.S. crude oil imports from Congo in 1991 totaled 11.3 Mbbl.

In the metals sector, the production of copper, lead, and zinc was suspended in 1984. Socorem manages a modest amount of gold production. During 1991, Socorem purchased gold at a fixed price of $11,343 per kilogram. However, in 1992, Socorem plans to purchase gold at a fixed price of about $9,900 per kilogram, reflecting the downward spiral of global gold prices.

Société de Cimenterie du Congo (Socico) is the parastatal that produces and sells cement, at $193 per ton, from a factory in Loutété, which lies along the railway between Brazzaville and Pointe-Noire. Cement production in Congo is heavily subsidized by the Government and utilizes only domestic clinker in its manufacture. The Government has established two nationwide fixed prices for cement. In 1991, the Government wholesale price for cement was $202 per ton and retailed at $222 per ton. Furthermore, the Government must pay inflated transportation subsidies to offer the cement at the same fixed prices at remote locations in Congo. In times of cement shortages and thus greater cement prices, it remains difficult for the Government to enforce the fixed prices. Lime is produced by only one operator in Congo, Chauco of Brazzaville. Once again a fixed price for lime at $427 per ton is sold to Socorem or the Ministry of Mines and Energy.

Congo is not a member of OPEC and is thus not subject to production quotas. Foreign companies and expertise continue to play a primary role in the development of the hydrocarbons sector. Société Nationale Elf Aquitaine (Elf) of France, operating through its subsidiary Elf-Congo, was the primary petroleum producer with 80% of Congo's total crude oil output. Production of crude oil in Congo represented 19% of Elf's global production. The other major producer in Congo, accounting for about 20% of total crude oil output, was Italy's Azienda Generali Italiana Petroli S.p.A. (Agip-Congo). Elf-Congo and Agip-Congo combined produce virtually all of Congo's crude petroleum. During the year Elf-Congo initiated production from the offshore Tchendo Oilfield. The production rate was 945 bbl/d from 1 well and will reach 20 kbbl/d in 1993

when 26 wells are expected to be completed. Elf-Congo holds a 65% interest in the license, with the remainder held by Agip-Congo. In early 1991, British Petroleum (BP) Exploration of the United Kingdom and Norway's Statoil agreed to a one-third share takeover by Statoil of BP's 30% stake in the offshore Kayes-B exploration block. Statoil has agreed to pay $40 million for the share of BP's existing license. Production on these tracts has not commenced.

Amoco Congo, a subsidiary of Amoco Production Co. of the United States, inaugurated petroleum production offshore of Congo in mid-1991. This represents the first U.S. company to operate production off Congo, and by yearend 1992 an estimated $500 million will have been invested in the exploration and development of this concession. This is also the first production field to involve direct working interest participation by Hydro-Congo. The producing field lies in the Yombo-Masseko-Youbi exploitation permit area of the Marine I concession, about 81 km northwest of Pointe-Noire. Initial production flow rates at Yombo are 6 kbbl/d. Eventual completion of 2 platforms with 22 wells is envisioned by Amoco Congo. The crude oil produced at Yombo is processed through a floating production, storage, and offloading (FPSO) vessel moored in about 114 m of water and 3 km from two fixed platforms supporting a drilling rig and completed wells. The FPSO can process 35,000 to 40,000 bbl/d with electrical power supplied by high-voltage submarine cables. Following processing, the crude petroleum is stored on the FPSO until its transferral to tankers for shipment to world markets. Equity investment in the project is Amoco Congo at 43.75%, Hydro-Congo at 50%, and Kuwait Foreign Petroleum Exploration Co. at 6.25%. Other U.S. petroleum corporations active in Congo, though not in a production phase, are Apache, Atlantic Richfield, Chevron, Citizens Energy, and Conoco.

Accusations of mismanagement and theft of petroleum revenues were made in a report by the Petroleum Subcommission of Congo's National Conference on May 30, 1991. The subcommission has also recommended the restructuring of Hydro-Congo. The subcommission's report alleged that the Government had not received its proper share of petroleum revenues and that much of the entitlements had been funneled to foreign banks by Government officials. Further details were expected in the investigation. Earlier in the year, rumored privatization of Hydro-Congo caused that company's workers to stage a brief strike for higher wages. The strike ended when privatization plans were canceled, but no clear resolution of the problem was forthcoming by yearend 1991. The transitional Government is planning a further review of Hydro-Congo.

Société Nationale d'Energie is the Government's electrical utility in Congo. A successful overhaul of selected power stations over the past several years resulted in decreased purchases of electrical power from neighboring Zaire. Total installed electrical capacity was 133 MW. Most of this capacity was hydroelectric, with diesel generators operating in isolated areas. Railroads within Congo totaled 797 km. Highways totaled 12,000 km, of which 560 km had a bituminous surface.

Estimated petroleum reserves in the Congo totaled 340 Mbbl. Congo's nonfuel mineral resource potential has yet to be fully exploited. Copper, lead, and zinc mineralization exist in Congo along with occurrences of iron ore. Industrial mineral resource potential includes potash and phosphate in southeastern Congo and bentonite, granite, gypsum, kaolin, marble, and talc elsewhere. Reform within the Congo petroleum sector is necessary to keep this key industry viable for the future. Additionally, successful nonfuel mineral resource development in Congo is dependent on the development of an adequate transportation infrastructure. *(See table 1.)*

[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF282.11=US$1.00.

TABLE 1

CONGO: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1987	1988	1989	1990	1991
Cement, hydraulic	metric tons	76,000	77,000	121,690	90,326	102,571
Gas, natural:e						
Gross	million cubic meters	368	368	368	368	368
Marketed	do.	350	350	350	350	350
Gold, mine output, Au content e	kilograms	4	4	[3]6	[3]7	[3]12
Lime e	do.	300	300	[3]398	[3]298	[3]300
Petroleum, crude	thousand 42-gallon barrels	44,895	49,275	55,000	58,765	56,575

eEstimated.

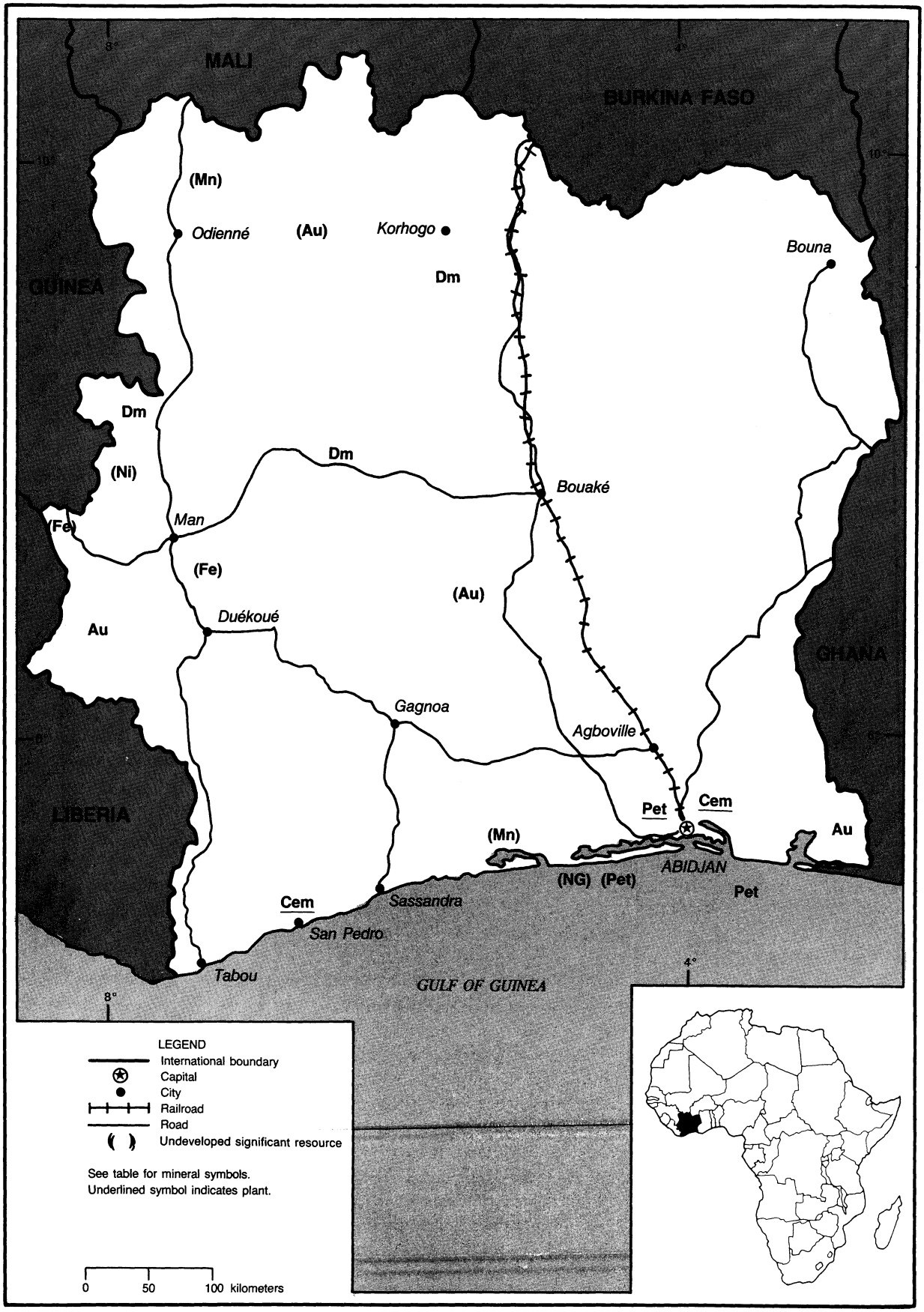
[1]Includes data available through Nov. 1992.

[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 324,460 km² **POPULATION 13.0 million**



THE MINERAL INDUSTRY OF

CÔTE D'IVOIRE

By Hendrik G. van Oss

In 1991, the production of mineral commodities played only a modest role in the agriculture-dominated economy of Côte d'Ivoire. Cocoa, coffee, and timber continued to be the most important commodities produced. Mineral commodity revenues are estimated to have been almost $530 million in 1991, equivalent to about 5% of the country's estimated 1991 GDP of $10 billion.[1] Compared with estimates for mineral commodity sales in 1990, which have been revised down to reflect new estimates of petroleum refinery output, the 1991 revenues show an increase of about 3%. This increase was due largely to the January 1991 startup of production from a new gold mine, but the new gold revenues were partially offset by a small decline in crude oil production. Mineral commodities, including transshipments, are estimated to have accounted for about 10% of the country's exports, excluding, for want of data, the value of smuggled gold and diamonds.

In value, the Ivoirian mineral economy was dominated by petroleum refining, although most of the input for this industry was imported. Similarly, the cement industry relied entirely on imported clinker. Oil refinery and cement plant output continued to be well below capacity. The domestic formal mining industry was dominated by gold, although there was also artisanal production of this commodity as well as of diamond. Employment in the minerals industry was relatively insignificant in 1991, numbering about 1,500 in the petroleum production and refining companies and about 1,000 in the cement and construction materials sector. The country's only producing gold mine employed 55 workers. Estimates of the number of artisanal gold and diamond miners are not available, but the number in 1991 probably did not exceed 1,000 persons. *(See table 1.)*

Following the lead of other countries in the region, the Government began drafting a new mining code in 1990; however, the basic mining law of Côte d'Ivoire during the year remained the Mining Code (Law No. 64-249) of July 3, 1964. A new contractual framework for oil and gas exploration was drafted during 1989 and was released in June 1990 as part of a new exploration promotion program. This supplemented the Petroleum Code (Law No. 70-849) of August 3, 1970, as modified in 1975, 1982, and 1983. The Government has traditionally taken an equity interest in mineral exploitation, either through the Société Nationale d'Opérations Pétrolières de la Côte d'Ivoire (PETROCI), or through the Société d'Etat pour le Développement Minier de la Côte d'Ivoire (SODEMI), for fuel and nonfuel minerals, respectively. These parastatals are also involved in mineral exploration, commonly in cooperation with foreign entities. The degree of state equity participation in new ventures has decreased in recent years; however, foreign investors are still encouraged to take Ivoirian partners.

The Government's new attitude to mining, and the geologic similarity of the country to its mineral-rich neighbors, have encouraged both the reevaluation of certain known deposits in Côte d'Ivoire and the startup of a number of new grassroots mineral exploration programs. These efforts have begun to pay off, and mineral production is expected to play a larger role in the Ivoirian economy in the near future. The country's first new gold mine in many decades commenced production in January. Mining commenced around August at another gold property; it had a very small test pour at yearend and its first commercial gold pour at the end of February 1992. Other gold exploration efforts were under way during the year. Financing was being sought to develop several nickel laterite deposits near Man, based on feasibility work done in 1990. Oil exploration was ongoing during the year, and efforts were being made to develop a known natural gas field. *(See table 2).*

Virtually all of Côte d'Ivoire is made up of Precambrian rocks, including a number of northeast-trending belts containing volcanosedimentary rocks of the Birimian series. This terrane hosts lode gold and other deposits such as iron, manganese, and nickel. Some gold deposits are in extensions of greenstone belts that have been the source of significant gold production in Ghana and Mali. Placer gold occurrences, most derived from Birimian lode occurrences, are widespread. Diamond-bearing kimberlites have been found in north-central Côte d'Ivoire; some of these have been mined in the past, as have several placer deposits derived from these kimberlites and from sources outside the country.

Tertiary clastic sedimentary rocks exist along and offshore part of the country's Atlantic coast. These rocks form a sedimentary basin that hosts Côte d'Ivoire's modest known oil and natural gas reserves and holds promise of additional discoveries.

Côte d'Ivoire's trade is dominated by the export of agricultural products, the import of petroleum products, and the transshipment of goods for some of the

country's landlocked neighbors. Total exports in 1989, the last year for which data were available, were about $2.7 billion and were estimated to have been about $3 billion in 1990 and in 1991. In 1989, sales of cocoa, coffee, and timber amounted to about $1.3 billion.

Total mineral commodity exports in 1991, including transshipments, are estimated to have amounted to about $380 to $400 million, about the same as in 1990. The petroleum product contribution to mineral exports is estimated to have declined about 10% to about $300 million, largely because of lower prices. Legal gold exports increased dramatically to about $12.5 million. Exports of nonmetallic minerals in 1991 are estimated to have been about the same as in 1990, or about $30 to $35 million. Cement accounted for about 90% of these exports. Fertilizer exports are estimated to have amounted to almost $10 million. Metallic minerals exports, other than gold, were insignificant. About 85% of Côte d'Ivoire's total mineral commodity exports were to neighboring West African countries. In 1990, the latest year for which data were available, mineral commodity exports to Europe and to the United States accounted for about 10% and 5% of the total, respectively; most of these exports were of refined petroleum products.

Total imports in 1991 are estimated to have fallen slightly to about $1.85 billion, largely as a result of a decrease in world petroleum prices. Mineral commodity imports are estimated to have amounted to about $250 million, of which crude petroleum accounted for an estimated 60% and refined petroleum products about 12%. As in past years, about one-third of the petroleum and petroleum product imports were destined for reexport, either as transshipped petroleum products or after refining in Côte d'Ivoire. Imports of nonfuel mineral commodities are estimated to have been at about the same level as in 1990. About 75% of these were accounted for by clinker and gypsum imports for the cement industry. Salt imports amounted to an estimated $5 million, and fertilizer imports were an estimated $20 million. Imports of metallic minerals were minor, amounting to about $2 million.

Although France and other European countries continued to dominate the country's overall import trade, most of Côte d'Ivoire's mineral commodity imports were from other African countries. Of greatest importance in this regard was Nigeria, which was the source of most of Côte d'Ivoire's crude petroleum imports.

Société des Mines d'Ity, a joint venture between SODEMI, 60%; and COFRAMINES of France, 40%; poured its first gold at the end of January from the Ity Mine about 100 km southwest of Man. Production by yearend totaled 1,075 kg of doré, assaying about 95% gold. Ore mined totaled 165,000 tons grading 10.5 g/mt gold. Reserves at yearend for the open pit, heap-leach operation are in auriferous laterites and were reported by the SODEMI to be 500,000 tons grading 7 g/mt of gold. In addition, there is a resource of almost 1.2 Mmt grading 9 g/mt of gold within a columnar clay zone beneath the laterite. There are reported to be metallurgical problems with this clay material, and the existing operation is restricted to the laterite.

Société Minière d'Afema commenced open pit mining in mid-1991 on its Afema gold concession about 120 km east of Abidjan. The operating company is a joint venture between Eden Roc Mineral Corp. of Canada, 90%, and SODEMI, 10%. Eden Roc, in turn, is 67% owned by Marshall Minerals Corp. of Canada. Site preparation had commenced in April. The heap-leach operation's modular cyanide plant, built by Kappes Cassiday, was tested at yearend and yielded a small gold pour of less than 1 kg. The first commercial gold pour was made at the end of February 1992 and amounted to 9.7 kg.

The ore mined at Afema in 1991 was from the Aniuri deposit, one of several gold deposits known on the concession. Not all of these had been thoroughly tested as of yearend. The deposits are within the Afema shear zone, which is an extension of the Bibiani gold belt of Ghana. The oxide ore at Aniuri and some satellite deposits will be mined open pit, whereas the Asupiri deposit, which has the largest reserves and best grades thus delineated, is an underground mining proposition. Several of the deposits have both oxide and sulfide reserves; the latter, which also contain active carbon, are not amenable to heap leaching.

At yearend 1990, the adjusted surface reserves for Aniuri were given by Marshall as about 640,000 tons, grading 4.31 g/mt of gold. This included about 140,000 tons of mixed sulfide-oxide ore in the lowest pit bench; leaching of this material will have a gold recovery of only about 50% to 60%, compared with 85% to 90% in the overlying pure oxide ore. The adjusted underground reserves for Aniuri were 456,000 tons (all classes) at an average gold grade of 4.6 g/mt. For Asupiri, the underground reserves (all classes) were about 463,000 tons at an average gold grade of 7.4 g/mt. Total surface reserves for the Afema concession, including several satellite deposits, were listed as 1.6 Mmt (all classes) at 3.5 g/mt of gold. The total underground reserves were given as about 920,000 tons grading about 6 g/mt of gold.

A number of companies are known to be exploring for gold in Côte d'Ivoire, although few results have been announced. In its 1990 annual report, France's Bureau de Recherches Géologiques et Minières (BRGM) announced that drilling in 1990 on the Angovia gold deposit, 90 km southwest of Bouaké, had delineated proven plus probable reserves (combined oxide and sulfide ore) of 4.3 Mmt grading 5 g/mt of gold. The BRGM also announced that it had located a number of gold prospects near Boundiali, about 90 km west of Korhogo. The prospects were described as being in the continuation of the zone hosting the Syama gold mine in Mali.

Significant nickel and cobalt resources in laterites overlying ultramafic rocks were discovered in the early 1970's by SODEMI near Sipilou, northwest of Man. These were drilled by Falconbridge Ltd. of Canada from 1979 to 1982. The largest deposit was at Sipilou, for which a resource of 81 Mmt, grading 1.55% Ni

and 0.1% Co, was outlined. At yearend 1989, Trillion Resources of Canada signed a joint venture with SODEMI to further evaluate the deposit. A feasibility study, which reevaluated the SODEMI and Falconbridge drilling, recalculated the reserves, and did some additional metallurgical work, was completed in September 1990. According to Trillion, the study concluded that the Sipilou deposit has minable reserves of 77 Mmt grading 1.84% Ni-equivalent (defined as equal parts Ni and Co), at a 1.4% Ni-equivalent cutoff. Because the stripping ratios at Sipilou are high, the company was seeking a partner to exploit the deposit and was planning additional exploration work on three smaller, higher grade deposits in the area that could be more cheaply mined. The best of these appears to be the Moyango deposit, with apparent reserves of 15 Mmt grading 2.5% Ni-equivalent. Part of this deposit has no overburden. The other two deposits, also with low stripping ratios, have combined resources totaling 28 Mmt grading 2% Ni.

[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate CFAF282.11=US$1.00.

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Agencies

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Ministère des Mines
B.P. V28
Abidjan, Côte d'Ivoire

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

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

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

Commodity[2]		1987	1988	1989	1990e	1991e
Cement[3]	thousand metric tons	653	700	e500	500	500
Diamond[e 4]	carats	21,000	5r11,157	5r11,689	12,000	15,000
Gold[4]	kilograms	7	6	13	20	1,100
Petroleum:						
Crude	thousand 42-gallon barrels	6r6,200	4,721	7r771	7r770	7r730
Refinery products:[e]						
Motor gasoline	do.	r3,528	r2,644	r1,794	r1,800	1,800
Kerosene and jet fuel	do.	r3,249	r1,970	r1,538	r1,600	1,600
Distillate fuel oil	do.	r4,364	r3,670	r3,618	r3,700	3,700
Residual fuel oil	do.	r3,563	r3,976	r2,644	r2,800	2,800
Liquefied petroleum gas	do.	r139	r151	r174	r175	175
Other	do.	r154	r182	r196	r200	200
Total	do.	r14,997	r12,593	r9,964	r10,275	10,275

eEstimated. rRevised.
[1]Includes data available through Mar. 11, 1992.
[2]In addition to the commodities listed, Côte d'Ivoire produces clay, stone, and sand and gravel for local construction purposes. Information is inadequate to make reliable estimates of output levels.
[3]Output based entirely on imported clinker.
[4]Does not include artisanal production smuggled out of the country.
[5]Reported figure.
[6]Data are for fiscal year ending July 30.
[7]Production from the Bélier Field only. Espoir Field shut down Oct. 26, 1988.

TABLE 2

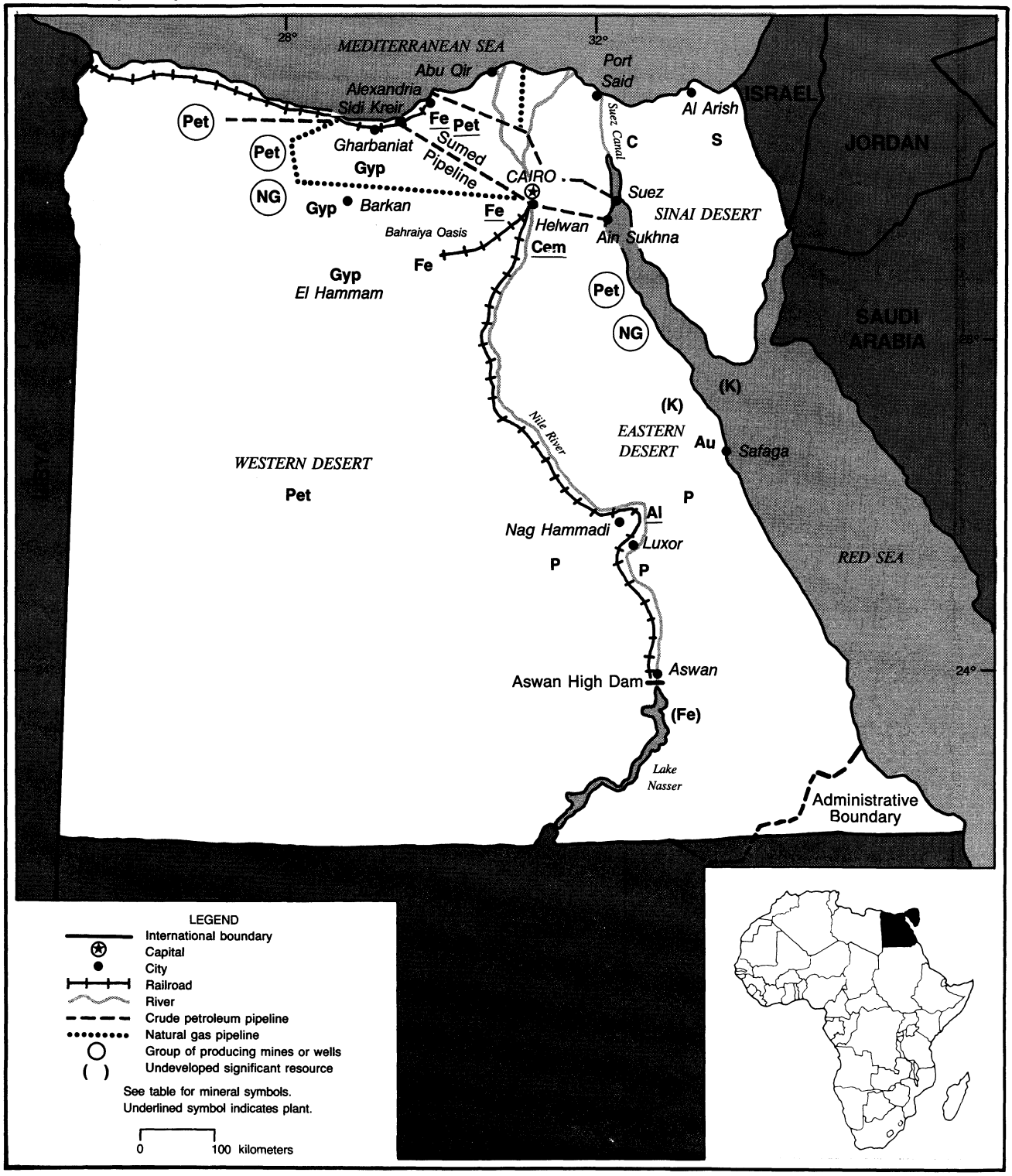
CÔTE D'IVOIRE: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

Commodity		Major producing companies and major equity owners	Location of main facilities	Annual capacity
Cement	thousand metric tons	Société des Ciments d'Abidjan (Government, 40%; Omnium Tropical, Côte d'Ivoire, 24%; SCOA, 12%; Socafracim, 9%, Ciments Vicat, France, 12%; Ciments Lafarge, France, 3%)	Clinker-grinding plant at Abidjan	Cement: e600.
Do.		Société Ivoirienne de Ciments et Matériaux (Ciments d'Origny, France, 80%; private Ivoirian shares, 20%)	do.	Cement: e750.
Do.		Société des Ciments du Sud Ouest (Government, Société Tropical)	Clinker-grinding plant at San Pedro	Cement: e300.
Gold	kilograms	Société des Mines d'Ity (SODEMI, 60%; Coframines, France, 40%)	Open pit mine, 90 kilometers southwest of Man	Doré: [1] 1,000.
Do.		Société Minière d'Afema (Eden Roc Mineral Corp., Canada, 90%; Government, 10%)	Open pit mine, 120 kilometers east of Abidjan	Gold: [2] 1,000.
Petroleum, crude	thousand barrels	Esso consortium (Esso Group, 63.75%; Shell, 21.25%; Government, 15%)	Bélier offshore field, 32 kilometers southeast of Abidjan	Crude oil: 730.
Petroleum, refined	do.	Société Ivoirienne de Raffinage (SIR) (Government, 47.27%, Shell, 10.29%; BP 10.10%, Total, 10.10%; others, 22.24%)	Petroleum refinery in Abidjan	Crude oil input: 21,500.
Do.		Société Multinationale de Bitumes (Government, 95.76%; Royal Dutch Shell, 2.88%; others, 1.36%)	do.	Crude oil input: 10. Asphalt output: 5.

[1]Doré from the Ity Mine is about 95% gold.
[2]Mine had its first commercial pour Feb. 28, 1992.

EGYPT

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



THE MINERAL INDUSTRY OF

EGYPT

By Thomas P. Dolley

Mineral fuels remained the most productive and lucrative sector in the Egyptian mining industry. During the year, declining petroleum reserves and increased domestic consumption of hydrocarbons prompted the Government to reformat petroleum tenders. This strategy was aimed at garnering greater foreign investment in the petroleum sector through more attractive terms. Toward that goal, the Government appointed a new Minister of Petroleum and Mineral Wealth in May 1991 to address these problems. Foreign investors in Egypt's petroleum industry often cite that joint-venture and production-sharing terms with the Government were too restrictive. Additionally, Egypt was not an OPEC member and set its own crude oil price, which increased greatly in the latter months of 1991.

Overshadowing its alliance with coalition forces in the Persian Gulf War of 1991, solutions for Egypt's external debt burden became paramount during the year. Total foreign debt was projected to be between $35 billion and $40 billion by yearend 1991.[1] Egypt's debt burden remained formidable despite debt writeoffs by the United States and other Gulf Arab lenders. Military debts totaling $7 billion were canceled by the United States at the end of 1990. Gulf Arab lenders also canceled $6 billion in Egyptian debts. Additionally, by yearend 1991 Egyptian debt service was in the midst of a Paris Club restructuring.

Difficulties surrounding aspects of Egypt's mineral industry surfaced during the year. Egypt's state-owned Egyptian Ferroalloy Co. (EFC) was the target of an EC investigation into alleged ferrosilicon dumping on the European market. EFC had an estimated production capacity of 8,200 mt/a and produced more than 15 times its domestic requirement of ferrosilicon. The majority of this surplus was sold to Europe. The EC investigation had been under way since 1990. Additionally, longstanding tensions with Egypt's southern neighbor, Sudan, grew in a dispute over oil exploration rights in both countries' administrative boundaries, which lie along their mutual borders.

GOVERNMENT POLICIES AND PROGRAMS

Mining legislation dated back to the Mining and Petroleum Code, law No. 66 of 1953, and Mining Code Law No. 86 of 1956. 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. Additionally, a new natural gas clause should allow foreign concessionaires to share directly in the profits from gas production and provide exploration incentives where they previously did not exist.

Egypt was not a member of OPEC. Thus, a Government commission sets the price per barrel of crude oil exports on the 1st and 15th of each month. Complaints about the high cost of the Egyptian crudes in 1991 prompted the Government to adopt a new market-based formula for pricing. Though meeting with limited success, the formula has been criticized for not allowing sufficient differential between high- and low-quality crude oils.

PRODUCTION

Total crude petroleum production increased marginally in 1991 to about 320 Mbbl from the 1990 total of 319 Mbbl. Natural gas and LPG production also increased.

Dominant nonfuel mineral production and concomitant downstream products in 1991 were phosphates, kaolin, gypsum, sand for glass, handmade porcelain, and finished glass products. (*See table 1.*)

TRADE

The Government reported that Egypt's petroleum industry recorded export revenues of $2.5 billion for the fiscal year 1990-91. Crude oil imports totaled $978 million, resulting in a trade surplus of about $1.5 billion.

Egypt's Suez-Mediterranean pipeline (Sumed) is owned by Arab Petroleum Pipelines, which in turn is 50% owned by the Government's EGPC. The Persian Gulf War proved the Sumed pipeline's criticality to Egyptian oil exports in 1991. Gross profits from Sumed are approximately $200 million per year and are predicted to rise because of increased European demand. Of this total, the Government receives 28% of total profits. Saudi Arabian, Iranian, and other crude oils from Persian Gulf states pass through the Sumed pipeline. Sumed can also provide a variety of Arabian crude oil mixes that the customer requests. The 350-km pipeline transports about 60% of Europe's oil imports from the Gulf region. Normally operating at 90% of capacity, during the Persian Gulf War the Sumed pipeline operated at more than 100% of theoretical capacity. Sumed's current capacity is about 560 Mbbl/a or double the amount of crude oil passing

through the Suez Canal. Oil storage capacity at the Sidi Kreir terminal is 21 Mbbl in 30 storage tanks.

Sumed pipeline expansion will proceed over the next several years through an investment program valued at $120 million. The pipeline's throughput capacity will be increased by 50% to 2.4 Mbbl/d. Storage tank capacity will be raised at the Sidi Kreir terminal to 29.5 Mbbl. Arab Petroleum Pipelines has planned a marketing strategy to enable the Sidi Kreir terminal to become the main crude oil source for southern Europe. Many oil tankers in the Gulf of Suez currently offload their crude oil at Ain Sukhna before passing through the Suez Canal, then reload the crude at Sidi Kreir before traveling to European ports.

STRUCTURE OF THE MINERAL INDUSTRY

Virtually all mining and mineral processing in Egypt was carried out by Government-owned mining companies. Egypt's Mining and Refractories Corp. (Maric) was the parastatal under the Ministry of Industry that controlled the mining and refractories industries. Foreign investors in the mining industry coordinate exploration activities through the Egyptian Geological Survey and Mining Authority (EGSMA), which is subordinate to the Ministry of Petroleum and Mineral Wealth. In the event that the foreign mining investor enters the production stage of development, a joint-venture company is formed with EGSMA.

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.

Mineral sector ventures involving foreign companies, along with oil production and refining, were based on production-sharing agreements. The Government generally held a 50% equity ownership in these production-sharing agreements. (*See table 2.*)

COMMODITY REVIEW

Metals

Aluminum.—Clecim of France signed a $222 million contract to build an aluminum rolling mill for the Aluminum Co. of Egypt at its Nag Hammadi complex. The yearend 1991 signing is accompanied by Pechiney of France whose responsibility will be to provide the technology for the plant, which is configured primarily for export. This activity is part of a long-term plan to refurbish and modernize the facility, which was originally built by the former U.S.S.R. Saudi Arabia was scheduled to provide a $40 million tranche in support of the project. The project's debt service is expected to be paid through exports from the mill.

Production capacity for the mill is expected to be 60 kmt/a of corrugated and flat aluminum sheets. Company officials stated that 50 kmt of the aluminum will be for export and 10 kmt will be for local consumption. The mill is scheduled to commence production in 1994 and employ 700 people.

By yearend 1991, Egypt had signed a $20 million trade agreement with Algeria under which Egypt will export aluminum in exchange for Algerian zinc. This signing possibly represents the largest agreement of its kind between the two countries.

Gold.—The United Kingdom's Greenwich Resources reported a loss of approximately $170,000 in 1991. The loss occurred because of restructuring costs following the company's departure from gold concessions in Egypt in 1990. The company considered it highly unlikely that it would return to its exploration gold concessions in the Eastern Desert.

Industrial Minerals

Cement.—One of the largest cement companies in Egypt, National Cement Co. (NCC), reported a loss of $15.5 million for the fiscal year ending in 1991. The loss represents more than 50% of NCC's capital in 1991. NCC is one of six state-owned cement companies in Egypt. The Government found it necessary to intervene in early 1992 to rescue NCC from financial collapse. The rescue plan will include $124 million in loans from the state-owned National Investment Bank. NCC stated that the losses were due in part to high interest charges and bank overdrafts totaling $104 million. NCC operates six cement plants with one still undergoing construction at Beni Suef. The project was awaiting an additional capital input from a Japanese consortium composed of Mitsubishi Corp. and Kobe Steel. Additionally, financial delays have interfered with the completion of a new cement project by Helwan Portland Cement Co.

Phosphate Rock.—Phosphate rock continued to be a major nonfuel mineral product in Egypt, although production had fluctuated since the mid-1980's. The fluctuation was due in part to changing markets and prices, along with export difficulties attributed to the Persian Gulf War. Attempts to refurbish and improve the phosphate industry infrastructure have been curtailed until recently due to Egypt's debt burden. Production of phosphate rock came principally from the East and West Sebaiya Mines on the Nile River, south of Luxor. Additional production came from mining activity adjacent to the Red Sea port of Safaga. Egypt's only phosphoric acid plant was located at Abu Zaabal, north of Cairo.

Potash.—The revenue-sharing contract signed in 1989 between the U.S. subsidiary of Australia's Broken Hill Pty. Ltd. Co. (BHP Utah Minerals International) and EGSMA was ratified by the Government on April 9, 1991. The agreement concerned exploration and development of potash resources along the western coast of the Gulf of Suez and the Red Sea. Exploratory drilling commenced in late 1991.

Sulfur.—Freeport Egyptian Sulfur Co., a wholly owned subsidiary of Freeport-

McMoRan Inc. of the United States, continued sulfur exploration operations at its North Sinai Desert concession in 1991. In late 1991, the sulfur concession agreement was renewed with the Government. Freeport reported the discovery of a 20,321,000-ton sulfur resource in the concession. A feasibility study was undertaken in 1991, possibly including delineation drilling, to determine the technical recoverability of the deposit. In mid-1994, Freeport must determine whether it will exploit the deposit or relinquish the concession.

Other Industrial Minerals.—The parastatal Misr Chemical Industries Co. produces caustic soda, sodium carbonate, and hydrochloric acid at Alexandria. However, as of early 1992 the company had contracted Dames & Moore of the United States to oversee a decontamination program at the Alexandria plant. The program includes replacing the mercury production cells with newer membrane technology. Additionally, traces of mercury caused by seepage must be removed from the site. The Federal Republic of Germany's Kreditanstalt fuer Wiederaufbau is expected to provide financing for the project in the form of a concessionary loan and grants totaling $97 million. The industrial complex at Alexandria has recently been the target of Government environmental agencies due to the severity of pollution.

Mineral Fuels

Crude oil production in Egypt is dominated by Amoco of the United States and Italy's Azienda Generali Italiana Petroli S.p.A. subsidiary International Egyptian Oil Co. (IEOC), predominantly through their Gulf of Suez fields. Crude oil production averaged 870 kbbl/d for 1991 with Amoco accounting for 50% of this total. Additionally, natural gas production averaged 1 billion ft^3/d and was totally utilized within Egypt.

The hydrocarbons sector in Egypt experienced a very busy year in 1991. By yearend, important changes had taken place in the mineral fuels sector. The Government appointed a new Petroleum and Mineral Wealth Minister at midyear to help stimulate otherwise sagging exploration interest in Egypt. Additionally, several major foreign petroleum interests were planning to pull out or scale down their activities in Egypt. This latter condition was highlighted by the eventual sale of petroleum production assets owned by the United Kingdom's British Petroleum Company (BP) after 15 years of activity in Egypt. After months of speculation, the $125 million sale was completed in early 1992 to the Spanish state oil company Repsol Exploracion. The assets sold include a 33.33% equity stake in the oil concessions containing the Ras Budran, Ras Fanar, and Zeit Bay Oilfields. Other equity partners in this consortium included the Netherland's Royal Dutch/Shell subsidiary, Shell Egypt, along with Egypt's Suez Petroleum Co. (Suco). BP's share of total Egyptian production was 15 kbbl/d, but the company was to maintain its interest in a gas project that was still under development.

By yearend Shell Egypt was also interested in selling its partnership with Suco but would remain committed to its natural gas production and exploration in the Western Desert. Shell Egypt produces about 100 kbbl/d of heavy crude oil from three Gulf of Suez fields. Operatorship of these fields was by Deminex of the Federal Republic of Germany. Some other operators have been reducing their operations and include France's Total and Société Nationale Elf Aquitaine, along with Italy's Azienda Generali Italiana Petroli S.p.A. subsidiary International Egyptian Oil Co. (IEOC).

The Gulf of Suez Basin is 20,000 km^2 in area. The stratigraphy is represented by a thick sequence of Carboniferous to Cenozoic sediments. The primary petroleum reservoirs are Miocene sandstones, clastics, and reef limestones. These units overlay hydrocarbon-bearing Carboniferous and Cretaceous rocks. In some instances, Miocene age oil migrated into these pre-Miocene rocks. Speculation on the pullout of some major petroleum partners centered on dissatisfaction with the heavy Gulf of Suez crude oils found here and produced by Suco. The crude oils are sulfurous, coupled with a high metal content. These conditions make the crudes unattractive to buyers and possibly uncompetitive with other crude oils on the market.

Recent discoveries of crude oil and natural gas, particularly in the Western Desert, have had a positive effect on the fuels sector during 1991. Some of the international companies exploring in this area include IEOC, Norsk Hydro of Norway, Phillips Petroleum Co. of the United States, and Kuwait Foreign Petroleum Exploration Co. The Western Desert concessions seem to be typified by smaller hydrocarbon deposits sprinkled throughout the area. Because of this situation, the Government has encouraged operators to pool and combine their exploration and development activities.

Reserves

The Government estimates reserves of crude petroleum at approximately 3.5 billion bbl and natural gas reserves at 339.8 billion m^3.

Gold and copper mineralization exist in Egypt but are not of sufficient grade to be economically viable. Though the mineral resources of Egypt have been exploited since antiquity, regions of the country remained geologically unexplored in detail.

INFRASTRUCTURE

According to Government sources, the Suez Canal Authority earned about $1.8 billion in revenue for the fiscal year ending in September 1991. This figure represents the greatest amount of revenue earned to date for canal activities.

The Ministry of Electricity and Energy (MEE) stated that electrical output will increase to 100 billion kW•h in 2005. This figure represents more than double the current electrical output. The MEE also forecast that power demands will increase an average of 6% per year until 2005. Under the current 5-year plan, electrical output will increase to about 65 billion kW•h by 1997.

OUTLOOK

Development within Egypt's mineral industry may follow a convoluted course in the next several years. Economic growth on the domestic scene has increased domestic consumption of a variety of mineral resources, particularly petroleum. Thus, without increasing its mineral reserve base through additional discoveries, the Government must satisfy domestic demand plus earn valuable export revenues.

New hydrocarbon discoveries have not kept pace with declining reserves. In the past, the Egyptian consumer has demonstrated disfavor with inreasing domestic commodity prices, crude oil notwithstanding. Increased exploration coupled with greater utilization of natural gas for energy needs within Egypt could reduce domestic oil consumption and allow more crude oil available for export.

[1]Where necessary, values have been converted from Egyptian pounds (£E) to U.S. dollars at a rate of £E3.25=US$1.00.

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TABLE 1

EGYPT: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991e
METALS						
Aluminum metal		178,850	173,460	179,500	179,167	[2]178,000
Copper, refined, secondary[e]		2,500	4,000	3,600	3,600	3,600
Iron and steel:						
Iron ore and concentrate	thousand tons	1,700	2,000	2,562	2,405	2,400
Metal:						
Pig iron	do.	1,069	1,112	1,105	1,100	1,250
Ferroalloys: Ferrosilicon		7,702	7,806	7,800	7,922	7,900
Steel, crude	thousand tons	1,433	2,025	2,114	2,235	[3]2,541
INDUSTRIAL MINERALS						
Asbestos		209	166	312	369	360
Barite		4,116	5,651	7,295	66,197	6,100
Cement: Hydraulic	thousand tons	8,746	9,787	9,507	155,299	15,000
Clays:						
Bentonite		3,827	3,166	3,512	44,904	4,900
Fire clay		148,727	150,000	250,000	128,130	128,000
Kaolin		125,256	e124,000	121,515	499,032	49,000
Feldspar, crude		15,963	6,131	27,731	9,894	9,800
Fluorspar		776	1,849	1,721	1,249	1,200
Gypsum and anhydrite, crude		1,088,472	1,100,000	1,309,426	482,310	480,000
Lime[e]		95,000	95,000	95,000	[2]67,650	67,000
Nitrogen: Ammonia, N content	thousand tons	789	788	728	735	700
Phosphate: Phosphate rock	do.	1,167	1,146	1,347	1,143	1,100
Salt, marine	do.	1,012	922	1,162	989	900
Sodium compounds:						
Soda ash		e45,000	47,711	47,000	52,180	52,000
Sodium sulfate		42,484	e42,000	45,677	41,418	41,000
Stone, sand and gravel:						
Basalt	thousand cubic meters	1,044	1,050	873	870	870
Dolomite[e]	thousand tons	500	500	500	500	500
Granite, dimension	cubic meters	2,000	e12,000	21,487	21,000	21,000
Gravel	thousand cubic meters	11,200	e11,000	11,527	11,000	11,000
Limestone and other calcareous n.e.s.	do.	14,785	e15,000	16,347	286	280
Marble blocks (including alabaster)	cubic meters	27,814	13,000	27,857	743	740
Sand including glass sand	thousand cubic meters	246	55	11,645	23,315	23,000
Sandstone	do.	417	e400	316	e300	300
Sulfur:						
Elemental, byproduct[e]		7,600	7,600	7,600	7,600	7,600
Sulfuric acid		e57,000	31,274	31,000	65,268	65,000
Talc, steatite, soapstone, pyrophyllite		e7,500	7,268	7,146	6,340	6,300
Vermiculite		e500	236	272	28	28
MINERAL FUELS AND RELATED MATERIALS						
Coke: Oven and beehive	thousand tons	e900	936	930	1,077	1,000
Gas, natural:						
Gross production	million cubic feet	195,200	195,000	226,000	240,000	[2]263,500
Marketed[e]	do.	155,000	155,000	155,000	155,000	155,000

See footnotes at end of table.

TABLE 1—Continued

EGYPT: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991[e]
MINERAL FUELS AND RELATED MATERIALS—Continued						
Petroleum and refinery products:						
Crude	thousand 42-gallon barrels	327,040	309,520	310,980	319,375	[2]320,470
Refinery products:[e]						
Gasoline and naphtha	do.	27,000	27,000	27,000	27,000	27,000
Kerosene and jet fuel	do.	20,000	20,000	20,000	20,000	20,000
Distillate fuel oil	do.	30,000	30,000	30,000	30,000	30,000
Residual fuel oil	do.	60,000	60,000	60,000	60,000	60,000
Lubricants	do.	1,000	1,000	1,000	1,000	1,000
Liquefied petroleum gas	do.	5,000	5,000	5,000	5,000	5,000
Asphalt	do.	2,000	2,000	2,000	2,000	2,000
Unspecified	do.	4,500	4,500	4,500	4,500	4,500
Refinery fuel and losses	do.	6,500	6,500	6,500	6,500	6,500
Total[e]	do.	156,000	156,000	156,000	156,000	156,000

[e]Estimated.
[1]Table includes data available through Mar. 25, 1992.
[2]Reported figure.

TABLE 2

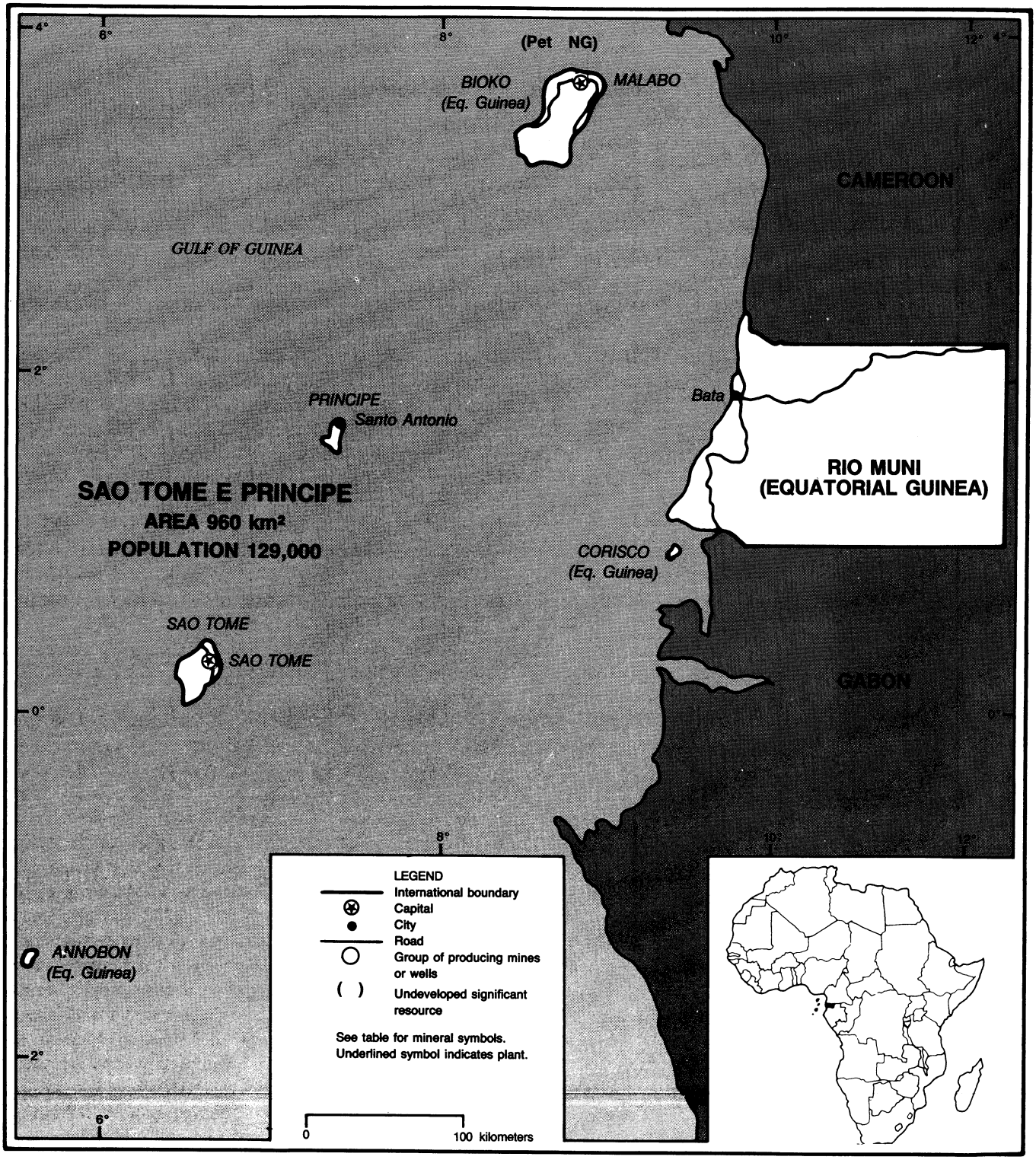
EGYPT: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	Aluminum Co. of Egypt (Government, 100%)	Nag Hammadi	170.
Cement	Helwan Portland Cement Co. (Government, 100%)	Helwan	1,400.
	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.

EQUATORIAL GUINEA AND SAO TOME E PRINCIPE

AREA 28,050 km² **POPULATION 379,000**



THE MINERAL INDUSTRY OF

EQUATORIAL GUINEA AND SAO TOMÉ E PRINCIPE

By Thomas P. Dolley

EQUATORIAL GUINEA

The Republic of Equatorial Guinea had no significant mineral industry in 1991. However, with the inauguration of production from the offshore Alba gas-condensate field, the mineral sector of Equatorial Guinea entered a new era. Equatorial Guinea is comprised of volcanic islands and territory in mainland Africa. Agriculture, forestry, and fishing account for approximately 60% of the GNP and practically all exports.

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

The most significant mineral industry event of 1991 was the initiation of production from the offshore Alba gas-condensate field in the Gulf of Guinea. The field is 36 km offshore, north of the island of Bioko, and had a lateral extent of 60 km in water 70 m deep. The producing zone is the Miocene Isongo sandstone that lies approximately 2,600 m to 3,000 m beneath the seabed. Exploration and development activity began in 1990 and 1991 by Walter International of the United States to exploit the petroleum and natural gas potential there. Walter International is the lead contractor of a group of smaller American independent oil companies that are exploiting the deposit. Samedan of north Africa, a subsidiary of Noble Affiliates Inc. of Ardmore, Oklahoma, in the United States, has a 40% equity interest in the project. The Government hoped for $10 million[1] per year in revenue when the Alba Field and associated facilities are completely on-stream.

Initially, only the condensates in the Alba Field will be exploited. Walter International plans to increase production to 4,000 to 5,000 bbl/d by the mid-1990's. Production should continue through the first decade of the 21st century. Walter International also planned for further drilling of a wildcat well in the Gulf of Guinea in early 1993. Located north of Bioko Island and south of the Cameroon maritime border, deeper hydrocarbon structures are the targets of this exploration.

By mid-1991, facilities onshore of Bioko Island were being constructed to separate the oil from the LPG and methane. This refining plant was being built by BCCK Engineering of Midland, Texas. Offshore Pipeline International of the United States was expected to build a 29-km-long submarine pipeline from the Alba Northern Platform to the island of Bioko. Additionally, Walter International subcontracted the construction of a $2 million multipoint conventional buoy mooring system for tankers up to 45,000 dwt to Oceaneering Production Systems of Houston, Texas. Completion of the mooring system occurred in late 1991. The system consists of four 8 ft=2.4 m by 15 ft=4.5 m mooring buoys anchored to the ocean floor with 76.2 mm chain and 13,620 kg anchors.

By yearend 1991, Walter International was producing from one well at the Alba Northern Platform at a rate of 567,000 m^3/d of gas and 2,200 bbl/d of condensate. As of early 1992 the gas was being flared; however, a future methanol or urea plant may be built. The condensate will be stored on the island of Bioko for later shipment by tanker. The Alba Northern Platform is to be linked by dual pipelines to a floating storage unit 3 km away. The pipeline's Intergrity Monitoring System will be contracted to the United Kingdom's Ferranti International and Chevron Oil United Kingdom, which will continuously check for leaks in the two pipelines. The system can accommodate additional pipelines if necessary.

SAO TOMÉ E PRINCIPE

Sao Tomé e Principe is a dual island archipelago just north of the Equator in the North Atlantic Ocean. South of Nigeria and west of Gabon, the Sao Toméan economy centered on the production and export of the cash crop cocoa. Sao Tomé e Principe had no significant mineral industry in 1991. Per capita GNP in 1990 was US$380.[2] The population in 1991 was approximately 129,000 people. The island nation had gained its independence from Portugal in 1975. Sao Tomé e Principe elected a new president in 1991 and made a formal transition from single party rule to a multiparty democracy.

Primarily an agrarian nation, cocoa exports represent 90% of total exports. The fisheries sector is also an important economic contributor.

The legal system of Sao Tomé was based on the Portuguese legal system and customary law. Decree Law 30-80 of July

1980 does not relate to mining investment specifically, but does stipulate the conditions for foreign investment.

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[1]Where necessary, values have been converted from Communauté Financiere Africaine francs (CFAF) to U.S. dollars at the rate of CFAF285.09=US$1.00.

[2]Where necessary, values have been converted from Sao Toméan dobras (STD) to U.S. dollars at the rate of STD239.99=US$1.00.

OTHER SOURCES OF INFORMATION

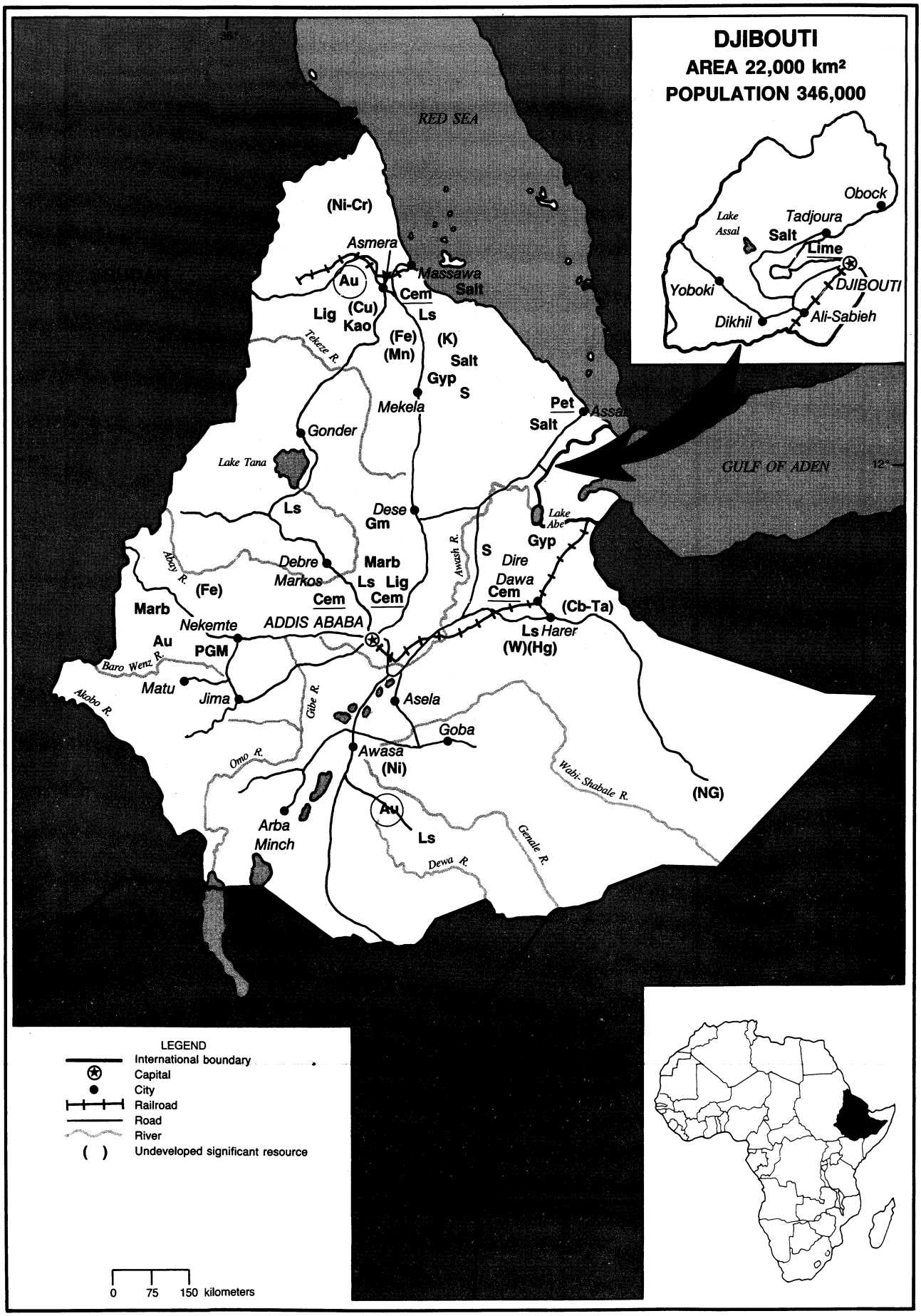
Agencies

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 Sao Tomé e Principe)

ETHIOPIA AND DJIBOUTI

AREA 1,221,900 km² **POPULATION 53.2 million**



THE MINERAL INDUSTRY OF

ETHIOPIA AND DJIBOUTI

By Lloyd E. Antonides

ETHIOPIA

Minerals-related activities in 1991 remained a small part of Ethiopia's GDP, which was estimated at $6.5 billion,[1] about the same as in 1990. It continued to be one of the world's lowest GDP per capita. The civil war increased in tempo and resulted in an overthrow of the statist military Government in Addis Ababa in May. This affected all parts of industry and society in the country. A democratically oriented, free-market leaning, multiparty coalition formed a new transitional Government. However, the existing Government structure, at least below subministry level, did not appear to be changed significantly. The availability of definitive mineral information declined further.

Construction materials, including cement, probably remained the most significant mineral commodity group both in value and quantity. Gold again was the principal export revenue-earning mineral commodity. A variety of other solid metallic and industrial minerals was produced. Many more, including lignite coal, were known to occur in deposits of potentially economic size and grade in various parts of the country, which was nearly double the size of Texas. Most of the hard-rock economic minerals were in the mountainous high plateau that comprised the western two-thirds of the country. Cutting through that region was a prominent rift valley, a funnel-shaped area extending southwesterly from around Djibouti in the northeast to Lake Turkana in the southwest. That valley, including the northern, below sea level, wide part of the funnel, was the locale for known evaporites and salt lakes. The eastern third of the country, a dry southeasterly sloping plain region, was mostly limited to oil and gas possibilities. Such possibilities also exist in the Red Sea area in the north, off Massawa, and along the western border with Sudan.

The economy is based on agriculture, which normally provided about 50% of GDP and about 80% of exports and employment. Coffee was the major source of export revenue for many years. Livestock products were another principal export. Periodic droughts, as well as soil erosion, were major problems for the agricultural sector. Manufacturing usually contributed less than 20% to GDP. Consumer price inflation typically was only about 5% in recent years despite the political turmoil. Unemployment was high and included many armed, former troops of the previous Government. Early in 1992 a number of countries and international agencies were offering financial assistance to the transitional Government to carry out reforms and rehabilitation of services as well as for food and medical supplies.

Long-existing economic problems were exacerbated by the political changes and continuing turmoil. There were periodic armed conflicts by contesting ethnic groups against each other as well as troops of the Tigrean-dominated transitional Government. Eritrea Province, which covered the northern point of the country and extended south along the Red Sea to Djibouti, was functioning as an autonomous state. It included the country's only ports, Massawa and Assab. The latter served most of the country and was the site of the sole refinery, but the port had management problems and its main access, by road, was subject to disruptions. The only railroad connection to the sea for most of the country, from Addis Ababa to the port in neighboring Djibouti, also was frequently closed as a result of hostilities.

Government policy to promote both foreign and domestic private investment in industry, and especially mining and petroleum, was expected to gain even more emphasis. The new transitional Government was drafting new investment and tax provisions to encourage ventures in certain crucially needed sectors. A one-stop investment center was available in Addis Ababa. To attract mineral investment in particular, a UN-assisted draft of a new mining code appeared to have been generally agreed upon and was awaiting Government action. Other UN minerals-oriented projects were continuing, which included assisting the Ministry of Mines and Energy in the reorganization and training of the staff to better monitor production activities, in training the staff to help improve small-scale mining operations, in preparing a mining investment promotional brochure, and in a multiprong effort to expand mineral exploration.

In December, 12 mining engineers were reported to have arrived at a university in Perth, Australia, to begin a training course aimed at helping Eithiopia to develop its gold industry. The course was described as covering operation and maintenance of sophisticated mining equipment. The report indicated that the Ethiopian Government was funding the program.

A new U.S.-educated, minerals-experienced Minister of Mines and Energy was named in August. The Ministry included three components involved in minerals: a geological mapping and mineral exploration group,

a mining monitoring and regulatory control division, and a mineral development and production corporation.

Mineral production data for the year were not available, but it was estimated that the civil war resulted in a reduction in volume of 15% from 1990's output, except for gold. The new Legi Dembi gold mine was in production. *(See table 1.)*

Trade data also were not available for the year. However, as in prior years, coffee and livestock products were probably the major exports and gold the major mineral export. Petroleum and petroleum refinery products were undoubtedly the principal imports, although food was of considerable importance because of the effects of drought and civil war. For a few years, Ethiopia's major trading partners typically included Germany, Italy, Japan, and the former U.S.S.R. The United States and Germany were the leading destinations for coffee. Ethiopia was an important market in Africa for U.S. goods, including mechanical equipment and chemicals, especially fertilizers.

The structure of the mineral industry remained dominated by the Government organizations that had assumed substantial ownership and control of all mineral activities under the previous socialist regime. However, the announced policy of the new coalition was to promote private ownership and investment. A sizable portion of mineral output was produced by artisans, and small cooperatives and units were being guided and encouraged to grow into larger organizations.

Gold mining at the Lega Dembi open pit in the Adola gold district about 350 km south-southeast of Addis Ababa was officially inaugurated in February. However, some bullion had been poured early in 1990 and reports indicated the design production rate of 3,000 kg/a of bullion was reached shortly thereafter. Nevertheless, the Government-reported figure for all gold mines in the year ending July 1990 did not show a significant increase, and for 1991 the political events probably had a negative effect on all production.

Feasibility studies for the main gold project were done by Seltrust Engineering, London, and BRGM of France. The plant was designed by Davey McKee Stockton Ltd., which also supervised construction. It was designed to receive 3,000 mt/d of ore for processing, first in a gravity separation section to recover free gold as an amalgam that was melted to produce bullion, contributing 50% to 60% of the total plant gold recovery. This was followed by cyanide tank-leaching, carbon-in-pulp adsorption, hot pressure-stripping, electrowinning, and calcining to recover the other 40% to 50% of the gold that was then also melted into bullion. The owner-operator was the Ethiopian Minerals Resources Development Corporation (EMRDC). The $90 million project was financed by the African Development Bank (ADB) and the European Investment Bank (EIB), as well as the Government.

Phosphate production possibilities were increased by ADB's announcement early in 1992 of a projected $27 million loan to the Government for development of the Bikalal deposit. Other sources describe it as an apatite-magnetite-ilmenite occurrence within a larger intrusion, about 300 km west of Addis Ababa, north of Gimbi, that has been studied since the early 1980's.

Petroleum exploration in an area along the border with Sudan in the central western part of the country, about 500 km west of Addis Ababa, was announced by International Petroleum Corp. It had a production-sharing agreement on the so-called Gambela concession.

Petroleum refining operations at Assab, on the Red Sea about 600 km northeast of Addis Ababa, were to be resumed shortly according to a news release in November. The plant had been shut down due to the civil war, presumably for several months. Operations were to be based on an agreement between the provisional Eritrean Government and the transitional Ethiopian Government that was subject to monthly renewal. Production was to go to both countries, and service charges were to be paid by the Ethiopian Government.

The infrastructure apparently did not suffer much physical damage in the closing days of the civil war. However, operations faced difficulties, especially in administration and also due to sporadic hostilities. Roads in several areas, especially in the east and south, and the railroad to Djibouti were periodically impassable. Early in 1992 agreements were concluded between the Ethiopian and Eritrean Governments to make Assab a free port for Ethiopia, which eased earlier problems. Additional electrical distribution lines were still under construction, and further harnessing of the underutilized hydroelectric possibilities was being planned.

The outlook for Ethiopia's mineral industry would be moderate growth, especially in industrial minerals exploitation considering the deposits available, if the political situation could be stabilized. Then development would depend on the Government pursuing policies that offer competitive attractions for the necessary financing.

DJIBOUTI

Little definitive news of activity related to the mineral industry of Djibouti was received in 1991. Although the industry was considered of very minor economic importance and production data were not available, there was production of construction mineral commodities, such as brick and tile clays, sand and gravel, and crushed and dimension stone. Most of these were particularly needed for use in the several road construction and rehabilitation projects being funded mostly by foreign aid. Lime production from an old limestone quarry and kiln just west of Djibouti city and solar-evaporated marine salt from facilities near Tadjoura, north across the bay from the city, probably continued. Bottling of mineral water was another established activity.

A potential for production of other mineral commodities was documented for some time. In the late summer of 1990, drilling for gold in the west near Yoboki was said to be in progress but results were not announced through 1991. The

parties involved were not identified. Industrial minerals were of periodic interest, including marble, granite, gypsum, and perlite. In September, bids were invited to supply equipment for a granite and marble quarrying operation at an undisclosed location. The African Development Bank was providing some financing for the presumably private venture that appeared to be open for outside participation. Foreign aid-funded efforts to develop the country's significant geothermal energy potential continued to be periodically announced as they were since 1973. One report mentioned some of the wells were found to be plugging with precipitated lead, suggesting a relationship to the Great Rift and the seafloor emanations in the central Red Sea off Sudan. Occasionally, reports continued to mention an untested petroleum potential.

The economy of the Massachusetts-size, former French terrritory was overwhelmingly dependent on activities related to transshipping and refueling at the port of Djibouti. The port, after which the Republic was named upon independence in 1977, was developed by the French around 1900, across from the British port of Aden. Both were on the busy sea lanes through the strategically important Gulf of Aden leading from the Red Sea into the Indian Ocean. The French also were instrumental in establishing the Djibouti-Addis Ababa railroad completed in 1917. A French military base continued to be maintained and was a source of foreign exchange. Banking was one of the few growing sectors of the rather stagnant economy. Industry and agriculture contributed very little to the GDP, which was estimated at about $350 million.[2] Stock breeding was the principal activity in rural areas. Development of the agriculture sector was hampered by the climate, hot and mostly dry, and terrain, a few patches of arable land among mostly volcanic rock-strewn desert wastes and some salt lakes. Year-round vegetation was mostly limited to the highlands north of Tadjoura. In 1991, although inflation was normal, low at less than 5%, so was unemployment, very high at about 50%. The work force included a sizable expatriate component and included many refugees from neighboring countries. The nation was heavily dependent on foreign aid to balance its payments and to develop projects. The country did offer a free trade zone and welcomed private investment with favorable laws and bilateral agreements. Early in 1992 the Government was reportedly finalizing a new mining code and related regulations.

However, political instability became more overt during the year, and early in 1992 separatist forces were occupying areas north and east of Tadjoura.

Little change in the economy or mineral industry was expected in the future, which became more clouded due to the political developments.

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

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

OTIIER SOURCES OF INFORMATION

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

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

TABLE 1
ETHIOPIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991e
Cement, hydraulic		350,321	405,504	e370,000	340,000	290,000
Clays:e 3						
Brick		17,000	23,000	8,000	17,000	14,000
Kaolin (China clay)		2,500	750	390	670	570
Diatomite e		340	20	e10	3	3
Gold: Mine output, Au content	kilograms	643	728	745	848	2,000
Gypsum and anhydrite, crude e 3 4		1,400	1,900	2,100	2,250	1,900
Lime		5,623	r e 3,000	4,000	4,000	3,400
Petroleum refinery products:6						
Liquid petroleum gas	thousand 42-gallon barrels	75	56	74	65	40
Gasoline	do.	1,059	865	1,060	904	600
Jet fuel	do.	421	382	503	400	250
Kerosene	do.	106	95	82	40	60
Distillate fuel oil	do.	1,612	1,294	1,534	1,409	850
Residual fuel oil	do.	2,269	2,056	2,412	2,271	1,300
Other	do.	550	340	50	468	200
Total	do.	6,092	5,088	5,715	5,556	3,300
Platinum: Mine output, Pt content e	grams	51,040	51,485	1,500	1,500	1,300
Pumice e 3		26,000	43,000	23,000	23,000	20,000
Salt:e						
Marine		120,000	120,000	100,000	100,000	85,000
Rock and marine		135,000	135,000	110,000	110,000	94,000
Scoria e		7,000	12,000	10,000	e10,000	8,500
Stone, sand and gravel:e						
Construction stone, crushed3	thousand tons	1,090	1,230	4,630	1,560	1,300
Dimension stone		5600	600	600	53,300	2,800
Limestone4	thousand tons	575	5145	150	100	85
Sand3	do.	680	990	775	1,250	1,000

eEstimated. rRevised.

[1]Data are for year ending July 7 of the year listed. Includes data available through July 1, 1992.

[2]In addition to the commodities listed, production of soda ash (1,408 metric tones in 1990 and 18,465 metric tons in 1991) and tantalite (6 metric tons in 1990 and 10 metric tons in 1991) was reported. Also some lignite and semiprecious gemstones reportedly were produced and some additional crude construction materials (clay, sand, gravel, stone, etc.) were presumably produced locally on a small scale, but information is inadequate to reliably estimate output levels.

[3]Reported as volume or pieces; conversions to metric tons are estimated.

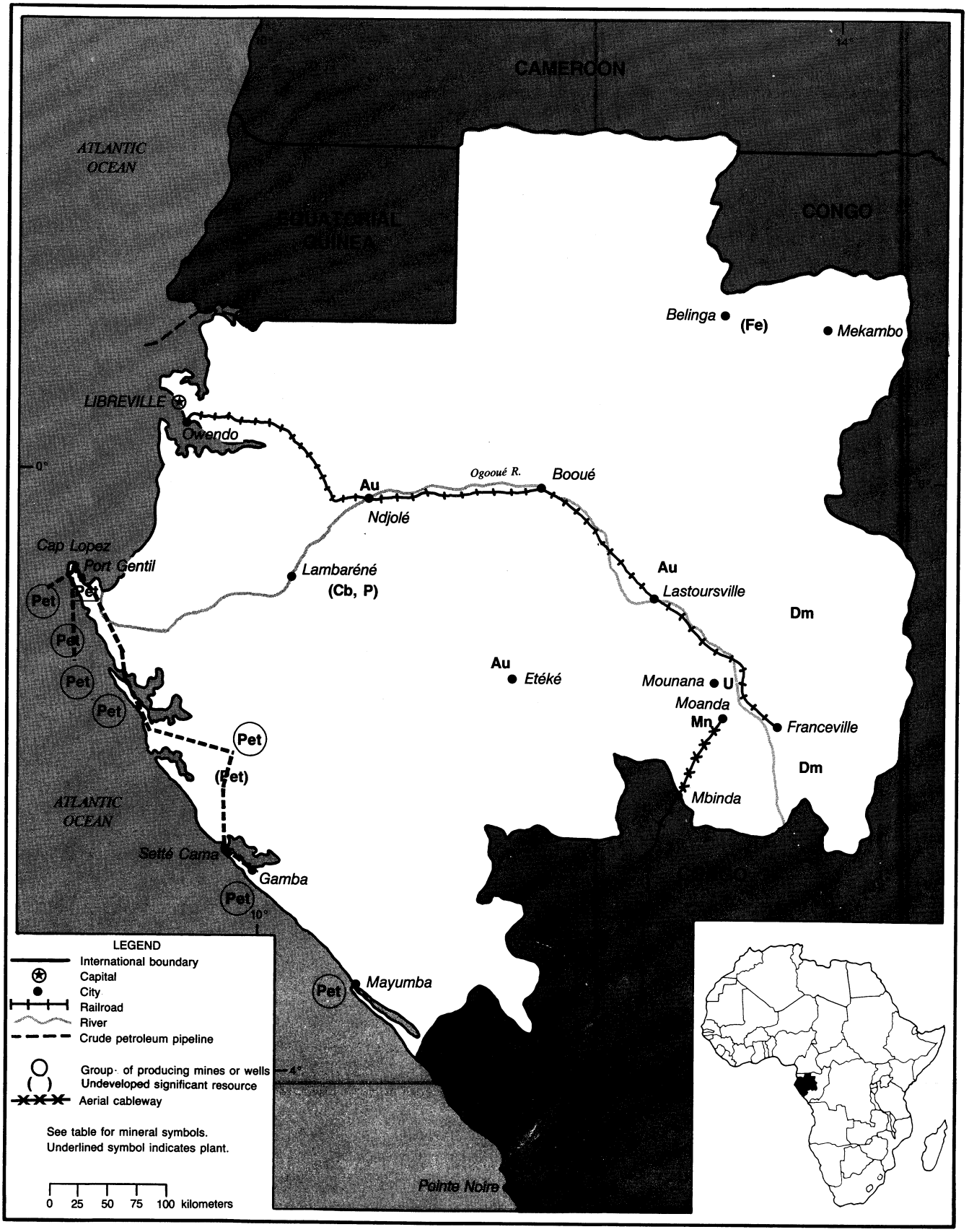
[4]Presumably does not include production for cement manufacture. Normally the manufacture of cement requires 30 to 50 kilograms of gypsum and 1.5 to 1.8 tons of limestone per ton of finished cement.

[5]Reported figure.

[6]Refinery fuel and losses were distributed among individual products except for 1990, which were estimated at 394,000 barrels and included in "Other." Data may not add to totals shown due to independent rounding.

GABON

AREA 267,670 km² **POPULATION 1.09 million**



THE MINERAL INDUSTRY OF

GABON

By Audie L. King

Following 2 years of double-digit growth in GDP, Gabon's economy, which is largely reliant on the mineral industry, stagnated in 1991. The performance of the mineral industry was mixed in both the petroleum and nonfuels mineral sectors of the economy. Gabon, the smallest OPEC member, continued to be the third largest petroleum producer in sub-Saharan Africa. The production of crude oil, the nation's principal export commodity, increased by about 10% to about 300,000 bbl/d, as the high levels of production attained following Iraq's invasion of Kuwait were maintained throughout the year. As in the previous 2 years, most of the gains came from the Rabi Kounga Field, which experienced its first full year at full production during 1991. However, because of a 12% fall in the average price of crude oil on the world market, the value of Gabon's petroleum output remained about the same as that in 1990. A slowdown in the world's economy caused manganese exports to fall by about 17%. Gabon continued to be the world's fourth or fifth largest producer of manganese ore and the largest producer of battery-grade manganese ore. The depressed uranium market caused the Franceville Uranium Mining Co. (Comuf) to cut costs by consolidating mining operations and laying off a number of employees.

In 1990, the latest year that data were available, Gabon's GDP grew by an estimated 13% to about $4.0 billion.[1] The nation's economy expanded by a similar 13% in 1989 following 3 years of deep depression. Gabon's mineral industry accounted for about 61% of the nation's GDP and 92% of total exports. The production of crude oil and refined petroleum products accounted for about 54% of the GDP and 82% of total exports. The nonfuel mining sector, which was dominated by manganese and uranium mining, accounted for about 7% of the GDP and about 10% of total exports.

GOVERNMENT POLICIES AND PROGRAMS

Provisions in the new constitution that require Government officials to have at least 7 years of professional experience, be at least 35 years of age, and to not have lost a public election during the previous 18 months forced the resignation of seven ministers in the present Government. Some ministerial changes may affect mineral policy. It is still uncertain if the new Minister of Mines, Petroleum, Energy, and Hydraulic Resources will carry out Government plans to create a national petroleum company that would operate in conjunction with other private companies.

The Government's new economic and financial program for 1991-92 sought to generate growth in the nonoil sector while limiting the rate of inflation. Special emphasis was placed on reducing the budget deficit. Projected gaps were to be filled mainly by external debt rescheduling. To facilitate anticipated financial maneuvers, the 1992 state budget addressed privatization of state-owned enterprises and reduction in Government spending. Only about one-third of the $31.6 million in International Monetary Fund funds that were approved in 1989 were actually distributed to Gabon because the Government was unable to stay within an agreed-upon spending range. It gave in to public pressure to loosen the economy and gave large salary increases to Government workers.

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.

PRODUCTION

Gabon began producing petroleum at its full capacity of 300,000 bbl/d during the latter part of 1990 as the new Rabi Kounga Field came into full production and continued to do so throughout 1991. This resulted in the production of 9.5% more crude oil in 1991, following a 32% increase in 1990. In February of 1992, Gabon's Government decided to cut crude oil production 7,550 bbl/d because of falling crude oil prices on the world market and to meet OPEC quotas that allowed it to produce only 285,000 bbl/d. It may, however, be difficult for Gabon to remain committed to these lower production limits because the Government relies on proceeds from the petroleum sector for more than 50% of its budgetary needs. Gabon's only oil refinery continued to operate well below its capacity of 8 to 9 Mbbl/a.

Manganese production fell sharply in 1991 as combined ore shipments from the port of Owendo in Gabon and Pointe Noire in the People's Republic of the Congo fell by 16.9%. This fall in exports was the result of a slowdown in the world's economy and political difficulties that caused all ore shipments via the People's Republic of the Congo to be suspended as of September 20, 1991.

Uranium production continued to fall as the industry struggled to cut costs by

consolidating facilities and reducing the size of the work force.

A small quantity of gold was produced, mostly from artisanal operations. Most of this gold was smuggled out of the country so the true output was unknown. Similarly, most of Gabon's diamond output went unreported. *(See table 1.)*

TRADE

Although 9.5% more petroleum, Gabon's principal export commodity, was produced in 1991, the total value of exports probably declined slightly owing to falling crude oil prices following the Persian Gulf conflict. In 1990, as production at the Rabi Kounga Field approached full capacity, the value of Gabon's total exports increased by 60% to $2.6 billion. This followed a 40% increase in exports during 1989. Petroleum constituted about 82% of Gabon's 1990 exports, up from a 74% share in 1989. Other major export commodities included manganese, wood, and uranium. In 1990, the latest year these data were available, the United States took 27% of Gabon's exports, 97% of which was petroleum. France took 31% of total exports and the United Kingdom, 19%. In 1991, crude oil exports to the United States increased by 31% to 30.6 Mbbl.

Imports decreased by 29% in 1990 to about $650 million despite a modest growth in the GDP. Almost one-half of Gabon's imports was machinery, equipment, and manufactured goods in support of the petroleum and mining sectors. Reliable 1991 trade data were not available, but total imports probably remained close to 1990 levels as capital spending in the transportation, petroleum, and mining sectors remained at low levels. France furnished about 47% of total imports, while the United States accounted for about 9%. Other major suppliers included Belgium, the Federal Republic of Germany, Italy, Japan, the Netherlands, and the United Kingdom.

STRUCTURE OF THE MINERAL INDUSTRY

Gabon's oil production is from four producing companies. Two companies, however, ELF-Gabon and Shell Gabon, accounted for most of the petroleum output. Other mineral production came from an oil refiner, a cement manufacturer, one manganese mine, and two uranium mines.

The Gabonese Government announced plans to significantly reduce some of its petroleum holdings. Its equity participation in the country's petroleum and mining companies ranged from 15% to slightly more than 90%.

Gabon's limited diamond and gold production was by private individuals using artisanal methods. *(See table 2.)*

Gabon's total salaried labor force was estimated to number about 120,000, of which about one-third was in the industrial and commercial sectors. The mineral industries employed about 9,000 workers, of which about 5,000 were employed in the petroleum sector. In addition, minerals-related employment in the transportation sector numbered several thousand. Gabon's low population necessitated the extensive employment of expatriate labor, including workers from neighboring countries. Wages in Gabon are very high by African standards.

COMMODITY REVIEW

Metals

Manganese.—Compagnie Minière de l'Ogooué (Comilog) experienced its third full year of manganese ore shipments via the Trans-Gabon Railroad to the minerals port of Owendo. Shipping costs were cut by $20 million per year when the Trans-Gabon Railway opened its services to the new port at Owendo. An estimated $9 million of the savings was in salaries and labor costs and $11 million was in transportation costs.

Comilog ranked among the world's lowest cost manganese producers. Costs will be even lower after September 20, 1991, when Comilog stopped all transport of ore via the longer, more costly route to Pointe Noire in the People's Republic of the Congo. Shipments along the Congolese line were stopped pending completion of an investigation of a train wreck on the line near Luombo.

Manganese ore shipments dropped by 16.9% in 1991 to 1,833,000 tons, despite an increased production capacity owing to the completion of a new ore blending facility in mid-1991.

The Government continued to investigate the feasibility of building a ferromanganese plant. The latest scheme proposes utilizing natural gas, from petroleum fields, that is currently being reinjected or flared. Such a plant would process an estimated 12 Mmt of currently unsalable stockpiled fines.

Uranium.—Comuf recorded a deficit of $11.7 million in 1990, the latest year data were available. To cope with depressed world prices and the prospect of a prolonged period of low demand, Comuf reduced its total number of employees from 1,119 in 1986 to only 818 as of January 1, 1991. To help pay for a 15% across-the-board salary increase, Comuf planned to reduce costs by concentrating its production efforts on only one mine.

A major sales contract with Belgium was canceled. Most of Comuf's sales were to France, Italy, and Japan.

Mineral Fuels

The massive Rabi Kounga Oilfield, operated by Shell Gabon, was discovered in 1985. By the end of 1990, it was producing at its peak capacity of 150,000 bbl/d. Gabon expanded crude oil production by almost 90% since the Rabi Kounga onshore oilfield began production at the beginning of 1989. The combined output of Gabon's other oilfields averaged about 160,000 bbl/d, of which about two-thirds was from the Mandji Field complex, operated by ELF-Gabon near Port Gentil. In total, Gabon produced oil from almost 500 wells, in 6 oilfield complexes, most of which were offshore. During 1991, Gabon celebrated the drilling of its 1,000th oil well drilled on the Mabora permit about 50 km from Lambrene.

The promise of new discoveries following the discovery of the onshore Rabi Kounga Oilfield coupled with higher oil prices led to a renewed interest in oil exploration. This was especially true onshore where production costs were much lower, averaging only $3 to $4 per bbl compared with an average of $13 offshore. More than one-half of Gabon's oil acreage came open for bid in 1991. Gabon's fifth round of bids for 13 deep-water blocks closed on November 30, 1991. Most of the world's major world oil companies were believed to have submitted bids. During the first quarter of 1992, ELF-Gabon was awarded all of the 13 blocks.

As compensation to the many foreign oil companies that submitted unsuccessful bids, the Government indicated that it would market its 40% share of 13 exploration permits recently awarded to ELF-Gabon.

Amerada Hess, an American company, paid $300 million for 10% of the Government's holdings in the Rabi Kounga Oilfield. The Government retained a 3.33% stake in a newly formed subsidiary Amerada Hess Production Gabon.

Following the expiration of its exploration concessions, the American Oil Co. (Amoco) announced that it is winding up oil exploration in Gabon owing to economic constraints. Amoco had operated in Gabon since 1983. It produced 18,000 bbl/d during 1991 at a large offshore oilfield.

ELF-Gabon started up the Coucal Field, 25 km northeast of Gabon's onshore Rabi Kounga Oilfield. Production is predicted to peak at 18,900 bbl/d. The field is estimated to contain 36.5 Mbbl of recoverable crude oil. Oil will be transported through a short spur into the main pipeline serving the Rabi Kounga Oilfield.

Amoco Gabon Exploration Co. is proceeding with plans to develop its new offshore oilfield, Nkombe Marin. A decision to use a floating production storage system is expected to increase the economic viability of the field. Officials said that it was too early in the production cycle to predict the reserves or the per barrel price of production.

During the first quarter of 1991, a new trade union, Union des Travaileurs du Petrole (UNDP), was formed.

Reserves

Gabon's high-grade manganese oxide ore reserves, about 50 km northwest of Franceville, were in excess of 200 Mmt grading about 48% Mn according to Comilog. About 25% of these reserves was in the immediate area of the existing mine. The Moanda area also had a large inventory of manganese carbonate, although no plans existed to mine this material.

Gabon's oil resources were large but are not well defined. The recently discovered Rabi Kounga Oilfield, onshore about 100 km north of Gamba, and its satellite deposits contain about 400 to 600 Mbbl of recoverable crude oil. Further exploration was expected to increase the reserves of this field. The combined reserves of the other producing fields and undeveloped discoveries were believed to total about 700 Mbbl. The Rabi Kounga discovery generated a great deal of interest in onshore exploration, and it was expected that future offshore and onshore exploration would significantly increase the country's known reserves. The Minister of Mines and Hydraulic Resources believes that Gabon's oil reserves could ultimately last at least another 20 years at current levels of production. If this is so, Gabon's total petroleum reserves exceed 2,000 Mbbl.

Reserves of natural gas were likewise significant, being in excess of 16 billion m^3, but again are poorly known. Currently, almost all of the country's gas production was flared or reinjected.

Uranium reserves were only well defined in the Mounana area, where total reserves in 1982 were given by the Government as about 33,000 tons of uranium metal. The total reserves in 1982 were distributed among four deposits: Boyindzi, 3,000 tons; Oklo, 15,000 tons; Okélobondo, 5,000 tons; and Mikoulougou, 10,000 tons. Production subsequent to 1982 had all been from the Oklo and Boyindzi deposits and has amounted to about 10,000 tons of uranium metal. The 1982 reserves were, however, based on more favorable economic conditions than those that existed in 1991. Recoverable reserves for yearend 1991 amounted to 12,000 to 15,000 tons of uranium metal. Gabon had very high uranium production costs, but had recently taken steps to reduce its overhead. If world uranium prices remain low, it is uncertain how long Gabon would be able to maintain its current level of production and sales.

Gabon had numerous deposits of iron ore, the most significant of which were in the northeast part of the country. The largest and best known of these was the Belinga deposit, 100 km west-northwest of Mekambo. It is an itabirite-type iron deposit that occurs in an east-west trending belt of Precambrian phyllites and gneisses. According to the Government, the resource at Belinga amounted to 566 Mmt grading 64.24% Fe, 2.18% silica, and 0.122% phosphorus. Of this amount, approximately 345 Mmt was low phosphorus (less than 0.07% phosphorus) material. The Boka Boka deposit, 40 km southwest of Mekambo, had a resource of 194 Mmt grading 62.5% Fe, 3.57% silica, and 0.106% phosphorus. The Batouala deposit, 70 km southwest of Mekambo, had a resource of about 100 Mmt grading 65.7% Fe. Of these deposits, only the Belinga deposit had been seriously considered for mining. However, exploitation of the Belinga deposit would require the construction of a 235-km extension of the Trans-Gabon Railroad from Booué to the deposit and the construction of suitable ship loading and storage facilities at the port of Owendo. This construction, and hence the exploitation of the Belinga deposit, was considered uneconomic under current market conditions.

The Mabounié carbonatite, 40 km east-southeast of Lambaréné, was discovered in 1987 during an exploration program carried out by the Bureau de Recherches Géologiques et Minières (BRGM). Subsequent research has determined its potential as a phosphate resource. According to the Government, the carbonatite contained about 85 Mmt of

phosphate rock that graded 24% P_2O_5. About 15 Mmt of this phosphate rock also contained 2% Cb_2O_5. An additional 27 Mmt of rock had between 1.78% and 2.0% Cb_2O_5. Tests showed that the columbium resource would not be economically viable except possibly as a byproduct of phosphate mining, and the economics of mining the phosphate resource had yet to be demonstrated.

Gold occurs at many locations in the Precambrian granitic rocks that dominate the eastern two-thirds of Gabon, but total production, virtually all by artisanal miners, has been small. In 1990, the BRGM's Transgabon Inventory Program conducted detailed gold exploration in the Pounga area, near Etéké and the Magnima area, southwest of Lambaréné where the gold mineralization is still being evaluated. The drilling program increased the Pounga area's reserves to several tons.

Potentially economic occurrences of barite, copper, lead, marble, talc, and zinc had also been reported.

INFRASTRUCTURE

Gabon's only railroad, the Trans-Gabon Railroad, ran 669 km from Owendo to Franceville. The 1.437-m-gauge track was completed in 1986. A short spur to the manganese mine at Moanda was inaugurated shortly thereafter. Plans to build a 235-km extension northeast from Booué to the Belinga iron deposit were on hold until world market conditions for iron ore greatly improve.

Shipment of manganese ore commenced in December 1988, following the completion of the ore shiploading facilities at the port of Owendo. Manganese ore railing capacity was at least 3 Mmt/a, utilizing trains of 70 to 96 rail cars hauling 6,000 to 8,000 tons per trip. The railroad was also used to export the country's uranium production. In addition, in 1988, the latest year that such data were available, the railroad carried 580,000 tons of lumber, 80,500 tons of cement clinker, 20,000 tons of fuel, about 150,000 tons of general freight, and about 250,000 passengers. Overall responsibility for running the railroad was with the Office de Chemin de Fer Transgabonais.

Prior to the completion of the ore port at Owendo, Gabon's manganese ore production was shipped out via a 76-km aerial cableway to Mbinda in the Congo and then by 296 km of railroad to the Congolese port of Pointe Noire. Shipments via this route, which had a capacity of about 3 Mmt/a, ceased as of November 1991. Gabon had about 1,600 km of navigable waterways, the most important of which is the 310-km stretch of the Ogooué River from Port Gentil to Ndjolé. It also had about 7,500 km of roads, of which only about 10% was paved, including city streets. Most of the roads were in poor condition.

Electricity production in 1988, the last year for which data were available, was 906,428,000 kW•h. Total installed generating capacity was about 310,000 kW. The nation's three hydroelectric plants provided 166,000 kW of this capacity. The Kinguélé and the Tchimbélé hydroelectric power stations were both on the Mbéi River about 110 km east of Libreville. They had 72-MW and 57-MW, respectively, of capacity. The Poubara station, on the Ogooué River about 40 km south of Franceville, had a 37-MW capacity. Both the manganese and uranium mines utilized power from the Poubara station. The bulk of the remainder of Gabon's electrical capacity was supplied by 24 thermal power stations. Much of the country's telecommunication system was solar powered.

A $50 million manganese ore storage and shiploading facility at the port of Owendo were inaugurated at yearend 1988. The mineral port at Owendo could handle ships of up to 42,000 dwt, drawing 11 m. As the water depth was only 11 m, ships with drafts up to 12.5-m could enter and leave at high tide. Ore was loaded by a 900-m conveyor at a maximum rate of 3,000 mt/hr. There was storage at the port for about 700,000 tons of ore. General port affairs were handled by the parastatal Offices des Ports et Rades. The mineral port was run by Société du Port Minéralier d'Owendo, the majority owner of which is Comilog.

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

OUTLOOK

The recent discovery of the Rabi Kounga and other oilfields will ensure that the economy of Gabon will continue to be dominated by the petroleum sector for many years. Increased drilling and seismic activity should lead to further discoveries and increased petroleum production.

Gabon's manganese industry should continue to depend on fluctuations in the world market. With recent infrastructural improvements, Gabon is well prepared to increase its production to record levels if demand for its high-grade ore should increase.

The uranium industry may remain depressed for the foreseeable future. Recent efforts to streamline operation should help the industry operate more profitably while producing smaller quantities of ore.

The long-term potential for the development of a more diversified

mineral industry is very good. Even though Gabon's geologic potential is good, the mining industry's progress will likely be slow. To become economically viable, many of Gabon's recently discovered deposits will require substantial infrastructural improvements.

[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate CFAF260=US$1.00.

OTHER SOURCES OF INFORMATION

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

TABLE 1
GABON: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991[p]
Cement, hydraulic[3]		140,196	132,038	115,442	115,000	117,000
Clinker		106,000	104,000	113,000	113,000	125,677
Diamond, gem and industrial[e]	carats	500	500	500	500	500
Gas, natural:[4]						
Gross	million cubic meters	1,770	1,904	2,100	1,965	2,000
Dry gas[e]	do.	113	127	—	—	—
Gold, mine output, Au content[5]	kilograms	79	138	81	80	50
Manganese:						
Metallurgical-grade ore, gross weight (50% to 53% Mn)		2,216,039	2,186,158	2,500,800	r2,360,390	6,1,565,348
Pellets, battery- and chemical-grade, gross weight (82% to 85% MnO_2)		187,135	67,977	91,607	r62,578	655,040
Total		2,403,174	2,254,135	2,592,407	r2,422,968	61,620,388
Petroleum:						
Crude	thousand 42-gallon barrels	56,243	57,895	75,819	100,000	6109,500
Refinery products:						
Gasoline	do.	447	459	r730	r800	800
Jet fuel and kerosene	do.	485	499	r730	r800	800
Distillate fuel oil	do.	1,121	1,153	r1,825	r1,800	1,800
Residual fuel oil	do.	1,100	1,080	r1,825	r1,800	1,800
Other[e]	do.	100	100	100	100	100
Refinery fuel and losses[e]	do.	150	150	r365	r365	365
Total[e]	do.	3,403	3,441	r5,575	r5,665	5,665
Uranium oxide (U_3O_8), content of concentrate		934	1,094	1,047	828	700

[e]Estimated. [r]Revised.
[1]Table includes data available through May 14, 1992.
[2]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) is also produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.
[3]Includes cement produced from imported clinker.
[4]Reinjected for repressuring.
[5]Gold production figures likely do not include production smuggled out of the country, for which there are no reliable data.
[6]Reported figure.

TABLE 2

GABON: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

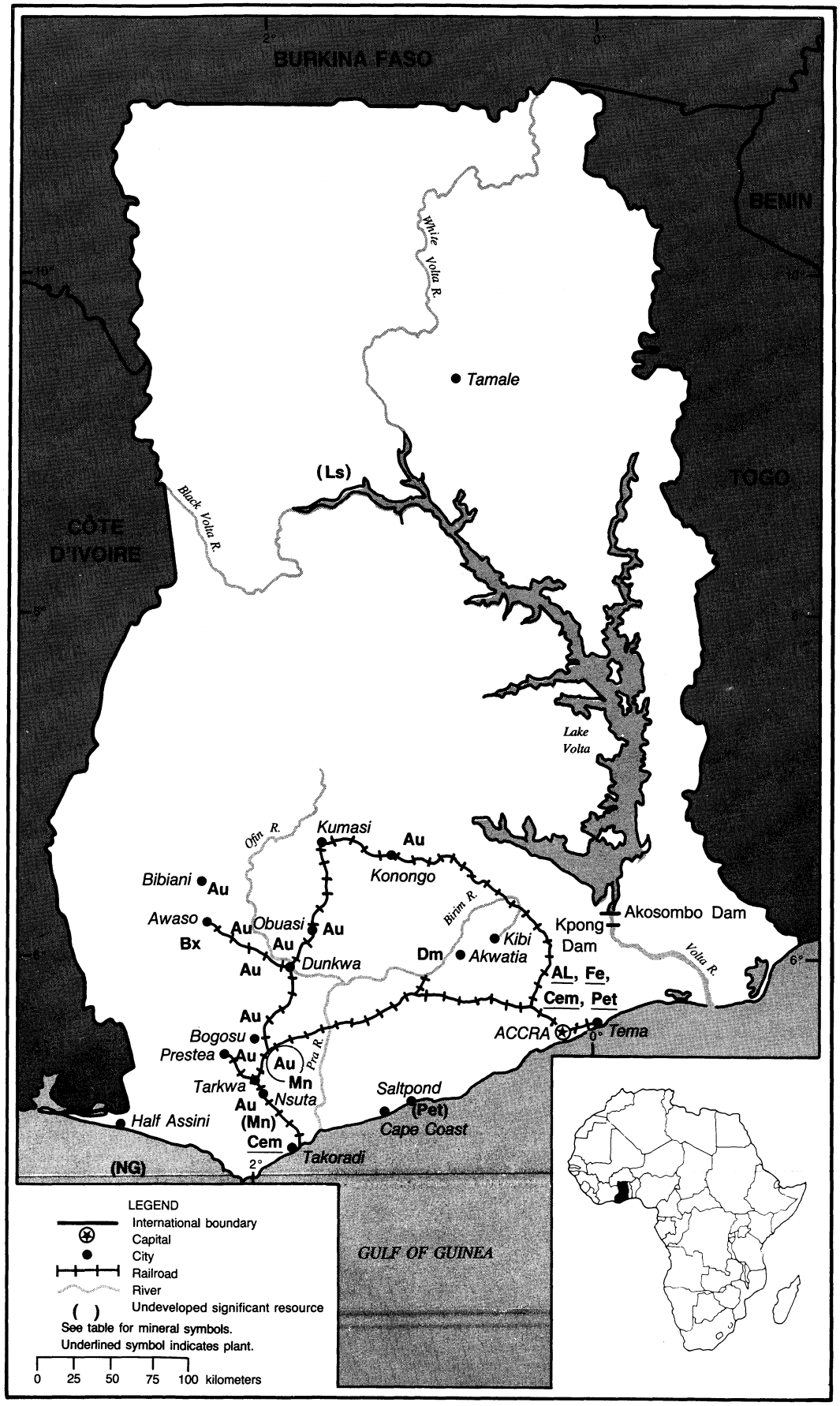
(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement		Société des Ciments du Gabon (Government, 90.54%; ELF-Gabon, 9.44%; other, 0.01%)	Clinker plant at N'Toum, 40 kilometers east of Libreville	350 clinker.
Do.		do.	Clinker-grinding plant at Owendo	270 cement.
Do.		do.	Clinker-grinding plant at Franceville	130 cement.
Manganese		Compagnie Minière de l'Ogooué (Government, 29.23%; Compagnie Française de Mines, 17.60%; United States Steel, 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%)	Mandji onshore and offshore field near Port Gentil	40,000.
Do.	do.	Shell Gabon (Royal Dutch-Shell, 75%; Government, 15%; Amerada Hess 10%)	Lucina Marine offshore field, 15 kilometers south of Mayumba	4,000.
Do.	do.	do.	Gamba-Ivinga Field, onshore at Gamba	4,000.
Do.	do.	do.	Rabi Kounga Field, 100 kilometers north of Gamba	55,000.
Do.	do.	AMOCO	Oguendjo offshore field, 85 kilometers southeast of Port Gentil	6,000.
Do.	do.	British Gas Corp.	Obando, Octopus, and Pelican offshore fields, 60 kilometers southwest of Port Gentil	5,000.
Petroleum products	do.	Compagnie Gabon-ELF de Raffinage (ELF-Gabon, 70%, Government, 30%)	Refinery at Port Gentil	8,760.
Uranium	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 uranium oxide.

[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-Ou Gabonese nationals: 0.62%.

GHANA

AREA 238,540 km² **POPULATION 15.6 million**



THE MINERAL INDUSTRY OF

GHANA

By Hendrik G. van Oss

Mining, particularly of gold and diamonds, has historically been a major factor in the Ghanaian economy and it remained so in 1991. Although, as in years past, primary mineral production was greatly dominated in value by gold, the country was also an important producer of bauxite, diamonds, and manganese ore. In addition, Ghana has a significant secondary mineral commodity industry. Notable in this regard is aluminum, output of which was the second largest in Africa in 1991, after Egypt. Ghana also produced modest quantities of cement, refined petroleum products, and steel semifinished products. Mineral production notwithstanding, the most important sector of the Ghanaian economy in 1991 remained agriculture, both in terms of domestic and export sales, and, especially, in terms of employment. But, whereas recent poor world prices for cash crops, notably cocoa, and environmental restrictions on the once-thriving timber industry have led to a decline in the agricultural sector, the mineral sector has experienced strong growth.

Apart from crude construction materials, most of Ghana's primary mineral production was exported. Exports of primary mineral commodities produced in Ghana in 1991 were equivalent to about 5.5% of the country's estimated GDP of $6.5 billion[1] and about 36% of total exports. Legal gold sales alone were worth about $307 million, an almost 50% increase in value from that in 1990. This reflected a major increase in gold production that more than offset a 6% decline in the gold price. By comparison, exports of Ghana's main agricultural products, cocoa and timber, were worth about $335 million and $72 million, respectively. Sales of aluminum, toll smelted in Ghana from imported alumina, were worth about $230 million; the country value-added component of this amounted to about $100 million. Domestic sales of locally manufactured cement were worth about $100 million.

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

The Birimian belts can have the gross form of synclinoria, some of which are cored by clastic rocks of the Tarkwaian Series. Near Tarkwa, these clastics include gold-bearing conglomerates very similar to the banket conglomerates of the Witwatersrand gold field in the Republic of South Africa. In 1991, there were two mines exploiting Tarkwaian conglomerate gold ore, and a third mine was expected to be in production by 1992 or 1993. Alluvial diamonds eroded from the Birimian Series, and gold from both the Birimian and Tarkwaian Series, form widespread placer deposits that are exploited formally and on an artisanal basis. 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.

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

GOVERNMENT POLICIES AND PROGRAMS

Agriculture, which has long dominated Ghana's domestic and export economy, has been hurt in recent years by low world prices for the country's principal cash crops and by periodic droughts. The need to conserve the country's tropical forests has led to even more severe cutbacks of the lumber industry. In contrast, mining, led by gold, has increased its contribution to the economy and is seen as the sector having the highest growth potential. For example, gold exports in 1991 came close to the value of exports of cocoa, the country's principal cash crop, and were expected to overtake cocoa exports in 1992, for the first time in decades.

In the 1980's, the Government began a major program to build up the mining

industry. In part, this effort was in response to the yearend 1980 report[2] by the Committee on Gold Mining. The Committee had been appointed to review the Ghanaian mining industry and to recommend a solution to the severe decline in mine output. It was recognized that the industry was suffering from many years of inefficient management of the state-owned mining companies, overly tight restrictions on the availability of foreign exchange, and unrealistic investment laws. These past policies had led to a major deterioration of the country's mine and transport infrastructure and an unfavorable climate for foreign investment in this sector of the Ghanaian economy. In addition, low wages and a general decline in the economy had led to the emigration of a large number of skilled Ghanaian nationals. The report identified the morass of more than 70 mining-related laws enacted since 1900 as being a significant contributor to the decline in mineral output and recommended enacting new investment and mining legislation to supersede the old laws. The Minerals and Mining Law, 1986 (PNDCL 153), which now governs mining and mineral exploration in Ghana, was a direct outcome of the 1980 report. Apart from pointing out the need for new gold mines, the 1980 report recommended a major rehabilitation program for the existing operations.

Restoration of the mining industry has been a major component of the ongoing general Economic Recovery Program, launched in 1983. Apart from new mining legislation, the Economic Recovery Program 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.

In 1984, rehabilitation work began at the Ashanti Mine, and in 1985, a similar program started for mines owned by the State Gold Mining Corp. (SGMC). The goal of these ongoing programs is to increase the production of the mines through a combination of expanding the workings, purchasing new equipment, repairing old shafts and mine workings, improving mine safety, rehabilitating the mills, and improving mine management and cost accounting. Loans for the rehabilitation programs have been secured, by and large, from international lending agencies such as the International Finance Corp. and the World Bank. The relaxation of the country's foreign exchange laws has allowed the mines to purchase much needed new equipment and supplies. Partly as a condition for the loans, but also in accord with its new privatization policies, the Government agreed to seek foreign investors in a number of wholly state-owned companies such as Ghana Consolidated Diamonds Ltd., and SGMC subsidiaries Dunkwa Goldfields Ltd., Prestea Goldfields Ltd., and Tarkwa Goldfields Ltd. Most recently, the Government has added Ghana National Manganese Corp. to the list. The Government has also obtained loans to rehabilitate the country's railroad and shiploading infrastructure, particularly that serving the mining industry.

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

Other related and applicable laws include the Additional Profits Tax Law, 1985 (PNDCL 122); the Minerals Commission Law, 1986 (PNDCL 154); and the Minerals (Royalties) Regulations, 1987 (LI 1349). The basic investment codes of Ghana are those of 1981 (Act 437) and 1985 (PNDCL 116). The Petroleum (Exploration and Production) Law, 1984 (PNDCL 84), controls petroleum-related activities. The importation, transportation, and transfer of mercury is governed by the Mercury Law, 1989 (PNDCL 217). Regulation of artisanal gold mining was set forth in the Small-Scale Gold Mining Law, 1989 (PNDCL 218). The Precious Minerals Marketing Corporation Law, 1989 (PNDCL 219), set up the Precious Minerals Marketing Corp. (PMMC) to promote the development of small-scale gold and diamond mining in Ghana and to provide a purchase mechanism for the output of such mining.

The Ministry of Lands and Natural Resources 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 must also be reported to the Ghana Chamber of Mines. The Chamber also provides information on Ghana's mining laws and negotiates with the mine labor unions on behalf of its member companies. All of the mining companies operating in 1991 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. The Government controls petroleum products

selling prices in-country and has generally charged only slightly higher prices than those needed to recover costs. However, from time to time this policy has been questioned, as it has led to smuggling of petroleum products into neighboring countries, particularly Côte d'Ivoire, for resale at much higher prices.

PRODUCTION

The production of several mineral commodities increased in 1991, gold and byproduct silver dramatically so (*see table 1*). Legal production of gold was at the highest level in 27 years and it was expected that the output in 1992 would exceed the record 28,470 kg reached in fiscal year 1958-59. In terms of African gold production, Ghana ranked second after the Republic of South Africa, and well ahead of the next largest producer, Zimbabwe. Apart from its formal production, Ghana had significant artisanal production of gold. The true output of artisanal production was unknown, owing to smuggling, but was believed to significantly exceed the 264 kg sold through legal channels. Ghana's increased official gold output in 1991 was mainly the result of the ongoing expansion program at the country's largest gold mine, but also reflected the first full year of production from two large gold mines that started production in 1990.

Ghana's official diamond output increased significantly in 1991, entirely as a result of increased purchases of artisanal production by the PMMC. Based on the past year's official estimates of smuggled production of up to 50,000 carats per month, it would appear that the PMMC purchases in 1991 may have represented the bulk of the country's artisanal production. Production from Ghana's only formal diamond mine, Akwatia, declined owing to deterioration of equipment. The mine's output remained well below that needed for profitability.

Ghana's bauxite production appears to have stagnated in 1991, as evidenced by the modest decline in sales resulting from a weak world aluminum market. Notwithstanding modest world demand and prices for manganese, Ghana's only manganese mine reported a significant increase in production. Cement production continued to benefit from the increased availability of foreign exchange, which allowed an increase in the level of imports of clinker.

TRADE

Ghanaian exports in 1991 totaled about $993 million, up about 25% from those of 1990. Depending on the true value of diamond exports, it would appear that almost 60% of this increase, or $115 million to $120 million, was due to improved mineral export revenues. Exports of primary minerals were in the range of about $355 million to $360 million.

Official exports of gold were worth about $307 million; a 47% increase over the value in 1990. The value of smuggled gold was not known, but may have declined somewhat from levels in 1990 owing to poor world gold prices and the reported shift of some artisanal gold miners to the diamond fields. In 1990, it was estimated that smuggled gold was worth about $20 million.

The true value of Ghana's diamond exports in 1991, and indeed for recent past years, was in doubt. Officially, the value in 1991 was likely in the range of $20 million to $25 million, somewhat higher than that in 1990. But, toward yearend, evidence emerged that, for several years, the PMMC had been significantly undervaluing diamonds produced by the Akwatia Mine. This would appear not to hold for PMMC purchases of artisanal diamonds, where the PMMC was trying to purchase diamonds that would otherwise have been smuggled to Côte d'Ivoire and Togo. Ghana itself appears to be an entrepôt for diamonds produced elsewhere in Africa. For example, U.S. Customs credited Ghana as being the source of imports into the United States in 1991 of almost 933,000 carats, worth approximately $63 million.

Manganese ore exports increased about 25% to about 320,000 tons, worth $22.1 million. Bauxite exports declined 13% to $8.7 million. By comparison with primary minerals, revenues from value-added mineral commodity exports were minor with the notable exception of aluminum. Aluminum exports were worth about $230 million in 1991.

Total imports into Ghana in 1991 increased slightly to about $1.2 billion, significantly less than expected owing to lower-than-expected oil prices. The dominant import commodities remained crude petroleum and refined petroleum products; these imports reportedly totaled $154 million. Alumina imports for the Volta Aluminum Co. (VALCO) aluminum smelter totaled about $72 million, a 28% decline in value from that of 1990 owing to dramatically lower world alumina prices. Clinker imports for the country's cement plants were worth an estimated $50 million. A major proportion of Ghana's machinery imports were for the mining industry.

Traditionally, the United States has purchased most of Ghana's aluminum output, but in 1990 and 1991 much of this material was sold on the London Metal Exchange. Officially, Ghanaian diamonds were sold to Belgium. Ghana was credited with $63 million in diamond exports to the United States in 1991, but these stones almost certainly included material from other African countries. Most of Ghana's bauxite exports were to the United Kingdom. Ghana's manganese exports were mostly to a variety of European customers and to Japan. Ghanaian gold was toll refined in Switzerland before being sold on the world market.

As in 1990, Nigeria was the source of Ghana's imports of crude oil and much of its refined petroleum products. In recent years, Jamaica has commonly supplied the bulk of Ghana's imports of alumina, although, in 1991, the United States supplied 28% of this commodity and all of the petroleum coke for the aluminum operation.

STRUCTURE OF THE MINERAL INDUSTRY

In terms of value, gold was by far the most important primary mineral commodity produced in Ghana in 1991. During the year, gold was produced by 12 formal mines, 7 of which were lode operations, 3 were placer gold mines, 1 was a placer diamond mine having a gold recovery circuit, and 1 recovered gold from old tailings. One of the lode operations was responsible for 74% of the country's total gold production. Apart from the formal mines, there was significant artisanal production of gold.

Diamonds were produced by one formal mine and by artisanal miners. During the year, one bauxite mine and one manganese ore mine were in production. Two cement clinker-grinding plants were in operation in 1991, as were three small steel mills. One small oil refinery was in operation, using imported crude oil. One aluminum smelter was in production, using imported alumina. (*See table 2.*)

Per 1990 estimates, Ghana's labor force comprised about 5.8 million workers. Almost 20% of the workers were in industry, and about 55% were in agriculture. The formal primary mining sector employed about 25,000 workers, about 20,000 of whom worked for gold mining companies. These numbers included workers directly employed in the mining and ore milling operations and in company-owned shiploading facilities, farms, lumber mills, and other captive service industries. Apart from the mining operations, an estimated 400 to 600 persons were employed on various mineral exploration projects. The value-added mineral industries employed about 4,000 persons, about one-half of whom worked for the VALCO aluminum smelter. 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 7,000 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.—In 1961, Kaiser Engineers of the United States was awarded the contract to build a dam and hydroelectric plant on the Volta River at Akosombo and an aluminum smelter at Tema. The dam and power station were completed in 1965. The VALCO aluminum smelter, the first in Africa, was completed in 1966, and the first potlines were put into operation in 1967. The smelter is run as a tolling operation and to date has used only imported alumina. In 1991, VALCO increased its output slightly; net salable production was 173,373 tons, up 964 tons only. As in 1990, the smelter operated on 90% of the plant's five potlines and had an operational capacity of 180,000 mt/a.

Bauxite in Ghana was discovered in 1914 and has been found in several parts of the country. The Awaso Mine, which opened in 1940, has been the only bauxite mine to date, but several other deposits have been drilled. Ghana Bauxite Co. Ltd. (GBC), operator of the Awaso Mine, continued with the upgrading and expansion of its loading infrastructure at the port of Takoradi. Additional financing for this project was secured in early 1991, and the work was expected to be completed in 1992. The goal of the port upgrade is to allow the company to increase its exports to 500,000 mt/a and, given adequate railing capacity, ultimately to 1 Mmt/a.

Gold.—Artisanal mining of placer and lode gold deposits in Ghana has occurred for centuries. Gold mining by Europeans in Ghana started in the 1620's, but the major gold boom started in the 1880's. The number of active formal gold mines declined precipitously after World War II; despite this, gold output reached its highest level—28,470 kg—in fiscal year 1958-59, after which it declined fairly steadily until 1983. Production since then has increased dramatically and Ghana's gold production in calendar year 1991 was the highest since fiscal year 1964-65. This performance was largely as a result of the ongoing rehabilitation and expansion project at the Ashanti Mine, and, to a lesser degree, to the output of the Bogosu and Teberebie Mines, both of which opened in 1990. One small placer operation, the Bonte Mine, opened in 1991 on a trial basis; it recorded an output of 17 kg for the year.

The level of artisanal gold mining in 1991 was not known, but legal sales of gold to the PMMC from this source declined 51% to only 264 kg. Several explanations have been put forth to explain the decline. It is believed that some of the artisanal miners responded to the lackluster gold price during the year by turning their attention to diamonds. At least part of Ghana's artisanal gold output has represented material stolen from the formal mining operations, either as high-grade ore or milled product. Improved security at the mines may also have had an adverse effect on this commerce. Citing inadequate levels of artisanal gold purchases by licensed buyers, the PMMC, in September, suspended a number of buyers' licenses.

The Ashanti Mine at Obuasi is a world-class gold mine that, by yearend 1991, had produced about 655,000 kg of gold since its opening in 1895. The ore grades from the mine have averaged about 20 g/mt gold, although much lower grade ores have begun to be exploited in recent years. The mine increased its output by almost 44% in 1991 to 19,343 kg, the highest level yet. This gold output accounted for almost 75% of Ghana's total for the year.

Increased output at the Ashanti Mine has been made possible by an ongoing expansion and rehabilitation program that began in 1984. The $156 million program has been funded in part by the company and in part by international financial institutions, particularly the IFC. Additional funding was being sought for a further expansion program, termed the Ashanti Mines Expansion Project (AMEP). The goals of the different facets of the expansion programs at the Ashanti Mine have evolved as new reserves were developed, new technologies and mining plans were examined and adopted, and as annual production targets were exceeded. Overall, the goal of the expansion program is to bring the mine's gold output to 1 million troy ounces (31,103 kg) in the fiscal year 1995-96 (ending September 30, 1996). This target is to be achieved by mining both surface and underground ore bodies and by improving the gold recovery facilities to allow the processing of hitherto below-cutoff-grade material. Underground, emphasis has been on developing relatively shallow quartz and sulfide ores toward the south end of the mine and a large sulfide ore body at moderate to deep levels in the central part of the mine. More recently, plans have been drawn to mine high-grade material in certain old safety pillars and backfill from the shallow portions of the northern workings. The surface extensions of the main Ashanti ore bodies are being developed by a string of open pits. Additionally, a large volume of old tailings will be reprocessed. 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.

Ongoing rehabilitation and expansion of the underground workings has mainly involved improving ore access and haulage and air flow by deepening certain existing shafts, developing new shafts, and installing rapid ore conveyance infrastructure underground. The target of the new George Cappendell and Kwesi Mensah shafts are the southern and central ore bodies, respectively. Deepening the main ore hoisting shafts to the north will allow improved ore haulage from the more southern ore bodies and access to deep portions of the northern ore body.

As part of the AMEP, it was decided that a ramp decline was to be put in at the north end of the mine to access certain high-grade safety pillars, old backfill, and below-previous cutoff ore above the 12-level in that area. Further, the 12-level will link the north area ramp decline with internal ramp declines to be developed to access sulfide ore bodies between the 25- and 40-levels in the central portion of the mine. Emphasis everywhere has been on the adoption, where possible, of mechanization and bulk mining methods, such as sublevel caving and, in older areas, the consolidation of small stopes.

The rehabilitation program has allowed the upgrade of the Pompora Treatment Plant (PTP), which handles all of the underground and part of the surface ores. Work on this plant has included the installation of a new ball mill, the replacement of some flotation banks, upgrading of the gravity circuit, and the conversion of the sulfide concentrate roasting furnaces from wood to oil-fired. At yearend, mill throughput capacity stood at 100,000 mt/month. Ore throughput during the 1990-91 fiscal year increased 8.2% to almost 1 Mmt from which 10,320 kg of gold was recovered. In response to long-standing concerns over the mill's arsenic oxides emissions, the company in 1991 commenced the installation of an arsenic-scrubbing unit for the roasting circuit. The unit was expected to be operational by April 1992, and its design would permit the addition of an electrostatic precipitator and SO_2 scrubber if needed. Further, the company completed construction of a sophisticated environmental monitoring laboratory and began widespread monitoring of air and water quality in the concession area.

In late 1990, the company commissioned the Expanded Tailings Treatment Plant; this was put into operation in January 1991. Modifications to the plant were made during the year to increase throughput capacity; the increase more than compensated for a slight reduction in recovery efficiency. During the 1990-91 fiscal year 1.35 Mmt of tailings was processed and 2,558 kg of gold recovered, for an efficiency of 43.25%.

The Sansu Project is a major component of the company's expansion plans. It had long been known that considerable resources of low-grade gold resources existed as surface extensions of the underground ore bodies. However, most of this material was oxide ore of inadequate grade for the PTP. Following the lead of the Southern Cross Mine at Obenemase, which used heap-leach extraction technology to treat similar ores, it was decided to apply this technology to the surface ores at the Ashanti Mine. Following receipt of financing from the IFC, the mine commenced surface mining in mid-1989. Initially, relatively high-grade surface ore was processed at the PTP pending completion of a dedicated oxide ore plant; this plant was completed in March 1991. Low-grade ore was stockpiled pending completion of the heap-leach pads and associated cyanide plant. Heapleaching commenced in early March 1990, with the first gold poured later the same month. Approximately 1.1 Mmt of ore was stacked on the pads in fiscal year 1990-91, a 109% increase from that of the previous year. The material had an average gold grade of 1.5 g/mt, 45% lower than in the previous year because relatively high-grade material was diverted to the new oxide plant following its completion in March 1991. The heap-leach operation yielded 1,134 kg during the fiscal year, a 61% increase. The new oxide plant had a fiscal year throughput of about 1.3 Mmt, grading 3.3 g/mt, for a yield of 6,190 kg. In 1991, mining was from six open pits. Reflecting the evolution of thought regarding the AMEP, it was decided that the Sansu Project open pits would be deepened to allow the mining of sulfide ores, to be treated at the PTP. Exploration was ongoing to increase the open pit reserves of both oxide and sulfide ores.

Reserves at the Ashanti Mine were increased dramatically during the year as a result of ongoing surface and

underground exploration and the inclusion of some hitherto below-cutoff material, safety pillars, and stope backfill in the northern part of the underground mine. As of September 30, 1991, proven underground reserves were given by the company as 8.17 Mmt grading 17 g/mt gold; total underground resources were 32.24 Mmt grading 4.8 g/mt gold. Open pit (Sansu) proven plus probable reserves were given as 21.33 Mmt grading 4.9 g/mt gold; total open pit resources were 30.28 Mmt grading 4.8 g/mt gold. In addition, the mine had proven plus indicated reserves of old mine tailings totaling 15.77 Mmt at 2.86 g/mt gold.

The Teberebie Mine was formally commissioned in March 1992, although mining had commenced in June 1990 with the first gold pour occurring in October 1990. The open pit heap-leach operation exploits Tarkwaian conglomerates. The mine overcame startup problems and reached full production levels late in 1991. Gold output of 2,461 kg for the year was about 80% of the design capacity at the time and was at the level expected. This performance made Teberebie the second largest formal gold producer in Ghana. The company was planning to increase the mine's output capacity significantly. Proven plus probable reserves at yearend 1991 were put at about 81,000 kg of gold in ore grading about 2 g/mt.

The Bogosu Mine had its first full year of operation in 1991. The mine exploits largely sulfide ore remaining following the closure of Marlu Gold Mining Areas Ltd.'s operation in 1955. Marlu's operation was unusual for Ghana in this respect; the usual practice was to take the sulfide ore and leave the oxide. Initial open pit mining by (then) Canadian Bogosu Resources Ltd. in 1990 was of the small remaining reserves of oxide ore. Following completion of the mill's fluidized bed roasting facilities in early 1991, mining was in part shifted to the sulfide ores. A number of problems were experienced, however, in both the flotation and roasting circuits and, later, with the conveyor system feeding the grinding circuit. These problems were partly mitigated by preferentially mining high-grade ore, but, nevertheless, gold output was less than expected. Output for the year was reported to have been 1,918 kg. Long-term output is expected to be in the range of 3,100 kg to 3,500 kg gold per year. Reserves (all classes) at the beginning of 1991 amounted to about 18 Mmt grading about 3.4 g/mt gold.

The sulfide ore at Bogosu is arsenopyrite-dominated and, accordingly, the mill's roasting circuit contains an arsenic recovery unit, the first in Ghana. Arsenic recovery data were not available, but, reportedly, the mine exported 244 tons of arsenic trioxide to the United States, worth $107,000, in 1991.

In early 1991, Sikaman Gold Resources Ltd. of Canada, which had been the operating partner in Bogosu, sold its 14% stake in the mine to majority owner Billiton International Metals BV of the Netherlands.

Despite efforts in 1991 to privatize the mines, SGMC remained the operator of the Prestea and Tarkwa underground mines and the Dunkwa gold dredging operation. The company has received loans from various international lending institutions to rehabilitate and expand operations at the mines with the goal of achieving a total output for the parent corporation of about 4,000 kg by the early 1990's. Most of the work was to be done at the underground mines and was to involve major rehabilitation of the underground workings, including repairs to the main shafts, replacement of the winders, dewatering of workings, and the purchase of mining machinery. The mills at both mines, but especially at Prestea, were to be rehabilitated. The rehabilitation program also aimed at increasing the reserves at both underground mines. Although some rehabilitation work was ongoing during the year, it appeared to be having only minor positive effect. Total gold production by SGMC increased 8.5% to 1,728 kg, still well below the level needed for profitability. As in 1990, the Tarkwa Mine had the best performance for the year, production increasing 12% to 858.3 kg. Tarkwa's mill was in relatively good condition, but the operation continued to suffer from inadequate throughput. The Prestea Mine recorded an output of 708.3 kg, an 11% increase. The mine continued to have problems with its milling circuit, which was inadequate to handle the decline in millfeed grade. Reportedly, Dunka Goldfields Ltd. continued to be beset by mechanical problems with its gold dredges and managed to produce only 5,202 kg for the year, a 15% decrease.

Although both the Tarkwa and Prestea Concessions are considered to have excellent potential for both underground and open pit reserves, the amount of actual exploration drilling done at the mines has been minimal in recent years. Reserves at yearend 1991 were not available but apparently have not increased appreciably from those at yearend 1988. At that time, total gold ore reserves of the Prestea Mine were given by the company as 7.162 Mmt grading 7.88 g/mt, of which about 30% was proven. However, much of this inventory was in pillars or was otherwise not available for mining. Reserves available for mining amounted to only 680,000 tons grading 5.7 g/mt. Total ore reserves of the Tarkwa Mine at yearend 1988 were given by the company as about 6.1 Mmt grading 6.8 g/mt. Of this inventory, only about 665,000 tons grading 8.1 g/mt was considered to be proven reserves, of which about 495,000 tons grading 8 g/mt was available for mining. Dunkwa's reserves, in contrast, appear to be large, exceeding 200 Mm^3 grading 0.15 g/m^3 gold, according to the company.

As part of the Government's privatization program, buyers were being sought for the SGMC mines. Despite the rehabilitation programs, hope for the survival of the operations seemed to rest in getting the properties into private hands. The most interest was shown in the Prestea Mine concession, which was considered to have excellent reserve potential. In early 1991, an Australian company signed an option on the Prestea Mine, but evidently decided not to excercise the option. The property was still for sale at yearend. Reportedly, a number of companies have expressed an interest in Tarkwa, especially the open pit

potential of the Tarkwa Concession, but no buyers had been announced at yearend.

Relatively little interest has been shown in Dunkwa, apparently because the company's dredges are ill-designed for the local conditions and because few of the international gold mining companies have much experience with placer operations. The negotiations over Dunkwa with Billiton International Metals BV of the Netherlands, ongoing at yearend 1990, apparently fell through early in 1991.

The Southern Cross Mine was on the verge of closing at yearend 1991. Production declined 55% for the year to only 379 kg. The mine, 7 km northeast of Konongo, was Ghana's first heap-leach gold operation, and at its startup in 1988 was the first new mine in the country in more than 40 years. After a highly successful 1989 production year, the mine began to experience problems in 1990. Its 70% owner, North Queensland Co. of Australia, was beset with cash-flow problems at home and was placed into receivership, and this resulted in inadequate funding of the Ghanaian operation. A significant proportion of the mine's rapidly dwindling oxide reserves proved to be somewhat refractory, to the detriment of gold recoveries. High cement costs led to higher-than-anticipated costs to agglomerate the clay-rich ore. The operational concession has significant sulfide ore resources, described by the company in early 1989 as amounting to 234,000 tons of proven reserves grading 11.68 g/mt and 170,000 tons of probable reserves grading 9.6 g/mt. However, the company lacked the wherewithal to build a roaster or other facility to process this material.

In October 1990, Goldenrae Mining Co. commenced production at the Goldenrae placer mine on the Kwabeng concession about 16 km north of Kibi. Owing to design and maintenance problems, the mine's floating washing plant's performance was inadequate; gold recovery for the year was only 172 kg. It was decided to replace the plant in 1992 with a new one better suited to the local conditions. The new plant would have a throughput capacity of 1,000,000 m^3/a. A second washing plant, for the adjoining Pameng Concession, was to be added in 1993. According to the company, proven plus probable reserves at yearend 1991 for the two concessions were 9.1 Mm^3, grading about 0.56 g/m^3 gold; possible reserves are about the same.

The mining subsidiary of Ghana Libya Arab Holding Co., a joint venture of the Government of Libya, 60%, and the Government of Ghana, 40%, continued to operate a small gold recovery plant exploiting tailings at an inoperative mine near Bibiani. Recovery for the year was only 20 kg, down from 22 kg in 1990 and 37 kg in 1989.

In September 1991, Bonte Gold Mining Ltd. poured its first gold from its placer operation southwest of Kumasi. Mining had actually commenced a year earlier, but gold recovery had been stymied by design problems with the plant, relating to the high-clay content of the feed. The company produced only 17 kg of gold in 1991 but expected to produce about 200 kg in 1992. Proven reserves on the concession were given by the company as about 16 Mm^3 grading about 0.75 g/m^3.

Development work commenced in 1991 on the Iduapriem Mine, owned by Ghana Australian Goldfields Ltd., a joint venture among Australian companies Golden Shamrock Mines, 69%; the IFC, 20%; the Government, 10%; and a private British investor, 1%. Golden Shamrock is itself 50.5% controlled by the Concord Group, of the United States. The Iduapriem Mine is 11 km southwest of Tarkwa and the concession adjoins the Teberebie concession. Iduapriem will be an open pit operation exploiting Tarkwaian conglomerate ores. However, Iduapriem will use conventional milling and carbon-in-pulp gold extraction, unlike Teberebie's heap leach. Minable reserves are about 14 Mmt grading about 2 g/mt gold, in addition to which are lower grade reserves of about 5 Mmt grading about 1 g/mt. Gold production was expected in late 1992 and output, once full capacity was reached, was expected to be about 3,100 kg/a to 3,400 kg/a.

A number of international companies were undertaking gold exploration in Ghana during the year. The most significant project unrelated to an operating mine was that of Cluff Resources PLC of the United Kingdom on its Bokitsi (Bokitiso) Concession near Ayanfuri, 15 km west of Dunkwa. Gold is associated with iron and copper sulfides and iron oxides in weathered granitic rocks and immediately adjacent in Birimian metasediments that the granitoids intrude. Four deposits have been identified. Both sulfide and oxide gold resources have been delineated, but attention has been focused on the oxide ore. A feasibility study and additional drilling were done in 1991 following the completion of a 126-hole reverse circulation drilling program in 1990. At yearend 1991, the company began raising financing for open pit mining of three of the deposits at Ayanfuri, to commence gold production in 1993 at a rate of about 1,250 kg/a to 1,500 kg/a. The ore is amenable to heap leaching but, because of the high cost of cement in Ghana, the company was planning on conventional milling of the ore, with carbon-in-leach extraction of the gold. According to the company, total (proven plus probable) open pit oxide reserves are about 4.3 Mmt grading about 2 g/mt gold.

Manganese.—Manganese ore has been mined in Ghana since 1916. The Nsuta Mine has been the only significant producer of manganese ore in the country. Manganese production from the Nsuta Mine, operated by Ghana National Manganese Corp. (GNMC), was reported to have increased significantly in 1991. The mine produces both oxide and carbonate ores; in recent years, the proportion of carbonate ore has increased. GNMC continued to explore for additional reserves during the year and has, reportedly, located a number of small pockets of oxide ore, enough to extend production of this type of ore for a few more years. Carbonate reserves on the GNMC concession are large. The mine's $18 million calcining plant completed in 1982 remained uncommissioned at yearend; the incentive

to commission the plant was lessened by the company's ability to sell its carbonate output to Japan.

A number of other manganese deposits are known in Ghana, many of which are in the area between Nsuta and the coast. One of these had small, sporadic production in the past. Few of the deposits have had their resources delineated in detail. Work by Soviet geologists in the early 1960's delineated a few million tons of, in general, low-grade manganese oxide scattered among several deposits in the area. During 1990, Brem-Wilson Mining Ltd. drilled the Kwesikrom manganese deposit, about 27 km south of Nsuta, with a view to opening a small manganese mine. In early 1991, the company reported having proved reserves of 1 Mmt of "high-grade" ore, out of a much larger inventory yet to be fully delineated. At yearend, however, the economics of developing the property remained uncertain.

Industrial Minerals

Diamonds were discovered in Ghana in 1919 and have been mined from several alluvial fields since that time. Only one company was still mining diamonds in 1991. Total formal-sector diamond production in Ghana peaked in the 1970's, when production exceeded 2.5 million carats, but has declined severely since. The Akwatia Mine, the only formal diamond mine in Ghana in 1990, opened in 1924 and was operated until 1982 by Consolidated African Selection Trust, at which time the Government assumed total ownership of the property through a new operating company, Ghana Consolidated Diamonds (GCD).

Production from the Akwatia Mine declined 4% to 145,887 carats and remained well-below the level needed for profitability. Most of the mine's production since 1987 has been from Birim River gravels 10 km or more from the mill, which was centered on the original terrace deposits, now exhausted. The Birim River gravel reserves had been delineated by a UN exploration program in the early 1980's and by GCD since. Exploitation of the river gravels has been made uneconomic by the long haulage and by the fact that the mill is in a state of severe disrepair. Citing a feasibility study completed in 1989, GCD proposed abandoning the old mill in favor of several semimobile plants to be located on the Birim gravels. These new plants would process about 1 Mm^3 of gravel annually and would produce about 1.1 million carats per year of diamond. Partly to finance the new plants, the Government, in 1990, announced plans to privatize GCD. Discussions were held in 1990 and 1991 with several international companies interested in acquiring the property. In late 1991, it was announced that the mine would be sold to a joint venture between Inco Ltd. of Canada and Lazare Kaplan International of the United States, each to take 40% of GCD with the Government retaining 20%. Inco was to be the operating partner and Lazare Kaplan was to do the marketing. The right to market Akwatia's diamonds was an issue of great contention at yearend. During 1984-89, the exclusive marketing rights to Akwatia's diamonds had been held by the parastatal Diamond Marketing Board; the rights were transferred to the PMMC at its inception in 1989. The PMMC opposed both the sale of GCD and any change in the marketing arrangements. In recent years the production from Akwatia had been described as averaging only 15% to 20% gem quality, with the remainder being industrials. However, it was recognized that the so-called industrials, many of which were clear, high-quality stones, were not gems simply because of their very small size. Prices paid to GCD since 1984 had averaged only $13/carat because of this. However, it was known that certain diamond cutting centers, particularly in India, could handle very small stones. GCD had long complained that the PMMC was greatly undervaluing the Akwatia diamonds, and, accordingly, favored the sale and new marketing arrangement.

In early 1992, it was reported that Lazare Kaplan had offered in excess of $40/carat for a parcel of Akwatia diamonds, more than twice the valuation placed on the stones by the PMMC. The Government announced that it was launching an investigation into the past marketing practices of the PMMC. The implications of long-standing undervaluation of the Akwatia diamonds were significant. Higher past revenues to the mine would have allowed the purchase of much needed equipment and spare parts for the mill and mining machinery. Equally important were the implications for the mine's rehabilitation and expansion plans, especially those concerning the fate of the old mill. It was felt that a new feasibility study for the project was justified.

Ghana has significant artisanal production of diamonds, the true output level of which is not known owing to smuggling of diamonds to Togo and Côte d'Ivoire, but which was estimated to be on the order of 50,000 carats/month. The PMMC had been set up in 1989 in part to attract the legal sale of this material to the Government. Accordingly, prices offered by the PMMC were much higher than those offered to GCD. The program appears to have been successful. Although sales to the parastatal Diamond Marketing Corp. (DMC) in 1988 had been only about 34,000 carats, sales to the PMMC, which replaced the DMC, in 1989 were almost 152,000 carats, jumped to almost 485,000 carats in 1990, and increased further to almost 542,000 carats in 1991. It was not clear, however, whether the high 1991 purchase level reflected a significant decrease in smuggling or included the possibility that some artisanal gold miners, discouraged by low world gold prices, had moved to the diamond fields.

Mineral Fuels

GNPC conducted a horizontal drilling program in 1991 in the South Tano Basin, about 32 km offshore, with the aim of proving sufficient natural gas reserves there to justify a minimum flow of 1.4 Mm^3/d to a new thermal power station at Half Assini. The power station was planned by the Volta River Authority to come on-stream in 1993. GNPC was integrating old and newly acquired

seismic data for the old offshore Saltpond Field, with a view to restarting production there.

Reserves

GBC claims that it has 30 years of bauxite reserves in the present ore body being exploited at the Awaso Mine, and reserves in other ore bodies nearby adequate to support a total mine life of 100 years. Mining plans call for an increase in output to 500,000 mt/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.

Proven and probable gold reserves of the country's operating gold mines and advanced gold projects at yearend 1991 amounted to almost 670,000 kg. The Ashanti Mine's reserves accounted for 52% of this inventory. Ghana's total gold resources are undoubtedly much larger than this, based on the known extent of host rocks, the widespread artisanal production of gold, and the encouraging results of a number of ongoing exploration programs. In addition, there are a large 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 1.4 Mmt, sufficient for about 10 more years of production at 1991 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. Manganese ore resources at the Kwesikrom deposit may be significant, but need further delineation.

Ghana's diamond resources are large, based on known reserves at the Akwatia Mine and the widespread artisanal production of diamonds. The low- and high-terrace gravel deposits that have accounted for almost all of the Akwatia Mine's historic output are now virtually exhausted. Future production from the 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 appears likely that GCD's current drilling in the marshy areas will greatly increase the total reserves.

Ghana's oil and gas resources are not well known, although ongoing drilling programs were testing resources in a couple of fields. As of yearend 1991, Ghana's only 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. The field was shut down in 1985 because of low pressures and other production difficulties. The field's original reserves, as indicated by the Government, 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. Indications are that there are economic resources of natural gas offshore, and work was underway to better delineate these. Recoverable resources of natural gas in the North Tano Field have been estimated at about 1.7 billion m^3; chances are considered good that this inventory can be doubled. The South Tano Field gas resources are estimated to be about 2.8 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.

In 1991, Ghana's road network amounted to about 36,000 km, of which about 18% was paved. Many of Ghana's paved roads were in poor condition, although the Government was improving some of the more heavily used stretches. The major rivers and Lake Volta provide about 1,400 km of navigable waterways. 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, with priority being given to the western line, which is the export route for the country's manganese ore and bauxite production and serves the major gold-producing area. As of yearend 1991, significant improvements had been made to the western line; however, the eastern and central lines remained in poor condition, and the entire system continued to suffer from a shortage of railing stock. All railing was by the Ghana Railway Corp., which transported an estimated 850,000 tons of freight in 1990, the largest tonnage railed in a decade. About 80% of this was ore and cement. Railing data for 1991 were unavailable.

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 was estimated to be about 350,000 mt/a for manganese ore and about 400,000 mt/a for bauxite. However, the bauxite loading facilities

were being expanded to handle a near-term shipping goal of 500,000 mt/a and a long-term export goal of 1 Mmt/a. 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 1990, the latest year for which data were available, Ghana's electrical generating capacity was reported to be 1,185 kW, of which 1,072 kW was from hydropower, installed in the Akosombo Dam (912 KW) and the Kpong Dam. Ghana produced 5,721 MW • h in 1990, a 9.4% increase over 1989 production. Approximately 60% of Ghana's electrical output is consumed by VALCO. Excess from the remainder is sold to Togo, Benin, and Côte d'Ivoire. Ghana's domestic grid is being rehabilitated and expanded. The grid was extended to the northern part of the country in 1989 and was further extended in that area in 1990 and 1991. Although the major mines all are connected to the national grid, most have backup oil- or wood-fired generators. Despite the use of electricity, more than 70% of the country's cooking and heating energy needs were met through burning wood. In an effort to reduce wood consumption, and thus slow the cutting of the country's rainforests, the Government was encouraging the use of LPG for cooking purposes. The Tema Oil Refinery used to flare gas, but started selling part of its gas output as LPG in 1989. In 1991, LPG consumption in Ghana was reported to have been 116 Mbbl, almost twice the level of that in 1990.

OUTLOOK

Ghana's export economy should continue to be dominated by the export of minerals and cash crops, especially cocoa. Gold is likely to remain by far the most important primary mineral export, and indications are that it may become Ghana's most valuable export in 1992. Gold output should increase significantly in the near term, largely because of the expanded output from the Ashanti Mine, but also reflecting the contribution of recently established mines and new mines to be opened in 1992-93. Ghana's formal gold output for 1992 may exceed 30,000 kg and should substantially exceed 31,104 kg (1 million troy ounces) in 1993. Ghanaian gold production in 1996, when output from the Ashanti Mine alone is forecast to reach more than 31,104 kg, may exceed 47,000 kg. Long-term production levels above 45,000 kg/a will depend on the ability of the Ashanti Mine to sustain its output level for fiscal year 1995-96 beyond 1996, the success of current expansion plans at the other mines, development of additional reserves at these operations, and the bringing on-stream of new mines. The last two factors are especially important because several of the new mines and advanced projects have announced reserves adequate for only about 10 years of mining. Of concern is the current lackluster price for gold and predictions of relatively stagnant gold prices for the near future. This is likely to reduce the available financing for new exploration in Ghana, particularly by small venture-capital companies—entities that have had much success in Ghana in recent years. Further, higher cutoff grades may be needed for new mines, and this may reduce the cost advantages of heapleaching for certain deposits.

Ghana's diamond output is expected to increase significantly in the near term, largely owing to the planned rehabilitation and expansion of the Akwatia Mine. Because of declining reserves and infrastructural problems, any increases in manganese ore output are likely to be modest, barring the development of new deposits. Ghana has the potential to increase its exports of bauxite, both through the expansion of output from the Awaso Mine and by the development of new deposits. However, most of the latter are only of modest grade and have high silica contents, and future world market demand for this bauxite is uncertain. In addition, the country's railing and shiploading infrastructure is inadequate for exporting this material. The development of an integrated aluminum industry in Ghana is subject to railing and power constraints that make questionable the economics of such a project under 1991 market conditions.

There is good potential for Ghana to produce modest quantities of natural gas and crude petroleum for domestic use. However, the potential to develop exportable quantities of these hydrocarbons appears to be less encouraging.

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[1]Where necessary, values have been converted from Ghanaian cedis (C) to U.S. dollars at a rate of C367.83 = US$1.00.

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

[3]Kesse, G. O. The Mineral and Rock Resources of Ghana; 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
Accra, Ghana

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

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

TABLE 1
GHANA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1987	1988	1989	1990	1991e
Aluminum:						
Bauxite:						
Gross weight	metric tons	196,255	284,500	347,065	381,273	380,000
Sales	do.	229,415	299,939	374,646	368,659	[3]324,313
Metal, smelter, primary	do.	150,316	161,392	168,581	174,241	[3]175,437
Cement, hydraulic[4]	thousand metric tons	274	477	565	675	[3]750
Diamond:						
Gem e [5]	thousand carats	65	155	124	163	175
Industrial e [5]	do.	400	465	370	487	525
Total e	do.	[3]465	[6]620	[6]494	[6]650	[6]700
Gold[7]	kilograms	10,201	11,601	13,358	16,840	[3]26,311
Iron and steel: Steel, semimanufactures e	metric tons	7,500	6,500	17,500	25,500	25,000
Manganese:						
Ore and concentrate,[8] gross weight	do.	274,451	259,614	279,210	246,869	[3]319,727
Mn content e	do.	98,000	97,000	110,000	96,000	125,000
Petroleum, refinery products:						
Gasoline	thousand 42-gallon barrels	1,309	1,207	1,233	r808	1,200
Jet fuel	do.	216	200	200	r200	200
Kerosene	do.	713	826	r1,108	r736	1,000
Distillate fuel oil	do.	1,641	2,163	1,716	r1,567	1,700
Residual fuel oil	do.	500	446	466	r480	500
Other e	do.	281	285	r345	r391	400
Refinery fuel and losses e	do.	300	300	300	280	300
Total e	do.	4,960	5,427	r5,368	r4,462	5,300
Salt e	metric tons	50,000	50,000	50,000	50,000	50,000
Silver, Ag content of gold ore e	kilograms	510	580	668	840	1,315

eEstimated. rRevised.

[1]Table includes data available through Sept. 18, 1992.

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

[3]Reported figure.

[4]All from imported clinker.

[5]Gem versus industrial diamond breakdown is per ratio reported by the Precious Minerals Marketing Corp. (PMMC) and the average price received from the PMMC for production from the Akwatia diamond mine for 1988-91. Based on prices received under a new marketing arrangement commencing yearend 1991, it appears that past production from Akwatia was greatly undervalued and that the proportion of gem material was significantly higher than that shown. Data are not yet available for the true breakdown.

[6]Production includes that of Akwatia Mine (1988—225,200 carats; 1989—134,030 carats; 1990—151,627 carats; 1991—145,887 carats), PMMC purchases of artisanal production (1988—34,231 carats; 1989—151,606 carats; 1990—484,876 carats; 1991—541,849 carats), and estimates of smuggled artisanal production.

[7]Does not include estimate of smuggled production.

[8]Manganese ore production for 1987-88 is processed ore output reported by Nsuta Mine. Production for 1989 is the reported mine production minus carbox fines, which were unsalable.

TABLE 2

GHANA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(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	[1]200.
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	e200.
Gold	kilograms	Ashanti Goldfields Corp. (Ghana) Ltd. (Government, 55%; Lonrho Plc, United Kingdom, 45%)	Underground and surface mine at Obuasi	20,000.
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, 90%; Government, 10%)	Placer mine at Esase, about 40 kilometers southwest of Kumasi	e300.
Do.	do.	Goldenrae Mining Co. (Roan Selection Trust Overseas S.A., Government, 10%, Akyem Abuakwa Development Fund, Ghana, 5%)	Placer mine at Kwabeng, 16 kilometers north of Kibi	e[2]450.
Do.	do.	Southern Cross Mining Ltd.[3] (North Queensland Co., Australia, 70%; Government, 30%)	Open pit mine at Obenemase, near Konongo	e400.
Do.	do.	State Gold Mining Corp. (Government, 100%)	5 gold dredges near Dunkwa Underground mine at Prestea Underground mine at Tarkwa	200. 800. 900.
Do.	do.	Teberebie Goldfields Ltd. (Pioneer Group Inc., United States, 90%, Government, 10%)	Open pit mine near Tarkwa	e3,800.
Manganese ore		Ghana National Manganese Corp. (Government, 100%)	Open pit mine at Nsuta	350.
Steel		Steelworks Co. subsidiary of Ghana Industrial Holdings Co. (Government, 100%)	Steel mill at Tema	2,500 (rebar).
Do.		Wahome Steel Ltd. (private Taiwanese investors, 95%; Ghanaian investor, 5%)	do.	18 (rod, rebar, and wire).
Petroleum products	thousand barrels	Tema Oil Refinery[4] (Government, 100%)	Refinery at Tema	e9,700.

eEstimated. NA Not available.

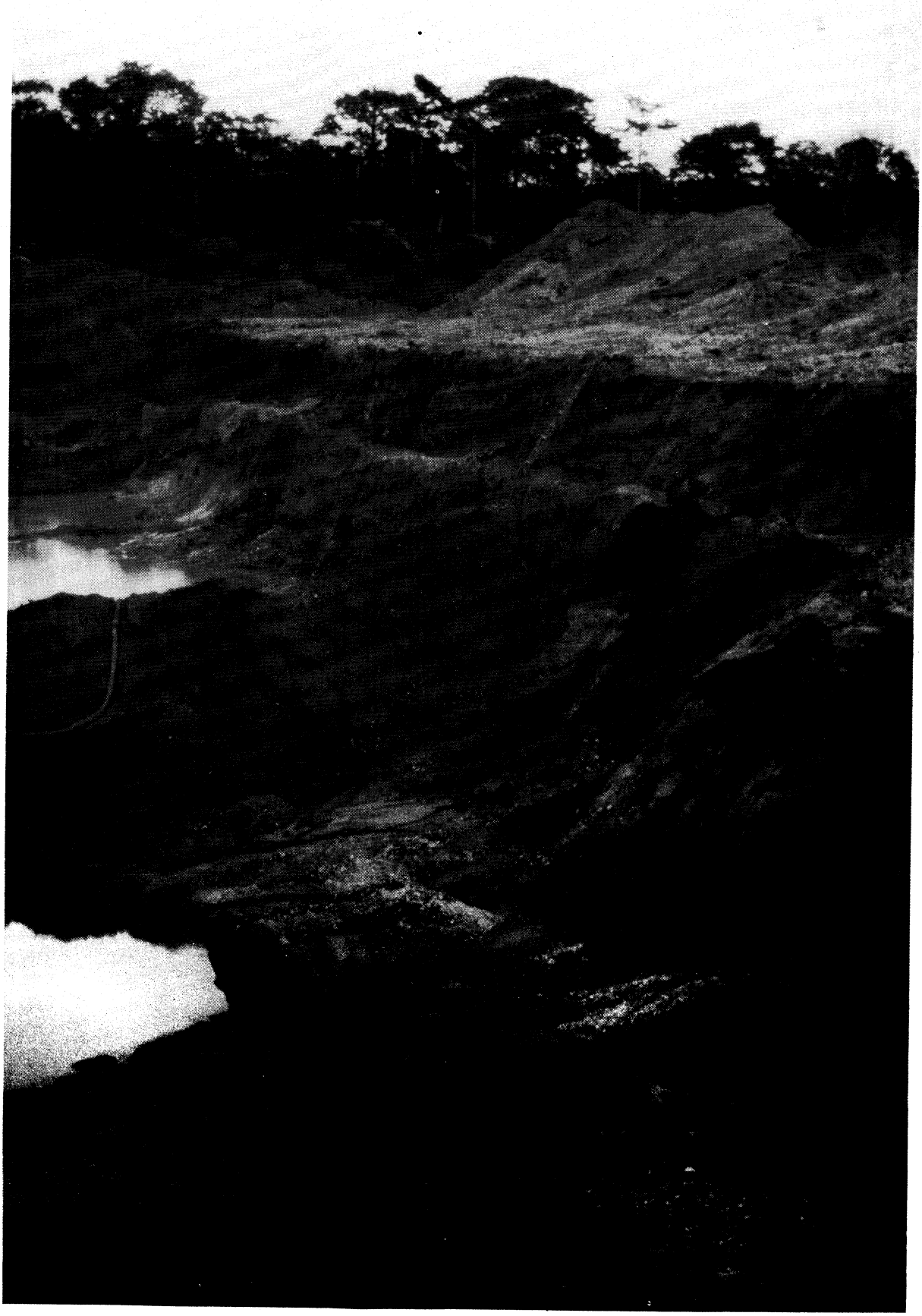
[1]Based on five potlines. Operational capacity in 1991 was 180,000 tons.

[2]Capacity based on new plant installed in early 1992.

[3]Ownership uncertain, as North Queensland Co. was in receivership in 1991.

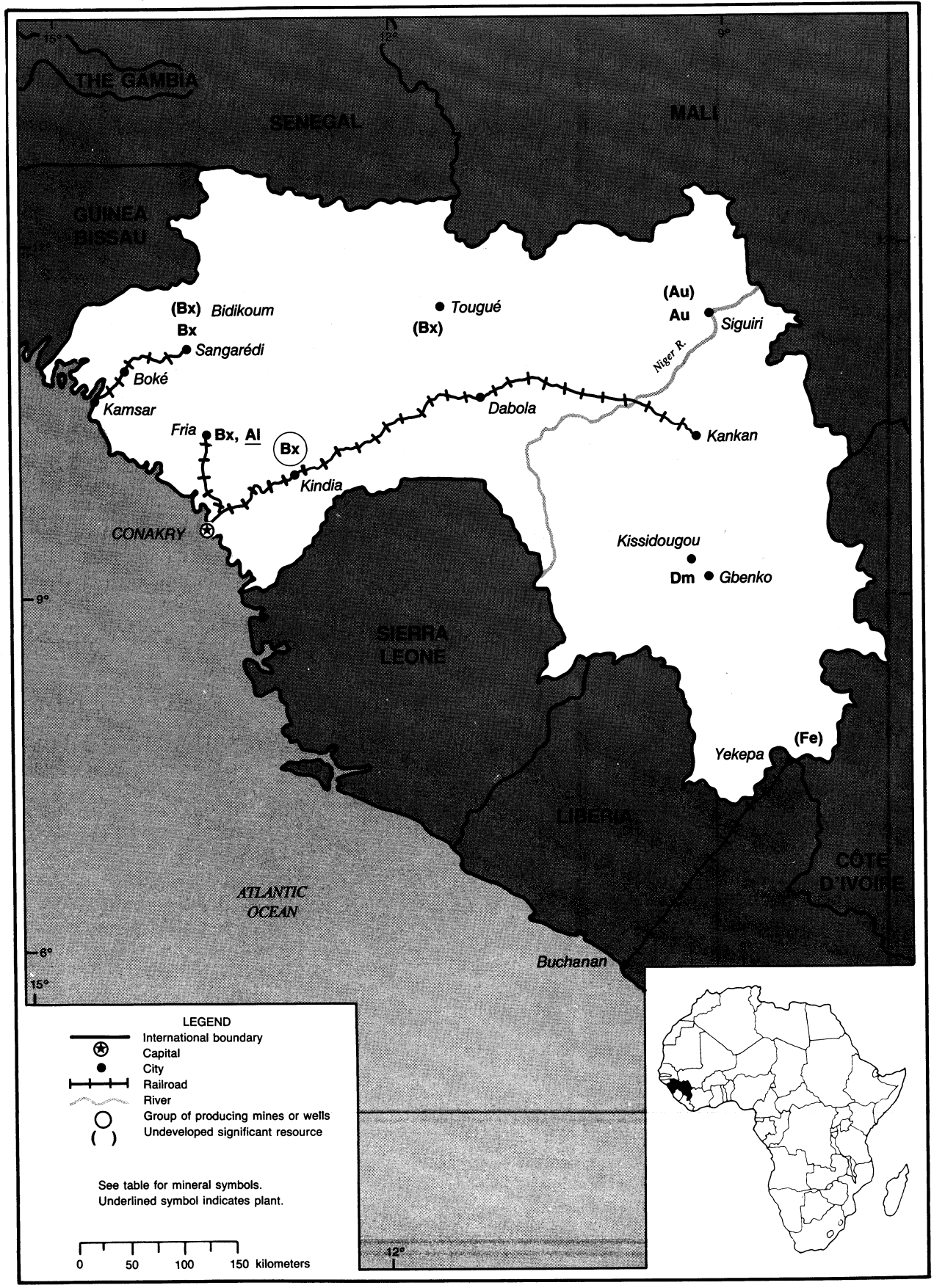
[4]Name changed in Sept. 1991 from Ghanaian-Italian Petroleum Co.

AKWATIA DIAMOND MINE, GHANA



GUINEA

AREA 245,860 km² **POPULATION 7.5 million**



THE MINERAL INDUSTRY OF

GUINEA

By David Izon

Guinea maintained its position as the second largest producer of bauxite in the world in 1991 after Australia. The mining sector dominated the economy of Guinea mainly through the production of bauxite, diamond, and gold. Alumina and bauxite were the country's principal foreign exchange earners. Guinea's bauxite deposits are perceived to be the largest and richest known deposits in the world. The alumina contents are between 50% and 60%. The minerals sector accounted for about 25% of the GDP of about $3 billion in 1991. The main foreign exchange earners, alumina and bauxite, accounted for more than 80% of all mineral exports, and mineral exports accounted for more than 90% of the country's total exports. Although the annual export volume of bauxite remained relatively constant, the export contract price declined somewhat. This was due to the pricing formula negotiated in 1986 that has built-in lags. The discovery and exploitation of other minerals such as diamond and gold have diversified the mineral economy of the country. Production of diamonds declined slightly, and gold production saw a significant drop. Artisanal production and trade in diamonds were not officially reported but plans were underway to coordinate such production. Artisanal gold production was partially accounted for because the Central Bank bought back gold at 50% market price. There was a slight growth in agricultural exports in 1991, especially palm kernels and fruit products.

The future of the MIFERGUI-Nimba iron ore mining project was not certain owing to delays stemming from lack of financing and inadequate infrastructure. Another major factor affecting the project was the civil insurgencies in Liberia.

There was no major change in investment patterns except that the country's investment code was being reviewed. Negotiations were also underway between the Governments of Guinea, Iran, and Egypt to establish a new joint venture to develop the Togue region bauxite deposits, which includes the Dian Dian deposits.

GOVERNMENT POLICIES AND PROGRAMS

Government policy in Guinea generally was to encourage mineral exploration and exploitation. A 10-month, $727,000 strategic study of Guinea's mining sector was approved by the African Development Fund in late 1991. The study is aimed at finding better ways of exploiting the country's mineral resources, reevaluation of known mineral deposits, reorganization of archived data and management, and the assessment of equipment requirements of companies and ministries involved in mining. The Government reform programs designed to encourage inflow of foreign assistance and investment started realizing some benefits. To this end, the Government continued on its policy analysis and review program that was intended to restructure the mining and investment codes, making them more attractive to foreign investors. The European Investment Bank provided a $19 million loan for modernization of the Friguia alumina plant. Aluminum Pechiney of France also provided technical assistance to Friguia, and the International Monetary Fund approved a credit of about $80 million for the reform program. The current mining code was code No. 076/PRG of March 1986, as amended by orders (Nos. 10236-10245) issued October 22, 1988. The current investment code was as adopted in code No. 001/PRG/87 of January 1987.

The Government's structural adjustment program established an incentive framework required for the revitalization of the economy. Tight fiscal policies were being implemented and planned for the 1991-94 period to ensure reduction in the dependence of Government revenue and export earnings on bauxite mining. The aim of the policies is to achieve an annual growth in real GDP of about 5% and reduce inflation to about 8% by 1994. Major areas of policy action include administrative reforms, restructuring of public enterprises, and continuation of privatization of Government parastatals.

PRODUCTION

Output of all minerals declined in 1991 except for gold, which dropped sharply owing to management problems at the mine site. However, Guinea remained the world's second largest producer of bauxite. The country has large resources of high-grade iron ore that remain undeveloped owing to lack of adequate infrastructure, cost, and regional stability. *(See table 1.)*

TRADE

Guinea's mineral trade was dominated by exports of bauxite. According to the Bureau de Stratègie et de Marketing Minier of Guinea, the total value of mineral exports for 1990, the latest year for which data were available, was approximately $588 million. Major mineral commodities traded were alumina, bauxite, diamonds, and gold. The country also exports palm kernels and some agricultural produce. Earnings

from bauxite and alumina account for about 90% of mineral exports and 80% of Government revenue. Total revenue from diamond sales in 1991 was reported by the operating company to be in excess of $30 million. In addition to this, a special stone of 193.2 carats was sold for $3.15 million. Revenue from sale of diamonds and gold do not include value of smuggled artisanal production. Mineral exports to the United States are mainly bauxite. Guinea's share of bauxite exports to the United States in 1991 declined slightly. Guinea imports industrial machines, vehicles, construction materials, fertilizers, and petroleum products from the United States.

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 one diamond mine and one gold mine in operation in 1991. In addition, there was widespread artisanal production of diamond 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 industry. Guinea's formal mining industry employed 7,401 workers in 1991. About 78% of these was in the bauxite and alumina sector. The diamond and gold industries accounted for 1,557 workers. 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

Bauxite and Aluminum.—The capacity upgrade of the Friguia alumina refinery that began in 1989 remained on schedule. The plant is to undergo a modernization program to increase production and rehabilitate the Conakry-Fria railway link. A $19 million loan by the European Investment Bank would be used to fund the project. In 1991, Friguia employed 1,485 people, of which 32 were expatriates.

Compagnie des Bauxites de Guinea's (CBG) bauxite production from the Sangarédi Mine was 11.977 Mmt, wet basis, for 1991. Total exports from CBG operations for the year amounted to about 10.619 Mmt, dry basis, 95,780 tons of which was calcined. The Government's scheduled phase-in of the Bidi-Koum deposit in 1992 remained on track. It would replace declining output at Sangarédi. Of 2,517 employed at CBG, 17 were expatriates. Bauxite operations at Office des Bauxites de Kindia employed 1,841 workers, including 67 expatriates.

Gold.—Aurifère de Guineé (AuG) continued production at its Koron Mine, 25 km north of Siguiri. Output declined owing to mine-related problems. Artisanal gold production from the Siguiri and Dinguiraye areas could approach 3,000 kg. A substantial amount of Guinea's artisanal production was smuggled out of the country because the Government offered less than the market price for the gold that was bought from individual miners. AuG's total work force of 450 included 27 expatriates.

Industrial Minerals

The Aredor[2] diamond mine at Gbenko near Kissidougou continued to experience decline in production in 1991. The decline may be attributed to widespread disruptions caused by illicit miners in November and December of 1991. According to Bridge Oil Services (Overseas) Pty. Ltd. of Australia, a London-based company that operates the Aredor Mine in Guinea, production for 1991 was 91,364 carats. There were no official estimates of artisanal production of diamond, but reports indicated that all such production was smuggled out of the country. In 1991, Aredor also produced a 193.2-carat diamond worth $3.15 million. Total revenue from diamond sales in 1991 was in excess of $30 million. Aredor's work force was 1,108, including 54 expatriates.

Reserves

Guinea's official estimates of total bauxite resources vary but are on the order of 20 billion tons, and proven reserves were about 18 billion tons, according to Direction Generale de Geologie, Guinea. Reserves remaining at Sangaredi were about 175 Mmt grading between 50% to 60% alumina and 0.5% to 2% SiO_2. Reserves at Bidi-Koum 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 reported to be about 28 Mmt grading about 45% to 46% alumina. Friguia's reserves were reported to be in excess of 200 Mmt grading about 40% alumina. Other bauxite deposits in Guinea include the Ayé-Koyé deposit 30 km northwest of Sangarédi, with reserves of about 195 Mmt grading about 50% alumina; the Dabola deposit with reserves of about 450 Mmt grading 42% alumina; and the Tougué deposit, with reserves in excess of 1 billion tons grading about 41% alumina.

There are no official estimates for Guinea's total diamond or gold reserves, although they were both believed to be significant.

Iron ore reserves on which the MIFERGUI-Nimba Project is based were estimated to be about 350 Mmt grading 66.5% iron. There are additional lower grade iron ore resources in the region and elsewhere in Guinea, but these are currently uneconomic to produce.

INFRASTRUCTURE

Guinea's transportation infrastructure has deteriorated considerably over the years, being barely adequate for its existing mining operations. Guinea's 1,045 km of railroads primarily serve the country's industries. The mining railroads totaled 239 km of standard-gauge 1.435-m line and 806 km of 1-m line. A 135-km standard 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. These railroads were considered to be in adequate condition for the present ore and equipment railing demands. In addition to the mine railroads, there was 661 km of 1-m-gauge line linking Conakry with Kankan that has been in very poor condition but which was undergoing rehabilitation with French assistance.

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 numerous rivers that are navigable by small boats and provide an adequate source of hydroelectric power.

OUTLOOK

Guinea's role as a major producer of bauxite should continue for the foreseeable future. It is likely that the development of new deposits should supplement production and amount to increased revenue for the country. Friguia's production of alumina should continue to improve as loans and technical assistance is received from financial institutions and foreign donors. Projects requiring major hydroelectric power such as the proposed aluminum smelter could become feasible if Guinea continues to maintain its favored status as recipient of development assistance from foreign donors. However, existing and projected market conditions coupled with financial constraints do not favor construction of the smelter at this time.

Guinea's diamond and gold resources appear adequate to sustain production at or above current levels in the short term. The Government's efforts to encourage foreign investment in Guinea is likely to increase exploration activities in the mining industry.

Assuming a rapid restoration of political stability in Liberia, it is likely that the MIFERGUI-Nimba iron ore project will become feasible.

[1]Where necessary, values have been converted from Guinean francs (GF) to U.S. dollars at the rate of GF813=US$1.00, which was the exchange rate for Dec. 1991.

[2]"Aredor" is an acronym for Association pour la Recherche l'Exploitation du Diamants et de l'Or. Aredor Holdings Ltd. is a consortim 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 SOURCES 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	1987	1988	1989	1990	1991e
Alumina:					
Production:					
Hydrate	543	593	627	642	640
Calcined	542	589	619	631	610
Shipments, calcined	539	593	624	631	580
Bauxite:					
Mine production:					
Wet basis	16,413	17,859	17,547	17,524	17,480
Dry basis[3]	14,672	15,964	15,685	15,665	15,625
Calcined[4]	114	130	143	140	[2]96
Shipments (dry basis):					
Metallurgical	13,829	14,524	14,750	13,835	13,600
Calcined	124	136	136	133	92
Diamond:[5]					
Gem[e]	163	136	137	119	[2]91
Industrial[e]	12	10	10	8	6
Total do.	175	146	147	127	113
Gold[6] kilograms	860	2,000	2,120	6,340	4,453

eEstimated.

[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; commodity includes data available through Apr. 10, 1992.

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

[3]Figures were estimated based on 3% moisture content for metal-grade bauxite.

[4]Data are for Compagnie Bauxite de Guineé, the sole producer of calcined bauxite.

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

[6]Figures include undocumented artisanal production. Audifere de Guinea (AuG) is the only reporting gold mining company, reporting the following, in kilograms: 1987—no production; 1988—324; 1989—1,202; 1990—1,745; and 1991—1,453.

TABLE 2

GUINEA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Million metric tons unless otherwise specified)

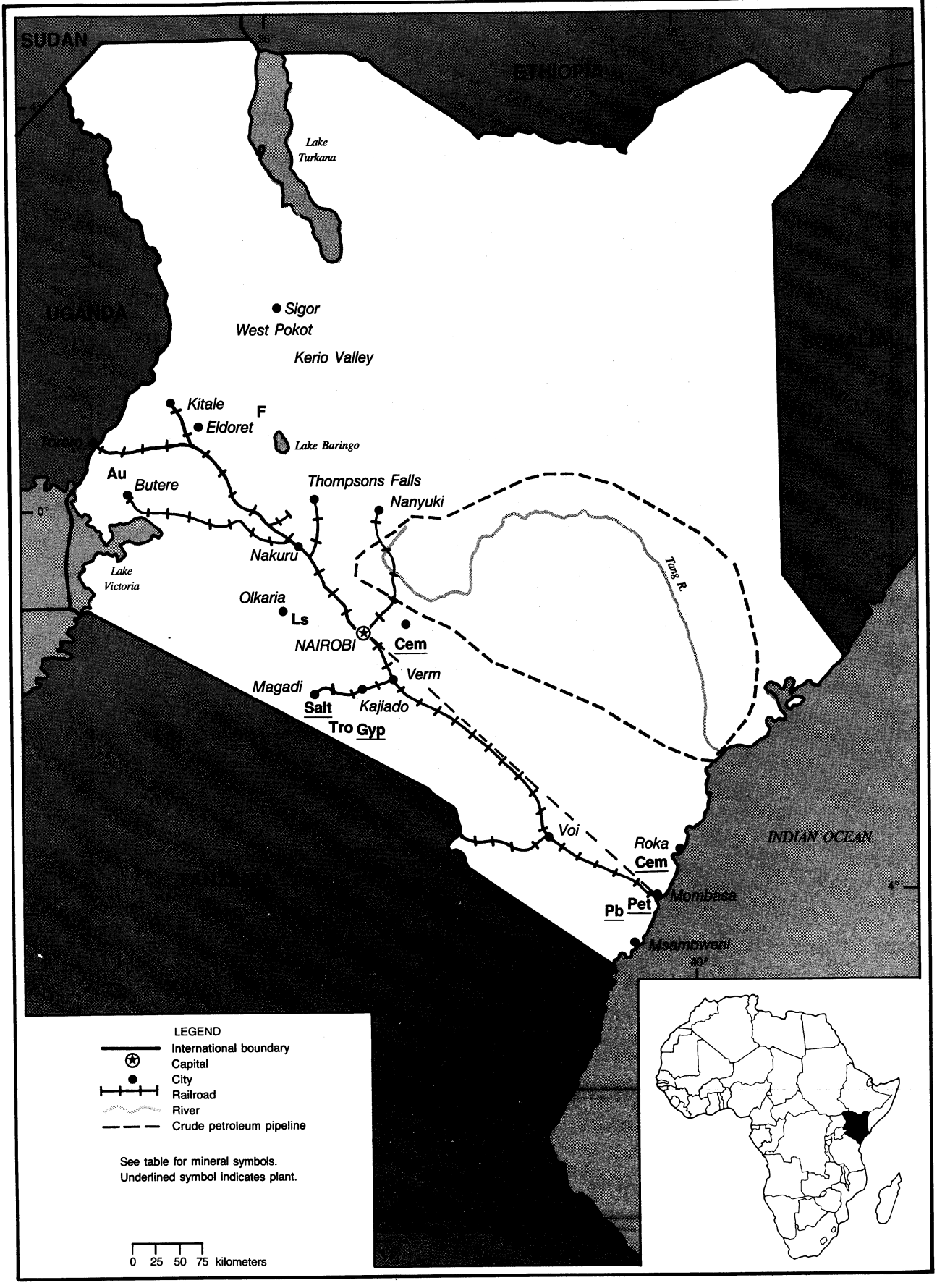
Commodity	Major operating companies and major equity owers	Location of main facilities	Annual capacity
Bauxite and alumina	Compagnie des Bauxites de Guinèe	Sangarédi Mine, about 242 kilometers north of Conakry. Drying and shiploading facilities are at Kamsar, 160 kilometers northwest of Conakry	12.2 bauxite.
Do.	Société d'Economie Mixte Friguia	Fria Mine and Kimbo alumina plant are at Fria, 75 kilometers north of Conakry	2.5 bauxite, .7 alumina.
Do.	Offices des Bauxites de Kindia	Kindia Mine (Debele deposit) at Kindia, about 110 kilometers northeast of Conakry	3 bauxite.
Diamond carats	Société Mixte Aredor Guinée S.A.3[1]	Aredor placer mine and mill are at Gbenko, 475 kilometers east of Conakry	200,000.
Gold kilograms	Aurifère de Guinée	Koron placer mine near Siguiri, about 540 kilometers northeast of Conakry	2,000.

[1]"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 Corporation, 11.28%.

SAMPLE TRENCH AT BLACKIES PIT, ASHANTI GOLD MINE, GHANA

KENYA

AREA 582,650 km² **POPULATION 25.2 million**



THE MINERAL INDUSTRY OF

KENYA

By David Izon

Kenya's mineral industry was not particularly important in the mineral economy of Africa or the world. The industry accounted for less than 1% of the country's GDP of $6.9 billion in 1991. Major mineral commodities produced were trona (soda ash), fluorspar, and limestone, in order of importance. Although Kenya's mineral resources were minimal, it was considered a well-developed industry in eastern Africa. The real rate of growth of the GDP declined to 4% in 1991. Mineral export earnings increased to about 20% of total exports because world market prices for coffee and tea declined in 1991. The production of three industrial mineral commodities, limestone, fluorspar, and soda ash, accounted for 70% of the total value of Kenya's mineral output. Petroleum products were becoming an important foreign exchange earner as the Government considered building a second refinery.

Investments made in Kenya were guaranteed under section 75 of the country's constitution. This allowed for repatriation of after-tax profit and also allowed for profits to be retained that have not been capitalized.

GOVERNMENT POLICIES AND PROGRAMS

Kenya's economic program for 1991-92 called for activities that encouraged growth, reduced inflation and the deficit, and built up foreign reserves for the country.

Progress was made in implementing the World Bank-backed structural reform program. Notable policy improvements were made in promotion of exports, liberalization of imports and price decontrol, and measures that strengthened exports of value added goods. The International Monetary Fund approved a $107 million loan to aid the Government in implementing the above program. This helped the funding of existing projects such as the Government-owned Export Processing Zone programs at Athi River and Mombasa. Programs were aimed at reducing the country's trade deficits to 3.5% and the inflation rate from 10.6% to about 7%. The Government planned to divest in several companies, including the Bamburi Portland Cement Co. Ltd. and Kenya United Steel Ltd. The other companies were nonmineral related. The 5-year development plan (1989-93) envisaged an annual 5.4% real growth in GDP. The Government was determined to achieve this goal by exercising measures to contain inflation. However, real growth in GDP in 1991 was 4%.

The Government continued with policies that allowed investors to deduct all foreign exchange losses on their investments. Investors in cities such as Nairobi and Mombasa were allowed an investment allowance of 35% on plant, machinery, and buildings. Rural investors were allowed 85% and manufacturers were allowed 100% investment allowance. The Government signed trade agreements with Tanzania and Iran to include cooperation in areas such as minerals and water resources.

PRODUCTION

In general, Kenya maintained a relatively stable minerals industry. The major minerals and mineral materials produced were cement, fluorspar, salt, and trona. Kaolin output was zero for the past 3 years. Industrial minerals were the main mineral commodities produced. *(See table 1.)*

TRADE

In 1991, Kenya spent about 42% of its export earnings on importation of oil for its refinery operations at Mombasa. Crude petroleum was imported mainly from the Middle East, and the refined product was usually exported to neighboring east and south African countries. Exports of petroleum products to Rwanda, Uganda, and Zaire experienced some decline in 1991. This was because importers considered it cheaper to import these products directly. However, oil imports grew by about 4% over those of 1990.

The main trading partners were France, Germany, Italy, Japan, the United Kingdom, the United States, and neighboring African countries. Imports from the United States remained mainly iron and steel, phosphate rock, and processed nonferrous minerals.

There appears to be substantial growth potential for trade between the Republic of South Africa and Kenya. Although the Republic of South Africa was not yet a member of the Preferential Trade Area of Eastern and Southern Africa, the Kenyan authorities were willing to consider granting south African firms the same privileges as others in the region.

STRUCTURE OF THE MINERAL INDUSTRY

At yearend 1991, the Government owned at least 51% of all mining companies, including the cement plants and oil refinery. In June 1991, the sale of Kenya's principal soda ash company to Penrice Ltd. of the United Kingdom was announced. Under the new agreement, Magadi Soda Ltd. would maintain its interest and the new parent company

would retain all employees. *(See table 2.)*

COMMODITY REVIEW

Metals

Bureau de Recherches Geologiques Miniere of France (BRGM) continued in 1991 to prospect for gold, copper, lead, and zinc in the Kerio Valley in northwest Kenya. In the Kakamega concession, BRGM discovered some sulfide ore containing 5.4% copper and 11% zinc. This area provided a very promising prospect on which work has continued. Two other companies continued their exploration efforts in other parts of the country. These operations involved San Martin of Switzerland and Kenor of Norway. At the present time, gold production in Kenya is limited to small-scale individual miners.

Industrial Minerals

Mining operations were largely confined to minerals such as fluorspar, limestone (for cement), and soda ash. A wide range of other industrial minerals was produced on a small scale. Silica sand was also mined at Msambweni and Roka on Kenya's southern and northern coasts, respectively, and shipped for bottle glass manufacture in Nairobi by Central Glass Industries.

Cement.—Most of the limestone and gypsum was produced by Bamburi Portland Cement Co.; East African Portland Cement Co. accounted for much of the remainder. Plans to build a third cement plant by Lonrho at Koru in Nyaza province of western Kenya would provide easy access to local and neighboring east African markets. This would increase combined total capacity of the three plants to 1.6 Mmt/a.

Soda Ash.—Acquisition of Magadi Soda Co. PLC by Penrice of the United Kingdom was good news to the Government of Kenya. The new owners only dealt in the soda ash business and were well known worldwide. The Magadi operation was also Kenya's largest source of crude salt. Production remained at more than 100,000 mt/a.

Mineral Fuels

Kenya does not produce crude petroleum, and ongoing exploration has not been successful. The Government of Kenya planned to increase its refinery capacity and make improvements to the refining process and oil residue cracking unit to increase the range of petroleum products.

Reserves

There were no officially reported reserve data.

INFRASTRUCTURE

Mineral commodities are transported on the country's railway system, which roughly parallels Kenya's southern border. The railroad enters the country near Tororo, Uganda, passes through Nairobi, and terminates at the port city of Mombasa, connecting key mining cities and districts along the way. Transportation of petroleum products from Mombasa to Nairobi is primarily by pipeline. The Government of Kenya plans to extend the Mombasa-Nairobi pipeline to western Kenya to reduce road and rail transportation. The main seaport is at Mombasa. Plans were also underway to upgrade the port at Mombasa to standards similar to that of the Republic of South Africa's port of Durban. Unicorn lines, one of the Republic of South Africa's two major shipping lines, was scheduled to start a new container service between Mombasa and Durban in late 1991.

OUTLOOK

The outlook for Kenya's industrial development projects would continue to be bright if the current political situation in the country is maintained. Improvements in trade relations with the Republic of South Africa could affect activities in the minerals sector.

In the energy sector, the long-term industrial energy conservation program that is being implemented could prove beneficial to the country in the future. Development of an industrial center in the Kerio Valley, after the completion of the Turkwell Valley hydroelectric scheme, could increase the labor force in the mineral industries.

Oil and gas exploration is a priority and is expected to continue. Government policies that are directed toward projects that will improve mineral production, increase foreign earnings, and reduce the deficit are also expected to continue.

[1]Where necessary, values have been converted from Kenyan shillings (KSh) to U.S. dollars at the rate of KSh30.52=US$1.00, which was the exchange rate for Dec. 1991.

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]		1987	1988	1989	1990	1991e
Barite		50	48	210	105	100
Carbon dioxide gas, natural		4,386	5,182	5,231	5,622	5,600
Cement, hydraulic	thousand tons	1,321	1,239	1,216	1,512	1,500
Clays, kaolin		40	42	—	—	—
Diatomite		616	712	783	944	900
Feldspar		—	—	1,112	1,290	1,200
Fluorspar (acid grade)		60,190	99,000	95,181	112,295	100,000
Gemstones, precious and semiprecious:						
Amethyst	kilograms	(3)	(3)	(3)	(3)	(3)
Aquamarine	do.	(3)	97	99	117	110
Cordierite (Iolite)e	do.	20	20	10	10	10
Garnet	do.	408	835	127	90	90
Ruby	do.	70	1,420	36	201	200
Sapphire	do.	222	1,390	37	20	20
Tourmaline	do.	11	23	1	9	10
Gold, mine output, Au content	do.	278	17	15	25	20
Gypsum and anhydrite		38,819	37,965	36,478	e36,000	36,000
Lead:e						
Mine output, Pb content		545	562	—	—	—
Metal:						
Smelter		2,000	2,000	1,000	1,000	1,000
Refined		1,800	1,800	900	900	900
Iron and steel: Steel, crudee		(3)	(3)	(3)	(3)	(3)
Kyanitee		(3)	(3)	(3)	(3)	(3)
Lime		26,482	27,326	32,167	13,941	14,000
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	304	300	320	330	300
Gasoline	do.	2,869	2,920	3,087	2,856	2,850
Jet fuel and kerosene	do.	3,261	3,285	3,587	3,391	3,300
Distillate fuel oil	do.	4,333	4,015	4,190	4,202	4,200
Residual fuel oil	do.	4,178	4,380	4,201	4,422	4,400
Other[4]	do.	844	400	766	956	950
Total including refinery fuel and losses	do.	15,789	15,300	16,151	16,157	16,000
Salt: Crude, rock		72,000	94,682	103,220	102,100	102,000
Sodium compounds, n.e.s.:						
Soda ash		228,650	220,000	240,880	244,480	245,000
Soda, crushed, raw		1,557	—	—	—	—
Stone, sand and gravel:						
Calcareous:						
Coral	thousand tons	1,331	1,352	1,427	1,650	1,600
Limestone	do.	400	416	16	18	20
Sand, industrial (glass)		e3,000	e7,000	10,841	12,344	12,300
Shale		142,428	e130,000	118,459	115,000	115,000
Vermiculite		3,887	3,707	2,436	2,655	2,600
Wollastonite		—	—	142	97	100

eEstimated.

[1]Includes data available through May 27, 1992.

[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]Less than 1/2 unit.

[4]Refinery fuel losses were as follows, in thousand barrels: 1987--625; 1988--470; 1989--653; 1990--700; 1991--700.

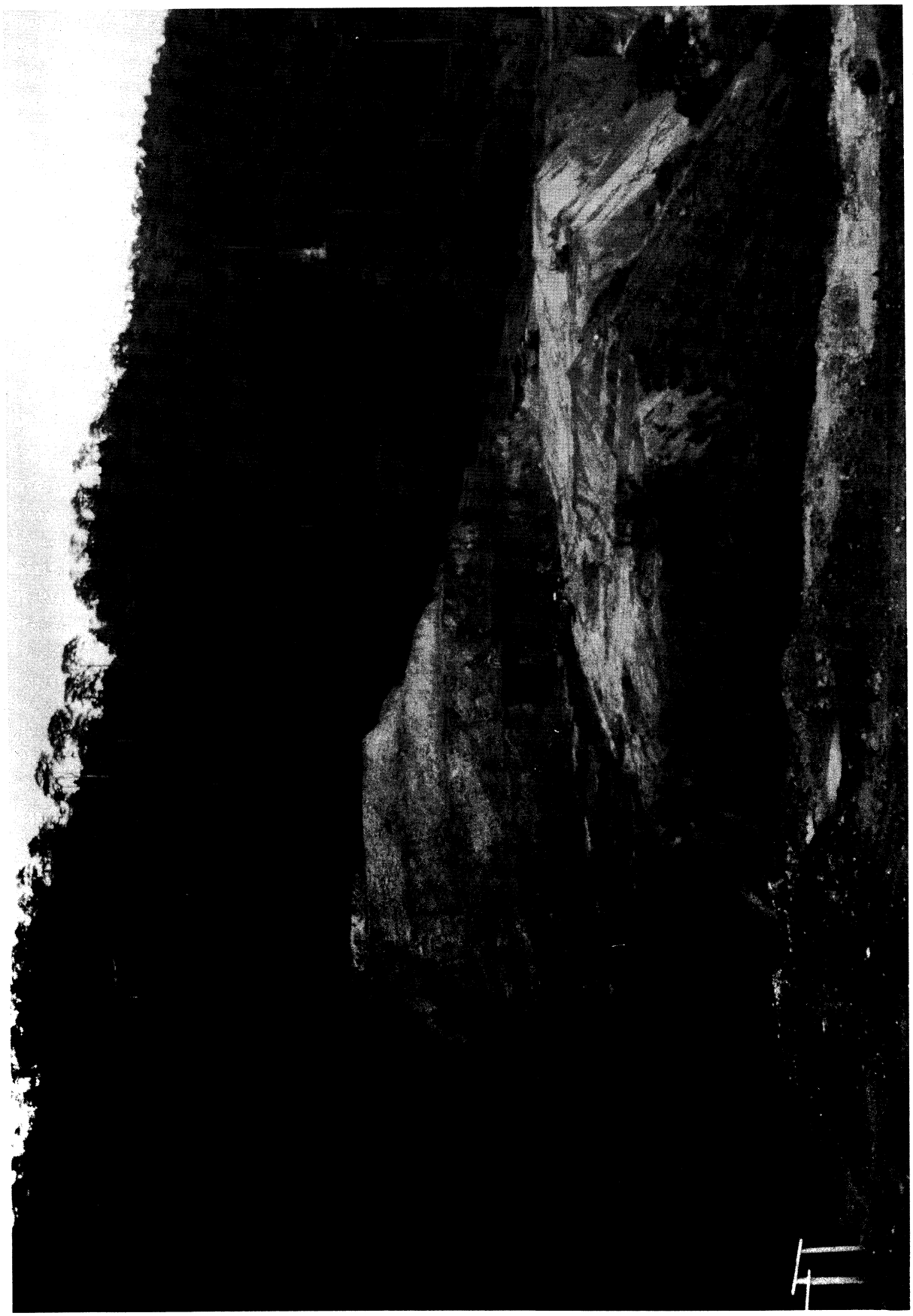
TABLE 2

KENYA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

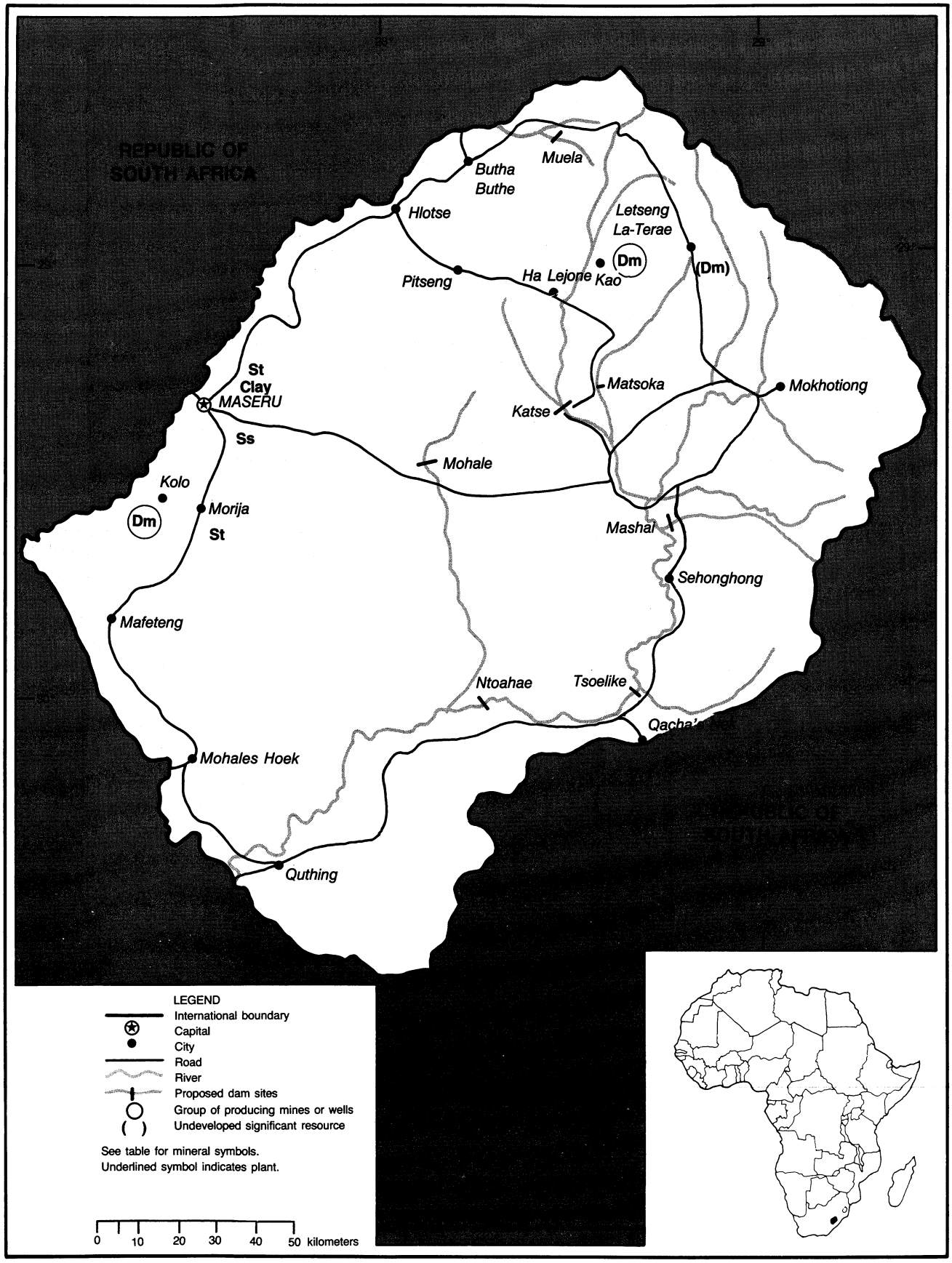
Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	The East African Portland Cement Co. (Blue Circle Industries PLC, 71%; Government, 29%)	Athi River, 30 kilometers southeast of Nairobi	350
Do.	Bamburi Portland Cement Co. Ltd. (Cemential Holding AG (Blue Circle Industries, 71%; Government, 29%)	Mombasa	1,156
Flourspar	Kenya Flourspar Co. Ltd. (Government, 100%)	Eldoret Mines: Kerio Valley, Eldoret, near processing plants: Kerro Valley; Eldoret	80
Gypsum and anhydrite	Atho Rivers Mining Ltd. (East African Portland Cement Co., 100%)	Nairobi Mines: Senya, Kajiado near processing plant: Athi River, Machakos District	2
Soda ash	Magadi Soda Co. PLC (Penrice Soda Products of Australia, share unknown; Government, share unknown)	Magadi Mines: Magadi, Kajiodo near processing plant: Lake Magadi 120 kilometers southwest of Nairobi	300
Salt	do.	do.	55

SANSU PROJECT - ORE DEVELOPMENT SCHEME AT THE ASHANTI GOLD MINE, GHANA



LESOTHO

AREA 30,000 km² **POPULATION 1.8 million**



THE MINERAL INDUSTRY OF

LESOTHO

By Audie L. King

The contribution of mining in 1991 accounted for only a minor portion of Lesotho's overall economy. Besides common construction materials, some gem-quality diamonds were mined by individuals with license to operate as diamond diggers. The output is mostly unreported and thought to be very small. Coal, limestone, phosphate, and uranium deposits have also been identified and may be exploited in the future.

As work progressed on the massive Lesotho Highland Water Project (LHWP), the stage was set for dramatic increases in the mining of industrial minerals. The LHWP will transfer surplus water from the highlands of Lesotho to the Vaal River in the Republic of South Africa via a system of holding dams and tunnels. The project will provide Lesotho with between $20 million[1] and $40 million per year in royalties from the export of a major portion of its unused water resources in the Maluti Mountains to areas around Johannesburg and Pretoria. This could amount to as much as 6% of the country's GDP.

Greatest mineral production volume gains will come from the production of sand and crushed diabase for dam and tunnel construction and for the construction of related projects such as road paving and other infrastructural improvements. The overall value of stone-aggregate mining to Lesotho's economy will, however, remain minimal because the LHWP construction contracts give designated contractors free access to Lesotho's stone deposits. Still, the development of a domestic stone-aggregate industry will save some or all of the estimated $8 million that Lesotho spends annually for imported aggregates.

Following a period of slow growth in the early 1980's, Lesotho's economy has been growing consistently at about 5% per year. Growth has been led by the industrial sector, which has grown by about 12% per year. Recent governmental policy changes have stimulated foreign investment in the industrial sector, which composes about 10% of the overall economy. The industrial sector is dominated by textiles, light manufactures, and construction.

The economy may also be reaping the initial benefits of the LHWP that is in the beginning stages of construction and promises to greatly improve economic conditions for the next 50 years. Long-term plans for the LHWP call for the construction of seven dams, three pumping stations, a hydroelectric powerplant, and a total of 225 km of water transfer-delivery tunnels.

GOVERNMENT POLICIES AND PROGRAMS

Recent Government programs aimed at expanding foreign investment in Lesotho's industrial sector have been highly successful. Led by increases in light manufacturing, particularly in textiles and clothing, industry's share of GDP has risen from 6% in 1982 to 15% in 1989. At least part of the industrial sector's gains was attributable to Lesotho's favorable access to world markets at a time when the neighboring Republic of South Africa was suffering from trade sanctions. Lesotho offers investors relatively low corporate tax-rates of 15% and minimal controls on business operations. New investors enjoy a tax-free holiday for up to 15 years, free access to foreign exchange, and the option to repatriate investment capital and a portion of earnings.

The Lesotho National Development Corp. (LNDC) was established in 1967, shortly after Lesotho's independence. It has the mandate to promote and establish industry in manufacturing, mining, and tourism. In 1977, the LNDC significantly changed its strategy as it expanded into financial aspects of investment. Today, the LNDC serves as a one-stop service center for foreign investors. It provides low-interest loans and guarantees loans made by other financial institutions. It also provides grants that cover up to 75% of eligible costs related to training Basotho (individuals from Lesotho) employees. The LNDC also assists investors in all official administrative matters that fall outside its domain.

PRODUCTION

Mineral production was limited to small amounts of crushed stone, sand and gravel, clay, and a small number of diamonds. The total value of minerals produced in 1990, the latest year these data were available, was less than 1% of the GDP. However, the LHWP was expected to increase consumption and production of industrial minerals. Projects involving the production of construction materials such as crushed stone for roads and dam construction, washed sand, and sandstone blocks were expected to be developed by the LNDC with the status of satellite industries of the LHWP. Plans call for all of the LHWP's cement to be imported; however, concrete products would be produced in Lesotho using domestic sand and crushed stone.

Diamond exports from 18 licensed dealers amounted to 4,330 carats for the

fiscal year ending March 1989, the latest year that data were available. It was suspected, however, that most diamonds never reached the legal market and went unreported. The Mountain Diamonds Co. and Senqu Diamond Cutting Works were the country's only active diamond cutting factories. Together they employed a total of 10 persons.

TRADE

Lesotho remained highly dependent on trade with the Republic of South Africa, though it has made some progress in expanding its markets into Europe and the United States. In 1989, the latest year that such data were available, the United States accounted for only 1% of Lesotho's $499 million worth of imports. The country's principal imports included petroleum products, building materials, clothing, motor vehicles, machinery, pharmaceuticals, and food products. The percentage of exports going to the United States was 25% in 1988, but slipped to less than 13% in 1989, when Lesotho's exports amounted to $66 million. Lesotho's main exports were baskets, cattle, hides, mohair, vegetables, wheat, and wool. It exported cotton apparel, rugs, textiles, and tapestry to the United States.

During the past few years, many companies relocated to Lesotho primarily to take advantage of the country's preferential access to world markets. Lesotho had negotiated markets in the EC as a signatory to the Lome Convention, the European Free Trade Association, the Southern African Customs Union, the Preferential Trade Area, and of the Southern African Development Coordination Conferences. Lesotho also has trade advantages with the United States under the general system of preference and most-favored-nation status.

STRUCTURE OF THE MINERAL INDUSTRY

Since the closing of De Beers Consolidated Mines Ltd.'s Letseng-La-Terai diamond mine in 1982, independent diamond diggers have taken part in small-scale mining. Small deposits of crushed stone and other crude building materials were also worked by private individuals. Increased volumes of sand and crushed stone that will be needed during the construction of the LHWP will be extracted by individual project contractors.

More than one-half of Lesotho's labor force worked in the Republic of South Africa. Mines centered around the Republic of South Africa's Orange Free State were the primary employers of Basotho miners, with 80% concentrated in the area around Welkom, north of Bloemfontein. It was estimated that 60% of the Lesotho's families owed their support to wages earned in these mines. Income derived from migrant miners was the principal way Lesotho's Government financed its trade deficit. The latest figures from the Republic of South Africa's Chamber of Mines reveal a downward trend in the number of Basotho mine workers employed in the Republic of South Africa. An average of 103,920 Basotho migrant workers were employed in South African mines in 1990 compared with an average of 106,605 in 1989. Of the 1990 total, 98,200 worked in gold mines and 5,720 worked in coal mines. By the end of January 1991, the number of Basotho mine workers employed in the Republic of South Africa had dropped to only 95,000 owing to reduced activity in the South African gold mines.

COMMODITY REVIEW

Lesotho's Department of Mines and Geology reported that stone quarries at Ha Faso, 15 km north of Maseru, and Morija, 30 km south of Maseru, produced crushed diabase for road construction and building purposes. A quarry at Thuathe, 10 km east of Maseru, produced sandstone blocks. New permits were issued for additional stone production at Bokong, 10 km north of the proposed Katse Dam, and at Pitseng and Moteng, near the proposed Muela Dam. Clay, for brick manufacturing, was mined by Loti Brick Co. at Thetsane, near Maseru.

More than 500 diamond miners were active at a number of sites near Kao and Kolo. It was reported that four more areas would be opened up to diamond digging during the 1989-90 fiscal year by Swissbourgh Diamond Mines. The company was granted mining leases covering a total of 367 km^2 of alluvial diamond-bearing sediments in the area around Kao.

INFRASTRUCTURE

For the next 30 years, most of Lesotho's construction efforts will be centered around the LHWP, a massive infrastructural project that calls for the construction of seven dams, a network of connecting tunnels, and a hydroelectric plant.

After more than 20 years of deliberation and sundry feasibility studies, a treaty was signed by Lesotho and the Republic of South Africa on October 24, 1986, to proceed with the LHWP. Under the agreement, the project would be divided into a number of selfcontained phases that would incrementally increase the flow of water into the Republic of South Africa's Vaal River system in stages to meet forecast demand. By the year 2020, when the LHWP is scheduled for completion, the flow rate is predicted to reach 70 m^3/second. The agreement also provided for the construction of facilities to generate substantial hydroelectric power for Lesotho. The treaty specified that the Republic of South Africa would be responsible for all costs related to water transfer and Lesotho would be responsible for all costs related to the generation of electricity.

The first phase of the LHWP, Phase 1a, involves the construction of a main storage dam at Katse on the Malibamats'o River, a hydroelectric plant, and 84 km of water tunnels. The total cost of phase 1a was estimated at $2,300 million, of which tunneling constituted about $820 million. The 180-m-high, 500-m-wide, double curvature concrete arch dam will be the largest in sub-Saharan Africa. Up to 18 m^3/s of water will be transported

from the Katse Reservoir through the Transfer Tunnel, which will be 48 km long with an unlined diameter of 4.85 m, to Muela where a hydroelectric plant will be constructed. After passing through the powerplant, the water will be discharged into a tailpond formed by the 55-m-high Muela Dam. When the Muela power station becomes operational, it is expected to be highly beneficial to the Basotho economy. The Lesotho Electricity Corp. currently imports more than 80% of the nation's electric power from the Republic of South Africa at a cost of about $8 million per year. The new plant will generate 260 GW•h/a of power, enough power to make Lesotho virtually self-sufficient. Tendering for the Muela hydropower project was due to begin in 1992, with financing already secured from the EC and the African Development Bank. A delivery tunnel 36 km in length and 5 m in diameter will carry water from the Muela Dam's tailpond to a tributary of the Vaal River in the Republic of South Africa where it will flow to the Vaal Dam, 70 km south of Johannesburg. The first 13 km of the delivery tunnel, which falls within Lesotho, is called the Delivery Tunnel South. Similarly, the northern portion that lies in the Republic of South Africa is called the Delivery Tunnel North. The completion date for Phase 1a is set for 1996.

By the end of 1991, the LHWP's administrative body, the Lesotho Highlands Development Corp. (LHDC), had designated all contractors for Phase 1a and assembled them on-site.

Financing for infrastructural improvements and planning was provided by the World Bank, the EC, the European Investment Bank, and various bilateral sources, including France, the Federal Republic of Germany, the United Kingdom, and the United States. Environmental assessment was completed in June 1990. It addressed soil and water conservation, terrestrial and aquatic biology, water quality control, public health, environmental monitoring, and cultural heritage issues. A resettlement program was also approved by the Government.

Early in 1991, LTA Bloemfontein, a South African construction company, and Dumez, a French company, completed a $63 million road from the Republic of South Africa to the site of the Katse Dam. In total, 650 km of new or improved roads were planned or under construction. These new roads should help open up the previously remote interior regions of Lesotho to tourism and industry.

Loans worth $500 million were signed between the LHDC, South Africa, the World Bank, and European commercial banks for the construction of the Katse Dam. Engineers from the Republic of South Africa's Murray and Roberts completed the site preparation work for the Katse Dam. The Malibamats'o River will be diverted through two tunnels, driven by drill and blast methods, each about 600 m in length and 7.5 m in diameter. Work was nearly completed on a 1,500-m-long tunnel (3 m in diameter) that will convey crushed aggregate from the primary crusher at the quarry to a secondary crusher near the concrete batching plant. A $111 million contract for the construction of the Katse Dam was awarded to the Highlands Water Venture Group, a consortium that consisted of Group Five of the Republic of South Africa, Concor Impregilo of Italy, Hochtief of the Federal Republic of Germany, Bouyges of France, and Sterling and Kier of the United Kingdom.

In the beginning of February, the Lesotho Highlands Project Contractors (LHPC) joint venture started work on its $335 million tunneling contract for the boring of the Transfer Tunnel and for the Delivery Tunnel South. The LHPC includes LTA Ltd. as the local partner, and Spie Batignolles and Campenon Bernard of France, Balfour Beatty of the United Kingdom, and Zublin AG of the Federal Republic of Germany. The transfer tunnel will be entirely in basalt where tunneling conditions will be good for the use of tunnel boring machines (TBM's). Orders were placed for one Atlas Copco and two Robbins TBM's. Delivery of the TBM's is expected early in 1992, and by June 1992, the machines should be fully operational. An additional 8 km of tunnel, mainly access adits, will be excavated by conventional drilling and blasting. The transfer tunnel is expected to be finished by the first quarter of 1995. An estimated 6,500 m of tunnel that will require lining will be finished by June 1996.

Lesotho Highlands Tunneling Partnership (LHTP), consisting of Lahmeyer International and Mott Macdonald International, held the supervision contract for the Delivery Tunnel South. LHTP is in charge of design review, construction drawings, and supervision of construction. The Delivery Tunnel South will be in massive sandstones and siltstones where tunneling conditions are expected to be favorable and little rock supports are expected to be needed. A refurbished Robbins TBM is scheduled for delivery by the end of 1991. Excavations should be completed by the end of 1995, and concrete lining, the full extent of which will be determined by rock conditions, should be finished by the beginning of 1996.

Highland Delivery Tunnel Consultants (HDTC), which consists of Ninham Shand Inc., Van Nickerk, Kleyn and Edwards, Steffen Robertson and Kristen Consulting Engineers Inc., and Keeye Styen Inc., all from the Republic of South Africa, hold the supervision contract for the Delivery Tunnel North. This portion of the delivery tunnel will traverse interbedded sandstones, siltstones, and claystones. Because the claystones are particularly weak, TBM operations will need to be shielded on both sides, and precast concrete segments will be erected within the shields. The contractor has ordered a Wirth TBM to be delivered in early 1992. Commissioning of this tunnel is also scheduled for 1996.

During 1991, construction sites were established at five locations where the provision of infrastructure was underway. A total of seven working sites will eventually be established in addition to camps at Ha Lejone and Butha Buthe and a co-ordination office at Hlotse. Besides the provision of roads, infrastructural development included the construction of about 200 homes for senior staff and accommodations for about 1,500 laborers.

Phase 1b will increase the yield of Phase 1a from 18 to 30 m^3/a. It will involve the construction of the Mohale Dam on the Senqunyane River and a transfer tunnel, 30 km in length and 3.4 m in diameter, that will transport water to the Katse Reservoir. In Phase 2, the Mashai Dam will be built, along with another transfer tunnel. In Phase 3, the Tsoelike Dam will be constructed, and finally the Ntoahoe Dam will be constructed in the fourth phase. The proposed dams range in height from 126 m to 180 m and have a total storage capacity of 6.5 billion m^3.

OUTLOOK

The LHWP will play an important part in improving the economy of Lesotho during the next 50 years. Besides the obvious economic gains derived from water transfer royalties and the reduction of the trade deficit by reducing energy imports, many positive secondary benefits will be realized. For example, major infrastructural projects promise to open up the interior to tourism, fishing, and modern agriculture.

If Lesotho's positive investment climate persists, the introduction of inexpensive electrical power could be extremely significant to growth in the manufacturing sector.

Lesotho will continue to depend heavily on the wages its citizens derive in the Republic of South Africa. The relative importance of these wages to the economy may diminish somewhat, however, as new jobs open up in manufacturing and in other sectors affected by the LHWP.

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

[1]Where necessary, values have been converted from Basotho maloti (M) to U.S. dollars at the rate of M2.56=US$1.00.

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Agencies

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Maseru, Lesotho

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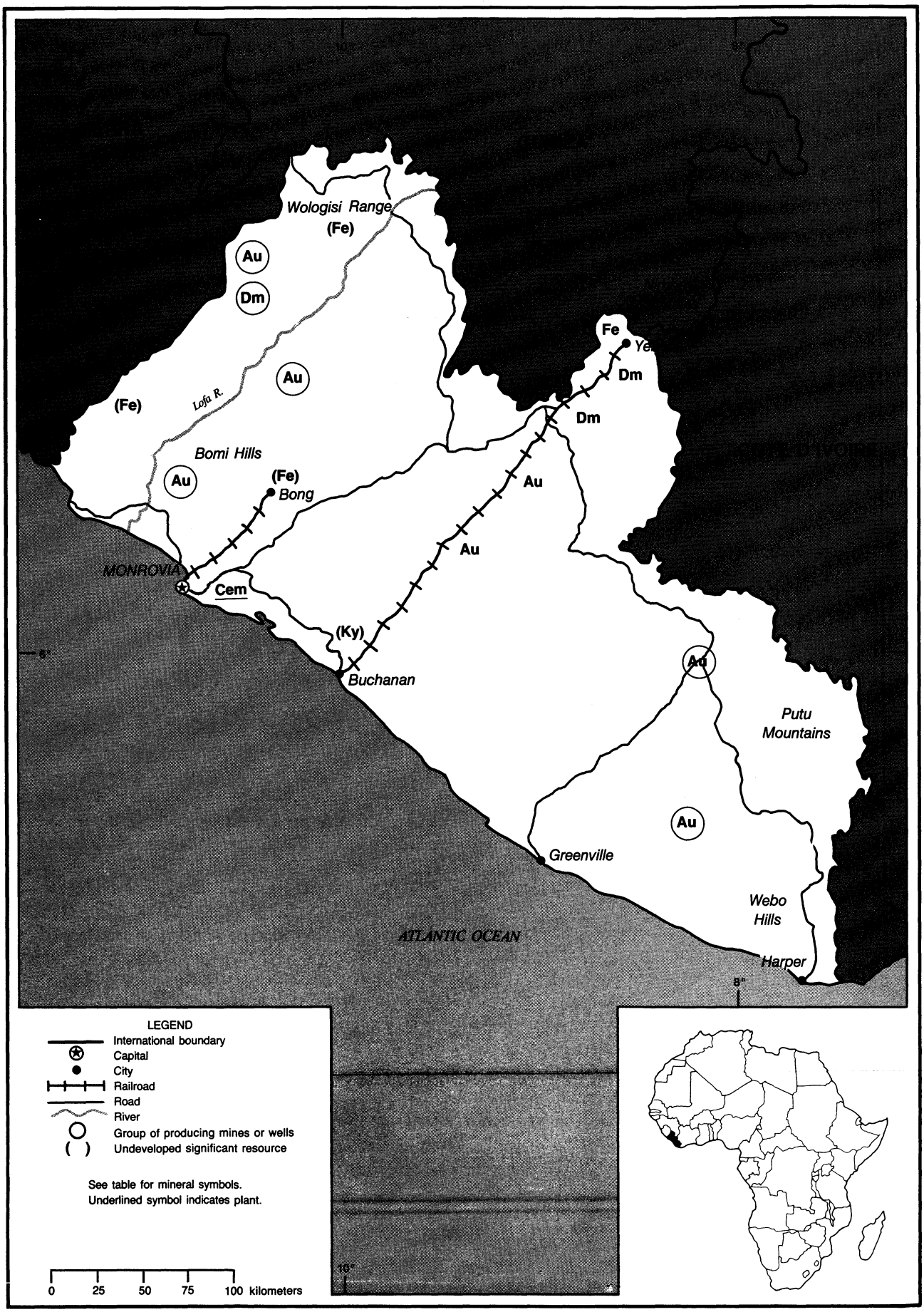
Annual Report of the Department of Mines and Geology.

LIBERIA

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



THE MINERAL INDUSTRY OF

LIBERIA

By Hendrik G. van Oss

Although slightly improved over that of the previous year, the Liberian economy remained crippled in 1991 as a result of the civil war begun in December 1989 and which had continued through much of 1990. This war brought to a halt, by mid-1990, virtually all industrial operations, including all formal mining activity. Agricultural output was largely stopped, and virtually all Government services ceased. Approximately one-half of the population was displaced or fled the country. An interim Government, formed in October, restored some stability to Monrovia and its environs. However, about 95% of the country remained in opposition hands. By yearend 1991, little change had occurred. Negotiations continued toward the restoration of democracy.

Traditionally, the economy of this heavily forested, well-mineralized country has been dominated by the export of mineral commodities, timber, and rubber, and by revenues from license fees from the world's largest merchant fleet. In 1989, the latest year for which data were available, mining revenues were equivalent to about 22% of the country's reported GDP of about $1 billion.[1] Most of these revenues were from the exports of iron ore, with lesser contributions from legal exports of gold and diamond. The GDP in 1991 is estimated to have amounted to only about 25% of the 1989 level. Sales of iron ore in 1991 are estimated to have been only about $16.1-16.5 million. As in past years, the true contribution of gold and diamond to the Liberian economy in 1991 was not known because of smuggling of both Liberian production and that from other countries through Liberia.

In 1991, Liberia's formal mining sector consisted of a single iron ore mine, operated by the Iron Mining Company of Liberia (LIMCO) and owned by the Government. Apart from a brewery and bottling plant in Monrovia and the minor processing of rubber on a couple of plantations, the iron ore mine was the only functioning industrial operation in the country during the year. The country's artisanal mining operations for gold and diamond appear to have been only marginally affected by the war, at least in terms of cumulative production. Liberia's only cement plant and the country's single sand operation remained closed during the year; both had closed at midyear 1990. The diamond and gold exploration project of Western Mining Corp. of Australia, involving an 18,000-km² concession in western and northern Liberia, remained on hold pending a return of political stability to the country.

Owing to the massive displacement of persons during the war, the size of Liberia's work force in 1991 was not known. It has traditionally totaled about 700,000 persons, most of whom worked in agriculture. Workers in the mining sector are estimated to have numbered about 15,000 during the year, of whom 2,300 worked for the iron ore mine and the remainder as artisanal miners. It has been estimated that the iron ore miners' wages supported about 35,000 persons.

Liberia's geology is dominated by a complex of Archean migmatitic and granulitic gneissic rocks. These contain several northeast-trending narrow zones containing iron formations, some of which have been mined for iron ore. Of these, the high-grade iron deposits near Yekepa in the Nimba Mountains were put into production in 1963 and were still in operation in 1991. Low-grade iron ore at Bong was mined from 1965 until mid-1990. In the southeast third of the country there are northeast-trending Proterozoic belts containing volcanic and sedimentary rocks, similar to those of the Birimian series found to the east in Côte d'Ivoire. Diamond-bearing kimberlites are known to exist near the Sierra Leone border, but have never been proven economic. Alluvial diamonds, however, are known from many parts of the country, particularly along the Lofa River and its tributaries in western Liberia. Gold is likewise widespread in alluvial deposits. Apart from silica sand and construction materials, Liberia's resources of other minerals have not yet proven economic. These include barite, chromium, kyanite, nickel, titaniferous sands, and uranium. *(See table 1.)*

LIMCO resumed railing ore from mine stockpiles to its port facilities at Buchanan in February 1991, after an almost 1-year closure, and after ascertaining that its mine and ore shipping facilities had come through the civil war essentially undamaged. Exports, to France, from Buchanan resumed in early March, and mining operations resumed near Yekepa in mid-April. Total ore shipments for the year are estimated to have totaled about 1.02 Mmt. By yearend, mining had recovered to a rate of about 50,000 mt/week. The purpose of the LIMCO project was primarily as a bridging operation to keep operational the mine's 267-km railroad to Buchanan and the shiploading facilities there. This infrastructure is key to the development of the MIFERGUI-Nimba high-grade iron ore body in Guinea. A connection from

this deposit to the railhead at Yekepa requires the construction of just 17 km of new track, as opposed to a much lengthier railroad to Conakry, Guinea. The LIMCO operation involves mining and shipping a blend of the small amount of high-grade iron ore remaining at the Nimba Mine at Yekepa, with more abundant but higher phosphorus material from the nearby Mount Tokadeh deposit. The delineation of small additional reserves at Nimba, and of high-grade ore at Mount Tokadeh, have allowed the company to maintain its blending ore reserves. These at yearend were considered adequate for 36 to 40 months of operations, a period considered just sufficient for the construction of the MIFERGUI mine and connecting railroad. However, development of the MIFERGUI-Nimba deposit remained uncertain at yearend because of the unresolved political problems in Liberia, the uncertain status of the 1989 project agreement between the Governments of Liberia and Guinea, and uncertainties in finance. Despite these concerns, a number of parties, chiefly in Europe, have continued to express interest in the project.

The Bong iron ore mine, which had closed for security reasons in June 1990, remained closed throughout 1991. The mine's modest remaining reserves were of low-grade, required highly energy-intensive grinding, and were difficult to access. For these reasons, and the fact that the mine facilities had reportedly suffered extensive pilferage and some damage during the war, it was considered unlikely that the mine would reopen.

The restoration of Liberia's economy hinges on the return of political and social stability to the country. Given this favorable development and a willingness of foreign investors to return to the country, it is likely that minerals will play a key role in the country's future. If the MIFERGUI-Nimba project comes to fruition, Liberia will receive revenues for transshipping the ore. Iron ore mining in Liberia beyond the limited reserves near Yekepa or at Bong will require the exploitation of the country's large resources of moderate-grade material, the best of which are near Yekepa. However, direct export of this material is unlikely because of poor world market conditions and the fact that the Port of Buchanan can only handle ships up to about 80,000 dwt. A long-proposed plan to concentrate and/or pelletize this material at Bong prior to export from Monrovia would require the construction of about 112 km of track to link Bong with the Yekepa-Buchanan railroad, and some upgrading of existing BMC facilities. The economics of this project were uncertain. Gold and diamond occurrences are sufficiently widespread in Liberia to augur well for the potential development of mines for these commodities.

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[1]Although the Liberian dollar (L$) remained at official parity with the U.S. dollar in 1991, most unofficial transactions utilized a parallel currency market where the L$ traded at a discount. This discount reportedly ranged from about L$6.00 to L$10.00 per US$1.00 during the year.

OTHER SOURCES OF INFORMATION

Agency

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

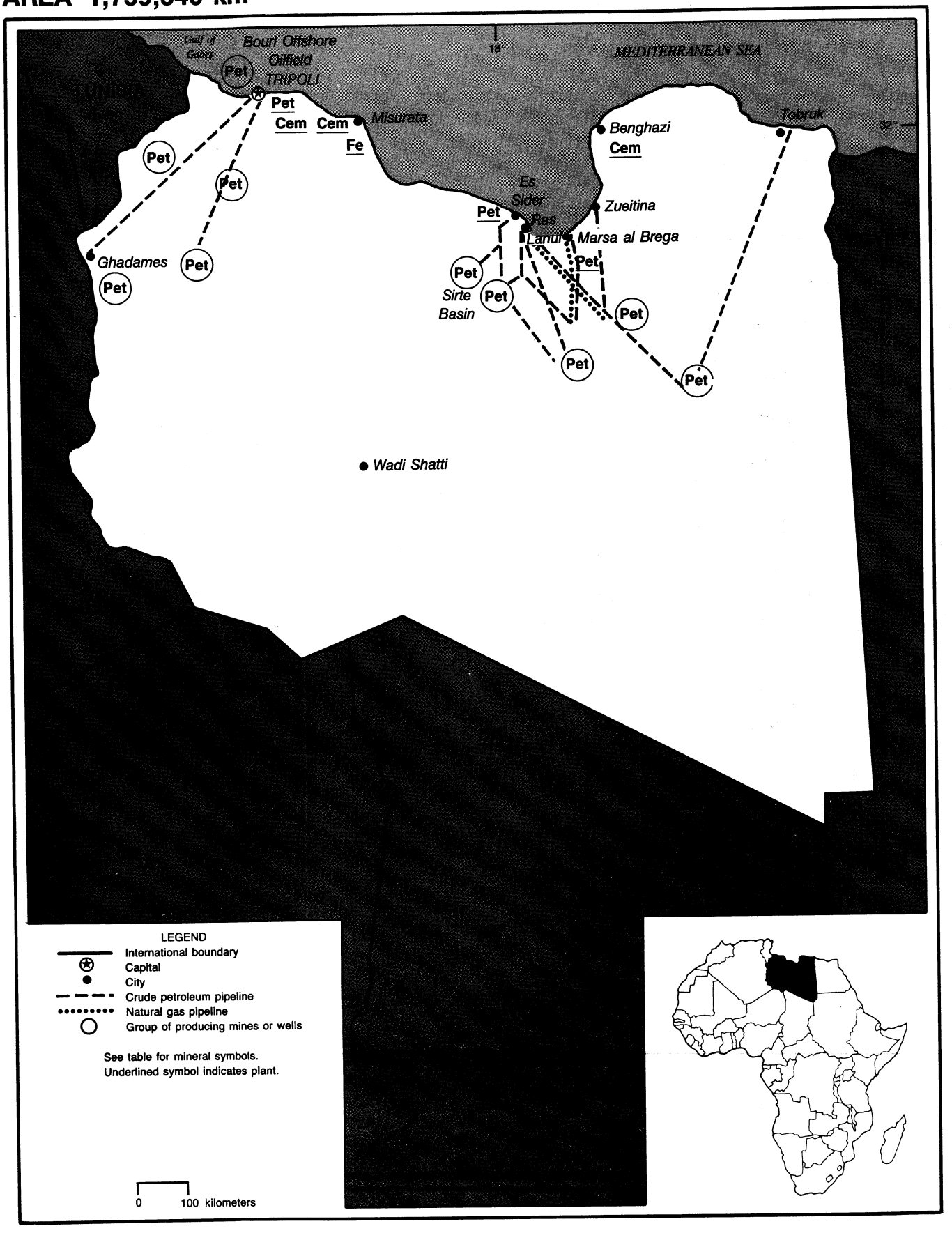
TABLE 1
LIBERIA: PRODUCTION OF MINERAL COMMODITIES

Commodity[1]		1987	1988	1989	1990e	1991e
Cement, hydraulic	metric tons	105,374	105,800	85,300	50,000	—
Diamond:[2]						
Gem	carats	112,113	e66,812	61,822	40,000	40,000
Industrial	do.	182,921	e100,218	92,732	60,000	60,000
Total	do.	295,034	167,030	154,554	100,000	100,000
Gold[2]	kilograms	467	677	734	600	600
Iron ore	thousand metric tons	13,742	12,767	11,700	[3]4,050	[3]1,100
Silica sande	metric tons	5,000	6,600	10,000	5,000	—

eEstimated.
[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 Feb. 28, 1992.
[2]Data through 1989 do not include smuggled production. Data for 1990-91 are estimates of artisanal production, likely smuggled out of Liberia, but which is comparable to that hitherto reported to the Government.
[3]Reported figure.

LIBYA

AREA 1,759,540 km² **POPULATION 4.3 million**



THE MINERAL INDUSTRY OF

LIBYA

By Thomas P. Dolley

The nonfuel sector of the Libyan mining industry was not significant on a global scale. However, Libya maintained a second place position to Nigeria among African crude oil producers in 1991. Petroleum production and export continued to play a predominant role in the Libyan economy. Total revenue from oil production and export in 1991 was valued at approximately $10 billion.[1] Typically, over the past several years, oil revenues have accounted for about 25% to 50% of the Libyan GDP. The estimated GDP for 1990 was $27.3 billion.

The Persian Gulf War helped to stimulate international oil prices, and Libya benefited from this. Libya, an OPEC member, has increased crude oil production for the fifth consecutive year.

Economic problems continue to be exacerbated by the Government's political rifts with France, the United Kingdom, and the United States. These international tensions have dissuaded major foreign petroleum companies from direct investment in Libya's petroleum sector. Additionally, ongoing economic sanctions imposed by the United States in 1986 continued to discourage major foreign investors in Libya's petroleum resources.

Foreign exhange shortages have curbed developmental projects, particularly in the petroleum sector. Government delays in passing a budget, U.S. sanctions, and the expense of the Great Manmade River project (GMR) have caused a lack of liquidity for developmental projects.

GOVERNMENT POLICIES AND PROGRAMS

The Libyan National Oil Corp. (NOC) maintains complete control of the oilfields and petroleum industry investments, including selling all of the crude oil produced. The NOC had an operating budget of approximately $3 billion for 1990-91.

Effective May 6, 1991, the U.S. sanctions of 1986 against the Government of Libya were extended to include Government-owned companies outside of Libya. The additional sanctions prohibit U.S. interests from unlicensed transactions with the Libyan companies or any properties associated with these companies. Some of these companies were associated with the Libyan mineral industry and included Libyan National Petrochemicals Co. (Germany); Mediterranean Sea Oil Services GmbH (Dusseldorf, Germany); Société Libyenne Centre Africaine des Mines (Bangui, Central African Republic); Tamoil Italiana SpA (Milan, Italy, and Cremona Refinery, Italy) and Umm Al-Jawaby Oil Service Co., Ltd. (London, United Kingdom).

On June 6, 1991, Libya and Italy signed an economic cooperation agreement. The agreement covers technical assistance for Libya in the areas of energy, water, and curtailment of desertification.

PRODUCTION

Libya increased its crude oil production output in 1991 to 1.48 M bbl/d. Libya was the third largest producer of natural gas among African countries, exceeded by Algeria and Egypt. Libya currently produces more natural gas than its local needs require. The Persian Gulf War was partly responsible for the increased production of hydrocarbons to exploit available markets and higher global oil prices.

Iron and steel production was not significant on a global scale and relied upon imported feed materials. The Misurata steel complex continued to be underutilized during the year. Libya continued to rely on foreign expertise to maintain its industrial infrastructure.

Additional mineral activity was minimal with the exception of salt harvesting from coastal pans, quarrying of clay, gypsum and limestone, cement, and ammonia production, which is utilized in the fertilizer and explosives industries. (*See table 1.*)

TRADE

In 1991, Libya's crude oil exports typically averaged 1.1 Mbbl/d. Libya's domestic refining operations supply about 150 kbbl/d of export oil products, despite having more than double the refining capacity. The two largest overseas customers for Libyan crude oil are Italy's Tamoil Italia and Azienda Generali Italiana Petroli S.p.A. (AGIP). Exemplifying crude oil export earnings, May 1991 posted $630 million in revenue. Crude oil price disputes between the NOC and long-term European customers are not uncommon. Roughly 20% of total Libyan imports is composed of foodstuffs.

In the past several years, Libya's parastatal Oilinvest has incorporated a variety of foreign retail outlets and refining capacity for its crude oil exports. The eventual goal of this strategy is thought to be a vertically integrated European oil company owned by Libya. Oilinvest's acquisitions are found in France, Germany, Italy, Spain, and Switzerland. The investment strategy is possibly being developed to thwart any

new EC energy investment codes that limit crude oil exports from developing countries.

In 1991, liberalization of trade regulations has led to improved relations between Libya and neighboring Egypt. First realized in 1988, economic benefits to both countries have allowed a renunciation of border restrictions and an influx of 150,000 Egyptian workers.

Spain imported roughly 45.3 Mm^3 of LNG from Libya in 1991. Italy, once a traditional customer for Libyan LNG, imported no supplies in 1990 or 1991. In 1990, Libya was Italy's primary supplier of crude oil and refined products, averaging 556 kbbl/d.

STRUCTURE OF THE MINERAL INDUSTRY

Libya possessed a predominantly state-run economy, and the mineral industry is no exception. In general, 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. This legislation was amended in 1980 with new production-sharing patterns based on the following criteria: 85% to 15% in the Government's favor for highly significant oil prospects, 81% to 19% for moderately significant oil prospects, and 75% to 25% for less significant oil prospects.

In the past several years, more flexibility had been introduced to these production-sharing patterns to attract additional investment following the departure of some foreign operators. Amendments to accomplish this were in the form of exploration and production-sharing agreements or EPSA's. This was most recently realized by a series of exploration contract signings under EPSA-3. EPSA-3 featured a production equity split of a 70:30 ratio in NOC's favor. However, with the exceptions of the Netherlands' Royal Dutch/Shell and Belgium's Petrofina, only a few small, independent foreign oil operators have signed under EPSA-3. Critics of EPSA-3 cite the contract's stipulation that operatorship can be suspended by the Government for no reason, along with the concomitant fear of nationalization of the foreign companies's assets. Additionally, many allies of the United States are reluctant to transgress the 1986 sanctions imposed on Libya that forced the withdrawal of U.S. companies. Since the first major hydrocarbon discoveries of the 1960's, Libya has continued to rely on foreign expertise and technical personnel to develop its petroleum and mineral industry.

The NOC was the parastatal created by the Government in 1970 to oversee petroleum and natural gas exploration, production, and marketing through its 11 wholly owned subsidiaries. AGIP was the largest foreign producer by virtue of its Bouri offshore oilfield production, but other significant foreign operators included France's Société National Elf Aquitaine (Elf) and Germany's Wintershall AG. (*See table 2.*)

COMMODITY REVIEW

Metals

The Misurata steel complex, which depends on imports of iron ore, continued to be underutilized in 1991. Earlier in the year, company officials considered adding another Midrex direct reduction module to complement the two Midrex modules already in operation. This plan was in a preliminary stage, ostensively to raise capacity for export. Only one module was reported in use in 1990, with both modules having a 550-kmt/a capacity.

Since the early 1970's, the iron ore deposits of Wadi Shatti were viewed as a possible feed source for the Misurata complex. An extensive geological study was conducted at this time by the French Group. This consortium was composed of France's Bureau de Recherches Géologiques et Minières (BRGM), Société Francaise d'Etudes Minières (Sofremines), Société Francaise d'Etudes et de Réalisations Ferroviaires (Sofrerail), and Société Centrale pour l'Equipment du Territoire (Scet) International. The ore minerals in the area were grouped into both oxidized and reduced iron minerals with low magnetic susceptibility and iron minerals with high magnetic susceptibility. The ore body itself is about 11.9 m thick, contained within a group of Paleozoic clastic sediments. Postulated supergene enrichment has produced 795 Mmt of 51.7% iron material, containing 0.9% phosphorus, 4% to 5% silica, and 4% alumina. The moderate ore grade coupled with the need to separate the magnetic and reduced ore for sintering has helped to postpone any development. Primarily, higher grade pelletized ores may be imported cheaply with the Wadi Shatti ores being a poor substitute. At present, the cost of mine, processing, and transportation infrastructure development make the project prohibitive.

Mineral Fuels

Natural Gas.—The Bouri offshore oilfield, the largest crude oil discovery in the Mediterranean Sea, was the target of a natural gas feasibility study in 1991. Production of crude oil from the field has doubled to about 100 bbl/d since its inception in 1988. This situation has provided impetus for further development of the field. The study focuses on the exploitation of gas and condensate at the Bouri field and eventual export to Italy. AGIP is the operator at Bouri where natural gas reserves have been estimated at 70 billion m^3. AGIP has been utilizing horizontal drilling techniques at Bouri to decrease the gas-to-oil ratio.

The study proposes that either the gas condensate production would be sent directly to Libya for treatment and then transshipped to Italy or construct an offshore treatment platform with the output piped to Italy. At present, two platforms and a storage tanker service attend the Bouri offshore operations. In lieu of building a new expensive pipeline that could be as long as 570 km, natural gas could be rerouted through the preexisting and expanding transMed pipeline.

Approximately 24 Libyan offshore hydrocarbon discoveries made by AGIP, Elf, and the parastatal Sirte Oil are under consideration through the gas export study. Intense exploration has yet to start

at the Libyan/Tunisian joint offshore 7 November oilfield. AGIP estimates that natural gas reserves are 250 billion m^3 at the 7 November offshore oilfield.

Petrochemicals.—Hyundai Engineering & Construction Co. of the Republic of Korea signed an estimated $190 million contract in early 1991 with the Ras Lanuf Oil & Gas Processing Co. (Rasco). The contract stipulates the construction of a 50-kmt/a low-density polyethylene unit, and an 80-kmt/a high-density polyethylene unit, both at Ras Lanuf. Construction was expected to be completed by 1994. The licensing for the polyethylene units was purchased from Union Carbide of the United States in 1982.

Petroleum.—**Exploration.**—Libya continued to be considered by international oil companies as a foremost exploration target. However, sanctions, embargoes, and political disputes have left Libya a dearth in investment by large international oil interests. Despite clauses in EPSA-3, and with the possible exceptions of the Netherland's Royal Dutch/Shell and Belgium's Petrofina, large oil corporations are wary of business agreements with Libya. As a result, most EPSA-3 contracts are dominated by smaller and inexperienced oil companies.

The United Kingdom's North African Petroleum Ltd. was awarded two offshore exploration permits by the NOC in mid-1991. The concessions were previously owned by Sirte Oil. The EPSA-3 agreement was capitalized at $10 million over 5 years.

Libya's increasing shortage of foreign exchange for developmental projects was noted by yearend 1991. Plans to develop the Kebir Oilfield near the Tunisian border were delayed. Additionally, plans for water injection projects for secondary recovery at existing oilfields were delayed for an indefinite period of time.

Refining.—Total throughput refining capacity within Libya was 347,600 bbl/d at three operating refineries. In the petroleum refining and merchandising sectors, Libya continued its overseas investment strategy in 1991. Libya's Mediterranean Sea-Oil (Medoil) refines about 140 kbbl/d of crude oil in Sicily and Sardinia. Additionally, the Libyan parastatal Tamoil has a controlling equity interest in Italy's Bortolotti, which operates a joint venture in retailing oil products in Italy. Tamoil has set up a new joint venture with Italy's Orion Petroli, capitalized at $12.5 million. Orion Petroli intends to do $92 million in retail business in Italy in 1992 through a network of 70 to 100 service station outlets.

Oilinvest had taken a controlling equity interest in the Holborn refinery in Hamburg, Germany, by mid-1991. The 80-kbbl/d refinery was originally owned in the late-1980's by Coastal Corp. of the United States. This recent acquisition by Oilinvest complements its $139 million takeover of the Swiss petroleum refining and distribution company Gatoil in 1990.

Reserves

Libya possesses the largest hydrocarbon reserves in Africa. Libya also possessed industrial mineral resources, including gypsum, magnetite, phosphate rock, potash, sodium chloride, and sulfur, for which reserves have not been officially reported. These resources remained largely untapped owing to high costs for development coupled with a lack of ready markets.

INFRASTRUCTURE

The Great Manmade River (GMR) Phase I was inaugurated in August 1991. Capitalized at $5 billion, GMR Phase I has taken 7 years to complete and is the first of five planned phases. The entire GMR project is projected to cost about $25 billion. The project was designed to transport 2 Mm^3 of water per day from 270 wells in east-central Libya via 2,000 km of pipeline connecting Benghazi and Sirte. The Government estimates that the artesian wells will remain viable for 50 years. The water will be utilized in coastal areas where 80% of Libya's agricultural activity takes place. The Government wishes to use GMR to reclaim desert regions and achieve food self-sufficiency. This task would seem difficult in Libya, where the United Nations Development Program reports that 94.6% of the territory is desert wasteland. Critics of GMR Phase I note that no adequate environmental impact study was completed on the project. Development started on GMR Phase II during the year. GMR Phase III contracts were to be awarded in 1992.

OUTLOOK

Economic concerns for Libya as it moves into the decade of the 1990's are directly related to the viability of the mineral industry, specifically petroleum production. Following the end of the Persian Gulf War, the drop in oil prices coupled with increased OPEC production levels signals a loss in Libyan revenues in the short term. Libya's overseas investment strategies covering the sale of crude oil and refined products in Europe could help to offset this revenue loss.

Additional pressures on the Libyan economy are exacerbated by food, accounting for 20% of Libyan imports. Only 1.4% of Libya's 1.7 Mkm^2 of land is arable and farmed by less than 20% of the population. The Government hopes that large infrastructure projects, such as the GMR, will aid the demands of the agricultural and industrial sectors.

Three central themes of concern for Libya would be to (1) increase oil and petrochemical production and markets; (2) improve political ties with nations that consume or could be target markets for Libyan hydrocarbons; and (3) to evaluate the progress of the GMR, considered a fiscal priority by the Government, and its effects on the Libyan economy as a whole.

Libya is in the initial stages of reviving its sagging international natural gas trade. Industry projections indicate that natural gas, desired as a relatively pristine energy resource, will experience a 50% growth rate in use by southern European countries. Consumption could grow to 350 billion m^3 per year by the year 2010.

Libya is geographically suited to increase its natural gas exports to southern Europe.

[1]Where necessary, values have been converted from Libyan dinars (LD) to U.S. dollars at the rate of LD0.35545=US$1.00.

OTHER SOURCES OF INFORMATION

Agencies

Secretariat of Petroleum
Sadoon Sweheli Street
Tripoli, Libya

Publications

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

TABLE 1
LIBYA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1987	1988	1989	1990[p]	1991[e]
Cement, hydraulic	thousand metric tons	2,700	e2,700	2,700	2700	2,700
Gas, natural:[e]						
Gross	million cubic meters	r12,000	3,11,886	3,13,782	12,000	13,600
Marketed[4]	do.	r6,000	3,5,495	3,6,452	3,5,745	6,500
Gypsum[e]	thousand metric tons	180	180	180	180	180
Iron and steel: Crude steel[e]	do.	10	10	10	500	500
Lime[e]	do.	260	260	260	260	260
Nitrogen: N content of ammonia	do.	e350	3,217	3,212	200	200
Petroleum:						
Crude	thousand 42-gallon barrels	367,555	374,125	412,450	501,510	3,541,295
Refinery products:						
Gasoline	do.	7,000	10,220	9,125	9,000	9,000
Kerosene and jet fuel	do.	11,000	4,015	12,775	12,000	12,000
Distillate fuel oil	do.	15,000	17,155	25,550	25,000	25,000
Residual fuel oil	do.	15,000	14,600	27,740	27,000	27,000
Other	do.	1,000	3,285	18,250	18,000	18,000
Refinery fuel and losses	do.	2,000	2,000	3,650	2,000	2,000
Total	do.	51,000	51,275	97,090	93,000	93,000
Salt	thousand metric tons	12	12	12	12	12
Sulfur, byproduct of petroleum and natural gas[e]	do.	14	14	14	14	14

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

[1]Table includes data available through Apr. 7, 1992.

[2]In addition to the commodities listed, a variety of construction stone, brick, and tile were produced, but available information was inadequate to make reliable estimates of output levels. Natural gas liquids were also produced but were blended with crude petroleum and were reported as part of that total.

[3]Reported figure.

[4]Excludes gas reinjected into reservoirs.

TABLE 2

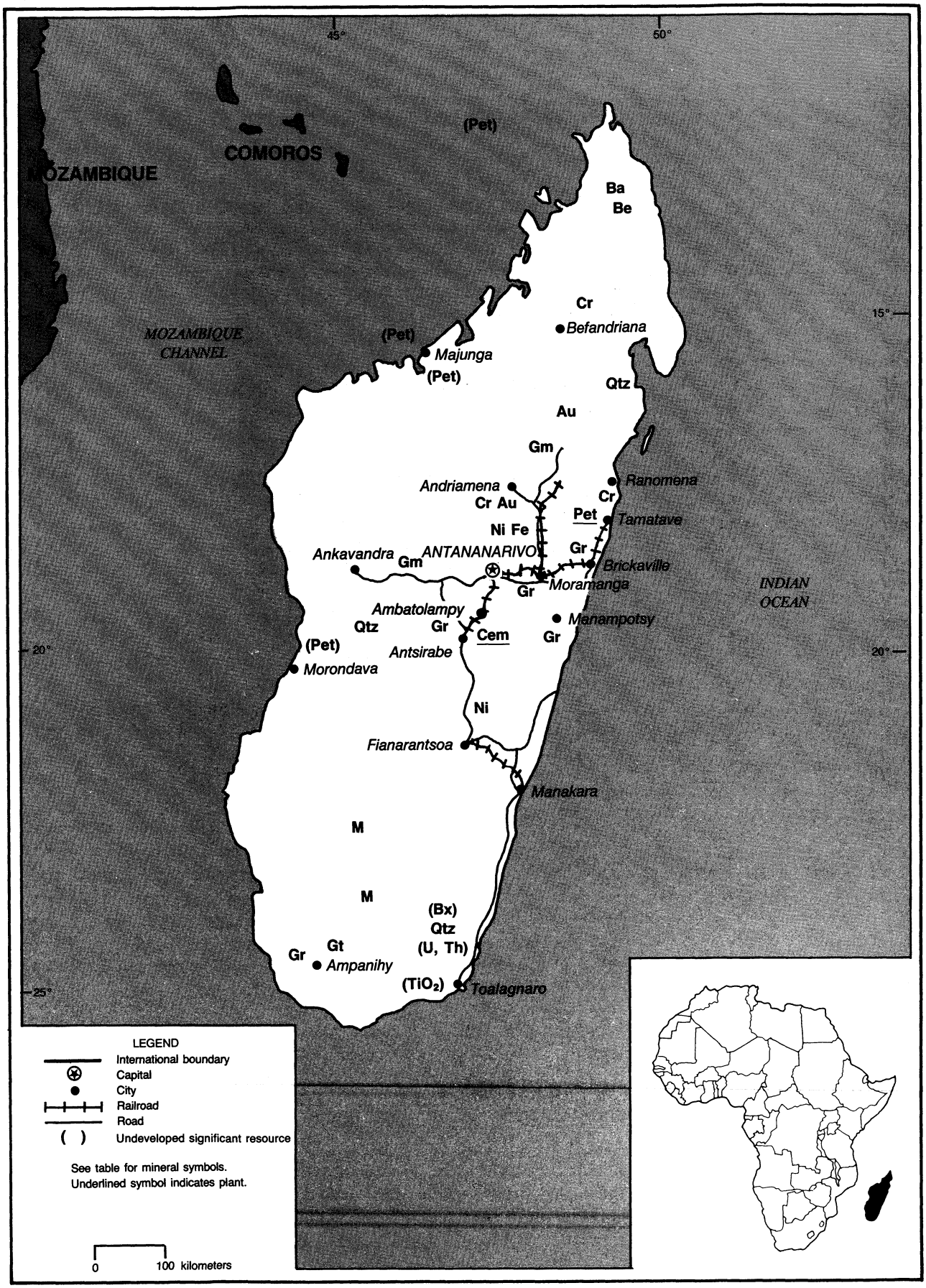
LIBYA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owner	Location of main facilities	Annual capacity
Cement	Libyan Cement Co. (100% Government ownership)	Hawari, near Benghazi	1,500
Do.	National Cement and Building Materials Co. (100% Government ownership)	El Margueb and Lebda	1,400
Do.	El Fataiah Cement (100% Government ownership)	Derna	1,000
Iron and steel, crude	Misurata Iron and Steel Complex (100% Government ownership)	Misurata	1,100
Petroleum, crude million 42-gallon barrels	Libyan National Oil Corp. (NOC) (100% Government ownership)	Mainly Sirte Basin	657
Do. do.	Agip-North Africa Middle East [85% NOC, 15% Azienda Generali Italiana Petroli (Agip), Italy]	Bouri offshore oilfield, Bu Attifel onshore oilfield, Rimal Katib onshore oilfield	19.3 50 2.3
Do. do.	Elf Aquitaine-Libya (85% NOC, 15% Société National Elf Aquitaine, France)	El-Meheiriga onshore oilfield	.3
Petroleum, refining do.	Azzawiya Oil Refining Co. (100% Government ownership)	Azzawiya	44
Do. do.	Ras Lanuf Oil and Gas Processing Co. (100% Government ownership)	Ras Lanuf	73.4
Do. do.	Sirte Oil Co. (100% Government ownership)	Marsa al-Brega	3.1

MADAGASCAR

AREA 581,540 km² **POPULATION 12.2 million**



THE MINERAL INDUSTRY OF

MADAGASCAR

By Thomas P. Dolley

Despite its potential, mineral industry development within the Democratic Republic of Madagascar slowed to an ebb in 1991. This situation was predicated by political discontent coupled with rioting, which led to the formation of an interim tripartite Government in Madagascar by yearend 1991. Nonetheless, chromite and graphite remained the dominant mineral products of Madagascar during the year. In addition to these minerals the Malagasy mining industry produces some nonmetallic minerals and a variety of semiprecious stones.

During the year economic woes continued in Madagascar. The current account deficit declined slightly from $199 million to $192 million during 1990-91.[1] Additionally, Madagascar's credit income for 1991 of $4 million was greatly offset by -$178 million worth of debit income for 1991.

GOVERNMENT POLICIES AND PROGRAMS

In 1991, the new transitional Government in Madagascar was supportive of the opinions of smaller domestic mining operators. The smaller operators feel that the new Mining Code of 1990 is inequitable and gives greater preference to generally larger foreign operators. The Government nationalized all mineral resources, with the exception of graphite and mica, in 1975. Madagascar was a former French colony and gained its independence on June 26, 1960. Thus, the Malagasy legal system is based on French civil law. In August 1990, the Government, in cooperation with the Federation of Mine Associations (FEDMINES), ratified the new Mining Code law No. 90-017. The revision of the mining code follows and augments law No. 89/007 of December 12, 1989, concerning industrial-free zones in Madagascar. Additionally, it also complements law No. 6 of December 14, 1989, legislating the new investment code.

The new 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, it is valid for 2 years before renewal is required. The duration of validity of type II and type III exploration permits is 3 and 5 years, respectively. Types II and III permits are designed for small to large mining companies that have been incorporated under Malagasy law. Under the new code, the size covered by the permit is stipulated as type II and type III exploration permits at 75 km^2 and 1,000 km^2, respectively. Type II and type III exploitation permits stipulate 100 km^2 and 200 km^2, respectively.

In 1991 and early 1992, a major goal of the Ministry of Energy and Mines was to encourage gold mining in Madagascar, and it sought aid and technical assistance from the UN. The Government removed certain regulations concerning gold mining in mid-1990. The targeted regulations prohibited private companies or individuals from mining gold and exporting it. The Government maintains the right of priority for the purchase of gold mined in Madagascar. Recent gold mining was in the form of artisanal, individual-operated mines. However, the Government does not acknowledge the significant artisanal mining of gold in its official statistical publications. In a prior cooperative effort, France's Bureau de Recherches Géologiques et Minières (BRGM) and the Government's Office Militaire National pour les Industries Strategiques (OMNIS) have explored for alluvial gold in the east-central rivers of Madagascar. The region is south of Antananarivo and west of Manampotsy, where gold was once mined in the 19th century.

The Petroleum Code, law No. 80-001 of June 6, 1980, provided for two different types of production-sharing contracts. The first type of contract covered equity ventures between foreign oil operators and OMNIS. The Government maintained 51% ownership, and cost and production-sharing were financed by income tax payments and royalties based on achieved rates of return. The second type of contract was a risk service contract in which the foreign oil company assumed all exploration and exploitation costs. Such costs would be repaid through a royalty on production of 10% to 20% for a crude oil discovery and 5% to 20% for a natural gas discovery.

The Government 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, livestock overgrazing, and massive erosion threaten Madagascar's agricultural and hydroelectric potential.

PRODUCTION

Chromite and graphite experienced production declines during 1991. Current chromite production levels represented

less than 50% of the production levels of the 1970's. The precious and semiprecious stone industry showed mixed results, but owing to black-market and/or artisanal activity, accurately reported official production figures remained elusive. Early in 1991, the Government sought technical assistance from foreign sources in setting up an organized and monitored gemstone industry. *(See table 1.)*

TRADE

Total exports, including mineral products, were valued at $344 million in 1991. Total imports in 1991 were valued at $445 million. The negative trade balance of 1991 can be attributed in part to the cost of importation of Madagascar's hydrocarbon requirements.

Japan remained a major importer of chromium from Madagascar. Madagascar exported approximately 66 kmt of chromium to Japan in 1991, 53 kmt in 1990, 73 kmt in 1989, 86 kmt in 1988, and 81 kmt in 1987. Additionally, some chromium was exported to the Federal Republic of Germany and Italy. For the years 1985 through 1989, France imported no chromium from its former colony. Chromite mined in the Andriamena area is shipped from the port at Tamatave.

STRUCTURE OF THE MINERAL INDUSTRY

The chromite industry is controlled by the parastatal Société Kraomita Malagasy (Kraoma). Graphite and mica production is owned and operated by foreign entities, but the Government asserted control of these operations in the form of taxes, royalties, and official approval of all foreign exchange transactions. OMNIS is primarily involved in research, joint ventures, and promotion of Madagascar's mineral potential. Coincident with the political turmoil of 1991, by midyear the supervision of OMNIS was transferred from the presidency to the Government at large. Additionally, a new director-general for OMNIS was appointed. Prior to the formation of the tripartite Government, the Ministry of Mines and the Ministry of Industry had been combined into a single unit. With the bureaucratic upheaval of 1991, the ministries were again separate entities but with no apparent definition of redistributed responsibilities. *(See table 2.)*

COMMODITY REVIEW

Metals

Chromite.—Madagascar's chromite ore is mined from the area around Andriamena. Initiated in 1967, chromite production from the calc-ferromagnesian rocks of 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, exclusive of probably more unidentified lenses. Beneficiation improvements have enabled Kraoma to produce a chromite grading 29% to 34% Cr_2O_3 with 0.002% to 0.003% phosphorus, bettering the typical chromite grade of 0.007% phosphorus. The latter grade is considered undesirable by global consumers of chromite.

Recent research funded by BRGM and the EC has established PGM-enriched zones within the mafic and ultramafic complexes of Andriamena, apparently concentrated by fractionation of the platinum-group elements. Additionally, the PGM anomalous zones are controlled by the shape of the intrusions and relict structures within these complexes. It has been hypothesized that the mafic and ultramafic complexes are part of a suture zone that extends to northwest Africa. The highest concentrations detected in the study contained up to 5 ppm platinum and palladium.[2]

Other Metals.—Madagascar contains some scattered gold deposits and a large black market for the mining and sale of gold. The Government officially reports only a few kilograms of production annually. However, actual production varies between 2 and 3 mt/a with an estimated production value of $25 million. The gold mining is primarily artisanal and employs approximately 5,000 to 10,000 people.

Owing to political unrest in 1991, Canada's QIT Fer et Titane Inc. (Quebec Iron and Titanium) made no significant progress toward exploiting the ilmenite beach sands near Toalagnaro. QIT is 100% owned by RTZ in a joint venture with OMNIS. An environmental impact study of the dredge mining of the ilmenite was conducted by OMNIS in 1990, which was partly financed by the World Bank. The study concluded that the mining operation would destroy 75% of the coastal forest zone or a total of 3,000 ha. QIT had suggested that special conservation areas be set up to limit mining damage to the environment.

Industrial Minerals

Graphite.—Madagascar is a modest, though important, producer of high-quality flake graphite when compared with the global market. Graphite deposits in the Manampotsy and Ambatolampy districts are on the eastern slope of the central highlands of Madagascar. Subjected to intense weathering, these two areas have accounted for virtually all of the past production of flake graphite in Madagascar. Poor concentrate grades, expensive processing, and lack of adequate infrastructure have prevented the development of the hard-rock graphite deposits of the Ampanihy mining district in southern Madagascar.

Mineral Fuels

Madagascar was lacking in domestic sources of hydrocarbons. No drilling activity had been reported in 1989 and 1990. Maxus Energy Corp. of the United States signed a risk service contract with OMNIS in June 1991. The contract covers geophysical exploration and wildcat drilling in 3.88 million acres off the northwest coast of the island. The term of the contract is 8 years. Several years of exploration by various petroleum companies have failed to yield

economically viable hydrocarbon deposits in Madagascar.

Madagascar's petroleum sector was to begin a restructuring program slated for 1992. The World Bank's International Development Agency is to contribute approximately $47 million to the project. Privatization of the Tamatave oil refinery and its distribution network are priorities of the project. France's Société Nationale Elf Aquitaine is one of the potential shareholders in the project. The current total throughput refining capacity at Tamatave is 16,350 bbl/d with 2,600 bbl/d of catalytic reforming.

Reserves

The Government stated that Madagascar had significant deposits of chromite, ilmenite, coal, bauxite, iron ore, and bastnasite. Graphite deposits and pegmatite deposits and minerals typical of these deposits have been historically exploited. Copper-nickel accumulations exist, but economic deposits have yet to be discovered. Semiprecious gemstone deposits were extensively mined and exported in Madagascar; however, the Government wished to organize and streamline the industry to better exploit it.

INFRASTRUCTURE

Total installed electrical generation capacity was 119 MW. Railroads totaled 1,020 km of 1-m-gauge track. The road system totaled 40,000 km, including about 4,700 km of paved roads and 800 km of crushed stone, gravel, or stabilized earth roads, with the remainder improved or unimproved earth. However, roads and railways have deteriorated and are in need of maintenance. Irrigation infrastructure remained one of the most developed in Africa. The Malagasy labor force is estimated at 5.7 million.

OUTLOOK

The recent formation of a coalition Government and bureaucratic restructuring were precipitated by popular protest. However, these developments coupled with poor transportation and electrical power infrastructure may continue to hamper major mineral development in the short term. Furthermore, the next several years could be critical for Madagascar as it seeks to develop mineral resources in the context of environmental concerns such as deforestation and desertification.

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[1]Where necessary, values have been converted from Madagascar francs (FMG) to U.S. dollars at the rate of FMG1,862.4=US$1.00.

[2]Ohnenstetter, M. Z. Johan, T. Auge, A. Cocherie, O. Legendre, B. Martel-Jantin, D. Rakotomanana: The West Andriamena Pan-African Ultramafic Complexes in Madagascar: A New Type of Pt-Pd Mineralization, Minéralisations Liées aux Roches Basiques et Ultrabasiques, Principaux Résultats Scientifiques et Techniques du BRGM, 45047 Orléans Cedex 02, France, 1989, pp. 165-167.

OTHER SOURCES OF INFORMATION

Agencies

Direction des Mines et de l'Energie
Ministere de l'Industrie et du Commerce
Ambohiday, 101 Antananarivo,
Madagascar

Office Militaire National pour les Industries Strategiques (OMNIS)
21 Lalana Razanakombana
Boite Postale 1 bis, 101 Antananarivo,
Madagascar

Publication

Ministere des Finances et du Plan, Direction de L'Institut National de la Statistique et de la Recherche Economique, B.P. 485, Antananarivo: Bulletin Mensual de Statistique, bimonthly.

TABLE 1

MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES[1]

(Kilograms unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991[e]
METALS						
Beryllium: Beryl in quartz concentrates, industrial and ornamental		35	3	154	3,345	3,000
Chromium: Chromite concentrate, gross weight	metric tons	106,600	64,177	62,540	73,000	[3]63,000
Gold, mine output, Au content[e]		[3]40	90	45	[3]216	200
Rare-earth minerals: Bastnasite[e]		10,000	10,000	10,000	10,000	10,000
INDUSTRIAL MINERALS						
Abrasives, natural (industrial only)[e]		10,000	10,000	10,000	10,000	10,000
Cement, hydraulic[e]	metric tons	35,000	50,000	60,000	60,000	60,000
Clay, kaolin	do.	1,427	365	1,315	485	[3]496
Feldspar[e]		5,000	5,000	5,000	5,000	4,000
Gemstones:						
Amazonite		3,783	525	23,885	2,185	2,000
Amethyst:						
Gem		11	1,700	3	1,713	1,700
Geodes[e]		9,000	9,000	9,000	[3]86	80
Citrine		6	112	754	50	[3]6
Cordierite		387	886	4,051	1,556	[3]20
Garnet		1,500	6	23	6,905	6,000
Tourmaline		2,000	2,367	97	54	[3]302
Graphite, all grades	metric tons	13,169	14,106	15,863	18,036	[3]14,079
Mica, phlogopite:						
Block	do.	25	5	7	93	90
Scrap	do.	300	605	899	538	500
Splittings and sheet	do.	77	8	162	90	90
Total	do.	402	618	1,068	721	680
Ornamental stones:						
Agate		14,034	13,886	9,005	4,696	[3]9,463
Apatite		1,948	2,090	9,016	1,139	[3]4,001
Aragonite	metric tons	500	[e]500	2,187	786	[3]126
Calcite	do.	2,934	1,243	1,373	3,757	[3]1,412
Celestite		4,365	34,511	28,398	26,000	26,000
Jasper		19,730	21,030	30,137	23,560	[3]11,694
Labradorite		24,320	27,748	23,015	24,000	[3]35,010
Other gem and ornamental[e]	metric tons	250	250	250	250	250
Quartz:						
Crystal		32,500	22,136	40,875	32,000	32,000
Geodes		[e]3,000	2,700	[e]2,700	2,700	2,500
Hematoid		6,825	9,089	5,795	3,157	[3]560
Piezoelectric		[e]150	153	163	160	[3]66,200
Rose quartz		77,980	360,290	64,384	10,832	[3]4,802
Smelting[e]		100,000	100,000	100,000	[3]179,521	180,000
Other ornamental		4,925	[e]5,000	6,578	14,360	[3]1,267
Tourmaline		276	520	3,140	4,076	[3]302
Salt, marine[e]	metric tons	30,000	30,000	30,000	30,000	30,000
Stone:						
Calcite, industrial[e]	do.	2,000	2,000	2,000	2,000	2,000
Dimension, marble, other[e]	do.	3,000	3,000	3,000	3,000	3,000
Marble, cipoline	do.	5	4	5	1	1

See footnotes at end of table.

TABLE 1—Continued

MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES[1]

(Kilograms unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991[e]
MINERAL FUELS AND RELATED MATERIALS						
Petroleum refinery products:						
Distillate fuel oil	thousand 42-gallon barrels	560	664	540	798	790
Gasoline	do.	425	451	219	405	400
Kerosene and jet fuel	do.	287	303	139	253	250
Residual fuel oil	do.	813	979	329	504	500
Other	do.	48	96	14	26	20
Total	do.	2,133	2,493	1,241	1,986	1,960

[e]Estimated.

[1]Table includes data available through June 1992.

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

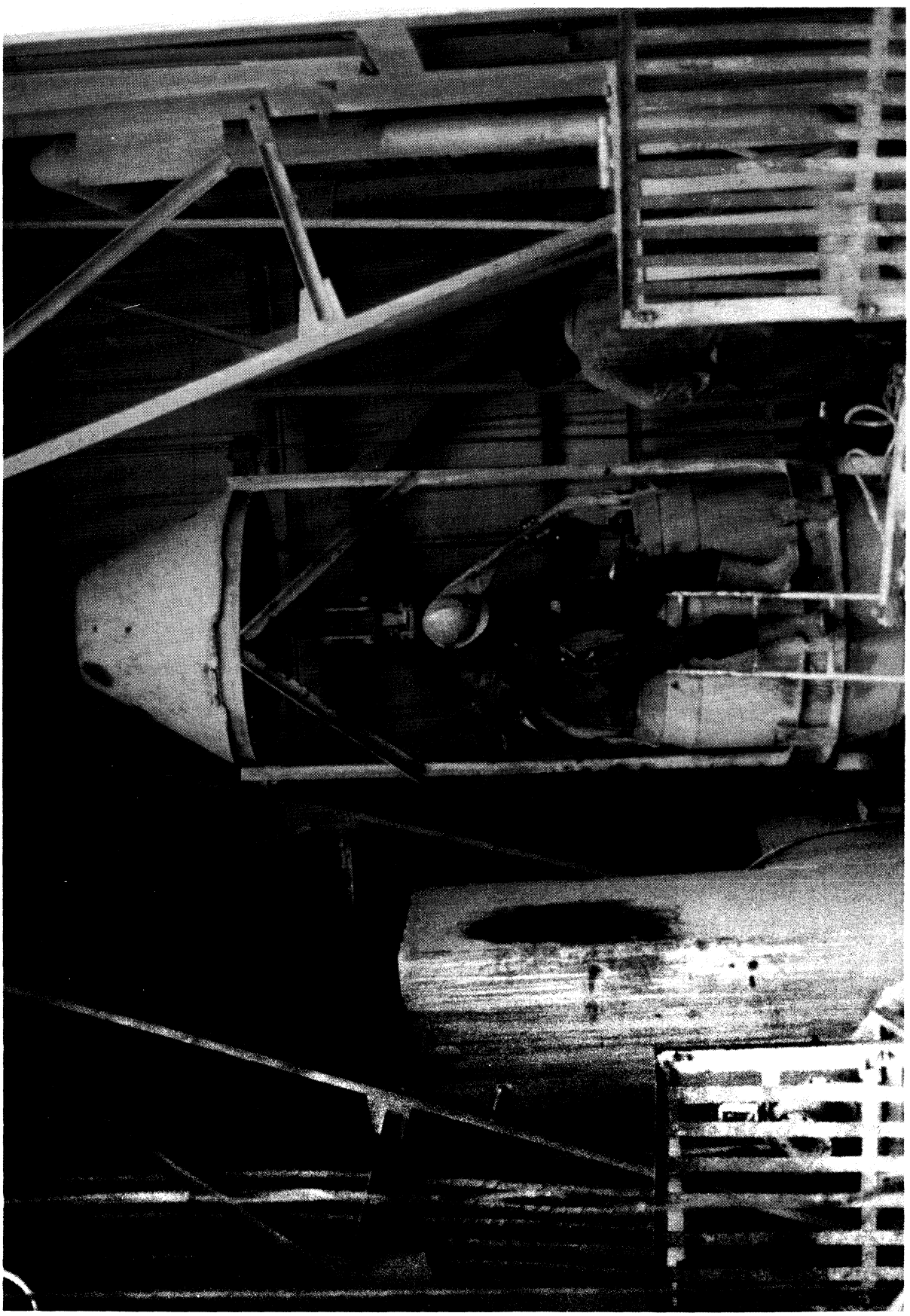
TABLE 2

MADAGASCAR: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

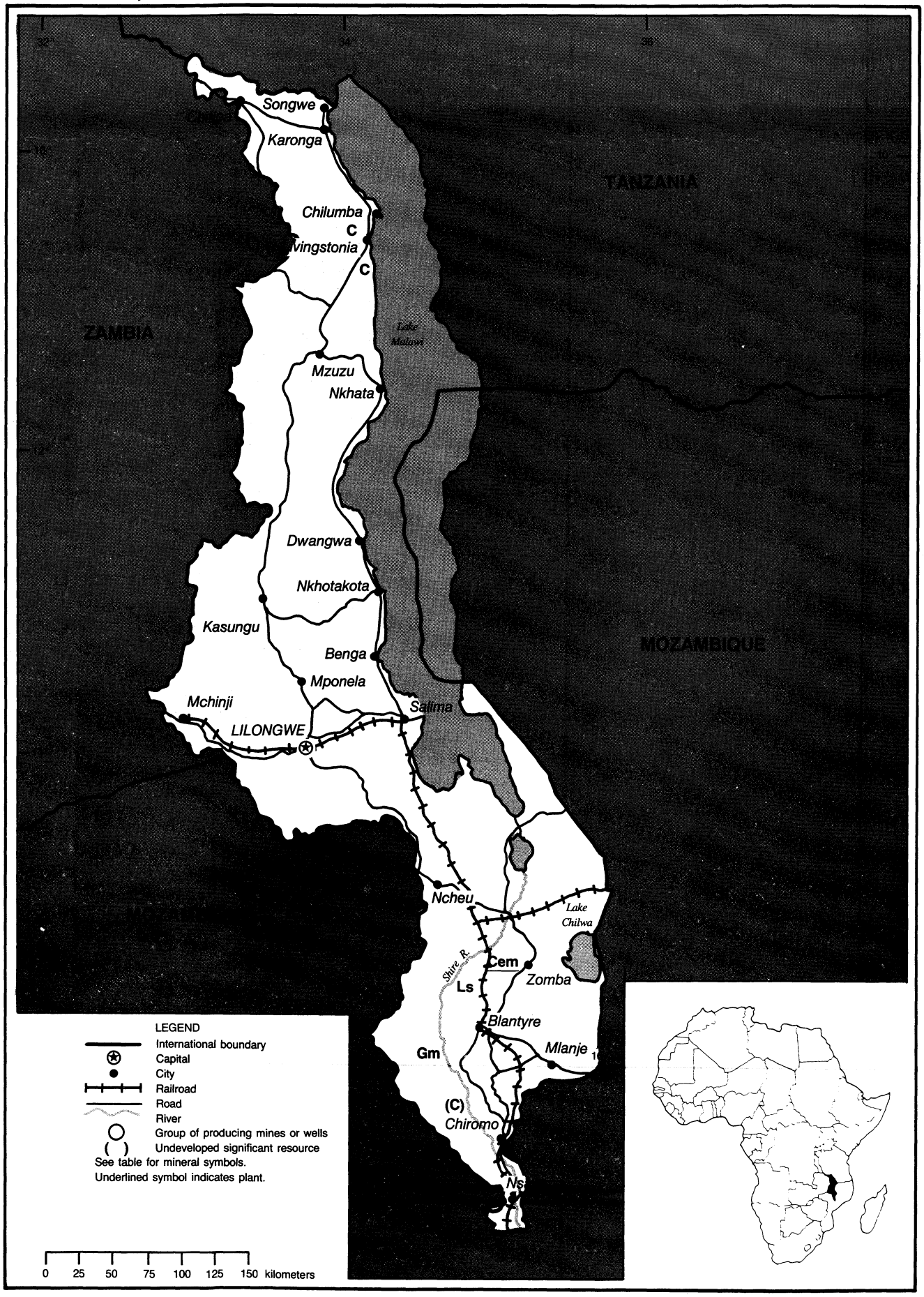
Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Chromite	Kraomita Malagasy (Government, 100%)	Andriamena	1.75.
Graphite	Etablissements Gallois (private, 100%)	Artsurakambo Mine, Brickaville	4.8.
		Marovintsy Mine, Vatomandry	3.6.
Do.	Societe Miniere de la Grande Ile (Societe Participation Industrielle et Miniere, France, 100%)	Ambatomitamba Mine, Tamatave	6.0.
Do.	Etablissements Izouard (private, 100%)	Faliarno Mine, Moramanga	2.0.
Mica	Societe des Mines d'Ampandrandava (Societe Participation Industrielle et Miniere, France, 100%)	Ampandrandava Mine and Sakamasy Mine	0.6 phlogopite.
			0.6 phlogopite.

MAIN ORE AND MAN HOIST AT THE KALANA GOLD MINE, MALI



MALAWI

AREA 119,000 km² **POPULATION 9.5 million**



THE MINERAL INDUSTRY OF

MALAWI

By Audie L. King

Malawi's mining industry was very limited. In 1991, mining accounted for about 0.6% of Malawi's GDP. Although a wide variety of mineral deposits have been discovered in Malawi, only coal, crushed stone, limestone, and minor quantities of gemstones are being mined at the present time. Agriculture dominated Malawi's economy. It accounted for 37% of the nation's GDP, more than 90% of exports, and employed 85% of the population.

Malawi's economy grew by 4.8% in real terms in 1991. This was the fourth consecutive year of economic growth following several years of poor performance. The strong economic performance can be attributed to recent adjustments made to the Government's policies on trade and industrial development, higher international prices for its principal exports of tobacco and sugar, and the increased availability of foreign exchange.

GOVERNMENT POLICIES AND PROGRAMS

The Government has shown interest in exploiting the nation's mineral resources as a means of developing the nation's industrial base and improving the economy. To this end, the Minerals Resources Development Commission was formed to investigate ways to encourage investment in the mining industry. Malawi's Department of Mines supports small-scale miners, as well as government and parastatal institutions, in mineral processing. The laboratory's applied mineralogy unit also conducts research on the utilization of raw materials. Malawi's Geological Survey Department (GSD) performs mineral exploration and conducts a geologic mapping program.

Malawi's economy had significantly improved since 1988 when the Government rescheduled its external debt and introduced an International Monetary Fund-sponsored fiscal austerity program that aimed to lower inflation by decreasing domestic demand. Tight budgetary controls were required to cope with adverse terms of trade brought about by the closure of Malawi's traditional rail links through Mozambique. The economy was also reaping the benefits of rising prices on its primary export commodities, tobacco and sugar. Assistance from Western donors was expected to remain at about $200 million[1] per year owing to continuing economic needs related to transportation difficulties and Malawi's commitment to host almost 1 million Mozambican refugees. Malawi's economy expanded by 5% per year throughout the 1970's before declining sharply in the early 1980's owing to the disintegration of domestic order in Mozambique that cut off Malawi's rail export routes through Nacala and Beira through which more than 90% of exports had been shipped. The highway through Tete in northwestern Mozambique that linked Malawi to Zimbabwe and the south was closed by rebel attacks in 1990 and remained closed until the latter part of 1991. The closure added 800 km to the trucking route and at least doubled transportation costs.

Malawi has a history of encouraging private enterprise and supporting market-oriented capitalism. In December 1991, the Parliament passed a new investment incentives bill that would establish the Malawi Investment Promotion Agency, a one-stop investment shop, to assist investors and reduce documentation procedures. The bill's other investment incentives include tax concessions, depreciation allowances, import duty exemptions on certain types of plant equipment, and deductions for land improvements. The net result of all these incentives is that a new investor would pay little or no local taxes for the first few years of operation. Royalties, dividends, profits, loan capital, and a portion of personal earnings may be repatriated with Government permission. Investors would also be permitted to retain up to 4% of earned foreign exchange.

PRODUCTION

Malawi's construction industry experienced a mixed year. While the value of buildings completed during 1991 decreased by more than 9%, cement production increased by an estimated 27% owing to increased demand from major infrastructural improvement projects. *(See table 1.)*

TRADE

Malawi's exports consisted mostly of tobacco, sugar, and tea. A very small quantity of gemstones was the country's only mineral export. Total exports in 1991 were about $429 million, based on the Reserve Bank of Malawi's first three quarters of trade figures, of which 12.7% went to the United States.

Malawi's imports consisted mostly of fuel, fertilizer, chemicals, and machinery. Imports were $692 million, of which 10.4% came from the United States.

Other major trade partners included the Federal Republic of Germany, Japan, the Netherlands, the Republic of South Africa, and the United Kingdom.

STRUCTURE OF THE MINERAL INDUSTRY

In 1985, the Government responded to increasing difficulties in importing the nation's energy needs by forming the Mining Investment and Development Corp. (Midcor). Midcor's primary responsibility was to develop the nation's marginal coal resources. It currently operates the Kaziwiziwi Mine and the Mchenga Mine in the northern district of Livingstonia. The Gem Co. of Malawi, a subsidiary of Midcor, produced gemstones from the Chimwadzulu Mine near Blantyre. The Portland Cement Co. has mined limestone at Changalumi, near Zomba, since 1960. Lime was produced by small-scale private lime burners.

In 1989, the latest year that employment data were available, the Kaziwiziwi coal mine employed an average of 264 people, while the Mchenga coal mine employed 53 people. The Portland Cement Co. employed an average of 650 people, and about 900 people were employed off and on by the lime industry. The Gem Co. of Malawi employed about 65 people.

According to the Chamber of Mines of South Africa, the number of Malawian workers employed in gold and coal mines in the Republic of South Africa had decreased from almost 18,000 in 1987 to only 60 in 1991. *(See table 2.)*

COMMODITY REVIEW

Metals

Lonhro PLC, of the United Kingdom, was reported to have delineated 11 Mmt of rock grading 1.97% rare-earth oxide in the Kangankunde Hill carbonatite complex about 75 km north by northwest of Blantyre. The Kangankunde deposit had also been investigated by the Bureau de Recherches Géologiques et Minières (BRGM) and on behalf of the Metal Mining Agency of Japan (MMAJ) and the Japanese International Co-operation Agency (JICA). The Tundulu carbonatite, at the southern end of Lake Chilwa, about 7 km northwest of Kasungu, was reported by the GSD to contain a substantial rare-earth resource that may be available as a byproduct of phosphate mining. The GSD also identified the Songwe carbonatite, about 60 km north-northeast of Mlanje, as a potential rare-earth resource.

Industrial Minerals

Gemstones.—The Gemstone Co. of Malawi, a subsidiary of Midcor, mined rubies, sapphires, and aquamarines at the Chimwadzulu Mine, near Ncheu, about 40 km southwest of Blantyre. The mine production is upgraded and valued at Blantyre before shipment to Germany.

Lime.—Efforts to improve methods of lime production continued by Malawi's Bureau of Mines and Midcor. Lime has traditionally been produced in rectangular boxlike trench kilns constructed of limestone rocks with mud mortar. The production method is a batch process where about 75 tons of high-purity limestone is fired using local hardwoods. There were about 40 producers divided equally between Malawi's two lime-producing areas. The Chenkumbi Hills lime-producing area is near Balaka, about 36 km southeast of Ncheu on the main road between Lilongwe and Blantyre, while the Lirangwe lime-producing area is near Blantyre. These producers seasonally fire between 2,000 and 3,000 tons of low-grade lime for the construction industry and the agricultural market. The sugar industry had to import its lime requirements of about 3,200 mt/a from Zambia and the Republic of South Africa because the Malawian product was insufficiently calcined. Most of the 40 kilns were used to make only 1 or 2 batches per year but some produced as many as 5. A typical batch took about 65 days and 426 worker-hours to produce about 50 tons of lime from about 75 tons of limestone. About 600 people were involved in lime production in the Chenkumbi Hills area and about 300 worked in the Lirangwe lime-producing area.

The Chenkumbi Hills limestone resources had about 3.7 Mmt of calcitic coarse-grained marble with a chemical purity good enough to produce high-grade lime suitable for use by the local water boards and in the domestic sugar industries. Malawi's Bureau of Mines, together with the Intermediate Technology Development Group, carried out trial runs on simple vertical kilns near the Chenkumbi Hills limestone deposit. Preliminary results indicate that the finished product could be upgraded to a 69% available lime content. The kilns were designed to be low cost and thus be made available to small-scale producers.

Midcor planned to produce lime from a proposed 2.75-km^2 quarry at Malowa Hill, about 11 km northeast of Blantyre. Midcor planned to retain 40% equity in the scheme and was searching for venture partners to help finance the remaining 60% of the $1.7 million project over a 3-year period. Midcor estimates that the plant's potential market would be about 15,000 mt/a. Initial production would be 4,000 tons of lime and 2,000 tons of aggregate.

Vermiculite.—The French-funded exploration, which began in mid-1989, continued at the vermiculite deposits near Mpatamanga, about 56 km west of Blantyre. More than a dozen sites were investigated, and at least four of the vermiculite-bearing deposits were found to contain ore of sufficient quality and quantity to be of commercial interest. The prospect of reopening of the Nacala railway was a favorable factor in determining the economic viability of these deposits.

Mineral Fuels

Although low-grade bituminous coal deposits were known for many years in the northern part of the country, they were not mined until recently because it was more economical to import coal from Mozambique. Mining these northern deposits presented economic difficulties because they were not close to an efficient transport system linking them to the nation's industry in the southern part of the country. When the civil war in Mozambique made coal imports unreliable, Malawi was forced to develop

its own resources. Malawi now operates two coal mines in the Livingstonia Coalfield, in the northern part of the country. The Kaziwiziwi Mine was at the end of its life, and the Mchenga Mine is in its development stage.

Analysis of more than 5,000 m of core drilled between October 1989 and August 1990 has demonstrated the economic potential of the coalfield in southern Malawi, about 65 km southwest of Blantyre. The French-funded exploration drilling program evaluated the Lengwe and Mwabvi Coalfields. While the Lengwe Field was of little interest, the Mwabvi Field was determined to contain 4 to 5 Mmt of high-ash anthracitic coal. This is enough to satisfy Malawi's domestic needs for the next few years. The Mwabvi Field has an advantage over the northern coal mines in that it is close to Malawi's commercial center and site of most of the country's coal consuming industry.

Reserves

The limestone deposit at Changalumi in southern Malawi was estimated to contain 100 Mmt of material suitable for cement production.

The Kaziwiziwi coal deposit in northern Malawi had an estimated minable reserve of 120,000 tons. At present production rates, this deposit will be exhausted in 4 or 5 years. The Ngana Coalfield, a larger deposit of poorer quality coal on the Tanzanian border near Karonga, is reported to contain about 85 Mmt of coal, of which up to 14 Mmt could be economically mined. The Mwabvi Coalfields in the lower Shire Valley northwest of Chiromo contain between 4 Mmt and 5 Mmt.

Malawi has significant deposits of other minerals that remain unexploited. An apatite deposit at Tundulu near the southern end of Lake Chilwa contains 1.25 Mmt of rock averaging 15% P_2O_5, including 900,000 tons at 22% P_2O_5. The Kangankunde carbonatite complex, about 75 km north-northwest of Blantyre, was reported to contain 11 Mmt of material with 8.4% $SrCO_3$ and 1.9% rare-earth oxides. A 28.8 Mmt bauxite deposit occurs on the Mlanje syenogranitic massif, 25 km northeast of Mlanje. The bauxite averaged 4 to 5 m in thickness and covered 5.2 km^2. China clay, corundum, dimension stone, graphite, silicon sand, uranium, and vermiculite deposits had also been investigated but not yet exploited. Exploration for chromite, copper, gold, gypsum, nickel, petroleum, rutile, and salt has been conducted in recent years.

INFRASTRUCTURE

Malawi, a landlocked country, had been highly dependent on its traditional trade routes through the Mozambican ports of Beira and Nacala. In 1981, more than 90% of Malawi's trade was shipped by rail through these two ports. Then in April 1984, the rail links to both ports were closed by insurgent activities related to Mozambique's civil war. This unfortunate situation presented Malawi with extremely serious economic constraints. The African Development Bank estimates that Malawi has the second most expensive external transportation routes in the world. Estimates indicate that more than $100 million or 15% of Malawi's import bill was due to increased costs resulting from the closure of the Mozambican trade routes.

Since the mid-1980's, most of Malawi's goods have been shipped by road through Mozambique's Tete Province, southward across Zimbabwe to the railhead at Messina, Republic of South Africa, where goods have been loaded onto rail cars and shipped to the port at Durban. In December 1990, however, Mozambican rebels closed down the road through Tete Province, requiring goods to be shipped through Zambia. The 3,800-km Zambian route was 1,100 km longer than the route through Zimbabwe. The performance of the transport sector became increasingly weak during 1991, as the Tete Corridor remained closed throughout most of the year. The route was reopened at the end of July but transport along the route was limited because insurgents continued to attack local settlements alongside the road. By the end of 1991, however, most commercial traffic had resumed along the Tete corridor.

A small quantity of goods have been shipped via the northern corridor, a provisional route to Dar es Salaam, Tanzania. A more permanent road link with Tanzania was being constructed with the help of foreign aid from many countries, including the United States. In 1991, freight handled by lake and rail declined because of reduced levels of cargo passing through the northern corridor and along the rail line to Nacala. Rehabilitation work continued at the Chilumba Port, on Lake Malawi, and in the Tanzanian sections of the northern trade route. Work at the Chilumba Port was completed by the end of 1991, and the importance of the northern corridor was expected to increase in 1992 when most of its facilities were scheduled for completion. Low levels of transport by rail were due to operational difficulties on the Nacala route. The Nacala railway resumed operation on a limited schedule in December 1989. Since then, operation of the line has improved owing to continuing rehabilitation work and pooling of Mozambican and Malawian locomotives and rail cars. Malawi Railways Ltd. was running a total of 10 trains per month in each direction between Malawi and Nacala. By 1991, a one-way trip was reduced to about 1 week compared with 10 days in 1989. Trains, however, were still considered vulnerable to derailment and insurgency attacks. It was estimated that a large investment in time and money would still be required to restore the line to the full operational status enjoyed in the early 1980's.

Malawi had about 13,300 km of roads, 678 km of railway lines, 4 lake harbors, and 4 commercial airports. Trucking operations were mainly private except for a parastatal that hauled most of the agricultural products. The parastatal Malawi Railways had responsibility for lake services as well as rail transport. The parastatal Air Malawi handled most of the domestic air travel and some of the regional commercial air traffic. The Ministry of Transport and Communications (MOTC) had

responsibilities for the overall transport policy and for regulation of all forms of transport.

Domestic trucking capacity was insufficient to meet demands. Critical distribution needs such as the transport of crops and the timely distribution of fertilizer could not be met. The domestic rail system experienced difficulties caused by the shortage of spare parts and railroad cars. Owing to financial problems during the late 1980's, the parastatal rail and air companies reduced their staffs by almost 15% and 30%, respectively, and delayed plans for equipment modernization. To help cover shortfalls in the budget, the Government made parastatals subject to income tax.

OUTLOOK

For the present, the health of Malawi's mineral industry, which was almost exclusively involved in supplying raw materials to the domestic construction industry, is dependent on the expansion of the country's economy. Except for the coal mining industry, the long-term future of the mineral industry looks bright. A wide range of undeveloped mineral deposits have been discovered, and the Government seems willing to cooperate with foreign agencies that have been offering technical and financial support in the areas of exploration and mineral processing. Development of new mines and process plants will diversify and expand the overall economy, but the mining sector will probably never become a major contributor to the nation's GDP.

When trade patterns are normalized, Malawi will probable abandon its marginal coal deposits in favor of cheaper imports. Renewed competition with foreign producers could also slow down the progress of other mining ventures.

Malawi's economy will continue to be dependent on foreign aid and on the agricultural sector, which is vulnerable to fluctuations in world commodity prices, insect infestations, and adverse weather conditions. The country's resolve in improving its internal and external infrastructural problems will, in large measure, determine its future economic expansion. Easing of political tensions in Mozambique and the subsequent reopening of Malawi's traditional trade routes would be highly beneficial to the country's external finances. Until Mozambique solves its internal problems, however, the high military and insurance costs of maintaining the shorter, more direct rail link to Nacala will negate most of the benefits and not substantially lower transportation costs. Commerce along this route may also be perceived as an unacceptable risk. Thus, the timely completion of improvements to the Dar es Salaam transportation corridor is especially important because it is Malawi's only secure alternative to the costly South African port of Durban.

[1]Where necessary, values have been converted from Malawian kwacha (MK) to U.S. dollars at the rate of MK2.63=US$1.00.

TABLE 1
MALAWI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	e1991
Cement, hydraulic		72,831	65,597	77,000	r99,349	120,000
Coal		18,256	39,376	41,700	r41,380	45,000
Dolomite e		2,500	2,500	2,500	2,483	2,500
Stone: Limestone for cement		107,040	105,000	113,000	r145,000	175,000
Gemstones: Ruby and sapphire e	grams	1,000	31,096	r500	500	1,000
Lime e		3,160	3,000	3,460	r4,096	4,000

eEstimated. rRevised.
[1]Includes data available through June 9, 1992.
[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.

TABLE 2

MALAWI: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

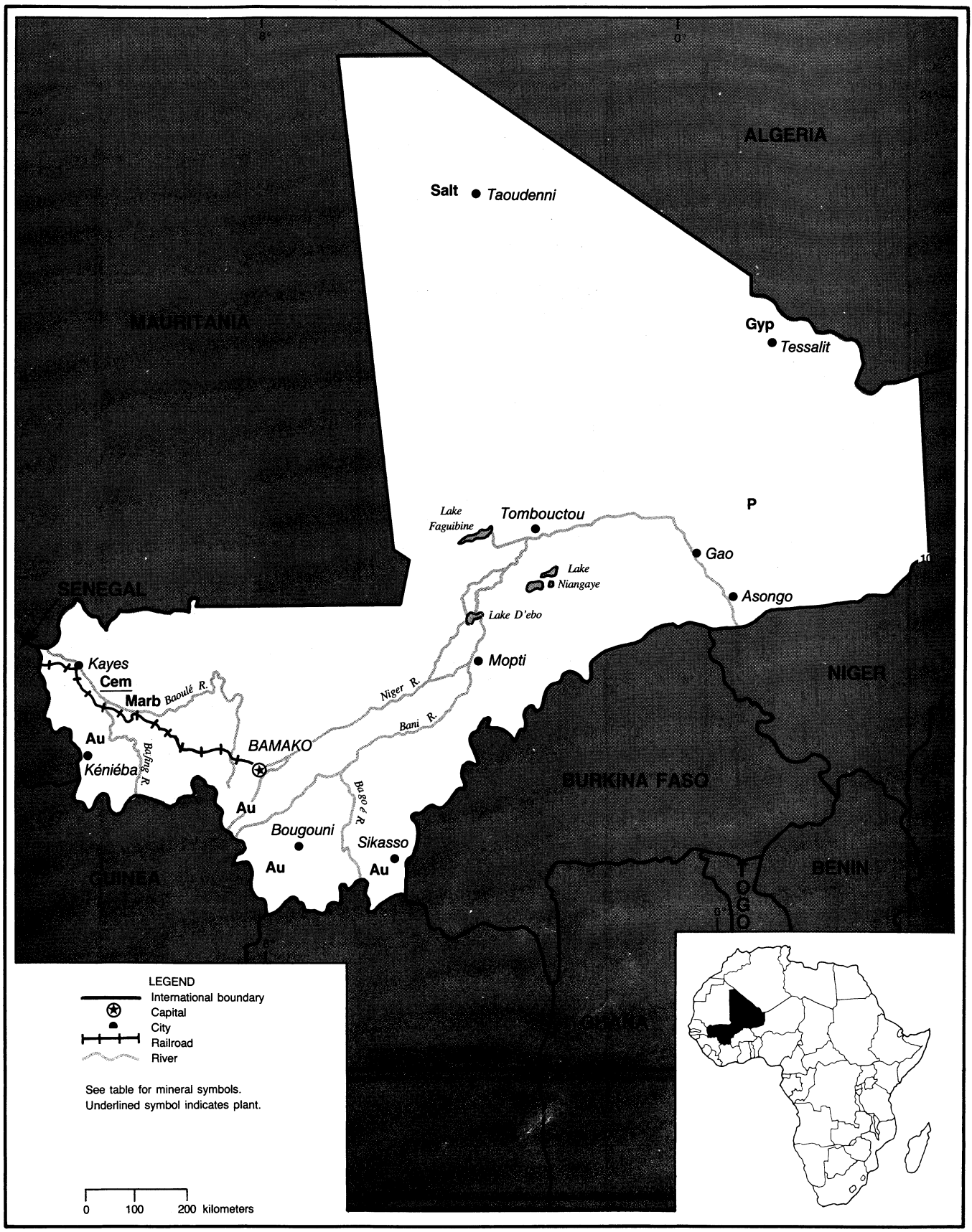
(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity[1]
Cement		The Portland Cement Co. (private, 100%)	Plant at Zomba	120,000
Coal		Mining Investment and Development Corp. (Midcor) (Government, 100%)	Kaziwiziwi Mine near Livingstonia	45,000
Do.		do.	Mchenga Mine near Livingstonia	10,000
Gemstones	grams	Gem Co. of Malawi (Midcor, 100%)	Chimwadzulu Mine near Blantyre	1,000
Lime		Numerous small-scale private producers	Chenkumbi Hills, 36 kilometers southeast of Ncheu	2,000
Do.		do.	Lirangwe area near Blantyre	2,000
Limestone		The Portland Cement Co. (private, 100%)	Changalumi Quarry near Zomba	200,000

[1]Capacity is based on output.

MALI

AREA 1,241,232 km² **POPULATION 8.3 million**



THE MINERAL INDUSTRY OF

MALI

By Hendrik G. van Oss

The mineral economy of Mali in 1991 continued to be dominated by the production of gold, which accounted for about 95% of mineral revenues. Total mineral revenues for 1991 were estimated at $68 million, equivalent to about 2.8% of GDP.[1] Apart from gold, small quantities of construction materials, gypsum, marble, phosphate, and salt were also produced. Despite its modest contribution to the GDP, mining was important to the country's foreign exchange earnings; gold accounted for about 18% of Mali's total exports and, as in 1990, was the country's third most valuable export commodity, after cotton and livestock. Most of Mali's mineral deposits, of which there is a wide variety, are uneconomic because of a lack of infrastructure.

The geology of Mali is dominated by Precambrian rocks in the southwestern and central parts of the country and Paleozoic to Cenozoic rocks over the remainder. By far the most important rocks economically are a number of north-to-northeast-trending belts of Proterozoic granitic rocks and greenstones, the latter belonging to the Birimian Series, that occur in the west and southwest, especially near Kéniéba, Bougouni, and Sikasso. The Birimian rocks in these areas, in common with similar rocks elsewhere in West Africa, host gold deposits. Most of these are associated with shear-zone-related iron sulfide-rich rocks, including quartz veins. Near Kéniéba, the Precambrian terrane also hosts diamond-bearing kimberlites; these have proven not to be of economic grade. Iron ore deposits are also known in this area, as are large but low-grade bauxite deposits. South-southeast of Gao, a relatively small area of Birimian rocks contains 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 determined.

In northeast Mali, overlapping into Algeria, Precambrian granitic and volcanic rocks are exposed in the Adrar des Iforas near Tessalit. A wide variety of minerals have been found in this region, including copper, gold, tin, uranium, and zinc. The remoteness of the area has made exploration very difficult and would make economic exploitation of most of the deposits prohibitively expensive.

Paleozoic and younger sedimentary rocks, particularly in northern and eastern Mali, host a number of industrial mineral deposits, some of which are exploited on a small scale. Paleozoic limestone deposits in western Mali are also exploited to a limited degree.

GOVERNMENT POLICIES AND PROGRAMS

The mining sector, particularly gold, is viewed by the Government as having the greatest growth potential of any sector of the Malian economy, especially in terms of generating foreign exchange. The Government encourages foreign private investment in this sector and has sought to improve the availability and quality of information about the country's geology and mineral resources. The Government was planning to privatize the Kalana gold mine, both in response to pressure from international lending institutions and by the loss of subsidies and management for the mine resulting from the break up of the U.S.S.R.

On September 19, 1991, a new mining code, Ordonnance No. 91-065/P-CTSO, was signed into law; it pertains to all primary mineral commodities other than liquid or gaseous hydrocarbons. The new law sets out the various types of mineral titles/concessions and the applicable procedures for obtaining them, the fee and tax regime, mine safety and environmental regulations, and rules and rights pertaining to the transportation of ore and necessary machinery. In addition, the new law includes certain regulations pertaining to artisanal miners (of gold and diamonds). A model agreement is included. The Government will automatically receive a 10% equity interest in all mining ventures and has the option to purchase an additional 10%. Objections have been raised by international financial institutions and by mining companies to certain provisions of the tax regime in the mining code, and it is likely that these tax provisions will be revised.

Petroleum exploration and exploitation remain regulated by Decree No. 30 of May 23, 1969, and by Decree No. 21, April 20, 1970. The current investment code is law No. 86-39/An-RM of March 8, 1986; this replaced the 1976 Investment Code.

Mining is overseen by the Direction Nationale de Géologie et des Mines (DNGM), which is part of the Ministry of Industry, Hydraulics, and Energy. In 1990, a quasi-independent organization, Programme pour le Développement des Ressources Minières (PDRM), was formed as part of the DNGM. The PDRM was set up with the assistance of the UN Development Program (UNDP) and maintains the UNDP laboratory and field exploration facilities and staff set up in the late 1980's as part of a major

regional exploration program conducted by the UNDP. The UNDP exploration program identified numerous mineral occurrences, including the gold deposit that was later developed by BHP-Utah International as the Syama Mine. PDRM facilities and equipment are available for hire to the private-sector exploration community.

PRODUCTION

Gold production continued to increase, largely owing to the Syama Mine, which opened in 1990, operating at full capacity throughout 1991. The mine produced about 2,500 kg of gold during the year. In contrast, the Kalana gold mine, the only other formal gold producer, continued to be plagued with engineering and financial problems and is believed to have had output in 1991 well-below its normal modest 400 to 450 kg/a. The mine was closed early in 1992. The remainder of Mali's gold production, amounting to an estimated 2,700 kg, was from artisanal and a few small, semi-industrial operations. (*See table 1.*)

TRADE

Mali's mineral commodity trade in 1991 was dominated by exports of gold, and imports of petroleum products, cement, and fertilizers. As in past years, there was believed to be significant smuggling of gold into Mali, particularly from Burkina Faso; data on this trade are 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 in 1991 of gold mined in Mali were worth about $64 million. In comparison, using 1990 data, exports of cotton and livestock were worth about $156 million and about $90 million, respectively.

Mali was entirely dependent on imports for the country's petroleum products needs. In 1991, these imports were worth about $52 million, or about 12% of total imports.

STRUCTURE OF THE MINERAL INDUSTRY

Mali's formal mining sector in 1991 was dominated by gold production from two gold mines (*See table 2.*). One of these, a parastatal enterprise, was being liquidated toward yearend. There was also gold production by semi-industrial operations and artisanal miners. Gypsum, marble, phosphate, 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.

Only about 1% of Mali's total labor force of approximately 2.6 million is in industry. The formal mining and related industries employ approximately 1,600 persons, of whom about 600 are employed by the gold mines. Recent estimates of the number of artisanal miners have ranged widely from 50,000 to 100,000 persons. However, many of these persons would work only part-time and/or on a seasonal basis, and would derive their primary income from agriculture. Reportedly, many of the artisanal miners are women.

COMMODITY REVIEW

Metals

The Syama gold mine, 75 km southwest of Sikasso, had its second full year of operation in 1991. Production was entirely from open pit oxide reserves and amounted to about 2,500 kg. Mining of open-pitable sulfide reserves and underground sulfide ore was planned following the exhaustion of oxide ore reserves, expected in mid-1994. Although technically feasible, the decision to proceed with the sulfide phase of the operation, which would require installing a fluidized bed roaster, hinged on energy costs, which had been artificially high as the result of high import duties on diesel fuel. Following lengthy negotiations with the Government in 1990 and most of 1991, the company was granted an exemption to these duties and, in November, made the decision to proceed with the sulfide phase of the project. The mine life at Syama was thus increased from the original 3 to 4 years to approximately 15 years. Largely owing to these negotiations, a fuel tax exemption for mining projects has been incorporated in Mali's new mining law.

The parastatal Kalana Mine, operated under Soviet technical management, continued to experience engineering problems during the year, largely having to do with water ingress to the underground workings and to inadequate ore hoisting and crushing facilities. Gold output from the mine had never exceeded about 27% of the design capacity of about 1,800 kg/a and, as a result, the mine was heavily in debt. Owing to financial difficulties in the U.S.S.R., it was evident that additional technical and financial subsidies from that source would not be forthcoming. Further, assistance from international financial institutions would not be made available to the mine under its existing management. Toward yearend, the Government began liquidation proceedings, and the mine was reported to have been closed in early 1992. Several international companies have expressed interest in the operation and other gold reserves on the Kalana mining concession.

A number of companies were involved in gold exploration in Mali during the year. BHP-Utah International continued with exploration in the Syama Mine area, and, owing to its success in developing the Syama Mine, had been offered several gold concessions elsewhere in the country. The most significant of these offers was the opportunity to enter into a joint venture on the Loulo property, near Kéniéba. The company signed an option on the property. Early in the year, Société Minière Sphinx of Canada was reported to be buying into the Bakolobi concession, 34 km southwest of Kéniéba. Toward yearend, Mink Mineral Resources of Canada was reported to have acquired a gold concession in the Kangaba area, southwest of Bamako.

Reserves

Mali is a well-mineralized country. Mineral exploration and development, however, have been hindered by the lack of infrastructure, which alone renders most of the known deposits uneconomic. Reserves have been delineated only for certain gold deposits and a few deposits of industrial and construction minerals. In addition, resources have been delineated for bauxite, iron, and manganese.

According to BHP-Utah International, the proven oxide ore reserves at the Syama Mine at yearend 1989 were 2.1 Mmt grading 3.7 g/mt of gold. These reserves were sufficient for a 3-year open pit operation; however, approximately 2 Mmt of additional oxide reserves have been delineated since that time, sufficient to carry the oxide mining phase through mid-1994. In addition, the deposit had reserves of open pit minable mixed oxide-sulfide and sulfide ore, and underground minable deep sulfide ore reserves. The mixed-oxide-sulfide and sulfide reserves have remained essentially unchanged at about 7 Mmt grading about 6.5 g/mt gold. The parent company, BHP (Pty) Ltd. of Australia, published total reserves at midyear 1991 of 19.1 Mmt grading 3.6 g/mt gold.

Published reserves at the Kalana Mine at yearend 1984, when mining commenced, were approximately 1 Mmt grading 36 g/mt of gold.[2] However, the ore consists of a number of largely subparallel quartz veins, and these have proven to have more variable grades than originally indicated. Gold output, totaling about 2,600 kg from the mine's startup at yearend 1984 through yearend 1991, has been much less than expected. In late 1989, the company estimated the deposits reserves as 1.7 Mmt grading 15 g/mt of gold. The Kalana concession is believed to have potential for additional reserves.

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 COFRAMINES of France, 49%; was formed to exploit the property. The economic viability of the deposit had not been demonstrated as of yearend 1991, but additional drilling was being conducted.

Mali's phosphate resources are in the southeast part of the country and have been delineated only for the Tamaguilelt deposit, which is being mined. According to the Government, reserves of this deposit total about 10 Mmt grading 31.4% P_2O_5. The potential of this region for additional reserves is high; reportedly, the phosphate-bearing formation can be traced for more than 400 km along strike.

Mali has large deposits of limestone and dolomite, some of which are suitable for cement and others which are suitable for ornamental stone (marble). Most of the deposits are uneconomical because of a lack of transport infrastructure or local markets. The cement plant at Diamou exploits the Gangontéry I deposit. According to the Government, the deposit had reserves of about 7 Mmt of limestone at the time the cement plant started production in 1969. About 500,000 tons have been mined to date. There is an additional deposit nearby, reportedly of somewhat lower quality, that has proven plus probable reserves totaling almost 60 Mmt. The Sélinkégni marble deposit has approximately 10.5 Mmt of reserves suitable for marble aggregate and tile, or for lime manufacturing.

The In Kereit gypsum deposit near Tessalit is being exploited on a small scale. According to Société Nationale de Recherches et d'Exploitation des Ressources Minièrees du Mali (SONAREM), the reserves of this deposit are approximately 370,000 tons. At Taoudénni, about 35 Mmt of gypsum has been delineated in evaporite beds. This area is also being exploited for salt, reserves of which are estimated to total 53 Mmt.

Mali has a number of iron ore deposits, most of which are in western Mali and most of which are low grade. The best known of these is the Balé deposit, 200 km west-northwest of Bamako, just north of the Guinea border. According to SONAREM, the Balé deposit has a resource of 146 Mmt grading 50% to 60% iron, within a larger inventory of lower grade material.

According to SONAREM, the Ansongo manganese deposit, about 20 km southeast of Ansongo, contains a resource of about 3 Mmt grading in excess of 40% manganese, and 4.5 Mmt grading 30% to 40% manganese. Exploitation of this deposit will only be conceivable at such time as the Tambao deposit, 120 km to the southwest in Burkina Faso, becomes economic. However, development of Tambao faces major infrastructural problems.

Western Mali contains a number of low- to medium-grade bauxite deposits. Tonnages range from 10 to 580 Mmt, and grades typically are in the range of 20% to 48% alumina. None of these is currently economic, especially in light of higher grade deposits elsewhere in West Africa, particularly in Guinea.

No reserves of energy minerals have been established, although occurrences of uranium mineralization, oil shale, and lignite are known.

INFRASTRUCTURE

In common with much of West Africa, Mali's transportation infrastructure is underdeveloped. The country's only railroad consists of a 642-km segment of the 1,286-km, 1-m-gauge line connecting Bamako with Dakar, Senegal. Railroad service is subject to frequent and lengthy interruptions during the rainy season. Mali had 15,700 km of highways in 1990, of which about 1,700 km were paved. The railroad and the major roads into Côte d'Ivoire are used to import mineral commodities, particularly fuels.

Mali's electrical generating capacity was 92 MW in 1989, the latest year for which data were available. The country's three hydroelectric plants accounted for 57 MW of the total. The Sélingué plant, at 45 MW, is the largest plant, but commonly produces below capacity owing to drought-induced low water

levels in its reservoir and an incomplete powerline network. The rest of Mali's electricity is generated by thermal plants. Mali's electricity production was about 210 GW•h in 1990. The Mantantali Dam, about 250 km west of Bamako, was completed in 1988 and is to have a plant of 91-MW capacity. Mali is to receive about 50% of the output, with the rest going to Senegal and Mauritania. Owing to a dispute among these countries over routing of the transmission lines, installation of the generating equipment has been indefinitely delayed.

Both the Kalana and Syama Mines had their own diesel generators; fuel for these was a major component of mining costs at both mines. Work was in progress to link the Kalana Mine to the Sélingué power grid.

OUTLOOK

Gold will continue to dominate Mali's mineral industry for the foreseeable future and the potential for discovery and development of additional gold deposits is high. Limited local markets and a general lack of infrastructure will continue to hamper the development of the country's known resources of other minerals, except on a very modest scale.

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[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF282.11=US$1.00.

[2]Direction Nationale de la Géologie et des Mines, 1987, Mineral Resources of Mali: United Nations UNDP/DTCD MLI/85/007 Project, 64 pp.

OTHER SOURCES OF INFORMATION

Direction Nationale de la Géologie et des Mines
B.P. 223
Bamako, République du Mali

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

TABLE 1
MALI: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990e	1991e
Cement, hydraulic		22,000	25,000	20,000	20,000	20,000
Gold: Mine output, Au content[e 3]	kilograms	r950	2,650	4,000	5,200	5,500
Phosphate rock[e]		8,092	10,000	10,000	10,000	10,000
Salt[e]		4,500	4,500	5,000	5,000	5,000
Stone: Marble		200	155	155	160	160
Gypsum[e]		600	720	700	700	700
Silver[e 5]	kilograms	34	50	r40	110	160

eEstimated. rRevised.

[1]Includes data available through July 14, 1992.

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

[3]Includes estimate (Government estimate 1988 and 1989) of artisanal production and may include some gold smuggled into Mali. The Kalana Mine accounted for about 35% of the total output in 1987; 18% in 1988; 13% in 1989; 8% in 1990; and about 6% in 1991. The Syama Mine began gold production in 1990 and accounted for about 42% of the total output that year and 45% in 1991.

[4]Reported figure.

[5]Estimated output from Kalana Mine only (1987-89) and for the Kalana and Syama Mines in 1990-91.

TABLE 2
MALI: STRUCTURE OF THE MINERAL INDUSTRY

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement		Société des Ciments du Mali (majority Government owned)	Cement plant at Diamou, about 50 kilometers southeast of Kayes	e50,000
Gold, fine	kilograms	Société de Gestion et d' Exploitation des Mines d'Or de Kalana[1] (Government, 100%)	Kalana underground mine, 110 kilometers southwest of Bougouni	500
Do.		Société des Mines de Syama (BHP-Utah International of the United States, 100%)[2]	Open pit gold mine at Syama, 75 kilometers southwest of Sikasso	2,500
Gypsum		Plâtre de Tessalit (Government, 100%)	Gypsum mine near Tessalit, 450 kilometers north of Gao	e1,000
Marble		Marbre de Sélinkégni (Government,100%)	Marble quarry at Sélinkégni, 80 kilometers southeast of Kayes	e200
Phosphate		Phosphates du Telemsi (Government, 100%)	Tamaguilelt Mine, 205 kilometers north of Ansongo	e25,000
Salt		Sel gemme de Taoudénit (Government, 100%)	Taoudénit salt mine, near Taoudenni	e6,000

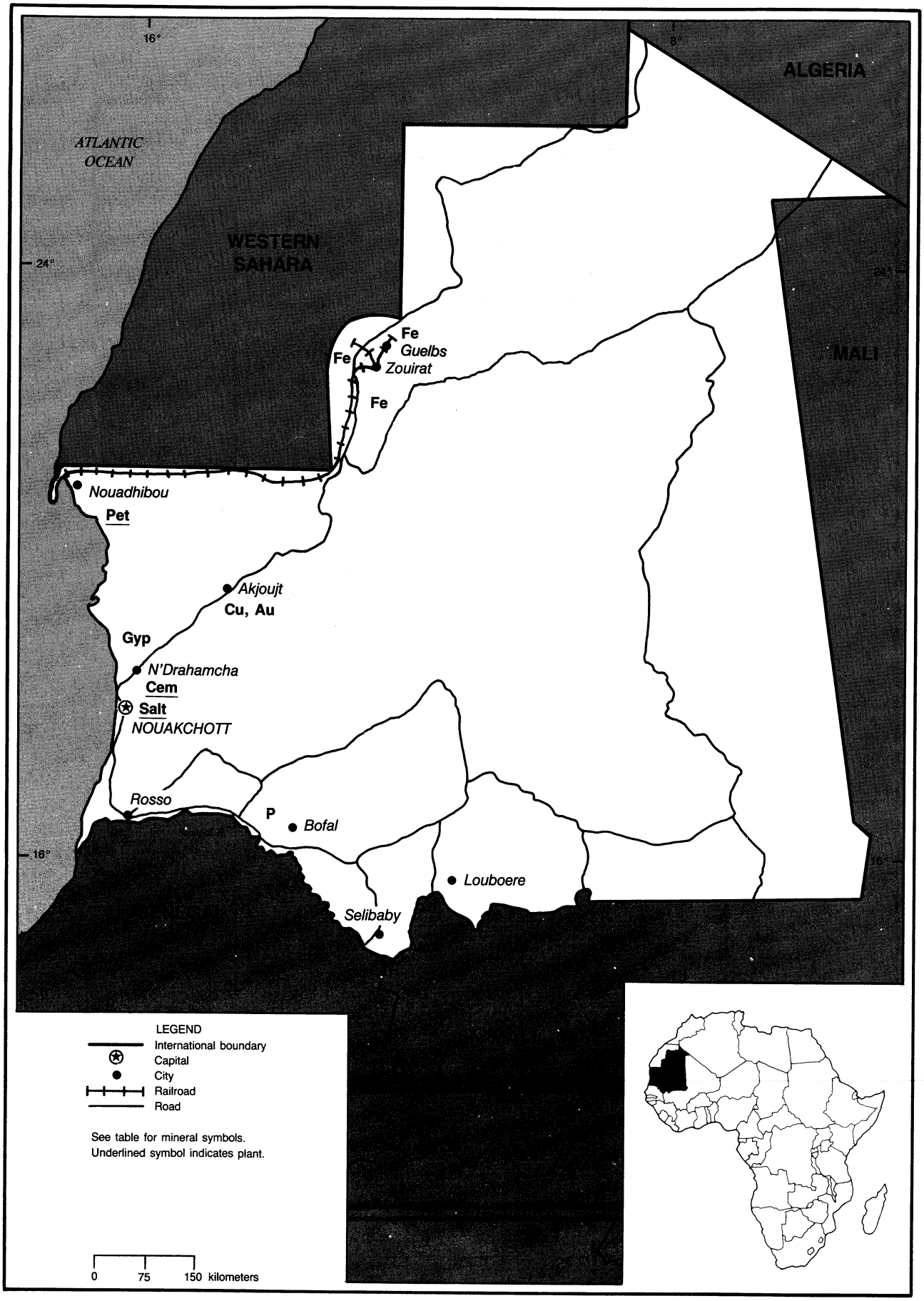
eEstimated.

[1]The Kalana Mine was being liquidated at yearend 1991 and was reported closed early in 1992.

[2]The Malian Government was to have had 35% of the mine but, for financial reasons, BHP has had 100% control since the mine's startup in 1990.

MAURITANIA

AREA 1,030,700 km² **POPULATION 1.9 million**



THE MINERAL INDUSTRY OF

MAURITANIA

By Bernadette Michalski

Iron ore mining and beneficiation was the dominant mineral industry in Mauritania, accounting for at least one-third of the nation's income. Cement, gypsum, and salt were also produced. Gold recovery commenced from the Akjoujt copper mine tailings that remained after the 1970-78 mine operations, and gold exports were anticipated by mid-1992. Interest continued in the resumption of mining at the Akjoujt copper deposit. Although scheduled for 1991, the reopening of the mine did not take place.

Mauritania's external debt service obligations substantially exceeded payment ability. Public and private investment programs focused on fisheries, iron ore mining, gold recovery from mine tailings, intensified hydrocarbon exploration, and infrastructure development.

GOVERNMENT POLICIES AND PROGRAMS

The Government's price controls were lifted on all but three goods, import controls were liberalized, investment laws were codified, tax reforms were instituted, and several Government-owned companies have been put up for sale to private parties. A hydrocarbon Research and Exploitation Code was adopted covering such areas as fiscal advantages, duty and tax exemptions, and royalties. The document constituted the first comprehensive legal framework for establishing work operation in Mauritania. Under the Code, all imported materials for research or exploration are exempted from duties and taxes. During the exploration period, no taxes are imposed on the company. However, royalties are imposed when production is achieved.

Eager to attract private funds, the Government liberalized the investment code. A major feature was the guaranteed freedom to repatriate profits and capital. Capital stock may be held in hard currency, and the Government sets no limitations on the repatriation of profits or capital. The National Investment Commission reviews all major foreign investment proposals.

PRODUCTION

Although production from the El Rhein Mine in the Guelbs did not meet expectations due to severe technical problems at the beneficiation plant, iron ore continued to be Mauritania's principal mineral commodity. Production totaled 10.4 Mmt in 1991 compared with 12.11 Mmt in 1989. Most of the iron ore output was derived from the Tazadit surface mine. Iron ore concentrate from the El Rhein Mine was less than 2 Mmt. *(See table 1.)*

TRADE

Mauritania's mineral export commodities were iron ore and small quantities of gypsum and plaster products. By 1992, the export list will be augmented by the introduction of gold exports valued at about $10 million.

Iron ore exports were 11.36 Mmt in 1990. Difficulty in beneficiating the ores from the Guelbs brought expectations down to a planned export of 11 Mmt in 1991. Actual exports for that year, however, were reported at 10.47 Mmt. Shipments were for the most part delivered to the steel mills of the EC. Leading importers in 1991 were Italy at 3.1 Mmt, Belgium-Luxembourg at 2.1 Mmt, France at 1.8 Mmt, the United Kingdom at 1.2 Mmt, and Spain at 1.0 Mmt.

Operations at the country's sole petroleum refinery recommenced in late 1987 using crude oil supplied by Algeria. Product imports in 1991 approached 1.5 Mbbl and accounted for almost one-half of consumption; the remainder was supplied from the refining of imported crude oil.

Mauritania mineral imports included about 12,000 mt/a of salt for the fish processing industry. *(See table 2.)*

COMMODITY REVIEW

Metals

Copper.—Development of copper deposits at Guelb Moghrein, 4 km west of Akjoujt, was under consideration. The deposits were estimated to contain 100 Mmt of ore averaging 2.25% copper and 1.17 g/mt gold.

Gold.—Gold recovery operations from the tailings of the Ajkoujt copper mine commenced in late 1991 by Mines d'Or d'Akjoujt (MORAK). The principal shareholders in the venture were Société Arabe des Mines de L'Inchiri (SAMIN) and Minroc Holdings of Australia. Investment capital included a $3 million loan from the World Bank's International Finance Corp. matched by $3 million advanced by MORAK shareholders in proportion to their equity. The mine tailings total 2.5 Mmt with an average gold content of 3.1 g/mt. Gold output was expected to exceed 1,000 kg/a by 1992.

Iron Ore.—Iron ore mining operations were conducted by Société Nationale Industrielle et Minière (SNIM) in northwestern Mauritania. Three mines were active in the Kedia d'Idjill region: Tazadit, Ruessa Sayala, and Azouazil. The El Rhein Mine was operating in the desert plains known as the Guelbs. Since 1984, low-grade magnetite ores of the Guelbs have been mined to augment exports from the depleting reserves of the Kedia d'Idjill mines. However, the Guelbs beneficiation plants employed a largely untested dry enrichment process involving magnetic separation. Heavy dust buildup and the rapid abrasion on mechanical parts due to the quartzite present in the ore required major plant modifications. The dry process concentrator at El Rhein was operating at 30% capacity with only one of the two beneficiation plants in operation. Production was less than 2 Mmt of concentrate in 1991.

A 15- to 20-Mmt ore body containing 64% to 67% Fe was located at D'kheilet, 8 km southeast of the Tazadit pit, in January 1991. Stripping was already under way in 1991, and production should commence in 1992, eventually reaching 2 Mmt/a. Production from M'Haoudat, 60 km northeast of Zouirat and 30 km from the existing railway, is expected in 1993, and peak output from this ore body is planned at 6 Mmt/a. Two ore types were found at M'Haoudat. A rich magnetite ore containing 64% Fe with a silica content ranging from 3% to 7% constituted about 70% of the 80-Mmt reserve. The remainder was represented by a silicious ore grading 55% Fe with up to 17% silica. Financing for the project was obtained through African Development Bank ($60 million), Caisse Centrale de Cooperation Economique ($16.1 million), and the European Investment Bank ($36.4 million).

SNIM had reported that energy consumption accounted for 20% of production costs. The consumption pattern included diesel oil for use by the railroad at 55% of total energy cost, fuel oil at 22.3%, lubricants at 20.5%, and gasoline at 2.2%.

In 1991, SNIM purchased four Bucyrus Erie 60R blasthole drills, three P&H 2800 XPA electric mining shovels, 17 T2200 Marathon LeTourneau 200-ton electric dumptrucks, and two L1100 Marathon LeTourneau front-end loaders. The new equipment was destined for the El Rhein Mine in the Guelbs where siliceous magnetite ores have created blasting pattern and loading problems. Equipment from the El Rhein will be transferred to M'Haoudat. This includes Bucyrus-Erie 290B electric mining shovels, 785 Caterpillar trucks, and Dart 110-ton trucks. This equipment is considered more suited to the selective mining and ore blending expected at the M'Haoudat operations. The SNIM work force totaled more than 4,600 full-time and over 1,700 part-time employees in 1991.

Industrial Minerals

Gypsum.—Production was derived from the N'Drahamcha quarry, 50 km northeast of Nouakchott. The quarry was owned and operated by the Société Arabe des Industries Metallurgiques Maritano-Koweitiennes (SAMIA). Although capacity was reported at 120,000 mt/a, actual output was dictated by the local market, and demand was estimated at 20,000 mt/a. Most of the output was processed into plaster, and additional amounts were used in the production of concrete blocks.

Phosphate.—The resources identified at Bofal and Loubboira in southern Mauritania were estimated at 120 to 150 Mmt of phosphate rock averaging 20% P_2O_5. The remote deposit requires high infrastructure development costs; however, the Mauritanian Government announced plans to commence mining by mid-decade.

Mineral Fuels

Petroleum.—Exploration.—Activities continued by Texaco and Amoco in the southern and central coastal waters, progressing as required by the terms of their respective exploration agreements.

Refining.—Mauritania's sole refinery was owned by the Société Mauritanienne d'Industrie de Raffinage (SOMIR) at Nouadhibou. The 20,000-bbl/d-capacity refinery, designed to process Algerian crude oil, was closed from 1983 to 1987 due to financial and technical difficulties. After completion of a $30 million renovation program funded by Algeria, the refinery reopened in September 1987 under the technical management of Naftal, an Algerian oil corporation. The Nouadhibou refinery supplied about one-half of the nation's demand for refined products.

Reserves

Information was limited to copper, gold, iron ore, phosphate rock, and salt. In addition to the iron ore reserves listed in table 3, iron ore reserves in the western Guelbs are described as probable and reported at 980 Mmt by SNIM. *(See table 3.)*

INFRASTRUCTURE

Mauritania enjoyed a number of advantages over most iron ore exporters, including the proximity of the Western European markets and a port with a water depth of 17.5 m that can accommodate vessels of 120,000 to 150,000 dwt. Iron ore is carried 670 km from Zouirat or 700 km from M'Haoudat to the port at Nouadhibou by unit trains of up to 220 cars, each car having a capacity of 80 tons, and hauled by up to five diesel electric locomotives.

The port facilities at Nouadhibou underwent extensive reconstruction, restoration, and equipment renewal in 1991.

OUTLOOK

A major barrier toward investment and development is the limited infrastructure. Commonly, it is the poor infrastructure that has rendered all but the largest deposits uneconomic. There are only two

paved high-quality long-distance roads in Mauritania. Internal air transport is the quickest and in some cases the only viable mode of transport. Mauritania's single railroad specializes in carrying iron ore from Zouirat to Nouadhibou.

Existing and proposed mining operations suggest an improved outlook for the nation's economy. Fortunes are, however, largely dependent on the successful development of the M'Haoudat iron ore project, which would ensure continued mining for the next 20 years. It offers a good opportunity to acquire updated mining equipment and the resolution of the technical difficulties at the Guelbs beneficiation plants. The improved outlook at SNIM offers much needed stability to the economy. However, the ultimate success of these projects is dependent on favorable world iron ore prices.

Border disputes between the Governments of Senegal and Mauritania have been eased as a result of the opening of formal talks between the Governments that began in July. Other factors bearing on the mineral economy included the collapse of iron and copper prices and rising energy costs. As a result of these factors, Mauritania has developed a heavy burden of external debt and significant fiscal balance of payments deficits.

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[1]Where necessary, values have been converted from Mauritanian ouguiya (UM) to U.S. dollars at the rate of UM81.61=US$1.00.

OTHER SOURCES OF INFORMATION

Société Nationale Industrielle et Minière
(SNIM)
20 Rue de la Paix
Paris, France 75002

TABLE 1
MAURITANIA: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1987	1988	1989	1990	1991e
Cement[3]	metric tons	80,000	90,000	90,000	90,000	90,000
Gypsum	do.	19,402	6,000	6,400	8,000	4 2,839
Iron and steel:						
Iron ore:						
Gross weight	thousand tons	9,000	10,004	12,110	r11,590	4 10,246
Iron content[e]	do.	5,850	6,500	7,150	r6,800	6,500
Metal: Semimanufactures	metric tons	5,465	NA	NA	NA	NA
Petroleum refinery products	thousand 42-gallon barrels	300	2,000	1,515	2,000	1,800
Salt[e]	metric tons	5,500	5,500	5,500	5,500	5,500

[e]Estimated. [r]Revised. NA Not available.
[1]Table includes data available through Aug. 1, 1992.
[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, sand and gravel, and stone) presumably are produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels.
[3]From imported clinker.
[4]Reported figure.

TABLE 2
MAURITANIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	Societe Ciment de Mauritanie (Government, 71%; private, 29%)	N'Drahamcha	60.
Copper, 25% concentrate	Mines d'Or d'Akjoujt (MORAK) (Societe Arabe des Mines d'Inchiri, 45%; Minroc Holdings of Australia, 42.5%, International Finance Corp. World Bank, 12.5%)	4 kilometers west of Ajkoujt	65.
Gold kilograms	do.	do.	1,250.
Gypsum	Societe Arabe des Industries Metallurgiques (Societe Nationale Industrielle et Miniere, 50%; Kuwait Foreign Trading, Contract and Investment Co., 50%)	N'Drahamcha	120.
Iron ore	Societe Nationale Industrielle et Miniere (SNIM) (Government, 77%; Kuwait Real Estate Investment Consortium, 7.6%; Arab Mining Co., 6%)	Kedia d'Idjill	9,000. 60% to 65% Fe.
Do.	do.	The Guelbs	4,000. 37% Fe.
Petroleum, products thousand barrels	Societe Mauritanienne d'Industrie de Raffinage (Government, 100%)	Nouadhibou	7,300.
Salt	Societe Arabe des Industries Metallurgiques (Societe Nationale Industrielle et Miniere, 50%; Kuwait Foreign Trading, Contract and Investment Co., 50%)	2 kilometers north of Nouakchott	6.

TABLE 3

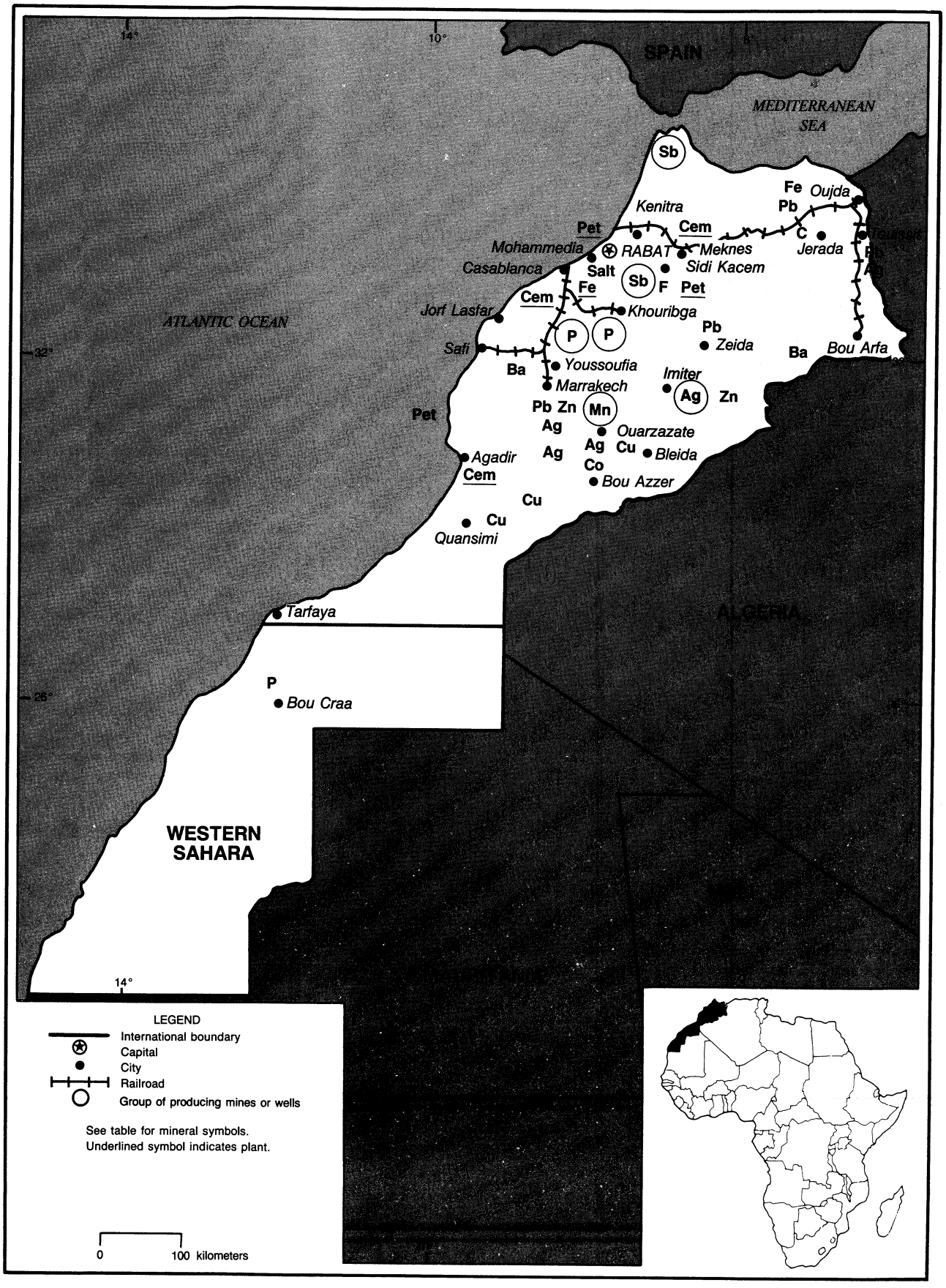
MAURITANIA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1991

(Million metric tons unless otherwise specified)

Commodity	Reserves
Copper	100 ore at 2.25% Cu.
Gold	100 ore at 1.17 grams Au per ton, 2.5 tailings at 3 to 5 grams Au per ton.
Iron ore	155 hematite at 60% to 68% Fe. 531 magnetite at 36% to 40% Fe.
Phosphate rock	100 ore at 20% P_2O_5.

MOROCCO AND WESTERN SAHARA

AREA 446,550 km² **POPULATION 26.1 million**



THE MINERAL INDUSTRY OF

MOROCCO AND WESTERN SAHARA

By Thomas P. Dolley

Production of phosphate rock and fertilizers continued to dominate both the Moroccan mining sector and economy in 1991. Phosphate mining accounted for 94% of an industry that produces a variety of minerals. Morocco is a significant producer of antimony, barite, copper, fluorspar, iron ore, lead, manganese, salt, silver, and zinc. Morocco is the largest producer of non-fuel minerals among North African nations. Furthermore, the mining industry as a whole is Morocco's largest foreign exchange earner. Revenue from the mining sector totaled $1.5 billion in 1991.[1] The Moroccan GNP from 1973 to 1989 amounts to about $242.7 billion.

Oil and gas legislative revisions and the attempts to diversify certain markets in anticipation of increased trade with the EC highlighted the year. Considered paramount among economic objectives were the privatization of parastatals, particularly the cement sector of the mining industry, and the Government's policy of increased foreign trade over foreign aid.

The external debt for Morocco has been estimated to be $20 billion. In 1991, Morocco's support of the UN coalition forces in the Persian Gulf War led to its receipt of $1 billion in oil and debt forgiveness from Saudi Arabia and other Arab lenders. Morocco's total debt relief assistance in 1991 amounted to $3.6 billion.

Foreign investment in Morocco had increased from about $145 million in 1989 to approximately $314 million in 1990. Generally, a large percentage of this investment capital is directly applied to the mineral industry. Indeed, capital investment in the mineral industry of Morocco increased from about $125 million in 1990 to $148 million in 1991. The Government has been active in the past several years attempting to create a European-style economy in Morocco. Foreign investments are aimed at increasing export markets targeting the EC along with supplying local markets.

GOVERNMENT POLICIES AND PROGRAMS

Current mining legislation in Morocco was based on Mining Code Bill No. 1-73-412 of August 13, 1973. In recent years, Morocco's parastatal Bureau de Recherches et de Participations Minières (BRPM) was particularly interested in attracting increased foreign investment in the mining industry. 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 would be null and void. Generally, the mining law revisions intended to expedite the bureaucratic process. Additionally, if a foreign company determines that a deposit under investigation is uneconomic, it may 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 newly revised law reduces the Government's share in agreements with international operators from 50% to 35%. Additionally, the law provides for corporate tax relief. Exploration activity will be fully deductible for over 10 years for newcomer contracts and over 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 km² from 5,000 km², and the minimum duration of an agreement was reduced from 15 years to 8 years. Though significant hydrocarbon finds have eluded Morocco, the petroleum geology of the country has been minimally examined.

The Government estimates that over the next 5 years total mining investment will reach about $2.4 billion. Approximately 86% of this investment will be in the phosphate industry. Investment packages and other financial scenarios will be part of the 5-year plan along with a remodeled investment code. The introduction of a privatization program designed to remove Government equity in mining activities, excluding the phosphate industry, is under consideration. In addition to substantial capital investment in mining and limited privatization, the Government planned an offshore banking enterprise to be located in Tangier. Ongoing discussions with the International Monetary Fund toward debt restructuring continued during 1991.

PRODUCTION

Production of key industrial minerals such as fluorspar, phosphate rock, and salt declined. Excluding iron ore and copper, Morocco's base metal production increased in 1991. *(See table 1.)*

TRADE

The export of mineral commodities plays a significant role in the Moroccan economy. As a percentage of total Moroccan exports, minerals account for 35% of value and 80% of the export volume. The volume of mineral exports in 1991 totaled about 9.8 Mmt with a value of approximately $1.3 billion. Most nonphosphate rock exportation is in the form of concentrates. Morocco is the world's leading exporter of phosphate rock, accounting for about 32% of global phosphate rock trade. In 1991, Morocco exported 9.14 Mmt of bulk phosphate rock, valued at about $343 million. This figure represented a significant drop over the previous year and was in part due to a drop in demand during the Persian Gulf crisis.

Value-added or derivative phosphate products including diammonium phosphate (DAP), monammonium phosphate, phosphoric acid, triple superphosphate are primary export products. The total value of these exported derivative phosphate products was approximately $800 million in 1991.

A significant, across-the-board decline in phosphate rock and fertilizer exports was noted in 1991. Causative factors for this decline were primarily a loss of sales to Eastern Europe and, to a somewhat lesser degree, Western Europe. Phosphate rock exports to Eastern Europe totaled 754,300 mt in 1991, down from 1.48 Mmt in 1990. However, by yearend 1991 the parastatal Office Cherifien des Phosphates (OCP) was working vigorously to expand markets. OCP's activities account for 30% of total Moroccan exports. Additionally, a baseline trade agreement was sought by OCP with Mexico for increasing purchases of phosphate rock by that country. As of 1991, Mexico was the third largest purchaser of phosphate rock and products.

To stimulate sales in late 1991, OCP lowered prices on bulk rock and derivative fertilizers. By yearend 1991, DAP was being traded at $172 to $174/mt. Typical freight rates for phosphate rock shipments from Morocco to northern France, assuming a 15 kmt consignment, would be $12 to $13/mt. Conversely, typical freight rates for phosphate rock or DAP from Morocco to India, assuming a 25 kmt consignment, would be $33 to $35/mt.

Labor is a significant export and foreign exchange earner for Morocco. Historically, the exported labor is primarily to European destinations as opposed to exportation to other Arab states. Remittances from these workers have amounted to about $14.6 billion from 1973 to 1989.

During the year, Morocco made positive steps toward greater trade and joint venture agreements with the EC. For example, France's SGS Thomson, through its subsidiary SGS Thomson Maroc, is producing semiconductors in Morocco through a joint venture agreement. Morocco now supplies a high percentage of printed circuits to the EC market.

France remained Morocco's leading trading partner in 1991. Morocco exported about $1.9 billion in consumer goods and farm products to France in 1991. *(See tables 2 and 3.)*

STRUCTURE OF THE MINERAL INDUSTRY

The mining sector directly employs over 70,000 people and indirectly provides jobs for 250,000 people through interaction with other industries. Approximately 12,000 laborers are involved in artisanal mining. Mining activity in Morocco is controlled by the Government through public-sector companies and parastatals. Established in 1928, BRPM is an autonomous public corporation involved directly or indirectly in the majority of Moroccan mining enterprises, excluding hydrocarbons and phosphates. Phosphate mining is managed and controlled by the parastatal OCP. Omnium Nord Africain (ONA), involved in mining and infrastructure projects, remained Morocco's largest private company. ONA was also involved in a variety of businesses including agriculture, finance, communications, and mining with a turnover of $1.8 billion in 1991. Mining accounts for about 5% of ONA's activity through the operation of six major mines. The Government parastatal that controls hydrocarbon exploration and production is the Office National de Recherches & d'Exploitations Petrolieres (Onarep). *(See Table 4.)*

COMMODITY REVIEW

Metals

A cooperative meeting between geologists and mining engineers from both Morocco and Algeria occurred at the beginning of the year. The mining city of Touissit, on the border between both nations, was the site of the meeting. Technical information was exchanged concerning the large lead and zinc deposits that are mined in the region.

Cobalt.—Cobalt continues to be produced from the Bou Azzer cobalt mine with a dramatic increase in production in 1991. Compagnie de Tifnout Tiranimine resumed mining at Bou Azzer in 1987 after a 6-year closure. Geologically, the cobalt ore was associated with copper-iron-nickel arsenides in altered igneous rocks of an ophiolite complex. Recovery of additional cobalt through nitroso-naphthol flotation from the gravimetric tailings and dumps associated with Bou Azzer has been postulated.[2] Historically, the cobalt concentrate has been primarily exported to China.

Lead.—Compagnie Minière de Touissit (CMT) reportedly produced 465,179 tons of ore containing copper, lead, and silver in 1991 from the underground Bediane Mine. The Bediane Mine, within the Touissit mining district, is 40 km south of Oujda, in the northeast corner of Morocco. In 1991, the milling and concentration facilities at the mine treated 463,190 tons of ore grading .29% copper, 11.66% lead, and silver at 69 g/mt. Production of lead concentrates totaled 76,516 tons in 1991. Lead concentrates are shipped to the El Heimer

smelter, located approximately 20 km southeast of Oujda. The smelter is operated by Societè des Fonderies de Plomb de Zellidja (PZ). PZ is owned 20% by CMT, 26% by BRPM, and 51% by ONA. Production capacity at the El Heimer smelter is 100 kmt/a of combined Pb-Zn metal and associated metals. Of this amount, 68 kmt is 99.9% Pb. Roasted concentrates from CMT are smelted using imported coke, and separate recovery of zinc, copper, antimony, and silver is achieved.

Silver.—The Imiter silver deposit is owned and operated by Société Métallurgique d'Imiter which, in turn, has equity ownership of 69% by BRPM and 31% by ONA. Located in south-central Morocco, it is considered a world-class deposit. Annual production at Imiter is 115-120 mt of silver with about 15-20 mt of byproduct mercury. Estimated ore reserves are approximately 2 Mmt with a silver content of about 2.1 kmt.

The Imiter deposit lies within the Precambrian Pan-African belt in the Anti-Atlas mountain range. The regional lithology is predominantly metasediments and volcanics that in many cases have undergone multiple stages of tectonic deformation. Large fault systems are associated with the region and are postulated to have been the avenue of hydrothermal mineralization. The silver mineralization found at Imiter was formed during the deposition of a black shale unit within a massive turbidite sequence, possibly through exhalative-sedimentary processes. However, the economic metals are thought to have been mobilized earlier and are associated with later multistage hydrothermal activity. Large sheets of native silver weighing tens of kilograms are known from the area. The orebodies are 100 m long by 100 m deep and 40 m thick. The deepest known orebodies are 250 to 300 m deep.[3]

Industrial Minerals

Cement.—Total cement milling capacity was about 2.5 Mmt/a and cement kiln capacity was 2.2 Mmt/a. Capacities could increase, however, with Polysius SA of France, a subsidiary of Krupp Polysius AG of the Federal Republic of Germany, being commissioned by Morocco's Cimenterie de l'Oriental (CLOR) to build a 1.2 kmt/d clinker plant. Located in Fez, the plant is to initiate production in 1992. CLOR has been an active customer of Polysius since the mid-1970's. It was at this time that Polysius built two production lines for CLOR at Oujda with an aggregate capacity of 1 Mmt/a of cement clinker and 800 kmt/a of cement. The Oujda operation has been expanded and refitted several times. The newly planned operation at Fez features the installation of an already existing Polysius kiln, a preheater, homogenizing and metering equipment, and two roller mills for the grinding of raw materials and coal. Additionally, CLOR has been targeted by the Government for privatization in 1992.

Phosphate Rock.—Globally, the phosphate rock and derivative fertilizer industry experienced a decline in demand in 1991. During the year OCP was forced to lower some of the prices on its products, such as DAP, to stimulate business. The Khouribga region, in west-central Morocco, was the area most extensively mined for phosphate in the country.

Production declines were noted for all of OCP's derivative phosphate products with the exception of phosphoric acid and nitrogen-phosphorus-potassium.

Despite the disappointing decline in phosphate rock production, OCP planned for a variety of developmental projects. Financing for such projects remained elusive, however. One such example is the construction of Moroc Phosphore V and VI, which OCP has planned for since the mid-1980's. These two large phosphate product plants would be built at the existing site at Jorf Lasfar. Financial difficulties continue to hamper development of the project, which has now been postponed until 1992-93.

Mineral Fuels

Coal.—Charbonnages du Maroc (CDM) is a Government parastatal that is 99% owned by BRPM. By yearend 1991, CDM was poised to close its coal mining operation at Jerada. Despite these plans by CDM, a royal order circumvented the mine closure. Declining production was cited by CDM as the reason for the planned mine closure. However, according to Government figures, mine production at Jerada has increased from 1989 to 1991. A large drop in production was noted from 1988 to 1989, due primarily to labor unrest at the mine in 1988 and early 1989. If the closure of the Jerada Coal Mine had proceeded, an estimated 200 jobs would have been lost. A commission to determine other economic options for the region will supposedly be appointed.

The stay of the mine closure indicates the importance of the Jerada Coal Mine to the energy resource base of Morocco. CDM's operation is the only coal mine in Morocco and produces a high-grade anthracite coal, with all of the output being utilized domestically. The Government has stated that only 15 years of coal reserves remain to be mined at Jerada. Typically, Morocco must import more than 1 Mmt/a of coal to offset its limited energy resources.

Petroleum.—Morocco had possessed 12 producing oil wells with an estimated production of 900 bbl/d in 1991. Total throughput petroleum refining capacity was approximately 55 Mbbl/a from two refineries at Sidi Kacem and Mohammedia.

An agreement in principle was negotiated between the United States' Ashland Oil Inc. of Houston and Onarep. The 1.3 million- acre petroleum exploration concession lies offshore of Agadir, Morocco. Ashland Oil will serve as operator and hold a 50% equity interest with the remaining 50% held by Santa Fe Energy Resources, also of Houston. Seismic surveys will be conducted into 1993 with the first wildcat well to be drilled by late 1993 or early 1994.

Due to the Government's support of UN coalition forces in the Persian Gulf War, Saudi Arabia and the United Arab Emirates provided free crude oil for 6 months at a rate of 30 kbbl/d and 20 kbbl/d, respectively.

Reserves

The Government's estimated reserve of phosphate rock was approximately 22 billion tons. Estimated proved oil reserves total 2.1 Mbbl. Natural gas proved reserves total 1.2 billion m^3. Sufficient reserves existed to sustain base metal production into the 21st century.

INFRASTRUCTURE

A midyear announcement by the Government stated that construction would begin in 1993 on a natural gas-fired power plant. The location of the proposed power plant was not given; however, its construction relies on the building of a gas pipeline from Algeria across Morocco to Spain. A preliminary agreement to construct the pipeline was signed between the Government and Algeria in April 1991.

OUTLOOK

The Government's medium and long-term objectives for mineral development can be summarized as the following: (1) intensify mining research efforts; (2) maintain and reinforce existing mineral production; (3) expand or develop new mineral production capacity; and (4) increase the production of value-added mineral products and beneficiation. In the 1990's, the Mediterranean basin should represent a geographically and economically advantageous region for Morocco to operate in. Through privatization and alleviation of public-sector debt, the Government can form an economically cooperative framework of trade and development with the EC.

Due to a lack of significant petroleum deposits, Morocco must continue to import an overwhelming percentage of its energy needs. Discovery of significant domestic sources of energy is critical to Morocco's future economic success. Until this occurs, the high cost of energy importation will continue to upset the country's balance of trade.

WESTERN SAHARA

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. The population as of mid-1991 was 196,737 with a growth rate of 2.6%. Economic activity, including all trade, is controlled by the Moroccan Government. Fishing and phosphate mining are the main industries and sources of revenue. The only significant mineral production from this region is from the phosphate mine at Bou Craa. Production data from Bou Craa is included with Moroccan phosphate output with the Bou Craa output usually amounting between 1 and 1.5 Mmt/a. The Netherland's Royal Dutch/Shell Group's petroleum exploration tracts lie offshore of Tarfaya.

In 1991, a UN-brokered referendum between the Moroccan Government and Polisario guerilla forces was sought. A cease-fire followed by a resumption of conflict typified peace efforts in 1991. The UN Mission for Referendum in Western Sahara (Minurso) was created to monitor a 1991 cease-fire and a planned election in January 1992.

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[1]Where necessary, values have been converted from Moroccan dirhams (DH) to U.S. dollars at a rate of DH8.78=US$1.00.

[2]De Cuyper, J. Milling of Cobalt Ores—An Overview, Extractive Metallurgy of Nickel and Cobalt. The Metallurgical Society, 1988, 23 pp.

[3]Leistel, J., Qadrouci, A. The Imiter silver deposit (Upper Precambrian of the Anti-Atlas, Morocco) Mineralization controls, genetic hypothesis and exploration guidelines. Chronique de la Recherche Minière, No. 502, Orléans Cedex 2, France, Mar. 1991, 17 pp.

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Agencies

Bureau de Recherches et de Participations Minières
5 Charia Moulay Hassan
P.O. Box 99, Rabat, Morocco

Ministere del-Energie et des Mines
5 Rue de Rich, Tour Hassan
Rabat, Morocco

Office Cherifien de Phosphates
Angle Route de'El Jadidaet Bd de Grande Ceinture
Casablanca, Morocco

Publications

Le Secteur Minier 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]		1987	1988	1989	1990	1991[e]
METALS						
Antimony concentrate:						
Gross weight		1,058	555	316	426	NA
Sb content		444	250	142	192	NA
Chromite		NA	1,000	1,000	300	[3]500
Cobalt concentrate:						
Gross weight		2,113	2,384	1,144	1,830	[3]5,000
Co content		224	253	121	194	525
Copper:						
Concentrates, gross weight		46,251	41,001	44,033	[4]45,332	[3]39,000
Matte, gross weight		2,441	2,981	2,126	[5]2,322	2,300
Cu content, concentrates and matte		16,541	15,396	15,988	16,411	14,000
Iron and steel:						
Iron ore:						
Gross weight		210,200	114,209	175,600	147,825	[3]97,000
Fe content		128,100	69,668	107,116	90,173	59,170
Metal:[e]						
Pig iron		15,000	15,000	15,000	15,000	15,000
Steel, crude		6,000	7,200	7,200	7,200	7,200
Lead:						
Concentrate:						
Gross weight		105,090	100,221	93,513	95,529	[3]102,000
Pb content		75,665	72,159	67,329	68,781	73,000
Cupreous matte, Pb content		635	775	553	604	600
Metal:						
Smelter, primary only		62,500	68,410	63,676	64,512	[3]63,000
Refined:						
Primary		62,497	68,410	[e]63,000	[e]64,000	64,000
Secondary[e]		2,000	2,000	2,000	2,000	2,000
Total[e]		64,497	70,410	[e]65,000	[e]66,000	66,000
Manganese ore, largely chemical-grade		42,500	30,100	32,000	49,450	[3]59,000
Silver:						
Ag content of concentrates and matte	kilograms	61,429	57,448	50,221	[6]53,708	53,000
Ag content of mine and smelter bullion	do.	108,302	168,767	186,390	[7]187,400	[3]200,000
Total	do.	169,731	226,215	236,611	241,108	253,000
Zinc concentrate:						
Gross weight		19,874	21,304	33,913	36,860	[3]71,000
Zn content[e]		10,300	10,865	18,652	[3]18,799	35,000
INDUSTRIAL MINERALS						
Barite		143,503	321,562	370,000	363,580	[3]433,000
Cement, hydraulic	thousand tons	3,800	4,220	[e]4,200	[e]4,200	4,200
Clays, crude:						
Bentonite		2,948	3,445	3,970	4,000	[3]9,000
Fuller's earth (smectite)		46,271	52,694	48,820	45,230	[3]38,000
Montmorillonite (ghassoul)		4,981	4,367	4,133	4,427	[3]4,000
Feldspar[e]		1,000	1,000	1,000	1,000	1,000
Fluorspar, acid-grade		78,000	100,500	105,000	86,500	[3]75,000

See footnotes at end of table.

TABLE 1—Continued

MOROCCO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991[e]
INDUSTRIAL MINERALS—Continued						
Gypsum[e]		450,000	450,000	450,000	450,000	450,000
Mica[e]		1,500	1,500	1,500	1,500	1,500
Phosphate rock (includes Western Sahara)	thousand tons	21,300	25,015	18,067	21,396	[3]17,900
Salt, rock		107,838	132,661	89,075	124,909	[3]130,000
MINERAL FUELS AND RELATED MATERIALS						
Coal, anthracite	thousand tons	634	637	504	526	[3]551
Gas, natural:						
Gross	million cubic meters	74	83	62	62	62
Marketed[e]	do.	57	57	57	57	57
Petroleum:						
Crude	thousand 42-gallon barrels	145	151	102	114	114
Refinery products:[e]						
Distillate fuel oil	do.	9,500	[3]14,454	[3]15,968	16,000	16,000
Gasoline	do.	3,300	[3]2,769	[3]2,897	2,800	2,800
Jet fuel	do.	1,500	[3]1,640	[3]1,684	1,680	1,680
Kerosene	do.	750	[3]347	[3]386	380	380
Other	do.	2,100	2,100	2,100	2,100	2,100
Refinery fuel and losses	do.	1,500	1,500	1,500	1,500	1,500
Residual fuel oil	do.	13,000	13,000	13,000	13,000	13,000
Total	do.	31,650	35,810	37,535	37,460	37,460

[e]Estimated. NANot available.

[1]Includes data available through May 8, 1992.

[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 (42,137 tons at 35% Cu); gold-silver-copper (3,195 tons at 9.9% Cu, 105.3 grams per ton Au, 770 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 3/ and 4/ above and in lead concentrates (95,529 tons at 500 grams per ton Ag).

[7]Contained in a presumably mine-produced bullion: 149.4 tons at 98.9% Ag and lead smelter product 41.2 tons at 99.8% Ag.

TABLE 2
MOROCCO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS				
Aluminum: Metal including alloys:				
Scrap	1,809	681	—	Belgium-Luxembourg 310; Netherlands 153; France 78.
Unwrought	—	15	—	All to France.
Semimanufactures	155	100	—	France 53; Tunisia 46.
Chromium: Ore and concentrate	551	750	—	All to Spain.
Columbium and tantalum: Tantalum metal including alloys, all forms	1	—		
Copper:				
Ore and concentrate	45,229	44,848	—	Spain 36,400; West Germany 8,448.
Matte and speiss including cement copper	2,647	2,057	—	All to West Germany.
Metal including alloys:				
Scrap	5,323	4,800	—	France 1,826; Netherlands 1,061; West Germany 1,055.
Unwrought	32	—		
Semimanufactures	75	55	—	Spain 50; Mali 3.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	86,909	63,266	—	Tunisia 50,000; Albania 7,300; Netherlands 3,400.
Metal:				
Scrap	96,144	84,053	—	Spain 55,930; Italy 19,100; Turkey 5,000.
Steel, primary forms	—	81	—	France 71; Belgium-Luxembourg 10.
Semimanufactures:				
Bars, rods, angles, shapes, sections	1,176	41	—	Saudi Arabia 26; Algeria 12.
Universals, plates, sheets	400	4,660	—	Libya 3,784; Belgium-Luxembourg 625.
Wire	28	684	—	Cameroon 588; Mali 48; Libya 23.
Tubes, pipes, fittings	2,843	4,360	—	Libya 2,536; Tunisia 1,379; Senegal 315.
Castings and forgings, rough	20	2	—	France 1; Mali 1.
Lead:				
Ore and concentrate	31,663	30,432	—	Spain 15,564; Belgium-Luxembourg 7,515; West Germany 3,000.
Oxides	20	—		
Metal including alloys:				
Scrap	72	—		
Unwrought	62,004	59,596	—	Italy 20,003; Iraq 10,700; Turkey 8,191.
Semimanufactures	1	1	—	Mainly to Libya.
Manganese:				
Ore and concentrate, metallurgical-grade	45,873	44,584	70	France 16,338; Spain 9,700; Italy 7,925.
Metal including alloys, all forms	—	2	—	All to Netherlands.
Nickel: Metal including alloys, scrap	—	6	—	Do.
Silver: Metal including alloys, unwrought and partly wrought value, thousands	$21,890	$23,289	—	France $16,063; Switzerland $3,647; Spain 2,294.

See footnotes at end of table.

TABLE 2—Continued

MOROCCO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Zinc:				
Ore and concentrate	35,332	33,325	—	Belgium-Luxembourg 13,367; Spain 9,550; Yugoslavia
Blue powder	—	89	—	All to France.
Metal including alloys, scrap	—	195	—	United Kingdom 17; India 60; Italy 18.
Other:				
Ores and concentrates	2,083	2,468	—	China 2,070; United Arab Emirates 202.
Oxides and hydroxides	2	—		
Ashes and residues	—	831	—	France 644; India 100.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc. value, thousands	—	$5	—	All to Algeria.
Grinding and polishing wheels and stones	2	1	(2)	Mainly to Senegal.
Asbestos, crude	400	1,228	—	All to Tunisia.
Barite and witherite	358,909	373,857	6,500	Norway 131,780; United Kingdom 103,350; Venezuela 29,600.
Boron materials: Oxides and acids value, thousands	—	$1	—	All to Libya.
Cement	29,436	50,958	—	Algeria 36,850; Spain 14,100
Chalk	—	25	—	All to Mauritania.
Clays, crude	92,372	109,654	—	Spain 55,000; United Kingdom 24,000; Italy 15,000.
Feldspar, fluorspar, related materials	110,578	84,383	9,900	Canada 28,350; Norway 23,114.
Fertilizer materials: Manufactured:				
Nitrogenous	—	11	—	All to Libya.
Phosphatic thousand tons	1,618	2,277	—	France 445; Italy 261; Iran 255.
Potassic	1	—		
Unspecified and mixed	128,000	116,000	—	Greece 66,300; Spain 25,431; Portugal 10,912.
Gypsum and plaster	239,842	164,851	—	Cote d'Ivoire 46,800; Spain 34,070; Japan 26,000.
Iodine[3]	13	—		
Lime	—	8	NA	Spain 1; unspecified 7.
Mica: Crude including splittings and waste	1,121	700	—	All to France.
Phosphates, crude thousand tons	12,426	11,672	408	Spain 1,508; Belgium-Luxembourg 1,260; Mexico 943.
Salt and brine	5,682	4,959	—	Netherlands 2,850; Spain 2,108.
Sodium compounds, n.e.s.: Soda ash, manufactured	632	—		
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	779	1,688	1	Italy 2,363; Portugal 175.
Worked	525	1,287	93	West Germany 1,001; Italy 88.
Gravel and crushed rock	108,531	222,405	—	Spain 222,400.
Sand other than metal-bearing	79,650	160,050	—	All to Spain.

See footnotes at end of table.

TABLE 2—Continued

MOROCCO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued:				
Sulfur:				
Elemental:				
Crude, including native and byproduct	—	3	—	All to Libya.
Colloidal, precipitated, sublimed	—	4	—	All to Egypt.
Sulfuric acid	33	66	—	Mauritania 48; Gabon 18.
Talc, steatite, pyrophyllite	—	23	—	Syria 18; Tunisia 5.
Other: Crude	35	—		
MINERAL FUELS AND RELATED MATERIALS				
Coal: Anthracite	2,659	—		
Peat including briquets and litter	(2)	1	—	All to Libya.
Petroleum refinery products:				
Gasoline thousand 42-gallon barrels	3,146	4,554	—	Netherlands 2,060; Spain 1,513; France 653.
Kerosene and jet fuel do.	288	318	—	All for bunkers.
Distillate fuel oil do.	75	58	—	Mainly for bunkers.
Lubricants do.	250	195	—	Tunisia 193.
Residual fuel oil do.	(2)	10	—	Mainly for bunkers.
Bituminous mixtures do.	(2)	(2)	—	All to Tunisia.

NA Not available.
[1]Table prepared by Virgina A. Woodson.
[2]Less than 1/2 unit.
[3]May include bromine and fluorine.

TABLE 3

MOROCCO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals:				
Alkaline-earth metals kilograms	4,000	—		
Aluminum:				
Ore and concentrate	10,841	9,102	—	France 4,500; Guyana 2,000; China 602.
Oxides and hydroxides	2,608	4,761	1	France 3,836; United Kingdom 200; Czechoslovakia 106.
Metal including alloys:				
Scrap	—	1	—	All from Spain.
Unwrought	2,151	2,461	—	Netherlands 931; Norway 555; Greece 379.
Semimanufactures	5,620	7,248	(2)	France 2,259; Spain 1,717; West Germany 885.
Chromium:				
Ore and concentrate	14	28	—	All from Belgium-Luxembourg.
Oxides and hydroxides	56	61	8	United Kingdom 41; France 4.
Cobalt: Oxides and hydroxides	1	—		
Copper:				
Matte and speiss including cement copper value, thousands	$7	—		
Metal including alloys:				
Scrap	38	109	—	Spain 57; France 36; Algeria 16.
Unwrought	761	733	—	France 503; West Germany 140; Italy 90.
Semimanufactures	14,753	17,179	1	France 8,374; Belgium-Luxembourg 4,378; West Germany 1,387.
Gold: Metal including alloys, unwrought and partly wrought value, thousands	—	$9	—	West Germany $6; Japan $3.
Iron and steel:				
Metal:				
Scrap	82	2,320	—	Italy 2,000; Algeria 180.
Pig iron, cast iron, related materials	1,665	3,702	—	Brazil 2,362; Canada 794; France 312.
Ferroalloys:				
Ferromanganese	122	177	—	Belgium-Luxembourg 70; Brazil 54; Spain 46.
Ferrosilicon	124	93	—	Norway 43; Spain 16; France 14.
Unspecified	102	122	—	Belgium-Luxembourg 54; France 21; West Germany 16.
Steel, primary forms	499,980	466,050	59,025	Brazil 131,573; Italy 93,404.
Semimanufactures:				
Bars, rods, angles, shapes, sections	104,427	114,759	217	Spain 44,701; Italy 13,837; Brazil 13,004.
Universals, plates, sheets	163,377	178,513	1	France 41,693; West Germany 24,020; Spain 27,161.
Hoop and strip	13,306	12,884	6	France 5,907; Spain 3,017; West Germany 1,882.
Rails and accessories	14,401	15,323	—	France 15,029; Italy 127.
Wire	21,556	25,989	—	France 8,705; Spain 6,768; Brazil 2,510.
Tubes, pipes, fittings	18,214	10,900	29	France 4,684; West Germany 1,553; Spain 1,546.
Castings and forgings, rough	483	143	1	France 80; West Germany 41; Spain 11.
Lead:				
Ore and concentrate	36,052	29,519	—	Canada 22,639; Italy 4,903.
Oxides	522	588	—	Spain 330; West Germany 105; Italy 82.

See footnotes at end of table.

TABLE 3—Continued

MOROCCO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	Sources, 1990	
				United States	Other (principal)
METALS—Continued:					
Lead—Continued:					
Metal including alloys:					
Unwrought		206	177	—	France 122; Netherlands 45; Portugal 4.
Semimanufactures		69	68	(2)	Netherlands 28; Portugal 11; Belgium-Luxembourg 10.
Manganese:					
Ore and concentrate, metallurgical-grade		42	—		
Oxides		721	781	—	Ireland 560; Spain 121; Belgium-Luxembourg 100.
Mercury		(3)	9	—	Algeria 8; West Germany 1.
Molybdenum:					
Ore and concentrate		—	209	—	Australia 146; United Kingdom 42; West Germany 21.
Metal including alloys, all forms:					
Semimanufactures		—	1	—	Mainly from Netherlands.
Nickel:					
Matte and speiss		8	7	—	Mainly from United Kingdom.
Metal including alloys:					
Unwrought		19	16	—	France 9; Belgium-Luxembourg 5; Zimbabwe 2.
Semimanufactures		316	254	(2)	West Germany 162; Italy 34; United Kingdom 15.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands	$3	$54	—	West Germany $49; Switzerland $3.
Rare-earth metals including alloys, all forms		—	35	—	West Germany 28; France 5.
Silver: Metal including alloys, unwrought and partly wrought	value, thousands	$135	$111	—	West Germany $49; France $37; Italy $8.
Tin: Metal including alloys:					
Scrap	do.	$7	$6	—	All from France.
Unwrought		138	171	—	Malaysia 70; Belgium-Luxembourg 30; Indonesia 25.
Semimanufactures		11	38	—	Belgium-Luxembourg 17; West Germany 8; France 5.
Titanium: Oxides		2,418	2,423	91	France 1,528; Belgium-Luxembourg 525.
Tungsten:					
Ore and concentrate		(3)	1	—	Mainly from France.
Metal including alloys:					
Unwrought	value, thousands	—	$2	—	All from France.
Semimanufactures	do.	—	$13	—	Netherlands $4; Austria $3; Italy $3.
Zinc:					
Oxides		628	1,633	—	France 1,276; Portugal 126; West Germany 116.
Metal including alloys:					
Unwrought		4,243	5,701	30	Algeria 3,160; Belgium-Luxembourg 1,193; France 703.
Semimanufactures		388	283	—	Belgium-Luxembourg 204; Italy 38; France 29.
Other:					
Ores and concentrates	value, thousands	$381	$2	—	Mainly from West Germany.
Oxides and hydroxides		168	243	25	France 80; West Germany 48; Netherlands 22.
Base metals including alloys, all forms	value, thousands	—	$3	—	All from France.

See footnotes at end of table.

TABLE 3—Continued

MOROCCO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	Sources, 1990	
				United States	Other (principal)
INDUSTRIAL MINERALS					
Abrasives, n.e.s.:					
Natural: Corundum, emery, pumice, etc.	value, thousands	$1,089	$1,836	—	Turkey $1,453; Greece $169; Italy $79.
Artificial: Corundum		506	424	—	France 328; Italy 78; Poland 18.
Dust and powder of precious and semiprecious stones excluding diamond	value, thousands	—	$5	—	All from Switzerland.
Grinding and polishing wheels and stones		466	466	1	Italy 272; France 82; Spain 31.
Asbestos, crude		3,944	7,157	—	Mozambique 3,650; Canada 3,138.
Boron materials:					
Crude natural borates	value, thousands	$2	$1	NA	NA.
Oxides and acids		20	45	—	France 27; West Germany 9; Netherlands 4.
Bromine[4]	value, thousands	$34	$15	—	West Germany $6; Chile $4; France $3.
Cement		58,741	167,697	—	Tunisia 106,648; France 25,722; Spain 18,566.
Chalk		551	435	—	Spain 258; France 150; Belgium-Luxembourg 24.
Clays, crude		21,824	26,146	53	France 14,884; United Kingdom 7,221; Spain 3,279.
Cryolite and chiolite		10	—		
Diatomite and other infusorial earth		416	697	—	Spain 430; France 214; West Germany 35.
Feldspar, fluorspar, related materials		651	837	—	Spain 432; France 354; Canada 40.
Fertilizer materials:					
Crude, n.e.s.		42	1,359	—	France 1,323; Italy 19.
Manufactured:					
Ammonia		467,478	469,832	25	U.S.S.R. 214,972; Trinidad and Tobago 107,811; Italy 58,915.
Nitrogenous		299,288	269,339	—	Belgium-Luxembourg 76,491; Poland 55,573; Bulgaria 33,108.
Phosphatic		19	29	—	All from Netherlands.
Potassic		67,686	87,225	—	Spain 28,080; France 15,547; Belgium-Luxembourg 14,930.
Unspecified and mixed		2,384	3,218	—	Austria 1,013; Spain 556; Belgium-Luxembourg 476.
Graphite, natural		36	36	—	France 28; Spain 5.
Gypsum and plaster		238	713	—	France 393; Algeria 300.
Lime		606	6	—	All from France.
Magnesium compounds, unspecified		207	185	—	Spain 91; Austria 90.
Mica:					
Crude including splittings and waste		10	2	—	Mainly from Norway.
Worked including agglomerated splittings		3	4	—	France 1; Netherlands 1; Spain 1.
Phosphates, crude		4	—		
Pigments, mineral: Iron oxides and hydroxides, processed		1,212	1,495	—	West Germany 542; Spain 381; United Kingdom 355.
Precious and semiprecious stones other than diamond:					
Natural	value, thousands	—	$3	—	All from France.
Synthetic	do.	$8	$195	—	France $176; Austria $14.
Pyrite, unroasted		—	3	—	All from Italy.
Salt and brine		19	42	—	France 29; West Germany 7; United Kingdom 3.

See footnotes at end of table.

TABLE 3—Continued

MOROCCO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	Sources, 1990	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sodium compounds, n.e.s.:					
Soda ash, manufactured		17,620	NA		
Sulfate, manufactured		7,662	10,647	—	Spain 10,069; West Germany 553.
Stone, sand and gravel:					
Dimension stone:					
Crude and partly worked		2,727	2,196	—	Italy 2,185.
Worked		5,156	7,205	—	Italy 4,755; Portugal 1,598; Spain 771.
Dolomite, chiefly refractory-grade		357	649	—	France 450; Netherlands 160; Spain 39.
Gravel and crushed rock		656	951	—	Belgium-Luxembourg 823; France 118.
Quartz and quartzite		670	855	—	Belgium-Luxembourg 685; Italy 149.
Sand other than metal-bearing		35,038	42,028	—	Belgium-Luxembourg 36,702; Portugal 2,600; Spain 2,519.
Sulfur:					
Elemental:					
Crude including native and byproduct	thousand tons	1,095	2,740	—	Saudi Arabia 860; Canada 846; Poland 586.
Colloidal, precipitated, sublimed	value, thousands	$10	$2	—	All from France.
Sulfuric acid		11,713	30	—	Spain 23; West Germany 3.
Talc, steatite, soapstone, pyrophyllite		1,482	1,566	—	France 1,295; Norway 124; Spain 80.
Other: Crude		18,053	20,829	—	France 16,231; West Germany 1,304; Gabon 1,240.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		25	26	—	France 25; West Germany 1.
Carbon black		5,200	6,744	9	Spain 2,660; Mexico 2,173; Portugal 835.
Coal: Anthracite and bituminous	thousand tons	1,278	1,189	682	United Kingdom 293; U.S.S.R. 134.
Coke and semicoke		31,262	28,705	—	Italy 28,689.
Peat including briquets and litter		7,436	6,600	—	West Germany 3,522; Netherlands 2,554; U.S.S.R. 521.
Petroleum:					
Crude	thousand 42-gallon barrels	42,113	44,108	—	United Arab Emirates 15,260; Iraq 11,703; U.S.S.R. 5,402.
Refinery products:					
Liquefied petroleum gas	do.	2,597	3,247	—	Algeria 1,250; Spain 744; France 647.
Gasoline	do.	59	61	(2)	Portugal 35; Spain 23.
Mineral jelly and wax	do.	80	129	(2)	China 56; Spain 33; West Germany 17.
Kerosene and jet fuel	do.	1	1	—	Mainly from Netherlands.
Distillate fuel oil	do.	39	184	—	West Germany 114; Belgium-Luxembourg 38; U.S.S.R. 32.
Lubricants	do.	51	48	(2)	France 22; Spain 8; Belgium-Luxembourg 4.
Residual fuel oil	do.	—	837	—	Italy 637; Portugal 200.
Bitumen and other residues	do.	(2)	(2)	—	Mainly from France.
Bituminous mixtures	do.	(2)	1	—	Do.
Petroleum coke	do.	(2)	—		

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

TABLE 4

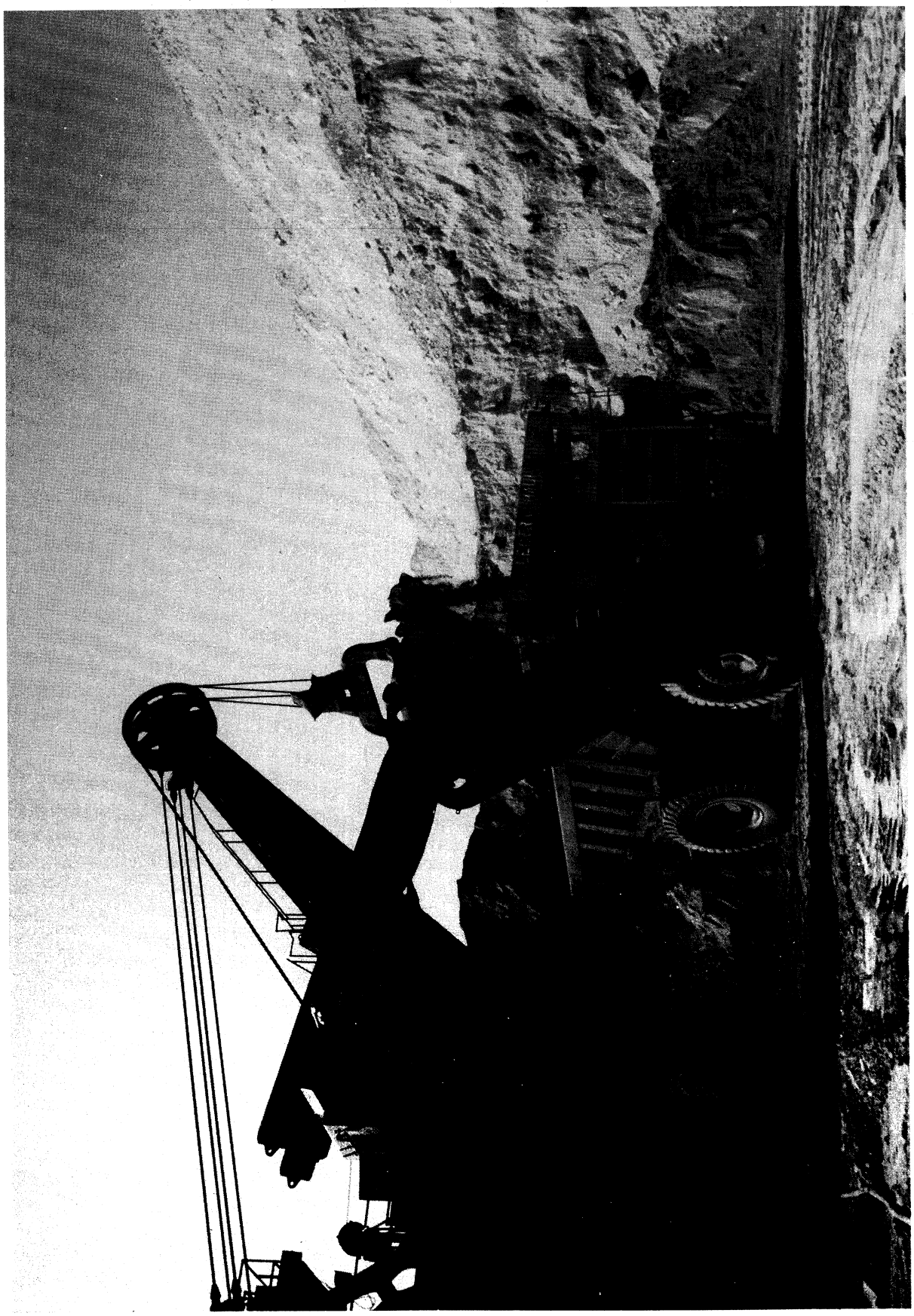
MOROCCO: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Metric tons 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) Société Minière Marocaine (SOMIMA) (75% BRPM) Société du Developpement du Cuivre de l'Anti-Atlas (SODECAT) (99% BRPM)	Bleida Quansimi Near Quansimi	50,000 concentrate. NA. NA.
Fluorspar	Société Anonyme de Entreprises Minières (SAMINE) (35% BRPM)	Near Khouribga	70,000 concentrate.
Lead	Compagnie Minière de Touissit (CMT) (50% Compagnie Royale Asturienne des Mines SA, Belgium) Société de Developpement Industrie et Minière (50% BRPM)	Touissit Zeida	73,000 concentrate. 40,000 concentrate.
Manganese	Société Anonyme Cherifienne d'Etudes Minières (SACEM) (43% BRPM)	Near Quarzazate	130,000 concentrate.
Phosphate	Office Cherifien des Phosphates (OCP) (100% Government ownership)	Khouribga and Youssoufia	25 concentrate.[1]
Silver	Société Metallurgique D'Imiter (SMI) (69% BRPM, 31% Omnium Nord Africain)	Near Quarzazate	73,000 ore.

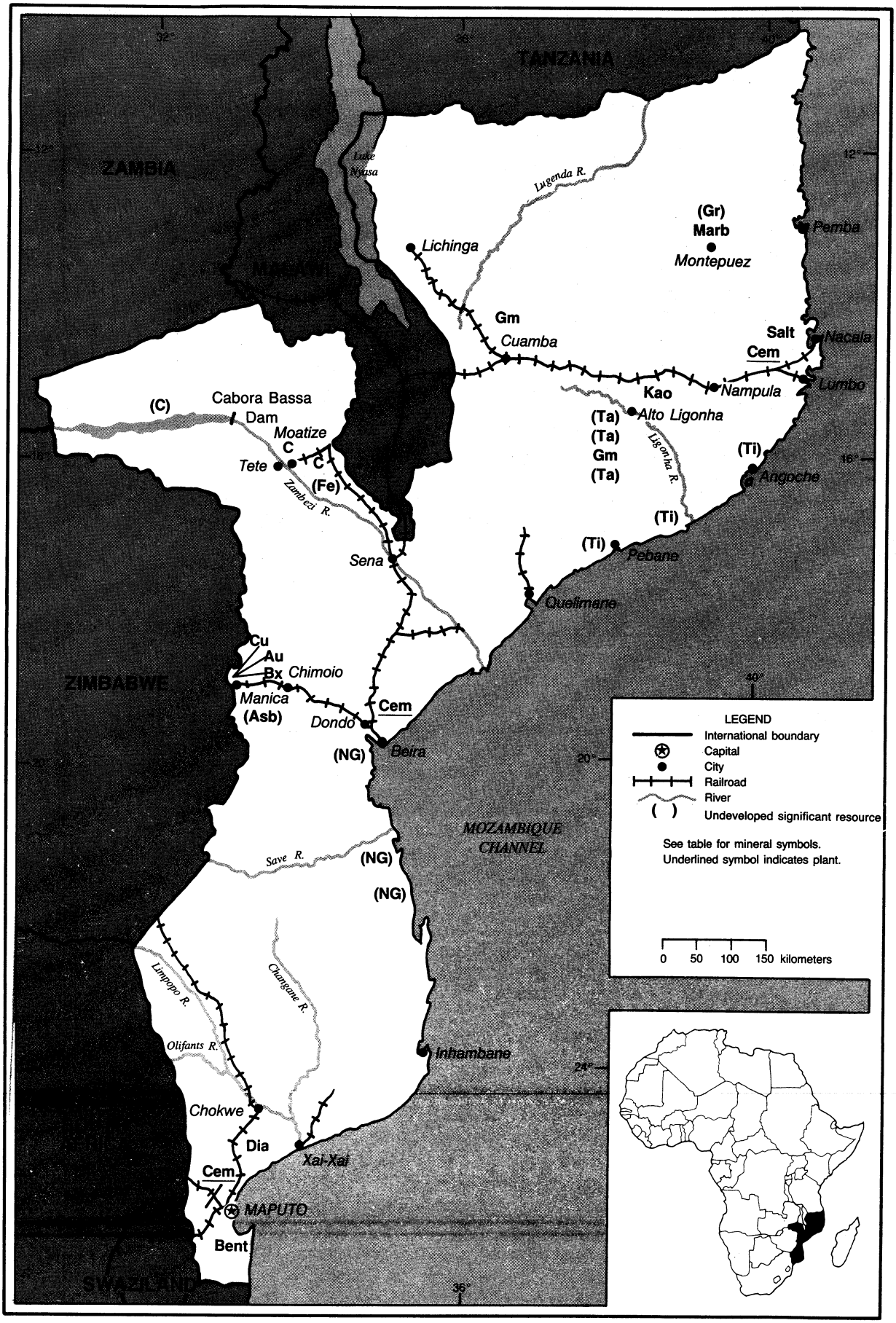
NA Not available.
[1]Million metric tons per year.

PHOSPHATE MINING AT KHOURIBGA, MOROCCO



MOZAMBIQUE

AREA 801,590 km² **POPULATION 15.1 million**



THE MINERAL INDUSTRY OF

MOZAMBIQUE

By Hendrik G. van Oss

Mozambique's mineral economy improved somewhat in 1991, largely owing to an increase in gold production. As in past years, mining was but a minor factor in the economy compared to the dominant agricultural sector. However, mining's relative importance was growing because farm revenues and output continued to be hurt by a number of factors. These included the ongoing drought, severe salt-contamination of soils in some prime agricultural areas, the continued displacement of large segments of the population by ongoing civil strife, and low world prices for agricultural products. Mozambique's ports and railways have traditionally been major components of the trade infrastructure of southern Africa. As in past years, significant revenues were earned in 1991 by Mozambique through the transshipment of goods, particularly mineral commodities, to and from the country's inland neighbors. This trade improved somewhat during the year owing to a decline in insurgent attacks on some of the major transportation corridors as a result of agreements signed at yearend 1990. Nevertheless, the ongoing insurgency continued to be a major drain on virtually all facets of the economy.

Mozambique's GDP reportedly grew less than 1% in 1991; reports of the value of the GDP ranged from about $1.3 to $1.5 billion.[1] Various accounts of Mozambique's mining revenues, at about $3 to $4 million, appear to have significantly undervalued the country's gold output, and, likely, that of coal and cut gemstones. Mozambique's reported gold output would alone have been worth about $4.6 million, and a more realistic value of total mineral output in 1991 is about $6.2 million. However, even this estimate does not include the value of cement, crude construction materials, and salt, production data for which are at best unreliable, but which may amount to an additional $3 to $4 million total. With the likely exception of cement, construction materials, and salt, most of Mozambique's mineral production was exported; this trade represented 3% to 4% of the country's total exports. Revenues from the transshipment of mineral commodities in 1991 are estimated at about $20 million, a modest increase over 1990 revenues owing to improved security conditions along two of the country's major transportation corridors.

Wages in the Mozambique mineral and mineral transshipment industry are estimated to have totaled about $5 million in 1991. Officially repatriated wages earned by Mozambique mine workers in the Republic of South Africa were reported to have been $55.3 million in 1991, but unofficial repatriation of wages from these workers likely totaled again as much. These wages supported an estimated 300,000 persons in Mozambique.

Imports of mineral commodities for domestic consumption appear to have declined slightly to an estimated $100 million to $110 million, or about 11% to 12% of total imports. Petroleum products accounted for almost all of the mineral imports. Electricity imports increased and were worth an estimated $15 million.

The geology of Mozambique is complex, and a wide variety of mineral deposits are found in the country. Many of the mineral deposits are associated with or derived from the Precambrian, mostly granitic, rocks that make up much of the northern one-half of the country. Complex pegmatites within this terrane, especially near Alto Ligonha, contain significant resources 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 gem tourmalines. Farther to the north, granitic gneisses host potentially important graphite deposits. Metasedimentary inliers to this crystalline terrane host some locally important metamorphic deposits, notably of marble and garnet. Adjoining the Zimbabwe border from about Tete to Manica is an area of Precambrian granitic rocks which, near Manica, contains a variety of metasedimentary inliers. A number of these host stratabound and vein gold deposits and some copper deposits. Lode and placer gold deposits have been mined in the past from this region, and currently one placer mine is operating there. Small bauxite deposits are also found in this area, including one that is currently being mined. Iron deposits in the area are not of economic grade. Precambrian gabbroic rocks found near Tete and Moatize host large low-grade iron-titanium deposits.

Near Tete, there is a 50- to 100-km-wide east-west strip of Permian rocks bounded by the Zimbabwe border on the west and south and by the Malawi border on the east. These rocks are of the Karoo System and contain major coal deposits, some of which are currently exploited.

Rimming the Precambrian terrane on the Indian Ocean coast are Tertiary and Quaternary clastic rocks and sediments. The latter host economically important concentrations of titaniferous minerals (ilmenite and rutile), zircon, and

monazite, derived from the granitic hinterland.

Most of the rest of the country is made up of Cretaceous and younger sedimentary rocks. These host a number of deposits of industrial minerals, especially clays and diatomite. In the coastal area near Beira are structural basins that are prospective for petroleum and natural gas. The basins are associated with normal faults related to the East African Rift system. The country's natural gas reserves are in this area.

GOVERNMENT POLICIES AND PROGRAMS

The Government continued its efforts to attract foreign investment in Mozambique's industrial sector, traditionally an underdeveloped component of the economy. Mining is seen as having exceptional potential for expansion, both through the rehabilitation of existing mines and through the development of new ones—most notably coal, natural gas, and titaniferous sands. Because mineral commodity transportation comprises much of the commerce for the country's railroads and major ports, rehabilitation of this transportation infrastructure is considered vital to the economic health of the country.

The current mining law of Mozambique is law No. 2/86 of April 16, 1986, as modified by the mining law regulations, Decree No. 13/87 of February 24, 1987. The mining law provides for the formation of either wholly foreign-owned mining companies or joint ventures with the Government. Fiscal incentives in the law include a set 50% tax on profits and the right to repatriation of profits after tax. Also included are exemptions from import duties on mining equipment and from export duties on minerals, and accelerated depreciation of capital investments. Royalties range from 3% to 10% of gross revenues, depending on the mineral(s) produced. Petroleum and natural gas exploration and exploitation are governed by law No. 3/81 of October 3, 1981. Negotiations for hydrocarbon exploration leases are handled by the parastatal Empresa Nacional de Hidrocarbonetos de Moçambique (ENH).

PRODUCTION

The production of most mineral commodities continued to be affected by equipment and power problems, as well as by civil strife. Coal mining was on a caretaker basis only, with the salable material being derived from washed stocks. The railroad to the coal mines remained closed owing to security problems, and shipments from the mine were by truck, at great expense. Cement production appears to have fallen significantly, owing to security-related problems supplying the plants with local limestone and cash shortages preventing the importation of clinker. Gold production increased significantly, reflecting the first full year of operation for the country's sole formal mine, albeit at below expected levels.

Mozambique reported a small output of tantalum minerals in 1991, the first production recorded since 1986 when the mines, near Alto Ligonha, were closed for security reasons. Although the Government secured the area in 1988, both of the tantalum mines that had been in operation in 1986 were found to have been severely damaged and in need of extensive rehabilitation. Foreign investors for these properties were being sought. It was not clear which mine(s) had resumed production in 1991 or whether the tantalum minerals were merely produced from stockpiles. Data on gemstone production are likely incomplete, but no increase in production was reported. This was despite a significant number of gemstone prospecting and exploitation licenses reportedly having been issued in 1990. However, a small output of dumortierite was reported, the first production recorded in many years.

The country's sole copper mine ceased mining in 1990 but did produce that year a small quantity of copper concentrates from stockpiled ore. No such production was recorded in 1991. Marble production continued to be at a reduced rate owing to ongoing rehabilitation of the workings near Montepuez. *(See table 1.)*

TRADE

Mozambique's total exports increased 28% to $162.3 million in 1991, largely as a result of improved security conditions along some of the major railroad corridors and progress with the rehabilitation of the ports. Not counting transshipments, exports of mineral commodities tripled to about $6 million; most of this increase was due to gold.

Revenues from mineral transshipments were estimated to have amounted to $20 million, including about $10 million from pipeline transport fees for petroleum products shipped to Zimbabwe. The bulk of the remainder was for copper shipments from Zambia and coal shipments from the Republic of South Africa and Swaziland.

Petroleum product imports for domestic consumption fell about 10% to 2.3 Mbbl, worth about $100 million. Foreign assistance made possible most of these imports, which were from the open market on a tender basis. Mozambique's electricity imports, all from the Republic of South Africa, increased 17% to 383.3 GW • h, worth about $15 million. Clinker imports are estimated to have fallen significantly to only $1 to $2 million, owing to a lack of funds for larger purchases. Coal imports, for the powerplant at Maputo, likely amounted to about $1 million. Mozambique's total imports for the year amounted to about $900 million, an increase of about 3%.

STRUCTURE OF THE MINERAL INDUSTRY

The mining industry of Mozambique is underdeveloped with, in general, commodities produced by single operations only. With the exception of the bauxite and gold mines and most of the salt operations, all mineral commodity production was controlled by the Government, through the Empresa Nacional de Minas. *(See table 2.)*

Mineral exploration in Mozambique included that for coal, diatomite, gemstones, gold, graphite, and titaniferous sands. Because of ongoing civil disorder, all exploration work was conducted in the accompaniment of Government troops.

Current data are unavailable on the mining component of the Mozambique labor force. It is estimated that in 1991 about 6,000 workers were employed in the mining or related value added industries. It is estimated that about one-third of the country's railroad and port employees, or about 10,000 workers, were involved in the transportation of mineral commodities. None of these estimates includes security personnel; these can number several hundred for each of the larger operations. It is estimated that wages in the domestic mining and related transportation sectors totaled about $5 million in 1991.

Approximately 43,000 Mozambique miners were employed by gold and coal mines in the Republic of South Africa. It is estimated that approximately $100 million in wages earned by these mine workers was repatriated, about 55% through official intergovernment channels.

COMMODITY REVIEW

Metals

Gold.—In October 1990, Lonrho Plc began production at its placer gold mine on the Chua River about 14 km northeast of Manica. In its first 12 months of operation, the mine produced 385 kg of gold, and output for 1991 totaled 393.72 kg. This performance, reflecting some minor technical problems, was slightly below the 35 kg/month predicted for the year. The company was exploring a lode gold property in the region but had announced no results as of yearend.

The Government viewed with concern the growing number of artisanal gold miners, particularly in the Manica area. In order to realize tax revenues from this activity, the Government was exploring various licensing options for these workers. No data were available on the number of artisanal miners or their output.

Titanium.—In late 1990, Kenmare Resources Plc suffered a setback in its efforts to finalize a joint-venture agreement with a South African company for the development of the Congolone titaniferous sands deposit, about 190 km southwest of Nacala, near Angoche. However, the company was reported to have later signed a joint-venture agreement with Sumitomo of Japan for this purpose. The approximately $100 million project, forecast to be in production in 1993 at the earliest, is expected to have an annual output of about 421,000 mt/a of ilmenite, 37,500 mt/a of zircon, about 8,100 mt/a of rutile, and about 1,000 mt/a of monazite.

In 1990, Edlow Resources Ltd. of the United States completed its exploration and prefeasibility work on the Pebane titaniferous sands concession, which covers about 200 km of coastline stretching northeast from a point about 75 km southwest of the town of Pebane. Armed with the favorable feasibility study, the company spent 1991 negotiating a joint-venture agreement with a major international mining company and with the Government. These negotiations were ongoing at yearend.

Industrial Minerals

Gemstones.—Toward yearend, the parastatal gemstone mining and cutting company Gemas e Pedras Lapidadas E.E. (GPL) signed a joint-venture agreement with an Israeli company to reopen an emerald mine in the Gilé District about 70 km south of Alto Ligonha. The mine had shut down in 1986 for security reasons. Mining was expected to resume in early 1992. The Israeli partner will also be allowed to purchase and export gemstones.

In 1990, GPL signed a joint-venture agreement with Hong Kong Gem Exchange Ltd. to operate the Cuamba garnet mine. Problems with the operation, however, led both to a significant decline in production in 1991 and the withdrawal of the Hong Kong company from the venture. GPL was negotiating with another company to assume management of the mine, and hoped to sign a new joint-venture agreement in early 1992.

Graphite.—Kenmare Graphite Co. Ltd., owned by Kenmare Resources Plc of Ireland, 70%, and the Government, 30%, received a mining license for the company's Ancuabe graphite deposit, 120 km west of Pemba. The deposit is in Precambrian graphitic gneisses and overlying residuum and is believed to have the potential to support a production level of 20,000 mt/a of flake graphite. The company completed its feasibility study of the project late in 1991 and, at yearend, was raising finance for the operation, which was expected to begin pilot-scale operations in mid-1993.

Mineral Fuels

Coal.—Although somewhat improved from that of 1990, coal production at Moatize was again well below capacity, being essentially on a caretaker status. The operation continued to be plagued by security problems, power outages, and equipment breakdowns. Coal shipments from the mine were sent to Malawi by truck, owing to the continued security-related closure of the Sena railroad line.

The Government, along with Brazil's Companhia Vale do Rio Doce (CVRD), Lonrho, and Trans Natal Corp. of the Republic of South Africa, formed an informal joint venture to promote the large-scale development of the coal resources of the Moatize area. The venture was to seek approximately $40 million, and possibly an operational partner, to undertake a full feasibility study. During the year, CVRD completed a prefeasibility study establishing reserves adequate to support a long-term output of 22 Mmt/a (9 Mmt/a salable). Several ore shipping options were explored, and the study confirmed that extensive new railing and port coal-loading infrastructure would be required to support open pit coal mining on such a scale.

Oil and Gas.—No new petroleum exploration took place in 1991. The Government was preparing to offer previously unreleased data covering the central and southern part of the country to attract exploration interest.

In September, the Government signed an agreement with the Norwegian Government to build a small powerplant to use natural gas from the Pande Field, about 170 km south of Beira. The 135-kW plant was due for completion in mid-1992 and would supply electricity to the nearby towns of Vilankulos and Inhassoro.

The Government was negotiating with a group of South African companies to build a 900-km gas pipeline from Pande to the Republic of South Africa.

Reserves

Mozambique is a mineralogically diverse country; deposits that are or have been exploited include asbestos, various clays, coal, copper, fluorspar, gemstones, gold, graphite, marble, rare earths, and tantalum. Reserve data are unavailable for most of these commodities, although an upsurge in mineral exploration since 1986 will likely improve this picture.

Mozambique's coal reserves are mostly in the Tete area and are known to be large. Exploitation to date has been confined to Moatize, where proven reserves, according to various Government publications, amount to several hundred million tons. The Government estimates, however, that the true exploitable resources of the Moatize and similar sedimentary basins in the region amount to at least 2 billion tons. The reserve potential of the region has attracted a great deal of attention from international coal companies in recent years.

Mozambique's total resources of titaniferous sands have yet to be established, but are believed to be large. This 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 recoverable heavy-mineral concentrate grades 77.35% ilmenite, 6.88% zircon, 1.66% rutile, 0.24% monazite, and 13.87% gangue minerals—mostly magnetite, kyanite, and sillimanite. Preliminary reserves for Edlow's Pebane concession, based on prefeasibility work completed in 1990, were about 250 Mmt grading 5% heavy minerals. The heavy-mineral concentrate grades 74% ilmenite, 2.7% rutile, 5.15% zircon, and has trace amounts of monazite; gangue minerals amount to about 17%.

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 in the Pande Field of 40 billion m^3 and hopes to prove much higher reserves.

Numerous gold occurrences are known in Mozambique, notably in the Alto Ligonha and Tete regions and, especially, in the Manica area. In the past, small lode and placer mines have operated in the country, but exploration in recent decades has been very limited, and little drilling has been done. Lonrho's gold reserves at its Chua River placer deposit had not been announced at yearend 1991.

Reserves of pegmatitic minerals such as beryl, columbite-tantalite, rare earths, spodumene, and tourmaline are difficult to determine. Few of Mozambique's numerous known occurrences of these, including placer deposits, have been explored in detail. In recent years, only the Muiane, Marropino, and Morrua pegmatites have been mined, and these chiefly for tantalum minerals. Current reserve data are unavailable for these three mines, the workings of which require extensive rehabilitation. Based on Government-supplied pre-1986 tantalum mineral production capacity data for the Muiane, Morrua, and Marropino deposits, it can be estimated that a 10-year reserve for these would total 1,000 to 1,500 tons of combined microlite and tantalite.

Mozambique has significant graphite resources, some of which were mined in the past. Most of the known occurrences are near Tete or in the northeast part of the country. According to the Government, graphite ore reserves, grading approximately 6% to 10% graphite, much of it coarse flake, exceed 10 Mmt. However, recent exploration for graphite in northeast Mozambique by Kenmare Resources has reportedly delineated resources of approximately 15 Mmt of ore grading about 2% to 5% carbon.

INFRASTRUCTURE

Mozambique has 3,288 km of railroads, of which 3,140 km are 1.067-m gauge and the remainder 0.762-m narrow gauge. The bulk of the country's railroads are in six routes or "corridors." These routes are, from north to south, the Nacala Corridor, linking Nacala to Malawi (300 km); the Sena Corridor, linking Beira, via Dondo, to the coalfields at Moatize (513 km) and to Malawi (370 km); the Beira Corridor, linking Beira to Zimbabwe (315 km); the Limpopo Corridor, linking Maputo with Zimbabwe (534 km); the Ressano Garcia line, linking Maputo to the Republic of South Africa (88 km); and the Goba line, linking Maputo to Swaziland (68 km).

Rehabilitation work was largely completed during the year on the Beira Corridor, largely owing to a cease-fire agreement for the Corridor negotiated at yearend 1990. It was reported that travel time from the Zimbabwe border to Beira in February had been reduced to 13 hours from 4 days. The Government reserves management for the section of the railroad from the Zimbabwe border to Gondola, 179 km inland from Beira; this section had been managed for several years by National Railways of Zimbabwe.

The yearend 1990 cease-fire agreement had also covered the Limpopo Corridor, but the line continued to come under attack, if less frequently, during much of 1991. Another cease-fire agreement was signed in October 1991 which, it was hoped, would be honored. Rehabilitation and limited freight use of the Limpopo

Corridor railroad was ongoing throughout the year, and it was anticipated that the work would be completed by early 1992. Rehabilitation work continued on the Nacala Corridor, despite the occasional attack on the line. Trains were reported to have been making two trips per month to Malawi and four trips per week between Nacala and Nampula. The Ressano Garcia and Goba Corridors continued to be affected by security problems, but remained operational. The Sena Corridor continued to be inoperative.

Maputo-Matola and Beira are the country's main ore ports. Maputo-Matola handled 2.9 Mmt in 1990, the latest year for which data were available; this was a decline over the previous year's performance. The port complex suffered from management problems and unacceptable levels of pilferage. The Government was reportedly considering privatizing the port to alleviate these problems. Beira handled about 2.39 Mmt in 1991, down from 2.7 Mmt in 1990. Steel and asbestos exports through Beira reportedly declined for the year owing to being routed to Maputo (Limpopo Corridor). Zambian copper exports in 1991 through Beira were reported to have been only 28,100 tons for the year through September, well below the agreed upon 12,000 mt/month. On the other hand, fuel imports through Beira for the period were up 2.2% to approximately 4.6 Mbbl.

In 1991, Mozambique's installed electrical generating capacity remained unchanged at 2,323 MW, of which 2,040 MW was accounted for by the Cabora Bassa hydroelectric plant. Sabotage of the main power line pylons continued to prevent any export of Cabora Bassa electricity to the Republic of South Africa. Data on electrical generation were not available for 1991; however, Cabora Bassa generated only 94.4 GW•h in 1990, for consumption by the cities of Tete, Quelimane, and Nampula. Mozambique's other hydroelectric plants, all comparatively small, generated a total of 153 GW•h in 1990, and thermal plant output totaled about 168 GW•h. Given the drought conditions during 1991 and a reported 19% increase in electricity imports, it is likely that Mozambique's electrical output for the year declined.

OUTLOOK

A number of international mining and petroleum companies have expressed interest in Mozambique's mineral potential. However, significant rehabilitation and development of Mozambique's mining sector, and virtually all other facets of the economy, is almost completely dependent on the termination of the ongoing civil strife.

Under the present security conditions, the most likely mineral production developments will be for Mozambique to become a significant producer of titanium minerals and a modest producer of gold and, possibly, graphite. Gemstone production could also increase significantly. In the intermediate term, but requiring a resolution of security concerns, coal production will likely return to levels approaching the installed capacity of the mines. Cement production could increase dramatically once the plants regained access to local limestone for the manufacture of clinker. Tantalum production may also resume if interest can be generated in rehabilitating the existing workings. The most significant long-term mineral development should be the development of large open pit coal mines and the necessary transportation infrastructure for large-scale coal exports. The sources of funding for this project, particularly for the necessary railroad, are uncertain. Another long-term development would be large-scale exploitation of the country's natural gas resources.

Given the significant impact of the repatriated wages from Mozambique mine workers employed in the Republic of South Africa, the prospect of mine closures and massive layoffs, particularly in the gold sector, in that country is not encouraging.

[1]Where necessary, values have been converted from Mozambique meticais (M) to U.S. dollars at the rate of M1,434.50=US$1.00.

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]		1987	1988	1989	1990	1991
Bauxite		5,114	6,548	5,501	7,186	7,690
Cement, hydraulic	thousand tons	r120	69	r75	r79	e30
Clays:						
Bentonite		936	986	126	—	682
Coal, bituminous		43,319	23,856	62,010	40,411	50,832
Copper:						
Ore, gross weight[e]		11,200	10,300	6,500	[3]—	—
Concentrate:						
Gross weight		719	660	420	[3]133	—
Cu content[e]		151	139	88	28	—
Gemstone:						
Cut stones, all types	carats	36,341	26,552	19,766	13,385	12,906
Aquamarine	grams	—	—	—	[4]NA	[4]NA
Beryl, morganite	do.	—	—	913	[4]NA	[4]NA
Emerald	do.	—	—	36	[4]NA	[4]NA
Dumortierite		—	—	—	—	73
Garnet[5]	kilograms	e1,201	2,026	1,966	2,558	1,281
Tourmaline	grams	—	—	966	[4]—	[4]—
Gold	kilograms	—	—	—	63	394
Marble	cubic meters	1,140	940	687	488	279
Salt, marine[e]		30,000	37,500	40,000	40,000	40,000

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

[1]Data available through Aug. 31, 1992.

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

[4]Production of gem beryls (aquamarine, emerald, morganite) was reported as not available, and that of tourmaline as nil. Although reported production of cut stones could have been from stockpiles, it is surmised that some of these stones were indeed mined in 1990-91. Information is inadequate to make reliable estimates of output levels.

[5]Facet-grade. In addition, there was waste garnet production, in kilograms, as follows: 1987—12,039; 1988—15,834; 1989—8,211; 1990—4,786; 1991—NA.

TABLE 2

MOZAMBIQUE: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity ownership	Location	Annual capacity
Bauxite	E.C. Meikle Plc of Zimbabwe	Open pit mine just west of Manica	e10,000 bauxite.
Cement	Cementos de Moçambique (Government, 100%)	Cement plant at Dondo	[1] e75,000 cement.
Do.	do.	Cement plant at Matola	[1] e100,000 cement.
Do.	do.	Cement plant at Nacala	[1] e50,000 cement.
Clays:			
Bentonite	Empresa Nacional de Minas (Government, 100%)	Luzinda deposit, 35 kilometers southeast of Maputo	e6,000.
Kaolin	do.	Boa Esperanca Mine, Ribáuè District, 120 kilometers west of Nampula	e300.
Coal	Empresa Nacional de Carvão de Moçambique (Government, 100%)	Underground mines near Moatize	100,000 bituminous coal.
Copper[2]	Empresa Nacional de Minas (Government, 100%)	Mundonguara Mine, 18 kilometers west of Manica	e500 copper concentrates grading about 21% copper.
Gemstones	do.	Several small-scale lode and placer operations near Alto Ligonha (beryl, tourmaline) and Cuamba (garnet)	NA.
Gold kilograms	Aluviões da Manica Lda. (Lonrho Plc, United Kingdom, 80%; Government, 20%)	Placer operation near Manica	e1,200 bullion.
Marble cubic meters	Empresa Nacional de Minas (Government, 100%)	Quarry 5 kilometers north of Montepuez	e2,500 blocks.
Salt	Numerous operations (mostly private)	Small seawater evaporation operations near most coastal cities	e40,000.

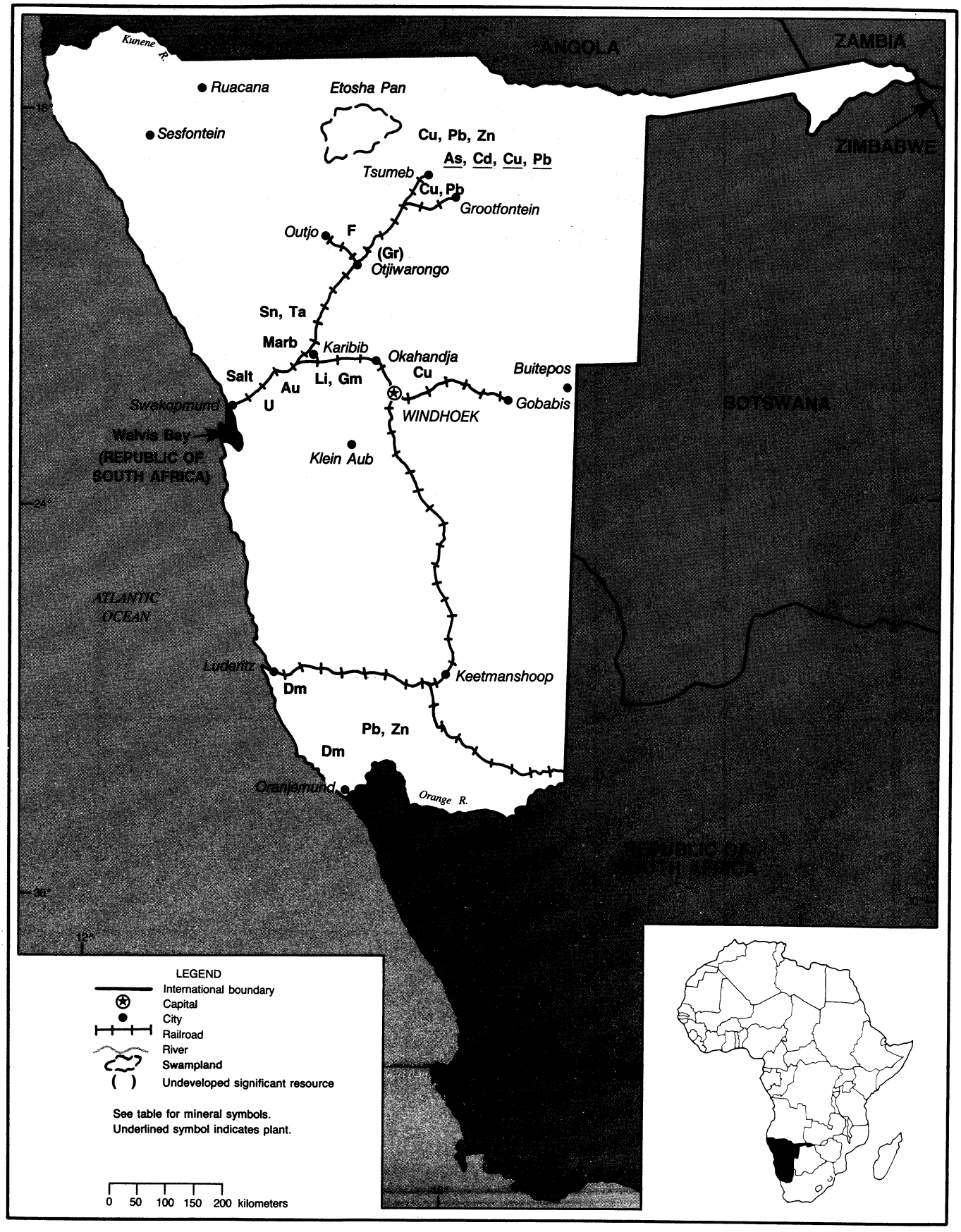
eEstimated. NA Not available.

[1]Reportedly, only Nacala plant was in operation in 1991; the others were closed due to lack of funds to import clinker.

[2]Production of concentrate in 1990 was from stockpiled ore; there was no mining.

NAMIBIA

AREA 823,000 km² **POPULATION 1.5 million**



THE MINERAL INDUSTRY OF

NAMIBIA

By Michael M. Heydari

The mineral sector was negatively affected in 1991 by, among other reasons, a major cutback at Rossing Uranium Ltd.'s operation due to an oversupply of uranium on world markets. Namibia produced about 30 different minerals, the most important, in order of value, being diamond, uranium, copper, silver, lead, zinc, gold, pyrite, and salt. Among major commodities, only diamond had substantially higher output and sales compared to those of 1990. The rest of the mining industry recorded a 20% decline in total sales value, attributable mainly to the cutback in uranium production and sales.

The mining industry accounted for about 29% of the GDP—surpassing all other sectors in relative share of the GDP—and about three-quarters of foreign exchange earnings. 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.

Northwestern Namibia continued to be the focus of new exploration activities in 1991. In the central zone west of Okahandja, 72 km north of Windhoek, prospecting for precious and base metal occurrences continued throughout the year, specially in the vicinity of the Navachab gold mine. Likewise, base metal exploration continued along the mineralized Matchless Belt, a geologic formation extending east and west of Windhoek. In contrast, relatively little base metal exploration took place in the southern part of the country. Consolidated Diamond Mines (CDM) and its associated companies continued to prospect for diamond both inland and in deep water off the southwestern coast of Namibia, in the vicinity of Oranjemund.

GOVERNMENT POLICIES AND PROGRAMS

During 1991 the Government issued important mining-related draft legislation for comment and discussion. These included the Mines and Minerals (Prospecting and Mining) bill and the Labor bill. The new Mines and Minerals Act was due to be approved in the first half of 1992 by the National Assembly. The act provides for a standard licensing regime with special provisions to encourage small-scale mining. 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. However, the Government stresses that overall taxation levels should not be increased since the taxes are lowered to compensate for the royalty payments. The new legislation has not stipulated compulsory state participation in mining ventures, although the Government may seek a minority equity interest in new projects.

Marketing of minerals will continue to be largely left to the private sector, although talks now underway with the Central Selling Organization (CSO), the De Beers Centenary AG's marketing and distribution arm, may involve modifications to the exclusive 5-year diamond marketing contract that expired at the end of 1991.

A number of new laws have been passed by the National Assembly since independence to regulate the development of the energy sector. Among these are the Petroleum Products and Energy Act of 1990, the Petroleum Exploration and Production Act of 1991, and the Petroleum Taxation Act of 1991.

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. are also part of the ministry. Four main directorates in the ministry were the Geological Survey, Mining, Energy, and Administration and Finance.

Namibia's inflation rate stood at 18.1% in December 1991, according to figures released by the Central Statistics Office in Windhoek. In July, the Government raised the general sales tax rate from 10% to 11%.

PRODUCTION

The diamond sector of mining industry was, by far, the best performer with record production of 1.2 million carats compared with 0.76 million carats in 1990. The reason for the increase was the startup of two new production sites and expansion of existing production centers. CDM, a subsidiary of De Beers Centenary AG, the Swiss-based company

that holds the non-South African interests of De Beers group, started new mines at Auchas on the Orange River and Elizabeth Bay near Luderitz and had significantly higher production from existing operations.

Output of the minerals sector was negatively affected by a series of cutbacks at the Rossing uranium mine, resulting in retrenchment or early retirement of 750 employees and a drop in production of uranium oxide from an estimated 4,100 mt/a in early 1991 to 2,500 mt/a at yearend. Lead and zinc production declined from their 1990 level. After the closure of the sole tin producer, the Uis Mine, in 1990, tin production dropped to an estimated 100 tons from small operations in 1991.

Gold Fields Namibia Ltd.'s Tsumeb Corp. operated mines at Tsumeb and Kombat and a copper and lead smelter at Tsumeb. Tsumeb Corp. also managed the Otjihase Mine, in which it had 70% joint-venture interest. Tsumeb Corp.'s mines had difficulties in achieving its production potential with lower-than-required equipment availability, poor ground conditions, and large volumes of underground water. Copper production was above that of the previous year but lead continued to decline. Gold Fields exploration expenditure during 1991 was $2.1 million and was applied to the search for base metals and in particular copper.[1] Exploration for tin was phased out in 1990 and ceased totally during 1991.

Namibia Lithium Mines (Pty.) Ltd. reduced production levels at the Rubicon-Helikon Mines near Karibib in western Namibia. The company had been losing money in recent years owing to lower sales and competition from Zimbabwean operations.

Exploration for, and the exploitation of, dimension stone increased during 1991. Ten quarries, between Swakopmund and Karibib and south of Aus, produced dimension stone on a day-to-day or demand-and-supply basis.

The Mineworkers Union of Namibia (MUN) continued to press for increased membership at the country's major mines. As a result, one additional Chamber member mine signed a recognition agreement with MUN. In 1991, labor strike actions were limited to a partial work stoppage of one shift duration on one mine. *(See table 1.)*

TRADE

Namibia's main trading partners, in order of importance, included the Republic of South Africa, the Federal Republic of 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.

Six companies provided the bulk of fuels and lubricants to Namibia through imports, there being no domestic refinery. All liquefied petroleum gas and bitumen were imported from the Republic of South Africa by railroad or truck transport. No bulk handling facilities exist at Walvis Bay or Luderitz. Prices of gas, diesel, and paraffin were Government controlled. In July 1991, the gasoline price increased from R1.28/L ($1.76/gallon) to R1.43/L ($1.96/gallon).

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 of the Namibian mining companies can be considered significant by world standards, CDM and Rossing Uranium Ltd. Together these account for 75% of the production value of the mining sector. CDM ranks sixth in terms of production volume of near-gem and gem diamond worldwide. Rossing ranks fifth in Western World uranium production with a share of just less than 10%.

The six other large Namibian operations are all metal mines, of which four are base metal properties. The six are Tsumeb Mine, Kombat Mine, Otjihase Mine, Rosh Pinah Mine, Navachab gold mine, and the now closed Uis tin mine. 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 30 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, they extract nonmetallic minerals.

During 1991, prospecting expenditure by Chamber of Mines members in Namibia amounted to about $14.5 million compared with $26 million in 1990.

The drafting of the new Minerals (Prospecting and Mining) Act, which is expected to be promulgated in 1992, caused delay in the awarding of prospecting grants. The number of new prospecting grants awarded declined from 34 in 1990 to 9 in 1991. The Ministry of Mines and Energy issued 303 new prospecting licenses, up 103 from those of the previous year. New claims registered dropped from 903 in 1990 to 674 in 1991.

The Chamber of Mines of Namibia reported that the total number of employees at its 34 member mines, as of December 31, 1991, was 12,265, down from 13,605 in 1990. The cash remuneration paid totaled $140 million in 1991 compared with $135 million in 1990. In 1991, 2 persons died and 41 were injured as a result of accidents in Chamber of Mines member operations. The fatality and reportable injury rates were 0.16 and 3.34 per 1,000 employees, respectively. The corresponding figures for 1990 were 0.07 and 3.53.

The improvement of safety performance remained a top priority for Namibian mines. While the smallest mines conducted their own safety programs, all others except Tsumeb Corp. continued to participate in the

industrial safety programs of the National Occupational Safety Association (NOSA). In 1991, three mines maintained their NOSA five-star status while a new mine was awarded four stars. At yearend, CDM had achieved an industry record of 11,118,995 fatality-free employee-shifts, with Rossing uranium mine following with 8,344,786. Rosh Pinah Mine, in the small mines category, had accumulated 10,381,971 fatality-free employee-hours by the end of the year. *(See table 2.)*

COMMODITY REVIEW

Metals

Arsenic.—Tsumeb smelter-refinery in northern Namibia, with a capacity of 2,500 mt/a, produced about 1,800 mt/a of 99%-pure arsenic trioxide in 1991. All of production is exported in drums to end users, including U.S. customers.

Copper.—The South African-based Revere Resources plans to develop the Haib copper deposit, 7 km north of the Orange River in southern Namibia. A sizable capital outlay has been spent on drilling, metallurgical test work, and engineering studies. The Haib area contains a resource base of 600 Mmt grading 0.3% copper, with a further 900 Mmt averaging 0.1%. The first stage of development will comprise the establishment of an oxide mining and leaching operation, scheduled to come on-stream by the end of 1992 for the production of about 1,800 mt/a copper, the planned output later rising to 5,400 mt/a. The company is aiming for low-cost production, using in-pit crushing and the latest heap—leaching plus solvent extraction-electrowinning processes. Estimated recovery costs are less than $0.55/lb.

Tsumeb Corp.'s operations had a mixed performance during 1991. Ores mined at the Tsumeb Mine were 16% below those of 1990 as a result of lower production from both the upper and lower levels of the mine and no mining taking place at Tsumeb West. Ore production at Kombat Mine was 13% higher when compared with that of the previous year. Otjihase Mine continued to perform below potential even though ore production exceeded that of 1990 by 3%.

Tsumeb Corp.'s Tschudi Mine, 32 km west of Tsumeb, is scheduled to come on-stream by the end of 1992. The 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 scheduled to be all but depleted within 2 years.

Gold.—Results from the Navachab gold mine near Karibib, Namibia's only primary gold producer, continued to improve satisfactorily. During 1991, 880,700 tons of ore was treated, producing 1,709 kg of gold from a plant head grade of 2.24 g/mt. This compared with 1,453 kg at 2.1 g/mt in 1990, the year Navachab came on-stream. In spite of the weak gold price, the mine operated at a significant profit. Total revenue for 1991 was about $22 million. Prior to 1990, Namibia's gold production was from the Tsumeb smelter.

Uranium.—The world uranium market deteriorated further in 1991, and the impact was felt by Rossing Uranium Ltd., Namibia's only producer. The spot uranium price began the year at $9.10/lb and fluctuated down to a low of $7.25/lb in October before ending the year at $8.75/lb. Rossing twice reduced its production level during 1991, from 4,100 mt/a to a 3,250-mt/a level in April and then to a 2,500-mt/a level in September. Its total production for the year was 3,185 tons compared with a capacity of 5,100 mt/a. The second cutback was accompanied by the retrenchment or early retirement of approximately 750 employees, bringing the company's labor force down to approximately 1,500. In early 1992, all Rossing's production was supported by long-term sales contracts, and no further step reductions in production or workers are anticipated.

The Government of Iran owned 10% of the shares in Rossing's Uranium Ltd. Iran's interest in Rossing, which reportedly entitled it to 175 mt/a of uranium oxide, was set up by Iran in the 1970's.

The Rio Tinto Zinc Corp. (RTZ), Rossing's major shareholder with 46.5% ownership, planned to establish a major exploration group independent of Rossing, Rio Tinto Namibia (Pty) Ltd., for mineral exploration in southern Africa.

Zinc.—The process for recovery of zinc concentrate at Rosh Pinah Mine has been improved to reclaim 0.32% zinc metal that was formerly lost to the slime's dams. This has resulted in an annual additional income of $1.7 million for the operation. Zinc production in Namibia, in the form of metal contained in concentrate, declined from about 40,850 tons in 1990 to 33,150 tons in 1991.

Industrial Minerals

Diamond.—Nineteen ninety-one was CDM's best production year since 1981. Total production was about 1.2 million carats compared with 0.76 million carats in 1990. The increase in production was due to contributions by new mines at Auchas on the Orange River and Elizabeth Bay near Luderitz, progress by the new marine operations (14% of total 1991 production), and significantly improved results from traditional land areas. Diamond sales for the second half of 1991 were up 21%, in rand terms, on the corresponding 1990 period.

CDM's Elizabeth Bay diamond mine, 25 km south of Luderitz, was officially opened early in August. A conventional opencast operation, the Elizabeth Bay Mine was brought into production at a capital cost of $50 million. The mine, at full production, will treat 4.1 Mmt/a of ore to yield about 250,000 carats of predominantly gem-quality diamond. During the expected 10-year life of the mine, an estimated 2.5 million carats will be recovered from 38 Mmt of ore.

With onshore diamond mining likely to be exhausted by the end of the century, CDM is turning its attention increasingly to offshore and deepsea mining.

Graphite.—Rossing Uranium Ltd. has diversified beyond uranium by opening a high-tech graphite mine at Okanjande, near Otjiwarongo, about 250 km north of Windhoek in north-central Namibia, where a $1 million, 2-mt/hr pilot plant has been built by Van Eck & Lurie (Pty.) Ltd. The pilot plant will assist Rossing in evaluating the graphite deposit, which extends from the surface to a depth of 70 m. The plant consists of crushing, screening, milling, flotation, and filtration modules followed by a drying, screening, and bagging plant. The ore reserve is estimated at 36 Mmt, with an average carbon content of 4.3%.

Mineral Fuels

There was no domestic output of crude petroleum or natural gas. The Oriental Petroleum Investment Corp. of Taiwan's Etosha concession northwest of Tsumeb produced only dry holes. As a result, the corporation gave up the search for oil in northern Namibia. This left Britlund Ltd., the American-owned company—Atlanta-based but Lichtenshtein-registered—that holds the concession, without an operating partner.

As a key policy instrument concerning energy, the Government has formulated the "Model Petroleum Agreement" to be used as a basis for negotiations with companies that have applied for oil and gas exploration licenses. It provides a broad framework for oil exploration and drilling programs, dealing with contractual issues such as the minimum exploration and drilling work that a company must carry out, expenditure obligations, submission of periodic reports, and other biddable elements that go into such complex negotiations.

The Government granted the first licenses for offshore oil exploration and production to three Norwegian companies—Norsk Hydro, Saga Petroleum, and the state-owned Satoil. The area to be explored is 11,000 km^2 on the northern coast and is believed to be geologically related to the Angolan shelf where there are several large oilfields. Under the permit, the three companies will spend at least $45 million in the next 4 years on drilling and seismic surveys. They are also committed to train Namibians in oil drilling. Norsk Hydro, with 51% of the license, is the main operator.

South African corporations are among serious contenders for oil exploration and drilling licenses in Namibia. Both Gencor's energy wing Engen, as a member of an international consortium, and Sasol are bidding for the rights to explore for oil off the Namibian coast. Several major U.S. and European oil companies have also submitted bids for exploration rights in Namibia. It is expected that up to seven petroleum exploration concessions will be awarded by the Namibian Government in 1992.

An oil refinery to be built at a cost of $100 million, capable of processing 10,000 bbl/d, is being planned for Namibia. The refinery's equipment is to be built in the Republic of Korea under the guidance of the London-based development group Energy Korea Ltd. (Enerkor). On completion it will be shipped to Usakos in central Namibia, where it will be reerected.

Reserves

Reserve data reported by 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, 20 tons of gold, 36 Mmt of graphite ore grading 4.3% carbon, and 70 Mmt of ore grading 0.135% tin.

INFRASTRUCTURE

Walvis Bay, part of the Republic of South Africa, had the ability to accept 28,000 mt/d of refined petroleum products, although private oil firms at the port had considerably larger handling capacity. Luderitz can handle 1,500 mt/d of product. More than 330 retail outlets handling petroleum products were in Namibia.

Electric power is primarily from the Ruacana hydroelectric plant using water diverted from the Kunene River in northern Namibia and southern Angola. Plans for expansion of this potential led to signing, in October 1991, of a co-operation agreement between Angola and Namibia on the development of a dam at Epupa Falls on the river, downstream from Ruacana. A dam and hydroelectric plant at Epupa could provide 450 MW of electricity. The country draws, on the average, about 1,000 GW • h/a from the Ruacana Hydroelectric Power Station on the Kuene River. It also imports mainly from the Republic of South Africa, on the average, 571 GW • h/a, which represents 38% of the total electricity consumed in Namibia. In addition, part of Namibia's power supply is generated from coal- and diesel-fired power stations. Important among these is the Van Eck Power Station near Windhoek with a peak capacity of 1,016 GW • h/a.

Transport services within Namibia were jointly provided by TransNamib Ltd. (the national carrier) and the private sector. TransNamib was responsible for the rail transport system and also provided road and air transport services countrywide as well as on certain international routes. The private sector was involved in road haulage and supportive services such as freight forwarding and freight consolidation.

The African Development Bank has decided to finance the rehabilitation work on a 75-km stretch of Trans-Kalahari highway connecting Namibia and Botswana. The plan calls for construction of a bitumen road of 7.4-m carriageway width and two 2.5-m surfaced shoulders between Gobabis and the border town of Buitepos.

OUTLOOK

The health of the industry will remain important to the country's overall economy as mineral exports are the main source of foreign exchange earnings.

The new mining and investment legislations due to be approved by the National Assembly in 1992 is expected to provide incentive and guarantees to foreign participation in the Namibian mining sector.

The loss of export sales of uranium will have a negative impact on the

sector's overall export earnings. On the other hand, increased production and sales of diamond, and development of new copper and graphite mines, provide hope for the country's depressed mining sector.

Several reputable U.S. and international oil exploration companies have submitted bids for petroleum exploration rights in the mostly unexplored Namibia's continental shelf. It is expected that up to seven companies will be awarded concessions in 1992.

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.

The outlook for diamond mining and markets for the future is positive. With new ventures coming on-stream, production will be increased. However, the uranium market may remain depressed for at least the next 3 years before a rise in demand for uranium oxide can confidently be expected.

The Government's willingness to adapt its policies to make the country more competitive, combined with Namibia's comparative advantages in mineral resources, international and regional transportation links, and its reasonably developed domestic infrastructure, should result in foreign investment over the next 5 years.

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[1]Where necessary, values have been converted from rand (R) to U.S. dollars at the rate of R2.59=US$1.00 for 1990 and R2.76=US$1.00 for 1991.

OTHER SOURCES OF INFORMATION

Agencies

The Chamber of Mines of Namibia
P.O. Box 2895
Windhoek, Namibia
Telephone: 061 37925/6; Fax: 061 222638

Association of Prospectors and Miners of Namibia
P.O. Box 5059
Windhoek 9000, Namibia
Telephone: 061 34798

Geological Survey
P.O. Box 2168
Windhoek 9000, Namibia
Telephone: 061 37240; Fax: 061 228324

Ministry of Mines and Energy
P/Bag 13297
Windhoek, Namibia

Publication

Chamber of Mines of Namibia,
13th Annual Report, 1991, 26 pp.

TABLE 1

NAMIBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991[p]
METALS					
Antimony, Sb content of sodium antimonate	24	73	34	47	e50
Arsenic, white, 99% arsenic trioxide	1,864	2,983	2,399	r1,610	1,804
Cadmium metal, refined	51	106	88	r69	67
Columbium and tantalum: Tantalite concentrate, gross weight kilograms	13,809	6,905	5,730	e2,000	e200
Copper:					
Mine output, Cu content of concentrate	37,557	40,892	26,929	e26,000	e30,000
Metal, blister[2]	r37,653	r42,163	37,978	r32,689	32,929
Gold kilograms	172	r240	336	r1,634	1,857
Lead:					
Mine output, Pb content of concentrate	32,997	37,200	23,710	r20,700	11,800
Metal, refined[2]	40,634	44,447	44,183	r35,134	33,367
Silver, mine output, Ag content of concentrate kilograms	103,264	116,520	108,247	r e93,000	e89,000
Tin, mine output, Sn content of concentrate	1,097	1,182	1,120	r900	e100
Uranium, U_3O_8 content of concentrate	4,175	e4,100	e3,700	r4,100	3,185
Zinc, mine output, Zn content of concentrate	39,650	36,694	41,675	37,719	33,133
INDUSTRIAL MINERALS					
Diamond:					
Gem[e] thousand carats	r980	r925	910	r733	1,170
Industrial[e] do.	50	r50	r20	r15	20
Total[3] do.	r1,030	r975	927	r748	1,194
Fluorspar, concentrate, chemical grade	—	r3,989	r25,679	25,980	29,246
Graphite	—	—	—	—	e200
Lithium minerals:					
Amblygonite	106	147	131	54	e50
Lepidolite	61	18	41	80	e50
Petalite	749	1,477	1,226	1,134	e900
Total[3]	916	1,642	1,398	1,268	e1,000
Quartz	2,173	48	7	10	e10
Salt	r130,041	r150,931	142,102	r111,780	98,222
Semiprecious stones:					
Agate	100	99	93	100	e100
Amethyst	189	115	149	150	e150
Beryl	1	1	—	1	e1
Chrysocolla kilograms	8,250	8,200	8,000	e8,000	e8,000
Dioptase do.	60	60	190	e200	e200
Rose quartz	365	896	602	300	e300
Sodalite	—	100	50	e50	e50
Tourmaline kilograms	1,709	223	973	1,000	e1,000
Silica:					
High-purity	2,190	r—	r—	r—	—
For flux	r4,976	r—	r—	r—	—
Stone, sand, and gravel:					
Granite	730	2,783	6,496	e10,000	e10,000
Marble	4,215	7,695	11,663	e10,000	e10,000

See footnotes at end of table.

TABLE 1—Continued
NAMIBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991[p]
INDUSTRIAL MINERALS					
Sulfur:					
Pyrite concentrate:					
Gross weight (50% S)	120,260	226,682	196,531	[e]200,000	[e]200,000
S content[3]	[r,4]61,116	[r,4]115,200	[r]100,000	[r]100,000	100,000
Wollastonite	500	[r]396	[r]—	—	—

[e]Estimated. [p]Preliminary. [r]Revised.
[1]Table includes data available through Apr. 30, 1992.
[2]Products of imported concentrate included.
[3]Data may not add to totals shown because of independent rounding.
[4]Reported figure.

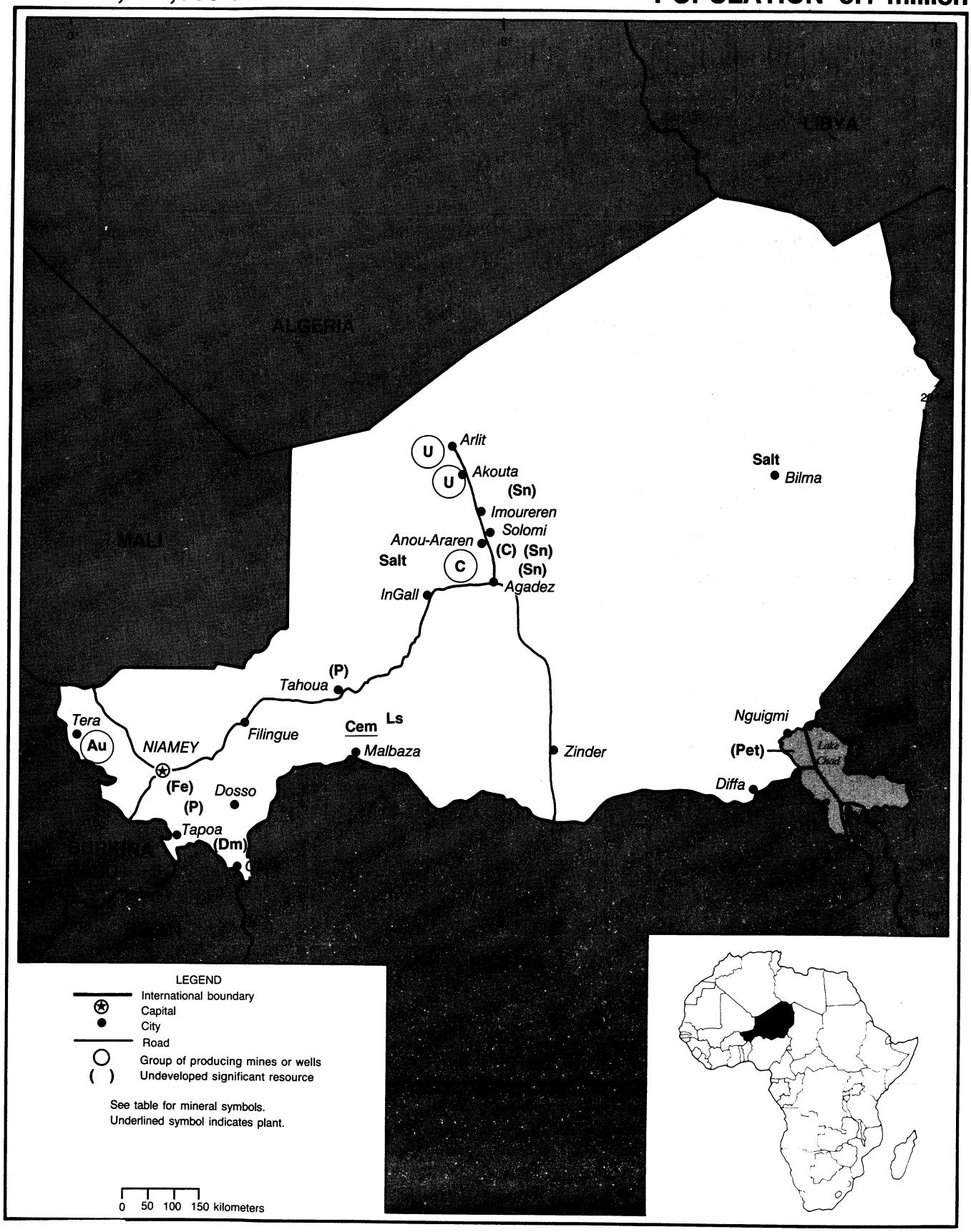
TABLE 2
NAMIBIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(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,70%; JCI, 30%)	Tsumeb	15,500 Cu in concentrate; 58,000 blister copper.
Do.	do.	Kombat, 50 kilometers south of Tsumeb	12,000 Cu in concentrate.
Do.	do.	Otjihase, near Tsumeb	16,500 Cu in concentrate.
Diamond million carats	Consolidated Diamond Mines (Pty.) Ltd. (De Beers Centenary AG, 100%)	Oranjemund	1.
Fluorspar	Okorusu Fluorspar (Pty.) Ltd. (Iscor, 26%)	Okorusu	40,000 98% calcium fluoride.
Gold	Navachab Gold Mine Co. (Anglo American Corp., 50%; CDM, 35%,Anglovaal, 14%)	Navachab	1.5 Au.
Lithium	SWA Lithium Mines (Pty.) Ltd. (Klockner, Federal Republic of Germany, Matramco, Republic of South Africa)	Near Karibib	1,500 concentrate.
Marble cubic meters	Karibib Marble (private, 100%)	Karibib	2,500 marble; 600 granite.
Salt	Salt Co. (Pty.) Ltd. (private, 100%)	Swakopmund	150,000.
Uranium	Rossing Uranium Ltd. (RTZ, 100%)	Rossing, 30 kilometers east of Swakopmund	4,800 uranium oxide.

NIGER

AREA 1,267,000 km² **POPULATION 8.1 million**



THE MINERAL INDUSTRY OF

NIGER

By David Izon

Uranium exports represented most of Niger's foreign exchange earnings in 1991. Niger was the fourth largest exporter of uranium in the world in 1991, although it was the seventh largest producer. Niger had the fifth largest uranium reserves in the world.

The minerals sector accounted for about 7% of the GDP of $2.4 million[1] in 1991. Uranium sales accounted for 75% of total export earnings and about 13% of Government revenue. Most of Niger's uranium exports go to two buyers in France and Japan. They were France's Compagnie General des Matieres Nucleaires (COGEMA) and Japan's Overseas Uranium Resource Development (OURD). COGEMA and OURD financed the country's uranium producers. The total expenditure for the year exceeded total revenues, leaving the country with a deficit of about $263 million.

The Government began to look into ways of starting new ventures in coal, gold, phosphates, and salt. The Government also assigned four concessions for exploration for oil and gas. The Government sought to encourage and attract foreign and domestic private investment in all aspects of the country's economy with its liberal investment policies.

GOVERNMENT POLICIES AND PROGRAMS

Niger continued with the structural adjustment program but emphasized major goals that would stimulate growth in the mineral sector. Other policies focused on increasing public and foreign investment in infrastructure and the oil and gas sector. Gold was also given considerable emphasis for exploration and development. There was a revision of the existing investment laws in 1991. Under the new laws investors were given exclusive rights to search for minerals and drill exploration wells for oil. The Government extended the length of the initial contract terms to 4 years. If discoveries were of commercial quantity, an initial concession to the licensee would last 15 years. An extension for an additional 15 years was possible. The new tax laws reduced income tax to 45% for petroleum ventures with a depletion allowance of 12.5%.

PRODUCTION

Uranium was the dominant mineral produced for export earnings in 1991. Occasional insurrections by the Tuaregs that closed the Trans-Saharan road hindered transportation of commodities slightly. The Tuaregs were a nomadic ethnic group whose traditional lands stretched across most of northern and eastern Niger. This road was also the transport route for coal and uranium. *(See table 1.)*

TRADE

Niger's principal export products for 1991 were uranium, agricultural products, and tin. In 1991, the value of uranium exports amounted to about $200 million. Areas of particular interest to U.S. industries included oil exploration, industrial equipment, and other manufactured goods. The country's major trading partners were France, Japan, and Nigeria. Other important trading partners were the Federal Republic of Germany and Italy. More than 80% of the country's recorded exports were to France, and 35% of imports came from France, the largest purchaser of Niger's uranium. Niger imported vehicles, machinery, and electronic equipment from France and imported petroleum products and other consumer goods from Nigeria.

STRUCTURE OF THE MINERAL INDUSTRY

The Government participated in equity sharing arrangements with several companies through its Office National des Resources Miniere. Production of uranium concentrates were by two companies, the Sociéte des Mines de l'Air (SOMAIR) and Compagnie Miniere d'Akouta (COMINAK). The Government planned to recover gold from 10 sites in the Tera area, starting from September 1991. Artisanal gold production was common.

Major operating companies in the country were Societe Nigerienne de Charbon for coal and Societe Miniere du Niger for tin. A joint venture of Elf Aquitaine Co. of France and Exxon Co. of the United States explored for oil. *(See table 2.)*

COMMODITY REVIEW

Metals

Gold.—The Government found several gold deposits owing to continued prospecting. New gold deposits identified were at Sefa-Nangue near Mbanga and Koma-Bangou 120 km^2 northwest of Niamey. The 1991-92 prospecting program focused on a 135-km^2 area considered strategic and unexplored. Efforts made to attract BHP-Utah International Inc. of the United States and Aurthec Inc. of Canada to develop the Koma-Bangou deposits did not result in

an agreement. Niger had considerable gold potential, but the Government declined to lease mining concessions until a full evaluation of the extent of the resources was determined. In 1991, small-scale artisanal miners continued to operate in the Koma-Bangou gold field. However, other deposits were known to exist along the Niger-Burkina Faso border.

Tin.—Mining of small quantities of tin ore continued at El Mecki, Tarouadji, Timie, Agahak, and Cuissat in the Air Mountains by private individual operators. Production was at its lowest in 1991, below a planned level of 250 mt/a, owing to lower demand and price.

Uranium.—Uranium prices fell to record average lows of about $10/lb for U_3O_8 in 1991. Niger's production level for 1991 remained stable despite the fall in prices. The international spot price of U_3O_8 in early 1991 was $9.20 but contracted buying prices for Niger's U_3O_8 remained at $28/lb. The two producing mines were joint-venture operations between the Government and several French, German, Japanese, and Spanish firms. The three open pit mines near Arlit operated by SOMAIR and the mine at Akouta operated by COMINAK produced uranium silicate. COGEMA of France controlled the management of both companies.

Reserves

The Government had no officially reported reserve figures for uranium in 1991, but reserves for elemental uranium according to the International Atomic Agency were about 210,000 tons in the Arlit-Akouta region. Large reserves also existed in other parts of the country that remained undeveloped due to the market conditions. Total reserves as estimated by the Mining Journal, London, were about 360,000 tons. The Mining Journal, London, also estimated coal resources at 6 Mmt. There were no official Government reserve figures in 1991 for other minerals produced in Niger.

INFRASTRUCTURE

The transportation system in Niger was still inadequate, despite considerable road development. There was 39,970 km of roads in 1991. The total distance of paved roads was 13,500 km, of which 3,170 km was bituminous. The paved roads included a 902-km all-weather road between Niamey and Zinder and a 651-km "uranium road" from Arlit to Tahoua. Gravel and laterite roads covered a distance of 3,470 km to 10,330 km.

There were no railways, but plans were under discussion to extend the Cotonou-Parakou line in the Republic of Benin to Niger. The inland waterway of the Niger River was navigable 300 km from Niamey to Gaya on the Benin border from mid-December to March. The bulk of foreign trade was shipped through Cotonou in Benin via the organization Commune Benin-Niger des Chemins de Fer et des Transports. Niger has no seaports but shared borders with countries such as Burkina Faso, Nigeria, and Togo that have ports.

There were 31 airports, 29 easy to use, and 7 with permanent-surface runways. The international airports were at Niamey and Agadez, together with four major domestic airports at Zinder, Diffa, Tahoua, and Dosso.

OUTLOOK

Uranium remains the most important mineral commodity produced in Niger. Uranium should continue to earn large shares of foreign exchange for the country in the immediate future. Long-term development goals are focused on gradual development of other minerals such as gold, iron ore, petroleum, and phosphates.

The short-term economic future of Niger is not very promising. However, current efforts by the Government to reschedule its' debts and investments by prominent oil companies should provide more revenue for the country. Both Elf Aquitaine of France and Exxon have already established deposits of commercial quantity in the explored region. Also, efforts to explore for other nonfuel minerals may pay off in the future.

Prospects for commercial development of gold and phosphates also appear good. The Government's economic recovery program, if continued, should improve the country's industrial growth. Foreign aid in the mining industry is encouraging and should continue as expected.

[1]Where necessary, values for Niger have been converted from Communauté Financière Africaine francs (CFA) to U.S. dollars at the rate of CFA276=US$1.00 in 1991.

OTHER SOURCES OF INFORMATION

Office Nationale des
Recherches Minieres
B.P. 734
Niamey, Niger

TABLE 1
NIGER: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1987	1988	1989	1990	1991
Cement, hydraulic	e40,000	26,400	27,000	r19,478	20,109
Coal	164,313	e160,000	171,434	r153,913	156,542
Gypsum e	3,000	3,000	3,000	r950	3,1,000
Molybdenum concentrate, Mo content e	8	15	13	10	10
Salt	e3,000	r2,902	r2,824	r2,740	e3,000
Tin, mine output, Sn content	94	119	71	r38	20
Uranium, content of concentrate	3,493	3,482	3,013	r3,161	3,330

eEstimated. rRevised.
[1]Includes data available through Sept. 8, 1992.
[2]In addition to the commodities listed, Niger also produced clay, sand, and gravel for local construction purposes; however, available information is inadequate to make reliable estimates of output levels.
[3]Reported figure.

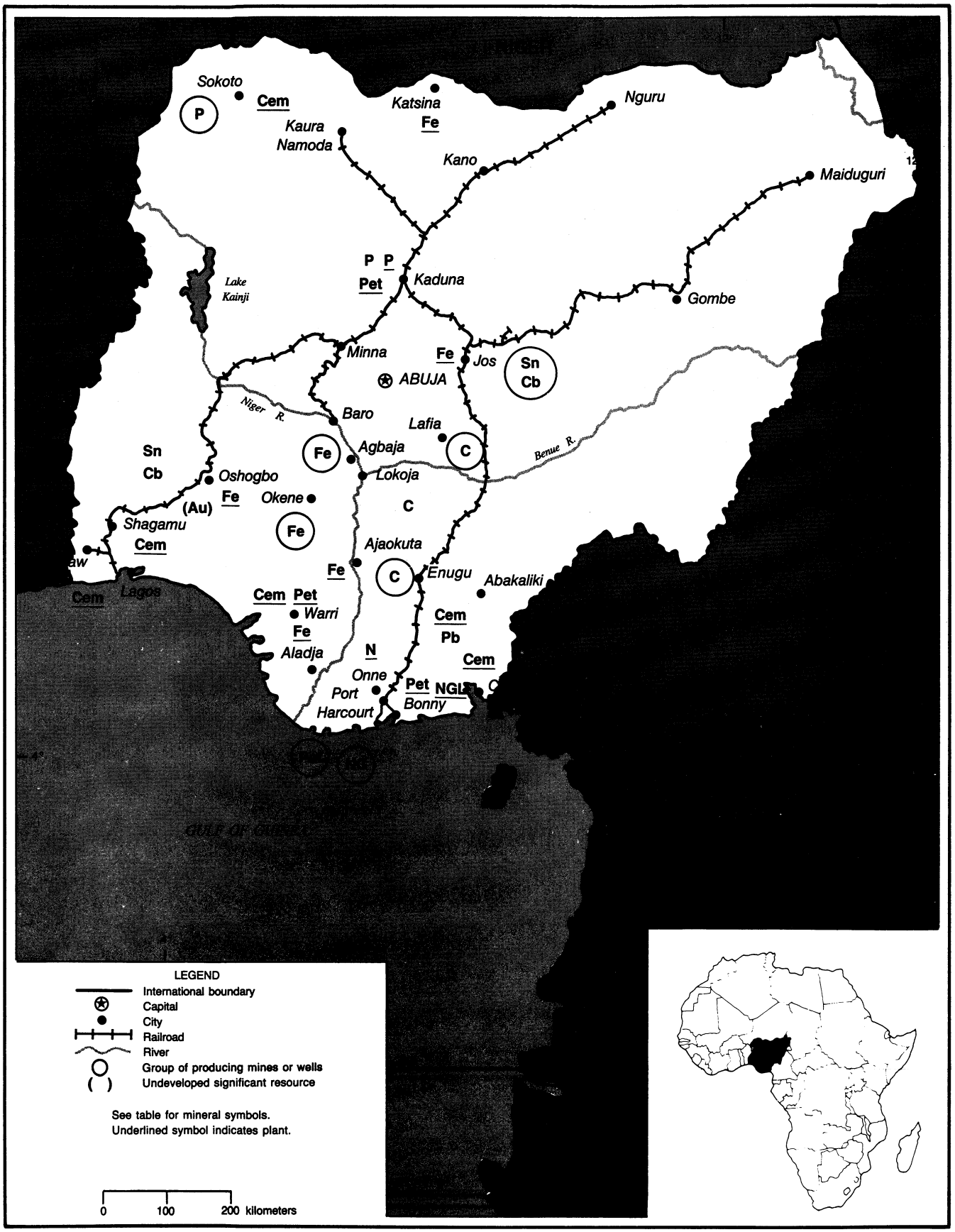
TABLE 2
NIGER: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	Societe Nigerienne De Cimenterie (Government, 100%)	Malbaza	40
Coal	Societe Nigerienne De Charbon d'Anou Araren (Government, 100%)	Anou-Araren	180
Tin	Societe Miniere du Niger (Government, 100%)	El Meki	.1
Uranium	Societe Des Mines De L'Air (Government, 33%; COGEMA-France, 27%; France's Compagnie de Mokta, 19%; and Sogerem, 19%; Federal Republic of Germany's Urangesellschaft, 6.5%; and Italy's Agip Uranio, 6.5%)	Arlit and Taza	3.5
Do.	Compagnie Miniere d'Akouta (COGEMA-France, 34%; Government, 31%; OURD-Japan, 25%; and Enusa-Spain, 10%)	Akouta	2

NIGERIA

AREA 923,770 km² **POPULATION 88.5 million**



THE MINERAL INDUSTRY OF

NIGERIA

By David Izon

Nigeria remained Africa's largest and the world's 10th largest crude oil producer. Oil and gas resources have almost turned the nation into a single product economy as they provided about 96% of Nigeria's export and foreign exchange revenue. This accounted for more than 13% of a GDP of $32.4 billion.[1] The oil sector accounted for 78% of total Government revenues in 1991. The oil industry was successful in adding 3 billion barrels to its reserves. The target was 20 billion barrels by 1995. The country also has nonfuel mineral resources, particularly barite, gold, and iron ore, whose development could help diversify the economy. The Raw Materials Research and Development Council (RMRDC) was working hard to see that Nigeria's mineral resources are exploited adequately. A process was developed by the RMRDC to convert about 40% of Nigerian coal to coking coal.

The UN Development Program granted Nigeria $750,000 through RMRDC to boost the nation's raw materials information system. The money was to be used for the purchase of a computer system to process all data procured under its techno-economic survey program. The information would be available to investors and the public.

GOVERNMENT POLICIES AND PROGRAMS

The Government's economic policies and programs in 1991 continued under the Structural Adjustment Program (SAP) that was instituted in 1986. Government policies were revised as part of SAP to encourage direct foreign investment. In 1991, the Government took steps to commercialize and privatize several Government-owned parastatals. Most prominent among these was the Nigerian National Petroleum Corp. (NNPC). Efforts were also made to diversify the minerals industry, which was almost entirely based on crude petroleum. To this end, a review of the Minerals Act was called for. The act was last amended by Decree 29 of 1969 but did not address crucial issues of land reclamation and restoration and production returns and safeguard against illegal miners. Reforms were undertaken to purge the Ministry of Mines of corrupt officials who aided and abetted illegal mining. A data bank and six zonal license issuing centers were set up as a means of enhancing the exploration and exploitation of the country's minerals. A $30 million minerals development fund was launched to help commercialize some of the scientific inventions and technological advances of the nonoil sector on a large scale. The country's RMRDC, which was established to expedite industrial development through the maximum use of local materials, was to control the funds. The Government maintained policies on tariffs, business, and expatriate structures established earlier to attract foreign investors. The national policy was closely related to programs associated with fuel minerals and almost neglected coal and other nonfuel minerals that occur in substantial quantities throughout the country. The Government's main policy was to maximize returns from petroleum exports by limiting domestic consumption.

PRODUCTION

Petroleum and natural gas production continued to increase in 1991. In general, the mineral industry experienced a 4.3% growth in 1991 mainly owing to the increased output of crude petroleum and natural gas. *(See table 1.)*

TRADE

Nigeria's mineral trade continued to be dominated by the oil sector, which accounts for about 96% of foreign exchange. The value of total Government revenue in 1991 amounted to about $88.16 billion, of which oil revenue accounted for 78%, about $68.83 billion. The value of total exports increased by 10% owing to depreciation of the Naira. However, exports totaled $12.3 billion, an apparent 10.3% decline from 1990 owing to the decline in value of crude oil exports from $13.3 billion in 1990 to $11.8 billion in 1991. Major mineral exports included coal, crude oil, steel billets, tin, and some industrial minerals.

Crude oil prices dropped by $3/bbl in 1991, and the value of nonoil exports rose by about 43% to $472 million in 1991. Most of Nigeria's crude oil was exported to North and South America. The United States remained the most important customer, importing about 57% of Nigerian crude oil, equivalent to about 309 Mbbl/a. Crude oil exports to Western Europe amounted to about 217 Mbbl, or about 36% of Nigeria's crude oil exports. The remainder was exported to African countries and was valued at about $401 million.

The United States became the third largest supplier of industrial input and equipment to Nigeria after the United

Kingdom and the Federal Republic of Germany, ranked in order of importance. Major imports from the United States included heavy-duty equipment for drilling, aircraft communication and medical equipment, computers, scientific instruments, and power generation and distribution equipment. The U.S. share of total Nigerian imports increased to about 10% while its share of Nigerian exports also increased from 45% to 54% in 1991.

STRUCTURE OF THE MINERAL INDUSTRY

The Nigerian mineral industry in 1991 was dominated by the oil and gas industry in terms of contributions to the country's GDP, employment, and export earnings. The Government had a 51% to 60% controlling interest in all foreign mineral companies operating in the country. In an effort to privatize its parastatal companies, Nigeria restructured its largest corporation, NNPC, into 10 subsidiary companies. They were to be run on a profit and loss basis without Government intervention. 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, columbite, and tin were mined by Government-owned companies or agencies. *(See table 2.)*

COMMODITY REVIEW

Metals

Exploration for bauxite was begun in 1991. A detailed study of a 30,000-km^2 area in the Adamawa-Mambilla Plateau for bauxite was under way. Bauxite from this deposit was planned for use in the aluminum plant to be built in southeastern Nigeria. Five new gold deposits, reportedly of commercial value, were discovererd in 1991. Efforts were directed at attracting investors for the mining of these deposits. Official production figures for gold mined at Ilesha were not available.

Iron and Steel.—The Nigerian steel industry was comprised of the Ajaokuta Steel Complex, the Delta Steel Co. plants at Aladja, the National Iron Ore Mining Co. (NIOMC) at Itakpe, and several rolling mills. There were a total of 14 rolling mills, 8 electric arc furnaces, and 1 blast furnace (Ajaokuta) in the country. The Government-owned mills are at Oshogbo, Katsina, and Jos. Total billets production capacity of the industry was 2.69 Mmt/a, and rolled products capacity was 3.5 Mmt/a.

Construction work on phase 1 of the Ajaokuta complex was 95% completed as of December 1991. The Ajaokuta complex was comprised of 1.3 Mmt/a of light section mill, bar mill, and wire rod mill; a central workshop; and a thermal powerplant. The complex's total combined capacity of billets and rolled products was 2 Mmt/a. Some modifications were made to the first phase in 1991 to include an accelerated flat sheet component to the continuous caster for the production of flat sheets. The thermal plant and workshop were in full operation while other units operated below full capacity because of inadequate working capital to procure necessary inputs. The thermal powerplant produced excess electricity of about 137 MkW•h, which was sold to the Nigerian Electric Power Authority.

Production at Delta Steel Co. at Aladja declined from 189,371 mt/a in 1990 to 136,867 mt/a in 1991. Production of billets accounted for about 80% while the remaining was in the form of rolled products. The plant operated at about 11% of capacity in 1991. Total capacity at Delta was 1 Mmt/a of billets and 0.32 Mmt/a of rolled products. This poor performance was attributed to shortage of basic inputs and lack of funds. Some of the billets and rolled products were exported.

NIOMC continued to stockpile iron ore that was expected to serve the Ajaokuta steel complex and the Delta Steel Co. Production declined as only 39,211 mt/a of ore was added to the stockpile in 1991, compared with 359,350 tons in 1990. This was due largely to inadequate maintenance of mining equipment, frequent theft, and industrial unrest in the country, particularly between June and December of 1991. At yearend, the total iron ore stockpiled at Itakpe since the inception of the project stood at 1.8 Mmt. Work on the beneficiation plant was progressing as other aspects of the project such as the rail link between Itakpe and Ajaokuta were completed. The Ajaokuta Steel Complex is expected to be commissioned in October 1992.

Performance of the three state-owned rolling mills declined in 1991 owing to inadequate supply of billets from Delta Steel Co. Construction at the mills was also constrained by inadequate funding. Production at the Jos rolling mill, which operated at about 7% capacity, fell to 11,746 mt/a in 1991 from 20,384 mt/a in 1990. Production at the Katsina Steel Rolling Mills Co., at only 8% of capacity, declined from 19,117 mt/a in 1990 to 16,404 mt/a in 1991. Production at the Oshogbo Steel Rolling Co. increased from 18,467 mt/a in 1990 to 19,982 mt/a in 1991, or about 10% of capacity. The three mills had several problems. The main ones were inadequate funding, shortage of raw materials, and high electricity costs.

Tin.—The tin industry continued to operate on the brink of collapse in 1991. Production was insignificant at about 246 mt/a compared with world production of about 197,000 mt/a. An estimated 50% of total production may have been lost in 1991 through smuggling by private miners. The major reason for the weak domestic tin industry was the depletion of minable reserves. Tin ore found at depths of 70 m was too expensive to mine with the limited resources available. Production was negatively affected by mine flooding, lack of spare parts for plants and machinery, and low prices.

Industrial Minerals

Adequate sources for industrial minerals were identified throughout the country. Nonmetallic minerals that occur in commercial quantities or that reportedly have proven reserves were asbestos, barite, bentonite, clay, kaolin, fire clay,

diatomite, dolomite, feldspar, fluorspar, graphite, gypsum, ilmenite, kyanite, limestone, phosphate, salt, soda ash, sulfur, and talc. Other industrial minerals found were primarily gemstones that included amethyst, aquamarine, sapphire, topaz, and tourmaline. Small quantities of some of these minerals were being produced in 1991. Illegal mining of barites, gemstones, and gypsum persisted as the Government continued to try to stop it. Two companies were formed to exploit and export barite and bentonite in the country as joint-venture partners of the Government.

Cement.—Cement production in the country improved with the purchase of new equipment and modernization in the cement industry. Production in 1991 was estimated at about 3.5 Mmt/a and capacity was 5.2 Mmt/a. The domestic demand was put at 8.6 Mmt/a. Four of the 10 plants in the country used the wet process while 5 used the dry process. Only the Ewekoro cement plant used the semiwet process.

The Cement Co. of Northern Nigeria operated at 48% of capacity and produced 271,087 mt/a in 1991, compared with 236,000 mt/a in 1990. All feed to the plant was produced domestically. Production at West African Portland Cement Co., Ewekoro, Lagos, declined from 1,120,000 tons in 1990 to 1,107,154 mt/a in 1991. The plant was operated at 69% of capacity. The decline was due to aging machinery and shortage of foreign exchange to affect the overhauling of the machinery. Production at the Nigerian Cement Co. at Nkalagu increased by 10% to 138,397 mt/a in 1991, or 23% of capacity. The Nkalagu plant used mainly imported material and had aging equipment. Performance at the Ashaka Cement Co. was 3.5% below its 1990 level with a production of 795,858 mt/a in 1991. There was a 45% drop in production at the Calabar cement Co. plant to 25,350 mt/a in 1991. The plant operated at 10% of capacity. Other cement plants at Ukpilla and Gboko reported more than a 50% drop in production in 1991. Production at Ukpilla and Gboko was 109,260 mt/a and 471,017 mt/a, respectively.

Fertilizer.—The National Fertilizer Co. of Nigeria continued as the sole ammonia and urea-producing company in the country. Average production of fertilizer at the Onne plant, near Port Harcourt, fell by about 6% in 1991. This was due largely to the high cost of raw materials imported, such as phosphate rock and sulfuric acid, and inadequate funds. Ammonia and urea production decreased to about 367,200 mt/a and 372,600 mt/a, respectively, in 1991. The volume of exports of ammonia and urea rose by about 2% to 330,694 mt/a, and the value increased $31.8 million from $22.4 million. The Onne plant operated at about 96% of capacity. However, the Federal Superphosphate Fertilizer Co. Ltd. at Kaduna operated at 25% of capacity. Its production for the year was 8,105 mt/a.

Mineral Fuels

Coal.—Coal began to witness a comeback as the Onyeama Mine joined other operating mines in Enugu in production of coal. About 7,500 mt/a coal was exported to Wales in the United Kingdom in 1991. Production from this mine was designated solely for export, but during 1991 most of the coal produced was utilized locally. Production is expected to rise from its present 100,000 mt/a to 220,000 mt/a in 1992 and subsequently from 440,000 mt/a to 500,000 mt/a between 1993 and 1995. Reserves at the Onyeama Mine were reported at 254 Mmt.

In an effort to raise production to an expected 1.3 Mmt/a, the Government formed joint-venture partnerships with Bulgarian and British firms. Bulnig Mining Co., a joint-venture partnership between Nigerian Coal Corp. and Bulgaria's EC Minstroy and its local affiliate Bienventures, was to mine the Okaba and Onwukpa Mines. Mining operations at these mines were suspended in 1991 due to a legal dispute. The Okaba and Onwukpa Mines were expected to produce 272,000 mt/a and 576,000 mt/a, respectively.

However, Eagle Mining Co. Ltd., a joint venture between Carbomin Ltd. of the United Kingdom and Nigerian Coal Corp., continued to mine the Onyeama Mines and planned to expand its operations to other parts of Nigeria. The Nigerian coal was selling at $42 to $45 per ton and was expected to generate a yearly foreign exchange of about $20 million.

Natural Gas.—Natural gas has great potential to capture a large share of the energy market and earn much needed foreign exchange for the country. In 1991, the Government started to work on this goal as a site was being developed within Obiafu and Obrikom oilfields, 90 km north of Port Harcourt, for Nigeria's first gas processing plant.

The $300 million plant would be operated by Nigerian Agip Oil Co. Ltd. with Nigerian Gas Co., a subsidiary of NNPC, and Phillips Oil Co. Nigeria Ltd., as partner. The plant was expected to produce natural gas liquids (NGL) and was scheduled to be completed in early 1993. The unit, when completed, would recover 85% of the ethane, 99% of the propane, and 100% of the butane and produce 25,800 bbl/d of NGL from associated gas that was usually reinjected in the Obiafu and Obrikom Fields. The NGL was expected to be used as feedstock for NNPC's $1 billion Eleme Petrochemicals Complex under construction in Port Harcourt.

The Nigerian Liquefied Natural Gas Ltd. (NLNG) concluded several sales and purchase agreements for 87.7% of its liquefied natural gas (LNG) project in 1991. Italy's National Electric Power Authority "ENEL" signed the latest agreement to purchase 3.5 billion m^3/a of gas, representing 61.4% of the LNG to be produced. Earlier, Spain's Enagas agreed to purchase 1 billion m^3/a, representing 17.5% of the LNG to be produced, and Gaz de France to purchase about 500 Mm^3/a, representing 8.8% of the LNG to be produced. The NLNG management hoped to conclude all purchase agreements when Distrigas of the United States is committed to the balance of 12.3%, about 701 Mm^3/a. The

agreements signed would last for 22 years. Four out of six ships were purchased for the transportation of the LNG.

Petroleum.—The production of crude oil increased from 660 Mbbl in 1990 to about 690 Mbbl in 1991. Of the total production, 586 Mbbl or 85% was exported. Exports averaged 1.6 Mbbl/d in 1991. The balance of production that was delivered to local and offshore refineries for manufacture of petroleum products totaled about 99 Mbbl. Exploration activities embarked on by the Government paid off with an increase of the country's oil reserves by about 3 billion bbl.

Reserves

Nigeria's proven oil reserves were 19 billion bbl in 1991, which could be increased to 20 billion by 1995. Known natural gas reserves were about 2.6 trillion m^3, ranking Nigeria fifth in the world in natural gas resources. Nearly 70% of the oil and gas reserves was onshore, and all were located in the Niger River Delta. Nigeria's oil reserves have high gas to oil ratios, and most of the new gas discoveries occurred during oil exploration. The total in situ reserves of Nigerian coal were reported at 1.5 billion mt. 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 mt with an iron content averaging about 37%. About 2 billion mt of the total iron ore reserves was at Agbaja with an average iron content of 45% to 47%. See table 3 for reported reserve figures of other minerals. *(See table 3.)*

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, 1,126 km, and from Port Harcourt to Maiduguri, 1,443 km, are connected by a 179-km east-west line from Kaduna to Kafanchan. There are also five branch lines with railheads at Nguru, Kaura-Namoda, Jos, Idogo, and Baro. The Ajaokuta-Port Harcourt line was still under construction in 1990. 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, their tributaries, and the navigable routes to Kainji Lake. The Kainji dam 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. Major airports were in Lagos, Kano, Port Harcourt, and most recently at Abuja, the new capital of the country.

OUTLOOK

Petroleum and natural gas will remain the mainstays of the economy for the foreseeable future. However, the key to new industrial development in Nigeria will continue to be based on the successful completion and operation of the iron and steel complexes. The iron and steel complex at Ajaokuta that was expected to be commissioned by the end of fiscal 1991 was postponed to October 1992. With the development of the steel industry, heavy equipment and metal-working industries are expected to grow, providing jobs for the extensive labor force yet untapped. Recently discovered coal deposits will add to reserves and provide an additional source of foreign exchange when exploited. Joint-venture agreements signed with foreign investors could increase production of coal and reduce importation of coal. Some of the raw materials will continue to be imported because domestic supplies will likely remain insufficient. The mineral industry as a whole should continue to enjoy considerable growth because of increasing activity in the mineral fuels sector. The output of crude petroleum is expected to be raised to 2 Mbbl/d by 1995. Because of its abundance, natural gas is being promoted as an energy source and as a chemical and petrochemical feedstock. Assuming no major declines in world oil prices, Nigeria's goals of achieving industrial stability in the near future may be feasible. Natural gas is expected to displace a small percentage of oil products from the local market and emerge into a substantial export business at the completion of the LNG program. When planned policies for curbing illegal mining are implemented, the country could see a boost in the economy as revenue sources would be increased considerably. The Government's fiscal and financial incentive programs to encourage local and foreign investment in new developments in the mineral industry are expected to continue through the mid-1990's.

[1]Where necessary, values have been converted from Nigerian naira (N) to U.S. dollars at N18.00=US$1.00 in 1991.

OTHER SOURCES OF INFORMATION

Federal Ministry of Mines and Power
Six Storey Building
Lagos, Nigeria

Nigerian National Petroleum Corporation
NNPC Building Falomo
Lagos, Nigeria

TABLE 1
NIGERIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991
METALS						
Columbium and tantalum concentrates, gross weight:						
Columbite		48	50	46	44	36
Iron and steel:						
Iron ore, gross weight	thousand tons	240	304	e300	374	398
Steel, crude	do.	184	192	r213	133	137
Lead:						
Mine output, Pb content	e	86	85	[2]—	106	e100
Metal, refined secondary		r—	r—	r—	r—	—
Tin:						
Mine output, cassiterite concentrate:						
Gross weight		844	432	350	227	246
Sn content		603	300	e254	e165	182
Metal, smelter		560	566	258	310	350
Zinc ore and concentrate, Zn content		([3])	([3])	[2]—	[2]—	—
INDUSTRIAL MINERALS						
Cement, hydraulic	e thousand tons	5,382	3,500	3,500	3,500	3,500
Clays:						
Kaolin		177	105	500	1,356	e1,300
Unspecifed		15,000	15,000	13,341	60,113	e60,100
Feldspar		485	190	945	714	e700
Nitrogen:						
N content of ammonia	thousand tons	225	300	364	e360	367
N content of urea	do.	200	260	522	e550	372
Stone:						
Limestone	do.	2,627	1,712	1,315	1,136	1,436
Marble		6,900	5,445	1,377	1,605	1,600
Shale	thousand tons	88	86	38	67	e70
MINERAL FUELS AND RELATED MATERIALS						
Coal	do.	110	150	28	78	138
Gas, natural:						
Gross	million cubic meters	18,687	20,740	24,831	r27,593	31,286
Marketed	do.	2,852	3,193	3,833	r3,233	2,568
Petroleum:						
Crude	thousand 42-gallon barrels	486,869	569,400	626,489	r660,462	689,800
Refinery products:						
Gasoline	do.	19,000	21,000	23,337	30,706	30,818
Jet fuel	do.	490	500	e510	e700	920
Kerosene	do.	9,000	10,600	11,873	14,521	14,760
Distillate fuel oil	do.	12,500	15,000	17,591	17,366	26,464
Residual fuel oil	do.	14,000	13,600	19,254	23,935	13,468
Unspecified	do.	5,000	5,000	2,274	3,806	1,615
Total	do.	59,990	65,700	e74,839	e91,034	88,045

eEstimated. rRevised.
[1]Includes data available through Aug. 10, 1992.
[2]Reported figure.
[3]Less than 1/2 unit.

TABLE 2
NIGERIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(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	144.
Iron ore	do.	National Iron Ore Mining Co. (Government, 100%)	Itakpe, near Okene	e325.
Iron and steel		Ajaokuta Steel Co. Ltd. (Government, 100%)	Ajaokuta City	1.3.
Do.		do.	do.	.7 rolled steel.
Do.		Delta Steel Co. Ltd. (Government, 100%)	Aladja	1.00 liquid steel.
Do.		do.	do.	.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.
Do.		do.	do.	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 (Government, 100%)	do.	22.
Tin	thousand metric tons	Makeri Smelting Co. Ltd (Government, 100%)	Jos	1.

eEstimated.

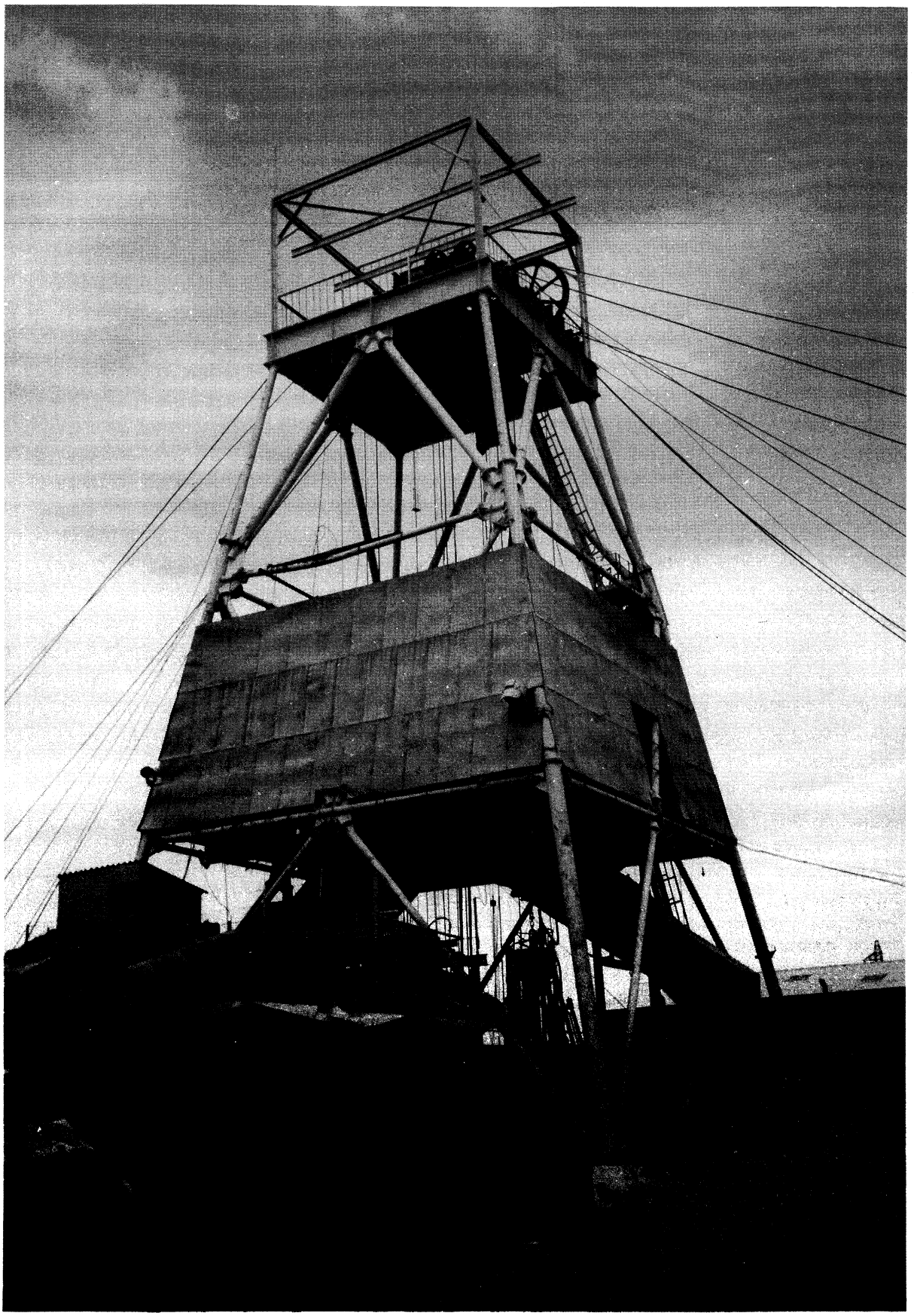
TABLE 3
NIGERIA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1991

(Million metric tons unlessons unless otherwise specified)

Commodity		Reserves
Asbestos		.4
Barite		700
Columbite		.14
Coal		5,000
Diatomite		10
Iron ore		2,300
Lead and zinc		.711
Natural gas	trillion cubic meters	2.6
Petroleum, crude	million barrels	19,000
Tin		.17

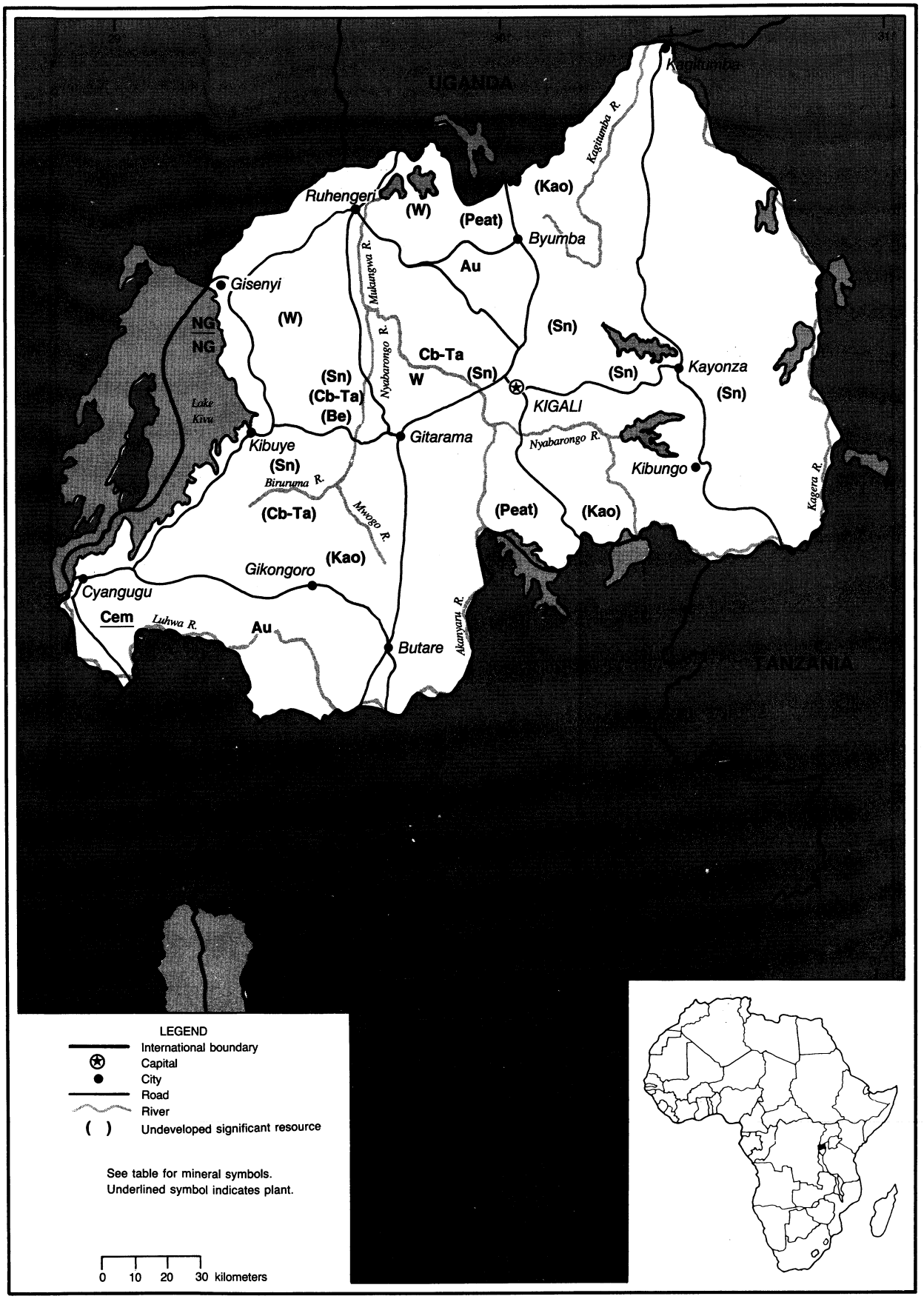
Source: Ministry of Petroleum and Natural Resources of Nigeria.

NEW SHAFT AND HEADFRAME AT JERADA COAL MINE, MOROCCO



RWANDA

AREA 26,340 km² **POPULATION 7.9 million**



THE MINERAL INDUSTRY OF

RWANDA

By Lloyd E. Antonides and George A. Morgan

Rwanda's mineral industry in 1991 was small, consisting mainly of long-established enterprises producing concentrates of the heavy minerals cassiterite, columbite-tantalite, and wolframite. Some gold, limestone, and natural gas were also produced. Exports of coffee and tea accounted for the vast portion of foreign exchange earnings.

Mineral exports accounted for 6% of total exports in 1990, the latest year data were available, or about $6.1 million.[1] In terms of value, cassiterite was the most important mineral exported at $3.6 million (1,005 tons), followed by columbium-tantalum concentrate at $2.1 million (81 tons), and wolframite concentrate at $0.45 million (196 tons). About 92% of all mineral exports was to Belgium. Four kilograms of sapphire was also shipped to Belgium. Cassiterite, 108 tons, was shipped to Singapore. Cement exports, possibly reexports, were solely to Zaire at 51 tons. In terms of value of overall exports, the Federal Republic of Germany accounted for 22%; Belgium-Luxembourg, 14%; and the Netherlands, 13%.

Mineral-related imports accounted for $69.3 million or 25% of total imports in 1990, the latest year available, compared with 24% of total imports in 1989. About 15% of the total import cost in 1990 was for fuels compared with 13% in 1989. Iron and steel products were the second major mineral-related import category. The principal importing countries in 1990 were Belgium-Luxembourg, the Federal Republic of Germany, France, and Kenya.

The Government continued its program of privatization and structural adjustment of public companies. The Government had holdings in 62 enterprises and remained a major participant in the mining sector, which had small operations or artisanal operators.

A project to commence operation of the Lake Kivu Methane Gas Industrial Trading Co. remained dependent upon the joint cooperation of Burundi, Rwanda, and Zaire. The three countries were members of the Economic Community of the States of the Great Lakes. Production of methane gas from Lake Kivu began in 1983. Output reportedly was 40,000 m^3/d and was used in a brewery in Rwanda.

Belgium made available about $20 million, through the World Bank, to Rwanda. The funds were primarily to assist Rwanda in its balance of payments requirements.

The African Development Bank (ADB) approved a $14.5 million structural adjustment loan to Rwanda. The loan was to help restore economic growth, providing funding for selected imports. Specifically, the funds would be used to offset foreign exchange costs of imports from ADB member countries.

Efforts to establish realistic pricing mechanisms in the economy, as well as privatization of public enterprises through the structural adjustment program, should yield some benefits. However, country's economy remains dependent upon agriculture, with developments in the mineral sector likely to be small scale.

[1]Where necessary, values have been converted from Rwanda francs (RF) to U.S. dollars at the rate of RF82.60=US$1.00 for 1990 values and RF79.98=US$1.00 for 1989 values.

OTHER SOURCES OF INFORMATION

Agencies

Ministry of Industry and Handicrafts
Republic of Rwanda
P.O. Box 73, Kigali, Rwanda
Telephone: 011-250-75417

Publications

Map of Mineral Deposits of Rwanda, Ministry of Natural Resources, Republic of Rwanda, 1982.

TABLE 1
RWANDA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1987	1988	1989	1990	1991e
Cement	69,364	58,073	67,706	60,339	60,000
Columbite-tantalite, ore and concentrate, gross weight[3]	—	r7	64	151	150
Gold, mine output, Au content[e 4] kilograms	9	15	745	700	700
Natural gas, gross thousand cubic meters	955	903	132	973	970
Tin: Mine output, Sn content[e 5]	—	r118	762	734	730
Tungsten, mine output, W content[e 6]	11	22	105	156	175

eEstimated. rRevised.

[1]Includes data available through May 1, 1992.

[2]In addition to commodities listed, some gemstones (sapphire and tourmaline), limestone for cement and possibly agriculture, and presumably some other construction materials (clays for brick and tile, sand and gravel, stone, etc.) are produced, but information is inadequate to make reliable estimates of output. Beryllium (beryl concentrate, estimated 10% BeO) production last reported in 1985 at 27 tons per year. Tin metal production (smelter output) last reported in 1985 at 800 tons per year when smelter reported shutdown.

[3]Estimated 22% Ta plus 30% Cb (reported in 1985 at 27% Ta_2O_5).

[4]Reported gross weight output estimated to contain 92% Au.

[5]Reported gross weight output estimated to contain 70% Sn.

[6]Reported gross weight output estimated to contain 54% W (68% WO_3).

TABLE 2
RWANDA: EXPORTS OF MINERAL COMMODITIES[1]

(Value, U.S. dollars)

Commodity	1989	1990	Destinations, 1990
Cement	—	51	All to Zaire.
Columbium and tantalum: Ore and concentrate	54	81	NA.
Salt and brine	27	—	
Tin: Ore and concentrate	965	1,005	Belgium-Luxembourg 897; Singapore 108.
Tungsten: Ore and concentrate	148	196	All to Belgium-Luxembourg.

NA Not available.

[1]Table prepared by Virginia A. Woodson. No mineral export commodities to the United States were reported for 1990.

TABLE 3

RWANDA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990
METALS			
Aluminum:			
Oxides and hydroxides		4	6
Metal including alloys		675	572
Chromium: Oxides and hydroxides	kilograms	1	2,000
Cobalt: Oxides and hydroxides	do.	1	—
Copper:			
Matte and speiss including cement copper	do.	—	400
Metal including alloys		137	167
Iron and steel: Metal, pig iron, cast iron, related materials		28,726	21,022
Lead:			
Oxides	kilograms	—	2,000
Metal including alloys, all forms		8	2
Manganese: Oxides		182	212
Nickel: Metal including alloys, semimanufactures		4	—
Platinum-group metals, unspecified	kilograms	12	—
Tin: Metal including alloys, all forms		10	14
Titanium: Oxides		51	68
Zinc:			
Oxides		2	3
Metal including alloys, all forms		1,600	797
INDUSTRIAL MINERALS			
Asbestos, crude	kilograms	4	—
Barite and witherite		43	18
Boron materials: Crude natural borates	kilograms	956	5,126
Cement		298	232
Chalk		184	278
Clays, crude		11	3
Diatomite and other infusorial earth		166	129
Graphite, natural		15	26
Gypsum and plaster		2,881	2,532
Lime	kilograms	109	96
Nitrates, crude		145	2
Phosphates, crude		18,101	6
Pigments, mineral: Iron oxides and hydroxides, processed		65	39
Precious and semiprecious stones other than diamond, natural	kilograms	9	—
Salt and brine		16,958	17,629
Stone, sand and gravel:			
Dimension stone: Crude and partly worked		77	—
Dolomite, chiefly refractory-grade		31	—
Sand other than metal-bearing	kilograms	5,750	20

See footnotes at end of table.

TABLE 3—Continued

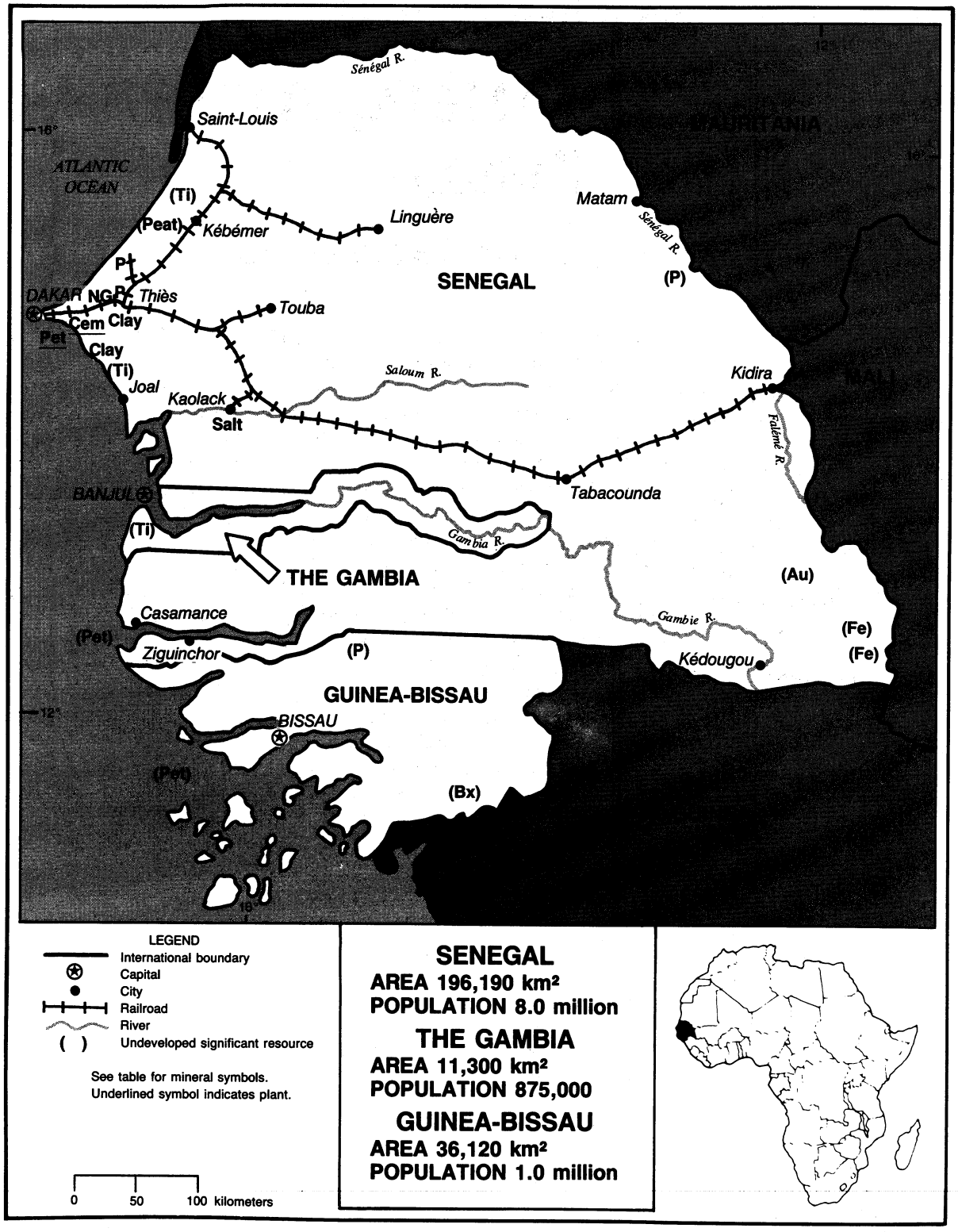
RWANDA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990
INDUSTRIAL MINERALS—Continued			
Sulfur:			
Elemental: Crude including native and byproduct		40	20
Colloidal, precipitated, sublimed		11	—
Sulfuric acid		71	121
Talc, steatite, soapstone, pyrophyllite	kilograms	857	12,750
MINERALS FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		906	162
Petroleum refinery products:			
Liquefied petroleum gas	thousand 42-gallon barrels	3	2
Gasoline	do.	332	301
Mineral jelly and wax	do.	1	1
Kerosene and jet fuel	do.	91	92
Distillate fuel oil	do.	187	176
Lubricants	do.	17	17
Residual fuel oil	do.	90	88

[1]Sources for 1990 imports are not available. Table prepared by Virginia A. Woodson.

SENEGAL, THE GAMBIA, GUINEA-BISSAU



THE MINERAL INDUSTRIES OF

SENEGAL, THE GAMBIA, AND GUINEA-BISSAU

By Hendrik G. van Oss and David Izon

SENEGAL

Mineral commodities dominated the industrial sector of the Senegalese economy in 1991. Total sales of domestically produced mineral commodities, including refined petroleum products, amounted to about $515 million, or about 8.7% of the country's GDP of $5.9 billion.[1] Primary minerals made up about 23% of the value of total mineral commodity sales. The production of phosphate minerals (calcium phosphates and lesser quantities of calcined aluminum phosphates) was worth about $83 million and dominated the primary mineral sector. Nonfuel secondary mineral production was mainly of cement, manufactured fertilizers, and phosphoric acid. Sales of these totaled about $165 million. Total sales of refined petroleum products amounted to about $231 million.

Domestically produced mineral commodities accounted for about 22% of Senegal's total exports in 1991 of about $904 million. Primary minerals exports were about 38% of total mineral commodity exports and about 62% of all primary mineral sales. Calcium phosphates contributed 79% of primary mineral exports. Non-fuel secondary mineral exports were about 51% of total mineral exports and 61% of secondary mineral sales. Phosphoric acid exports, worth $78.5 million, dominated this trade. In contrast, exports of Senegalese refined petroleum products amounted to only about $23 million.

Senegal is an important regional entrepôt, and some of its mineral commodities trade, particularly imports of refined petroleum products and fertilizers, represents material for transshipment. Imports of mineral commodities for domestic consumption totaled about 15% of Senegal's total imports in 1991 of about $1.2 billion. These imports were dominated by crude oil and refined petroleum products, sulfur and ammonia for the fertilizer industry, and semifinished steel products.

Geologically, most of Senegal is made up of Mesozoic and Tertiary sedimentary rocks of the Senegal Basin. Lower Tertiary rocks host the country's phosphate and clay deposits. Salt diapirs, sourced from Jurassic salt beds, have formed stratigraphic traps for oil derived from Cretaceous source rocks. Other hydrocarbon traps are associated with folds that appear to have been formed by normal faulting related to the opening of the Atlantic Ocean. Senegal's coastline contains a large resource of titaniferous sands, derived from Precambrian granites outside of Senegal and deposited in Senegal by longshore currents. Lower Proterozoic granites and Birimian Series volcano-sedimentary rocks are found in southeast Senegal. These host a number of gold deposits, generally associated with quartz veins and/or iron sulfides, and commonly within northeast-trending shear zones. Large iron deposits are also found in this terrane, as are scattered occurrences of base metals, tantalum, and columbium mineralization.

Government Policies and Programs

Under pressure to privatize state-controlled industries, the Government was negotiating the sale of Senegal's only cement plant. The Government remained a major participant in the rest of the country's mining sector in 1991. In recent years, the Government has actively encouraged development of the mineral industry, particularly for nonphosphate mineral commodities. In this respect, emphasis has been placed on attracting investment for the development of the country's resources of titaniferous sands, iron ore, gold, peat, and crude oil.

In 1986, a new petroleum code was adopted to replace the Petroleum Code of 1960. The new petroleum legislation was followed by the adoption of a new investment code, law No. 87-25 of July 30, 1987. Apart from detailing certain licensing and tax exemptions for new investments, the new investment code identifies mining as a high-priority sector of the economy. A new mining code, law No. 88-06, was adopted August 26, 1988.

Production

The output of mineral commodities was again mixed in 1991 (see table 1). Output of calcium phosphates, the most important mineral produced in Senegal, fell almost 20%, largely because of mining disruptions experienced by Compagnie Sénégalaise des Phosphates de Taïba (CSPT), the larger of the country's two phosphate producers. As in 1990, crude aluminum phosphate production by Société Sénégalaise des Phosphates de

Thiès (SSPT) was reported to be nil. However, this merely reflected the fact that none of the mine's output was sold in crude form but was all calcined.

Cement production again showed a large increase, apparently driven by strong local sales; cement exports were negligible. Although not listed in table 1, phosphoric acid production by Industries Chimiques du Sénégal (ICS) increased 32% to 301,946 tons, but the company's output of manufactured fertilizers declined slightly to 170,845 tons. Artisanal miners in Senegal produce a modest but undocumented quantity of gold each year. A pilot plant was in operation toward yearend on a long-explored gold deposit in southeast Senegal; reportedly, the plant produced 1 kg of gold during the year.

Natural gas production data for 1991 were not available. Toward yearend 1988, the country's sole producer reportedly had an output of about 14,000 m^3/d. Output has likely declined since then, based on declines in reported crude petroleum output, as condensate, from the same wells.

Trade

Senegal's exports totaled approximately $904 million in 1991, of which an estimated $200 million was accounted for by mineral commodities. The main mineral commodities exported continued to be phosphate rock and derived manufactured fertilizers and phosphoric acid (see table 2). Exports of calcium phosphate rock amounted to 1,366,721 tons, virtually unchanged from the level in 1990. The value of these exports, however, declined 16% to $59 million, owing to weak world prices. Exports in 1991 of crude aluminum phosphate rock were nil because the entire production was calcined. Exports of the calcined product, called clinker, declined 44% to 55,074 tons; the value declined 46% to $2.45 million. In contrast, phosphoric acid exports followed the 28% increase in exports in 1990 with a further 31% increase in 1991 to 253,536 tons. The value in 1991 increased 33% to $78.5 million. However, manufactured fertilizer exports declined 13% to $22 million.

Concerns in the EC over the high cadmium content of the Senegalese calcium phosphates continued to hurt exports to that region. In 1991, sales of calcium phosphates to EC countries fell 64% to only 113,535 tons; this followed a 29% fall in sales in 1990. Sales to the EC represented only 11.5% of total calcium phosphate exports, compared with 27% in 1990. Sales to the Philippines fell 21% to 282,331 tons, and sales to Canada fell 67% to 15,614 tons. These declines were partly offset, however, by a 78% increase in sales to Iran to 374,674 tons and an 11% increase in sales to India to 348,011 tons. Calcined aluminum phosphate sales continued to be all to Europe but fell 44% to 55,074 tons. As in past years, phosphoric acid exports were all to India. Manufactured fertilizer exports were mainly to Europe and to various countries in West Africa. West African countries were also the main customers for Senegalese refined petroleum products exports and salt. Attapulgite exports were almost all to the EC.

Senegal's total imports in 1991 amounted to about $1.2 billion, of which mineral commodities accounted for about 15%. Of this trade, imports of crude oil amounted to about $75 million and refined petroleum products about $125 million. Based on 1990 trade statistics (see table 3) and the 32% increase in the production of phosphoric acid in 1991, it is estimated that Senegal's 1991 imports of sulfur for the fertilizer industry increased proportionately to about 300,000 tons, worth an estimated $29 million. Ammonia imports for the fertilizer industry, however, likely remained about the same as in 1990, or about 30,000 tons, worth about $3.5 million. Imports of steel semifinished products were worth about $65 million in 1990, the latest year for which data were available.

Structure of the Mineral Industry

In 1991, the mining industry of Senegal was dominated by the production of phosphates and derived phosphoric acid and manufactured fertilizers, and cement (see table 4). The Government owned 50% of both phosphate mining companies, part of the fertilizer factory, and, for much of the year, 100% of the cement factory. Apart from construction materials, nonphosphate primary mineral production was dominated by the production of limestone for cement, and of attapulgite and salt. The Government owned shares in most of the producers of these commodities.

An estimated 4,500 persons worked in the mining and related industries, of which about 2,400 were employed in phosphate mining and about 1,000 in the fertilizer industry. In addition, the majority of the country's approximately 2,000 railroad employees and a significant proportion of Dakar's port workers owed their livelihood to the transportation of mineral commodities.

Commodity Review

Metals.—Gold.—A consortium of Canadian and European companies and Société Minière de Sabodala operated a pilot recovery plant on the Sabodala gold deposit for part of the year. Reportedly, the 1 kg of gold recovered by the plant was ceremoniously presented to the Government at yearend. Evaluation of the property was expected to continue into 1992. The Sabodala deposit is about 75 km north of Kédougou.

Titanium.—Du Pont Senegal, Inc., a subsidiary of E.I. du Pont de Nemours & Co., continued exploration on its northern titaniferous sand concession, west of Kébémer. A feasibility study was completed during the year on the deposit and the results presented to the Government in November. The company felt that the deposit, although having ample tonnage for its needs, was not economic given prevailing low world titanium prices. Additional exploration work was planned in the area, however, and the company expected to renew its concession for another 3 years. In contrast, evaluation the previous year of the company's concession south of Dakar

had determined that the heavy-mineral distribution there was too erratic to be of further commercial interest.

Industrial Minerals.—The country's largest phosphate producer in 1991 continued to be CSPT. The economics of mining at the company's main deposit, Keur Mor Fall, continued to worsen owing to an ever-increasing stripping ratio and lower world phosphate prices. This, combined with the continuing decline in demand by its European customers for the company's high-cadmium content ore, led CSPT to shift more of its production to the nearby Tobène deposit. The move severely disrupted output for about 6 production months and was the main reason for the company's output declining 24% to only 1.546 Mmt. Nevertheless, this performance still represented 89% of Senegal's total output of calcium phosphate.

Total sales of calcium phosphates by CSPT increased slightly to 2.03 Mmt, driven by a 30% increase in local sales to 846,672 tons. Virtually all of the local sales were to the fertilizer company ICS. Exports declined by 7% to about 1.18 Mmt. Purchases by the EC declined 68% to 89,547 tons, owing to concerns over the cadmium content of the ore. Exports to the Philippines, CSPT's largest customer in 1990, were only 282,331 tons in 1991, a 21% decrease. Iran, a new customer in 1990, became CSPT's largest customer in 1991, increasing its purchases by 78% to 374,674 tons. India was second, with 348,011 tons, an 11% increase.

In contrast, SSPT experienced strong local and export demand for its production of calcium phosphate. Output increased 80% to 194,500 tons. Local sales increased almost ninefold to 62,691 tons. Exports increased 21% to 120,463 tons, largely driven by sales to a new customer, China, of almost 43,000 tons. Sales to EC customers declined 13% to about 77,500 tons. The company's emphasis on calcium phosphate, as in 1990 and 1989, reflected a continued lack of demand for SSPT's traditional product, aluminum phosphate. When calcined and ground, aluminum phosphate can be used directly as a fertilizer. In past years, because of high energy costs in Senegal, only about one-half of the material was calcined in-country; the rest was sent to Europe where energy costs were lower. But demand for the raw product overseas had been nil since 1988. Mine production, which had been reported as nil since that time, actually was all calcined. Output of this material, reported as clinker, was only 65,800 tons in 1991, a 28% decline. Clinker sales were largely to Belgium and France and declined 44% to about 55,100 tons. Sales of ground clinker, called Phospal, were only 500 tons, but represented a 50% increase. Côte d'Ivoire was the sole customer reported for this material in 1991.

ICS continued with its expansion program, commissioning a new phosphoric acid plant at yearend. The new plant has a design capacity of 165,000 mt/a of sulfuric acid and 97,000 mt/a of phosphoric acid. With the new plant, ICS's total capacity for the two acids reportedly stands at 860,000 mt/a and 330,000 mt/a, respectively. The new capacity was reflected in the company's 1991 output of 301,946 tons of phosphoric acid, a 32% increase. Reportedly, the company was considering adding yet another 100,000 mt/a to its phosphoric acid capacity. Manufactured fertilizer output declined slightly to about 171,000 tons, but exports declined 14% to about 130,000 tons, largely owing to a decline in exports to the EC. The EC announced at yearend 1990 that it would provide financial assistance to Senegal to help make its phosphate industry more competitive on the European market. The assistance, in the form of loans, was to be used in researching methods to reduce the cadmium content of both fertilizers and phosphate rock and to lower the production costs at ICS, SSPT, and CSPT to partially compensate for the anticipated costs of reducing the cadmium levels.

Mineral Fuels.—The Government continued to promote petroleum exploration in Senegal, particularly in the southern part of the country. At yearend 1991, UNOCAL received a 3-year concession for three blocks covering the Dôme Flore area, 60 km offshore of Casamance. UNOCAL, reportedly, was committed to drill two exploration wells and conduct a 500-line-km seismic survey on its concession, which covered 6,500 km^2. Talks were conducted with other companies during the year, mainly concerning onshore exploration near the border with Guinea-Bissau and near Thiès.

Reserves.—Exploration for phosphates has been ongoing in Senegal for about 50 years. The first commercial deposit was that of aluminum phosphate near Thiès, which has been in production by SSPT since 1949. The large calcium phosphate deposits at Taïba have been in production since 1960, and the calcium phosphates near Thiès have been in production since 1974. Several other phosphate deposits are known,[2] but few appear to be potentially economic. Near Thiès, SSPT has reserves of aluminum phosphate of about 100 Mmt grading 27.5% P_2O_5, within which inventory are reserves of about 50 Mmt grading 28.5% P_2O_5. Original reserves of calcium phosphate on SSPT concessions totaled about 4 Mmt grading about 29.5% (concentratable to 34%) P_2O_5. Approximately 32% of this inventory had been mined by yearend 1991. The remaining inventory of calcium phosphate at the Keur Mor Fall deposit exploited by CSPT consists of about 30 Mmt grading about 29% P_2O_5, concentratable to 37.5% P_2O_5. The stripping ratio at the mine is increasing. It is not clear how much of the inventory can be classified as reserves given the increased mining costs, low world phosphate prices, and the material's high cadmium content. The adjoining Tobène deposit has reserves, according to the company, of about 50 Mmt, capable of being concentrated to 36.2% P_2O_5. A number of phosphate occurrences are known just south of the Mauritania border in the Senegal River valley. The largest resource is in two deposits near Semmé, 60 km southeast of Matam. The total resource at Semmé is 40.5 Mmt (36.5 Mmt recoverable) grading 28.7% P_2O_5. Development of the Semmé phosphates,

except on a very small scale for local consumption, would require the construction of railing and port facilities, the cost of which has been estimated to be in excess of $100 million. Given the large remaining reserves in the Taïba-Thiès area, the Semmé deposits are not likely to become economic for many years.

Senegal has had past small-scale mining of titaniferous sand deposits. Numerous studies have been done to determine reserves of heavy minerals. At yearend, Dupont Senegal announced an in-the-ground inventory on its concession north of Dakar of 8 to 10 Mmt; no grade was announced, however.

Numerous gold occurrences are known in the Precambrian terrane of southeast Senegal. The Sabodala deposit is the only occurrence examined to date that appears to warrant exploitation. Société Minière de Sabodala, a joint venture between France's Bureau de Recherches Géologiques et Minières, 51%, and the Government, was formed in 1983 to explore and develop the deposit. According to the Government, a feasibility study completed in 1982 concluded that reserves amounted to 240,000 tons of oxide ore grading 7.42 g/mt of gold, plus 2.42 Mmt of sulfide ore grading 4.92 g/mt of gold. A 1983 study concluded that the oxide reserves were 235,260 tons grading 6.5 g/mt of gold. A consortium of foreign companies set up a small pilot plant on the property in 1991, but the results of its evaluation had not been released at yearend.

Probably the most significant undeveloped mineral resources in Senegal are the iron occurrences of southeast Senegal, generally called the Falémé deposits. A 1990 audit of past feasibility studies on the Falémé deposits put the reserves of the largest deposit (Koudékourou) at approximately 300 Mmt grading 60% iron. Exploitation of the deposit would require the construction of extensive railing and port shipping infrastructure, and the expected cost of this makes the project economically questionable. Four other iron ore deposits are known in the region; these alone could not justify the cost of the required ore transportation infrastructure but could potentially be viable once Koudékourou was developed. Two of these other deposits are hematitic; the Karakaène deposit has a resource of 60 Mmt, and the Kouroudiako deposit contains 51 Mmt. Both grade about 56% iron and occur 50 to 60 km north of the Koudékourou deposit. About 35 km north of the Koudékourou deposit are two magnetite iron ore deposits; these contain a total resource of about 190 Mmt grading 41% to 45% iron.

Senegal's oil and gas reserves are not well known. Despite sporadic exploration for almost 40 years, including the drilling of approximately 150 wells, commercial discoveries have been limited to small gasfields east of Dakar. The most significant of these is the Diam Niadio Field, currently in production. According to the Government, reserves in this field total about 50 Mm^3; large-scale production from this field has yet to be achieved. The offshore Dôme Flore Field has been explored intermittently since 1958 and has been the subject of a number of border disputes with Guinea-Bissau. These disputes were largely resolved in 1986, leaving the known resources in Senegal territory. According to the Government, known reserves in this field are approximately 640 Mbbl of very heavy-weight crude oil (± 10° API), and perhaps 14 Mbbl of light crude.

Senegal has extensive peat deposits along the coast between Dakar and Saint-Louis. The largest deposits are in the so-called Central Zone, a 1- to 3-km-wide belt extending 30 to 70 km northeast of Dakar. This zone contains an extractable resource estimated to be almost 23 Mm^3, sufficient for 20 years of feed for a 30-MW electrical plant. Smaller deposits within this zone and in zones to the northeast and southwest contain an additional resource of 6 Mm^3 that is not suitable for large-scale mining but could be used for domestic heating purposes. In this regard, the peat is said to have a heat output equivalent to 58% of that of charcoal. In addition, there is a resource of approximately 15 Mm^3 of peat that is too sandy for burning but that could be used as much for agricultural purposes.

Infrastructure

Senegal's railroad infrastructure is relatively well developed only in the northwest part of the country. The railroad network in 1991 consisted of 1,034 km of 1-m-gauge track, all single track except for 70 km of double-track line from Dakar to Thiès. The line from Dakar to the Mali border (and thence to Bamako) was completed in 1923, and trade along this route led to Dakar's early development as a significant regional port. More than 95% of the total railing tonnage in Senegal in recent years has been related to the transport of mineral commodities, including fertilizers. Most of freight and passenger railings are handled by the parastatal Régie des Chemins de fer du Sénégal. However, traffic related to ICS is handled by that company's own railroad company, Société d'Exploitation Ferroviaire des Industries Chimiques du Sénégal. Although the present railroad infrastructure is adequate for current mining output, exploitation of the Falémé iron ore deposits in southeast Senegal will require the construction of a railroad from the deposit to the existing Dakar-to-Mali line. The line to Mali is being rehabilitated, but to medium-duty use rather than to the heavy-duty specifications necessary for safe and efficient iron ore transport.

Senegal had about 14,000 km of roads in 1991; about 30% of this network has been paved. The country has about 900 km of navigable waterways, mostly on the Sénégal River, which forms the border between Senegal and Mauritania, and 115 km on the Saloum River as far as Kaolack.

Senegal has four main ports: Dakar, Saint-Louis, Kaolack, and Ziguinchor; the latter two are river ports that can handle oceangoing ships. Only Dakar is a significant mineral port, although some of the country's salt production is shiploaded at Kaolack. In 1991, Dakar had 43 docks of total length of 7,618 m and had a harbor entrance depth of 11 m. The port

had facilities adequate for offloading approximately 1.5 Mmt/a of crude oil and petroleum products, 300,000 mt/a of sulfur, and about 30,000 mt/a of ammonia. In 1988, the latest year for which data were available, trade through Dakar totaled about 5 Mmt. Imports of mineral commodities (mostly crude oil, petroleum products, sulfur, and steel semifinished products) amounted to 752,000 tons of this. Mineral commodity exports, including fertilizers, amounted to 2 Mmt. Exploitation of Senegal's iron ore deposits will require the construction of an ore port at Bargny, 30 km east of Dakar.

Senegal had an electrical generating capacity of 231 MW in 1990, the latest year for which data were available. All of this installed capacity was in thermal plants. Production of electricity in 1990 was 684 GW • h. Except for the burning of the country's modest natural gas output, all of the country's electricity generation used imported fuel. Senegal is involved in a joint project with Mali and Mauritania to harness the Senegal River and its tributaries for hydroelectric and irrigation purposes. The project involves two dams, although only the Manantali Dam, on the Bafing tributary to the Senegal River in Mali, will have a hydroelectric plant. Installation of the turbines at Manantali continued to be held up in 1991 because of a dispute with Mauritania over the routing of the power transmission lines from the dam to Dakar. Senegal will receive approximately two-thirds of the expected 800 GW • h/a output.

Outlook

Senegal's mineral economy will continue to be dominated by the exploitation of phosphate deposits. Exports of phosphates and manufactured phosphate fertilizers to some markets will continue to be hurt because of concerns over cadmium. However, research into reducing the level of this contaminant may, if successful, restore export demand to former high levels, given the high-phosphorus content of the ore. There are large phosphate reserves at or near the existing mines; consequently, the near-term exploitation of the Semmé phosphate deposits, which would require extensive infrastructure development, is unlikely. Senegal's resources of titaniferous sands require an improvement in world prices to justify development, but if developed would require a lead time of only about 2 years. There appears to be some modest potential for the discovery of commercial petroleum deposits. The production of natural gas, from known onshore fields, is likely to remain small but may well increase above current levels. Installation of hydroelectric capacity at the Manantali Dam in Mali will greatly reduce Senegal's need to import fuel for electricity generation and would reduce the incentive to exploit the country's large deposits of peat. The economics of exploiting the Falémé iron ore deposits remain very uncertain given the high cost of constructing the necessary railing and port infrastructure and current world market conditions for iron ore.

The near-term prognosis for Senegal becoming a modest producer of gold is good, initially through the exploitation of the Sabodala gold deposit, but also through the discovery and development of additional deposits.

THE GAMBIA

Mining is a negligible component of the Gambian economy, which has for many years been dominated by agriculture, tourism, and the largely unregistered transshipment of goods into Senegal. Output of agricultural products, especially cotton and rice, continued to decline in 1991 owing to a prolonged drought and the resulting influx of salt water into the fields. Production of mineral commodities in 1991 was limited to brick clay, laterite, sand and gravel, and cockle shells, for local construction purposes. Deposits of these materials are believed to be significant and could support a greater level of exploitation. Fewer than 200 persons were believed to be employed full time in mining.

The geology of The Gambia is dominated by Mesozoic and Cenozoic sedimentary rocks, deposited in a regional basin related to the opening of the Atlantic Ocean. There is believed to be some potential for the discovery of oil in this basin. Several thousand kilometers of seismic surveys have been run over the past 30 years and a few petroleum exploration wells, all unsuccessful, drilled. The Government was negotiating funding for additional seismic surveys and was trying to attract petroleum exploration investment in the country.

The Gambia has significant glass sand deposits; these have yet to be exploited. In the 1950's, titaniferous beach sands were mined. According to the Government, the remaining resource, at a 1% heavy-mineral cutoff, amounts to 20 Mmt grading 4.9% heavy minerals. At a 3% cutoff, the resource is 9 Mmt grading 8.6% heavy minerals. The heavy-mineral concentrates average 70.2% ilmenite, 15.9% zircon, 3.3% rutile, and 10.6% gangue minerals.

The Gambia has no railroads but has about 3,100 km of highways. The Gambia River is navigable for approximately 240 km by oceangoing ships of up to 5.5-m draft. Electrical generating capacity, all from thermal plants, was 23 MW in 1991; annual production in recent years has been about 70 GW • h. The Government plans to expand electricity output by about 15% annually.

GUINEA-BISSAU

The Government of Guinea-Bissau continued to prospect for mineral deposits in 1991. Past exploration has confirmed the existence of significant deposits of bauxite and phosphates. The bauxite deposits are in the Boé region along the border of Guinea and Guinea-Bissau and grade about 44% Al_2O_3. Discussions were held during the year with the Government of Guinea concerning joint exploitation of the bauxite, but no agreements toward this end had been announced by yearend. Phosphate deposits occur near Farim in the north-central part of the country. They grade about 30% P_2O_5. Discussions have been held with the Government of France to finance the development of the phosphate

deposits. Mineral production in 1991 was limited to crude construction materials, worth about $6 million.

In 1990, the UN Department for Technical Cooperation and Development (UN/DTCD) assisted the Government in formulating a new mining code and in creating a National Mining Fund. The UN/DTCD also assisted in preparing a model agreement for foreign investors interested in investing on prospects in the country. The UN/DTCD was planning to conduct a regional exploration program for gold and diamond in various parts of the country. There has been no significant mining investments by foreign investors since the approval of the mining code in 1990. The Government maintains a minerals data base to facilitate preliminary research on the country by foreign mining companies. There is, however, an ongoing exploration program for petroleum in the Anetibené region. Lack of adequate infrastructure is seen as being the main impediment to the development of the country's mineral resources.

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[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF282.11=US$1.00.

[2]Direction des Mines et de la Géologie, 1984, Plan Minéral de la République du Sénégal.

OTHER SOURCES OF INFORMATION

Direction des Mines et de la Géologie
B.P. 1238
Dakar, Senegal

The Ministry of Economic Planning and
Industrial Development Central Bank
Building
Banjul, The Gambia

TABLE 1

SENEGAL: PRODUCTION OF MINERAL COMMODITIES[1]

Commodity[2]		1987	1988	1989	1990	1991
Cement, hydraulic	metric tons	372,071	390,956	379,793	469,537	503,317
Clays: Fuller's earth (attapulgite)	do.	[3]111,048	118,725	98,882	114,610	129,403
Petroleum:						
Crude	thousand 42-gallon barrels	e11	20	13	8	4
Refinery products:						
Gasoline	do.	800	951	[4]2,261	[4]2,520	[4]2,124
Kerosene and jet fuel	do.	576	799	652	682	644
Distillate fuel oil	do.	1,270	1,564	e2,000	2,057	1,374
Residual fuel oil	do.	1,395	1,815	1,493	e1,500	e1,300
Other	do.	43	e44	e57	e32	55
Refinery fuel and losses	do.	213	227	e185	209	193
Total	do.	[5]4,297	e5,400	e6,648	e7,000	e5,690
Phosphate rock and related products:						
Crude:						
Aluminum phosphate	thousand metric tons	191	119	r e[6]140	r e[6]127	e92
Calcium phosphate	do.	1,874	2,326	2,273	2,147	1,741
Manufactured:						
Aluminum phosphate, dehydrated[7]	do.	89	61	100	91	66
Other[8]	do.	4	2	2	1	1
Salt	metric tons	75,442	75,000	r e97,000	e92,000	102,000

eEstimated. rRevised.

[1]Includes data available through Jan. 24, 1992.

[2]In addition to the commodities listed, Senegal produced clay, 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, at yearend 1988, gas production was reportedly at a rate of 14,000 cubic meters per day and, reportedly, has fallen significantly since then.

[3]Attapulgite production for 1987 is for Société Sénégalaise des Phosphates de Thiès (SSPT) only. Data are unavailable for the production from Compagnie des Produits Chimiques et Matériaux for this period, although it was likely to have been about 10,000 mt/a.

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

[5]Output was reported by SSPT 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]SSPT products marketed under the trade names "Balifos" and "Phospal."

TABLE 2

SENEGAL: EXPORTS OF MINERAL COMMODITIES[1] [2]

(Metric tons unless otherwise specified)

Commodity	1990	Principal destinations
METALS		
Aluminum: Metal including alloys, semimanufactures	3	France 1; unspecified 2.
Copper: Metal including alloys:		
Scrap	1,067	France 455; United Kingdom 209; Netherlands 154.
Semimanufactures	62	United Kingdom 60.
Iron and steel: Metal:		
Scrap	10,934	Italy 7,340; France 1,965; Spain 1,581.
Semimanufactures:		
Bars, rods, angles, shapes, sections	403	Mali 125; France 51; Guinea 37.
Universals, plates, sheets	522	France 306; Mali 152; Gambia 15.
Wire	99	Congo 21; Guinea 20; Guinea Bissau 6.
Tubes, pipes, fittings	66	Mali 51; unspecified 15.
Castings and forgings, rough	13	All to bunkers.
Lead:		
Oxides	2	All to Guinea.
Metal including alloys:		
Scrap	385	United Kingdom 124; Republic of Korea 83; Italy 63.
Semimanufactures	10	All to bunkers.
Nickel: Metal including alloys, semimanufactures	5	All to Guinea.
Zinc: Metal including alloys:		
Scrap	80	All to Belgium-Luxembourg.
Semimanufactures	1	NA.
INDUSTRIAL MINERALS		
Cement	14,770	Mali 14,245; Gambia 303.
Clays, crude	108,691	Netherlands 51,932; France 51,177.
Fertilizer materials: Manufactured:		
Ammonia	27	Guinea-Bissau 3; bunkers 22.
Nitrogenous	851	Mali 694; Gambia 107; Guinea-Bissau 35.
Phosphatic	122,751	France 60,777; Belgium-Lexembourg 26,850; Netherlands 21,500
Phosphoric acid	201,383	India 185,280; Iran 9,100; Nigeria 4,444.
Potassic	900	All to Mali.
Unspecified and mixed	122,116	Spain 32,364; Côte d'Ivoire 32,200; Mali 18,810.
Gypsum and plaster	108	Mali 60; Guinea 24; Gambia 20.
Phosphates, crude thousand tons	1,209	India 312; Philippines 310; Iran 208.
Salt and brine	110,139	Côte d'Ivoire 46,176; Mali 29,664; Benin 10,912.
Sodium compounds, n.e.s.: Soda ash, manufactured	21	Mali 20.
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	5,431	Gambia 5,125; Guinea-Bissau 305.
Worked	22	Guinea 20; Gambia 2.
Gravel and crushed rock	2,723	Gambia 2,112; Guinea-Bissau 600.
Sand other than metal-bearing	90	All to Japan.
Sulfur:		
Elemental: Crude including native and byproduct	60	All to Mali.
Sulfuric acid	52	Guinea 26; Mali 25.

See footnotes at end of table.

TABLE 2—Continued

SENEGAL: EXPORTS OF MINERAL COMMODITIES[1] [2]

(Metric tons unless otherwise specified)

Commodity		1990	Principal destinations
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Liquefied petroleum gas	thousand 42-gallon barrels	1	Mainly to Gambia.
Gasoline	do.	1,188	Mali 139; bunkers 1,024.
Mineral jelly and wax	do.	(3)	All to Guinea-Bissau.
Kerosene and jet fuel	do.	20	Mainly to Mali.
Distillate fuel oil	do.	957	Mali 190; Guinea-Bissau 12; bunkers 699.
Lubricants	do.	23	Mali 10; Togo 2; bunkers 7.
Residual fuel oil	do.	368	Italy 128; Mali 127; bunkers 113.

NA Not available.

[1]Comparable data not available for 1989. Table prepared by Virginia A. Woodson.

[2]Senegal did not report any exports of mineral commodities to the United States for 1990.

[3]Less than 1/2 unit.

TABLE 3

SENEGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1990	Sources	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals		1	—	Mainly from France.
Aluminum:				
Oxides and hydroxides	value, thousands	$1	—	All from France.
Metal including alloys, semimanufactures		955	(2)	France 266; Sweden 236; Cameroon 173.
Copper:				
Matte and speiss including cement copper	value thousands	$8	—	All from France.
Metal including alloys:				
Scrap		3	—	All from Guinea-Bissau.
Unwrought		1	—	All from France.
Semimanufactures		150	2	France 129; China 6; Italy 6.
Gold: Metal including alloys, unwrought and partly wrought	kilograms	1	—	All from Côte d'Ivoire.
Iron and steel: Metal:				
Scrap		39	—	France 25; Guinea-Bissau 7.
Ferroalloys: Unspecified	value, thousands	$1	—	All from France.
Steel, primary forms	do.	$10	—	Do.
Semimanufactures:				
Bars, rods, angles, shapes, sections		43,357	—	Brazil 17,537; Spain 9,723; Turkey 5,154.
Universals, plates, sheets		23,329	—	France 11,577; Côte d'Ivoire 3,902; Belgium-Luxembourg 2,559.
Hoop and strip		1,010	—	Hungary 500; France 144; Belgium-Luxembourg 136.
Rails and accessories		1,373	—	Italy 1,087; France 260.
Wire		1,474	—	China 440; France 249; Spain 230.
Tubes, pipes, fittings		9,946	1	France 4,525; West Germany 2,174; Spain 1,329.
Castings and forgings, rough		363	(2)	France 191; Italy 131; Belgium-Luxembourg 40.
Lead:				
Oxides		32	—	Mainly from France.
Metal including alloys, semimanufactures		70	—	All from France.
Manganese: Oxides		1,321	—	Gabon 1,320.
Mercury	value, thousands	$4	—	Mainly from France.
Nickel: Metal including alloys, semimanufactures		184	—	Spain 76; Lebanon 41; West Germany 29.
Platinum-group metals: Metals including alloys, unwrought and partly wrought	value, thousands	$11	—	All from Netherlands.
Silver: Metal including alloys, unwrought and partly wrought	do.	$148	—	Belgium-Luxembourg $146; Switzerland $2.
Tin: Metal including alloys:				
Unwrought	do.	$4	—	All from France.
Semimanufactures		5	—	France 3; Belgium-Luxembourg 1.
Titanium: Oxides		8	—	Mainly from France.
Zinc:				
Oxides		27	—	France 23; Belgium-Luxembourg 2.
Metal including alloys, semimanufactures		4	—	France 2; Spain 2.
Other: Oxides and hydroxides		39	—	France 11; Belgium-Luxembourg 8; Switzerland 8.

See footnotes at end of table.

TABLE 3—Continued

SENEGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1990	Sources	
			United States	Other (principal)
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	value, thousands	$1	—	All from France.
Grinding and polishing wheels and stones		26	—	France 21; Italy 2.
Asbestos, crude		646	—	U.S.S.R. 338; Canada 308.
Barite and witherite		4	—	All from France.
Boron materials:				
Crude natural borates		1,102	1,100	France 2.
Oxides and acids		3	—	All from France.
Cement		3,182	—	France 1,972; Republic of Korea 600; Belgium-Luxembourg 265.
Chalk		3,509	—	France 3,260; Morocco 210.
Clays, crude		45	—	France 21; United Kingdom 19; Switzerland 4.
Diatomite and other infusorial earth		40	—	France 29; Netherlands 10.
Fertilizer materials:				
Crude, n.e.s.		159	—	All from France.
Manufactured:				
Ammonia		28,778	—	Trinidad and Tobago 7,500; Italy 8,688; U.S.S.R. 6,893.
Nitrogenous		32,533	—	Poland 20,099; East Germany 9,400; Hungary 1,437.
Phosphatic		75	—	All from Belgium-Luxembourg.
Potassic		34,698	—	U.S.S.R. 27,590; Spain 5,800.
Unspecified and mixed		8	—	France 4; Italy 2; United Kingdom 1.
Gypsum and plaster		14,546	—	Morocco 13,751; France 569.
Lime		1,087	—	France 823; Spain 249.
Magnesium compounds: Magnesite, crude		15	—	Netherlands 10; France 4.
Mica:				
Crude including splittings and waste		9	—	France 8; Canada 1.
Worked including agglomerated splittings	value, thousands	$3	—	France $1; India $1.
Phosphates, crude		3	—	All from France.
Pigments, mineral: Iron oxides and hydroxides, processed		106	—	West Germany 75; France 23.
Salt and brine		90	—	France 68; Netherlands 21.
Sodium compounds, n.e.s.: Soda ash, manufactured		785	(2)	France 418; West Germany 100; Belgium-Luxembourg 83.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked		1,012	—	Italy 631; Portugal 207; Spain 69.
Worked		1,163	—	Italy 892; Portugal 182.
Gravel and crushed rock		98	—	France 94; Italy 4.
Quartz and quartzite		6	—	France 5.
Sand other than metal-bearing		190	—	France 170; Italy 20.
Sulfur:				
Elemental:				
Crude including native and byproduct		237,204	98,454	Canada 70,067; Saudi Arabia 28,096.
Colloidal, precipitated, sublimed		1	—	All from France.
Sulfuric acid		122	—	Netherlands 81; Belgium-Luxembourg 35; France 6.

See footnotes at end of table.

TABLE 3—Continued

SENEGAL: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1990	Sources	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Talc, steatite, soapstone, pyrophyllite		230	2	France 203; Belgium-Luxembourg 24.
Other: Slag and dross, not metal-bearing		5,602	—	All from France.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		154	—	Spain 150; France 4.
Carbon black		394	(2)	France 228; Mexico 96; Spain 50.
Coal[3]		16	—	Poland 10; France 6.
Coke and semicoke		503	—	France 492; Belgium-Luxembourg 11.
Petroleum:				
Crude	thousand 42-gallon barrels	5,661	—	Nigeria 3,214; Gabon 2,447.
Refinery products:				
Liquefied petroleum gas	do.	400	—	Spain 204; Nigeria 89; France 73.
Gasoline	do.	735	—	Italy 168; Greece 141; Spain 138.
Mineral jelly and wax	do.	32	(4)	Belgium-Luxembourg 8; France 8; Spain 5.
Kerosene and jet fuel	do.	3	—	Mainly from Saudi Arabia.
Distillate fuel oil	do.	1,970	—	Nigeria 1,043; Italy 311; Argentina 254.
Lubricants	do.	116	(4)	United Kingdom 38; France 34; Netherlands 3.
Residual fuel oil	do.	1,557	—	Netherlands Antilles 1,025; Spain 149; Italy 121.
Bitumen and other residues	do.	19	—	Spain 18; France 1.
Bituminous mixtures	do.	13	—	France 6; Spain 6.

[1]Comparable data not available for 1989. Table prepared by Virginia A. Woodson.
[2]Unreported quantity valued at $1,000.
[3]May include lignite and peat.
[4]Less than 1/2 unit.

TABLE 4

SENEGAL: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

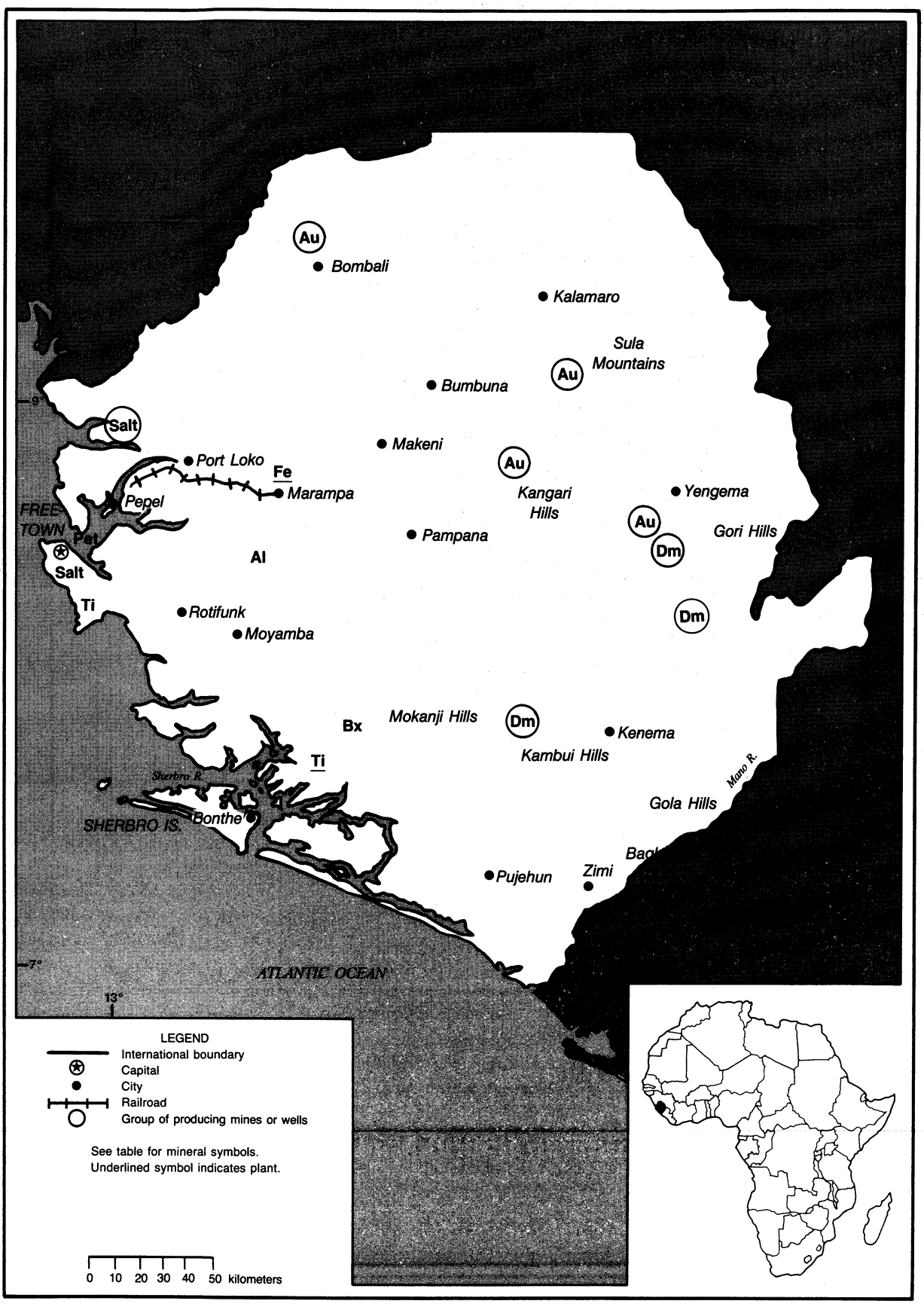
(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Attapulgite	Compagnie des Produits Chimiques et Matériaux (Carbonisation et Charbon Actifs, France, 100%)	Open pit mining of 4 deposits at Nianing, 80 kilometers southeast of Dakar	*25,000 attapulgite.
Do.	Société Sénégalaise des Phosphates de Thiès (SSPT) (Rhône Poulenc Group, France, 50%; Government, 50%)	Open pit mine 15 kilometers southwest of Thiès	*120,000 attapulgite.
Cement	Société Ouest-Africaine des Ciments (Government, 100%)	Limestone quarry and cement plant at Rufisque, 20 kilometers east of Dakar	700,000 kiln output.
Mineral fuels:			
Crude oil and natural gas	Tullow Oil Plc. of Ireland and Société des Petroles du Sénégal	Diam Niadio gasfield, 40 kilometers northeast of Dakar	NA.
Petroleum products, thousand barrels	Société Africaine de Raffinage (Société Nationale Elf Aquitaine, France, 30.0%, Royal Dutch/Shell, 23.6%; British Petroleum, 11.8%; Total, France, 11.8%; Mobil Corp., 11.8%; Government, 10.0%; Exxon Corp., 1.0%)	Oil refinery near Dakar	8,800 crude input.
Phosphates:			
Aluminum phosphate	SSPT	Open pit mine 17 kilometers north of Thiès	*375,000 aluminum phosphate ore, 200,000 clinker.
Calcium phosphate	Compagnie Sénégalaise des Phosphates de Taïba (CSPT) (Government, 50%; Compagnie Française des Mines, 14.64%; Nouvelle Compagnie Finacière pour l'Outre Mer, France, 13.65%; International Minerals and Chemical Corp., United States, 10.42%; Others, 11.29%)	Open pit phosphate mines at Taïba, 38 kilometers north-northeast of Thiès	2,300,000 calcium phosphate ore.
Do.	SSPT	Open pit mine near Thiès	*200,000 calcium phosphate ore.
Salt	Société Nouvelle des Salins de Siné-Saloum (Government, Compagnie des Salins du Midi et des Salines de l'Est, France)	Marine salt recovery ponds west of Kaolack	*150,000 salt.

*Estimated. NA Not available.

SIERRA LEONE

AREA 71,740 km² **POPULATION 4.2 million**



THE MINERAL INDUSTRY OF

SIERRA LEONE

By Bernadette Michalski

The production and export of mineral commodities, particularly rutile and ilmenite, bauxite, diamonds, and gold, listed by order of value, have traditionally sustained Sierra Leone's economy. In recent years, heavy revenue losses attributed to illegal trading in diamonds and gold contributed to the country's serious trade deficits and faltering economy. Revisions to the diamond and gold mining and trading regulations continued to be promulgated in an effort to reverse this situation.

GOVERNMENT POLICIES AND PROGRAMS

The Government made a serious effort to comply with the recommendations for a more stable economy as made by the International Monetary Fund (IMF) and the World Bank. The National Provisional Ruling Counsel that took over the Government in May 1992 confirmed its commitment to the economic recovery program agreed to between the previous Government and the IMF. A credit agreement with the World Bank was also to be honored by the new Government.

Sierra Leone's official foreign debts exceeded $600 million, including the $150 million in arrears to the IMF. Several bilateral assistance programs have been canceled or delayed due to outstanding arrears.

PRODUCTION

With the exception of rutile, which experienced a fourth successive record production year in 1991, mineral output was relatively stable. The production of iron ore remained suspended since 1985, and the reactivation of the Marampa iron ore mine remained under consideration. Government efforts to curb diamond and gold smuggling have brought only very limited improvement to 1991 reported official production levels for these commodities. *(See table 1.)*

TRADE

The value of Sierra Leone's mineral exports was estimated at $195 million in 1991, equal to approximately 90% of total exports for the year. Rutile continued to be the nation's principal mineral export, valued in excess of $115 million, with shipments destined for Western Europe and the United States. Bauxite exports earned approximately $50 million in 1991. While illicit trading of diamonds and gold continued, official diamond exports were valued at approximately $30 million. This represented a threefold increase over the previous year as a response to Government policy changes instituted in early 1991.

STRUCTURE OF THE MINERAL INDUSTRY

The Government maintained total control of petroleum refining operations and a controlling interest in the diamond and gold mining industries. The mining of bauxite, rutile, and ilmenite remained open to foreign investment. *(See table 2.)*

COMMODITY REVIEW

Metals

Bauxite.—The Sierra Leone Ore and Metal Co.(SIEROMCO), the nation's sole bauxite producer, operated the Mokanji Mine. A second bauxite operation and an alumina plant were planned for development at Port Loko.

Gold.—The National Diamond Mining Co. holds exclusive licenses for gold prospecting in three areas of the country, including Pampana North and Gori Hills. The Government, however, began returning gold exporting activities to the private sector. Traders were permitted to retain 40% of export earnings while 60% was required to be repatriated to the Central Bank of Sierra Leone at the official rate.

Iron and Steel.—African Metals Ltd., a subsidiary of FERROMET, has signed a $40 million contract with the Sierra Leone Government to collect and process ferrous and nonferrous scrap. An estimated 200,000 tons of mostly ferrous scrap is found in industrial sites. African Metals will collect and compress the scrap for export through the FERROMET network.

Titanium.—In 1991, rutile production from Sierra Rutile Ltd. attained a record level for the fourth consecutive year with output reported at 154,800 tons. About three-quarters of the rutile production came from primary production and the remainder from retreating mine tailings. Ilmenite, a byproduct of rutile production, was reported at 60,371 tons. Bucket-ladder dredging operations were sustained throughout the year in the low-grade Pejebu deposit. Sierra Rutile Ltd. anticipated moving in March 1992 to Lanti, which is purported to be the richest known deposit of commercially minable rutile. The Lanti deposit and its associated Gbeni deposit are expected to

have a lifetime of 10 years at the current production rate.

The pisciculture program at the lake resulting from the former mining operations at the Bamba-Belebu rutile-ilmenite deposit progressed beyond the fish nursery stage. By 1991, it provided a source of income to local fishermen and provided fish for local consumption.

Intercontinental Gold and Minerals NL and MC Mining NL of Australia have entered into agreement with the Government to develop the titanium dioxide-bearing mineral deposits near Rotifunk, about 60 km southeast of Freetown. On development, mining operations were expected to yield 56,000 tons of rutile and 83,000 tons of ilmenite annually for a projected production life of 12 years commencing in 1992.

Zirconium.—April 1991 marked the completion of the dry section of the zircon recovery plant. The wet-processing section of the plant came on-stream in September of 1990 when high-grade zircon-bearing material, in the form of froth flotation concentrate, was stockpiled for processing by the dry section. The plant was designed to recover zircon and to a lesser extent rutile and ilmenite. Raw materials for the plant were supplied from both old mill tailings and current mine production from Sierra Rutile Ltd.'s mining operations.

Industrial Minerals

Diamonds.—In an effort to maximize Government earnings and to reduce the level of illicit trading, the Government began returning diamond and gold exporting activities to the private sector. Traders were permitted to retain 40% of export earnings while 60% was required to be repatriated to the Central Bank of Sierra Leone at the official rate. Those intending to mine or export diamonds or gold had to obtain annually renewable licenses with fees sometimes as high as $100,000.

The Government is courting international diamond miners and dealers. An important new source of revenue is anticipated under the mining concession agreement signed in early 1991 on the largest known kimberlite pipe in the nation. The Sunshine Mining Co. of Dallas, Texas, has been granted a 20-year concession to extract and market diamonds from the Koidu area where a total of 2.4 M carats of mostly gem-quality diamonds are anticipated over a 15-year period. Production startup is anticipated by late 1992. Ore production rate is projected at 485,000 mt/a.

Mineral Fuels

The Sierra Leone Petroleum Refining Co. of Freetown operated a 10,000-bbl/d-capacity refinery based on imported crude. Traditional crude oil suppliers have been Nigeria, Iran, and Libya, but overdue obligations have jeopardized Sierra Leone's credit position. The lack of foreign exchange resulted in the frequent closure of the refinery causing an almost chronic shortage of gasoline. The situation improved as Unipetrol of Nigeria agreed to supply Sierra Leone with 260,000 bbl/month of crude oil commencing October 1991. Under a joint-venture agreement, the refined oil will be marketed in Sierra Leone by Unipetrol Sierra Leone, a company with 60% equity held by the Panaf Group of Sierra Leone and 40% held by Unipetrol Nigeria.

Reserves

Rutile and ilmenite reserves described as proven and probable were reported by Sierra Rutile Ltd. as 239.3 Mmt averaging 1.57% recoverable TiO_2 equivalent at yearend 1990. Reserves at the Rotifunk deposit were reported at 146 Mmt containing 0.6% rutile and 0.8% ilmenite.

INFRASTRUCTURE

The nation's roadways totaled 7,400 km. Only 1,150 km of roadway was bituminous surfaced; the remainder was gravel or improved earth. A 43-km road link between Waterloo and Masiaka is to be rebuilt at a cost of $13.9 million. Financing was attained by a grant from the European Development Fund.

A $48 million loan was secured from the African Development Bank to construct the Bumbuna Hydroelectric Dam on the Seli River, which will provide 50 MW of power 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 up-river 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.

OUTLOOK

A significant proportion of diamond and gold mining and trading activity continues to bypass Government revenue collection channels. There are, however, indications that the diamond market is responding to policy changes instituted in early 1991. Nonetheless, the nation continues to record deficits forcing heavy reliance on external financing. Because the Government continues to borrow or issue more currency when a liquidity crisis occurs, rampant inflation continues to destabilize the economy.

The mining of titanium-bearing sands has met with success over recent years as Sierra Leone's rutile is of high grade with notably low radioactivity. These aspects should continue to make it highly marketable. All future mineral development programs must take into consideration high infrastructure and environmental restoration planning and costs.

OTHER SOURCES OF INFORMATION

Ministry of Mines
Freetown, Sierra Leone

Bank of Sierra Leone
Freetown, Sierra Leone

Nord Resources Corp.
8150 Washington Village Drive
Dayton, Ohio 45458
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TABLE 1

SIERRA LEONE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991e
Aluminum: Bauxite, gross weight	thousand tons	1,390	1,379	1,562	1,430	[2]1,288
Diamond:						
Gem e	thousand carats	214	12	90	66	160
Industrial e	do.	100	6	39	12	83
Total	do.	314	18	129	78	[2]243
Gold	kilograms	422	44	226	32	[2]26
Gypsum e		4,000	4,000	4,000	4,000	4,000
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	9	8	7	6	4
Gasoline	do.	250	225	190	180	125
Jet fuel	do.	150	125	100	100	100
Kerosene	do.	50	45	35	30	25
Distillate fuel oil	do.	450	425	375	375	300
Residual fuel oil	do.	360	350	300	300	250
Other	do.	1	1	1	1	1
Total	do.	r1,270	r1,179	r1,008	992	805
Salt e	thousand tons	200	200	200	200	200
Titanium:						
Rutile ore and concentrate 96% TiO_2, gross weight		113,300	126,332	128,198	144,284	[2]154,800
Ilmenite ore and concentrate 60% TiO_2, gross weight		5,600	42,118	62,310	54,639	[2]60,371
Zircon		—	—	—	—	[2]1,119

eEstimated. rRevised.

[1]Table includes data available through July 31, 1992.

[2]Reported figure.

TABLE 2

SIERRA LEONE: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

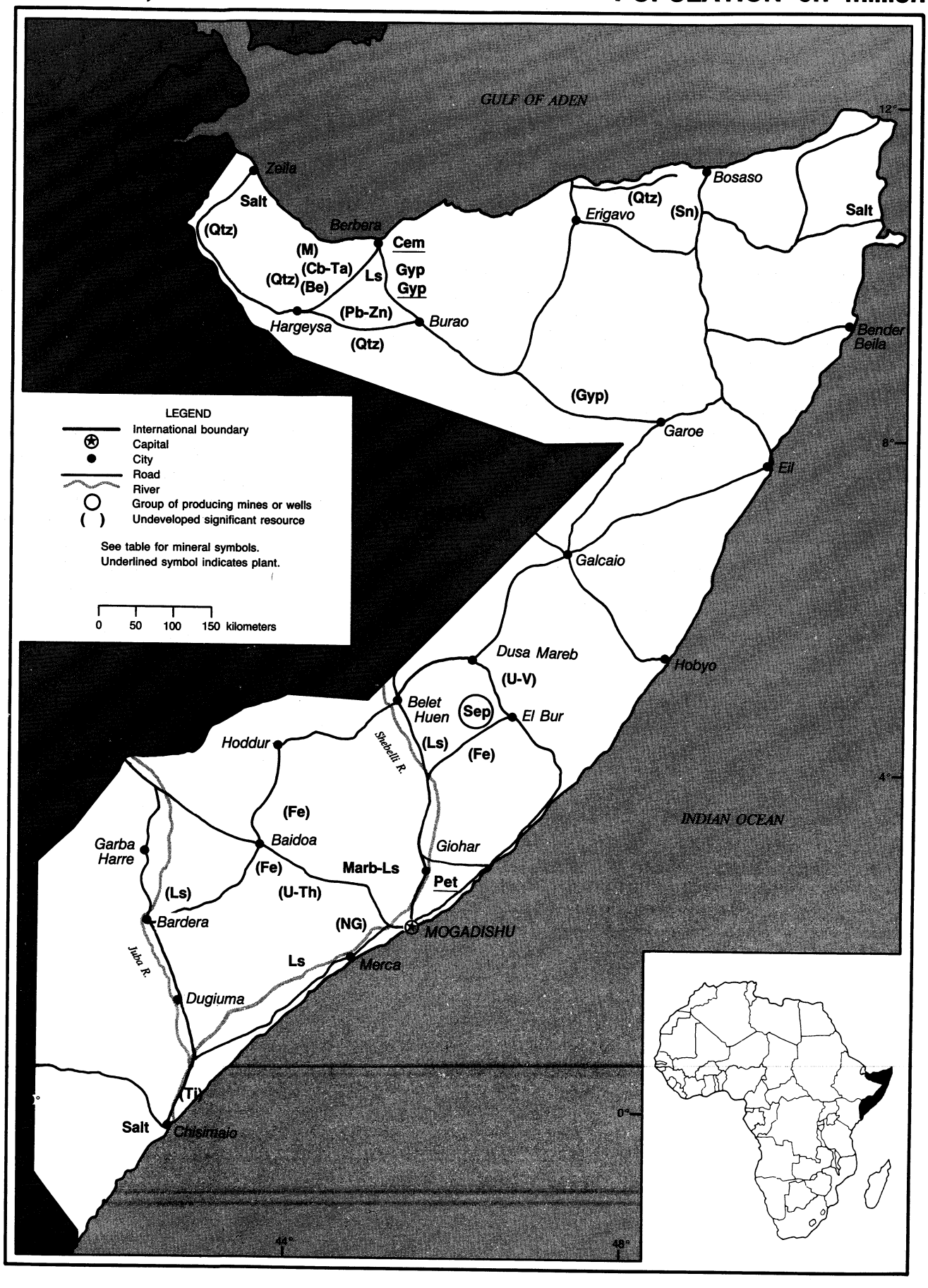
(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Bauxite	Sierra Leone Ore and Mineral Co. (Subsidiary of Alusuisse, 100%)	Mokanji Hills near Moyamba	1,600,000.
Diamond	National Diamond Mining Co., Ltd. (Government, 51%; British Petroleum Minerals International, 49%)	Yengema region	NA.
Gold	do.	do.	NA.
Petroleum products thousand barrels	Sierra Leone Petroleum Refining Co. (Government, 100%)	Freetown	3,650.
Titanium	Sierra Rutile Ltd. (Nord Resources Corp., 100%)	Pejebu near the mouth of the Shrebro River	130,000 rutile.
Do.	do.	do.	65,000 ilmenite.
Do.	Rotifunk Rutile Co. (Intercontinental Gold and Minerals NL, 50%; MC Mining NL, 50%)	Rotifunk, 60 kilometers southeast of Freetown	56,000 rutile.
Do.	do.	do.	83,000 ilmenite.

NA Not available.

SOMALIA

AREA 637,660 km² **POPULATION 6.7 million**



THE MINERAL INDUSTRY OF

SOMALIA

By Lloyd E. Antonides

Somalia's economy, including its very small minerals industry, was in disarray during 1991 and into early 1992 because of a continuing chaotic political situation. Little specific economic information was available—other than reports of growing shortages of food, medical supplies, and fuel—since the 21-year-old authoritarian Government collapsed in January 1991.

Most, if not all, foreign embassy representatives had left the country prior to the collapse during fierce battles in the capital. Afterwards, interfactional fighting developed. In April, the somewhat calmer northern region was declared an independent republic, Somaliland, by the locally dominant political group. The area was British Somaliland before independence and merged with Italian Somaliland to the south in 1960. Despite UN and several other countries efforts at mediation, by November the southern conflicts turned into particulary vicious heavy weapon warfare in Mogadishu. The fighting, together with the resulting anarchy, homelessness, and spreading famine, continued into mid-1992. In the north, the strife seemed to be less severe although news was meager. Early in 1992 Britain and France were considering aid to the new Somaliland, and Saudi Arabia reportedly had provided funds for petroleum purchases. But armed clashes also continued to be reported in the region.

Historically, the mineral industry was an insignificant part of the primarily pastoral economy of mostly semidesert, Texas-size Somalia. In the recent past, the industrial sector, including the minerals industry, accounted for well under 10% of a GDP approaching $2 billion.[1] Agriculture, mostly livestock raising, comprised almost 60%. Such a GDP and a population of about 7 million, one-half of which was nomads or seminomads dependent on raising livestock, defined one of the world's poorest countries. Large deficit trade balances and government budgets, mostly to maintain the military, resulted in high foreign debt and price inflation, as well as an economy dependent on foreign aid.

Mineral commodities produced in recent years consisted of cement—and its components, limestone and gypsum—as well as gypsum plaster and crude minerals for construction, plus meerschaum, sea salt, and refined petroleum products from imported crude. But meerschaum was the only noteworthy mineral export commodity.

However, mineral possibilities, including oil and gas, were an important concern of the country. Over several decades a number of investigators supported by international aid agencies and various individual countries reported many potentially valuable solid mineral occurrences. These appear to be concentrated in three main areas as follows, in order of importance: the northern highlands along the Gulf of Aden, the southern highlands centered a few hundred kilometers northwest of Mogadishu, and a central area centered a few hundred kilometers north of Mogadishu. From the late 1940's through 1990, many international oil companies explored the oil and gas potential over much of the country with only limited success. But a dozen companies still maintained concessions into 1990 and, although planned work for 1991 was apparently suspended, at least some continued to have interest into 1992. The most attractive possibilities appeared to be onshore in the north and offshore along the Indian Ocean Coast on the east.

GOVERNMENT POLICIES AND PROGRAMS

The precollapse Government made a decision in 1980 to start a program of liberalizing the statist economic order imposed 10 years earlier. Its policy became one of encouragement of private investment. The foreign investment law adopted in 1987 guaranteed against unreasonable expropriation. It also provided for the right to repatriate profits and investment costs, as well as for other benefits. Additional economic reforms enacted in 1988 and revisions to the constitution in 1989 moved the Government from socialism to reliance on market forces.

In the mineral field, the Government also successfully promoted investigations by international agencies and foreign country Government organizations for many years.

PRODUCTION

Officially reported production data were not available in the past 10 years. However, mineral commodity production in 1991 was estimated to be severely reduced by the civil strife and Government collapse. Estimated cement production in table 1 is questionable because of unconfirmed information that became available in early 1992. The information indicated the cement plant that reportedly began production in 1987 in the north near Berbera may have had major startup problems. The information

also gave a plant design output capacity larger than the previously reported 200,000 mt/a. Reexamination of the bases for estimating production shown on table 1 in prior years indicated figures for salt were probably too high and for meerschaum were probably too low. Table 1 was adjusted accordingly. *(See table 1.)*

TRADE

Trade statistics were generally unreported or unreliable for many years. Undoubtedly, there was little trade in 1991 and that was probably restricted to imports of food, medical supplies, and petroleum products.

However, in recent years prior to 1991, Somalia's mineral commodity exports appeared to be only 10 to 20 tons of meerschaum and some incidental petroleum refinery byproducts. Livestock was the largest export item in terms of value, estimated at more than 60% of the total, and bananas about 20%. Hides and other items related to livestock were also significant exports. Arabian countries and Italy were principal destinations. Exports to the United States were negligible.

Prior to 1991 the most important import commodities were crude petroleum and refinery products, more than double the value of the next largest, foodstuffs. Imports of construction materials were almost as large in value as foodstuffs. Saudi Arabia and Bahrain appeared to be the principal sources of petroleum. Italy and the United States were important sources of other imports.

STRUCTURE OF THE MINERAL INDUSTRY

Parastatal organizations were operators of the two major mineral commodity ventures in Somalia: the 10,000-bbl/d crude petroleum refinery at Mogadishu and the 200,000-mt/a cement plant near Berbera. But the small sea salt, meerschaum, and crude mineral construction material producers were believed to be privately owned and operated. Presumably, a 1,500-mt/a plaster (calcined gypsum) production facility reported near Berbera was also privately held. Oil and gas operations were limited to exploration by international oil companies.

COMMODITY REVIEW

Metals

Base and precious-metal minerals were accidently discovered in 1989 in coastal sand dunes at Gesira on the coast 20 km southwest of Mogadishu. A report of investigation by Rompetrol-Geomin of Romania was due early in 1990. Although the status of the report and project was unknown, political events undoubtedly precluded any further development.

Industrial Minerals

Cement plant improvements funding and technical assistance were requested of the French Government, which had financed a French firm's completion of the plant in 1987. The new Somaliland government asked for the help in July 1991, but early in 1992 no action had yet been announced.

Mineral Fuels

Natural Gas.—Development was still pending on a 6 Mm^3 natural gas field at Afgoi, 30 km west of Mogadishu, although World Bank funding was first made available in the mid-1980's.

Petroleum.—Conoco, at least, apparently continued to have interest in further pursuing earlier work that had included geophysical work and at least one hole more than 3,000 m deep in the northeast, completed in May 1990. At mid-1992, they had restablished a presence in Mogadishu and maintained an office compound in the northeast at Garoe, about 800 km northeast of Mogadishu.

Mobil and Pecten were reported to have closed down operations. Presumably, they suspended their joint-venture wildcat offshore in the Indian Ocean, planned to be started early in 1991.

Some site work done prior to 1991 was the only accomplishment announced through early 1992 on a new, privately owned 190,000-bbl/d oil refinery at Gesira on the coast 20 km southwest of Mogadishu. The $500 million venture was started several years earlier by a partnership of Al Sultan Trading and Construction Co. of Saudi and a Somali businessman, according to press reports.

Reserves

Any official government data on reserves remained unavailable. Several international organizations and consultants prepared reports on a number of mineral deposits in Somalia during the prior three decades. But, since the standards for ore reserve classification were not given, tonnages and grades appearing in the press probably should be, at best, considered as indicated or inferred resources of undetermined economic potential. These included the following: (distance and direction are from Mogadishu):

- Gypsum—950 km north near Berbera, 7 to 16 Mmt of unspecified grade.
- Iron minerals—200 km northwest near Baidoba, two deposits totaling 50 to 170 Mmt of 30% to 35% iron (Fe).
- Natural gas—30 km west near Afgoi, 6 Mm^3.
- Quartz—900 km north near Hargeisa, unspecified quantity of electronic and optical grade.
- Sepiolite—350 km north near El Bur, 10 Mmt of unspecified grade. Reported as probably the world's largest occurence (50 to 100 Mmt hypothetical).
- Tin minerals—1,500 km north-northeast near Bosaso, veins and placers averaging 3% tin (Sn).
- Titanium minerals (ilmenite beach sands)—400 km southwest near Chismaio, 10 Mmt of 1.0% TiO_2.
- Uranium—thorium minerals—150 km northwest near Baidoa and 400 km north near El Bur, total at all

locations, 8.5 to 17.0 Mmt of 0.07% U_3O_8 or equivalent.

Additionally, other occurences of potentially valuable minerals were reported without reference to quantity or grade. Among these were barite, beryl, columbium-tantalum, kyanite, lead-zinc, manganese, mica, phosphate, and tungsten.

INFRASTRUCTURE

Regardless of the political situation, considering the size of the country, Somalia's transport infrastructure was limited. It had about 22,000 km of roads, of which 12% was paved and 85% was earth, and no railroads. There were three main sea ports at Berbera, Chisimaio, and Mogadishu; essentially no internal waterways; and little coastal shipping. There were four paved airports, at the port cities and Hargeisa, plus other airfields at most towns. Wheeled vehicles were the principal means of conveyance but pack animals (donkey and camel) were also important. The major road linking the north and south, Berbera to Mogadishu, was almost completely bituminous surfaced, as were roads from Mogadishu to Baidoa, Berbera to Hargeisa, and some others around Chisimaio and Merca. The 5,000 km of primary and secondary roads was judged an adequate network but not all in satisfactory condition by World Bank investigators in 1990. Road improvements and maintenance had been an important focus of foreign aid for some time.

The Port of Mogadishu in prior recent years handled more than 70% of Somalia's export and import traffic; Berbera, about 20%, mostly the livestock exports; and Chisimaio, about 5%, mostly banana exports. Coastal shipping was limited to northern ports, as there was little sustainable interregional trade.

Electric power demand, even under peaceful conditions, frequently exceeded available production from the country's public generating system. The major plants, about 50 MW total of the approximate 70-MW capacity for the total system, were near Mogadishu. But there also were six regional centers (about 10 MW total) and isolated rural plants (about 10 MW total) as well. Additionally, many small, specially dedicated and private generating units were estimated to have a total capacity almost equal to the public system. Except for a 15-MW oil-fired steam turbine and four 0.2-MW windmills of the public system, all were oil-fueled diesel units. Hydroelectric plants were planned for the Juba River near Bardera and the Shebelli River near Mogadishu. These would significantly increase total system capacity. However, even prior to 1991's chaos, output of the system was much less than capacity. Lack of trained personnel and maintenance funding were major problems. Enhancement of the system was an important major objective of foreign aid.

Water resources were scanty and unevenly distributed. Wells were the main source of supply. Surface water of reasonably assured volume was limited to the area around two main rivers flowing south from Ethiopia across the southern third of the country.

Telecommunications were very limited. Telephone and telegraph service and facilities were reportedly among the poorest in Africa with less than 10% of local calls and less than 2% of incoming international calls being successful.

OUTLOOK

It was doubtful that mineral production would develop into a important factor in Somalia's economy for some time. Although few mineral occurrences had been thoroughly investigated, the lack of infrastructure was an obstacle. But most of all the competitive disadvantage of an unstable political situation would probably preclude any sizable foreign investment other than by international and bilateral aid agencies. Resolution of the political strife would quickly result in some further oil and gas exploration. But significant solid mineral developments would take more time. Domestic investment in small mineral commodity ventures would probably lead the way.

[1]Because of lack of data, no meaningful conversion of Somali currency to U.S. currency was possible for 1990-91. However, in 1989, the exchange rate averaged Somalia shillings (SoSh) 409.68=US$1.00, and in Dec. 1991 a rate of SoSh 2620=US$1.00 was published in news pubications.

OTHER SOURCES OF INFORMATION

Ministry of Mineral and Water Resources
P.O. Box 744
Mogadishu, Somalia

United Nations
Department of Technical Cooperation for Development
Natural Resources & Energy Division
1 UN Plaza
New York, NY 10017

TABLE 1
SOMALIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991e
Cement, hydraulic e		25,000	50,000	r50,000	r40,000	10,000
Gypsum e		2,500	3,500	3,500	2,500	1,000
Limestone e 3		43,000	85,000	85,000	65,000	17,000
Nitrogen: Ammonia, N content e		7,000	—	—	—	—
Petroleum refinery products: e						
Gasoline, motor	thousand 42-gallon barrels	4725	4742	750	r560	150
Jet fuel	do.	4168	4160	170	r130	30
Kerosene	do.	470	477	80	r60	20
Distillate fuel oil	do.	4612	4597	600	r450	120
Residual fuel oil	do.	493	4100	100	r80	20
Other[5]	do.	4259	4252	250	r180	50
Total	do.	41,927	41,928	1,950	r1,460	390
Salt, marine e		r2,000	r2,000	r2,000	r1,500	500
Sepiolite, (meerschaum) e		r20	r20	r20	10	4

eEstimated. rRevised.

[1]Includes data available through June 15, 1992.

[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.

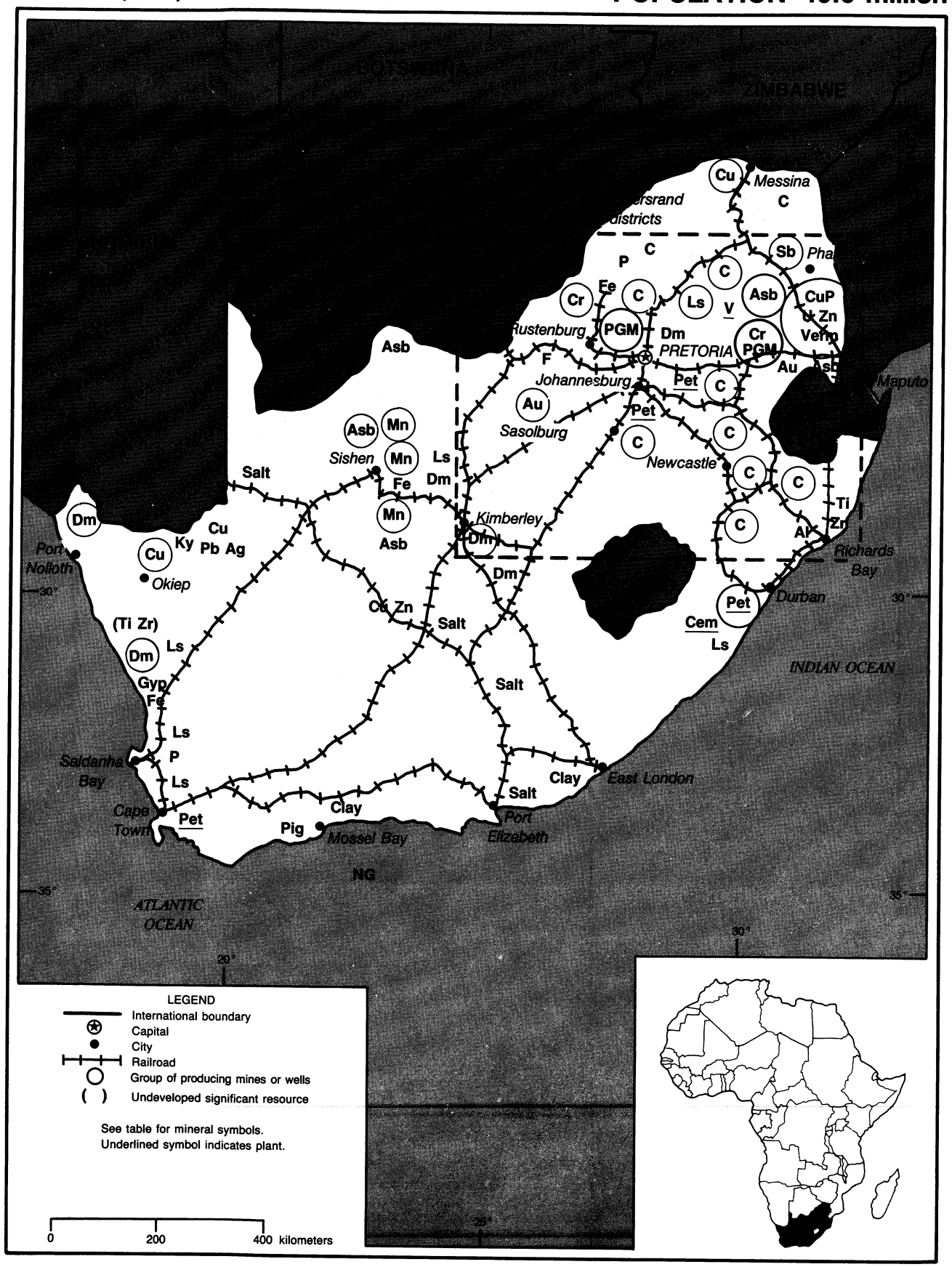
[3]Estimated for cement manufacture only.

[4]Reported figure.

[5]Includes nonenergy products (lubricants, bitumen, and miscellaneous other) and refinery fuel and losses. Refinery fuel and losses were estimated as follows, in thousand barrels: 1987—217; 1988—203; 1989—182; 1990—140; and 1991—40.

REPUBLIC OF SOUTH AFRICA

AREA 1,221,040 km² **POPULATION 40.6 million**



THE MINERAL INDUSTRY OF

THE REPUBLIC OF SOUTH AFRICA

By Michael M. Heydari

The Republic of South Africa[1] remained one of the most important producing and exporting nations for mineral commodities, despite some diversification of its economy away from mining in 1991. The single most important event affecting the Republic of South Africa was the lifting of most trade embargoes by the United States[2] and other countries. In 1991, the mining and quarrying industry accounted for 10.4% of the country's GDP at factor incomes at current prices of $96.6 billion.[3] Gold alone contributed 5.5% to the GDP. The industry's contribution to Government revenue, which had been as much as 16% in 1982, decreased from 4.5% in 1990 to 3.9% in 1991. The long-term decline in the contribution of mining and quarrying to GDP was attributed to rising operating costs, low commodity prices, and expansion of the country's manufacturing sector. Total crude mineral sales in 1991 were $15.8 billion,[4] down about 2% from those of 1990. Total local sales of crude minerals were about $3.3 billion, of which coal was $1.6 billion; quarry products, $170 million; limestone and dolomite, $170 million; and copper, $150 million. Primary mineral exports totaled $12.5 billion and accounted for more than 52% of 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 are included, about two-thirds of the Republic of South Africa's 1991 export revenue would come from mineral-based products.

The gold industry was hard hit by a fall in the dollar price of gold and by rising production costs. Gold mines were forced to rationalize their operations and lay off substantial numbers of workers. Gold production declined slightly to 601 tons owing to the closure of uneconomic sections of the mines. Although the Republic of South Africa remained the world's largest producer, its high inflation rate and difficult mining conditions have resulted in the industry becoming one of the world's highest cost producers.

An average of 641,000 workers were employed in the mining and quarrying industry in 1991, compared with 698,000 in 1990. This represented more than 6% of the country's total economically active population. The mining industry has lost 115,000 jobs from peak employment in 1986. This decline roughly equals the fall in employment in the gold mines this same period. A 16,000-job decline in coal mining was offset by an equivalent increase in other mining sectors. Total mining salaries, wages, and allowances exceeded $4 billion, including $2.8 billion for the gold and coal industries. The Employment Bureau of Africa (Teba) continued to recruit unskilled and semiskilled workers throughout southern Africa for members of the Chamber of Mines. Teba's contracts for these workers lasted an average of 14.5 months. About $193 million was repatriated directly to Botswana, Lesotho, Mozambique, and Swaziland, mainly as compulsory deferred pay.

GOVERNMENT POLICIES AND PROGRAMS

During 1991, the Department of Mineral and Energy Affairs (DMEA) was the primary Government entity with responsibility for oversight of the country's mineral industry. Within DMEA were the Minerals Bureau, the Geological Survey, and the Government Mining Engineer. In March 1992, the National Energy Council was reincorporated into DMEA as the Energy Branch.

The Minerals Bureau had responsibility for collecting, classifying, and analyzing mineral data to assist the Government in formulating policies on mineral development. It also provided mineral information to the industry.

The Geological Survey of the Republic of South Africa had responsibility for geological mapping and basic studies relevant to the identification, nature, extent, and genesis of ore deposits.

The National Energy Council, formed under the Energy Act of 1987, advised the Minister of Mineral and Energy Affairs and Public Enterprises on matters relating to energy policy. It administered or implemented various Government policies related to energy, including the coal export program and the purchase and stockpile of crude petroleum.

The Council for Mineral Technology (Mintek), formerly a Government agency, had the responsibility of promoting technology in the mineral field. It conducted research into the properties, composition, recovery, extraction, processing, and utilization of minerals and mineral products.

The Council for Scientific and Industrial Research (CSIR) had the responsibility of undertaking research related to specific minerals, mineral exploration, air quality, water pollution and purification, as well as mining and mineral processing problems.

The new Minerals Act, Act No. 58 of 1991, came into effect on January 1, 1992. It repeals nine principal statutes, including virtually all sections of the Mines and Works Act of 1956. It eliminates the state's exclusive right to mine precious metals, changes some of the safety and health provisions, and

creates a new Government mining organization.

Under the new law, the Republic of South Africa is divided into nine mining regions, each headed by a regional director. Each director will have almost complete authority for the enforcement of mining laws within the region. The new organizational structure represents a substantial decentralization of authority. Prior to January 1, 1992, the state reserved the right to mine for and dispose of all precious metals, precious stones, and crude oil. The owner of the mineral rights needed to obtain a mining lease from the state to mine these commodities. An element of the lease was the payment of a "lease consideration" or royalty to the state. Under the new minerals act, the state does not claim the right to mine precious metals and stones. The mining lease and the payment of royalty have been eliminated. Instead, there is a requirement to obtain a prospecting permit or mining authorization from the state.

The Minerals Act requires that, by January 1994, all mines will have to reapply for mining permits. In addition, strict environmental laws have been introduced requiring the preparation of reclamation plans and environmental impact statements. Penalties for noncompliance include fines and possible imprisonment of the individuals involved. Chapter 5 of the new act, with few refinements, incorporates the health and safety provisions previously found in the Mines and Works Act of 1956. Discriminatory references in terms of sex and race are being removed, and women will be allowed to become mining engineers, geologists, and mine managers, although they will not be allowed to carry out "manual work."

The Income Tax Act of 1962 has been amended to promote investment in industries that add value to locally produced minerals. Special tax deductions facilitate accelerated depreciation of machinery, plant, and buildings used in the beneficiation of local minerals. Incentives also allow for tax deductions against preproduction interest costs incurred in financing machinery, and plant and buildings for beneficiation projects. The incentives are subject to certain conditions. To benefit from tax deductions and incentives, the beneficiation process must add at least 35% to value, be internationally competitive, and more than 60% of output must be exported. The income tax amendment has been welcomed by the South African mining industry. It has also been suggested that, in the longer term, the Republic of South Africa could become a beneficiation center for minerals produced elsewhere in Africa.

Other changes in the mining tax laws included the full implementation of the gold mining tax formula, recommended by the 1988 Marais Technical Committee. The formula is expressed as $y=61(305/x)$; where x is the percentage of total income from gold mining that is taxable. The tax rate for nongold mines was also amended in 1991. The effective tax rate became 50.88% compared with the previous rate of 54.5%. In addition, provision was made for a drop in the rate of tax on nonmining income, from 50% to 48%, and it was expected to continue to drop in the next few years to an ultimate target of 40%.

A bill, referred to as the local authorities rating ordinance amendment bill, was proposed. It would require mining companies to pay tax to local authorities on properties in municipal areas. Implementation of the bill was delayed to give the Chamber of Mines more time to recommend amendments. Mining companies were concerned that taxes could be assessed on structures and underground workings as well as the land.

PRODUCTION

The Republic of South Africa was one of the world's major producers and exporters of mineral commodities in terms of both quantity and diversity. In 1991, it produced more than 60 different mineral commodities from a total of 1,050 mines and quarries. There were 83 gold, 93 coal, and 68 diamond operations in 1991. Metals for which the Republic of South Africa was among the world's leading producers included antimony, chromite, gold, manganese, platinum-group metals (PGM), titanium, uranium, vanadium, and zirconium. Industrial minerals of significance were andalusite, asbestos, diamond, fluorspar, pyrophyllite, and vermiculite.

In 1991, production of gold, diamond, and most other mineral commodities declined. Coal production increased as did production of chrome ore, copper, lead, and silver. Nonmetallic commodities that had higher production in 1991 were asbestos, barite, feldspar, gypsum, and sillimanite. *(See table 1.)*

Increasing costs of production continued to negatively impact the mining industry, while productivity increases have not kept pace with these costs. In June 1991, a wage settlement between the National Union of Mineworkers (NUM) and the Chamber of Mines resulted in an average increase in wages of 6% at gold mines. This was the lowest wage increase in recent years and less than one-half the inflation rate.

TRADE

The bulk of the Republic of South Africa's mineral production was exported. Exports in 1991 were to 85 countries. However, increasing amounts of chromite, crude steel, diamond, dimension stone, gold, and manganese were being upgraded or consumed in higher value-added products locally and then were exported. Downstream processing of mineral commodities by domestic companies was a major growth area in the country.

International demand for most of the mineral commodities produced in the Republic of South Africa declined in 1991 owing to the slowdown in world economic growth. However, lower export volumes were largely offset by improved domestic sales and the further depreciation of the rand against the U.S. dollar. The value of crude mineral exports in 1991 was $12.5 billion, down from $12.9 billion in 1990. This was more than 52% of the Republic of South Africa's total exports. The value of exported processed mineral products such

as refined base metals, ferroalloys, iron and steel, and refinery products produced from coal is estimated at $3.5 billion. As a result, about two-thirds of the Republic of South Africa's 1991 export revenue came from mineral-based products. Gold was once again the country's highest foreign currency earner at $7 billion, down from $7.4 billion in 1990. Coal exports of 49 Mmt were the second highest revenue earner at $1.5 billion, followed by PGM, iron ore, and copper. In line with the softening of the world steel market, exports of chrome ore, manganese ore, and ferroalloys fell.

In 1991, the United States had imports from the Republic of South Africa totaling $1.7 billion. Of these imports, 92% was minerals and metals, mainly PGM and ferroalloys. Restrictions on imports by the United States of South African coal, gold, iron and steel, and uranium, in effect since sanctions were imposed in October 1986, were lifted in July 1991. EC and other restrictions on the importation of iron and steel from the Republic of South Africa were also lifted during the year.

The Republic of South Africa remained the largest export market for U.S. products and services in sub-Saharan Africa. U.S. exports to the Republic of South Africa in 1991 were $2.1 billion, compared with $1.7 billion in 1990. The United States was the country's third largest supplier, behind Germany and the United Kingdom. Principal U.S. exports to the Republic of South Africa were mining equipment, chemicals, aircraft and parts, electronic data processing and related equipment, and office machinery.

STRUCTURE OF THE MINERAL INDUSTRY

The mining industry is dominated by six major mining investment groups *(see table 2)*: Anglo American Corp. of South Africa Ltd. (AAC); Anglovaal Ltd.; General Mining, Metals and Minerals Ltd. (Gencor); Gold Fields of South Africa Ltd. (GFSA); Johannesburg Consolidated Investment Co. Ltd. (JCI); and Rand Mines Ltd., a subsidiary of Barlow Rand Ltd. The groups, often referred to as mining houses, interact through the Chamber of Mines of South Africa, a private organization having the primary objective of promoting and protecting the interests of its members. The members include the great majority of gold and coal mines and a number of producers of other mineral commodities, notably PGM. The Chamber of Mines is responsible for a variety of advisory and service functions, as well as technical research, which is handled on a co-operative basis. The Chamber also controlled the Rand Refinery, reportedly the largest gold refinery in the world.

According to an analysis released early in 1992,[5] in 1990 AAC was the Western World's largest mining company, controlling 8.5% of the total value of the entire Western World nonfuel minerals production, more than double the 4.2% share of its nearest rival, Rio Tinto Zinc Ltd. (RTZ) of the United Kingdom. AAC had major ownership interests in the giant diamond-producing and diamond marketing group De Beers Consolidated Mines Ltd./De Beers Centenary AG. Gencor, with 1.3% of the Western World's value of all nonfuel mining commodities produced, was placed 11th in the world, according to the aforementioned source, while Rand Mines was 22d and Anglovaal was 27th.

The mineral industry was dynamic, with numerous changes in corporate ownership and joint ventures, and active trading on the Johannesburg Stock Exchange. The six major domestic mining investment groups had highly diversified investments during 1991. AAC's gold interests increased to 23%, versus 21% in 1990, of the value of its investments. Industrial and commercial interests were unchanged at 23%, as was diamond mining at 13%. The coal sector contribution was 5%, while platinum, base metals, and other mining commodities' contribution to investment earnings was unchanged at 20%. The largest change was recorded in the financial services and property sector where the contribution fell from 19% to 16%. Anglovaal Ltd. had 23% of its investments in packaging and rubber; 21% in base metals and minerals; 15% in gold mining; 15% in consumer goods; 10% in fishing and frozen food; 6% in engineering and textile; 6% in construction and electronics; and 4% in finance. Gencor had 22% of its net asset value in energy; investments and financial services, 19%; gold, 14%; ferroalloys, 11%; forest products, 11%; PGM, 7%; manufacturing and marketing, 6%; other mining products except coal, 5%; coal, 3%; and other, 2%.

GFSA's group net asset value, by sector, was as follows: gold, 59%; PGM, 10%; financial, 10%; mining finance, cash (including dividends receivable and payable), 6%; energy, 4%; and base minerals, 2%. JCI's net asset value, by sector, was as follows: industrial and financial, 38%; PGM, 33%; diamond, 10%; gold, 7%; coal, 7%; ferroalloys, 2%; mining finance, 2%; and property, 1%. Barlow Rand Ltd.'s net assets by sector were as follows: food and pharmaceutical, 27%; industry, 16%; packaging and textile, 15%; coal, 13%; financial services, 10%; international, 9%; cement, gold, and other noncoal mining, 5%; and other, 5%.

Apart from the six major mining houses, two other South African concerns, Iscor Ltd.—ranked 39th largest Western World producer of nonfuel minerals in 1990—and Sasol Ltd., were world-class mineral producers in 1991. Iscor is a fully integrated steel producer and ranks 14th in the world among individual producers of liquid steel. It operates several large coal and iron mines in the Transvaal, Natal, and northeastern Cape Provinces. Sasol, a world leader in the conversion of coal to oil and gas, is a major coal producer with operations near Secunda, 100 km southeast of Johannesburg.

The largest foreign-owned mining group operating in the Republic of South Africa is RTZ. RTZ is the co-owner of Palabora copper mine in the northeastern Transvaal, one of the largest copper mines in the world. RTZ is the main shareholder in Richards Bay Minerals Ltd. (RBM), a major world producer of mineral sands, with operations in the coastal areas of Natal Province. In addition, several smaller groups and

numerous independent operators carry out other mining and beneficiation activities. Not only do they contribute substantially toward the creation of employment opportunities, but they also exploit smaller mineral deposits that might not be economically attractive to the larger groups. Some of the small operators are also members of the Chamber of Mines.

The Government had an important interest in certain mining and mineral processing enterprises. Participation was pronounced in the synthetic fuels sector, which was based on domestic coal resources. Sasol III remains partly Government owned through Industrial Development Corp. of South Africa (IDC). The Government was also funding and overseeing the development of natural gas reserves offshore Mossel Bay.

Inflation, lower prices, and rising costs reduced profits at many mining companies in 1991, particularly gold mines. Capital expenditure by the mining industry, which has experienced a steady decline since 1988, dropped by 16.7% in 1991, to $725 million.

In 1991, the average number of persons employed in the mining sector was 641,000. Almost 90% of the workers employed was unskilled and semiskilled with an average monthly wage and benefit package of $460. A total of 458,000 workers were employed by member companies of the Chamber of Mines, including 366,000 workers on gold mines and 38,000 workers on collieries. Rock bursts and ground falls were the major cause of injuries and deaths from mining accidents. The reportable injury rate in gold mines rose by 2.8% to 19.70 per 1,000 employees in 1991. However, the fatality rate in gold mines declined by 6.5% to 1.16 per 1,000 employees. Coal mines were able to reduce the reportable injury rate to 4.46 per 1,000 employees and the fatality rate to 0.40 per 1,000 employees, the lowest rate on record.

COMMODITY REVIEW

Metals

Aluminum.—Primary production in 1991 at the Richards Bay-based Aluminum South Africa (Pty.) Ltd. (Alusaf), the only South African primary aluminum producer, was at full capacity. However, the company's exports in 1991 fell by 2.7% to 70,000 tons. Alusaf supplied 99% of the Republic of South Africa's primary aluminum needs, including melting ingot, extrusion ingot, rolling ingot, and T-bar, all to customer requirements. Imports of finished aluminum products, mainly alloys and forms, were at 4,000 tons, about the same as those in 1990.

Alusaf announced that construction was to proceed in 1992 on its $2.5 billion aluminum smelter expansion project. The project includes a new reduction plant capable of producing about 466,000 mt/a of aluminum for export. Approval for the new smelter had been postponed pending a more detailed study on the environmental effects of fluoride emission at the proposed site. The shareholders were Sanlam-Genmin-Geduld Investments, IDC, Alusuisse, the IFC, Hulett Aluminum, and Southern Life. The shareholders were to fund 70% of the project's capital cost, with the balance to be funded by debt. The new smelter will be built at Richards Bay, about 4 km from the existing facility. Three alumina refineries were to supply input to the new smelter in quantities of 300,000 mt/a, 400,000 mt/a, and 500,000 mt/a, respectively. One-half of the primary aluminum produced was to be sold back to the alumina suppliers, and the company expected to export the remainder. The new smelter would make the Republic of South Africa the fifth largest world producer of primary aluminum. The project may provide incentive for further investigation into the mining of low-grade bauxite deposits in Natal, containing 27% recoverable alumina on average, and for the production of alumina. Because it may become possible to extract alumina from the South African phlogopite, Alusaf's new alumina supply contracts will contain a 3-year rolling clause.

Secondary aluminum products are produced in the Republic of South Africa by Hulett Aluminum and several other smaller companies. In 1991, a total of 25,000 tons of aluminum semi-manufactures was exported. Hulett has invested substantial capital in plant modifications to increase its rolled products capacity from 55,000 mt/a to 120,000 mt/a by 1995.

Antimony.—Consolidated Murchison Ltd., the world's largest single antimony producer, remained the Republic of South Africa's sole producer of antimony sulfide concentrate. The ore contained gold and silver byproducts. In 1991, ore milled increased by 2.6% to 401,000 tons from the previous years's level, and about 14.5% from the level in 1989. The antimony head grade fell to 1.28% from the previous year's average of 1.46%. The improved rate of recovery in the flotation plant partially compensated for the ore grade decline, and a total of 7,533 tons of antimony concentrate was produced. A 2% increase in sales to 7,109 tons and a more favorable dollar/rand exchange rate resulted in increased rand revenues from antimony sales in 1991. Concentrate stocks increased from 1,620 tons to 2,045 tons. The company reported that operating costs in 1991 declined to $35.78 per ton of ore milled from $42.33 per ton in 1990. This was largely due to a reduction in staffing and stringent cost containment measures. As with most producers, the South African antimony industry continued to be adversely affected by oversupply and price discounting by Chinese producers of antimony in all forms. Limited underground exploration development and drilling activities were carried out in the Athens and Monarch shaft areas. Substantial extensions to known ore bodies were delineated, resulting in the maintenance of reserves at 1990 levels.

Chromite.—The Republic of South Africa has about three-quarters of known

world chromite reserves, according to the Minerals Bureau of South Africa. Despite an increase in production in 1991, exports of chromite fell by 18% to about 922,000 tons as world demand for chromite and alloys continued to decline due to contraction in the stainless steel market, as well as stockpile drawdown by consumers.

The Republic of South Africa's largest chromite producer was Samancor, a Gencor subsidiary, with a production capacity of approximately 3.6 Mmt/a. In 1991, the company acquired the Winterveld chrome operation from Rand Mines. This caused some concern to Consolidated Metallurgical Industries (CMI), the second largest chromite producer, because it was the Winterveld Mine that supplied the chrome ore fines requirements for CMI's Lydenburg ferrochrome plant. CMI is therefore looking to purchase its chrome ore requirements from the Thorncliffe deposit, about 65 km northeast of Lydenburg, which is owned by CMI's major shareholder, JCI.

Two local companies, Trojan Exploration Ltd. and Rhombus Exploration Ltd., were investigating the possibility of establishing a new chromite mine in the Steelpoort area, between the Lavineo and Winterveld Mines, and close to Samancor's Tubatse ferrochrome plant. Samancor's Mooinooi chrome mine, which was shut down at the end of 1990 as a result of labor problems, restarted operations in early 1991.

Copper.—Palabora Mining Co., the Republic of South Africa's major copper producer, reported that the total ore and waste material loaded and hauled during 1991 amounted to 37.3 Mmt compared with 49.1 Mmt in 1990 and 62.1 Mmt in 1989. The average mining rate of 126,500 mt/d, down from 165,301 mt/d in 1990, was in line with the revised target established during the year as a result of an improved waste-to-ore ratio. Due to repairs to the autogenous grind mill shells, the average milling rate fell to 77,204 mt/d during 1991 compared with 80,256 mt/d of ore achieved in 1990. The average ore grade of 0.533% Cu was in line with the planned grade and exceeded 0.506% Cu achieved in 1990. The average concentrate grade was 36.2% Cu, compared with 38.7% Cu the previous years. Copper recovery for the year was 84%, excluding the gas scrubbing plant concentrates. The average concentrate smelting rate was 913 mt/d. Performance was expected to be improved by 50 mt/d by mid-1992 as a result of the company's $500,000 smelter upgrade project. Palabora signed a contract with the international commodities trader Marc Rich for the sale of 25,000 tons of Copper concentrate in 1992 to Zambian Consolidated Copper Mines (ZCCM). An option for a further 10,000 tons was also negotiated. Total anode production in 1991, including copper derived from purchased concentrates, amounted to 121,774 tons of fine copper, 1.9% more than that in 1990. Because of the commissioning of a cathode press in the third quarter of 1991, total production of refined copper cathode increased to 118,670 tons from 116,005 tons in 1990. The reported average exmine unit production cost of cathode copper was $1,213 per ton or $0.55 per lb. The casting plant produced 60,863 tons of continuous cast copper rod for the domestic market. This was the lowest tonnage since 1979, but was adequate to meet domestic demand, a reflection of the poor economic conditions that prevailed in the Republic of South Africa during 1991.

It is estimated that Palabora's reserves recoverable by open pit mining will be depleted by the year 2000. Underground mining, presently under way, will extend the mine's life by a further 20 years. It is believed that an underground operation, costing about $900 million, could yield 114,000 mt/a of copper.

Gold.—The Republic of South Africa remained the world's largest gold producer in 1991 with more than 30% of total world output. Gold production fell only slightly in 1991, despite effects of higher working costs, to a reported average of $295 per ounce, and a 5.6% drop in the rand gold price. Exports were up slightly, from 605,121 kg in 1990 to 605,743 kg in 1991. Average grade of ore mined was 5.20 g/mt in 1991, compared with 5.05 g/mt in 1990.

Marginal mines were obliged to reduce their labor forces in an attempt to reduce overhead, particularly with labor contributing about 45% of gold mine working costs in 1991. About 45,000 jobs were lost in gold mines in 1991, reducing the labor force to 433,000, or about 100,000 less than in 1986, the peak employment year. The decline in employment was expected to continue in 1992. In light of the depressed state of the industry, NUM agreed to wage increases of only 5% to 6%, supplemented, in some cases, by a profit-sharing scheme. In contrast, the 1990 wage settlement was 14.5% to 17%, during a period of 15% price inflation.

Operations at many gold mines were curtailed in 1991. AAC subsidiary South African Land and Exploration Co. (SALLIES) closed down. The company had been treating rock and sand from dumps since it ceased mining operations in 1976. Two small mines, Modder B and Eersteling, were liquidated. Rand Mines' Harmony Mine and Genmin's West Rand Consolidated Mine carried out extensive retrenching programs. One medium-sized producer, Genmin's Stilfontein, announced that it was curtailing underground operations and would cease mining in 1992. East Rand Gold and Uranium (ERGO) reorganized its operations to improve profitability and closed its Simmergo treatment plant. Development operations at Genmin's new Weltevreden Mine were curtailed, and work was stopped on the new subvertical shaft at the Winkelhaak Mine. Anglovaal's Loraine gold mine may be operated if it is able to sell forward 50% of its planned gold production. In an attempt to eliminate losses, mining was conducted on a more selective basis at the Loraine Mine. Milling rates were reduced 29% to 90,000 mt/month. In addition, Loraine planned a 45,000-mt/month dump-retreatment operation in 1992 to boost output at minimum cost.

The $400 million No. 1 shaft at Freegold's North Region's Freddies Mine near Welkom in the Orange Free State

was opened in 1991. The project, which began in September 1984, was scheduled to reach full production of 180,000 mt/month of ore by 1998. Mine planning allows this to be increased to 280,000 mt/month. At full production the new shaft will contribute about 10 mt/a of gold to Freegold's production. The new shaft, which has an expected life of 28 years, incorporates new semimechanized mining technology to mine low-grade ore reserves in the Basal Reef at an average depth of 1,750 m. Multishift mining operation will be implemented to achieve high rates of face advance on the shaft's six production levels. Two 8-hour drilling and blasting shifts and a nighttime cleaning and maintenance shift in each 24-hour cycle will produce sufficient tonnage to justify the use of rubber-tired load-haul-dumpers and articulated dump trucks. Innovative technologies to be used in stoping include high-pressure water-jet and diamond-wire cutting, which could eventually become an alternative to conventional drilling and blasting. The new technology is expected to reduce working costs by 13%.

AAC is to develop a new high-grade, deep-level gold mine 25 km south of Klerksdorp, immediately southeast of the Vaal Reefs Mine lease area. At full production, this new $600 million extension to the Vaal Reefs Mine is expected to produce about 13 mt/a of gold. Over the mine's 25-year life span, an estimated 26 Mmt of ore, grading 11 g/mt, will be milled at Vaal Reef's existing plants. Mining will be via a main shaft to a depth of about 2,500 m and two subvertical shafts to a depth of 3,700 m below surface. The main shaft will have a total hoisting capacity of 150,000 mt/month. Production is expected to begin in 1997.

Iron and Steel.—Major changes took place in the country's stainless steel sector in 1991. In October, the go-ahead was given for the long-awaited Columbus steel project, which is expected to come on-stream in 1996. Renamed Columbus Stainless, it is a $900 million joint venture between AAC's Highveld Steel and Vanadium and Gencor's Samancor. Originally planned as the Republic of South Africa's second stainless steel operation, the project instead took over the country's sole producer, Middelburg Steel and Alloys (MS&A), in September 1991. Columbus Stainless should give the Republic of South Africa the potential to become the world's fifth largest stainless steel producer after Japan, Germany, the United States, and France. The project is to have a production capacity of just under 500,000 mt/a of hot- and cold-rolled stainless steel, compared with MS&A's 1991 capacity of 120,000 mt/a. The existing product range is to be supplemented by thinner gauge hot-rolled products as well as bright annealed products. The Columbus project is aimed at the export market and, when fully operational in 1997, is expected to generate about $700 million per year in foreign exchange earnings.

Iscor, founded in 1928 and privatized in 1989, was the major South African steel producer, with 73% of the country's total production in 1991. The company produces a wide range of steel products and grades, with roughly 50% flat products and 50% profile products by volume. Iscor has emphasized higher value-added products. Its capital expenditure program, which cost more than $1.3 billion over the past 3 years, is nearing completion. About $290 million is to be spent in 1992 and $180 million in 1993. The $56 million electrogalvanizing line was due to be commissioned in the second quarter of 1992. A comprehensive $50 million relining of the No. 5 blast furnace at the Newcastle plant was to be carried out between April and June 1992. This project followed the relining, refurbishing, and modernization of the D blast furnace at the Vanderbijlpark works, which has improved production levels by 25%. Iscor's other projects include an RH-Degasser for the Newcastle steel plant which, when completed in 1992, should provide low-carbon and low-oxygen steels. A 750,000-mt/a-capacity continuous single strand slab-casting plant and ladle furnace for the Pretoria plant's arc furnaces, as well as a bloom reheating furnace for the heavy mill, are scheduled for completion in November 1992. As a result of relaxation of embargoes, Iscor benefitted from the Japanese decision to renegotiate the 1976 iron ore export contract, which had lapsed in recent years. The contract, with six major Japanese steel producers, involves the export of 20 Mmt of iron ore over the period 1992-97.

Usko Ltd., the country's oldest steelmaker, having been registered since 1911, sold its steel assets to its largest shareholder, Iscor. The company had a loss of $4 million for the first 6 months of 1991. While Usko no longer produces steel, it continues to operate its other ventures, including Transvaal copper rod (a Phalaborwa-based joint venture with Palabora copper); Alustang (Richards Bay-based producer of aluminum rod); and Vereeniging-based Thames Wire and Cable; all these ventures reportedly were sound businesses.

Highveld Steel and Vanadium is the Republic of South Africa's second largest steel producer. The company's facilities are concentrated in the Witbank area. Highveld produces about 1 Mmt/a of steel, 70% of which is estimated to be exported. Highveld is an integrated corporation, with iron ore being mined at the company's Mapochs Mine at Roossenekal, 60 km west of Lydenburg. Quartz is produced from the Spitzkop quarry near Witbank. In 1991, the company was negatively affected by the decline in world demand for steel and was forced to close two furnaces in November. In March 1991, Highveld's $30 million pelletizing plant came into operation at the Mapochs Mine. More than 3 Mmt of iron ore fines currently stockpiled at the mine is to be processed at the new facility.

Ferroalloys.--The Republic of South Africa is the world's second largest producer of ferroalloys. Ferroalloys exports in 1991 were the third largest earner of foreign exchange after gold and coal. Ferrochrome, of which the Republic of South Africa is the world's largest producer, earned well over one-half of the revenue received for all ferroalloy exports.

Major changes have taken place in the ownership of ferrochromium facilities, and the number of producers has been reduced by takeovers. A collapse in world stainless steel production at the end of 1991 triggered Samancor's decision to close all its ferrochrome furnaces (including the 120,000-mt/a-capacity direct-reduction plant taken over from MS&A) for at least 3 months in 1992 for maintenance. Production cutbacks commenced in January 1992 and all of Samancor's furnaces were shut down by March 1992. Accordingly, Samancor also sharply reduced production at its chromite mines. Samancor held sufficient stocks of ferrochrome to meet its contractual obligations owing to stocks from MS&A, which it took over in October 1991. Samancor also ran its own furnaces at near full capacity in December to take advantage of the low end-of-year electricity rates offered by the Electricity Supply Commission (Eskom), the Republic of South Africa's national electric utility company. The extent and timing of the reinstatement of production will be dictated by future market developments. However, with the announcement that the Columbus stainless steel project is to go ahead, the outlook for Samancor is positive because the project will need approximately 150,000 mt/a of ferrochrome.

Because of lower sales volume, CMI has also reduced output from its 330,000-mt/a facility. In the beginning of 1992, the three-furnace plant at Lydenburg was operating at two-thirds of its 220,000-mt/a capacity and the two-furnace plant at Rustenburg at one-half of its 110,000-mt/a capacity. Like Samancor, CMI produced at full capacity in December 1991. However, as a result of a 3-week strike in September and refurbishment of a furnace, CMI's stockpile was not as large as those of other South African producers. The only major capital expenditure that CMI incurred in 1991 was the overhaul of the "B" furnace at Lydenburg.

Chromecorp Technology (CCT), backed by the international commodities trader Marc Rich, shut down its 180,000-mt/a ferrochrome furnaces on January 1, 1992, for the first time since operations began in 1988. CCT's plant operated at a maximum of 60% of its 330,000-mt/a capacity in 1991.

A feasibility study reportedly was under way into the establishment of a new ferrochrome smelter to process ore from the Goudini chrome mine, about 40 km east of Zeerust in the western Transvaal. The mine produces high-quality ore with a chromium-iron ratio of more than 2:1, compared with an industry average of 1.5:1. The mine has been running below capacity since the cancellation of a supply contract with Samancor's Middelburg division.

The Republic of South Africa had two producers of ferrosilicomanganese—Samancor and Highveld Steel and Vanadium's subsidiary, Transalloys. Transalloys' ferrosilicomanganese facilities operated at about two-thirds of capacity until July 1991 and thereafter at below 50% capacity. This was because China and Eastern European countries brought low-priced ferrosilicomanganese onto an oversupplied market in 1991. Although medium-carbon ferromanganese prices were somewhat better, the overall decline in alloy prices and the reduction in demand resulted in the closure of Highveld's medium-carbon furnaces at Witbank from June to October 1991.

The Republic of South Africa's two producers of ferrosilicon, Samancor and Highveld's subsidiary Rand Carbide, produced 68,337 tons of metallurgical ferrosilicon, down from 78,150 tons in 1990. Exports dropped from 76,376 tons to 17,407 tons. The closure of Eastern European steelmaking plants resulted in an oversupply of silicon alloys that were disposed of at low prices in Western markets. Consequently, Rand Carbide reduced ferrosilicon production to 70% of capacity in February and 45% of capacity in November 1991. The company negotiated a customer incentive scheme contract with Eskom in which its power tariff will be tied to ferrosilicon prices. This could lead to substantial reduction in costs as ferrosilicon production is extremely energy intensive, consuming 9,000 MW·h/mt. Power costs make up 44% of variable costs in ferrosilicon production. CCT announced that it was to start production of ferrosilicon by October 1992. CCT's subsidiary, Silicon Technologies, purchased Sentrachem's Ballengeich calcium carbide plant near Newcastle for $22 million. The plant will be converted to produce 50,000 mt/a of ferrosilicon from two furnaces. African Explosives and Chemical Industries Ltd., an AAC subsidiary, formerly owned the plant.

Iron Ore.—In 1991, the Republic of South Africa ranked eighth among world iron ore producers and seventh among iron ore exporters. About 15.5 Mmt or 53% of production was exported, compared with 17 Mmt in 1990. The 9% decrease in exports was attributed to reduced demand for steel.

Iscor's two iron mines, Sishen and Thabazimbi, produced 80% of the Republic of South Africa's total iron production.

Iscor's higher steel production in 1991 led to a corresponding increase in demand for raw materials from the company's two iron ore mines. Iron ore was also produced as a byproduct by Associated Manganese's Beeshoek Mine, about 120 km south of Sishen. Titaniferous magnetite was supplied to Highveld's iron plant for pig iron production and to its Vantra plant for vanadium recovery. Production was from Mapochs open pit mine near Roossenekal, 140 km northeast of Witbank. Mapochs Mine's output is believed to have fallen sharply because of Highveld's reduced steel production in 1991. However, production from the mine is likely to be increased over the next few years to build up a stockpile for the Columbus stainless steel project that is to come on-stream in 1996. Titaniferous magnetite was also recovered at the Palabora and Phosphate Development Corp. (Foskor) Mines, as byproduct to copper and phosphate rock production, respectively.

Tisand (Pty.) Ltd., a unit of RBM, mined titanium-bearing beach sands north of Richards Bay. Concentrates were supplied to Richards Bay Iron and Titanium Ltd., also a unit of RBM, to

produce both low manganese pig iron and titanium slag.

In 1991, six major Japanese steel producers signed 5-year contracts with Iscor for the importation of 20 Mmt of South African iron ore. Japan was the largest market for Iscor's iron ore, representing about 25% of the company's export. The Republic of South Africa's only other iron ore exports were from the Beeshoek Mine. Byproduct magnetite produced at Palabora is stockpiled, with only a small quantity used domestically.

Manganese.—The bulk of the Republic of South Africa's production of manganese ore was of metallurgical grade, with a manganese content of more than 48%. It was mined in the Kalahari Field north of Sishen mainly by two companies, Samancor and Associated Manganese Mines Ltd. A third company, National Manganese, was a small producer. Chemical-grade ore was produced near Zeerust in the western Transvaal by Klipveld and Metmin as well as by Samancor's Mamatwan Mine in the Kalahari Field.

In 1991, total South African manganese ore production dropped by 29% to 3.146 Mmt, and ore exports fell by 23% to 1.66 Mmt, in a response to reduced world steel production. It was expected that this situation would continue in 1992. In the face of depressed market conditions and price-cutting by Australian managanese ore producers, Samancor and Associated Manganese reduced the price of high-grade manganese ore by 14% to $0.285 kg of contained manganese for 1992.

Nickel.—Exploration of the AAC's Uitkomst nickel-copper prospect, about 20 km north of Badplaas near Barberton in the eastern Transvaal, was suspended in 1991. The deposit had comparatively low-grade mineralization and limited ore reserves. Exploration may resume if the world price of nickel shows substantial improvement. If developed, the property could yield 17,000 mt/a of nickel.

The Republic of South Africa's supply of nickel, a byproduct in PGM mines, is likely to increase in 1992 owing to better recoveries and expansion in the PGM industry. Local consumption is expected to increase sharply owing to commissioning of the Columbus stainless steel project, which could require an additional 24,000 mt/a of nickel.

Platinum-Group Metals (PGM).—Although Rustenberg Platinum Mines Ltd. (RPM), the world's largest producer, does not disclose production figures, it is believed that production, both in terms of ore tonnage milled and PGM produced, was marginally higher in 1991 than that in 1990. The expansion of production from the UG2 reef at Union section by 30,000 mt/month was achieved ahead of schedule. The new No. 1 shaft at Amandelbult, which will increase output by 140,000 mt/month, is expected to be completed in April 1993. RPM also announced that it will sink a new $44.6 million shaft at Amandelbult that is expected to be commissioned in June 1997. Mining at the new shaft is to commence on the Merensky reef initially, but ultimately both the Merensky and the UG2 reefs will be mined. Current production at Amandelbult is from both reefs. The company has renewed a major long-term contract for the supply of PGM to the Japanese motor company Honda.

Expansion plans at Lebowa Platinum Mines Ltd.'s Atok Mine have been cut owing to cash-flow problems and high production costs. In addition, the planned mining of an outcrop of UG2 reef to increase output beyond the current 70,000 mt/month has been deferred as a result of further deterioration in the PGM prices.

Because of refinery problems and labor unrest, Impala Platinum Ltd.'s total output of platinum in 1991 fell by 3,100 kg, and the company had to purchase 2,200 kg of platinum to meet its contractual obligations. Impala's plan to develop the Messina deposit was put on hold.

PGM production at the Lonrho-controlled mines, including Western Platinum, Eastern Platinum, and Karee Mines, was reported to be 19,400 kg. The mines were engaged in a substantial production expansion program. Problems at Western Platinum's smelter resulted in output falling below the rated capacity. Sharply lower rhodium prices had negative implications for the operation, which is heavily dependent on rhodium-rich UG2 ore. At the Eastern Platinum Mine, mining and grade control problems have increased as operations approach a major fault system. The mine resorted to its open pit operations in a bid to alleviate the situation, but lower grade surface ore proved to be barely profitable at current prices. The open pit operation was being phased out, and declines sunk to exploit fresh ore.

Because of unexpected problems caused by the difficulty of mining a "pothole reef," GFSA's new Northam Mine is now expected to start selling precious metals in December 1992, when output is expected to be 60,000 mt/month of ore. The mine, the world's deepest platinum operation, was scheduled to reach full production of 150,000 mt/a in 1995. Gerald Metals Inc. of the United Sates and Mitsubishi of Japan have been contracted to act as selling agents for Northam.

Uranium.—The Republic of South Africa's uranium production continued to decline owing to low demand. Production was reduced at most gold mines where uranium was a byproduct. The Vaal Reefs Mine produced 1,104 tons of yellowcake in 1991, accounting for over 50% of the country's total output of 2,025 tons. Western Areas Mine produced 285 tons; Hartebeestfontein Mine, 263 tons; Buffelsfontein Mine, 228 tons; and East Rand Gold and Uranium Co. Ltd. (ERGO), 4 tons. Free State Consolidated Gold Mines Ltd. (Freegold), Buffelsfontein, and ERGO's uranium production units were closed in 1991. The Palabora copper mine produced 130 tons.

Nuclear Fuels Corp. of South Africa (NUFCOR) processes and markets the combined yellowcake output of the gold mining companies. On July 10, 1991, the Republic of South Africa signed the Nuclear Non-Proliferation Treaty through NUFCOR. NUFCOR, a Chamber of Mines operation, markets most of its uranium to nuclear power stations.

Palabora Copper Mining Co., which markets its own uranium oxide production, made no sales in 1991. Its output has been stockpiled since the expiration of existing sales contracts in 1990. The Atomic Energy Corp.'s Valindaba uranium enrichment plant advanced toward commercialization. The plant, which supplies fuel for Eskom's Koeberg nuclear power station near Cape Town, has reportedly signed small export contracts.

Vanadium.—The three major South African vanadium producers were Highveld, Vanadium Technology (Vantech), a subsidiary of CCT; and Vametco, which belongs to the Strategic Metals Corp., a U.S. company. South African producers have the capacity to meet nearly all current world vanadium demand. Highveld, the world's largest individual vanadium pentoxide producer, has a total rated capacity of about 8,000 mt/a of contained vanadium, almost 50% of world capacity. Most of Highveld's production is in the form of slag produced as waste in the manufacture of steel and contains about 25% V_2O_5. The slag is sold to converters in Europe for production of V_2O_5 in an intermediate product, which is subsequently converted to ferrovanadium. It is also sold to the United States where it is used directly to produce a proprietary alloy known as Ferovan. Highveld's Vantra plant normally produces V_2O_5 flakes directly from vanadiferous magnetite ore using the salt-roast, water-leach process. However, the closure of a number of plants around the world in 1991 provided Highveld with the opportunity to convert existing facilities to beneficiate about 20% of the company's slag output to V_2O_5 at its Vantra plant. The company has spent about $3.6 million on this conversion project, which is expected to be completed by mid-1992. Further modification of the Vantra plant was planned to produce vanadium trioxide, a more cost-effective way of producing ferrovanadium. Demand for vanadium fell, and Highveld continued to close and reopen its Vantra plant according to prevailing market conditions in a bid to support prices and limit the size of vanadium inventories. This was due to a 5% decline in world steel consumption and a 16% decrease in domestic demand. Highveld also cut its production of vanadium-bearing slag to about 60,000 mt/a (about 15,000 mt/a of contained V_2O_5) and dropped its price to $2.10/lb in 1992, the lowest level in 3 years.

Vansa Vanadium's mothballed plant and mineral rights were sold to Vantech in May 1991. Vantech made extensive modifications to the plant to improve recovery and lower working costs. The modified plant, which became operational in early 1992, uses the salt-roast, water-leach process to extract V_2O_5 from vanadiferous ores. Output exceeded initial forecasts of 250 mt/month of V_2O_5. However, Vantech may find it difficult to match Highveld's production costs, reportedly the lowest in the industry.

Vametco mined and processed vanadiferous ores near Brits in the Transvaal. It produced more than 4,000 tons of V_2O_5 equivalent and produced vanadium products as vanadium pentoxide, vanadium trioxide, and nitrovan (a proprietary alloy). Part of this production was sold to Vametco's sister company, U.S. Vanadium Corp., for further beneficiation to a range of vanadium products.

Despite very low vanadium prices, world oversupply, and the failure of both the Rand Mines Vansa Vanadium and the Rhombus Vanadium (Pty.) Ltd. (Rhovan)/Usko Ltd. joint venture in 1990-91, Rhovan may reenter the vanadium market. The company received backing in principle from the IDC for the construction of a new multimillion-dollar vanadium beneficiation plant. The plant would produce vanadium oxides from magnetite from Rhovan's Ba-Mapoga Mine near Brits in the Transvaal. Rhovan was confident that the high quality of its ore combined with a new beneficiation plant will result in low production costs, enabling the company to survive the current economic downturn.

Zirconium.—The Republic of South Africa's major zircon producer is RBM. The company exploits mineral sands on the Natal coast about 150 km north of Durban. Other companies are assessing deposits on both the east and west coasts. RBM has recently completed an expansion program to increase its zircon production capacity to 300,000 mt/a by the end of 1992, making RBM the world's largest producer of zircon. Low zircon prices have caused RBM to accumulate 150,000 tons of stock. RBM continued to review plans to expand mining operations into the Lake St. Lucia area.

The world's only significant source of primary zirconia is the Phalaborwa carbonatite in the northeastern Transvaal, where baddeleyite (ZrO_2) is extracted as a byproduct of phosphate and copper production by Foskor. Several grades of baddeleyite, together with zirconium sulfate and purified zirconia powder, are produced by means of flotation, gravity separation, and leaching. The world's third largest fused-zirconia plant has been commissioned by Foskor at Phalaborwa to supplement the supply of baddeleyite with zirconia products manufactured from zircon sand. While details of production were not available, output is believed to be in the region of 2,000 mt/a from sands supplied by RBM. Most of Foskor's production is exported.

AAC approved the $340 million Namakwa Sands heavy-minerals project at Brand Se Baai, about 220 km north of Saldanha Bay, on the coast of Cape Province. The $200 million equity portion will be funded 80% by AAC and 20% by De Beers. The IDC will be lending the balance. More than 95% of the revenues will be generated by exports. The main product at Namakwa Sands will be ilmenite, which will be smelted to produce titanium slag and pig iron. Zircon and rutile will be recovered as byproducts. At full production, about the year 2000, it is estimated that production should be 140,000 mt/a of zircon, 38,000 mt/a of rutile, 195,000 mt/a of titanium slag, and 120,000 mt/a of pig iron. Production is expected to start in 1994 at an initial mining rate of 4 Mmt/a, rising to full capacity of 16 Mmt/a. Ore reserves are in excess of 500 Mmt.

Rand Mines has dropped out of the Rhosands joint venture with Rhombus Exploration Ltd. (Rhoex) to mine mineral sands, northeast of East London, on the east coast. Rhoex is seeking another partner to exploit the sands, for which it has been granted new prospecting rights. The Alexander Bay-based state-owned Sea Diamond Recovery Co. (Alexkor), previously known as the State Alluvial Diggings, is also considering the possible exploitation of heavy minerals. A prospecting program is being carried out by Mintek, and a report was expected by yearend 1992.

Industrial Minerals

Andalusite.—The Timeball Mine, one of the Republic of South Africa's two andalusite producers in the western Transvaal, was acquired by Anglovaal and renamed Rhino Andalusite Mines. The other producer, Andafrax Mine, together with Annesley andalusite mine, in the northeastern Transvaal, were taken over by Damrec of France. Damrec operates, in France, the only large andalusite mine outside of the Republic of South Africa. The Verref Div. of AAC subsidiary Anglo American Coal Corp. Ltd. (Amcoal) successfully tested high-intensity magnetic upgrading of andalusite from the Havecroft Mine in the northeastern Transvaal. New equipment, to be installed at the mine, will eliminate the more costly calcination at the company's Vereeniging plant.

Asbestos.—The Republic of South Africa's production of asbestos increased by 1.8% as a result of higher output of amosite and crocidolite. However, the Griqualand Exploration and Finance Co. (GEFCO) suspended mining and milling operations in 1991 at its Penge asbestos mine because of shrinking demand for long-fiber amosite asbestos. About 700 jobs were thereby lost.

Cement.—Cement is produced by three companies, Pretoria Portland Cement, Anglo Alpha Cement, and Blue Circle Cement. In line with expected growth in the local building industry, Anglo Alpha planned to increase the capacity of its major plant by up to 35%. This would boost the company's production levels to between 600,000 mt/a and 1 Mmt/a. About 5% of the country's production of cement and clinker was exported. About 70% of the exports was to Zimbabwe, and the rest was to Mozambique and various Indian Ocean islands.

Diamond.—Although the Republic of South Africa is acknowledged as a leading producer of gem-quality diamond, it ranked after Australia, Zaire, Botswana, and the U.S.S.R. in the 1991 overall production of diamonds of various grades. Diamond production declined in 1991 to 8.4 million carats. De Beers' operations accounted for about 95% of South African production. The balance was produced by several independent producers, primarily along the western coast of Namaqualand, between Saldanha Bay and Port Nolloth in the Cape Province. Prospecting continued offshore in the Namaqualand area, although it was at a much less advanced stage than that off the neighboring Namibian coast.

De Beers' mines were the Finsch, the Kimberley, the Koffiefontein, the Namaqualand, Premier, and Venetia Mines. In 1991, they treated 25.7 Mmt of ore to recover about 7.9 million carats of diamond. Kimberley Mines produced 672,398 carats from 3,931,000 tons of ore against 574,188 carats from 3,931,000 tons in 1990. Production from the dump-retreatment section accounted for about 47% of the total Kimberley Mines' production and was expected to increase to 70% in 1992. Production at the 850-m block cave sublevel of the Wesselton Mine was suspended as a result of two mudrushes in January and February 1991. A new block cave sublevel at the 995-m level was to start production in October 1992. Rehabilitation of the flooded areas of the Dutoitspan Mine was completed in January 1991, and the new 870-m level area was expected to be in full production by mid-1993.

The total tonnage treated at the Koffiefontein Mine amounted to 2,703,000 tons yielding 220,606 carats. Plant throughput was adversely affected by the occurrence of diabase gangue in the run-of-mine ore. Plant feed treated included 401,000 tons of surface dump material.

During the first full year of underground mining operation, the Finsch Mine, to the west of Kimberley, produced 2,266,000 tons of ore. A further 2,453,000 tons was reclaimed from the surface buffer stockpile that had been accumulated for this purpose, and 107,000 tons was reclaimed from the surface tailing dumps. Production from all sources in 1991 amounted to 4,826,000 tons of ore yielding 3,482,855 carats, compared with 4,919,000 tons treated and 4,177,572 carats recovered in 1990.

Total diamond production from the Namaqualand Mines, including tailings retreatment, surface-zone mining, and prospecting, was 1,004,168 carats at an average grade of 15.3 carats per 100 tons of ore. Production was 932,392 carats at an average grade of 14.6 carats per 100 tons in 1990.

The Premier Mine treated 7,300,000 tons of ore yielding 2,249,728 carats, down from 1990 output as a result of lower-than-expected grades recovered in dump retreatment and difficulties experienced in increasing production from the higher grade areas below the sill.

Construction works at Venetia diamond mine, the first major diamond mine to be developed in the Republic of South Africa in more than 25 years, was scheduled to be completed in August 1992. The mine is 150 km north of Potgietersrus in the northern Transvaal. Venetia will become the largest diamond producer in the Republic of South Africa, with a planned output of 5.9 million carats per year, accounting for about 40% of the country's total production. In 1991, Venetia's diamond recovery grade increased to 85.8 carats per 100 tons compared to the lower-than-expected 1990 level of 55.5 carats per 100 tons. When full production levels are reached, in 1993, the mine is expected to employ 750 people. Operating life is expected to be at least 20 years.

Dimension Stone.—The Republic of South Africa's exports of dimension stone, consisting mainly of "granite" (including true granite, gabbro, norite, syenite, diabase, and tonalite), amounted to 180,000 m^3 or about 500,000 tons. The country was one of the main suppliers of rough "granite" blocks to world markets and was the largest supplier of the much sought-after "black granite" (norite). Japan was a major buyer of this material. Although an estimated 50% of total "granite" exports was to Europe, mainly Italy and Spain, much of this material was reexported from Europe after further processing. The industry was negatively affected by the Gulf war, as one of the industry's major markets is the Middle East. Local sales of "granite" and marble increased by 50% and 22%, respectively, whereas local sales of slate decreased by 10%.

Rhoex discontinued its Parys granite project after establishing that, due to poor market conditions, the project was uneconomic. The Republic of South Africa's major "granite" producers included Keeley Granite (28% owned by Gencor), Marlin Corp. Ltd., and the recently merged Kudu Granite Holdings Ltd./Impala. The producers established a regional trade association, the Southern African Granite Association (SAGA), to coordinate export efforts and establish orderly marketing to bring about price stability. At a later stage, SAGA plans to address the issue of establishing in-country downstream processing of "granite."

Fluorspar.—In the Republic of South Africa, metallurgical-grade fluorspar is produced in lumpy and briquetted form. Acid- and ceramic-grades are recovered as flotation concentrates. The country's most significant fluorspar deposits are in the Transvaal, with less important deposits found in Namaqualand, northwestern Cape Province, and Natal. During 1991, four mines were operative, of which the Buffalo and Vergenoeg Mines were in the Bushveld Complex, 100 km northeast of Pretoria, and the Witkop and Van den Heever Mines were in the dolomites, 160 km west of Johannesburg. The largest South African producer, Genmin's 41-year-old Buffalo fluorspar mine, cut production back to 70% of capacity and laid off a number of employees. In contrast, Phelps Dodge's Witkop fluorspar mine, which produces acid-grade fluorspar, increased ore production to 600,000 mt/a. Output of 75,000 tons of concentrate was exported to North America, Asia, and Europe.

Production of fluorspar, which peaked at 522,700 tons in 1980, has been adversely affected by the consequent contraction in world fluorspar demand. Total exports amounted to 247,300 tons, slightly higher than those of 1990.

Phosphate.—Foskor, with production of about 2.8 Mmt/a of phosphate, accounted for 95% of the Republic of South Africa's production. Drought conditions in Southern Africa, in 1991-92, had a negative effect on company profits as phosphate fertilizer consumption dropped to the lowest level since 1967. Foskor has developed a process to recover alumina, magnesia, and potash from the mining of phosphate rock. A $38 million demonstration plant was under construction to test the process.

Mineral Fuels

The Southern Oil Exploration Co. (Soekor), the state-owned petroleum exploration company, controlled all offshore oil and gas prospects. It conducted all exploration efforts offshore, with the exception of test drilling in which private companies could participate. Soekor continued to explore the waters off the Republic of South Africa in 1991 without success. Other South African exploration companies shifted their activities up the West Coast of Africa at the expense of local waters.

In its search for oil-bearing reservoirs, Soekor concentrated its exploration efforts in the Bredasdorp Basin, 90 km off the southwest coast. Eleven exploration wells were completed, of which three were classified as potentially commercial gas producers, one flowed oil and another condensate at potentially commercial rates. A drillship, Neddrill 2, was procured for a test well off the West Coast in 744 m of water, a record for the Republic of South Africa. Soekor continued its seismic surveying program off the West Coast.

Total crude petroleum resources in the Bredasdorp Basin, excluding those earmarked for Mossgas, are only modest and are estimated at 200 Mbbl of oil, less than the Saudi Arabian's production for 1 month. The basin also contains 34 billion m^3 of gas, less than the North Sea's production for 3 months, spread over several fields.

Coal.—The Republic of South Africa was the 5th largest coal-producing country in the world after China, the United States, the former U.S.S.R., and India. Bituminous coal accounted for more than 98% of South African coal production. Four companies—Amcoal, Trans-Natal Coal Corp. Ltd., Rand Mines, and Sasol Mining (Pty.) Ltd.—accounted for more than 80% of the country's coal production. Other producers included Iscor, which produces coal for its own use, GFSA, and numerous independent medium to small coal companies.

Although there are 19 coalfields in the Republic of South Africa, spread over an area of 300,000 km^2, the main coal-producing area is the Witbank Basin, which accounts for 42% of the country's output. About 65% of the coal is produced from underground mining operations with the remainder coming from open pit mines. Most open pit mines are no deeper than 70 m.

Weak domestic demand resulting from the depressed state of the South African economy caused local sales of coal to decline by 1.7% to 132.3 Mmt. The largest domestic consumer of coal continued to be Eskom, followed by Sasol. Eskom uses just under 40% of the coal produced in the Republic of South Africa for power generation. About 89% of its energy output was derived from coal. Sasol, the only successful commercial oil-from-coal plant in the world, consumed about 21% of the country's coal production. Other significant domestic users were Iscor's

metallurgical plants, the cement industry, and large municipalities.

The Republic of South Africa's coal exports, dominated by Amcoal, Rand Mines, and Trans-Natal, remained unchanged in 1991 at about 49 Mmt. About 92% of all coal exports were through Richards Bay Coal Terminal, 7% through Durban, and very small quantities were occasionally exported through Port Elizabeth and Cape Town. Coal exports through Maputo in Mozambique dropped to 140,000 tons in 1991 from 800,000 tons in 1989. The country ranked third in world coal export after Australia and the United States. About 36% of exports were to Asia with the balance to Western Europe. It is expected that Eastern Europe will emerge as an important market for South African coal in the longer term.

The major mining houses continued to participate in coal exploration and reserve acquisition programs. Prospecting activities were mainly concentrated in the established eastern Transvaal coalfields and in parts of the northern Transvaal, notably the Waterberg Coalfield, about 100 km north of Thabazimbi and bordering on Botswana. The Waterberg Coalfield is largely undeveloped, with the exception of Iscor's Grootgeluk Mine near Ellisras, 250 km northwest of Pretoria. Extensive mineral rights are held by Sasol Coal in the Waterberg Coalfield, which may contain more than one-third of the Republic of South Africa's coal reserves.

The new North shaft at the Van Dyks Drift Mine, part of a $36 million development program at Rand Mines' Douglas Colliery, 25 km southeast of Witbank, was opened. The shaft will increase the colliery's total production by 2 Mmt/a when in full production.

The official opening of the new $193 million Arthur Taylor (ATCOM) open pit mine, about 30 km south of Witbank, took place at the end of January 1992. The mine is a 50-50 joint venture between Total Exploration South Africa and JCI's Tavistock collieries. The coal plant is designed to produce 2.4 Mmt/a of export quality coal for markets in Europe and Asia. This will bring the total production from the ATCOM complex, which includes an existing underground mine, to 3.9 Mmt/a.

The Kilbarchan Mine, one of the Trans-Natal's oldest collieries near Newcastle, ceased mining operations at the end of March 1992. More than 700 workers were retrenched. The washing plant at the mine was kept in operation for the benefit of some local customers with coal purchased from an independent producer. Local customers will be supplied by increased output from Trans-Natal's Savmore Colliery, about 100 km northeast of Newcastle, when reserves of purchased coal are depleted. Kilbarchan was a captive mine to Eskom's Ingagane power station until 1988, when the power station was mothballed. Since then it has supplied coal to both domestic and export markets.

In 1991, GEFCO, an asbestos-producing company, purchased the Annandale Colliery near Dundee in Natal, 70 km southeast of Newcastle. The colliery was a low-tonnage, unprofitable producer of coal for the domestic market. However, early in 1991, a new washing plant was built to enable the operation to meet the terms of an export contract. GEFCO is also evaluating additional coal rights near Hendrina, 50 km southeast of Witbank, and is considering buying into an existing colliery in the eastern Transvaal.

Sasol's Middelbult underground coal mine, part of the company's Secunda collieries, 80 km south of Witbank, instituted a new production shift system, consisting of two 9-hour shifts per day, replacing the conventional three 8-hour shifts. In the four production sections of the North shaft, productivity has increased by 30% since the system was introduced in May 1991.

The Foston Coal Mining and Exploration Co., which was recently bought out by Revere Resources, exercised its rights over 16 Mmt of anthracite in the Wakkerstroom district, 70 km northeast of Newcastle in Natal. The new 30,000-mt/month mine will be controlled by the company's wholly owned subsidiary, Sink-Ton (Pty.) Ltd. Production will be primarily for export. Foston also operates and manages the new 2,500-mt/month Arbor Colliery through a wholly owned subsidiary, Rappfos Holdings. Mine production is to be increased as a result of installation of a heavy-media cyclone plant. In addition to these two projects, Foston, in cooperation with overseas partners, is also examining other coal deposits with a view to developing an export-grade bituminous coal mine in 1993.

Frigate Mining (Pty.) Ltd., an independent coal company, suffered from poor performance. The company incurred heavy debt since switching from contract mining to ore beneficiation.

Natural Gas.—The only developed gasfield in the Republic of South Africa is 90 km off the southern coast near Mossel Bay. Four production wells were drilled during 1991, and drilling continued on other wells. Construction and commissioning of the Mossel Bay Gas Project (Mossgas), the large synthetic fuels venture with private-sector participation, continued through 1991 and is set to be completed in August 1992. The plant will produce about 25,000 bbl/d of transport fuel consisting of 50% diesel and 50% gasoline and byproducts, including nitrogen, oxygen, and alcohol. The first synthetic fuel production is expected in the fourth quarter of 1992. Soekor, which played a major role in the early development of the project, was contracted to Mossgas for the operation of the offshore facility and the pipeline. Reserves were adequate to maintain production for at least 30 years. The project's life could be extended in a second stage by tapping one medium-sized and four smaller gasfields.

Petroleum, Refining.—The Republic of South Africa produced no crude petroleum in 1991. Four domestic refineries processed imported crude oil. They are all in the process of expanding and/or upgrading their facilities. It was expected that South African refinery capacity will exceed demand for the next few years.

Sasol produces petroleum products from coal at its plants in Sasolburg and

Secunda. Since its inception in 1950, Sasol has undertaken extensive diversification, and its activities now include coal mining, coal conversion, oil refining, fuels marketing, and the manufacture of chemicals, polymers, mining explosives, and fertilizers. Ethyl alcohol is produced as a byproduct by Sasol in amounts too large to be absorbed as solvents or feedstocks; it is added to premium-grade gasoline sold in the Transvaal and parts of the Orange Free State and Cape Province.

Reserves

Geologically, the Republic of South Africa's mineral wealth was derived primarily from the Witwatersrand Super Group, the Bushveld Complex, and the Transvaal and Griqualand West Sequences. The Witwatersrand Super Group, dating from about 2.9 billion years, consists of successive layers of quartzite, conglomerates, siltstones, and shales in an elongated basin. It is considered to be the world's largest single repository of gold and uranium. Some PGM and silver are also present in the Witwatersrand. The Bushveld Complex is a layered mafic igneous intrusion into the overlying Transvaal Super Group and is dated at about 2 billion years. Within it are the world's largest known reserves of chromium, PGM, and vanadium. Cobalt, copper, and nickel are also found in the Bushveld Complex and are recovered as byproducts in the mining of PGM. Within the vicinity of the contact between the Bushveld Complex and upper layers of the Transvaal Super Group are important reserves of andalusite, fluorspar, and tin. The Transvaal and Griqualand West Sequences, dating from about 2.6 billion years, are series of dolomites, ironstones, and shales found in northern Cape Province and in central Transvaal Province. Within it are found major reserves of amosite and crocidolite asbestos, iron ore, limestone, and manganese. *(See figure 1.)*

The Minerals Bureau of the Republic of South Africa reported the country's total reserves in terms of reserve base *(See table 3)* for many mineral commodities. The Minerals Bureau reported a reserve base of 50.8 Mmt for combined andalusite, sillimanite, and kyanite, almost all of which was andalusite. The reserve base for lead of 4.8 Mmt contained metal was broken down further to 2.33 Mmt of demonstrated reserves and 2.43 Mmt of demonstrated marginal reserves. Of demonstrated reserves, Broken Hill's Black Mountain Mine had 1.54 Mmt, Gamsberg Mine had 715,000 tons, and Pering Mine had 86,000 tons. The zinc reserve base of 14.872 Mmt contained zinc was broken down to 11.768 Mmt of demonstrated reserves. The Black Mountain Mine had 726,500 tons, the Gamsberg Mine had 10.6 Mmt, the Prieska Mine had 15,248 tons, and the Pering Mine had 430,860 tons. Demonstrated marginal reserves of zinc were 3.1 Mmt. The only potash production in the Republic of South Africa was by Iscor at its Vanderbijlpark and Newcastle Works, where several kmt/a of a byproduct, containing from 30% to 60% potassium chloride, is produced from iron ore at the sinter plant. However, potential resources, according to the Minerals Bureau, were 200 Mmt in phlogopite at the Phalaborwa Complex and 700 Mmt in glauconite in seabed sediments off Cape Town.

Other research centers involved in mineral reserve assessments in the Republic of South Africa reported updated estimate for certain minerals. The Economic Geological Research Unit of the University of the Witwatersrand estimated that 40,000 tons of gold remained to be mined in the country, compared with about 42,000 tons mined to date. About 60% of this would be derived from existing mines. Recovery of the remainder would involve development of new deep-level mines. The Minerals Bureau of the Republic of South Africa reports a gold reserve base of 18,000 tons for current mining leases only. This figure excludes the gold reserve base of "independent" homelands within the Republic of South Africa.

The recoverable reserves of coal in the Republic of South Africa were estimated at 55 billion tons by the Minerals Bureau, ranking it fifth in the world.

Most of the country's coal is of bituminous thermal-grade, with 2% anthracite and 1.6% metallurgical quality. Only a few deposits of lignite, estimated to be uneconomic, have been recorded in the Southern Cape Province and KwaZulu in Natal.

Recoverable reserves of anthracite coal were 863 Mmt, mainly in Natal Province in the Kliprivier and Zululand Coalfields. About 31% of the total reserve occurs between 15 and 200 m depth, in seams 0.7 to 2 m thick. At these same depths, another 13% of the reserves was in seams 2 to 4 m thick. The remaining 56% of the reserves occur at 200 to 500 m depth in seams 0.7 to 2 m thick.

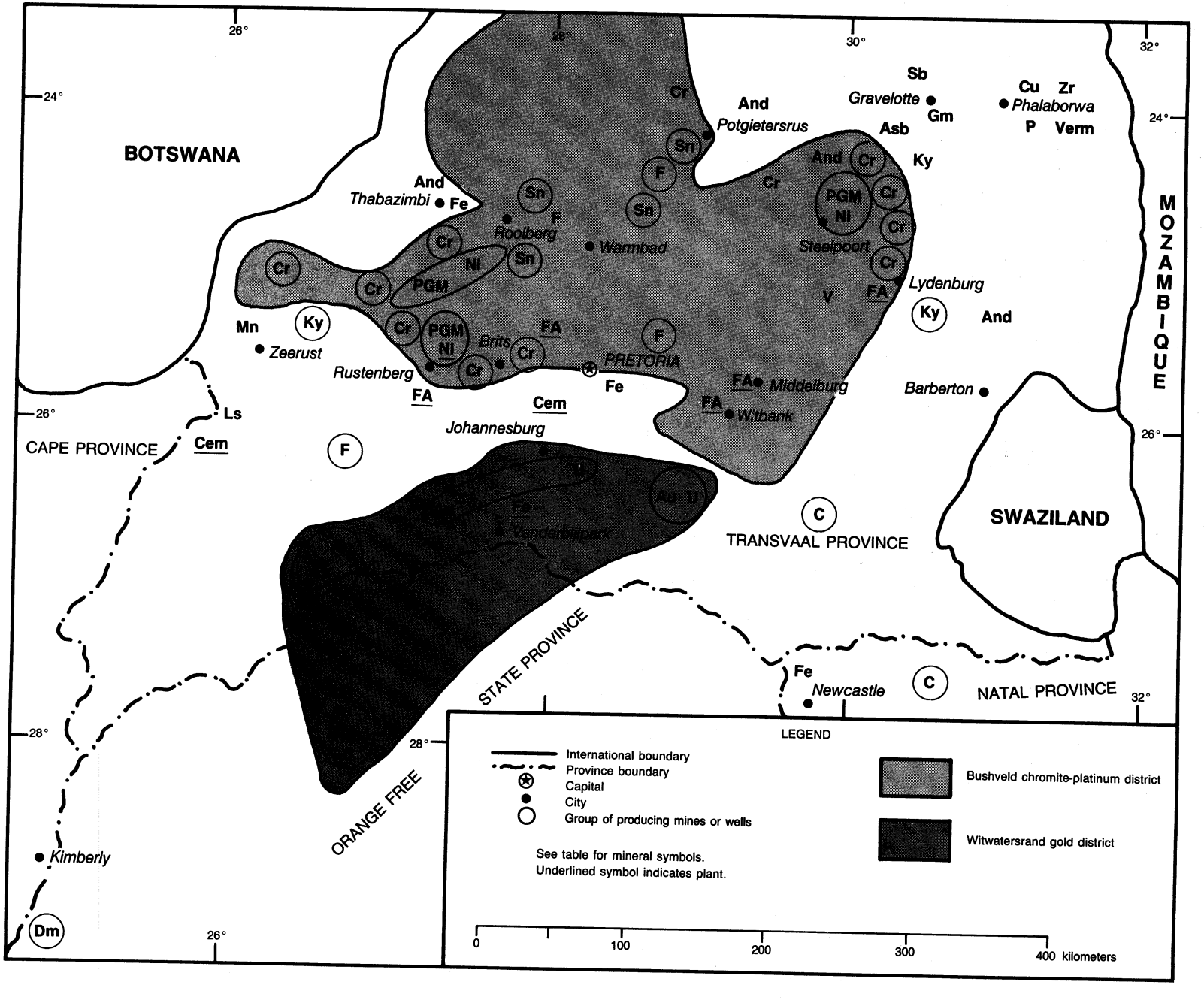
INFRASTRUCTURE

The country had a well-developed and maintained road, rail, and air transportation system, serving not only the Republic of South Africa, but also southern Africa. Road transportation was carried out by numerous private trucking firms as well as by Autonet, a Government-owned road transport company. Almost all of the Republic of South Africa's mineral exports were transported to the country's harbors by Spoornet, the Government-owned rail transport company. Spoornet also linked other African countries to South African ports.

The Republic of South Africa's major ports are Durban, Richards Bay, Cape Town, and Port Elizabeth. In addition to fulfilling the requirements of the Republic of South Africa itself, they also served as outlets for landlocked countries such as Botswana, Lesotho, Swaziland, Zaire, Zambia, and Zimbabwe. Walvis Bay, a territory of the Republic of South Africa within Namibia, is a major port for Namibia. Durban, which serves the Pretoria-Witwatersrand-Vereeniging commercial area, remained the busiest of the more than 80 ports on the African continent while Richards Bay handled the greatest volume of cargo. A total of 45.3 Mmt of coal was exported through the Richards Bay Coal Terminal (RBCT) at

FIGURE 1

SOUTH AFRICA: WITWATERSRAND AND BUSHVELD MINERAL DISTRICT



Richards Bay in 1991, only slightly lower than the 1990 level of 45.5 Mmt. The upgrading program to expand RBCT's capacity to 53 Mmt/a was completed in 1991. AGIP Spa of Italy, GFSA, Iscor, Sasol, and a number of smaller coal producers such as Duiker Exploration Ltd. and Messina Ltd., are considering either increasing their coal exports or entering the export market. The aforementioned coal companies and Portnet, the Government authority that controls South African harbors, are conducting feasibility studies to establish the viability of a second coal terminal, the so-called Red Terminal at Richards Bay, to export 10 to 12 Mmt/a of coal starting in 1995. Sasol could export about 3 Mmt/a from its new open pit Syferfontein Mine, and this tonnage would provide a solid base for a new terminal. However, the existing large users of RBCT are strongly opposed to a second terminal, believing that an increase in exports of 10 Mmt/a will aggravate the world coal oversupply situation and depress coal prices. They are, however, considering allowing Sasol to buy into RBCT, which would then make it unlikely that a second terminal would be built. Coal exports through Durban are 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 had a 1991 coal export capacity of 3.5 Mmt/a. An upgrading program, which would increase capacity to 5 Mmt/a, was in progress. The Port of Maputo in Mozambique, which is closer to the east Transvaal coalfields than are South African ports, is being considered as an export outlet by some coal companies. Two South African firms, Rennies Bulk Terminals (Pty.) Ltd., which operates the coal loading facilities at Durban, and Semtec Ltd., a partnership between SWF Technology Ltd. and EMS Transvaal Ltd., are competing for the contract to upgrade the port's coal capacity to 3.5 Mmt/a.

Eskom, with an installed capacity of about 36,000 MW, supplied 98% of electricity used in the Republic of South Africa. Eskom's average price per kW·h sold was $0.0306, one of the lowest in the world. The mining industry consumed 31,366 GW·h of electricity in 1991, or 22.7% of Eskom's sales, compared with 33,363 GW·h in 1990. Gold and uranium mines accounted for 72.5% of Eskom's sales of electricity to the mining industry, while the iron and steel industry accounted for 31.1% of Eskom's sales to the South African industrial sector. Seventeen coal-fired power stations accounted for 88.5% of the Republic of South Africa's installed electricity generating capacity in 1991, with nuclear power and hydroelectric power contributing 5.1% and 1.5%, respectively.

OUTLOOK

The removal of sanctions allows the Republic of South Africa to compete with other mineral-producing countries in a number of areas. The country can be expected to acquire new markets, qualify for international mining finance capital, and gain access to prospecting rights. Exports of iron ore and steel are expected to increase as a result of the relaxation of embargoes.

Coal exporters, who lost about 14 Mmt/a of coal export markets due to sanctions and other trade restrictions, should also benefit from the removal of trade barriers. Coal exporters are now able to place on long-term contracts the substantial quantities of South African coal that moved onto the volatile spot market from 1986 to the end of the embargoes.

Further declines in gold production as a result of low prices, and the closure of marginal mines and uneconomic sections of other mines, are expected to continue. However, the decline may not be severe as the gold mines increase extraction of higher grade ore. AAC's new Moab shaft is seen by the Chamber of Mines as proof of growing confidence in the future of this sector in spite of the low gold price and resultant widespread retrenchments during 1991. South African mining houses anticipated that a worldwide economic upturn in 1993 would boost demand for jewelry in the West and thus demand for gold among jewelers.

A modest increase in the volume of PGM exports, especially rhodium, is estimated based principally on an expected increase in demand for autocatalysts from Europe, following the introduction there of more stringent environmental regulations.

Chrome ore exports are forecast to be bolstered by restocking ahead of the long-awaited upturn in the world economy. Likewise, shipments of ferrochrome are expected to increase in line with an anticipated improvement in the stainless steel market. Owing to increases in production capacity, the Republic of South Africa's exports of titanium, zirconium, and zinc, are expected to increase. In particular, the commissioning of ventures such as the Columbus, Alusaf, and other base metal projects is likely to lead to an expansion in exports of beneficiated mineral commodities.

Prospects for the Republic of South Africa's industrial minerals sector and for processed minerals are generally forecast to improve beyond 1993. Export volumes and prices are expected to maintain positive growth rates in the medium term. Environmental factors could, however, adversely affect exports of specific minerals such as asbestos and fluorspar.

With its large mineral resource base, the Republic of South Africa has great potential for increasing mineral production under favorable economic conditions.

In the longer term, diversification of the economy away from mining is likely to continue. Increased foreign investment in the Republic of South Africa remains dependent upon settlement of the economic and political issues confronting a new Government. Changes in mining code, investment code, and tax law are likely to increase the level of risk to potential investors, both domestic and foreign based.

[1]Unless otherwise specified, reference to the Republic of South Africa includes Bophuthatswana, Ciskei, Transkei, and Venda, as well as the 10 tribal homelands, all within the boundary of the Republic of South Africa.

[2]The U.S. sanctions imposed under title III of the Comprehensive Anti-Apartheid Act of 1986 (CAAA) and the Rangel double-taxation amendment were lifted on July 10, 1991. As of that date, U.S. companies and citizens were no longer prohibited by the CAAA from making new investments in the Republic of South Africa. However, other U.S. sanctions remained. The 1985 Gramm Amendment prohibits U.S. support for new IMF funding for the Republic of South Africa. The United States maintains a ban on all exports to the South African military and police; a total ban on all export of arms, ammunition, and equipment for their manufacture and maintenance; and prohibition on the import of arms from the Republic of South Africa. While Americans are no longer prohibited by Federal laws from investing in the Republic of South Africa, a number of sanctions imposed by State and local authorities hinder companies from doing so.

[3]Where necessary, values have been converted from South African rands (R) to U.S. dollars at the rate of R2.76=US$1.00 for 1991, R2.59=US$1.00 for 1990, and R2.62=US$1.00 for 1989.

[4]The Minerals Bureau reports $14.4 billion, which excludes sales of minerals from homelands. The total sales of all crude and processed mineral commodities and products is estimated at $30 billion and includes the following: crude minerals, $15.8 billion; ferroalloys and other processed mineral products, $1.9 billion; steel estimated at $2.8 billion; cement, estimated at $0.4 billion; petroleum products, estimated at $8 billion; fertilizers, estimated at $0.6 billion; and others, $0.5 billion.

[5]Raw Materials Group RMG AB, Stockholm, Sweden. Who Owns Who in Mining 1992. Roskill Information Services Ltd., London, 1992, 327 pp.

OTHER SOURCES OF INFORMATION

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Publications

Anhaeusser, C. R., and Maske, S. Mineral Deposits of Southern Africa, v. I and II, Geol. Soc. S. Afr., 1986, 2,335 pp.

Chamber of Mines of South Africa, Annual Report 1991, 64 pp.

Eskom, Annual Report 1991, 48 pp.

Minerals Bureau, Department of Mineral and Energy Affairs, South Africa's Mineral Industry 1991/92, 110 pp.

Mintek, Annual Report 1991, 43 pp.

National Energy Council, Annual Report, 1991-92, 64 pp.

TABLE 1

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991
METALS						
Aluminum metal, primary		170,600	170,400	165,900	r159,489	171,108
Antimony concentrate:[2]						
Gross weight		11,453	10,855	8,838	8,113	e7,600
Sb content		6,673	6,264	5,201	4,815	4,485
Beryl concentrate (11% to 12% BeO)	kilograms	135	72	—	1,000	103
Cadmium, Cd content of cadmium cake[e]		33	37	40	40	40
Chromite, gross weight:						
More than 48% Cr_2O_3	thousand tons	65	20	54	47	70
44% to 48% Cr_2O_3	do.	r2,285	2,721	2,583	2,383	2,673
Less than 44% Cr_2O_3	do.	r1,512	1,503	2,314	2,188	2,367
Total[4]	do.	r3,862	4,245	4,951	4,618	5,110
Cobalt:						
Mine output, Co content[e]		380	300	300	350	300
Refinery output:						
Metal, powder[e]		80	60	60	70	60
Sulfate, contained cobalt[e]		180	150	140	180	150
Total[4]		263	206	199	249	209
Columbium-tantalum concentrate	kilograms	8	140	20	6	14
Copper:						
Mine output, Cu content		188,088	168,452	181,854	178,704	184,556
Metal:						
Smelter		189,800	180,600	184,800	176,000	170,400
Refined		146,500	136,700	144,200	133,000	138,800
Gold, primary	kilograms	607,000	621,000	r607,460	r605,100	601,013
Iron and steel:						
Ore and concentrate:						
Gross weight	thousand tons	22,008	25,248	29,958	30,291	28,958
Fe content	do.	14,297	16,461	19,461	19,689	18,819
Metal:						
Pig iron	do.	6,317	6,171	6,543	6,257	6,968
Direct-reduced iron	do.	844	730	840	r900	900
Ferroalloys, electric arc furnace:						
Chromium ferroalloys	do.	965	994	r1,050	1,022	1,127
Ferromanganese	do.	315	447	r394	404	260
Silicomanganese	do.	282	248	258	234	e235
Manganese metal	do.	32	37	40	35	e35
Ferrosilicon	do.	83	87	93	r78	68
Silicon metal	do.	34	39	36	36	40
Ferrovanadium[e]	do.	1	1	2	r1	1
Total[4]	do.	1,712	1,853	r1,873	r1,810	1,766
Crude steel	do.	r8,991	r8,837	r9,337	r8,691	9,358
Lead:						
Concentrate, Pb content		93,642	90,233	78,171	69,417	76,262
Smelter, secondary		38,268	37,361	36,900	31,200	32,200

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991
METALS—Continued						
Manganese:						
Ore and concentrate, gross weight:						
Metallurgical:						
More than 48% Mn	thousand tons	970	1,108	1,228	2,102	1,637
45% to 48% Mn	do.	492	674	1,357	610	181
40% to 45% Mn	do.	937	710	702	689	628
30% to 40% Mn	do.	749	1,405	1,518	917	653
Total[4]	do.	3,148	3,897	4,805	4,318	3,100
Chemical:						
More than 65% MnO_2	do.	3	2	1	6	1
35% to 65% MnO_2	do.	138	122	77	69	45
Less than 35% MnO_2	do.	5	2	—	9	—
Total	do.	146	126	79	84	46
Grand total[4]	do.	3,294	4,023	4,884	4,402	3,146
Nickel:						
Mine output, Ni content		34,300	34,800	34,000	r30,000	e30,000
Metal, electrolytic		29,248	29,217	r28,100	r28,200	26,863
Platinum-group metals, metal content of concentrate, matte, refinery products	kilograms	127,980	131,722	133,684	141,913	142,861
Silver:						
Mine output, Ag content	do.	208,118	199,746	179,829	r161,003	170,832
Metal[e]	do.	1,900	1,800	1,700	r1,500	1,600
Thorium, monazite[e]		1,200	1,200	1,200	r1,317	1,300
Tin:						
Cassiterite concentrate:						
Gross weight[e]		3,620	3,400	3,350	2,800	2,600
Sn content		1,438	1,377	1,306	1,140	1,042
Metal, primary[5]		1,508	1,389	1,307	1,152	1,088
Titanium:[e]						
Concentrate		55,000	55,000	60,000	r64,056	75,000
Titaniferous slag		650,000	700,000	725,000	r840,000	900,000
Uranium oxide (U_3O_8)		r4,676	r4,583	r3,456	r2,875	2,039
Vanadium:						
Vanadiferous slag, gross weight[e]		72,000	80,000	80,000	70,000	60,000
V content:						
Of vanadiferous slag[e]		10,100	11,300	11,300	10,000	8,480
Of V_2O_5 and vanadate products[e]		5,840	6,330	7,270	7,100	7,000
Total[4]		15,942	17,631	18,567	17,106	15,477
Zinc:						
Concentrate:						
Gross weight		e220,000	r176,180	r145,452	r139,266	e120,000
Zn content		112,686	89,551	77,334	74,792	64,425
Metal, smelter		96,051	85,193	84,997	r91,900	91,516
Zirconium concentrate (baddeleyite and zircon)[e]		140,000	150,000	150,000	r151,536	230,000
Sillimanite		1,243	781	170	256	422

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991
INDUSTRIAL MINERALS						
Aluminosilicates:						
Andalusite		218,560	259,556	284,617	283,677	209,824
Asbestos						
Amosite		26,026	20,325	26,124	26,570	27,325
Chrysotile		101,722	113,468	115,420	103,410	101,650
Crocidolite		7,326	11,885	15,050	15,820	19,550
Total[4]		135,074	145,678	156,594	145,791	148,525
Barite		8,617	8,735	8,570	2,490	4,790
Calcite		466	65	—	—	2,556
Cement, hydraulic	thousand tons	7,256	8,486	r8,030	r7,811	7,427
Clays:						
Attapulgite		6,026	7,161	6,609	7,628	8,109
Bentonite		48,953	66,750	62,987	66,059	64,600
Fire clay		230,519	267,184	282,885	232,393	132,813
Flint clay		106,915	139,112	128,586	130,174	123,849
Kaolin		151,730	152,500	139,711	132,421	134,485
Corundum, natural		5	2	2	e2	e2
Diamond, natural:						
Gem[e]	thousand carats	4,000	3,800	4,000	3,900	3,800
Industrial[e]	do.	5,050	4,700	5,120	4,810	4,620
Total[4]	do.	9,051	8,504	9,116	8,708	8,421
Diatomite		194	199	133	2,798	2,352
Feldspar		r66,513	61,440	52,964	56,124	70,324
Fluorspar:						
Acid-grade[e]		279,000	283,000	310,000	262,000	240,000
Ceramic-grade[e]		7,000	8,000	9,000	7,500	6,000
Metallurgical-grade[e]		30,600	37,420	49,340	41,530	24,340
Total[4]		316,606	328,421	368,340	311,032	270,341
Gemstones, semiprecious:						
Rose quartz	kilograms	r e40,000	44,165	47,210	17,842	—
Tiger's eye	do.	r412,147	368,462	r279,617	r550,245	508,466
Gypsum, crude		349,079	372,169	406,743	390,765	420,146
Lime[5]	thousand tons	r1,917	1,916	1,939	1,830	1,765
Magnesite, crude		74,961	74,088	75,695	114,182	92,634
Mica, scrap and ground	kilograms	970	1,669	1,708	1,765	1,883
Nitrogen: N content of ammonia		546,600	471,800	455,200	456,200	457,000
Perlite		—	978	1,950	200	41
Phosphate rock, gross weight	thousand tons	2,623	2,850	2,963	3,165	3,050
Pigments, mineral, natural:						
Ochers		621	1,944	1,327	e2,860	1,122
Oxides		147	126	—	e50	—
Total[4]		768	2,070	1,327	r2,909	1,122
Quartz, glass sand	thousand tons	1,937	2,011	2,182	1,986	2,068
Salt		705,531	678,225	692,391	728,110	664,624
Silcrete[5]		r5,838	815	4,079	1,244	e1,200
Sodium sulfate, natural		241	255	15	e20	e20

See footnotes at end of table.

TABLE 1—Continued

REPUBLIC OF SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991
INDUSTRIAL MINERALS—Continued						
Stone, n.e.s.:						
Dimension:						
Granite and norite		379,200	566,300	626,800	692,400	806,100
Marble		7,100	8,600	6,000	11,500	12,100
Slate		39,200	42,300	33,900	29,400	26,300
Crushed and broken:						
Limestone and dolomite	thousand tons	19,827	18,644	18,903	19,946	19,971
Nepheline syenite		1,066	260	141	e200	20,966
Shale		353,546	421,802	398,374	386,286	391,108
Sulfur:						
S content of pyrite	thousand tons	545	r507	461	452	293
Byproduct:						
Of metallurgy[e]	do.	r 3100	110	100	110	105
Of petroleum[e]	do.	115	120	120	120	120
Total[4]	do.	e760	738	682	683	517
Talc and related materials:						
Talc		8,005	10,111	11,596	11,179	8,235
Pyrophyllite (wonderstone)		3,467	3,162	3,942	2,759	4,448
Vermiculite		228,863	209,177	224,500	220,311	214,656
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Anthracite	thousand tons	5,252	4,951	4,208	3,622	2,689
Bituminous	do.	171,294	176,409	172,075	171,161	175,507
Total[4]	do.	176,546	181,360	176,283	174,784	178,196
Petroleum refinery products:						
Gasoline	thousand 42-gallon barrels	36,865	36,865	37,230	e37,000	e37,000
Jet fuel	do.	3,285	3,285	3,285	e3,300	e3,300
Kerosene	do.	3,285	3,285	3,285	e3,300	e3,300
Distillate fuel oil	do.	39,055	39,055	39,420	e39,000	e39,000
Residual fuel oil	do.	23,725	23,725	24,090	e24,000	e24,000
Lubricants	do.	2,555	2,555	2,555	e2,500	e2,500
Other	do.	16,060	14,965	15,330	e15,000	e15,000
Refinery fuel and losses	do.	8,030	7,665	7,665	e8,000	e8,000
Total	do.	125,925	124,830	132,860	e132,100	e132,100

eEstimated. rRevised.

[1]Table includes data available through Nov. 30, 1992.

[2]Data are for the year ending June 30 of that stated.

[3]Reported figure.

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

[5]Domestic sales plus exports.

TABLE 2

REPUBLIC OF SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity ownership[1]	Location of main facilities	Annual capacity
Aluminum	Aluminium South Africa (Pty.) Ltd. (Alusaf) (Gencor, 40.5%; IDC, 38%; Alusuisse-Lonzo Holding, Ltd., 15.3%)	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, 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%; Anglovaal Ltd., 2.4%; Middle Witwatersrand, 5.5%)	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.
Do.	Anglo Dutch Exploration & Mining Co. (Pty.) Ltd.	Stella Mine, 25 kilometers east of Barberton	NA chrysotile.
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.
Do.	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.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity ownership[1]	Location of main facilities	Annual capacity
Coal—Continued:		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 Company (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.	Kimberley Mines, Kimberley	.8.
Do.		do.	Koffiefontein Mine, 70 kilometers south of Kimberley	.2.
Do.		do.	Namaqualand Mines, 50 kilometers north of Port Nolloth	1.0.
Do.		do.	Premier Mine, 70 kilometers east of Pretoria	2.3.
Do.		do.	Venetia Mine, 150 kilometers north of Potgietersrus	.3.
Fluorspar		Transvaal Mining and Finance Co. Ltd. (Gencor, 100%)	Buffalo Mine, 110 kilometers northeast of Pretoria	200 acid-grade fluorspare.
Do.		Vergenoeg Mining Corp. (Pty.) Ltd. (Bayer AG, Germany, 100%)	Vergenoeg Mine, 90 kilometers east of Pretoria	200 acid-and metallurgical-grade fluorspare.
Do.		Phelps Dodge Mining (Pty.) Ltd. (Phelps Dodge Corp., U.S., 100%)	Witkop Mine, 130 kilometers west of Johannesburg	75 acid-grade fluorspare.
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.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity ownership[1]	Location of main facilities	Annual capacity
Gold tons	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.	Gencor (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.	Rand Mines Ltd. (Barlow Rand Ltd., 74%)	Harmony Mine 20 kilometers southeast of Welkom and others	55 Au.
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.	JCI (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 Krugersdorp, 30 kilometers west of Johannesburg	300 ferrochromium. 120 ferrochromium.
Do.	Consolidated Metallurgical Industries (Pty.) Ltd. (JCI, 49.9%; AAC, 26.4%)	Lydenburg Purity in Rustenburg	210 ferrochromium. 120 ferrochromium.
Do.	Chromecorp Technology (Pty.) Ltd. (CI Chromeinvest AG, Germany, 50%; Investinox AG, Germany, 50%)	Rustenburg	180 ferrochromium.
	Feralloys Ltd. (Associated Manganese Mines of South Africa Ltd., 100%)	Machadadorp, 80 kilometers east of Middelburg	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.

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity ownership[1]	Location of main facilities	Annual capacity
Iron and steel—Continued:			
Ferroalloys—Continued:	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 PL (Shell South Africa, 50%; British Petroleum Co., 50%)	Refinery in Durban	73 crude.
Do.	Caltex Oil SA PL (private, 100%)	Refinery in Cape Town	33 crude.
Do.	National Petroleum Refiners of South Africa PL (Sasol, 100%)	Refinery in Secunda, 100 kilometers southeast of Johannesburg	28 crude.
Do.	Genref (Engen Ltd., 62%)	Refinery in Durban	24 crude.
Phosphate	Phosphate Development Corp. Ltd. (Foskor Ltd.) (IDC, 100%)	Foskor Mine at Phalaborwa	3,500 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.	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

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity ownership[1]	Location of main facilities	Annual capacity
Platinum-group metals—Continued:	tons	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.		Eastern Platinum Ltd. (Lonhro plc, United Kingdom, 73%; Impala Platinum Holdings Ltd., 27%)	40 kilometers northeast of Rustenburg	3 PGM.e
Do.		Western Platinum Ltd. (Lonhro plc, United Kingdom, 73%; Impala Platinum Holdings Ltd., 27%)	20 kilometers east of Rustenburg	10 PGM.e
Do.		do.	Karee Mine 25 kilometers northeast of Rustenburg	5 PGM.e
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.		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, 25%; IDC, 25%)	Opencast operations near Richards Bay	125 rutile concentrate; 1,280 ilmenite.
Titanium slag		Richards Bay Iron and Titanium Corp./Richards Bay Minerals (Rio Tinto Zinc Corp. plc, 50%; Gencor, 25%; IDC, 25%)	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
Do.		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.		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	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

See footnotes at end of table.

TABLE 2—Continued

REPUBLIC OF SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity ownership[1]	Location of main facilities	Annual capacity
Uranium	tons	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	do.	Highveld Steel and Vanadium Corp. Ltd. (Anglo American Industrial Corp. Ltd., 51.8%; De Beers, 3.8%)	Mapochs Mine near Lydenburg	24,000 vanadium pentoxide.e
Do.		Vametco Minerals Corp. (Strategic Metals Corp., U.S.A., 100%)	Krokodilkraal Mine and plant near Brits	10,000 vanadium pentoxide.e
Do.		Transvaal Alloys Pty. Ltd., (Highveld Steel and Vanadium Corp., 100%)	Wapadskloof Mine and plant near Witbank	2,250 vanadium pentoxide.e
Do.		Vanadium Technology Ltd. (Vantech) (Chromecorp Technology (Pty.) Ltd., 100%)	Kennedy's Vale (ex Vansa Vanadium) Mine and plant near Lydenburg	3,000 vanadium pentoxide.
Do.		Rhombus Vanadium Holdings Ltd. (Rhombus Exploration Ltd., 50%; Usko Ltd., 50%)	Ba-Mogopa Mine and Usko plant near Brits	9,000 vanadium pentoxide.
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.
Do.		Black Mountain Mineral Development Company (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, 25%; IDC, 25%)	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

[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

REPUBLIC OF SOUTH AFRICA: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1991

(Million metric tons unless otherwise specified)

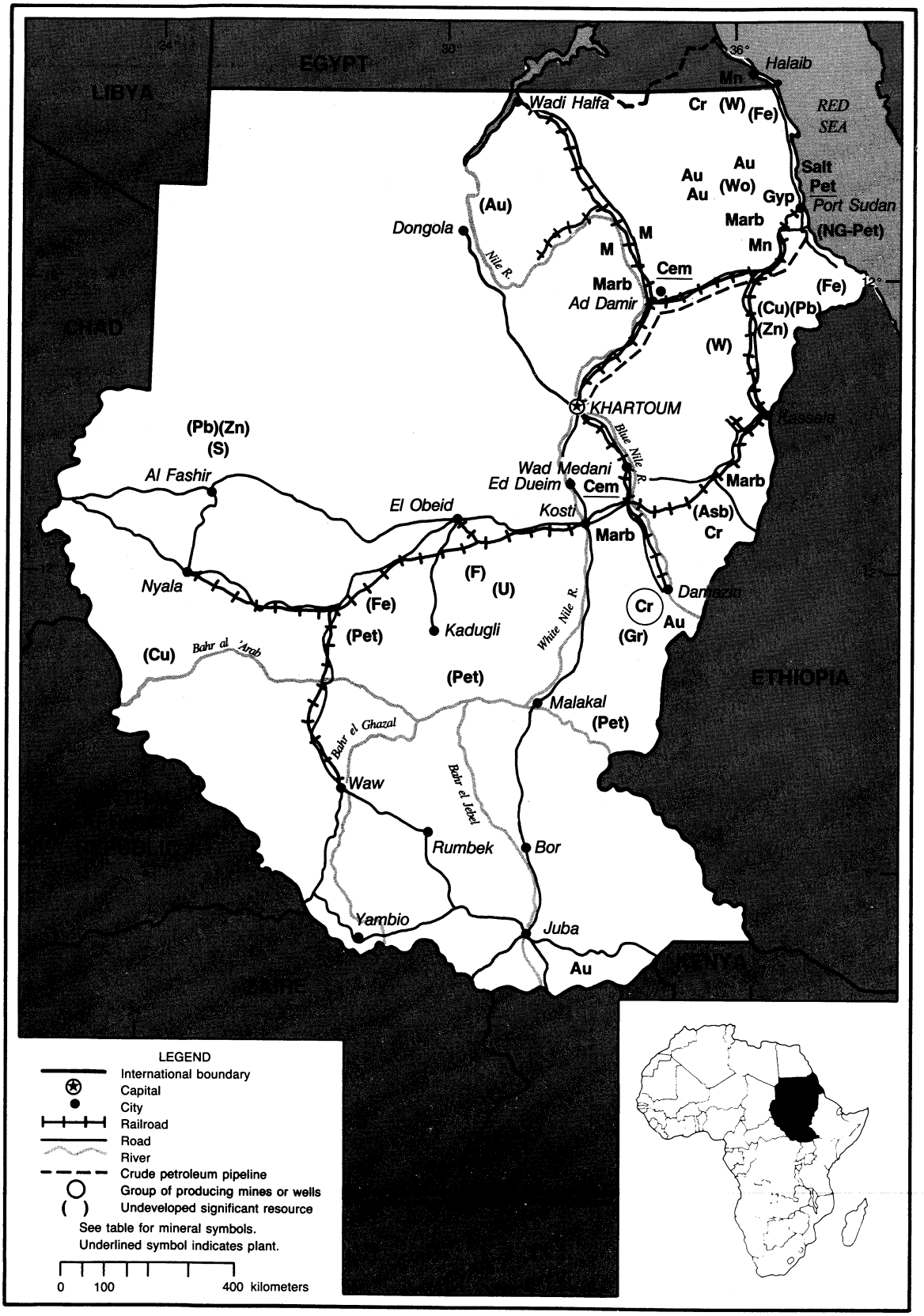
Commodity		Reserve base
Andalusite		51.
Antimony	tons	120,000 contained Sb.
Asbestos		8.
Chromium		3,200 chrome ore.
Coal		55,000.
Cobalt	tons	16,000 contained Co.
Copper		8 contained Cu.
Fluorspar		32.
Gold	tons	18,000 Au.[1]
Gypsum		86.
Iron ore		5,900 contained Fe.
Lead		5 contained Pb.
Manganese		4,000 contained Mn.
Nickel		12 contained Ni.
Phosphate rock		2,310 concentrate.
Platinum-group	metals	30,200 contained PGM.
Silver	tons	10,000 Ag.
Titanium		31 contained Ti.
Uranium	tons	305,000 contained U.[2]
Vanadium		8 contained V.
Vermiculite		73.
Zinc		15 contained Zn.
Zirconium		7 contained Zr.

[1]The Economic Geology Research Unit of the Witwatersrand University's estimate of the gold reserves, including from potential new goldfields, is 40,000 tons Au.
[2]Recoverable at a cost of less than $80/kilogram.

Source: Minerals Bureau, Department of Mineral and Energy Affairs, 1991.

SUDAN

AREA 2,505,810 km² **POPULATION 25.7 million**



THE MINERAL INDUSTRY OF

SUDAN

By Lloyd E. Antonides

Sudan's minerals continued to have relatively little impact on the economy of the country in 1991, much less the world's. However, cement production and the promise of oil and gas production were important factors in the country's future plans. Gold lost some of its attraction with the closure of two mines. But chrome and manganese ores were starting to be looked at again. As Africa's largest country, more than one-fourth as large as the United States, it undoubtedly had other possibilities for mineral production. Many hard-rock minerals of potential value were found in the eastern highlands where transport distance to Port Sudan on the Red Sea was not a major obstacle. There was natural gas offshore near the port and oil in the south-central part of the country. Most of the country remained essentially unexplored.

The Government's 3-year economic program launched in January 1990 was aimed at reduction of state involvement in the economy, deregulation of price and profit controls, privatization of parastatal corporations, and ending subsidies on food and fuel. It was also aimed at liberalization of the trade evironment and stabilization of the exchange rate. By mid-1992, the Government had mainly met those goals, but the economy was slow to respond. Major imbalances persisted in the external balance of payments and internal Government budget accounts.

Concerned with continued economic deterioration, in February 1992 the Government speeded up its reform program by floating the local currency and lifting subsidies on wheat and fuel. The Sudanese pound immediately dropped in value from Ls15 to Ls90 per dollar, and bread and gasoline more than quadrupled in price. This also boosted inflation, which already was under pressure from Government budget deficits. There was little hope for improvement in the budget deficit and inflation as long as the 9-year-old civil war in the south continued.

One bright spot in the economy was agriculture, which normally accounts for more than one-third of the GDP and employs more than 75% of the work force. In spite of a continuing drought in the west, it had a boom year and was the major cause of a 9.6% rise in real GDP for the fiscal year ending June 1992, according to the World Bank. The bank estimated the nominal GDP at about $5 billion[1] and consumer price inflation at 140% for that year.

Mineral production included cement, chromite, gold, gypsum, limestone, petroleum refinery products, and salt. No significant change in volume was apparent. Typically, mineral exports consisting of chromite, gold, and salt provided a very small fraction of export revenues, which mostly came from cotton and livestock. Petroleum refinery products and crude oil were by far the most significant commodity items imported. Libya agreed late in the year to supply 6,100 mt/month of petroleum products, and in December Iran agreed to trade 100,000 mt/month of oil for meat and other agricultural products. *(See table 1.)*

State-owned companies were a major factor in the mineral industry of Sudan since the early 1970's. However, private firms also operated since 1979. Privatization and foreign participation was encouraged by the Government as part of its economic program begun in January 1990. Small primitive mining operations were common. *(See table 2.)*

Chromite mining was again being considered by several parties that had previously been operators.

Copper mining studies apparently continued at the Hofrat en Nahas deposit in western Sudan. Armeno Resources and the Government were participants.

Gold production from the Hassai Mine was reported to have started in August 1991. However, earlier reports said it had been operated by the French Bureau de Recherches Geologiques et Minieres since early 1987. Two other gold mines started up in the past few years, Gebeit and Akerketeib, remained closed since early 1990. The first closed because of low grades and high costs and the foreign partner, Greenwich Resources, announced in December 1991 that earning any return was unlikely. The Akerketeib, in which Kenmare Resources was involved, was claimed to have been closed mostly due to import restrictions on needed supplies. With the Government's new policies, this could change. All the mines were located generally northwest of Port Sudan in the Red Sea Hills.

Cement production expansions at both of the Sudan plants, Atbara and Rabak, were shown in Cembureau's 1991 Directory. The new facilities were scheduled for startup by yearend 1991 but confirmation was not available. At Atbara the capacity for grinding was to increase from 180,000 mt/a to 500,000 mt/a, and for the kilns, from 150,000 mt/a to 375,000 mt/a. At Rabak, the previously announced expansion was shown to be from a capacity of 100,000 mt/a to 300,000 mt/a.

Petroleum activity increased. Undoubtedly this was partly because of the Government's strong efforts to start crude oil production to reduce the trade deficit, much of it due to oil imports. In

December 1991 a Sudan subsidiary of International Petroleum Corp. (IPC), based in Canada, was awarded two blocks of concessions along the shore of the Red Sea. One between Port Sudan and Ethiopia was 28,199 km^2 and covered two gas and condensate discoveries that Chevron made in the mid-1970's. The other block was north of Port Sudan in the triangle formed by the different "political" and "administrative" boundaries with Egypt. Ownership was being disputed by Eqypt. One dry hole was reported drilled in the area in the past. The agreement called for IPC to drill at least six holes during the 6-year exploration period. The contract will be extended to at least 25 years in the event of commercial production of oil or gas.

Rompetrol of Romania entered into an agreement with Sudan in November 1991 to carry out some production drilling. It was to complete a well started by the Government company early in 1991, then drill two new wells. Rompetrol will finance 60% of costs. The area is called Abu Gabra, about 750 km southwest of Khartoum. Chevron discovered the field in 1979 but relinquished the block in 1990.

Chevron discovered seven fields in the general area since starting work in 1975. The company apparently ceased work in 1990 because of insufficient security from rebel attack. In February 1992, Chevron agreed to resume activities or the Government could find third parties to develop the fields. The Government is to give priority to companies that will reimburse Chevron for some of its $1 billion expenditures.

Iraq, in July, and Iran, in December, agreed to assist Sudan in developing the petroleum sector from exploration to refining.

The future of the mineral industry in the Sudan depends on resolving the political conflict and continuing to improve the general economy. If this is accomplished, the rather extensive base of mineral deposits should attract further exploration and result in increased production.

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[1]Where necessary, values have been converted from Sudan pounds (Ls) to U.S. dollars at the rate of Ls5.43=U.S.$1.00 in 1991, the average official rate. However, according to Middle Eastern publications the illegal market rate in that period was about Ls80.00=U.S.$1.00. In February 1992, the Government announced a float of the rate and it became Ls90.00=U.S.$1.00.

OTHER SOURCES OF INFORMATION

Agencies

Ministry of Energy and Mining
Republic of the Sudan
Khartoum, Sudan
Telex 22638

Publications

Arab Oil & Gas Directory 1992,
Arab Petroleum Research Center,
7, Avenue Ingres, 75016 Paris, France.

TABLE 1

SUDAN: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991e
Cement, hydraulic e		[3]121,732	140,000	150,000	[3]166,538	170,000
Chromium: Chromite, mine output (e48% Cr_2O_3), gross weight		13,015	8,000	25,000	12,500	10,000
Gold, mine output, Au content e	kilograms	[3]85	300	500	100	50
Gypsum and anhydrite, crude e		7,000	[3]5,000	[3]10,000	5,000	7,000
Petroleum refinery products: e [4]						
Liquefied petroleum gas	thousand 42-gallon barrels	100	[3]101	100	r e[3]90	100
Gasoline	do.	700	[3]1,275	r1,100	r e810	900
Jet fuel	do.	400	[3]669	r400	r [3]330	400
Kerosene	do.	100	[3]128	100	r100	100
Distillate fuel oil	do.	1,000	[3]2,026	r1,500	r [3]1,380	1,400
Residual fuel oil	do.	1,300	[3]1,573	r1,200	r [3]1,190	1,200
Other	do.	200	[3]208	r150	r150	150
Total, including refinery fuel and losses e		3,800	5,980	r4,550	r4,050	4,250
Salt		51,662	r e50,000	91,000	68,262	75,000

eEstimated. rRevised.

[1]Includes data available through July 1, 1992.

[2]In addition to the commodities listed, limestone for cement manufacture (at least 1.25 tons per ton of 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 construction materials (clays, sand and gravel, stone, etc.) presumably are produced, but available information is inadequate for reliable estimates of output; also production of manganese ore (48% to 50% Mn) was reported for 1989 at 1,100 metric tons and for 1990 at 60,000 metric tons. Mica production was last reported in 1984 and has been deleted from this year's table.

[3]Reported figure.

[4]Refinery fuel and losses are included in output of individual products.

TABLE 2

SUDAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

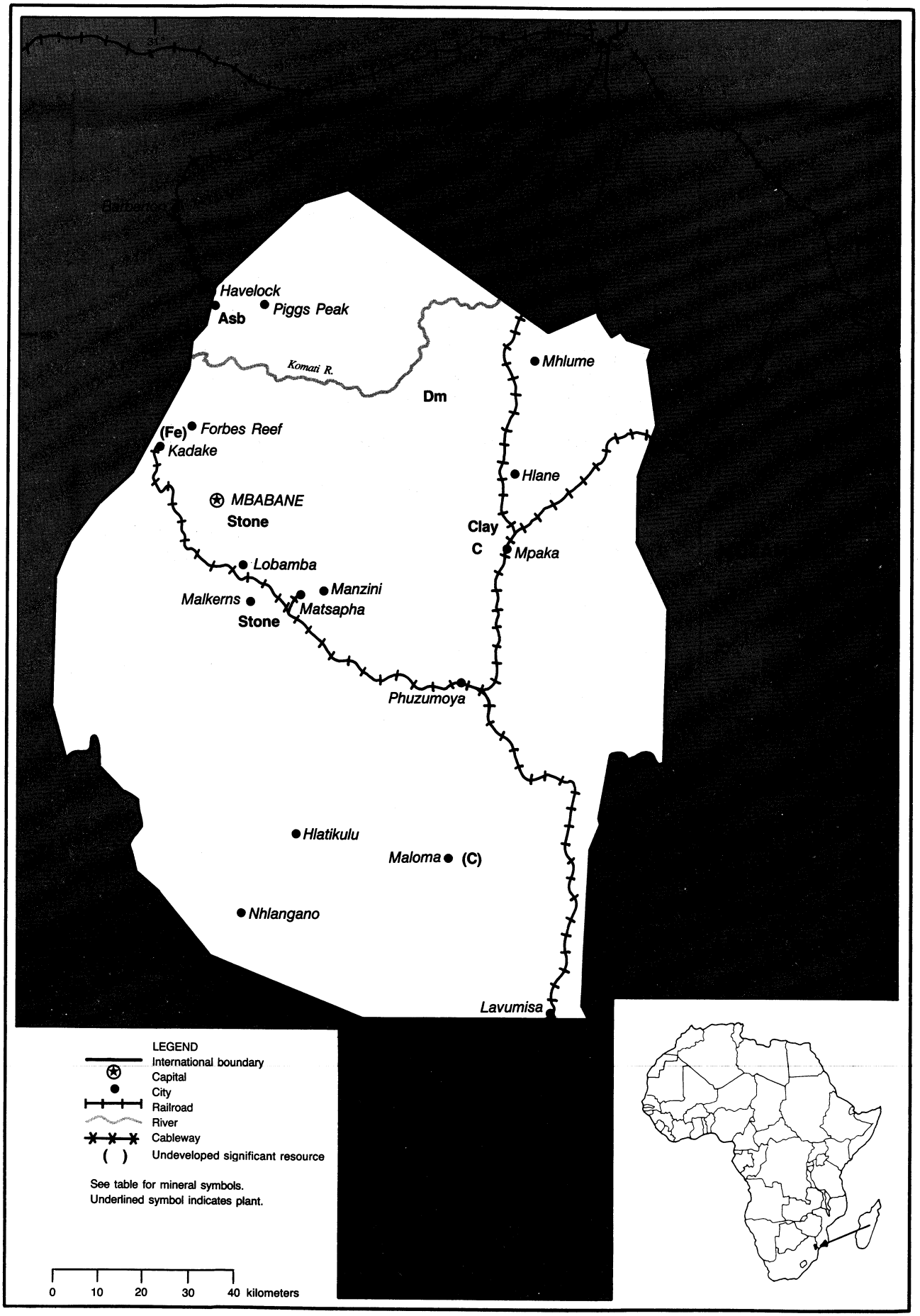
(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owner	Location of main facilities	Annual capacity*
Cement		Atbara Cement Co. Ltd.	Atbara, 275 kilometers northeast of Khartoum	150,000.
Do.		Nile Cement Co.	Rabak, 250 kilometers south of Khartoum	100,000.
Chrome ore		Ingessana Hills Mines Corp.	Gam Mine, 500 kilometers south-southeast of Khartoum	15,000 ore.
Gold		Joint venture between Minex Minerals (Sudan) Ltd., 49%; and Sudanese Mining Corp., 51%	Gebeit Mine, 175 kilometers north-northwest of Port Sudan	35,000 ore.
Do.		Bashken Mining Co. Ltd.	Aberketeib Mine, 250 kilometers northwest of Port Sudan	25,000 ore.
Do.		Joint venture between Bureau Recherches Geologiques et Minieres, 10%; Total Cia Miniere, 30%; and Sudanese Mining Co., 60%	Hassai Mine, 200 kilometers west of Port Sudan	60,000 ore.
Gypsum		Khor Eit Gypsum Quarries	Bir Eit Mine, 60 kilometers north of Port Sudan	20,000.
Marble		Pentco Engineering & Trading Co.	Port Sudan and Gedaref, 375 kilometers east-southeast of Khartoum	100,000.
Petroleum, crude	million barrels	Chevron Oil Co. of Sudan	Unity, Heglig and other oilfields and gasfields, 750 kilometers southeast of Khartoum	29.2 potential.
Petroleum refinery products	do.	Port Sudanese Refinery Ltd.	Port Sudan	8.7.

*Estimated.

SWAZILAND

AREA 17,360 km² **POPULATION 859,300**



THE MINERAL INDUSTRY OF

SWAZILAND

Hendrik G. van Oss

Swaziland's total mineral commodity production fell significantly in both tonnage and value in 1991. *(See table 1.)* Nevertheless, the mining sector remained a small, but important, component of the country's economy, which was dominated by agriculture. The mineral production decline was mainly due to a large decrease in asbestos and coal output, but also reflected a 6.2% decline in the value of the country's currency against the dollar.[1] Mineral commodity sales in 1991 were reported as $14.4 million, but did not include the value of clay for bricks, estimated at $3 to $5 million. Thus, total mineral sales were equivalent to almost 2.5% of the country's estimated GDP of $775 million. Most of Swaziland's mineral production other than stone was exported and this trade accounted for about 3% of the country's total exports. Revenues from mineral sales have traditionally been a major direct funding source for national health, housing, and scholarship programs. In 1991, mining sector wages, including those of Swazi miners in the Republic of South Africa, directly supported an estimated 10% of the Swazi population. Most of the country's railroads were built to service the mining industry.

Historically, Swaziland has been a significant regional producer of asbestos, iron ore, and gold, although only the first of these is still being mined. Coal mining at Mpaka commenced in 1964, and diamond mining at Dvokolwako commenced in 1984. Iron ore was mined at Ngwenya, 18 km northwest of Mbabane, from 1964 to 1977. However, prehistoric diggings on the Ngwenya deposit, for ocher, are believed to be the world's oldest mine workings. Swaziland produces a modest amount of brick clay, stone, and a variety of other construction mineral commodities, and has had past small production of barite, fluorspar, pyrophyllite, and tin (in cassiterite).

Swaziland's geology is dominated by Archean granitic rocks, which make up most of the western two-thirds of the country. Tin-bearing pegmatites in some of these rocks have given rise to alluvial tin deposits. Along the northwest Swaziland border is part of an Archean greenstone belt known in the Republic of South Africa as the Barberton Mountain Land. This terrane in Swaziland has hosted asbestos, barite, gold, and iron deposits. In east-central Swaziland, there is a 20-km-wide north-south belt of Karoo sedimentary rocks; these rocks host 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. In addition to being a rather steady source of revenues, the mining industry in Swaziland is an important source of employment. Approximately 1,200 Swazis were directly employed by the mining industry in Swaziland, equivalent to about 3% of the industrial and related sectors labor force. A significant factor in Swaziland's relations with the Republic of South Africa is the approximately 16,300 Swazis employed in gold, coal, and platinum mines in that country. It is estimated that almost 10% of Swaziland's population is directly supported by mine wages, which are estimated to have totaled about $70 million in 1991.

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. However, in late 1987, a separate committee was formed to renegotiate the royalty provisions of certain existing mine leases. In the past, certain construction materials, such as clay, sand and gravel, and stone, were treated differently from "minerals," such as asbestos and coal. However, the Mining (Amendment) Act of 1990 altered the definition of "mineral" to be all-inclusive; this change will allow a more uniform system of leasing and royalty payments. Applications for prospecting and mining licenses are made through the Geological Survey and Mines Department, which transmits them to the Minerals Committee.

Equity participation in mining ventures by the Swazi nation is through the national trust organization Tibiyo Taka Ngwane (TTN), which was formed in 1968. TTN's equity share in mining ventures is commonly on the order of 40% to 50%, and through such holdings TTN became financially self-supporting in 1976. Since that time, in accordance with the Mineral Rights Taxation Regulations of 1976, all mineral royalties and lease revenues have been paid to another national trust organization, Tisuka Taka Ngwane, for the support of housing and infrastructure development. In 1987, the Swaziland Industrial Development Co. Ltd. (SIDC) was set up as a private development finance company to promote private-sector projects, including mining, in Swaziland. SIDC can provide financing for up to 50% of a project's total cost and can take a minority shareholding of up to 35%, but will not participate in the management of a project.

The total reported value of mineral production decreased 40.3% to $14.4 million in 1991, although this only included asbestos, coal, diamond, and stone. Based on the output of bricks made

from local ball clay, the true total value of Swaziland mineral production in 1991 is estimated to have been between about $17.5 million and $19.5 million. Mine output declined for most commodities. The main factor in the decline in value of mineral production was the 71.4% decrease in the sales value of asbestos as a result of a large fall in mine output and poor world prices. Coal production also fell, following a cave-in at the country's only mine. Diamond production increased significantly owing to partial resolution of technical problems at the mine; however, sales suffered from low world diamond prices. Output of crushed stone fell owing to mechanical problems at the country's main quarry.

A clay quarry is operated near Mpaka by the Langa National Brickworks. Clay production data for 1991 were not available; however, the brick factory had an output in 1988 of 34.4 million units, about one-half of the factory's capacity. It is likely that subsequent output has been higher, in line with strong construction industry demand. The value of this output is estimated to be between $3 and $5 million, with perhaps $3 million of that reflecting exports. *(See tables 1 and 2).*

Along with Botswana, Lesotho, and the Republic of South Africa, Swaziland is a member of the South Africa Customs Union, which provides for duty-free internal shipping, a common external tariff, and access to a market of about 35 million persons. 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 accounted for about 6% of total Swazi exports in 1990 and about 1% of imports; this trade did not involve a significant quantity of mineral commodities.

Swaziland's exports are estimated to have totaled about $575 million in 1991. In terms of minerals, Government data show separately only the value of asbestos, coal, and diamond exports, which totaled $12.87 million, down 42.5% in value. If the estimated value of brick exports is added, the true value of Swaziland's mineral commodity exports was about $16 million. All of the asbestos output, worth $3.58 million, was exported through the Republic of South Africa. Historically, about 60% of the asbestos has been destined for overseas customers, largely in east Asia and Japan. Virtually all of Swaziland's coal production was exported, mostly to Kenya. Despite an almost 20% decline in output, coal revenues fell only 9.4% to $3.65 million. Diamond revenues fell by 3.8% to $5.64 million, reflecting an almost 30% decrease in the value received per carat.

Swaziland's imports in 1991 are estimated to have totaled about $637 million. Based on an almost 50% increase in the level of overall imports since 1989, the latest year for which data were also available for most mineral commodity imports, it is estimated that Swaziland's 1991 imports of mineral commodities totaled about $130 million. Mineral fuels and lubricants accounted for about $95 million of this total. Fertilizer imports are estimated to have been worth about $20 million, and coal imports for the year are estimated at about $5 million. Imports of electricity, also from the Republic of South Africa, amounted to about $10 million in 1991.

The Havelock asbestos mine had a turbulent year in 1991. At the end of January, the mine's management announced the closure of the property. This move came as a surprise because sales revenues in 1990 had been 30% higher than in 1989 and the production level in 1990 had been the highest since 1978. And the bulk of the production had been from the company's new, high-grade deposit called the Far West Area. The operation had been plagued by financial problems despite having received from the Government three loans totaling $8.6 million since 1988. Further, the Government had, in 1990, converted $6.3 million of the loans to nonpaying preferred shares in the company. A Government task force was formed at yearend 1990 to examine the company's finances. The investigation showed that the operation needed a further loan of $7 million to survive, and it was the subsequent refusal of the Government to provide this loan that was believed responsible for the company's decision to cease operations.

Because the Havelock Mine employed almost 1,800 workers, was a significant source of foreign exchange, and was essentially the sole source of revenue for the remote town of Bulembu, the mine's closure was of grave concern to the Government. Accordingly, during the mandatory 3-month liquidation period, the Government sought buyers for the operation and, at the end of April 1991, announced that the Havelock Mine had been sold to Consolidated Mining Corp. of South Africa. Under the new management, operations resumed at midyear at a reduced level and with a greatly reduced work force of only 648. The asbestos output was, however, at a higher grade. The new company, HVL Asbestos (Swaziland) Ltd., planned to mine about 3.5 Mmt of ore through 1996, at which time the mine's reserves would likely be depleted.

Coal production from the Emaswati coal mine at Mpaka fell significantly in 1991, owing to the June 8 collapse of a 100-m by 200-m section of the workings. The collapse occurred at 10:00 a.m. and trapped 26 miners 65 m underground. The miners were uninjured and were able to make their way to a safety bay; this had air and water lines to the surface. Communications were rapidly established with the surface and, in the meantime, a summons went out to the South African Chamber of Mines' rescue drill team and its Ingersoll-Rand T5 drill. This drill, never before used in an actual mine rescue, was purchased in 1977 and was designed expressly for coal mine rescues. It is equipped with a tungsten carbide down-the-hole hammer and is capable of drilling a 64-cm-diameter to a maximum depth of 275 m, at a rate of 9 m/h through sedimentary rocks and 3.6 m/h through diabase. Workers are lowered or raised through the hole in a capsule, one at a time. The drill and rescue team arrived on-site at 1:30 a.m. on June 9th.

Poor surface ground conditions led to one of the rescue team members being killed during the set-up of the drill-rod crane. Despite this accident, which proved to be the only fatality of the rescue operation, drilling commenced at 3:15 a.m. Breakthrough to the correct tunnel was achieved at 11:45 a.m. and a rescue team was lowered underground. The first miner was brought to the surface at 2:38 p.m. and the last miner reached the surface at 5:10 p.m.

The Government is anxious to increase the exploitation of Swaziland's high-grade coal resources, which are estimated to total about 1 billion tons, much of it anthracite. Carbonex Co. of Denmark was developing anthracite reserves near Maloma and, reportedly, was planning to bring a mine on-stream by yearend 1992. The company planned to mine 300,000 mt/a over a mine life of about 20 years. The Government estimates that minable reserves on the Maloma concession total about 20 Mmt.

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[1]Where necessary, values have been converted from Swazi emalangeni (E) to U.S. dollars at the rate of E2.76=US$1.00.

OTHER SOURCES OF INFORMATION

Geological Survey and Mines Department
P.O. Box 9
Mbabane, Swaziland

TABLE 1
SWAZILAND: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991
Asbestos, chrysotile fiber		25,925	22,804	27,291	35,938	13,888
Coal, anthracite		165,371	164,845	165,122	150,967	122,502
Diamond	carats	e80,000	72,676	55,264	42,484	57,420
Stone: Quarry product	cubic meters	96,114	107,205	128,463	155,347	128,759

eEstimated.
[1]Includes data available through July 15, 1992.
[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.

TABLE 2
SWAZILAND: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Asbestos		HVL Asbestos (Swaziland) Ltd. (Consolidated Mining Corp., Republic of South Africa, 85%; Government, 15%)	Underground mines at Bulembu, 5 kilometers southeast of Havelock	Asbestos fiber: e40,000.
Coal		Emaswati Coal (Pty.) Ltd. (Trans Natal Coal Corp., Republic of South Africa, 50%; Swazi Nation,[1] 50%)	Open pit and underground mine 5 kilometers southwest of Mpaka	Anthracite: e200,000.
Diamond	carats	Dokolwayo Diamond Mines (Pty.) Ltd. (Trans Hex Group, Republic of South Africa, 50%; Swazi Nation, 50%)	Open pit mine at Dvokolwako, 45 kilometers northeast of Manzini	e100,000.
Stone	cubic meters	Kwalini (Pty.) Ltd. (Trans Hex Group, Republic of South Africa, 50%; Swazi Nation, 50%)	Crofthead Quarry near Malkerns	e170,000.
Do.		Wales Crushers (Pty.) Ltd. (private Swaziland interests)	Crushed stone quarry at Tonkwane Estates, Mbabane	NA.

eEstimated. NA Not available.
[1]Equity participation by the Swazi Nation, as distinct from the Government, is through organization Tibiyo Taka Ngwane.

TANZANIA

AREA 945,090 km² **POPULATION 26.9 million**

THE MINERAL INDUSTRY OF

TANZANIA

By David Izon

Minerals that accounted for the major share of export earnings in 1991 were diamonds, gold, gemstones, phosphates, salt, and tin. Other minerals produced included coal, kaolin, and soda ash. Activities in the diamond sector of the minerals sector showed that diamond could remain the most important mineral commodity to the economy of the country. Diamonds accounted for about 85% of total mineral export earnings. Overall, the mineral industry made up only about 0.3% of the GDP of $3 billion[1] and less than 1% of the labor force in 1991. Agriculture was the main foreign exchange earner, accounting for 80% of total export earnings.

The Government had embarked on reform programs intended to create an investment climate hospitable to private enterprise and foreign investors. The Government was a major participant in mining. Tanzania devoted about 3% of its national budget to mining—50% for development and 50% for exploration.

The new Investment Promotion Policy encouraged private and foreign investors to wholly own mining operations. The Government encouraged joint ventures between local and foreign investors.

GOVERNMENT POLICIES AND PROGRAMS

In 1991, Government policies intended to attract foreign investors and provide support and incentives for small-scale miners. This was to help expand their operations and output. The Government continued with the economic policies and programs of the Economic Recovery Program that began 6 years ago. The reforms guaranteed favorable tax and regulatory treatment for mining investors. The 1979 Mining Act applied to all mining-related investments. New guidelines for taxing were established under the new act. Other benefits of the reforms included assurance of access to foreign exchange for repatriation of profits. This also allowed a quick and simplified handling of investment proposals. The country adopted policies to encourage exploration, development, and exploitation of mineral resources. Under the new policy, the Government allowed a 7.5% minimum equity in any company established in Tanzania. Also, the Government had an option to buy up to 32% of the shares and to negotiate any participation with each investor.

The Tanzanian Government signed a contract with a foreign firm and a local subsidiary involving diamond prospecting and mining. The companies involved were Willcroft Co. Ltd. of Bermuda, a subsidiary of De Beers Centenary AG of Switzerland, and Tanex Ltd. of Tanzania. They signed an agreement to explore an area covering 22,300 km^2. Tanzania also signed a joint-venture agreement with BHP Minerals International Exploration of Australia and Sutton Resources of Canada for exploration and development of a 100 km^2 area for cobalt, lead, nickel, platinum, and zinc. These agreements showed the Government's positive attitude toward foreign investors.

PRODUCTION

In 1991, the mineral industry continued to experience an overall decline in production of minerals. Areas of improvement were in diamond and gold production. However, most of the gold was produced by private individuals. The apparent increase in gold production was due to the gold buying program started by the Bank of Tanzania. (*See table 1.*)

TRADE

In value, diamonds remained Tanzania's most important mineral produced, accounting for about 85% of foreign exchange earnings. Other minerals of importance were gemstones and gold. Tanzania'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 included manufactured goods, machinery and transport equipment, and spare parts.

STRUCTURE OF THE MINERAL INDUSTRY

The state owned all mineral rights in the country since so declared in 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 dealt directly with mining. Before 1991, major investors in mining operations were Placer Dome (Kahama) Ltd., Kabanga Nickel Co., and the United Nations Revolving Fund for National Resources Exploration. There were several underexplored and underdeveloped geological structures in Tanzania, covering an area of more than 800,000 km^2. These areas have high potential of providing opportunities for large deposits of nickel and other minerals, including coal, diamond, gemstones, gold, graphite, iron, kaolin, and tin. Development of any new remote mineralized areas would require funding for infrastructure development and

modern equipment or technology. (*See table 2.*)

COMMODITY REVIEW

Metals

Tanzania had confirmed deposits of copper, lead, iron ore, and nickel. These minerals could be developed to their full potential. In 1991, a limited amount of lead was produced. A small-scale iron and steel industry produced about 30,000 mt/a of rolled products at Tanga and Dar Es Salaam.

Gold.—Tanzania's official production figures for gold increased from 1,629 kg in 1990 to 2,779 kg in 1991. The increase in reported production was largely due to gold bought by the Bank of Tanzania from private miners.

Small-scale gold mining continued at Musoma east of Lake Victoria, at Lupa southeast of Lake Rukwa, and at Mpanda east of Lake Tanganyika. These mines represented the three main gold fields: Lake Victoria, Lupa, and the Mpanda. In the past, the Lake Victoria field provided 73% of production and the Lupa field 23%. Gold produced from the Mpanda field as a byproduct from lead concentrate accounted for the rest. The Sengambi Mine, operated by Mans Mining Ltd., and the Rubble Mine were two other mines operating in the Lupa area.

The Buck Reef Mine operated by STAMICO closed owing to operational problems in 1991. The Bank of Tanzania's continued gold buying program was responsible for the decline in illegal gold trade in the country.

Nickel.—Nickel deposits in the Kabanga area west of Lake Victoria were to be developed by Sutton Resources of Canada. The deposits had an approximate reserve of 40.5 Mmt grading 1.05% nickel, 0.11% cobalt, 0.21% copper, and 0.31 g combined gold and platinum per ton. The Kabanga deposits occurred in the northwestern part of Tanzania, which is in the southern end of the mafic-ultramafic intrusion of the Karagwe-Ankolean system near the border of Burundi. Mineral composition of the nickel-bearing sulfides was mainly pyrrhotite, pentlandite, and chalcopyrite. The agreement signed by Sutton Resources allowed for a full-scale development of the largest still undeveloped nickel and cobalt belt in the world.

The nickel mines would be operated by a local subsidiary, Kabanga Nickel Co. Initial engineering work done on the concession projected an annual production of 24,000 tons of nickel, 3,000 tons of copper, and 1,400 tons of cobalt. Sutton Resources believed that the mine could be operated as an open pit mine. The United Nations Development Program (UNDP) study of Tanzania considered an underground mine and identified areas that had good prospects for nickel-sulfide development. These included the Kabanga deposits west of Lake Victoria, Kagera region, and Zanzui, a prospect that was 150 km southeast of Mwanza.

Sutton Resources also signed a deal to explore for cobalt, copper, lead, nickel, platinum-group metals, and zinc. The deal covered reconnaissance, prospecting, and mining on 26,400 km^2 in the Kagera area.

Industrial Minerals

About 90% of the diamonds mined in Tanzania came from the Mwadui Mines operated by Williamson Diamond Co. The Mwadui mines were near Shinyanga and the New Alamasi Mines, about 200 km south of Mwanza. All other production was from individual prospectors and artisanal miners working with handtools. In 1991, Tanzania had more than 300 undeveloped kimberlite pipes occurring in clusters. The Williamson Mine had produced more than 17 million carats since it started. Almost one-half of the diamonds mined have been gem quality, grossing almost $1 billion.

Mineral Fuels

Coal.—The country's only coal mine was at Kiwira, northeast of the Kinpengere range. The mine operated on a small scale in 1991, producing only about 33,000 mt/a. The expected production of the mine was 150,000 mt/a, but lack of equipment and adequate funds contributed to a decline in production. The Government was unable to attract much-needed export markets for the coal in 1991. At maximum capacity, the mine's output could reach 180,000 mt/a by 1995. Total known reserves in the southern part of the Rift Valley were estimated to be about 1.2 billion tons.

Petroleum and Natural Gas.—After several exploration programs both onshore and offshore, no significant oil deposits were found in Tanzania. In 1991, the Tanzania Petroleum Development Corp. started a program of collecting core samples for a comprehensive evaluation of hydrocarbon prospects in the country. The oil refinery at Dar Es Salaam ran on imported oil. About 65% of foreign exchange earnings in 1991 was spent on crude petroleum import.

The Songo Songo natural gas field about 300 km southeast of Dar Es Salaam in the Indian Ocean was yet to be developed. Ocelot International Inc. of Canada signed an agreement with the Government in 1991 to develop the Songo Songo Field. The agreement required that field production and the setting up of treatment plants and pipelines be completed between 1992 and 1994. Ocelot Inc. was to provide funds for the initial phase and facilities of the project.

Reserves

Tanzania's natural gas reserves were about 41 billion m^3. All the reserves were offshore in the Songo Songo Field just off the southern coast. The total in situ coal reserves were 1.2 billion tons in nine main coal-fields in the southern part of the Rift Valley. Estimates of iron ore resources were about 45 Mmt with an

iron content averaging about 51% Fe. Gold reserves at the Bulyanhulu deposits were 10 Mmt of ore. Estimates of diamond reserves were about 3.8 million carats. Phosphate reserves were about 10 Mmt. Officially reported reserve figures were not available for tin and other minerals.

INFRASTRUCTURE

Tanzania's infrastructure system was the fourth largest in Africa. It was semideveloped consisting of 3,600 km of railroads and 50,000 km of roads that also linked neighboring countries. Dar Es Salaam was the ocean terminus of the railway to Kigoma and Lake Tanganyika, and to Mwanza on Lake Victoria. Tanzania was connected to Zambia by three ground links: the Tanzania-Zambia Railway Authority (TAZARA) railroad, the Tanzania-Zambia highway, and the Tanzania-Zambia pipeline.

The Tanzanian Railway Corp. (TRC) operated all the rail lines except TAZARA. TAZARA was used mainly to transport goods for Zambia and Malawi while the TRC handled freight for Burundi, eastern Zaire, Uganda, and Rwanda. The roads have deteriorated so much that their condition had an adverse effect on the economy of the country. Major ocean ports were at Dar Es Salaam, Mtwara, Tanga, and Zanzibar. Mwanza on Lake Victoria and Kigoma on Lake Tanganyika were inland ports.

Most mining projects and mineral deposits were in remote areas where the infrastructure was extremely poor. Tanzania relied 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 were responsible for all public power generation and delivery.

OUTLOOK

Nonfuel minerals such as diamonds will remain the mainstays of the economy for the immediate future. Further development of key mineral resources may enhance the importance of those commodities to the country's economy.

The development of the Songo Songo natural gas field is expected to continue because funding would be provided by Ocelot International Inc. of Canada. The Government's economic recovery program should improve Tanzania's ability to attract investors and promote industrial growth.

Road and rail improvement projects being implemented or studied could help to lessen 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. Discovery of commercial quantity of crude would reduce the high production cost of refined products.

[1]Where necessary, values have been converted from Tanzanian shilling (Tsh) to U.S. dollars at Tsh 330=US$1.00 in 1991.

OTHER SOURCES OF INFORMATION

Ministry of Water, Energy and Minerals
Dar Es Salaam

Ministry of Commerce and Industry
Mineral Resource Division
Dar Es Salaam

TABLE 1

TANZANIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991
Cement, hydraulic		e300,000	189,390	540,000	e540,000	e540,000
Clays:						
Bentonite e		75	75	75	75	75
Kaolin		1,446	528	1,554	2,021	1,739
Coal, bituminous		2,860	3,349	46,000	51,569	33,213
Diamond[3]	carats	150,000	e150,000	e150,000	84,598	99,763
Gemstones, precious and semiprecious excluding diamond[4]	kilograms	e4,400	e9,400	11,398	38,700	59,630
Gold, refined	do.	201	52	116	1,629	2,799
Gypsum and anhydrite, crude		24,648	19,570	5,895	36,155	35,263
Lime, calcined and hydrated e		3,000	3,000	2,505	1,466	870
Limestone, crushed		680,701	792,454	986,537	861,253	553,436
Mica, sheet		(5)	(5)	(5)	(5)	(5)
Petroleum refinery products:						
Liquefied petroleum gas	thousand 42-gallon barrels	44	73	49	e50	35
Gasoline	do.	909	784	835	e800	858
Kerosene	do.	330	325	321	e300	437
Jet fuel	do.	220	232	107	e100	237
Distillate fuel oil	do.	1,069	1,088	1,097	e1,000	820
Residual fuel oil	do.	525	1,771	1,543	e1,500	1,568
Other	do.	540	320	321	e300	470
Total including refinery fuel and losses	do.	3,637	4,593	4,273	e4,050	4,425
Phosphate minerals: Apatite		18,386	4,466	4,657	25,066	22,419
Salt, all types		41,123	19,777	20,010	39,315	64,419
Sand, glass		6,071	12,043	13,101	6,365	4,263
Soda ash e		300	300	300	300	300
Tin, mine output, Sn content e		2	2	15	15	6

eEstimated.

[1]Includes data available through Aug. 24, 1992.

[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.

TABLE 2

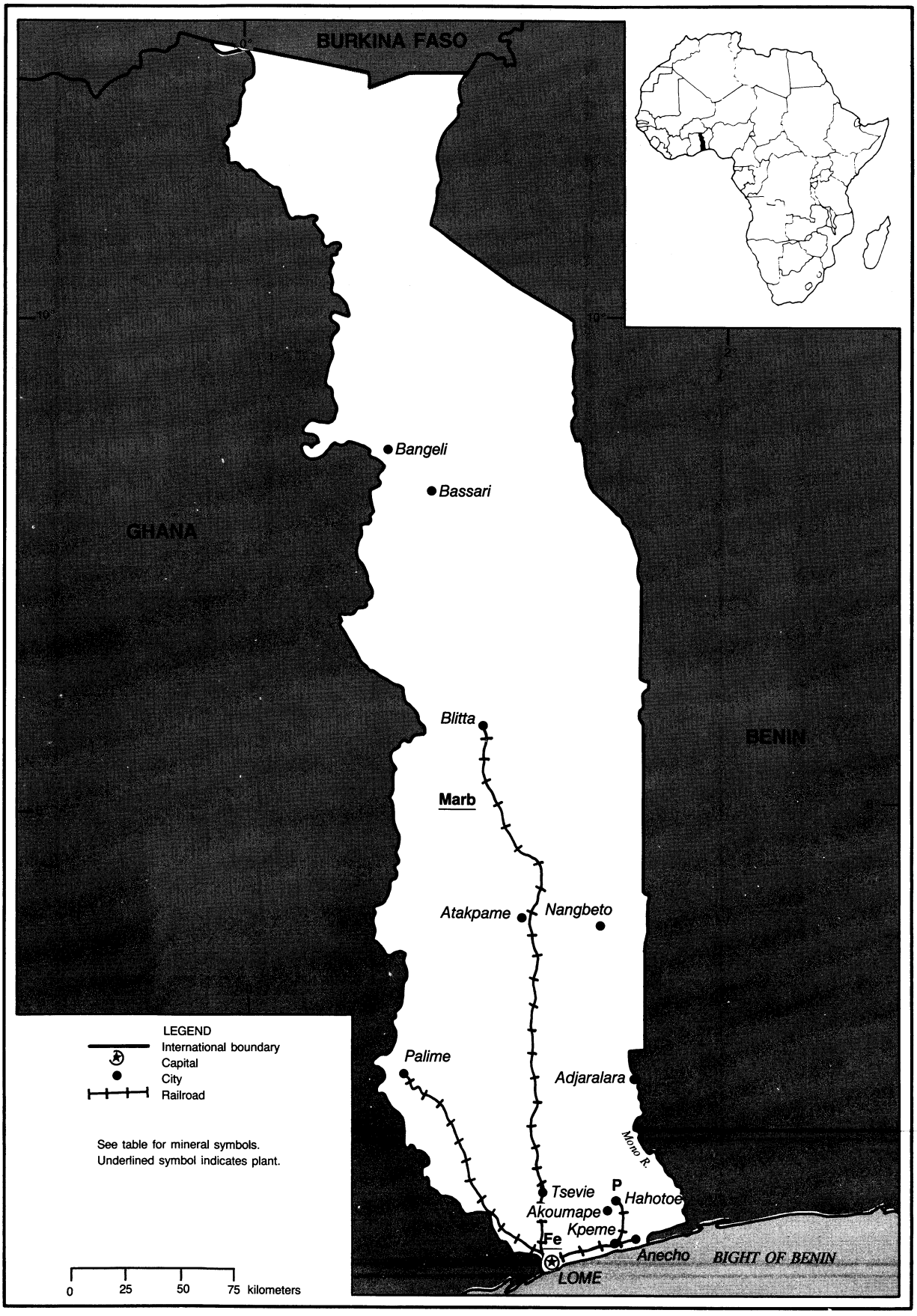
TANZANIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement		Tanga Cement Co. Ltd. (Government, 100%)	Tanga	500
Do.		Tanzania Portland Cement Co. (Government, 100%)	Wazo Hill, near Dar Es Salaam	600
Do.		Mbeya Cement Co. (Government, 100%)	Mbeya, southwest of Dar Es Salaam	250
Coal		State Mining Corp. (Government, 100%)	Songea-Kiwira	150
Diamond	thousand carats	Williamson Diamonds Co. (STAMICO, 50%; Willcroft of Canada, 50%)	Mwadui	3.5
Gold	thousand kilograms	Placer Dome (Kahama) Ltd. (Placer Dome, 90%; Government, 10%)	Bulyanhula	3
Petroleum, refinery products	thousand barrels	Tanzania and Italian Petroleum Refining Co. Ltd. (Government, 50%; Agip Petroi SpA of Italy, 50%)	Dar Es Salaam	17

TOGO

AREA 57,000 km² **POPULATION 3.9 million**



THE MINERAL INDUSTRY OF

TOGO

By Audie L. King

The satisfactory performance of the mineral industry proved to be one of the few bright spots in Togo's otherwise troubled economy. A number of internal and external factors combined to make 1991 a poor year for the Togolese economy. Disruptive and often violent strikes, weak domestic demand, rising wages, a poor harvest, and a fall in regional commerce adversely affected the economy. The International Monetary Fund (IMF) and the World Bank postponed planned structural adjustment dispersements following a large increase in the Government's budget deficit. The deficit was attributed to a pronounced fall in domestic productivity and a rise in the wages of public employees. Most foreign investment and new international trade deals were put on hold until multiparty elections could be held in 1992.

Mining and the production of mineral commodities continued to be Togo's most important industrial activity, equaling more than 10% of the GDP in 1991. Phosphate rock production by the Government-owned phosphate company, Office Togolaise des Phosphates (OTP), continued to dominate the mining industry. Phosphate rock exports rebounded in 1991 after having fallen sharply in 1990 owing to concerns over the relatively high cadmium levels in the country's phosphate ore. Worries over the potentially negative environmental effects of cadmium caused Togo's phosphate exports to decline in its traditional markets in Western Europe and the United States. Togo has, however, successfully negotiated new foreign contracts for the delivery of its exceptionally high-grade phosphate rock. The total worth of Togo's phosphate exports went from about $99 million[1] in 1990 to $126 million in 1991.

Production at the Government-owned cement factory decreased about 3% in 1991. The troubled marble industry reported minimal production in 1991, and the country's only metal manufacturer, an American-owned steel mill, suspended operations owing to financial difficulties.

In an effort to diversify its resources, Togo, with help from France's Bureau de Recherches Géologiques et Minières (BRGM), has engaged in a significant geologic mapping and mineral exploration program. Its efforts have yielded a number of mineralized sites containing base metals, bauxite, chromite, diamond, and gold. The Government has recently enacted a realistic environmental code and has requested assistance from the United Nations in the revision of its mining legislation to promote foreign investments in minerals. Togo hopes that a new mining code will stimulate potential investors to further investigate mineral finds.

After having grown by an estimated 2% in 1990 to about $1,600 million, primarily owing to the strength of Togo's currency relative to the dollar, the GDP likely declined in 1991. The extent of the economic fall was not yet reported, but matters may have deteriorated further in 1992 as the worldwide recession persists and 1991's wage increases filter through the markets, causing inflation to heat up.

GOVERNMENT POLICIES AND PROGRAMS

In August 1991, two decades of one-party rule came to an end when a transitional Government was organized to oversee the country until democratic elections could be held in 1992. The country's progressive economic liberalization plans were temporally stalled because of political and economic unrest. Both the IMF and the International Development Association (IDA) postponed scheduled cash dispersements because Togo was unable to maintain fiscal discipline. The Government's mushrooming budget deficit was of greatest concern to the international agencies. The deficit worsened when wage increases were granted to striking civil employees at a time when economic activity was flagging. Togo was in the midst of its fourth structural adjustment program covering the period from 1990 to 1992. This portion of the ongoing project aimed to improve public-sector management by restructuring the Ministry of Planning and Mines, the Ministry of Economy and Finance, and the Ministry of Commerce and Transport. Its objective was to promote growth with equity. Stress was put on human resource development and expenditures for critical social services.

Three previous structural adjustment programs dealt primarily with privatization or simple liquidation of some of the state's unprofitable enterprises. Privatization had stopped the outflow of Government funds but failed to create new jobs or attract new investment. Most future foreign investment will likely be approved in the export processing zones (EPZ) that were established in 1989 to attract foreign companies. The EPZ law gives tenants duty-free imports and exports, a 10-year income tax holiday, reduced payroll taxes, a 10-year exemption on dividends paid foreign shareholders, an exemption from the general business tax, the right to hire and fire workers, reduced water and electricity rates, and the right to hold foreign currency accounts. By the end of 1991, 32 companies had been approved

under the EPZ, 12 of which had already begun operations.

PRODUCTION

The mineral industry accounted for about 10% of GDP in 1991 compared with about 9% in 1990 and 11.5% in 1989. Mineral exports accounted for an estimated 38% of the nation's total exports in 1990, the latest year these data were available, compared with 46% in 1989 and 41% in 1988.

In 1991, phosphate ore production rebounded to near-record levels following 1990's 31% decline. Despite a continuing worldwide recession, Togo managed to find new markets for its expanded output. Concerns over the marketability of Togo's high-grade phosphate ore owing to its high cadmium levels seemed to have proven unfounded. OTP expects production to increase in coming years as it successfully negotiates new contracts.

As a result of structural and financial difficulties, very little marble production was registered in 1991. The country's only steel mill closed in October 1991. *(See table 1.)*

TRADE

A recent trend toward reduced trade was made significantly worse in 1991 owing to strikes and civil unrest. Togo had long enjoyed its status as a regional trade center owing to its port and other infrastructural improvements that were among the best in west Africa. Although about 25% of Togo's imports was still reexported to neighboring countries, Togo's regional advantages continued to erode as its neighbors improved their own trade facilities. In a bid to improve its relative position, Togo simplified its tax and tariff structure and eliminated export taxes. Additionally, most of the products approved for production under the new EPZ law will be aimed at the west African regional market. The country's products also enjoyed preferential entry into the United States under the Generalized System of Preferences and into the EC under the Lome Convention.

Exports to the United States rose from $2.9 million in 1989 to $3.7 million in 1990, the latest year that such data were available, and consisted mainly of clothing, wheat bran, and beer. Imports from the United States, which consisted mainly of aircraft, spare automobile parts, office equipment, and textiles, increased from $27.9 million in 1989 to $30.7 million in 1990.

Cement produced in Togo was from imported clinker mainly from Angola, Germany, Greece, Spain, Tunisia, and Venezuela. Togo exported cement to Burkina Faso, Ghana, Guinea, Mali, Niger, and Nigeria. In 1991, 289,000 tons of clinker was imported and 388,000 tons of cement was produced. According to Ciments du Togo (Cimtogo), 95,000 tons was exported.

Phosphate rock remained Togo's principle foreign exchange earner. In 1991, Togo was able to maintain its share of world phosphate exports. It exported to more countries and increased its sales to some established customers. *(See tables 2, 3, and 4.)*

STRUCTURE OF THE MINERAL INDUSTRY

Togo's mineral industry was dominated by the Government-owned phosphate producer, OTP. With 2,500 workers, it was by far the country's largest industrial employer. It operated phosphate strip mines centered around the cities of Hahotoe and Akoumape, about 30 km from its treatment plant and export terminal at Kpeme. The national marble company, the Societe Togolaise de Marbrerie et de Materiaux (Sotoma), had operations near the railway about 40 km south of Blitta. Sotoma employed about 60 people. Cimtogo, a joint venture with the Government and a Norwegian company, operated a cement factory in Lome. It was originally built to process clinker from the Cement Co. of West Africa (Cimao) project that Togo jointly owned with Côte d'Ivoire and Ghana. The Cimao clinker manufacturing plant, near a large limestone deposit about 60 km northeast of the cement plant, shut down in 1984 when it was no longer able to compete with imported clinker. Cimtogo rapidly increased its production capacity since it first opened in 1971 from 120,000 mt/a to 600,000 mt/a based on strong domestic and regional demand. *(See table 5.)*

COMMODITY REVIEW

Metals

The U.S.-owned steel company, Societe Togolaise de Siderurgie (STS), which produces iron rods from semifinished and scrap metal, was closed in October 1991 owing to financial difficulties.

Industrial Minerals

Marble.—During 1991, the state run Nouvelle Societe Togolaise de Marbre et de Materiaux (Nouvelle Sotoma) was able to generate some money through the sale of crushed stone, decorative bricks, and roofing materials. However, following a period of serious production and financial difficulties, Sotoma was forced to close in September. The Government still hoped to find private investors to rent or buy its marble facilities.

Phosphate.—In recent years, OTP has experienced a serious decline in phosphate rock exports to its traditional Western European and North American markets because of concerns over the possible negative environmental impact of the relatively high cadmium content of its ores. The EC's share of Togolese phosphate exports, for example, has fallen from 90% in recent years to about 30% in 1991. 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 in its traditional western markets. For this reason, cadmium removal procedures were being researched with grant money from the EC.

OTP was working with the BRGM of France on the development of a new mining area adjacent to the current

workings. The planned development would allow for expansion in the mid-1990's if demand allowed for it, or would be available for phasing in production after the current mine is exhausted.

Mineral Fuels

Controlling interest in the state-owned petroleum complex a few km from Lome was acquired by Shell International in February 1990. The refinery was built in 1977 and operated for 4 years before being shut down in 1981. The complex included a dormant oil refinery and storage facility that Shell had leased and used as a depot since 1984. Shell took a 60% share of the new company called Complex Petrolier de Lome (Compel), and the Government retained a 40% share. There were currently no plans to restart the refinery because Shell believed that it would not be profitable. Shell invested $10 million in improvements to the storage facilities and was keeping the refinery in shape by running fluids through the pipes.

Reserves

Industry sources estimate that Togo's total phosphate reserves were about 260 Mmt of commercial-grade ore. Togo was also reported to have had very large deposits of lower grade carbonate phosphates around Bassari, about 150 km north of the end of the rail line. The existing phosphate pit contained reserves for about 8 years at 1991 levels of mining of about 3.0 Mmt/a. OTP was working with the BRGM on the development of a new mining area next to the current workings.

Apart from phosphate rock and small quantities of marble and limestone, exploitation of minerals in Togo was negligible. A number of potentially valuable 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 east of Bassari. The deposit, which averages more than 40% iron, mainly as magnetite, has been investigated periodically by the local Bureau National de Recherches Minieres (BNRM) and most recently in conjunction with the BRGM. Laterites containing 46% to 53% Al_2O_3 and 18% to 30% Fe_2O_3 occurred on Mount Agou, the highest point in the Atakora Mountains, near Palimé, 100 km northwest of Lome. Manganese deposits were reported in the Bayega area in northern Togo.

A mineral inventory began in northern Togo in 1987 and later extended to other areas of the country. The exploration team, a joint venture between the BRNM and the BRGM, identified many gossans, some of which had elevated levels of arsenic, copper, lead, and zinc. They also discovered a zone of gold anomalies about 60 km east of Bassari, which might become a target for further exploration. Diamond indications were revealed on the d'Akposso Plateau and in the surrounding alluvial basins, about 50 km north of Palimé. The exploration team also discovered potentially economic deposits of chromite, rutile, and uranium in the northwestern part of the country.

INFRASTRUCTURE

Togo had a good highway network that consisted of 1,762 km of paved roads. The network linked the capital, Lome, with neighboring Benin, Burkina Faso, and Ghana. Its port and airport facilities at Lome were among the most modern in the region. About 515 km of 1.0-m-gauge single-track railway connected Lome with the cities of Anecho, Blitta, and Palimé. All of the principle mineral deposits being mined had access to the rail lines. Exploitation of the iron and manganese deposits in the northern part of the country would require infrastructural improvements.

The 65-MW Nangbeto hydroelectric power station on the Mono River in southern Togo near the border with Benin began operation in 1987. It has a maximum annual capacity of 150 GW•h, which was sufficient to meet 25% of the combined demand of Togo and Benin. A 15- to 20-MW hydroelectric plant was also proposed for Adjaralara, 75 km downstream on the Mono River.

Most of Togo's electricity is imported from Ghana's Akosombo hydroelectric plant and distributed by Communaute Electrique du Benin, a company set up jointly by the Governments of Benin and Togo in 1975.

In January 1991, France signed agreements that granted about $13 million to the Togolese Electrical Power Co. to partially finance the rehabilitation of the country's electrical system and the extension of services.

OUTLOOK

The Government remained optimistic that it would be able to maintain or increase its market share of world phosphate exports despite recent concerns over the cadmium level of its ore. If current efforts to reduce cadmium levels in its phosphate ore fail, however, future contracts can be expected to be negotiated at lower prices. Togo's economy should continue to be dominated by its phosphate industry well into the next century. New industry attracted to the country by the Government's liberal economic policies should provide an important economic buffer during periods of low phosphate prices. However, even with optimistic growth projections, the industrial sector will remain too small to isolate Togo from economic slowdowns when commodity prices are low.

[1]Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF282.11=US$1.00.

OTHER SOURCES OF INFORMATION

Chambre de Commerce d'Agriculture et d'Industrie du Togo: Bulletin Mensuel, bimonthly, Lome, Togo.

TABLE 1
TOGO: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991
Cement[3]		369,579	377,838	389,070	398,530	388,000
Iron and steel, semimanufactures[4]		12,100	14,000	6,197	8,400	e6,000
Phosphate rock, beneficiated product:						
Gross weight	thousand metric tons	2,644	3,464	3,355	r2,314	2,965
P_2O_5 content	do.	960	1,257	1,270	r840	1,076
Stone, marble:e						
Dimension	square meters	5,10,800	5,11,000	r 5,11,206	r 5,6,500	—
Blocks		—	—	5,354	5,357	250
Crushed		—	—	5,977	5,912	600

eEstimated. rRevised.

[1]Includes data available through Oct. 2, 1992.

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

[3]In 1984, production of domestic clinker ended. Since that time, all cement has been produced from imported clinker.

[4]Iron rod production from semifinished metal.

[5]Reported figure.

TABLE 2
TOGO: EXPORTS OF CRUDE PHOSPHATE

(Metric tons)

Country	1987	1988	1989	1990	1991
United States	339,570	—	—	—	—
France	287,570	301,850	319,840	302,400	290,100
Spain	283,450	283,575	384,865	218,600	263,600
Canada	262,880	840,006	890,380	802,400	758,000
Poland	260,189	351,918	293,680	67,700	102,900
United Kingdom	230,650	404,787	296,800	161,400	—
Netherlands	217,120	48,600	—	6,500	—
Italy	177,760	239,747	58,688	171,400	218,700
Philippines	116,050	223,700	285,116	225,300	274,800
India	89,600	137,600	178,700	217,600	161,900
Yugoslavia	51,700	66,630	65,625	25,000	25,500
Cyprus	51,130	110,210	—	—	—
Norway	42,850	44,100	—	—	—
Greece	31,850	—	—	63,100	152,800
Indonesia	29,580	—	—	—	—
Uruguay	25,000	46,650	33,000	33,600	32,700
China	23,700	—	—	—	44,000
Turkey	21,000	—	—	—	—
Portugal	16,500	17,300	—	—	—
Germany, Western states	15,750	—	—	—	—
Australia	—	141,250	261,653	—	25,000
Belgium	—	54,850	—	—	—
Mexico	—	—	80,800	160,400	420,900
Oceania	—	—	—	—	299,300
Nigeria	—	—	—	—	4,000
Total	2,646,070	3,312,773	3,347,147	2,455,400	3,074,400

TABLE 3

TOGO: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	Destinations, 1990	
				United States	Other (principal)
METALS					
Copper: Metal including alloys:					
Scrap		25	43	—	France 36; Netherlands 7.
Semimanufactures		2	—		
Gold: Metal including alloys, unwrought and partly wrought	kilograms	6,499	—		
Iron and steel: Metal:					
Scrap		3,500	1,566	—	Italy 1,500; Côte d'Ivoire 26.
Semimanufactures:					
Bars, rods, angles, shapes, sections		2,953	1,987	—	Benin 542; Burkina Faso 501; Niger 499.
Universals, plates, sheets		3,158	1,548	—	Ghana 1,091; Benin 457.
Wire		4	151	—	Ghana 143; Congo 4.
Tubes, pipes, fittings		20	11	—	Benin 8; Congo 3.
Zinc: Metal including alloys, semimanufactures		153	118	—	France 78; United Kingdom 40.
INDUSTRIAL MINERALS					
Abrasives, n.e.s.: Grinding and polishing wheels and stones		—	5	—	Mainly to Belgium-Luxembourg.
Cement		122,942	125,480	—	Burkina Faso 116,208; Ghana 8,415.
Clays, crude		—	1	1	
Diatomite and other infusorial earth		22	—		
Fertilizer materials: Manufactured:					
Phosphatic		—	6	6	
Unspecified and mixed	value, thousands	—	$2	—	All to West Germany.
Gypsum and plaster		3,740	2,960	—	All to Burkina Faso.
Phosphates, crude[2]	thousand tons	3,347	2,455	—	Canada 802; France 302; Spain 219.
Salt and brine		31	8	—	All to Switzerland.
Stone, sand and gravel: Dimension stone:					
Crude and partly worked		12	944	—	Italy 908; France 32.
Worked		109	1	—	All to Norway.
Other: Crude		3,400	7,433	—	All to Burkina Faso.
MINERAL FUELS AND RELATED MATERIALS					
Coal: Bituminous and anthracite		15	—		
Petroleum refinery products:					
Liquefied petroleum gas	42-gallon barrels	—	1,090	—	All to Ghana.
Kerosene and jet fuel	do.	—	202	—	All to Côte d'Ivoire.
Lubricants	do.	—	14	—	All to Burkina Faso.

[1]Table prepared by Virginia A. Woodson.

[2]Source: Chambre de Commerce d'Agriculture et d'Industrie du Togo: Bulletin Mensuel, bimonthly, Lome, Togo.

TABLE 4

TOGO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	2	5	—	All from West Germany.
Aluminum:				
Oxides and hydroxides value, thousands	—	$1	NA	NA.
Metal including alloys, semimanufactures	99	143	27	Côte d'Ivoire 71; France 24.
Chromium: Oxides and hydroxides value, thousands	—	$1	—	All from France.
Cobalt: Oxides and hydroxides	1	—		
Copper:				
Matte and speiss including cement copper value, thousands	$1	—		
Metal including alloys:				
Scrap	1	—		
Unwrought	1	19	—	All from West Germany.
Semimanufactures	24	25	—	France 21; West Germany 1.
Gold: Metal including alloys, unwrought and partly wrought kilograms	2,329	11,207	—	Ghana 10,343; Benin 864.
Iron and steel: Metal:				
Scrap	70	422	—	France 168; Ghana 163; Benin 45.
Pig iron, cast iron, related materials	9	4	—	All from France.
Ferroalloys, unspecified value, thousands	$1	—		
Steel, primary forms	11,296	9,747	51	West Germany 4,858; Brazil 649; unspecified 3,969.
Semimanufactures:				
Bars, rods, angles, shapes, sections	4,887	7,106	64	Brazil 1,146; France 685; unspecified 4,421.
Universals, plates, sheets	2,347	2,806	—	France 1,041; West Germany 645; Italy 444.
Hoop and strip	30	103	4	Ghana 63; Belgium-Luxembourg 24; Netherlands 8.
Rails and accessories	592	908	NA	France 793; unspecified 115.
Wire	885	1,193	—	France 276; Poland 200; Switzerland 149.
Tubes, pipes, fittings	885	1,094	(2)	France 571; Spain 342; Belgium-Luxembourg 94.
Castings and forgings, rough	94	486	—	Belgium-Luxembourg 465; France 21.
Lead:				
Oxides	5	—		
Metal including alloys:				
Unwrought value, thousands	—	$23	—	France $21; Côte d'Ivoire $2.
Semimanufactures do.	$1	—		
Manganese: Oxides	1	2	—	All from France.
Mercury value, thousands	$33	$2	—	Do.
Platinum-group metals: Metals including alloys, unwrought and partly wrought do.	—	$12	—	France $11; West Germany $1.
Silver: Metal including alloys, unwrought and partly wrought do.	$6	—		
Tin: Metal including alloys, semimanufactures	2	1	—	Mainly from France.
Titanium: Oxides	1	7	—	Italy 4; France 3.

See footnotes at end of table.

TABLE 4—Continued

TOGO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Zinc:				
Oxides	1	4	—	All from France.
Metal including alloys:				
Unwrought	300	399	—	Belgium-Luxembourg 249; France 150.
Semimanufactures	4	—		
Other: Ores and concentrates	42	22	—	Benin 13; Ghana 6.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.: Grinding and polishing wheels and stones	14	81	—	Netherlands 41; France 29; Nigeria 11.
Barite and witherite	3	—		
Boron: Oxides and acids value, thousands	$2	—		
Cement	277,131	471,085	—	Norway 139,775; Angola 77,484; Spain 65,369.
Chalk	2	23	—	Morocco 22; France 1.
Clays, crude	10	78	—	France 39; Italy 26; Netherlands 12.
Diamond, natural: Gem, not set or strung value, thousands	—	$1	—	All from Benin.
Diatomite and other infusorial earth	64	2	—	Mainly from West Germany.
Fertilizer materials:				
Crude, n.e.s.	8	26	—	Denmark 22; Nigeria 4.
Manufactured:				
Ammonia	7	10	—	France 4; Denmark 2; West Germany 2.
Nitrogenous	10,686	3,721	23	Netherlands 3,600; France 92.
Phosphatic	9,000	300	—	All from Senegal.
Potassic	7	967	—	France 950; United Kingdom 15.
Unspecified and mixed	15,112	11,368	—	Senegal 7,410; France 3,102; Japan 855.
Gypsum and plaster	16,786	16,984	—	Spain 16,571; France 412.
Lime	790	928	—	France 519; Belgium-Luxembourg 250; Spain 157.
Magnesium compounds: Magnesite, crude	—	7	NA	France 1; unspecified 6.
Nitrates, crude value, thousands	—	$2	—	All from Netherlands.
Phosphates, crude	4,965	21	—	All from France.
Pigments, mineral: Iron oxides and hydroxides, processed	2	4	—	Do.
Potassium salts, crude	58	41	—	Do.
Precious and semiprecious stones other than diamond: Natural value, thousands	$1	$1	—	All from Benin.
Salt and brine	10,282	14,658	—	Ghana 14,430; France 46.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	323	260	—	West Germany 164; Denmark 66; Netherlands 20.
Sulfate, manufactured	40	152	—	West Germany 140; Nigeria 12.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	69	85	—	Italy 67; Benin 8; France 4.
Worked	54	136	—	France 128; Italy 8.
Gravel and crushed rock	3	9	—	All from Ghana.
Sand other than metal-bearing	37	6	—	All from France.

See footnotes at end of table.

TABLE 4—Continued

TOGO: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	Sources, 1990	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental:					
Crude including native and byproduct		9,281	2	—	All from France.
Colloidal, preicipitated, sublimed		20	3	—	Do.
Sulfuric acid		173	55	—	France 22; Belgium-Luxembourg 15; Portugal 11.
Talc, steatite, soapstone, pyrophyllite		32	—		
Other:					
Crude		33,145	39,354	—	Spain 39,230; France 124.
Slag and dross, not metal-bearing		26	14	—	All from Ghana.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		45	11	—	All from France.
Carbon black	value, thousands	—	$1	—	All from West Germany.
Coal: Bituminous and anthracite		—	15	—	Do.
Petroleum:					
Crude	value, thousands	$1	—		
Refinery products:					
Liquefied petroleum gas	42-gallon barrels	9,384	10,614	—	Ghana 5,904; Nigeria 4,454.
Gasoline	do.	508,530	554,430	43	Côte d'Ivoire 401,192; Gabon 44,209; Netherlands 32,691.
Mineral jelly and wax	do.	417	527	—	West Germany 252; France 165; Netherlands 71.
Kerosene and jet fuel	do.	82,933	117,994	—	Côte d'Ivoire 99,673; Greece 8,169.
Distillate fuel oil	do.	334,305	324,234	—	Argentina 88,692; Côte d'Ivoire 79,173; Italy 23,506.
Lubricants	do.	21,784	154,399	(3)	France 94,766; Nigeria 21,413; Côte d'Ivoire 18,522.
Residual fuel oil	do.	285,221	333,886	26,906	Gabon 146,447; Côte d'Ivoire 118,042.
Bitumen and other residues	do.	12,265	47,965	—	Côte d'Ivoire 47,444; Benin 394.
Bituminous mixtures	do.	867	721	—	France 461; Nigeria 260.
Petroleum coke	do.	72	3,824	—	All from France.

NA Not available.

[1]Table prepared by Virginia A. Woodson.

[2]Unreported quantity valued at $2,000.

[3]Unreported quantity valued at $3,000.

TABLE 5

TOGO: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

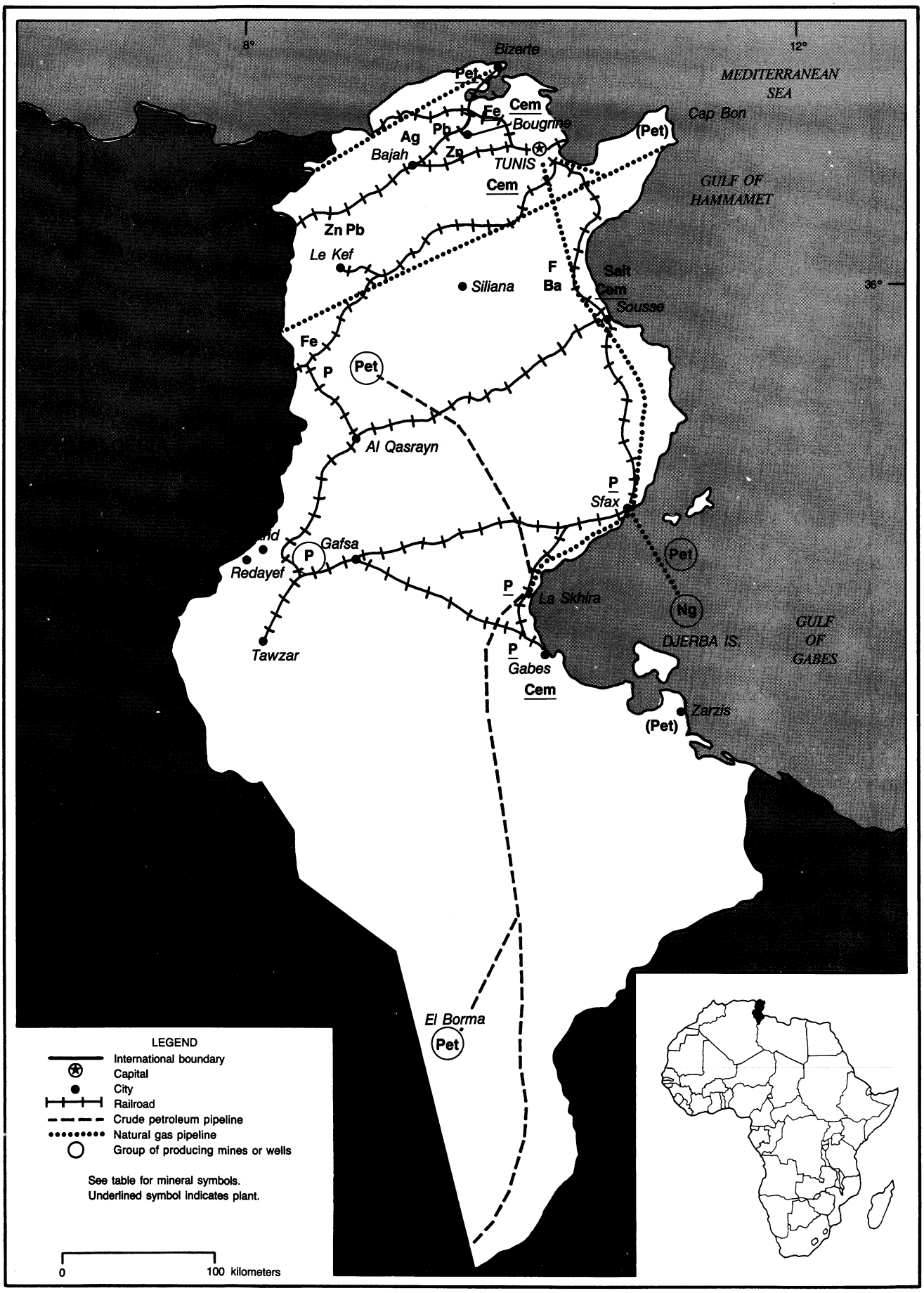
(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement	Ciments du Togo (Cimtogo) (Government, 50%; Norsen, Norwegian, 50%)	Lome	600.
Iron	Societe Togolaise de Siderurgie (STS) (Private U.S. interest, 100%)	do.	e20, semimanufactures.
Marble, thousand square meters	Nouvelle Societe Togolaise de Marbre (Nouvelle Sotoma) (Government, 100%)	40 kilometers south of Blitta	e90.
Phosphate rock	Office Togolaise des Phosphates (OTP) (Government, 100%)	Near Hahotoe and Akoumape	[1] e3,600.

eEstimated.
[1]Beneficiated product.

TUNISIA

AREA 164,000 km² **POPULATION 8.2 million**



THE MINERAL INDUSTRY OF

TUNISIA

By Thomas P. Dolley

The nonfuel mineral industry of Tunisia exhibited marginal growth in 1991. This situation mirrored the Tunisian economy as a whole in 1991. Phosphate mining remained the dominant enterprise in the minerals sector. Lead-zinc mining, in small and difficult to mine underground mines, has remained a traditional enterprise over the past several years but contributes little to the overall economy. In recent years, small- to medium-scale fluorspar mining was the only additional mining activity in Tunisia.

The Tunisian petroleum sector, once thought to be a fading enterprise, experienced renewed growth and development during the year. Additionally, the base metal sector of the mineral industry proceeded with the development of the Bougrine lead-zinc mine through international funding and technical assistance.

The Gulf War did not damage the Tunisian economy as severely as anticipated in 1991. However, internal and external political strife concerning the Government and its policies during the Gulf War caused some economic repercussions for Tunisia. Primarily, the Government's support for Iraq in the Gulf War resulted in a reduction of financial aid from important international donors. The United States reduced its financial aid to Tunisia by 76% for a total of $19 million[1] for 1991.

Minimal economic growth was recorded in 1991, as compared to that of the previous year. Downturns were noted in international aid and investment, tourism revenues, and exports. The estimated GNP for 1991 was $13.2 billion.

GOVERNMENT POLICIES AND PROGRAMS

Basic investment codes covering mining legislation in Tunisia were based on law No. 72-38 of 1972, concerning industries producing exclusively for the export market, and law No. 74-74 of 1974, concerning domestic industries.

Significant changes were made in 1990 to the laws governing hydrocarbon exploration and production in Tunisia. 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 carry out 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. The latter agreement nominally stipulates obligations by the operator and must be approved by law. If a hydrocarbon discovery is to be developed, a joint venture is signed with the Tunisian parastatal Entreprise Tunisienne d'Activities Petrolieres (ETAP). ETAP is obligated to cover its share of expenses if it chooses to participate. Tax and royalty rates have been lowered under the new law, and a sliding scale for royalties and taxation is based on a profit to investment ratio. A large signature bonus is not required; however, capital expenditures covering the operator's exploration, valued between 10% to 30% above those specified in the original statutes, has been introduced. The Government has also streamlined the administrative procedures concomitant with the operator applying for an exploration permit.

In the fourth quarter of 1991, the Government petitioned international lenders, such as the World Bank, for $400 million in loans over a 2-year period toward a financial and economic reform program. Privatization was high on the list of the Government's reform progams, and 300 to 400 public-sector companies were slated for these changes. Among the companies for sale were the parastatal cement and building materials companies.

PRODUCTION

Mineral production in Tunisia, though not very diverse, is important to the economy as a whole. Production of the two most important mineral commodities in Tunisia, crude petroleum and phosphate rock, increased over that of the previous year. Production of base metal concentrates declined significantly, probably in response to a considerable lowering of world commodity prices for lead and zinc in 1991. Key industrial minerals, barite and fluorspar, both declined in production in 1991. Marine salt had a resurgence in production during the year. *(See table 1.)*

TRADE

The trade deficit for 1991 was approximately $1.1 billion, up from the $662 million trade deficit of 1990. Total imports for 1991 were valued at $4.8 billion. Total exports for 1991 were valued at about $3.7 billion. Of this latter figure, crude petroleum exports were valued at about $445 million. The phosphate industry accounted for approximately $254 million of export revenue. Phosphate accounts for about 10% of exports and ranks second after

petroleum exports. Two of the largest customers for fertilizers were Italy in Western Europe and Saudi Arabia in the Middle East.

Cement exports are becoming another significant revenue earner for Tunisia. More than 1 Mmt of cement was exported in 1990 to a variety of markets in both the Mediterranean and Africa. Algeria, Benin, Burkina Faso, Cameroon, France, Ghana, Ivory Coast, Morocco, and Spain represent the diversity of markets served. *(See tables 2 and 3.)*

STRUCTURE OF THE MINERAL INDUSTRY

Phosphate rock production in Tunisia was entirely controlled and operated by the Government parastatal Compagnie des Phosphates de Gafsa (CPG), founded in 1896. CPG is the largest mining company in Tunisia. 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. By yearend 1991, it is expected that SIAPE and SAEPA will merge to form one integrated company.

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 as a 45% to 50% equity partner. *(See table 4.)*

COMMODITY REVIEW

Metals

Société Miniere de Bougrine (SMB) will proceed with the development of a lead-zinc mine at Bougrine in the northwestern part of the country. SMB has equity ownership amounting to 50% by Canada's Metal Mining Corp., which is in turn a subsidiary of the Federal Republic 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 Seoudiene d'Investissement (STUSID), Banque Tuniso Koweitienne de Developpement (BTKD), and Banque de Developpement Economique de Tunisie (BDET).

Significantly, the development of the Bougrine Mine will be Tunisia's first privately owned and managed mine and will create more than 200 jobs. Providing investment capital for the project amounting to $16.1 million, the World Bank's private-sector development subsidiary, the International Finance Corp. (IFC), is a major contributor. Additional funding amounting to $11.3 million will be provided by the Federal Republic of Germany's Deutsche Investitions und Entwicklungsgesellschaft (DEG).

Geologically, Bougrine represents a unique high-grade Pb-Zn deposit in Tunisia. Mineralization occurs on the northeastern edge of the Jebel Lorbeus salt diapir and stratigraphically astride the Triassic-Cretaceous boundary and within the Cretaceous. Exploration and data acquisition was first conducted from 1977 to 1986 by France's Bureau de Recherches Géologiques et Minière (BRGM). BRGM's data indicate that the ore mineralization was controlled by paleogeographic and paleostructural features. Additionally, tectonic movement of a horst-and-graben type was contemporaneous with mineralization and caused variations in the types of economic concentrations of ore found. There are three coexisting ore accumulations. Two discordant accumulations include (1) lenticular massive sulfide ore bodies featuring pyrite-sphalerite-galena in the Triassic to Cretaceous transition zone and (2) semimassive ore bodies or hanging wall ore composed of sphalerite-galena that is cutting across Cretaceous strata. The remaining ore accumulation is stratiform with sphalerite in calcareous rock that has a high organic component.[2]

Industrial Minerals

Cement.—Total cement milling capacity for 1991 in Tunisia was approximately 4.5 Mmt/a. The largest cement producer in Tunisia, with a capacity of 1.2 Mmt/a, was Société des Industries Cimentières du Centre (SICC). SICC's main installation is its Enfida cementworks at Sousse. Despite the decline in tourism and associated development in 1991, cement production facilities are ideally situated in the coastal regions of Tunisia to facilitate any related resurgence of contruction. Owing to increased production capacity, cement has become a significant export product of Tunisia in recent years. During the year, a $2.7 million contract was signed by Société Mixte Algero-Tunisienne de Ciment Blanc with Algeria's Entreprise de Distribution de Materiaux de Construction de la Wilaya de Oum El Bouaghi for the supply of 28 kmt of white cement. The contract contains an option for an additional 12 kmt of white cement and has been financed by the Banque Nationale Agricole de Tunisie.

Phosphate Rock.—Phosphate rock was first discovered in Tunisia in 1896. The discovery of the deposit, south of Gafsa, led to the creation of CPG. CPG mines all phosphate rock in Tunisia and currently produces more than 6 Mmt of rock from several open pit and underground mines in the Gafsa region. SIAPE, incorporated in 1947, utilizes about 80% of the bulk phosphate rock produced for downstream products such as simple, binary, and complex fertilizers. These products include triple superphosphate (TSP), monoammonium phosphate (MAP), diammonium phosphate (DAP), nitrogen-phosphorus-potassium (NPK), dicalcium phosphate (DCP), and sodium tripolyphosphate (STPP).

In late 1991, SIAPE invited bids for the construction of a 400-kmt/a DAP plant at Gabes. Inclusive with this bid is the construction of a fertilizer storage facility with a capacity of 30 kmt of fertilizer. An accompanying loading

facility should be capable of loading at a rate of 500 mt/h. Additionally, SIAPE signed an agreement in August 1991 with Syria to supply fertilizer in exchange for $15 million worth of crude oil.

Mineral Fuels

Petroleum production increased to an average of about 106 kbbl/d in 1991, an increase of 14% from that of the prior year. Of historical note, Tunisia's oil production reached an alltime high of 131,918 bbl/d in August 1991. Petroleum exploration and development continued at an accelerated pace in 1991, overtaking similar progress in the previous year. Many geological formations that were suspected petroleum reservoirs are being reexamined and evaluated. The hydrocarbon discoveries made over the past 2 years are helping to forestall Tunisia's slide toward import fuel dependence.

Favorable fiscal and legislative developments have led to the signing of a contract at yearend 1991 to develop the Miskar natural gas field in the Gulf of Gabes. Miskar lies about 121 km offshore in 67 m of water. First discovered in 1975 by France's Société National Elf Aquitaine (Elf), Miskar is Tunisia's largest gasfield with reserves estimated at 23 billion m^3. First acquiring the tract in 1988, the United Kingdom's British Gas will develop the Miskar Field over the next 4 years. The project has been capitalized at about $600 million and should begin production in 1995. ETAP has the option to take a 20% equity interest in the project. Additionally, the natural gas produced will be marketed to Société Tunisienne d'Electricite & du Gaz (STEG).

Initial development of the Miskar Gasfield calls for the drilling of 12 wells and the installation of 2 offshore platforms. One platform will be dedicated to drilling and production and will be linked via bridge to the remaining platform housing accommodation and utilities. These platforms will be linked by a 660-mm pipeline to an onshore processing facility at Chaffar Wadi, 24 km south of Sfax. The pipeline will have a 127-km offshore and 4.8-km onshore extent. Production at the Miskar Field is expected to be 4.5 Mm^3/d of natural gas.

The independent Samedan Oil Corp. of the United States commenced evaluation of the Isis offshore petroleum tract during the year. Originally discovered by France's Total in 1974, the Isis permit was later taken over by the Netherland's Royal Dutch Shell and subsequently by Samedan. Wildcat drilling of the tract in five areas has yielded up to 2,900 bbl/d in flow tests. Samedan has related that a moderate-sized production platform accompanied by a floating production and storage system may be utilized in the future. Samedan is also involved in exploration at offshore concessions in the Gulf of Hammamet.

By yearend 1991, ETAP and Libya's National Oil Co. (NOC) announced that seismic tests would be conducted on both nation's 7 November offshore oilfield. The tests, including the drilling of two wildcat wells, would be initiated in late 1992 through a joint venture named Joint Operating Co. (JOC) formed by ETAP and NOC. JOC is headquartered on the island of Djerba. Seismic tests would be conducted by France's Compagnie Generale de Geophysique (CGG) over 2,500 km^2 of the 7 November Oilfield in the Gulf of Gabes. Petroleum industry analysts state that at least four oil-bearing structures exist in the area, including the El-Amal Oil-field, speculated to contain about 1.6 billion bbl. In the event that production is initiated from the 7 November Oilfield in the late 1990's, the crude oil would probably be exported through the Zarzis free port terminal in Tunisia. Currently, Libya exports about 7 Mbbl/a through the Zarzis terminal. These projects are further amplifying development in the geographic area between Sfax and Zarzis, the fastest growing region in Tunisia.

Another major player in petroleum exploration and production in Tunisia is Marathon Oil of the United States. By yearend 1991, Marathon's Ezzaouia Field development has increased to 34 kbbl/d of crude oil. Marathon's wildcatting activities on the Cap Bon peninsula have targeted the Eocene Bou Dabbous limestone. The 1 Belli wildcat well on this permit has tested to 6,800 bbl/d with suspected greater potential. The two other associated wildcat wells on this permit have yielded minor shows of oil and water. Marathon reports that the company will continue drilling to deeper targets within the Cretaceous Abiod chalk. The Abiod chalk has been evaluated in the recent past utilizing horizontal drilling techniques.

The beginning of 1991 featured the withdrawal of the Netherland's Royal Dutch Shell after the sale of most of its assets in Tunisia. Most of the sales of tracts went to U.S. companies. Shell will retain ownership of an offshore tract in the Gulf of Gabes. During the year, new exploration permits and extensions were awarded to Canada's Coho Resources Ltd., the United Kingdom's Sovereign Oil and Gas PLC, National Oil & Gas Trust (OKGT) of Hungary, and Italy's Azienda Generali Italiana Petroli S.p.A. (AGIP).

Reserves

The African Development Bank estimated Tunisian phosphate reserves at 3.5 to 4 billion tons, which represents about 5% of of the world reserve of phosphate rock. Potash deposits in the country have been determined to be of too low a grade or to have extremely high production costs. Petroleum and natural gas, Tunisia's other major mineral commodities, contain reserves that are constantly changing due to increased exploration. Industry sources estimate that Tunisian crude petroleum reserves are approximately 1.7 billion bbl.

INFRASTRUCTURE

Railways were the primary mode of transportation of phosphate rock to chemical plants or seaports. Zarzis free port terminal is slated for further development at an estimated cost of $20.8 million. The work would expand harbor and storage facilities.

At the beginning of 1991, the European Investment Bank (EIB) approved a $48.4 million loan to facilitate

pollution control by Tunisia's Groupe Chimique consortium in the Gulf of Gabes region. This area has been targeted by World Bank/EIB studies owing to pollution from byproducts of phosphate production. Approximately 3.5 Mmt/a of gypsum waste is dumped into the Mediterranean Sea. Gypsum stockpiling has been one solution submitted by the World Bank/EIB study. Under the terms of the loan, air pollution control in Gabes and Sfax will be addressed.

OUTLOOK

The Government hopes to attract more foreign investment in the petroleum exploration and production arena. Increasing success has been achieved, forestalling the notion that dwindling energy sources may leave Tunisia in the position of being a net energy importer by 1992.

The Government hopes that through the development of the Miskar natural gas field and its related infrastructure, other marginal natural gas fields will be developed. By 1995, it was hoped that the development of the Miskar Gasfield would enable Tunisia to substitute natural gas for much of its energy requirements while directing petroleum output primarily to export markets, thus allowing the country to remain a net exporter of petroleum.

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[1]Where necessary, values have been converted from Tunisian dinars (D) to U.S. dollars at a rate of D0.9246=US$1.00.

[2]Legendre, O., J.J. Orgeval Fluid Inclusion Studies of the Bou Grine Zn-Pb Mineralization (Tunisian Atlas). Principal Scientific and Technical Results, 1989. Bureau de Recherches Géologiques et Minières, 45060 Orléans Cedex 2, France, 1991, 4 pp.

OTHER SOURCES OF INFORMATION

Direction des Mines et de la Geologie
Ministere de l'Economie Nationale
195 Rue de la Kasbah
Tunis, Tunisia

Ministere de l'Industrie, des Mines et de l'Energie
195 Rue de la Kasbah
Tunis, Tunisia

Service Geologique de Tunisie
95 Avenue Mohamed V
Tunis, Tunisia

Compagnie des Phosphate de Gafsa
GAFSA
Cité Bayache, Tunisia

TABLE 1
TUNISIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991[e]
METALS						
Iron and steel:						
Iron ore and concentrate, gross weight	thousand tons	295	325	280	291	[3]295
Metal:						
Pig iron	do.	163	128	140	140	140
Steel, crude	do.	196	150	194	184	[3]200
Lead:						
Mine output, Pb content		3,465	3,653	2,702	2,966	[3]1,285
Metal:[e]						
Primary[4]		2,200	2,200	2,200	2,200	750
Secondary		500	500	500	500	250
Total		2,700	2,700	2,700	2,700	1,000
Silver metal, primary	kilograms	1,555	933	933	930	900
Zinc, mine output, Zn content		4,500	8,500	10,000	7,000	[3]9,353
INDUSTRIAL MINERALS						
Barite		14,412	18,868	33,104	30,885	322,366
Cement, hydraulic	thousand tons	3,400	3,228	3,228	3,300	3,300
Clays, construction[e]	do.	350	350	350	350	350
Flourspar, chemical and metallurgical grades		43,298	55,416	53,575	40,974	[3]37,580
Gypsum[e]		100,000	100,000	100,000	100,000	100,000
Lime	thousand tons	650	650	650	650	650
Phosphate rock, gross weight	do.	6,390	6,103	6,610	6,258	[3]6,400
Salt, marine	do.	425	485	480	402	[3]441
MINERAL FUELS AND RELATED MATERIALS						
Gas, natural:						
Gross[e]	million cubic meters	391	368	388	374	[3]405
Marketed	do.	195	184	29	29	29
Petroleum:						
Crude	thousand 42-gallon barrels	37,960	37,230	37,595	36,500	[3]38,690
Refinery products:						
Gasoline[e]	do.	1,800	1,800	1,800	[3]2,200	2,200
Kerosene[e]	do.	2,400	2,400	2,400	[3]2,400	2,400
Distillate fuel oil[e]	do.	3,000	3,000	3,000	[3]4,042	4,000
Other[e]	do.	400	400	400	[3]400	400
Refinery fuel and losses[e]	do.	200	200	200	[3]111	100
Residual fuel oil[e]	do.	4,000	4,000	4,000	[3]3,857	3,800
Total[e]	do.	11,800	11,800	11,800	[3]13,010	12,900

[e]Estimated.
[1]Table includes data available through July 8, 1992.
[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 is quarried for cement manufacture is substantial; however, information is inadequate to make accurate estimates of output.
[3]Reported figure.
[4]From domestic and imported ores.

TABLE 2

TUNISIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	1,016	24	—	All to Libya.
Aluminum:				
Oxides and hydroxides	—	32	—	Do.
Metal including alloys:				
Scrap	1,149	688	—	Italy 365; Spain 105; United Kingdom 90.
Unwrought	513	97	—	All to Italy.
Semimanufactures	598	767	—	Iraq 227; Italy 125; Algeria 124.
Copper:				
Metal including alloys:				
Scrap	5,735	2,747	35	France 497; Switzerland 458; Libya 412.
Unwrought	1	—		
Semimanufactures	381	545	—	Iraq 507; France 31.
Gold: Metal including alloys, unwrought and partly wrought kilograms	—	1,500	—	France 1,090; West Germany 163; Italy 80.
Iron and steel:				
Iron ore and concentrate including roasted pyrite	5,693	3,771	—	Italy 2,420; United Kingdom 1,351.
Metal:				
Scrap	1,805	5,220	—	Italy 4,000; Spain 823; Belgium-Luxembourg 113.
Steel, primary forms	2,295	2,498	—	All to Egypt.
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated		879	—	Libya 656; Algeria 177; Greece 46.
Clad, plated, coated		18,486	—	U.S.S.R. 5,054; Italy 4,922; United Kingdom 2,619.
Of alloy steel	46,354	17	—	Libya 9; Greece 7.
Bars, rods, angles, shapes, sections		12,236	—	Libya 12,194; Greece 41.
Rails and accessories		3	—	All to Libya.
Tubes, pipes, fittings		9,462	—	Libya 4,581; Algeria 2,609; France 1,266.
Lead:				
Ore and concentrate	1,500	3,700	—	France 2,200; Morocco 1,500.
Oxides	8	—		
Metal including alloys:				
Scrap	980	1,429	—	Greece 723; Italy 593; United Kingdom 113.
Unwrought	1,055	922	—	Libya 511; Egypt 290; France 121.
Semimanufactures	4	102	—	France 101; Libya 1.
Magnesium: Metal including alloys:				
Scrap	—	8	—	All to Spain.
Nickel: Metal including alloys:				
Scrap	—	29	—	All to France.
Semimanufactures value, thousands	$1	—		
Tin: Metal including alloys:				
Unwrought	—	10	—	All to Libya.
Semimanufactures	—	19	—	Libya 18; France 1.

See footnotes at end of table.

TABLE 2—Continued

TUNISIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Destinations, 1990	
			United States	Other (principal)
METALS—Continued				
Tungsten: Metal including alloys, unwrought	—	8	—	All to Spain.
Zinc:				
Ore and concentrate	19,425	17,700	—	Italy 7,400; Cyprus 2,800; Yugoslavia 2,500.
Blue powder	—	261	—	All to France.
Metal including alloys: Scrap	148	272	—	France 155; Spain 60; Netherlands 20.
Other:				
Ores and concentrates	28,950	26,800	—	Italy 15,000; Netherlands 11,800.
Oxides and hydroxides	60	101	—	Algeria 100.
Ashes and residues	—	1,297	—	Italy 1,027; India 167.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	81	3,201	—	Libya 3,200.
Grinding and polishing wheels and stones	—	153	—	Libya 130; Algeria 23.
Barite and witherite	1,116	930	—	All to Italy.
Cement thousand tons	1,658	1,282	—	Spain 427; Côte d'Ivoire 219; Cameroon 147.
Chalk	142	55	—	All to Libya.
Clays, crude	3	80	—	Algeria 70; Libya 10.
Diamond, natural:				
Gem, not set or strung value, thousands	$19,211	$18,172	—	All to Belgium-Luxembourg.
Industrial stones do.	—	$3,527	—	Do.
Feldspar, fluorspar, related materials:				
Fluorspar	NA	1,945	—	All to Italy.
Unspecified	11,070	—		
Fertilizer materials: Manufactured:				
Ammonia	—	6	—	All to Libya.
Nitrogenous	92,983	114,005	—	France 89,387; Spain 13,583; United Kingdom 6,003.
Phosphatic thousand tons	1,567	1,566	—	Italy 307; France 253; Syria 157.
Gypsum and plaster	2,654	1,252	—	Côte d'Ivoire 500; Niger 311; Libya 243.
Lime	50	150	—	All to Algeria.
Mica: Worked including agglomerated splittings	—	93	—	All to Libya.
Phosphates, crude thousand tons	1,082	602	—	France 169; Turkey 144; Romania 66.
Precious and semiprecious stones other than diamond: Natural value, thousands	—	$41	—	All to Egypt.
Salt and brine	483,450	399,488	25,031	Italy 89,077; Norway 81,985; Iceland 67,125.
Sodium compounds, n.e.s.: Sulfate manufactured	604	—		
Stone, sand and gravel:				
Dimension stone:				
Crude or partly worked	2,222	1,290	—	Italy 699; Libya 390; Greece 112.
Worked	792	728	—	Libya 550; Italy 94; Belgium-Luxembourg 56.
Gravel and crushed rock	1,489	11,127	—	Libya 11,094; Honduras 33.
Quartz and quartzite	—	3	—	All to Libya.
Sand other than metal-bearing	13	16	—	West Germany 11; Italy 4.

See footnotes at end of table.

TABLE 2—Continued

TUNISIA: EXPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	Destinations, 1990	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Sulfur:					
Elemental: Crude including native and byproduct		—	3	—	All to Libya.
Sulfuric acid		1,519	1,481	—	Do.
Other:					
Crude		11	15	—	Mainly to Libya.
Slag and dross, not metal-bearing		1,542	2,730	—	All to Italy.
MINERAL FUELS AND RELATED MATERIALS					
Carbon black		1	—		
Petroleum:					
Crude	thousand 42-gallon barrels	32,778	23,448	—	Italy 15,607; France 3,412; West Germany 2,375.
Refinery products:					
Liquefied petroleum gas	do.	466	483	—	Italy 439; France 44.
Gasoline	do.	843	4,995	—	Italy 3,386; United Kingdom 650; Spain 403.
Kerosene and jet fuel	do.	10	—		
Distillate fuel oil	do.	20	—		
Lubricants	do.	1	—		
Residual fuel oil	do.	2,438	—		
Bituminous mixtures	value, thousands	$15	—		

NA Not available.

[1]Table prepared by Virginia A. Woodson.

TABLE 3

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS				
Alkali and alkaline-earth metals	102	—		
Aluminum:				
Ore and concentrate	r1,838	3,053	—	Italy 3,000; Netherlands 41.
Oxides and hydroxides	r37,773	30,122	(2)	France 11,382; Italy 7,075; Yugoslavia 4,765.
Metal including alloys:				
Scrap	34	5	—	All from Libya.
Unwrought	2,190	1,583	—	Canada 795; Egypt 598; France 65.
Semimanufactures	4,363	4,361	(2)	Bahrain 1,301; Italy 1,001; Belgium-Luxembourg 576.
Antimony: Metal including alloys, all forms	—	84	—	All from China.
Bismuth: Metal including alloys, all forms value, thousands	—	$1	$1	
Chromium:				
Ore and concentrate	23	45	—	Belgium-Luxembourg 25; Netherlands 20.
Oxides and hydroxides	39	23	—	France 12; West Germany 11.
Cobalt:				
Oxides and hydroxides value, thousands	$1	$6	—	United Kingdom $4; West Germany $2.
Metal including alloys, all forms do.	—	$1	NA	NA.
Copper:				
Matte and speiss including cement copper	169	131	—	Italy 91; France 40.
Metal including alloys:				
Scrap	35	56	—	All from Libya.
Unwrought	486	503	—	Italy 302; Belgium-Luxembourg 146; France 45.
Semimanufactures	8,672	10,615	4	France 5,308; Belgium-Luxembourg 2,649; Italy 801.
Gold: Metal including alloys, unwrought and partly wrought kilograms	366	283		Czechoslovakia 184; West Germany 98.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite	88,202	66,619	—	Morocco 50,246; Mauritania 10,300; Spain 6,060.
Pyrite, roasted	—	2	—	All from Italy.
Metal:				
Scrap	3,022	2,183	273	France 1,699; Algeria 68.
Pig iron, cast iron, related materials	4,761	5,891	(2)	Turkey 5,000; Canada 600.
Ferroalloys:				
Ferrochromium	NA	129	—	All from U.S.S.R.
Ferromanganese	44	456	—	Belgium-Luxembourg 380; Brazil 44.
Ferrosilicon	1,127	862	2	Egypt 850; China 10.
Silicon metal	—	11	—	All from Belgium-Luxembourg.
Unspecified	658	331	—	Egypt 200; Norway 100; West Germany 29.
Steel, primary forms	28,153	46,601	—	Greece 30,916; Turkey 10,100; Spain 5,525.

See footnotes at end of table.

TABLE 3—Continued

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Semimanufactures:				
Flat-rolled products:				
Of iron or nonalloy steel:				
Not clad, plated, coated		105,951	—	Italy 60,267; West Germany 13,795; France 5,773.
Clad, plated, coated		31,997	1	Greece 9,862; West Germany 7,042; France 4,783.
Of alloy steel		3,130	4	France 2,060; Italy 440; Belgium-Luxembourg 157.
Bars, rods, angles, shapes, sections	325,570	229,595	1	Turkey 89,678; Czechoslovakia 32,027; Yugoslavia 27,086.
Rails and accessories		12,524	—	France 12,212; United Kingdom 114.
Wire		1,892	3	France 615; China 400; United Kingdom 331.
Tubes, pipes, fittings		29,041	2,136	France 4,912; Italy 3,987; West Germany 3,965.
Lead:				
Oxides	161	161	—	France 88; Spain 60; Italy 12.
Metal including alloys:				
Scrap	1	5	—	Belgium-Luxembourg 4; France 1.
Unwrought	4,078	3,763	—	Morocco 3,559; Mexico 200.
Semimanufactures	6	11	—	France 8; Austria 2.
Magnesium: Metal including alloys, semimanufactures	—	2	—	Mainly from Italy.
Manganese:				
Ore and concentrate: Metallurgical grade	182	200	—	Gabon 180; France 20.
Oxides	106	164	—	Belgium-Luxembourg 47; France 41; India 36.
Mercury	12	6	—	Mainly from Algeria.
Molybdenum: Metal including alloys, semimanufactures	—	1	—	Mainly from Belgium-Luxembourg.
Nickel: Metal including alloys:				
Unwrought	—	9	—	France 5; Italy 2.
Semimanufactures	43	23	—	West Germany 13; France 10.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$9	$10	—	Belgium-Luxembourg $5; Italy $4.
Silver: Metal including alloys, unwrought and partly wrought do.	$576	$761	—	Morocco $545; France $168.
Tin: Metal including alloys:				
Scrap do.	—	$1	—	All from France.
Unwrought	47	66	—	Indonesia 26; Malaysia 15; Brazil 13.
Semimanufactures	31	36	(e)	France 21; West Germany 10.
Titanium: Oxides	172	107	27	Italy 38; Yugoslavia 18.
Tungsten: Metal including alloys:				
Unwrought value, thousands	—	$4	—	All from France.
Semimanufactures	—	5	—	Mainly from United Kingdom.
Uranium and thorium: Metal including alloys, all forms value thousands	$82	$2	—	All from France.

See footnotes at end of table.

TABLE 3—Continued

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
METALS—Continued				
Zinc:				
Oxides	428	413	—	France 178; Spain 108; West Germany 69.
Metal including alloys:				
Scrap	16	2	—	All from France.
Unwrought	4,112	4,064	—	Italy 1,667; Algeria 1,659; Belgium-Luxembourg 529.
Semimanufactures	308	80	—	France 30; Belgium-Luxembourg 29; Italy 15.
Zirconium: Ore and concentrate	—	64	—	All from Italy.
Other:				
Ores and concentrates	36	—		
Oxides and hydroxides	132	182	48	West Germany 82; Norway 35.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc.	7,239	9,875	45	Turkey 9,180; France 373.
Artificial: Corundum	317	274	—	West Germany 159; France 85; United Kingdom 16.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$43	$56	—	Belgium-Luxembourg $39; Tanzania $13.
Grinding and polishing wheels and stones	326	393	(*)	Italy 230; France 52; Denmark 19.
Asbestos, crude	6,181	7,179	—	Greece 1,920; U.S.S.R. 1,071.
Barite and witherite	—	117	—	West Germany 85; Yemen 30.
Boron materials:				
Crude natural borates	1	5	—	Mainly from France.
Oxides and acids	64	91	—	Italy 39; Chile 18; China 18.
Bromine[5]	8	6	—	West Germany 4; France 1.
Cement	2,348	6,751	—	Italy 5,300; France 1,045; West Germany 270.
Chalk	3,336	6,229	—	Italy 3,673; France 1,956; Jordan 600.
Clays, crude:				
Bentonite	NA	2,226	5	Bulgaria 1,000; Spain 740; Algeria 250.
Kaolin	NA	30,223	—	Turkey 12,850; Spain 9,409; United Kingdom 3,730.
Unspecified	39,730	13,144	18	France 5,843; Italy 3,145; United Kingdom 1,623.
Cryolite and chiolite	2	—		
Diamond, natural:				
Gem, not set or strung value, thousands	$19,910	$14,159	—	Belgium-Luxembourg $10,766; Tanzania $3,238.
Industrial stones do.	—	$717	—	Zaire $590; Belgium-Luxembourg $122.
Diatomite and other infusorial earth	763	3,183	—	France 2,122; Algeria 956.
Feldspar, fluorspar, related materials:				
Feldspar	NA	2,177	—	Turkey 1,361; Italy 462.
Fluorspar	NA	6,575	—	China 5,605; Italy 970.
Unspecified	3,855	—		
Fertilizer materials:				
Crude, n.e.s.	41	264	—	France 218; Hungary 45.

See footnotes at end of table.

TABLE 3—Continued

TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1989	1990	Sources, 1990	
			United States	Other (principal)
INDUSTRIAL MINERALS—Continued				
Fertilizer materials—Continued				
Manufactured:				
Ammonia	276,711	262,302	—	U.S.S.R. 227,448; Bahrain 20,009; Saudi Arabia 14,716.
Nitrogenous	16,988	28,234	—	Czechoslovakia 11,207; Bulgaria 7,249; Poland 6,831.
Phosphatic	2	—		
Potassic	11,132	56,598	—	U.S.S.R. 51,296; West Germany 3,300.
Unspecified and mixed	28	40	—	West Germany 20; Italy 9; France 7.
Graphite, natural	6	132	—	United Kingdom 102; West Germany 24.
Gypsum and plaster	150	562	—	France 551.
Lime	—	16	—	France 11; Algeria 5.
Magnesium compounds:				
Magnesite, crude	—	49	—	Italy 47; France 2.
Oxides and hydroxides	—	854	—	Greece 449; Netherlands 231; Austria 78.
Unspecified	812	—		
Mica:				
Crude including splittings and waste	10	10	—	All from France.
Worked including agglomerated splittings	3	2	—	Do.
Nitrates, crude	—	20	20	All from East Germany.
Phosphates, crude	(2)	18	—	France 1; undetermined 17.
Pigments, mineral: Iron oxides and hydroxides, processed	415	315	—	West Germany 177; Spain 88; China 18.
Precious and semiprecious stones other than diamond:				
Natural value, thousands	$1	—		
Synthetic do.	$148	$1	—	All from France.
Pyrite, unroasted	32	12	—	All from Italy.
Salt and brine	241	78	—	West Germany 62; France 7.
Sodium compounds, n.e.s.:				
Soda ash, manufactured	25,055	45,866	—	Poland 16,791; Bulgaria 15,947; Spain 7,909.
Sulfate, manufactured	10,237	10,249	—	Turkey 8,074; Spain 1,652.
Stone, sand and gravel:				
Dimension stone				
Crude and partly worked	26,589	23,664	—	Italy 21,831; Greece 1,665.
Worked	113	1,787	—	Mainly from Italy.
Dolomite, chiefly refractory-grade	154	712	—	France 372; Spain 310.
Gravel and crushed rock	45,861	39,568	—	Italy 28,168; Greece 11,205.
Quartz and quartzite	868	1,594	—	Belgium-Luxembourg 1,419; Italy 158.
Sand other than metal-bearing	123	516	170	Belgium-Luxembourg 305; West Germany 20.
Sulfur:				
Elemental:				
Crude including native and byproduct thousand tons	1,234	1,287	20	Canada 271; Poland 254; Saudi Arabia 194.
Colloidal, precipitated, sublimed	130	131	—	West Germany 129; France 1.
Dioxide	—	101	—	West Germany 74; France 24.
Sulfuric acid	776	572	—	Libya 558; France 10.

See footnotes at end of table.

TABLE 3-Continued
TUNISIA: IMPORTS OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1989	1990	Sources, 1990	
				United States	Other (principal)
INDUSTRIAL MINERALS—Continued					
Talc, steatite, soapstone, pyrophyllite		1,262	1,146	—	France 912; Spain 72; Norway 37.
Other:					
Crude		172	89	—	West Germany 46; France 34.
Slag and dross, not metal-bearing		1	1	—	All from Switzerland.
MINERAL FUELS AND RELATED MATERIALS					
Asphalt and bitumen, natural		122	39,039	—	Italy 23,895; Spain 9,885; Greece 5,254.
Carbon black		3,560	3,718	—	France 1,100; Italy 874; Spain 816.
Coal:					
Anthracite and bituminous		11,588	10,078	3,150	Belgium-Luxembourg 3,873; France 3,055.
Other coal		—	2,947	—	All from Poland.
Coke and semicoke		110,935	132,400	—	Egypt 105,454; France 9,232; Portugal 9,200.
Peat including briquets and litter		30	22	—	Italy 18; France 4.
Petroleum:					
Crude	thousand 42-gallon barrels	4,073	2,880	NA	Iraq 1,876; Syria 944.
Petroleum refinery products:					
Liquefied petroleum gas	do.	16,908	1,661	—	Italy 695; Algeria 463; France 316.
Gasoline	do.	(2)	15,985	246	Italy 13,196; Spain 1,451; U.S.S.R. 421.
Mineral jelly and wax	do.	8	10	(2)	West Germany 5; France 4.
Kerosene and jet fuel	do.	1,649	—		
Distillate fuel oil	do.	4,118	—		
Lubricants	do.	205	—		
Residual fuel oil	do.	4,703	—		
Bitumen and other residues	do.	326	132	—	Italy 107; Greece 14.
Bituminous mixtures	do.	3	3	—	France 1; Spain 1.
Petroleum coke	do.	(2)	—		

[r] Revised. NA Not available.
[1] Table prepared by Virginia A. Woodson.
[2] Less than 1/2 unit.
[3] Unreported quantity valued at $40,000.
[4] Unreported quantity valued at $6,000.
[5] May include iodine and fluorine.

TABLE 4

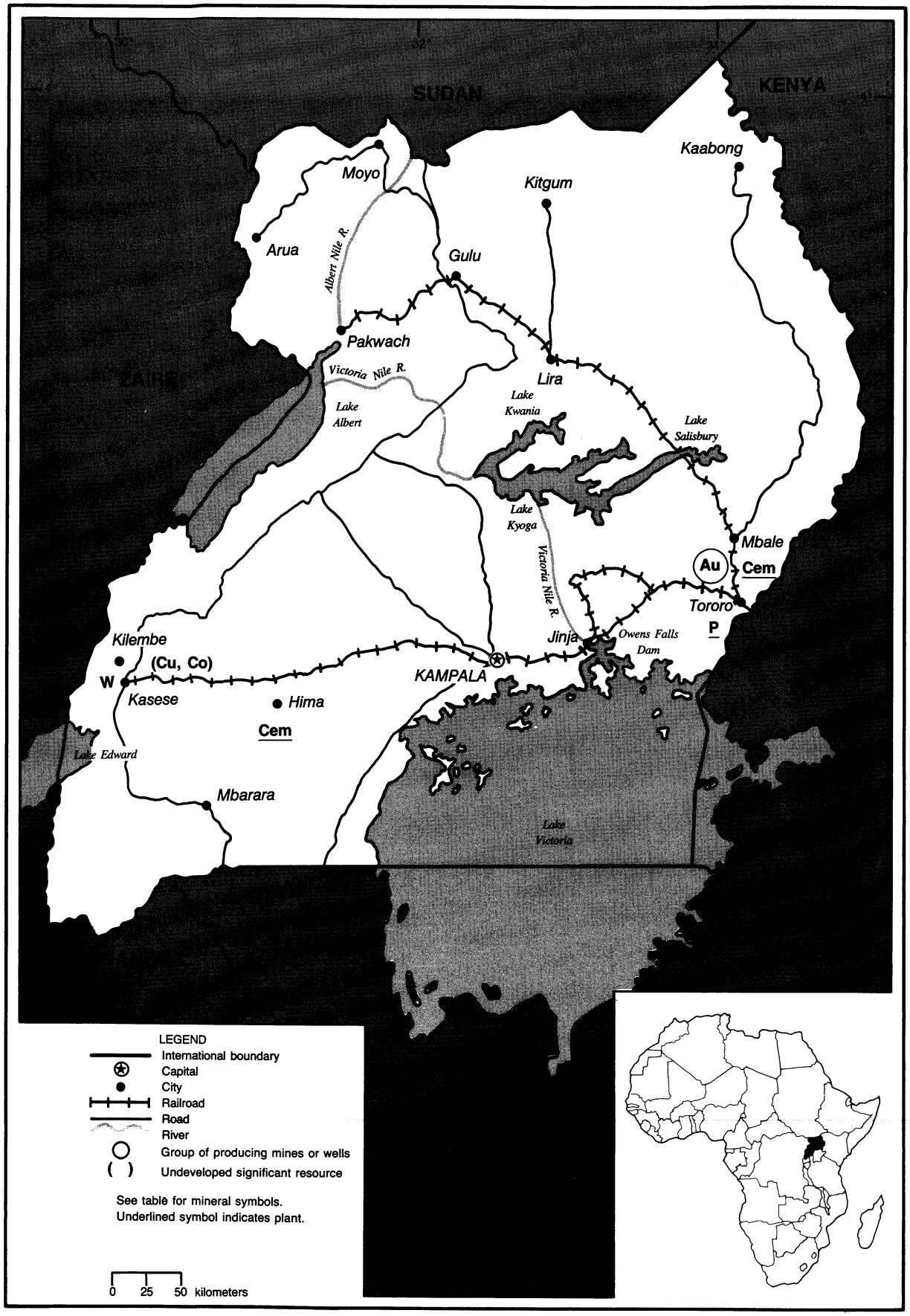
TUNISIA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Barite	Société Tunisienne d'Expansion Miniere (Government, 100%)	Zirba	3,000
Cement million metric tons	do.	Bizerte, Gabes, Tunis	2.5
Iron ore	do.	Djebel Djerissa iron mine	295,000
Crude steel	do.	El Fouladh steel mill	200,000
Lead, zinc concentrate	do.	Fedj Hassen Mine, Bou Jaber	4,000 3,000
Petroleum, crude million barrels	Elf Aquitaine, Enterprise Tunisienne d'Activities Petrolieres (ETAP) (Société National Elf Aquitaine, France, 50%; ETAP, 50%)	Ashtart	9,125
Do. do.	Agip-Tunisia, Société Italo- Tunisienne d'Exploitation Petroliere (SITEP) (Azienda Generali Italiana Petroli-Tunisia, (Agip-Tunisia), Italy, 50%; SITEP, 50%)	El Borma	25,900

UGANDA

AREA 236,040 km² **POPULATION 18.7 million**



THE MINERAL INDUSTRY OF

UGANDA

By David Izon

Uganda's economy depended on agriculture, which accounted for about 50% of the GDP of about $4.5 billion[1] in 1991. Agriculture also accounted for about 98% of export earnings. Coffee was the primary export commodity accounting for 70% of foreign exchange earnings. The country took steps to reduce inflation. A new investment code was enacted in 1991 with attractive investment incentives such as import duty and sales tax exemptions. It also provided exemptions on corporate income and dividend taxes for a maximum of 5 years. The Government launched a civil service reform program during 1991 that prepared the way for privatization of Government parastatals.

The Government signed an agreement with Bureau de Recherches Géologiques et Minières of France (BRGM) and Barclays Metals Ltd. of the United Kingdom to process the Kilembe Mine tailings for cobalt. The initial $4 million pilot study is expected to produce 1,000 mt/a of cobalt. The 12-month study would include the construction of facilities for pilot bioleaching, solvent extraction, and electrowinning. A full-scale $50 million plant that would start operations in 1995 is to follow. BRGM intended to apply a new method where thiobacillus ferro-oxidans, a naturally occurring bacteria, is used to liberate cobalt metal from the mine tailings. This procedure was used before only on copper, gold, and uranium. It is anticipated that this method would be least expensive and environmentally safe. The mine tailings were estimated to contain 1.1 Mmt of cobalt. Cobalt retrieval from the Kilembe Mine tailings by this method should take 12 years. The Government holds 45% equity in the venture and BRGM and Barclays each hold a 27.5% share. The African Development Bank's $127 million phosphate mine and fertilizer plant project started on schedule in September 1991.

The value of total exports was about $177 million, and imports amounted to about $550 million, resulting in a deficit of $373 million. The country had a negative trade balance of $444 million. Uganda's major export products, in order of importance, were coffee, salt, sugar, and tea. Its major trading partners were France, the Federal Republic of Germany, Kenya, the United Kingdom, and the United States. The country imported machinery, parts, and clothing mainly from the Federal Republic of Germany, the United Kingdom, and the United States. Uganda imported petroleum products from neighboring Kenya.

Mineral production was minimal due to the lack of financing for the reconstruction or rehabilitation of degenerated mining equipment and facilities. The family-run steel plant at Jinja operated by Alam Steel Rolling Mills Ltd. continued its small-scale production of rolled products. An electric furnace was installed in the plant, increasing its production to 24,000 mt/a. The plant's product range was also expanded to include rebars, angles, flats, and Z- or T-sections for the construction industry. The Government-owned East African Steel Corp. plant, also in Jinja, was dormant owing to lack of funds to revive it. The 24,000-mt/a-capacity plant required $5 million to reactivate it. The makeup of the plant was a twin-strand continuous caster, a six-stand rolling mill, and a four-stand roughing train. The Madveni Family holds 49% equity in the plant. *(See table 1.)*

Cement production increased by 42%, reflecting the rehabilitation of the Hima Cement plant. The plant was closed for long periods owing to the shortage of electric power. Other industries that experienced difficulties were salt and tin. Several companies, including Petro-Vine of the United Kingdom, Petro-Chemical Industries of Zimbabwe, and Development and Commerce of the United Arab Emirates, submitted bids to buy the state-owned Lake Katwe Salt Project.

There were no officially reported reserve figures for minerals, but the outlook was encouraging. The country's continued efforts to revive its mining industry and improve its infrastructure could lead to growth of the mineral industry and may help stabilize the economy. The cobalt project underway, if managed properly, could stimulate foreign investors' confidence in the economy. Also, the completion of the phosphate mine and fertilizer plant could enhance production of food crops and provide an additional export commodity. Extraction of known mineral resources of copper, gold, iron, phosphate, tin, and salt would improve the country's economic outlook.

[1]Where necessary, values have been converted from Ugandan shillings to U.S. dollars at USH1,175.00=US$1.00 in 1991.

TABLE 1

UGANDA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]	1987	1988	1989	1990	1991
Cement, hydraulic	15,908	14,244	13,755	r26,920	e50,000
Lime, hydrated and quick[e]	500	500	500	r1,500	2,000
Phosphate minerals: Apatite[e]	100	100	100	100	100
Salt, evaporated[e]	5,000	5,000	5,000	5,000	5,000
Tin, mine output, Sn content[e]	10	10	10	r25	25
Tungsten, mine output, W content[e]	4	4	4	4	4

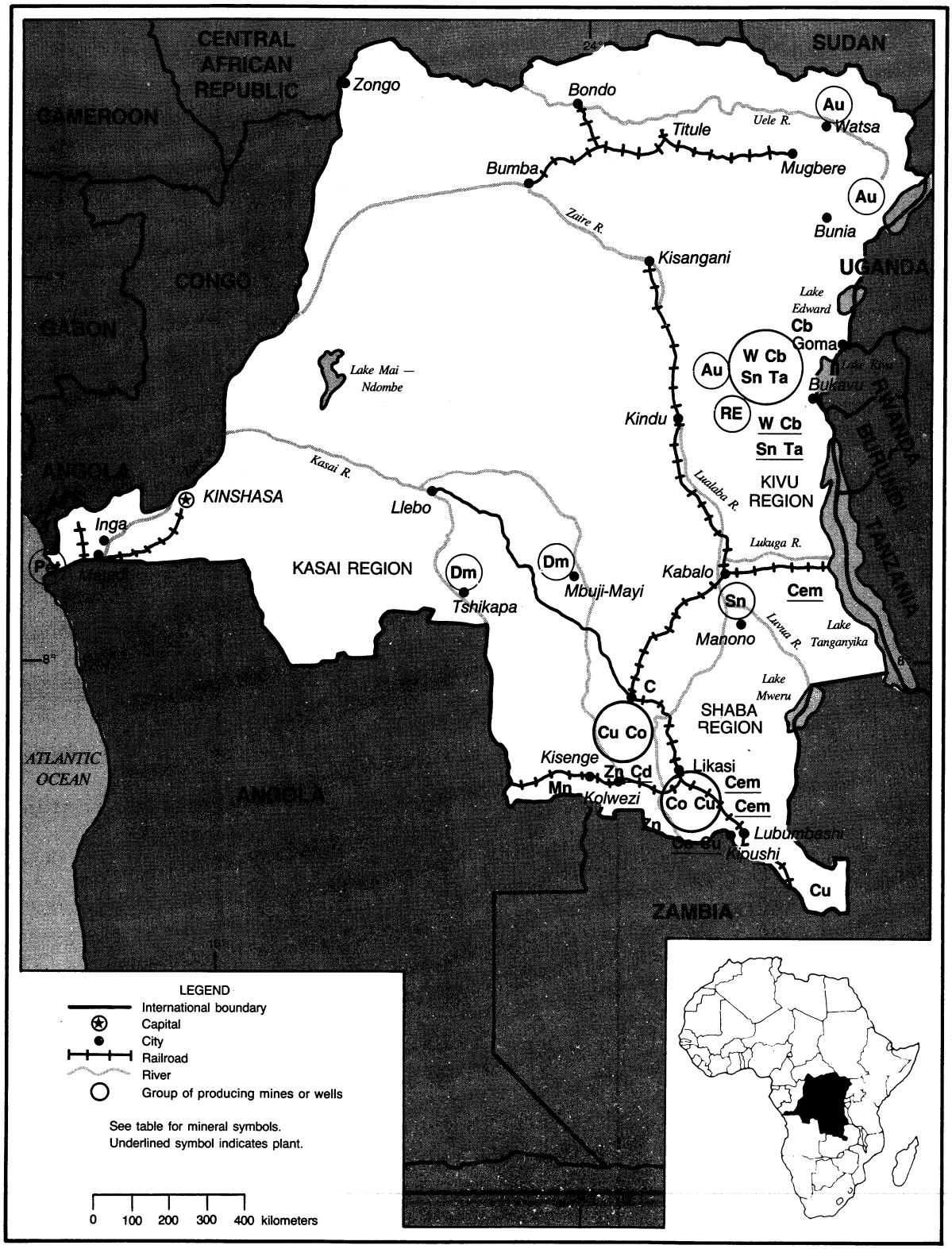
[e]Estimated. [r]Revised.

[1]Includes data available through Aug. 31, 1992.

[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.

ZAIRE

AREA 2,345,410 km² **POPULATION 37.8 million**



THE MINERAL INDUSTRY OF

ZAÏRE

By Michael M. Heydari

The overall decline of Zaïre's mining industry continued at a rapid pace in 1991 as production of copper and cobalt, the two major foreign currency earners, decreased again. Finished copper production declined 35% to 222,097 tons, while cobalt metal output fell 14% to 8,620 tons. Decreased cobalt recovery from stockpiled intermediate-grade cobalt hydroxide did not make up the shortfall in output. Other byproducts such as cadmium, silver, and zinc declined. Historically, the mining industry had accounted for 25% of the GDP and about three-quarters of total export revenues. However, in 1991, La Générale des Carrières et des Mines (Gécamines), the parastatal mining company responsible for most mineral production, suspended payments to the Bank of Zaïre. This eliminated the source of about 25% of total Government revenues and caused a critical shortage of foreign exchange in the country.

The poor output performance of the mining industry, which is dominated by Gécamines, was due primarily to a lack of investment funds, aging equipment, insufficient equipment maintenance, fuel shortages, and poor management. Partly as a result of continued difficulties with Gécamines' Kamoto copper mine, which suffered a major cave-in in September 1990, Gécamines' copper production dropped to one-half of its 1989 level and hit a 10-year low in 1991. Zaïre's export of refined copper dropped as a result of both the lower mine production and railway disruptions due to lateness of payments to Zambian railway companies. The drop in export revenues further aggravated the company's already weak cash-flow situation and negatively affected the Zairian economy.

In September 1991, soldiers who had not been paid for several months engaged in widespread rioting and looting, prompting the evacuation of expatriate workers. Damage to plants in Kinshasa was severe. The riots were followed by general strikes called by trade unions in October. However, the mining infrastructure in the Shaba region did not suffer significant damage during these events.

GOVERNMENT POLICIES AND PROGRAMS

Despite a drop in foreign assistance and in receipts from vital exports such as copper and coffee, Government spending accelerated during 1991. This resulted in four-digit inflation that pushed prices to record levels as wages failed to keep pace and troops were not paid. In September 1991, army troops mutinied over pay and led crowds in 2 days of looting that destroyed many of the Kinshasa's businesses and left scores dead. The violence quickly spread to other regions of Zaïre. A coalition government was formed after 5 days of rioting and looting. A National Conference was also formed to negotiate and draw up terms of a new Constitution and transition to democracy.

In response to pressure from international donors and private banks to privatize state-owned industries, the Government announced major reform measures aimed at stabilizing the economy. It was not clear whether these measures would be implemented in an appropriate and timely manner to prevent further deterioration of the minerals and related sectors.

Gécamines' $700 million investment plan for 1987-91 had the emphasis on improving productivity, rehabilitating plant and machinery, and raising copper refining capacity. By the end of 1991, however, the management admitted that few of the plan targets had been met owing to donors' reluctance to commit funds to the plan.

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.

PRODUCTION

Gécamines faced multiple crises in production, transportation, and finance in 1991. Production from the Kolwezi area was about one-third of its 1989 level, largely because of the Kamoto mine cave-in. The resulting shortfall in production idled facilities throughout the enterprise. Efforts to make up for lost underground mine production with that from open pits were severely hampered by parts and fuel shortages owing to a lack of cash or credit.

In a change from previous policy where production of cobalt was seen as a secondary activity compared to copper production, Gécamines decided to increase emphasis on receipts from cobalt, with the goal of earning equivalent profit from cobalt and copper.

To increase production of copper, cobalt, and sulfuric acid, Gécamines planned four projects. The first of these was the rehabilitation of the Kamoto

Mine, including bringing in service the No. 3 crusher. The second was to improve the stripping ratio in the open pit Kolwezi Mine. The mixed ores from this project will feed the Kamoto concentrator, which is presently underutilized. The third project was the introduction of an in-pit crusher at the KOV Mine and a conveyor belt to transport ore. The KOV Mine will continue to be the main source of cobalt for the granules and cathodes produced in the Shituru plant in Likasi. The fourth project was the opening of a new shaft in the Kipushi Mine. This project will increase the level of zinc production and therefore the production of sulfuric acid needed for the treatment of concentrates in the hydrometallurgical works. *(See table 1.)*

TRADE

Exports of mineral commodities dropped by about 15% from the 1990 level of $1.7 billion. The main mineral commodities exported were as follows: copper, $612 million; cobalt, $322 million; diamond, about $240 million; crude petroleum, about $170 million; gold about $40 million; and zinc, $33 million. The bulk of the decline in total mineral exports was owing to a fall in copper production and exports. In contrast, cobalt export revenues increased due to the rise in the contract price of cobalt from $11/lb to $25/lb.

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 were $302 million—about 5% less than those in 1990—consisting mainly of crude petroleum, diamond, cobalt, copper, and zinc. During the first half of 1991, Zaïre's crude petroleum exports to the United States amounted to about $108 million, substantially higher than the corresponding figure of $56 million for 1990. U.S. exports to Zaïre were $62 million in 1991—less than one-half the value in 1990—and consisted mainly of wheat, used clothing, spare parts, and mining and transport equipment.

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. *(See table 2.)*

COMMODITY REVIEW

Metals

Cobalt.—Zaïre's total cobalt production dropped 14% from its 1990 level to 8,620 tons. The rate of decline was far below that of copper, about 33%, owing to the utilization of about 5,500 tons contained cobalt of previously stockpiled cobalt hydrates as additional feed to the refineries. For many years Gécamines has been precipitating excess cobalt as hydrate from its hydrometallurgical plants' cobalt leach circuits and stockpiling this material for later use. At the current rate of drawdown of cobalt hydrates, it is estimated that there are sufficient stockpiles outside of the Luilu plant to sustain the current cobalt production level through 1993. There are additional stockpiles of cobalt hydrate and matte at Shinkolobwe, about 20 km west of Likasi. The Shinkolobwe Mine supplied uranium for the Manhattan project in the early 1940's, and earlier for radium for Madame Curie. Stockpiles at Shinkolobwe are being assessed for grade, quantity, and recoverability. Gécamines has undertaken a technical and economic study of the solvent extraction technique to treat its existing and future tailings.

In December 1991, Gécamines and Zambia Consolidated Copper Mines (ZCCM) revised their joint cobalt producer price upward to $25 per pound for the first one-half of 1992, while the free market price increased to more than $30 per pound. They had originally set the price at $13 per pound, from $11 per pound, in October 1991, when free market prices were about $19 per pound. The cobalt was mostly trucked to South African ports for export to European, Japanese, and North American destinations. Several incidents of theft of cobalt, at the mines and shipment points, were reported during the year.

As a result of higher cobalt prices, Gécamines placed more emphasis on cobalt as a primary foreign currency earner and restarted production of white alloy and cobalt-nickel matte. The white alloy contains 40% cobalt, 40% iron, and 10% copper. The doubling of cobalt prices also allowed Belgium to release about one-half of the Zairian cobalt stockpiles kept in Belgium as collateral against the country's debts.

Columbium-Tantalum.—Société Minière et Industrielle du Kivu (Sominki) continued to produce about 57 mt/a of columbite and tantalite concentrate. Société Minière du Kivu (Somikivu)—a joint venture of Gesellschaft für Electrometallurgie, Gmbh of Germany (70%); the Government of Zaïre (20%); and Sominki (10%)—operated the Lueshe Mine, 70 km north of Goma. The deposit is a carbonatite with pyrochlore mineralization. Average ore grade in 1991 was 2.90% Cb_2O_5, and about 1,000 tons of pyrochlore concentrate containing 69% to 73% Cb_2O_5 was produced. The concentrate was trucked to Mombassa in Kenya and then shipped to Hamburg, Germany, and thence to the Gesellschaft fur Elektrometallurgie, Gmbh plant in Nurnberg, Germany. Somikivu estimated that increasing the concentrator's production capacity from 1,000 mt/a to 1,300 mt/a would cost about $400,000. However, construction of a new plant with a capacity of 5,000 mt/a would require an investment of about $100 million.

Copper.—In May 1991, Gécamines, the country's main copper producer, declared force majeure on 45% of all its outstanding copper commitments or roughly 100,000 tons. Gécamines' decision was prompted as a result of a

series of strikes at Gécamines and Zaïre's railway network and delays in restoration of production at the Kamoto Mine.

Rehabilitation of Gécamines' underground Kamoto Mine progressed slowly. Mine production, which averaged about 300,000 mt/month of ore grading 4.3% copper and 0.3% cobalt in the first half of 1990, dropped to a 60,000-mt/month level in 1991. An independent investigation commissioned by the EC determined that a host of factors, including earth movements, faulty mine design, failure to backfill mined areas, and the pressure to meet production goals at any cost, were responsible for the accident. In 1991, copper and cobalt output (content in ore) from the Kamoto Mine dropped to 2,300 mt/month and 120 mt/month, respectively, down from the preaccident levels of 13,000 mt/month and 900 mt/month, respectively. By early 1992, Gécamines determined that the caved area would have to be abandoned.

To make up for loss of copper and cobalt from the Kamoto Mine, Gécamines decided to step up plans for development of the copper-cobalt deposits at Tenké Fungurumé. Some aspect of privatization was being considered for their development. These deposits form part of the copper belt that stretches from Lubumbashi to Kolwezi in Zaïre. They were evaluated in the early 1970's by Charter Consolidated of the United Kingdom, but in 1975-76, initial plans to produce 130,000 mt/a of copper and 6,500 mt/a of cobalt were dropped. Reserves, according to Gécamines, consist of about 10 Mmt of contained copper.

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, which is mostly smuggled across the eastern and northeastern borders. Zaïre's formal gold output continued its downward trend, largely due to obsolete equipment and lack of new development work at the mines. Sominki gold production was primarily from two operations, the Mobale underground mine at Kamituga, 100 km southwest of Bukavu, and the Lugushwa alluvial operation. Gécamines' gold production, as a byproduct of copper, was about 16 kg in 1990, down from 30-kg levels in previous years, reflecting the substantially lower copper production.

The plan to develop the new Kimin gold mine within the Kivu concession of the state-owned Okimo was further delayed due to civil unrest. Okimo is a 51% shareholder in the project. Other shareholders are Compagnie Française des Mines (France), in association with Mining International Development (France and Belgium) and the Republic of South Africa's Rand Mines Ltd. (32%); the Orgaman Group (10%); and the IFC (7%). Feasibility studies had indicated that with an initial investment of $162 million, Kimin could produce about 500 kg of gold in the first year, increasing to about 2,000 kg the following year, and leveling off at about 8,000 kg/a the fifth year.

Zinc.—Electrolytic zinc metal production fell from 54,043 tons in 1989 to 38,206 tons in 1990 to 28,321 tons in 1991. Zinc output was a byproduct of Gécamines' Kipushi Mine west of Lubumbashi. The Kipushi Mine's production dropped to about 2,500 mt/d of ore grading about 2% Cu and 10% Zn. As a result of mining deeper horizons, the copper grade has fallen from 4% to 2%, whereas the zinc grade has increased from 7% to 10%. The ore also has about 600 g/mt of germanium concentrate. The zinc-bearing ore undergoes initial concentration on-site and is then sent to Likasi for roasting and recovery of sulfur, and then on to Kolwezi for final processing. Mining, transport, and fuel problems considerably hinder zinc production, resulting in an overall recovery of only 25% for Zn.

Gécamines is considering final processing of zinc on-site at the Kipushi Mine. This would eliminate transport bottlenecks created by difficult road conditions and an inefficient railroad system, resulting in higher zinc production and recovery. It is not clear whether funding can be arranged for this project.

Industrial Minerals

The Société Minière de Bakwanga (MIBA), 80% owned by the Zairian Government, remained the major diamond producer in Zaïre. It sells its output to a subsidiary of the De Beers Consolidated Mines group under contract. The company's 1991 production dropped to less than 7.5 million carats from an 11-year high of 9.6 million carats in 1990. The overall grade of the deposits mined was about 5 carats/m^3.

The balance of output is by artisanal workers who have historically accounted for the largest portion of diamond production in Zaïre. Output by artisanal workers is purchased by buyers/counters known as "comptoirs." Among these is a subsidiary of De Beers and other companies owned by various interests. Production in 1991 by artisanal workers, scattered throughout the diamond regions of Tshikapa and Mbuji Mayi, was estimated at more than 10 million carats. The ratio of gem to industrial diamond recovered by artisanal workers is higher than that for MIBA, but their level of recovery is lower.

Total official country diamond exports amounted to 17.8 million carats, down from 19.4 million carats in 1990. Smuggling became endemic during the unrest of September-October, followed by a sharp rise in the availability of Zairian diamonds on the Antwerp market. It was estimated that diamonds and gold worth $400 million were smuggled out of Zaïre annually.

Mineral Fuels

Production at the Petrofina SA-operated onshore petroleum concession stopped on October 25, 1991, when rioters ransacked the company's headquarters and supply base. Rioters mainly looted equipment, leaving the buildings intact and all of Petrofina's field infrastructure unharmed. In 1991, Petrofina's onshore fields produced a total of 2.839 Mbbl of oil, an average of 9,543 bbl/d up to October 25.

Offshore production, operated by Chevron Overseas Petrol Inc., was not interrupted by the October 1991 troubles although a drilling program underway at the time was halted.

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 result in reduced levels of exploitation. In its 1977 Annual Report, the Zairian Department of Mines and Energy reported reserves as of December 31, 1977, for a number of major operating companies. Reserve data for recent years are imcomplete. *(See table 3.)*

INFRASTRUCTURE

Zaïre is a landlocked country except for a small coastal area on the Atlantic Ocean where the Port of Matadi is located. Matadi has a capacity of about 2 Mmt/a. Zaïre has a combination of railroad, road, and riverboat transport to move equipment, food, and other supplies into the mining and mineral processing regions and to move ores, concentrates, and finished mineral products, both within the country and for export. Much of this transport network is in varying degrees of disrepair or requires upgrading. 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 and electrification are Government-owned; small, private trucking and riverboat companies provide limited local service. Mineral products are normally shipped on the Voie Nationale, the only transport route entirely within Zaïre, as well as other routes to Dar es Salaam in Tanzania and to ports in the Republic of South Africa. Trains head northwest on the Voie Nationale and carry the products as far as Ilebo, where they are off-loaded for transport on the Kasai River, a tributary of the Zaïre River, to Kinshasa. At Kinshasa, cargo is reloaded to railcars and shipped to Matadi for transfer to oceangoing vessels. However, the river is insufficiently dredged, and the railway is chronically short of rolling stock. It takes 45 days to get copper seaborne by rail transport, either via Zambia and Zimbabwe or eastward along the Tazara railway, operated by both Zambia and Tanzania.

Owing to rail and river transport problems, most cobalt and copper wirebar products are currently shipped by truck to the Port of Durban in the Republic of South Africa. In the case of cobalt, convoys of 10 to 12 trucks leave Likasi once a week and arrive at Durban after 7 to 10 days. There is usually a waiting period of 8 to 10 days for vessel connection at the port.

An increasing portion of the electricity consumed in the Shaba region, site of most of the country's mining activity, is via the 1,800-km Inga-Shaba electric line. Gécamines is also dependent upon imported coke and petroleum refinery products for its mine and metallurgical operations.

OUTLOOK

The short-term economic prospects for Zaïre are poor. The inability to meet goals for improvement of internal transport, mining, and processing of copper and cobalt ore has led to a continued decline in output of the country's most important company, Gécamines. Because of its size and wealth of resources, Zaïre's long-term potential is more promising and the country should remain an important supplier of copper, cobalt, and diamond for years to come. Zaïre's prospects depend on its ability to achieve political stability, mobilize its resources, control Government spending, and renew multilateral and bilateral aid programs. Much of Zaïre's future copper output will depend on the availability of financing.

Demand for U.S. mining and materials handling equipment is expected to remain strong. The state mining company, Gécamines, has 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. However, any major projects will likely have to await a new structural adjustment program and the payment of a substantial portion of Zaïre's existing debt arrears.

OTHER SOURCES OF INFORMATION

Agency

Département de l'Economie Nationale
et de l'Industrie
Kinshasa, Zaïre

Publications

République du Zaïre: Conjoncture Economique, Dec. 1989.

Zaïre: Minerals Perspective, Sept. 1985, U.S. Bureau of Mines, Washington, DC.

Foreign Economic Trends and Their Implications for the United States, Zaïre, June 1992, Dep. of Commerce, Washington, DC.

TABLE 1

ZAÏRE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991
METALS						
Cadmium, smelter		299	281	224	127	65
Cobalt:						
Mine output:						
Ore milled:						
Gross weight	thousand tons	13,701	13,833	13,324	11,898	8,415
Co content		42,700	46,800	37,700	39,500	20,900
Concentrate produced:						
Gross weight	thousand tons	1,456	1,613	1,464	1,290	902
Co content		r23,200	r26,000	r18,400	r19,000	9,900
Refinery input, Co content:						
Concentrate*		23,200	26,000	18,400	19,000	9,900
Hydrates		1,042	—	—	3,194	5,483
Scrap		33	31	27	49	517
Total* [2]		24,275	26,031	18,427	22,243	15,900
Metal, Co content:[3]						
Luilu cathodes		5,634	4,914	4,814	3,474	2,989
Shituru refinery:						
Cathodes		2,506	1,912	3,492	3,117	2,439
Granules[4]		3,731	3,200	1,005	3,356	2,686
White alloy, matte		—	—	—	34	506
Total[2]		11,871	10,026	9,311	r9,981	8,620
Columbium-tantalum:						
Columbite-tantalite concentrate:						
Gross weight		*50	34	48	36	57
Cb content*		13	9	12	9	15
Ta content*		14	10	13	10	16
Pyrochlore concentrate:						
Gross weight		—	287	711	900	*1,000
Cb content*		—	130	320	400	450
Copper:						
Mine output by company:						
Ore mined:						
Gross weight:						
Gécamines	thousand tons	13,023	14,187	11,510	12,115	7,936
Sodimiza	do.	993	1,176	946	769	684
Total[2]		14,015	15,363	12,456	12,885	8,620
Cu content:						
Gécamines	thousand tons	517	653	504	489	292
Sodimiza	do.	31	32	20	21	18
Total[2]		549	686	524	509	310
Concentrate:						
Gross weight:						
Gécamines	thousand tons	1,610	1,765	1,591	1,403	992
Sodimiza	do.	56	60	40	38	32
Total[2]		1,666	1,825	1,630	1,441	1,024

See footnotes at end of table.

TABLE 1—Continued

ZAÏRE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991
METALS—Continued						
Copper—Continued:						
Mine output by company—Continued:						
Concentrate—Continued:						
Cu content:						
Gécamines	thousand tons	477	506	455	396	252
Sodimiza	do.	28	29	18	17	14
Total[2]		506	535	472	413	266
Metal:						
Intermediate products:						
Electrowon cathode		305,300	307,100	280,800	229,100	e180,000
Smelter:						
Black copper		13,800	12,000	15,000	9,500	e5,000
Blister		168,296	147,665	153,380	117,174	52,536
Total		487,396	466,765	449,180	355,774	e237,536
Finished products:[3]						
Blister		168,296	147,665	153,380	117,174	52,536
Electrowon cathode[5]		94,998	87,970	87,242	80,566	65,569
Refined, wirebar		r210,379	r202,784	r181,570	r140,868	103,992
Total		473,673	438,419	422,192	338,608	222,097
Gold[e]		r12,000	r12,500	r10,600	r9,300	8,800
Silver[e]	kilograms	r6 36,767	r6 74,000	r70,000	r84,000	80,000
Thorium:						
Monazite concentrate, gross weight		97	168	175	124	e120
Tin:						
Mine output, Sn content		2,378	r2,771	2,346	2,221	1,635
Smelter, primary[e]		r6 90	r r6 118	100	90	70
Tungsten, mine output, W content		21	20	16	r17	e15
Zinc:						
Mine output:						
Ore milled:						
Gross weight	thousand tons	1,315	1,386	1,297	1,340	1,042
Metal content		r133,000	r141,500	r127,700	r114,700	81,400
Concentrate:						
Gross weight		158,100	176,000	156,400	144,600	99,300
Metal content		74,700	75,700	72,800	r61,800	42,400
Metal, primary, electrolytic		r54,880	r61,091	r54,043	r38,206	28,321
INDUSTRIAL MINERALS						
Cement, hydraulic		491,600	495,000	e460,000	460,581	e250,000
Diamond:						
Gem	thousand carats	3,885	2,724	2,663	2,914	e3,000
Industrial	do.	15,540	15,439	15,092	16,513	e14,814
Total[2]	do.	19,425	18,163	17,755	19,427	17,814
Lime		r98,490	100,300	r100,208	r92,011	82,933
Stone, crushed[e]		r r6 418,077	r r6 457,946	475,000	450,000	360,000

See footnotes at end of table.

TABLE 1—Continued

ZAÏRE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991
INDUSTRIAL MINERALS—Continued						
Sulfur:						
Byproduct of metallurgy, S content of sulfuric acid from sphalerite[e]		34,500	r32,000	r29,000	r23,500	16,000
Sulfuric acid, gross weight:						
From sphalerite		103,821	96,994	87,478	70,736	48,596
From imported sulfur		40,475	59,550	60,932	61,445	50,545
Total		r144,296	r156,544	r148,410	r132,181	99,141
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous[e]	thousand tons	6122	6112	r130	r100	60
Petroleum:						
Crude	thousand 42-gallon barrels	11,418	10,728	10,119	10,597	9,955
Refinery products:						
Liquefied petroleum gas	do.	6	6	5	4	4
Gasoline	do.	336	399	578	687	375
Kerosene and jet fuel	do.	256	508	613	756	468
Distillate fuel oil	do.	520	833	1,027	1,541	714
Residual fuel oil	do.	339	398	867	1,182	383
Refinery fuel and losses	do.	r118	r105	r222	150	111
Total[2]	do.	r1,575	r2,249	r3,312	r4,320	2,055

[e]Estimated. [r]Revised.

[1]Table includes data available through Aug. 23, 1992.

[2]Data may not add up to total shown because of independent rounding.

[3]Products shown are primarily salable products.

[4]Granules are produced from cathode produced primarily at Shituru and are not double counted.

[5]The portion of electrowon cathode that is exportable for further processing and may include high-purity cathode.

[6]Reported figure.

TABLE 2

ZAÏRE: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners (ownership)	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 Elektrometallurgie, 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%; Société d'Entreprise et d'Investissements S.A., 20%)	Mbuji Mayi	9.2.
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	e3,000.
Do.	Office des Mines d'Or de Kilomoto (Okimo) (Government, 100%)	Eastern Zaïre	e3,000.
Do.	Artisanal miners (Private, 100%)	Eastern and northeastern Zaïre	e3,000.
Tin	Société Minière et Industrielle de Kivu (Sominki) (Lencourt Ltd., 71.7%; Government, 28.3%)	Kalima, Kindu	3,000 Sn in concentrate.
Zinc	Générale des Carrières et des Mines du Zaïre (Government, 100%)	Kipushi	85,000 Zn in concentrate.
Do.	do.	Kolwezi	75,000 refined Zn.

eEstimated.

TABLE 3

ZAÏRE: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1991

(Thousand tons unless otherwise specified)

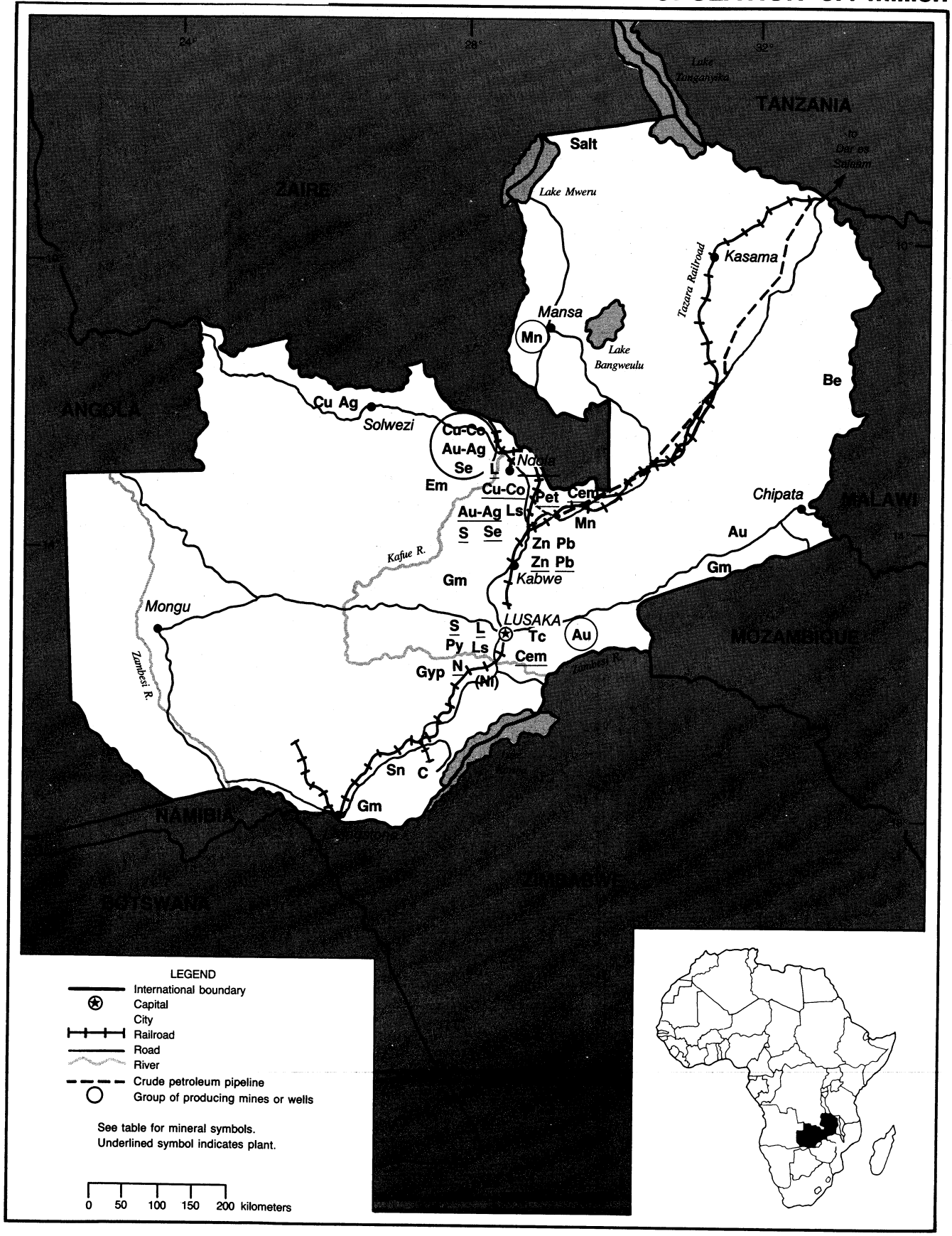
Commodity	Reserve
Cobalt	2,949
Copper	45,671
Gold kilograms	85,986
Manganese, manganese dioxide	[1]3,000
Tin, cassiterite	[2]654

[1]Reserves of carbonate ore were reported to be several million tons.
[2]Includes 200,000 tons in Gécamines concession and 300,000 tons in Société Zairetain's concession.

Source: 1977 Annual Report of the Department of Mines and Energy; 1983 Annual Report of the Société Minière et Industrielle du Kivu; and 1985 Mineral Perspectives, Zaïre, U.S. Bureau of Mines.

ZAMBIA

AREA 752,610 km² **POPULATION 8.4 million**



THE MINERAL INDUSTRY OF

ZAMBIA

By Lloyd E. Antonides

Copper production continued to be the foundation of Zambia's economy in 1991. The country was the world's fourth largest producer of copper and second largest producer of cobalt, its associated product. Copper and other mineral commodity production contributed less than 15% to the GDP and employed about 15% of the work force, earned more than 85% of foreign exchange, and was the source of about 30% of Government revenue. In comparison, agriculture and manufacturing accounted for about 20% and 25%, respectively, of GDP. The potential for growth of the industry was indicated by the many mineral deposits that were known to occur but as yet were inadequately explored and defined.

A multiparty political system began to grow in 1990, and elections held in October 1991 resulted in a complete change in Government. Many officials in the Government and in many parastatal companies were replaced, including the head of Zambia Consolidated Copper Mines Ltd. (ZCCM), the major parastatal. A free market economy was being developed. The Government took major steps to liberalize the economy as part of an economic restructuring program monitored by the IMF. It was considered one of the most rigorous structural adjustment plans the IMF ever tried. Price controls were removed except for a phaseout on maize and liberalization of agricultural producer prices. Most imports were freely obtainable.

The system of exchange rates and distribution of foreign exchange was being revised or abandoned. The Government announced its intention to sell 49% of its share in all parastatals and was studying outright sale of some. In addition, the investment and mining codes were being revised to attract foreign investment. Heavy foreign debt was a formidable obstacle for the economy.

Production of copper continued to follow the generally declining trend of the prior several years. Lead and zinc output in particular declined about 30%. Gemstones production was irregular even though steps were taken to liberalize all controls and end the illegal, unrecorded operations. *(See table 1).*

Copper, cobalt, lead, and zinc were usually considered the major mineral exports. However, smuggled gemstones were reported to be very significant. Japan was the leading destination for official exports in recent years. Crude oil was by far the major import. The Republic of South Africa and the countries of the Middle East were the pricipal sources of imports. Some oil supply difficulties were experienced during the year. The United States was not a significant trading partner.

The Government dominated the industry. The state-owned Zambia Industrial and Mining Corp. Ltd. (ZIMCO) held a majority interest in all major commercial and industrial ventures. ZCCM was the principal entity in the minerals field. Officials of the new Government continued to state that the privatization program extends to all parastatals. New investment and mining acts were expected to result in formation of new private companies.

Copper ore reserves of ZCCM were ample for at least 15 years of continued full-scale operation according to ZCCM officials. Additional known resources of ZCCM were huge, and there were other known copper deposits as well. Cobalt reserves associated with copper ore were substantial. Gold ore resources were being studied by several groups and appeared to be rather extensive. Lead-zinc reserves at existing operations were limited, but additional resources were known. Nickel resources were being defined by a private company, Appolo Mining (Pty.) Ltd. A large variety of other metallic mineral deposits was also known but needed further exploration. Most work has been done on iron, molybdenum, and tin.

Industrial mineral resources that were being studied or exploited included: fluorspar, gemstones, limestone for cement and lime, marble, and talc. Phosphate resources were considered to have some potential. Mineral fuel resources were reported as 250 Mmt of bituminous coal.

A fairly extensive road and railway network existed within the country and externally for access to ocean and lake ports for international trade. The major routes were northeast to Dar es Salaam, Tanzania, and south to South African ports. External political unrest sometimes limited use of links southeast to Beira, Mozambique, and prevented use of links to the west to Lobito, Angola. Also, the railroad system had rolling stock shortages, and lack of maintenance on internal routes was of concern. However, 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. International and domestic air transport is generally considered excellent.

Electric power supply was adequate, furnishing about 70% from hydroelectric, 20% from oil, and 10% from coal plants. Expansion of hydro sources was planned. Telecommunications were also considered very good both internally and externally.

For the near term economic difficulties were expected to continue. But the longer term looked bright given the new open political environment and market oriented Government, together with reasonable personnel and financial assistance from international and bilateral sources. Agricultural and mineral resources should remain the basis for a balanced economy. With political stability and the new investment and mining policies, the international mining community could be expected to recognize the opportunities.

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[1]Where necessary, values have been converted from Zambia kwachas (K) to U.S. dollars at the rate of K61.73=US$1.00 for 1991 and K28.99=US$1.00 for 1990. These were the official year averages quoted by the Bank of Zambia, which also quoted yearend rates for 1991 at K89.29=US$1.00 and 1990 at K42.74, and end of June 1992 at K161.29.

OTHER SOURCES OF INFORMATION

Agencies

Ministry of Mines
P.O. Box 31969
Lusaka, Zambia
Telephone: 227-653

Mines Development Department
P.O. Box 31969
Lusaka, Zambia
Telephone: 227-653

Geological Survey Department
P.O. Box 50135
Lusaka, Zambia
Telephone: 250-174

Publications

Survey of Development Potential of Mineral Industry in SADCC, September 1989, by R. Marjonen and J. Huhta, UN Revolving Fund for Natural Resources Exploration No. 1, UN Plaza, New York, NY 10017.

TABLE 1

ZAMBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991[p]
METALS						
Beryllium: Beryl	kilograms	1,131	1,343	880	r,e850	863
Cobalt:[3]						
Mine output:						
Ore milled:[4]						
Gross weight	thousand tons	7,015	6,634	6,596	6,505	6,138
Co content		11,198	10,687	10,590	10,870	10,751
Concentrate:						
Gross weight		295,285	268,662	274,989	258,698	243,504
Co content		7,365	7,090	7,255	7,086	6,991
Metal:						
Materials treated:						
Gross weight		286,024	313,897	299,811	261,608	282,927
Co content		7,261	7,519	7,075	6,666	7,104
Refined electrolytic cathode		4,694	4,871	4,447	4,674	4,741
Copper:[3]						
Mine output:[5]						
Ore milled:						
Gross weight	thousand tons	24,419	24,040	23,640	22,952	21,559
Cu content		507,446	540,701	538,115	519,400	479,511
Concentrate:						
Gross weight		1,642,907	1,507,632	1,487,749	1,343,642	1,101772
Cu content		403,450	394,122	419,080	400,221	345,519
Metal:						
Electrowon:						
From tailings leachate[6]		98,306	97,690	78,716	67,774	70,614
From copper concentrate leachate		18,940	20,041	16,857	12,418	11,108
From cobalt concentrate leachate		27,228	29,986	25,233	24,379	28,214
Total electrowon		144,474	147,717	120,806	104,571	109,936
Smelter output, blister/anode[7]		347,909	308,928	345,486	r331,739	300,329
Refined:						
Electrorefined[8]		347,342	311,983	342,735	334,878	314,126
Shapes[9]		79,281	85,728	75,383	50,546	42,938
Subtotal		426,623	397,711	418,118	385,424	357,064
Electrowon[10]		69,638	51,848	45,444	52,660	45,390
Total refined grade		496,261	449,559	463,562	438,084	402,454
Gold[3 11]	kilograms	356	227	129	129	136
Iron ore: Magnetite (e65% to 70% Fe), gross weight		910	445	318	576	400
Lead:[3]						
Mine output, Pb content of ore milled		12,510	12,118	8,807	9,638	9,084
Metal, refined, gross weight[12]		7,554	6,345	3,653	3,670	2,637
Manganese concentrate (e48% Mn), gross weight		—	502	351	712	662
Selenium: metal, refined, gross weight[3 13]	kilograms	26,819	24,083	20,861	21,692	21,858

See footnotes at end of table.

TABLE 1—Continued

ZAMBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991[p]
METALS—Continued						
Silver[3 11]	kilograms	27,843	24,093	19,719	17,031	13,657
Tin concentrate:						
Gross weight (65% to 72% Sn)		24	2	2	2	9
Sn content		17	1	1	1	6
Zinc:[3]						
Mine output, Zn content of ore milled		30,287	25,169	22,853	32,074	19,825
Metal, refined, gross weight		20,899	18,343	12,351	9,717	6,339
INDUSTRIAL MINERALS						
Cement, hydraulic		374,982	404,600	385,937	e375,000	366,914
Clay:						
Brick[14]		6,606	e5,000	5,126	3,732	2,817
Building, not further specified[e]		[15]3,096	2,000	2,000	2,000	2,000
China and ball		r375	367	e350	r e250	120
Feldspar		45	120	20	60	718
Gemstones:						
Amethyst	kilograms	3,757	4,701	6,275	18,130	168,220
Aquamarine	do.	63	56	89	166	65
Emerald	do.	992	1,039	334	619	265
Gypsum[e 16]		15,000	15,000	15,000	15,000	15,000
Lime, hydrated and quick	thousand tons	235	239	320	r e250	184
Limestone for cement and lime manufacture[e 17]	do.	790	840	920	810	720
Nitrogen: N content of ammonia		33,330	16,200	r11,700	3,900	4,700
Sand and gravel, construction	thousand tons	150	200	226	e1,000	e1,000
Stone, construction:						
Limestone, crushed aggregate	do.	720	999	775	772	739
Phyllite	do.	22	25	22	23	15
Other	do.	130	1,536	933	e50	e100
Sulfur:[3]						
Pyrite concentrate:						
Gross weight (e42% S)		56,122	74,952	70,828	72,060	73,483
S content[e]		23,600	31,500	29,700	r [15]30,200	30,600
In sulfuric acid:[e 18]						
From pyrite roaster gas, S content		23,000	31,000	29,000	30,000	30,000
From smelter gas, S content		r87,000	r78,000	73,000	70,000	70,000
Total, S content		109,000	106,000	102,000	100,000	100,000
Talc		258	73	114	160	89
MINERAL RELATED FUELS AND RELATED MATERIALS						
Coal, bituminous	thousand tons	463	524	395	382	345
Petroleum, refinery products:[3]						
Liquefied petroleum gas	thousand 42-gallon barrels	77	84	43	e40	e40
Motor gasoline	do.	972	1,149	1,237	e1,230	e1,230
Jet fuel	do.	416	520	e540	e530	e530
Kerosene	do.	253	318	e323	e320	e320

See footnotes at end of table.

TABLE 1—Continued

ZAMBIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		1987	1988	1989	1990	1991[p]
MINERAL FUEL AND RELATED MATERIALS—Continued						
Distillate fuel oil	thousand 42-gallon barrels	2,041	2,149	2,071	e2,070	e2,070
Residual fuel oil	do.	615	564	623	e620	e620
Other	do.	407	466	431	e430	e430
Total, including refinery fuel and losses	do.	4,781	5,250	5,268	e5,240	e5,240

eEstimated. pPreliminary. rRevised.

[1]Table includes data available through Oct. 1, 1992.

[2]In addition to commodities listed, fluorspar production was reported in 1989 (99 metric tons) and 1990 (35 metric tons); also some additional crude construction materials (clays, sand and gravel, stone, et al.) presumably were produced by artisanal operations; and clay and/or shale is normally produced for cement manufacture; but available information is inadequate to reliably estimate output.

[3]Data are for year beginning Apr. 1 of year stated.

[4]Ores from which both a copper concentrate and a cobalt concentrate or a cobalt concentrate only were produced.

[5]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.

[6]Apparently included metal recovered from ores toll processed by ZCCM for another company in 1986 (501 tons) and 1987 (106 tons).

[7]Included the following quantity of blister anodes produced on toll from Zairean and, in 1991, South African concentrates, in metric tons: 1987—29,205; 1988—24,812; 1989—15,303; 1990—16,182; 1991—19,678.

[8]Included the following quantity of electrolytic cathodes (presumably refined grade) produced on toll from blister smelted from Zairean concentrates, in metric tons: 1986—26,111; 1987—28,099; 1988—28,886; 1989—15,094; 1990—16,494; 1991—15,691 (1991 figure includes toll production from concentrates originating at a none-ZCCM mine and in South Africa, as well as Zaire).

[9]Reported as "finished production, refined shapes" (wirebar and billets), presumably 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]Reported as "finished production, leach cathodes" which apparently were a portion of the total electrowon cathodes that were not further refined (presumably meeting specifications for refined grade). Also included electrowon cathodes produced on toll by ZCCM for another Zambian company and not further refined in 1986 (501 tons) and 1987 (106 tons).

[11]From copper and cobalt refinery mud-slimes produced by ZCCM only.

[12]For practical purposes, outputs of crude (smelted) and refined metal were regarded as equal.

[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]Weight of finished brick.

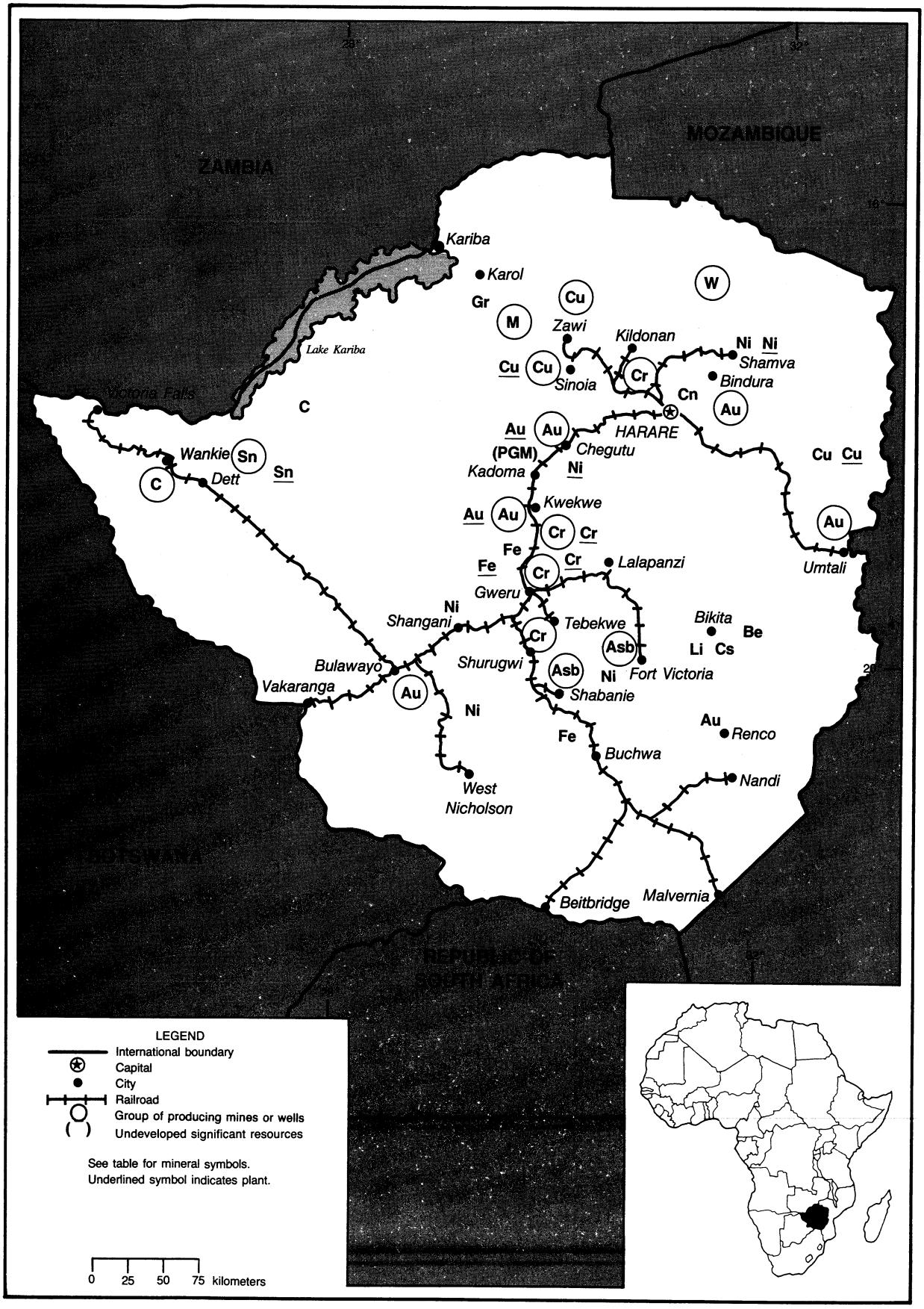
[15]Estimated for cement production only. Available information is inadequate to reliably estimate additional output for other uses (e.g., plaster).

[16]Estimated for cement and lime manufacture only. Also see below for "Stone, construction: Limestone, crushed aggregate."

[17]Some acid may also have been produced by burning imported sulfur, starting in 1987, but available information is inadequate to reliably estimate output or determine if it is additional to or included in smelter gas figure.

ZIMBABWE

AREA 390,580 km² **POPULATION 11.0 million**



THE MINERAL INDUSTRY OF

ZIMBABWE

By David Izon

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. The most important minerals, in order of value, were gold, asbestos, nickel, coal, copper, chromite, tin, and silver.

The mining sector contributed 7% of the GDP of $6.4 billion,[1] and 40% of total foreign exchange earnings in 1991. The mining industry was inhibited by a chronic drought that forced a 15% reduction of power supply in the country. The Minerals Marketing Corp. controlled all mineral exports, but imports of equipment were by individual companies. The value of mineral exports in 1991 was 26% higher than that in 1990. The apparent increase was primarily due to the devaluation of the Zimbabwean dollar. Mineral imports were limited mainly to petroleum products.

The Government continued to promote investment incentives first announced in 1990. This was intended to stimulate more exports, give industry more foreign exchange, and allow foreign investors to repatriate a higher percentage of their profits.

GOVERNMENT POLICIES AND PROGRAMS

The Government's policies and programs ensured continued modest growth in the mining sector. An economic reform scheme was adopted that aimed at increasing exports and foreign investment. These included trade liberalization measures that were intended to lessen some of the foreign exchange constraints on the mining industry. The Government, to secure more revenue in the face of the chronic drought, announced the legalization of gold panning under the Mining (Alluvial Gold, Public Streams) regulations of 1991. The Government also enacted the Natural Resources (Protection) Regulations of 1991, complimentary to the Mining regulations. Under the new law, all gold panners must sell their gold to the Reserve Bank of Zimbabwe. The regulations were aimed at improving safety and ensuring that all the gold won was disposed of to the Reserve Bank or its agents. It was also meant to control damage to the rivers.

The Mining (Alluvial Gold, Public Streams) regulations of 1991 prohibited the sale of gold to private individuals. The most welcomed aspect of the code was lifting of restrictions on equipment purchase and the allotment of unlimited foreign exchange to companies that exported more than 75% of their production. Also, mining industries were allowed to retain 5% of their export earnings for the purchase of imported raw materials and capital goods.

Major projects planned for implementation were the $350 million rehabilitation and expansion of Zimbabwe Iron and Steel Co. (ZISCO), the building of a new international airport in Harare, and the $1 billion Bakota Gorge hydroelectric project 50 km from Victoria Falls, on the Zambezi River. The Government, under another program, provided $400 million to purchase trucks, buses, and automobiles to address the shortage of vehicles.

PRODUCTION

The most important minerals produced were asbestos, copper, ferrochromium, gold, and nickel. Gold had the highest value, accounting for 33% of mineral export earnings. Most of the country's mineral industries were export oriented and thus were exposed to world market fluctuations. (*See table 1.*)

TRADE

The main export commodities, in order of importance, were tobacco, gold, ferroalloys, cotton, nickel, asbestos, iron and steel, coffee, sugar, and copper. Zimbabwe's leading trade partners were Germany, Japan, the Republic of South Africa, Switzerland, the United Kingdom, and neighboring African countries.

Most of the minerals produced were exported in beneficiated form, such as ferrochromium, pig iron, steel, and coke. Total mineral export earnings in 1991 were about $2.3 billion as reported by the Zimbabwe Chamber of Mines. When the rate of depreciation of the Zimbabwean dollar is considered, the earnings were almost the same as those of 1990. However, currency depreciation provided benefits to exporters in the minerals industry as they made profits. Principal mineral exports to the United States were ferrochromium and nickel. Major import commodities were machinery and transport equipment, chemicals, farm equipment, petroleum products, and computers. Principal imports from the United States were aircraft, computers, farm equipment, synthetic fibers, and packaging materials.

STRUCTURE OF THE MINERAL INDUSTRY

Mining in Zimbabwe was carried on by about 13 major companies and their subsidiaries. They were often privately owned but subsidiaries of international mining companies. The mines belonging to these companies produced 85% of the country's mineral output. The rest of the production was from about 500 small mines. These small mines were operated by small works having 10 to 200 employees. They were mostly engaged in gold mining, but a few of them produced other minerals such as tantalite, tin, tungsten, and semiprecious stones. The drought has encouraged the increase in gold panning in the country.

Most of the minerals produced in Zimbabwe were processed before being exported through the Minerals Marketing Corp. of Zimbabwe. Refractory minerals containing gold were treated at the state owned and operated roasting plant. The mining industry employed about 56,000 workers, about 5% of the national labor force. The mining industry accounted for 50% of rail tonnage, and its annual electricity consumption amounted to 33% of the total electricity consumed in the country. A large share of the locally manufactured goods and industry's output, such as chemicals, explosives, coal, and liquid fuels, were consumed by the mining industry.

Oil and gas prospecting was conducted around the Zambezi Valley by joint-venture agreements with foreign partners in equity sharing arrangements. *(See table 2.)*

COMMODITY REVIEW

Metals

Chromite.—Production of chromite decreased from 643,098 mt/a in 1990 to 563,634 mt/a in 1991. This reduced production, as with other commodities, resulted from the shortage of foreign exchange experienced by the operating companies. The companies were unable to purchase replacement equipment and spares, which affected performance. However, Zimbabwe Mining and Smelting Co. (ZIMASCO), a subsidiary of Union Carbide, operated an underground mechanization project on the North Dyke. The project was to exploit the narrow but high-quality chromite seams of the North Dyke by using mechanized methods. Union Carbide ordered a low-profile, remote-controlled continuous miner with a vacuum extraction system to start operations at the pilot plant in 1994. These investment plans were designed to earn the country more foreign exchange and make some profit for the companies. The plans also increased ZIMASCO's productivity and strengthened its share of the world high-carbon ferrochrome market. The projects were also to be complemented by new investments in housing, education, training and resource development, hospitals, and other social activities. ZIMASCO planned the installation of a second induction melting furnace and the addition of a seventh smelting furnace when the mechanized mining project is adequately developed.

Gold.—Cluff Resources' Freda-Rebecca Mine in Bindura had a decline in production, from 2,120 kg in 1990 to 1,923 kg in 1991. Shortage of foreign exchange was also the reason cited in Cluff's annual report for the decline that prevented it from replacing certain drill rigs and earthmoving equipment. There were about 1,400 small-scale miners, and alluvial gold panners number in the 100's of thousands in the country. Overall output was up in 1991 because of increase in production at these major mines: Renco Mine, Lonrho's Mazowe Mine, Cam and Motor Mine near Kadoma, and the giant tailings near Chegutu by Delta's Masasa Mines. Also, a new mine, "Elvington Mine," near Chegutu was commissioned in April 1991 by the Zimbabwe Mining Development Corp. The mine was expected to add 50 kg of gold to the country's monthly production. The Reserve Bank of Zimbabwe purchased all gold in the country.

Nickel.—Bindura Nickel Corp. (BNC) was a major producer of nickel in the country. In 1991, Bindura's four mines at Epoch, Madziwa, Shangani, and Trojan milled a total of 12,244 tons of nickel in concentrates. BNC produced 11,297 tons of nickel cathode and toll refined 947 tons from BCL Ltd. of Botswana. However, nickel production from the smelter and refinery was adversely affected by reduced concentrate feed from the concentrators. Total nickel recovery at the plant was 91.6%, 0.5% below that of 1990. This was partly due to the poor condition of the furnace gas handling system and the electrostatic precipitator that was being replaced.

According to the Zimbabwe Chamber of Mines Journal, the toll treatment contract with BCL Ltd. of Botswana was terminated in 1991. Details of the contract and the termination were not available. Production at the Madziwa Mine was lower than expected. The Epoch and Madziwa Mines continued to suffer some reduction in head grade because mine development problems prevented production from better grade stope blocks.

Platinum-Group Metals.—The Great Dyke was explored by a consortium of companies for its copper, nickel, and platinum potential. Four major projects were being considered for development: the joint venture of Delta Gold (Pty.) Ltd. of Australia and BHP-Utah's Hartley project, Union Carbide's Mimosa Mine, the consortium of Anglo American's Rio Tinto and Plateau's Zinca Mine Project, and Anglo American's Unki Project. It was anticipated that two of these projects could be developed within 2 years. The most promising of the four projects were the Mimosa Mine near Zvishavane and Delta and BHP-Utah's Hartley project. Feasibility studies at the Mimosa Mine were completed in September of 1991. Mimosa's proven ore reserves were estimated at 44 Mmt with a mine and mill capacity of 3 Mmt/a.

Delta and BHP-Utah of San Francisco formed a joint venture to develop a platinum-group metal operation near Chegutu on the Hartley complex of the

Great Dyke. Initial studies put proven and probable ore reserves at 37 Mmt in a portion of the Hartley Complex, 80 km southwest of Harare. The mine capacity was estimated at 2.2 Mmt/a. Production was scheduled to start in 1994, making it the largest underground platinum-group metal mine outside the Republic of South Africa. Current development efforts indicate that the Hartley Complex could produce 3% of world supply of PGM and contribute 7% of Zimbabwe's total export earnings as well as employ 2,000 people.

Industrial Minerals

New developments included a feasibility study showing large deposits of bauxite occurrence along the Mozambique-Zimbabwe border east of Mature. The study was funded by the United Nations Developmemt Program and undertaken by Austroplan Co. that was based in Vienna, Austria. The study estimated ore reserves to be more than 2 Mmt, averaging about 40% Al_2O_3. Zimbabwe had a bauxite mine that was operated between 1953 and 1974, producing 50,000 mt/a of ore until it was closed.

Reserves

Officially reported reserve figures were not available. However, some data have been reported by the Zimbabwe Chamber of Mines Journal (CMJ) on resources and reserves. Reserves of chromite in the Great Dyke have been reported by CMJ at 448 Mmt. Coal reserves were estimated at more than 30 billion tons, copper ore at 13 Mmt, lithium ore at 6 Mmt, nickel ore at 23 Mmt. PGM ore at the Hartley Complex of the Great Dyke, 80 km south of Harare, was estimated by CMJ at 37 Mmt. PGM ore at the Mimosa Mine in the Wedza Complex, about 35 km southwest of Masvingo in the southern end of the Dyke, was estimated at 44 Mmt.

INFRASTRUCTURE

The National Railways of Zimbabwe (NRZ), one of the largest in Africa, consists of 4,304 km of total railroad. The system was operated by the Government with its Motor Transport Service. All major cities and industrial centers are along the rail network that serves most of the country. Most of the bulk imports and exports are moved by rail to the international markets, making it the backbone for agricultural and industrial development. The existing road system is not capable of carrying large tonnages for long distances in competition with the railroad.

OUTLOOK

Nonfuel minerals such as asbestos, chromite, gold, and nickel should remain the mainstays of the economy for the immediate future. The recovery in mine production is expected to continue in the 1990's, with increases mainly in the production of coal, gold, and platinum-group metals. The new investment regulations should encourage further foreign participation and increase output. The construction of a new dam to provide electricity and an efficient transport system in the second 5-year development plan are expected to address the needs of the mining, energy, and transport sectors. However, continued drought may adversely affect such projects and the mining industry's productivity.

[1]Where necessary, values have been converted from Zimbabwe dollars (ZD) to U.S. dollars at ZD2.40=US$1.00 for 1991.

OTIIER SOURCES OF INFORMATION

Agencies

Ministry of Mines
P.O. Box 7709, Causeway
Harare, Zimbabwe
Telephone: 703781

Minerals Marketing Corp. of Zimbabwe
Globe House, 5th Floor, 51 Stanley Avenue
P.O. Box 2628
Harare, Zimbabwe
Telephone: 703402/705826

Chamber of Mines
4 Central Avenue, P.O. Box 2677
Harare, Zimbabwe
Telephone: 702843

National Resource Board
Head Office, Block 1
Makombe Building
Box 8070, Causeway
Harare, Zimbabwe

Publications

Chamber of Mines, Zimbabwe:
Journal of Mining and Metallurgy, monthly.

TABLE 1

ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		1987	1988	1989	1990	1991
METALS						
Antimony, mine output, concentrate, Sb content		153	165	210	101	160
Beryllium: Beryl concentrate, gross weight		83	33	46	28	29
Chromium: Chromite, gross weight		570,298	561,477	627,424	643,098	563,634
Cobalt:[2]						
Mine output, Co content[e]		88	104	90	102	105
Metal		110	126	112	127	130
Columbium and tantalum: Tantalite concentrate:						
Gross weight	kilograms	37,000	66,000	32,000	35,000	e31,800
Cb content[e]	do.	2,600	9,900	4,800	5,200	4,730
Ta content[e]	do.	6,100	23,100	11,200	12,200	11,100
Copper:						
Mine output, concentrate, Cu content[e]		19,800	16,900	16,400	14,698	14,420
Metal:						
Smelter output, blister/anode, primary[e 3]		19,000	16,300	15,800	14,100	13,830
Refinery output, refined/cathode, primary		18,819	16,116	15,659	14,080	13,811
Gold	kilograms	14,710	14,191	16,003	16,900	17,820
Iron and steel:						
Mine output, iron ore:						
Gross weight	thousand tons	1,328	1,020	1,143	1,259	1,136
Fe content[e]	do.	824	632	686	730	660
Metal:						
Pig iron[e]	do.	575	600	520	521	500
Steel, crude	do.	515	500	650	580	e580
Ferroalloys:						
Ferrochromium		212,300	224,000	173,000	222,102	186,774
Ferrosilicochromium		21,192	29,000	25,000	16,612	27,755
Ferromanganese		—	2,000	—	—	—
Total		233,492	255,000	198,000	238,714	214,529
Nickel:						
Mine output, concentrate, Ni content[e]		12,320	13,500	13,600	13,490	12,371
Refinery output, refined metal[4]		10,394	11,490	11,633	11,426	11,297
Platinum-group metals:						
Palladium	kilograms	29	46	43	31	30
Platinum	do.	18	28	25	21	19
Total	do.	47	74	68	52	49
Silver	do.	25,351	21,953	22,305	21,221	19,380
Tin:						
Mine output, Sn content[e]		1,410	1,140	1,130	1,120	1,060
Smelter output, metal		1,038	855	848	838	796
Tungsten, concentrate:						
Gross weight		1	1	(5)	(5)	(5)
W content[e]		1	1	1	1	1
INDUSTRIAL MINERALS						
Asbestos		193,925	186,581	187,006	160,861	141,697
Barite		191	3,400	1,900	320	866
Cement, hydraulic		810,712	775,736	719,469	700,000	865,000

See footnotes at end of table.

TABLE 1—Continued

ZIMBABWE: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity	1987	1988	1989	1990	1991
Clays:					
Bentonite (montmorillonite)	116,802	113,157	104,865	99,854	e99,900
Fire clay	16,022	16,171	19,100	19,914	23,304
Kaolin	780	95	17	—	65
Feldspar	2,962	3,730	2,697	2,197	3,820
Gemstones, precious and semiprecious: Emerald kilograms	1,979	6,380	6,300	13,010	e13,000
Graphite	13,530	11,441	18,147	16,383	12,903
Kyanite	—	1,795	1,869	160	e160
Lithium minerals, gross weight	14,959	15,073	20,647	19,053	9,186
Magnesium compounds: Magnesite	28,991	30,121	33,423	32,639	23,295
Mica	800	1,797	1,471	1,301	506
Nitrogen: N content of ammonia	53,300	64,400	e61,500	62,500	e62,500
Phosphate rock, marketable concentrate thousand tons	155	125	134	148	117
Pigments, iron oxide	e200	363	287	416	e400
Stone, sand and gravel:					
Limestone thousand tons	1,537	1,408	1,370	1,252	1,428
Quartz[6] do.	41	55	62	63	70
Sulfur					
Pyrite:					
Gross weight	46,606	39,659	47,561	66,571	69,851
S content[e]	20,500	17,500	20,900	29,300	30,734
Byproduct acid, metallurgical and coal process gas[e]	5,000	5,000	5,000	5,000	5,000
Total	25,500	22,500	25,900	34,300	35,734
Talc	516	976	1,513	1,787	1,676
MINERAL FUELS AND RELATED MATERIALS					
Coal, bituminous thousand tons	4,848	4,900	5,111	5,505	5,616
Coke, metallurgical[e 7] do.	e592	600	600	565	560

[e]Estimated.

[1]Table includes data available through Oct. 23, 1992.

[2]"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.

[3]Smelter copper includes impure cathodes produced by electrowinning in nickel processing.

[4]May include nickel content of nickel oxide.

[5]Less than 1/2 unit.

[6]Includes rough and ground quartz as well as silica sand.

[7]Data 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.

[e]Reported figure.

TABLE 2

ZIMBABWE: STRUCTURE OF THE MINERAL INDUSTRY FOR 1991

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Capacity
Asbestos	Shabanie and Mashaba Mines (Pvt.) Ltd. (Turner and Newall Ltd., 100%)	Shabanie	300
Chromite	Zimbabwe Mining and Smelting Co. (Pvt) Ltd. (Union Carbide Corp., 100%)	Kwekwe	350
Do.	Zimbabwe Alloys Ltd. (Anglo Amirican Corp., 100%)	Gweru	450
Coal	Wankie Colliery Co. Ltd. (Government 100%)	Wankie	5,000
Cobalt	Bindura Nickel Corp. (Anglo American Corp., 100%)	Shangani, Samva	.15
Copper, refined	Mhangura Copper Mines (MCM) (Government, 54.5%; MCM, 45.5%)	Sinoia	30
Gold kilograms	Cluff Minerals Zimbabwe Ltd. (Cluff Minerals PLC of the United Kingdom, 100%)	Bindura	2,500
Do.	Rio Tinto Mining (Zimbabwe) Ltd. (Rio Tinto-Zinc Corp. PLC; 56%)	Renco	1,500
Iron and steel:			
Crude steel	Zimbabwe Iron and Steel Co. (Government, 50%; British Steel Corp., 16%; Anglo American Corp., 13%; Messina of South Africa, 13%; Lancshire Steel, 8%)	Redcliff, near Gweru Buchwa	750
Pig iron	do.	do.	630
Nickel, concentrate	Bindura Nickel Corp. (Anglo American Corp., 100%)	Bindura	16
Nickel, metal	Empress Nickel Refinery Ltd. (Rio Tinto Zimbabwe Ltd., 100%)	Eiffel Flats near Chegutu	9
Tin	Kamativi Tin Mines Ltd. (Government, 91%; private, 9%)	Near Dett	1,000

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

a =	year
° API =	American Petroleum Institute gravity
bbl =	barrel(s)
cal =	calorie(s)
c =	centi (prefix)
cm =	centimeter(s)
m^3 =	cubic meter(s)
d =	day(s)
dwt =	ton(s), deadweight
G =	giga (prefix)
GW =	gigawatt(s)
GW•h =	gigawatt hour(s)
g =	gram(s)
g/mt =	gram(s) per metric ton
ha =	hectare(s)
k =	thousand
kcal =	kilocalorie(s)
kg =	kilogram(s)
kL =	kiloliter(s)
km =	kilometer(s)
km^2 =	square kilometer(s)
kmt =	thousand metric ton(s)
kV =	kilovolt(s)
kW =	kilowatt(s)
kW•h =	kilowatt hour(s)
L =	liter(s)
M =	mega (prefix)
MW =	megawatt(s)
MW•h =	megawatt hour(s)
m =	meter(s)
M =	million
Mmt =	million metric ton(s)
m^2 =	square meter(s)
mt =	ton(s), metric
SCE =	standard coal equivalent
V =	volt
W =	watt
W•h =	watt hour

Abbreviation

API =	American Petroleum Institute
EC =	European Community
EFTA =	European Free Trade Association
FTA =	Free Trade Agreement
GATT =	General Agreement on Tariffs and Trade
GDP =	gross domestic product
GNP =	gross national product
LNG =	liquefied natural gas (methane)
LPG =	liquefied petroleum gas (propane-butane)
NAFTA =	North American Free Trade Agreement
OECD =	Organization for Economic Cooperation and Development
OPEC =	Organization of Petroleum Exporting Countries
UN =	United Nations
UNDP =	United Nations Development Program

*U.S. G.P.O.:1993-352-126:80396