

# THE MINERAL INDUSTRY OF OTHER COUNTRIES OF AFRICA

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## Benin<sup>1</sup>

The production of mineral commodities, primarily cement and crude petroleum, represented a minor part of the economy of Benin. (See table 1.) Benin's mineral commodity imports were dominated by refined petroleum products and clinker for cement.

Act No. 83-003 of May 17, 1983, was the Benin Mining Code. Decree No. 89-296 implemented the Code's regulations and Act No. 83-004 addressed fiscal policy affecting mineral development. The Government was deliberating an updated mining code. The Office Béninoise des Mines (OBEMINES), under the Ministry of Energy, Mining, and Hydraulics, had administered mineral developments in Benin. The Department of Mines was charged with promoting and developing the mineral sector. The Government controlled a majority interest in the Société des Ciments d'Onigbolo, the country's largest and only integrated cement plant. CIMBENIN and Société des Ciments du Benin were private clinker-grinding companies.

The Government continued its promotion of the country's natural resources to take advantage of the increased interest in West African exploration. However, the general state of the nation's transportation infrastructure has hampered development of inland mineral resources. Several private companies were negotiating for exploration permits for gold. On the petroleum front, Abacan Resources Corp. of Canada secured 50% of Addax Petroleum Ltd. of Switzerland's interest in offshore Block 1, proposing to explore the block from the adjacent Block 309 in Nigerian territorial waters. The Société Tarpon-Benin, a subsidiary of the Bettis Group of the United States, secured the contact to explore for petroleum on offshore Block No. 2.

A number of gold occurrences, placer and vein, had been identified in the Precambrian terrane in northwest Benin. Reserves of limestone near the cement facility at Onigbolo were sufficient to supply the plant at design capacity for more than a century. Other mineral resource development opportunities identified by OBEMINES included a number of deposits of brick and china clay along the coastal plain; feldspar at Idadjo and Tchaourou-Waria; the marble deposits at Idadjo, Atomè-Lonkly (Mono), and Lanta (Couffo); peat deposits adjacent to the Togo frontier; silica sand along the coast south of Porto Novo; and, in the north, the Loumbou-Loumbou iron-bearing deposit, the Mékrou phosphate deposit, and a number of potential ornamental stone quarrying sites. OBEMINES also

documented occurrences of columbium-tantalum, industrial diamond, gypsum, mica, rare earths, rutile, tungsten, and zircon in Benin (Ministry of Energy, Mining, and Hydraulic, 1992).

## Burundi<sup>2</sup>

Mineral commodity production remained a minor factor in the agriculturally dominated economy of inland Burundi. Minor quantities of gold, tantalum, tin, and tungsten minerals, kaolin, limestone, and presumably construction materials were produced. Expanding the output of gold and initiating production of nickel and associated platinum-group metals from a lateritic deposit and phosphate from a carbonatite-apatite deposit, remained of considerable interest. However, the July military coup signified continued ethnic and political tensions and consequently an unstable climate for mineral development by international investors despite the good geological potential for a substantial economic contribution from the minerals sector.

Nickel exploration by RTZ Corp. of the United Kingdom and Broken Hill Pty. Co. Ltd. (BHP) of Australia remained suspended. No activity was reported on the Butihinda and Muyinga gold deposits.

Government policy, laws, and regulations, including those specifically covering mining and petroleum in 1976 and 1979, were designed to attract private investment, particularly by foreign entities. A free-trade (import-export tax free) zone system covering the entire country, launched in 1993, offered many benefits to industrial and commercial ventures. However, minerals processing no longer qualified, according to a Government announcement in May 1995, which resolved a political controversy over the fact that a gold buyer-refiner, Affimet, was the only beneficiary. For a number of years, the Government promoted foreign support for several progressively more detailed studies aimed at exploiting nickel, gold, phosphate, peat and other mineral resources.

Environmental problems in mining apparently were not of much concern because of the small-scale operations.

The Ministry of Energy and Mines reported mineral production valued at about \$9 million<sup>3</sup> in 1995 (Mathias Sebanhene, Director General of Geology and Mines, Ministry of Energy and Mines, written comm., 1996). (See table 1.) With the July military coup and the ensuing blockade, the value of

<sup>2</sup>Text prepared July 1997 by Bernadette Michalski.

<sup>3</sup>Where necessary, values have been converted from Burundi francs (FBu) to U.S. dollars at the rate of FBu282=US\$1.00.

<sup>1</sup>Text prepared May 1997 by Philip M. Mobbs.

mineral production in 1996 was most likely appreciably reduced.

The principal mineral commodity exports were gold, cassiterite, columbium-tantalite, and wolframite with destinations mostly to Europe; these were small compared with mineral imports, principally petroleum products, cement, steel, and fertilizer. During the first 7 months of 1996 and before the imposition of a blockade, exports included 2,256 kilograms (kg) of gold; 53.3 metric tons (t) of titanium oxide; 23.5 t of cassiterite; and 12 t of wolframite.

Infrastructure included an extensive domestic road network, although only a few were paved. Beyond the border, roads to available railheads were rather poor, except northward through Rwanda into Uganda and Kenya. By this route, the ocean port of Mombasa, Kenya, was about 2,100 kilometers (km) from Bujumbura. Lake vessels were a major mode of transportation, connecting Bujumbura with several railheads in Tanzania, Zaire, and Zambia. An international airport was at Bujumbura, but only a few other airstrips existed. Hydroelectric power was reasonably available in much of the country, with a potential for additional development. Telecommunications were limited.

The outlook for the minerals industry was for little change, pending resolution of the political situation. Hydropower potential and abundance of water were advantages, but export transportation, as well as infrastructural factors in general, were not favorable.

#### **Cape Verde<sup>4</sup>**

Mining's contribution to the economy of Cape Verde was minimal. Most of the nation's mineral requirements were imported. Salt and volcanic rock were produced for local use. Salt was economically significant because one of its main uses was to preserve a portion of Cape Verde's fish harvest. The fishing industry has accounted for about 60% of the nation's export earnings in recent years. Other mineral deposits, formerly produced commercially but abandoned as noneconomic, include gypsum, kaolin, and dimension stone.

#### **Comoros<sup>5</sup>**

The Federal Islamic Republic of the Comoros has a total area of 2,170 square kilometers (km<sup>2</sup>), located on three main islands, in the Mozambique Channel about two-thirds of the way between northern Madagascar and northern Mozambique. It had a 1996 population of 570,000 and a gross domestic product (GDP) per capita, last estimated in 1994 at \$700.

The mineral industry of Comoros continued to be limited to the production of common construction materials, such as clay, sand, gravel, and crushed stone for local consumption. Quantities were not available but were presumably very low because there were no significant construction projects noted in the press since the early 1980's. Geothermal energy was

considered a possibility for development. However, the outlook on minerals output was for no significant change. The former French colony was totally dependent on imports to meet its energy needs.

The economy of Comoros is based on the export of agricultural products, chiefly spices. Political instability in recent years has continued to have a negative affect on the economy.

#### **Djibouti<sup>6</sup>**

The few reports available in recent years on mineral industry activity in Djibouti indicated intermittent entrepreneurial production of small quantities of solar-evaporated sea salt, limestone (some of which was at least periodically calcined to lime), and construction materials, including clays, sand, gravel and crushed stone, as well as some marble and granite dimension stone. However, other mineral occurrences of economic interest include diatomite, geothermal fluids and mineral salts, gold, gypsum, perlite, pumice, and possibly petroleum. Most of these are near Lake Asal, although some gold indications were further west near Yoboki and in the south near Ali Sabieh. Oil interest was focused in the south and offshore in the Gulf of Aden.

The Government was trying to attract foreign investment to develop the mineral industry. However, no major changes in the status of the mineral industry were expected in the immediate future.

#### **Equatorial Guinea<sup>7</sup>**

The Republic of Equatorial Guinea consisted of the volcanic island of Bioko in the Gulf of Guinea and Rio Muni on the African mainland. Decree No. 9/1981 regulated mining activity, except aggregate and radioactive minerals. Mineral resources were the property of the state. Production was subject to a 5% royalty rate. Petroleum exploration and production in Equatorial Guinea were controlled by the Decree No. 7/1981, pursuant to the earlier Hydrocarbons law (Model of Agreement), section II, paragraph 2.8 (E). Production-sharing agreements initially credited the state with 10% of output.

Several mineral and geologic surveys have been conducted in recent years by various organizations. In 1975, the Soviets assessed Rio Muni's bauxite, gold, iron, and radioactive minerals. In the early 1980's, Guineo Español de Minas S.A. conducted aero-magnetic and aero-radiometric surveys and ground exploration. From 1981 to 1985, France's Bureau de Recherches Géologiques et Minières (BRGM) identified occurrences of bauxite, copper, alluvial gold, ilmenite beach sands, lead, phosphates, and zinc in Rio Muni.

UMC Equatorial Guinea Corp., a subsidiary of United Meridian Corp. of the United States, was entered an exclusive 33-month mineral development agreement for the entire Rio

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<sup>4</sup>Text prepared May 1997 by Philip M. Mobbs.

<sup>5</sup>Text prepared August 1997 by George J. Coakley.

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<sup>6</sup>Text prepared May 1997 by Philip M. Mobbs.

<sup>7</sup>Text prepared July 1997 by Philip M. Mobbs.

Muni area in March 1996. During 1996, UMC conducted reconnaissance sampling for a gold exploration program and was pursuing partners for joint ventures on its Rio Muni concession (UMC Equatorial Guinea Corp., 1997).

CMS NOMEKO Oil & Gas Co. of the United States had acquired the Equatorial Guinea operations of Walter International Inc. of the United States during 1995. CMS NOMEKO effectively increased its working interest in the Alba gas-condensate field in the Gulf of Guinea, 36 km offshore of Bioko from 16.67% to approximately 35%. Samedan Oil Corp. held 34.8% interest in the consortium, and Globex International and Axem Resources held the remaining interest. CMS NOMEKO was constructing a 3-million-cubic-meter-per-year liquefied petroleum gas plant in Equatorial Guinea to process production from Alba. Natural gas from the field had been flared since condensate production began in 1991.

Mobil Oil Equatorial Guinea Inc. (75%), a subsidiary of Mobil Corp. of the United States, and UMC (25%) continued development of the offshore Zafiro prospect. The companies had a 268,000 deadweight-ton tanker converted into a floating production, storage, and offloading (FPSO) vessel. Oceanengineering Production Systems of the United States operated floating facility. Two processing lines with a total 80,000-barrel-per-day (bbl/d) capacity were installed and the FPSO has a storage capability of approximately 1.2 million barrels. Production from Zafiro Field began on August 25, 1996.

The Mobil and UMC venture was actively drilling exploration and development wells on Block B. During 1996, the Zafiro-4 and -5 were drilled; as well as the Topacio-1 and -2, approximately 5 km to the south; the Rubi-1, 4 km southeast of Zafiro-1; the Amatista-1; and the IQI-105 (re-designated the Jade-1), 5 km to the southeast. Being drilled at yearend were the Zafiro-6 and the Azurita-1. UMC (75%) and Yukong Ltd. of the Republic of Korea (25%) were reviewing data on their Block C and Block D leases, with water depths ranging from 150 to 750 meters (m). On Block D, the partnership was drilling the Perla-1 at yearend.

### Lesotho<sup>8</sup>

Lesotho has long been known as a source of diamonds, mostly from alluvial deposits. In recent years, 33 kimberlite pipes and 140 kimberlite dykes, of which 24 are diamondiferous, have been identified by the Lesotho Geological Survey. The Liqhobong Kimberlites Complex, northeast of Lesotho, is one of three areas in which Messina Corporation of Canada carried on an intensive exploration program during 1996. The first phase of exploration that covered an area of approximately 400 hectares was accomplished at a cost of \$2.5 million, which included detailed mapping and sampling. The sampling was done on two kimberlite pipes. The main pipe covering about 9.5 hectares (ha) and the satellite pipe covering approximately 1.6 ha, are connected by a narrow, 1 meter wide, dyke. According to a February 4, 1997 press release of Messina

Diamond Corp., the preliminary evaluation of samples collected in 1996 indicate a high-grade kimberlite at the satellite pipe and a medium-to-high grade kimberlite at the main pipe which, when combined with the large tonnage, give the project a potential to be pursued in 1997. The second phase of the exploration, a major bulk sampling, was planned for 1997 that will provide large parcels of Liqhobong stones for evaluation prior to commencement of the feasibility study.

Liqhobong Kimberlite Complex is situated northeast of the Lesotho Highlands Water Development Project (HWP) in the Maluti mountains. The first dam of this project was completed during 1996. Total cost of HWP, which is provided by World Bank, is estimated at \$4 billion.

Lesotho produced, for domestic consumption, a small amount of crushed stone, clay, and sand and gravel. Diamond production during the year was 1,500 carats, which was mined primarily by rudimentary methods.

### Liberia<sup>9</sup>

The mineral economy of Liberia continued to be adversely affected by the civil war that started in 1989. Negotiations between the opposing parties resulted in a peace accord during 1995. The agreement subsequently collapsed as had prior cease-fires.

Mineral production consisted mainly of artisanally mined diamonds and gold. (See table 1.) Many of the diamonds exported from Liberia were believed to have come from other West African countries.

### Malawi<sup>10</sup>

The Republic of Malawi is a landlocked country surrounded by Mozambique, Tanzania, and Zambia. It has an area of 119,140 km<sup>2</sup> of which 20% is Lake Malawi. With a population of about 10.7 million in 1996, Malawi's per capita GDP was estimated by the U.S. Embassy at \$193. The economy of Malawi is based mostly on agriculture, which contributes to 35% of the GDP and for over 90% of total export earnings (U.S. Embassy, Lilongwe, 1997). The mineral sector contributed modestly to the economy and accounted for an estimated 3% of the GDP in 1996. Production of cement, coal, crushed stone for aggregates, dolomite, limestone, and some artisanal salt production was consumed locally. (See table 1.) Malawi also produced small amounts of lime. The Department of Mines also reports that some companies are producing various gemstones like (in order of volume) rubies, sapphires, aquamarine, amethyst, garnet, agate and corundum on a small scale and at organized levels (Malawi Ministry of Energy and Mines, 1997). Coal, from the Mchenga Mine, and limestone produced in Malawi were essential components of the country's cement and lime industries. The production of stone for aggregate and

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<sup>8</sup>Prepared June 1997 by Ebrahim Shekarchi.

<sup>9</sup>Text prepared May 1997 by Philip M. Mobbs.

<sup>10</sup>Text prepared August 1997 by George J. Coakley.

cement was the largest component, by value, of Malawi's mineral production.

The country has known mineral deposits of apatite, aquamarine, bauxite, corundum, glass sand, granite, graphite, kaolin, kyanite, phosphates, pyrite, tourmaline, uranium, and vermiculite. Current exploration efforts are directed toward deposits of base metals, diamond, garnet, gold, rare earths, and rutile and ilmenite sands.

Mineral activities are covered by the Mines and Minerals Act, 1981; the Mines and Minerals (Mineral Rights) Regulations, 1981; and the Petroleum (Exploration and Production) Act of 1983. All minerals are vested in the President on behalf of the people of Malawi. The Ministry of Energy and Mines is authorized to negotiate incentives and benefits with investors. The Government encourages local and foreign investment and anticipates that mining would diversify the Nation's economy from its agricultural base. The preferred methods of investment in Malawi are joint ventures or the establishment of local subsidiaries.

Three types of mining licenses are issued in Malawi for small-mining operations, 1) the mineral permits/rights; for larger operations, 2) the exclusive prospecting licenses, and 3) mining licenses (which are submitted to the Commissioner for Mines and Minerals to be considered by the Licensing Committee). According to the Minister of Energy and Mines, processing time for the mining license is 2 months (U.S. Embassy, Lilongwe, 1996). All mining licenses can be transferred. In addition to the Ministry of Energy and Mines, the Mining Investment and Development Corp. (MIDCOR) is the Government holding company responsible for overseeing the mining sector. Environmental provisions in the Mines and Minerals Act, a result of Malawi's review of its environmental concerns in June 1994, included the requirement that the Department of Research and Environmental Affairs review an environmental impact assessment with each mineral rights application (United Nations Development Programme, 1995).

In 1996, the Government began a process of privatizing a number of state-owned corporations. Among the first of these was the government sale of 51% of its share of the Portland Cement Company Ltd. (PCC) to the Commonwealth Development Corp. of the United Kingdom (CDC). As Malawi's only cement producer, PCC operates from two main sites; at Chingalume, where the limestone quarry and kilns are located, and at Blantyre, 70 km to the south, where the clinker grinding and final packaging is done. CDC planned to invest \$16.5 million in 1996 and an additional \$8.9 million in 1998 to expand and upgrade the quarry operations and main kiln. CDC planned to expand production from 125,000 metric tons per year (t/yr) to 180,000 t/yr by the year 2000 (International Cement Review, 1996).

A 1994 African Development Bank study identified a bauxite reserve of around 28 million metric tons (Mt) averaging 43.9% aluminum oxide at Mulanje Mountain, for which the Government, in 1996, was actively seeking investment to develop an integrated mine and alumina plant and possibly an aluminum smelter. Gencor Ltd. of South Africa indicated an interest in purchasing alumina from any potential project for its

subsidiary, ALUSAF Ltd.'s aluminum smelter in Richards Bay, South Africa (Mining Journal [London], 1996).

Renewed interest in the mining sector included MIDCOR's study of the flake graphite deposit at Katengeza in the Dowa District. MIDCOR also was looking for joint-venture investors to develop the Ngana coal, Bwanje Valley high-calcitic marble, precious and semiprecious stones, and apatite deposits. The apatite would be used as a feed for the country's fertilizer industry. The Ministry of Energy and Mining also estimated total coal reserves of more than 800 Mt. Caledonia Mining Corporation of Canada acquired an 8.4 km<sup>2</sup> prospecting license covering the Kangankunde Hill carbonatite complex about 50 km north of Blantyre. MIDCOR reported that BRGM of France studies of the carbonatite showed that there are "2 Mt of possible reserves at 6.6% monazite and 546,000 tons of minable reserves averaging 10.3% monazite. Drill indicated reserves amount to 11 Mt of ore grading 2.0% rare-earth oxides and 8% strontianite" (Malunga, 1997).

### **Mauritius<sup>11</sup>**

The Republic of Mauritius is a small island nation of 1,860 km<sup>2</sup>, located about 1,000 km east of Madagascar. It has a population of 1.14 million and a healthy GDP per capita, last estimated in 1995, of \$9,600.

The mineral industry of Mauritius was a negligible factor in the economy which is based chiefly on tourism and the export of sugar and textiles. As a participating member of the Uruguay Round and the World Trade Organization, Mauritius lost its preferential trade status in several of its major export markets, which negatively impacted the economy of Mauritius in 1995 (World Trade Organization, 1995). Mauritius expanded its tourism sector and was trying to position itself as a regional financial hub in 1995. It maintained a favorable foreign investment climate and a Free Port Authority.

Historically, mineral output consisted of the local production and use of basalt construction stone, coral sand, lime from coral, and solar-evaporated sea salt. Quantitative information was rarely available and then appeared to be inconsistent. Data on production of mineral commodities were not available, but based on past activity Mauritius produces about 7,000 t/yr of lime, 6,000 t/yr of salt, 300,000 t/yr of sand, and 1,000,000 t/yr of stone. Environmental concerns were being raised over the mining of coral sand and its impact on coastal lagoons. Sand made from crushing basalt rock was used as a substitute for natural sand in construction materials.

Polymetallic nodules occurred on the ocean floor at about 4,000 m depth, extending from 400 km to 800 km north of Port Louis, northeast of Tromelin Island. The nodules averaged more than 15% each of iron and manganese and more than 0.3% cobalt, with an abundance averaging from 2 to 6 kg per square meter. The abundance of land-based resources of these commodities made it unlikely that these resources would be developed in the foreseeable future.

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<sup>11</sup>Text prepared August 1997 by George J. Coakley.

While the country is totally dependent on imports for its energy requirements, oil possibilities were of interest east of the polymetallic nodules area at shallower depth. The area was inconclusively explored with geophysics and drilling by Texaco in the 1970's. Mbendi Information Services of South Africa reports energy consumption coming from electricity (10.5%), coal (5.4%), and oil-derived products (84.1%). Mauritius consumed about 570,000 tons of oil products in 1993 and was growing at a rate of about 7% per year (Mbendi Information Services, 1995). Bids were being sought during 1996 to conduct a feasibility study for a 5-megawatt irrigation-hydroelectric dam in Midlands (Africa Energy & Mining, 1996).

Steel reinforcing bars were made from imported ingot at three rolling mills. The near-term outlook for the exploitation of minerals other than construction materials was negligible.

### Reunion<sup>12</sup>

Reunion, an overseas department of France, is a small island of 2,510 km<sup>2</sup>, located about 650 km east of Madagascar. It has population of 680,000 and a gross national product per capita estimated in 1995 at \$4,300. It has an agricultural economy dominated by sugar cane exports. In 1996, France began to promote investment in Reunion for value added products that would have duty-free export access to European Union markets.

Mineral commodities production represented only a small part of the economy of Reunion in 1995 as in prior years, even though little quantitative information was available. However, output of hydraulic cement, made by grinding imported clinker, presumably remained substantial, well above 300,000 t/yr. The plant, owned by Ciments de Bourbon S.A. at Le Port, had a capacity of 350,000 t/yr. Additionally, production of basic volcanic rock and sea coast coral undoubtedly continued to meet the needs of construction. Little change in future mineral activity was anticipated.

### Rwanda<sup>13</sup>

The mineral industry, principally the mining of columbium-tantalum, tin, and tungsten ores, made only a very minor contribution to Rwanda's economy. Agricultural products, principally coffee and tea, provided the bulk of export earnings while the mineral industry contributed less than 10% to total exports valued at \$40 million. Mineral commodity imports, predominantly petroleum products, structural steel, and cement constituted about 25% of total imports valued at \$250 million. Trade was mostly with the United States and Europe. Rwanda has no crude oil reserves or refinery activities, importing all of its commercial energy in the form of refined petroleum products from Kenya and Tanzania. Petroleum product consumption is less than 2,000 bbl/d. Gasoline and diesel were the principal petroleum imports; however, heavy fuel oil, consumed by a few industrial units, accounted for about 15% of petroleum imports.

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<sup>12</sup>Text prepared August 1997 by George J. Coakley.

<sup>13</sup>Text prepared July 1997 by Bernadette Michalski.

The price of gasoline and diesel is determined by the Government, however, other petroleum products are not controlled. Most of the distribution and marketing of fuels was conducted by the following privately owned companies: Enterprise Rwandaise de Petrole, Societe Generale de Petrole, and Rwanda Petrogaz. The Government is a major equity holder in PetroRwanda which enjoys a market share of approximately 25%.

The structure of the industry consisted mostly of a number of small cooperatives and individual artisanal miners that produced the concentrates of tin, tungsten, columbium-tantalum, and gold ores from scattered locations, generally in a zone about 30 km wide extending east-west through Kigali. Mineral production data were estimated. (See table 1.) Mineral reserves data were not available.

Transportation was tied to the internal network of paved roads. Rwanda must rely on neighboring states for access to seaports on the Indian Ocean 1,500 km east of Kigali at Mobassa (Kenya) and Dar es Salaam (Tanzania). Typical c.i.f delivered costs of imports were 30% higher than f.o.b. vessel in port. There were no railroads in Rwanda, but several terminals were located about 400 km from Kigali—north in Uganda, and south and southeast in Tanzania. Lake Kivu, navigable by shallow-draft barges, provided low-cost transportation to a limited area, and the international airport at Kigali was an important factor in the transportation picture.

Ample hydroelectric power was advantageous to further industrial and mine development. However, the electrical distribution system was still rather limited. For several years, Rwanda was only able to generate 60% of the country's electricity requirement. The diesel-powered Ntakura electric powerplant has been down since 1993.

Environmental problems at the many small mines were known to exist, but economic conditions were not conducive to their resolution. The outlook on mineral production was for a gradual return to pre-1994 conditions as, and if, the political situation stabilized. In view of continued civil unrest, significant changes were not likely for some time.

### São Tomé e Príncipe<sup>14</sup>

The Democratic Republic of São Tomé e Príncipe is a dual island Nation south of Nigeria and west of Gabon on the Equator in the Atlantic Ocean. The country's mineral production encompassed some small clay and stone open pit operations supplying local construction needs. All other minerals and refined petroleum products were imported.

### Seychelles<sup>15</sup>

The Republic of Seychelles is a group of 40 granitic and 50 or more coralline islands with a total area of 455 km<sup>2</sup>, located in the Indian Ocean, northeast of Madagascar. It has population of

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<sup>14</sup>Text prepared May 1997 by Philip M. Mobbs.

<sup>15</sup>Text prepared August 1997 by George J. Coakley.

nearly 73,000 and a GDP per capita of \$6,000. The economy is based on tourism.

Mineral production in Seychelles consisted mostly of unspecified quantities of construction materials—clay, coral, stone, and sand. Output of guano, an organic phosphate fertilizer composed of bird droppings, ceased in the mid-1980's, but a 5,000-t/yr-capacity remained; occasional small production was unofficially reported.

Granite in the bedrock of Mahe and nearby islands had some economic potential. It was quarried for dimension stone on a trial basis by an Italian firm in the early 1980's. In 1992, Gondwana Granite, a South African company, was granted a license to extract and export up to 3,000 cubic meters of granite. Tile and statuary products were the most likely end uses. Lime and cement production from the abundant coral also continued to be considered. However, preservationists and other environmentally concerned groups opposed both the granite and coral use projects.

Polymetallic nodules were known to occur on the ocean bottom near the Admirante Islands. Limited sampling was done in the mid-1980's, but funds for further planned work were not available.

The oil potential of the entire Seychelles region continued to be promoted by the Government-owned Seychelles National Oil Company (SNOC) through the Petroleum Mining Act of 1976. Tar balls from subsurface seeps were known for many years to occur on beaches of Coetivy Island, as well as on Mahe and some nearby islands. Exploration began in 1969, and up to 1994, 23,150 km of seismic profiles and 27,911 km of aeromagnetic lines had been accumulated. In the early 1980's, Amoco drilled three wells about 150 km west of Victoria, each of which showed evidence of hydrocarbons, but gave up its acreage when oil prices dropped. In the late 1980's, several other companies acquired exploration rights in the Seychelles: Enterprise Oil PLC, a British major oil firm, in the southeast, and Texaco of the United States and Lasmo PLC of the United Kingdom in the north and west. Enterprise reportedly undertook a \$10 million drilling test in 1995 on its 10,000-(km<sup>2</sup>) offshore concession, 200 km southeast of Victoria. Mbendi Information Services of South Africa reported that Enterprise Oil's offshore appraisal well in the southern Constant Bank was declared dry in August 1995 (Mbendi Information Services, 1996). A comprehensive 1996 report on the Seychelles geology, hydrocarbon potential, historical exploration activity, geophysical data availability, and the terms of SNOC's Model Petroleum Agreement are available through the Mbendi Internet site.

Petroleum could well play a larger role in the future economy of the Seychelles.

### **Somalia<sup>16</sup>**

Continued political instability extended the Somali minerals industry's historically insignificant influence in the nation's

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<sup>16</sup>Text prepared July 1997 by Philip M. Mobbs.

economy. For a number of years, officially reported mineral production and trade data have not been available. The country was one of the world's least developed, and prior to the authoritarian Government's overthrow early in 1991, all of industry—with minerals production being only a small part—was estimated typically to contribute less than 10% to the nation's GDP.

The structure of the mineral industry prior to 1991 consisted of a 10,000-bbl/d petroleum refinery at Mogadishu and a 200,000-t/yr cement plant near Berbera, both operated by parastatals; and a 1,500 t/yr plaster (calcined gypsum) production facility near Berbera, plus a number of small marine salt, sepiolite (meerschaum), and crude construction material producers at various locations, all believed to be privately owned and operated. A few tens of tons per year of meerschaum was the only noteworthy mineral export commodity.

Mineral production presumably continued in a limited way during 1996, despite the political situation, because of the artisanal nature of salt and meerschaum production. The cement and gypsum plants in Berbera, in the relatively stable, unrecognized, breakaway republic which calls itself Somaliland may have increased production. (See table 1.)

Infrastructure was rather limited. The transport system was poor, with no railroad and the 5,000-km road network in need of repair. There were three main sea ports at Berbera, Chisimaio, and Mogadishu.

### **Sudan<sup>17</sup>**

Mineral commodities produced in Africa's largest country included cement, chromite, crude construction material, crude oil, gold, gypsum, limestone, petroleum refinery products, and salt. Although the quantities were small in the world view and the industry contributed very little to Sudan's economy, the country had some potential for increasing output of oil and gas, gold, and chromite, as well as for reviving production of manganese ores and several industrial minerals. Although minerals typically provided less than 1% of export revenues, mineral commodity imports, principally petroleum refinery products, crude oil, fertilizer, and structural steel constituted a significant proportion of total imports.

The 13-year-old civil war in the south adversely affected petroleum exploration in the region. The Sudan People's Liberation Army declared international exploration activity to be a military target (Journal of Commerce, 1997).

Sudan had been under sanction by the United States Government since 1993 when Sudan had been placed on its list of state sponsors of terrorism. The Antiterrorism and Effective Death Penalty Act of April 1996 prohibited American companies from entering into financial transactions with Sudan; however, Sudan was excepted from the Act in August 1996 (Washington Post, 1997). Beginning in April 1996, members of the Sudanese Government were subject to travel constraints under United Nations Resolution 1054 and United Nations

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<sup>17</sup>Text prepared July 1997 by Philip M. Mobbs.

Resolution 1070 restricted international flights by the Government's Sudan Airways.

Government policy codified in the Investment Encouragement Act of 1980 encouraged foreign investments, especially in minerals. That Act and the Mines and Quarries Act of 1972 and Regulations of 1973, together with the Petroleum Act and Regulations of 1972 and 1973, respectively, appeared to be the principal laws affecting the minerals industry, except for radioactive minerals and precious stones, which were treated separately.

The structure of the mineral industry consisted of mostly rather small companies, often producing intermittently, although gold and oil possibilities were attracting larger foreign companies into at least some exploration. State-owned companies had become significant in the early 1970's and remained the sole producers of cement and oil refinery products. Private firms began operating again in 1979.

The only known gold producer, Ariab Mining Co., was owned 60% by the Government's Sudanese Mining Co. and 40% by the Mine Or S.A., an affiliate of LaSource Compagnie Minière. Ariab expanded its treatment plant's processing capacity to 220,000 t/yr to handle increased output from the Hadal Avatil and Baderuk pits. (*See table 1.*)

Gold prospecting licenses were the subject of negotiations between the Government and several international companies during 1996. Mine Or and Bulgarian and Chinese companies were actively pursuing gold exploration opportunities.

Crude oil production by Government's Public Petroleum Corp. and/or Romania's Rompetrol Group was reported in the Abu Ghabra area, about 750 km southwest of Khartoum. The Government operated a small 2,000 bbl/d refinery at Abu Ghabra.

State Petroleum Corp., a subsidiary of Arakis Energy Corp. of Canada, began production in April 1996 from wells in the Heglig Field. Crude oil production was trucked to the railroad and transported to the refinery at El-Obeid. The 10,000-bbl/d refinery was commissioned in July 1996. In December 1996, Arakis, China National Petroleum Corp., Petronas Carigali Sdn. Bhd. of Malaysia, and the Government agreed to fund the proposed pipeline from the Heglig and Unity Fields in the Muglad Basin to a new terminal to be built south of Port Sudan (Arab Petroleum Research Center, 1997).

Gulf Petroleum Corp. of Qatar, National Oil Co. of Sudan, and Concorp Ltd. of Sudan were working to develop the Adar-Yail Field. In January 1996, International Petroleum Sudan Ltd., a subsidiary of Red Sea Oil Corp. plugged and abandoned the offshore Suakin-2 well. Total Exploration, a subsidiary of Total S.A. of France, has suspended exploration operations on two onshore blocks since 1985 because of the civil war.

Reserve data on minerals in the Sudan were not considered sufficiently reliable for publication.

Infrastructure problems in the country were severe. Roads were the primary transportation mode and were badly in need of repair. A 4,800-km railway network linked major cities, but was in poor condition and carried only a fraction of the tonnage it had in the early 1970's. A refined petroleum products pipeline 800 km from Port Sudan to Khartoum operated much below

capacity. Port Sudan and nearby Suakin were deepwater ports on the Red Sea.

Electric power shortages were not uncommon, and studies on generation and distribution improvements were a focus of foreign aid. Hydropower was an important component, but liquid-fueled steam-turbine units were widely used. An additional thermal plant north of Khartoum and new hydro dams and facilities were also being planned.

The outlook for development of additional oil production appeared promising. Increased chromite and gold output also was probable. However, the political climate and continued economic instability were likely to deter major international efforts at further exploiting the remaining mineral potential of Sudan for some time. The generally poor infrastructure was an additional obstacle to any significant mineral production increases.

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TABLE 1  
OTHER COUNTRIES OF AFRICA: PRODUCTION OF MINERAL COMMODITIES

(Metric tons unless otherwise specified)

Commodity	1992	1993	1994	1995	1996 e/
<b>BENIN 1/ 2/</b>					
Cement, hydraulic e/	370,000	380,000	380,000	380,000	380,000
Petroleum, crude	931	950 e/	884	570 e/	1,000
Steel, crude e/	8,000	2,000 3/	--	--	--
<b>BURUNDI 4/</b>					
Clays: Kaolin	9,690	5,000 e/	2,331	4,766	4,500
<b>Columbium-tantalum, mine output, ore (30% Ta<sub>2</sub>O<sub>5</sub>):</b>					
Gross weight e/	30,000	--	90,000	160,000	200,000
Ta <sub>2</sub> O <sub>5</sub> content	8,527	--	26,125	46,692	60,000
Gold e/	32	20	1,000 r/	2,000 r/	2,200
Lime e/	182 5/	150	150	200	200
Peat e/	12,000 5/	10,000	10,000	10,000	10,000
<b>Tin, mine output, ore ( 60% SnO<sub>2</sub>):</b>					
Gross weight e/	183 5/	100	--	25	45
Sn content e/	110	60	--	15 5/	25
<b>Tungsten, mine output, ore (65 % WO<sub>3</sub>)</b>					
Gross weight e/	--	--	--	42,500	30,000
WO <sub>3</sub> content	--	--	--	27,493	20,000
<b>LIBERIA 1/ 6/</b>					
Cement, hydraulic	8,282	8,300 e/	--	-- e/	--
Diamond e/	150,000	150,000	100,000	150,000	150,000
Gold e/	700	700	700	800	700
Iron ore	1,742	--	--	-- e/	--
<b>MALAWI 7/ 8/ 9/</b>					
Cement, hydraulic	112,000	127,000	121,954	138,675	140,000
Coal	39,200	52,800	34,630	14,635	20,000
Dolomite e/	2,500	2,000	1,321 5/	876 5/	700
Gemstones: Ruby and sapphire e/	20,000	20,000	21,454 5/	75,588 5/	100,000
Lime e/	4,000	2,560	3,544 5/	1,119 5/	2,000
<b>Stone:</b>					
Crushed for aggregate	420,000	380,308	65,039	65,601	456,000
Limestone, for cement	175,000	126,000	173,758	175,578	133,648 5/
<b>RWANDA e/ 10/ 11/</b>					
Cement	60,000	60,000	10,000	10,000	10,000
<b>Columbite-tantalite, ore and concentrate:</b>					
Gross weight	100,000	100,000	10,000	149,000	100,000
Cb content	34,000	34,000	3,400	40,000	30,000
Ta content	22,000	22,000	2,200	28,000	25,000
Gold, mine output, Au content	1,000	1,000	100	26	25
Tin, mine output, Sn content	500	400	50	242	200
Tungsten, mine output, W content	175	175	30	47	40
<b>SOMALIA e/ 12/</b>					
Cement, hydraulic	25,000	25,000	25,000	25,000	30,000
Gypsum	2,000	2,000	2,000	2,000	2,000
Limestone 13/	40,000	40,000	40,000	40,000	45,000
Salt, marine	1,000	1,000	1,000	1,000	1,000
Sepiolite (meerscham)	2	5	5	6	6
<b>SUDAN e/ 14/</b>					
Cement, hydraulic	250,000	250,000	250,000	391,000 r/	380,000
Chromium, chromite, mine output, gross weight 15/	10,000	11,500	25,000	25,000	15,000
Gold, mine output, Au content	1,000	1,600	3,000	3,700	4,500
<b>Petroleum:</b>					
Crude (including lease condensate)	110	360	730	730	1,000
Refinery products	6,000 r/	6,200 r/	6,500 r/	6,600 r/	7,000
Salt	75,000	75,000	75,000	75,000	50,000

e/ Estimated. r/ Revised.

1/ Includes data available through July 1997.

2/ In addition to the commodities listed, a variety of industrial minerals and construction materials (clays, gypsum, sand and gravel, and stone) are produced; but information is inadequate to make reliable estimates of output.

3/ Plant closed in 1993.

4/ Table includes data available through July 15, 1997.

5/ Reported figure.

6/ In addition to the commodities listed, a variety of industrial minerals and construction materials (clays, gypsum, sand and gravel, and stone) are produced; but information is inadequate to make reliable estimates of output.

7/ Estimated data are rounded to three significant digits.

8/ Includes data available through May 21, 1997.

TABLE 1  
OTHER COUNTRIES OF AFRICA: PRODUCTION OF MINERAL COMMODITIES

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9/ In addition to commodities listed, modest quantities of unlisted varieties of crude construction materials (clay, sand and gravel, and other stone) may also be produced, but information is inadequate to make reliable estimates of output levels.

10/ Includes data available through June 30, 1997.

11/ In addition to commodities listed, the following are produced but information is inadequate to reliably estimate output: some gemstones (sapphire and tourmaline); limestone for cement and possibly agriculture; shale and/or clay for cement; and probably crude construction materials (e.g., clays for brick and tile, sand and gravel, stone) from small local operations. Beryllium (beryllium concentrate, estimated 10% BeO) production was last reported in 1985 at 27 tons. Tin smelter output was last reported in 1985 at 800 tons metal when the smelter was reported shut down.

12/ In addition to 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, however, available information is inadequate to make reliable estimates of output.

13/ Estimated for cement manufacture only.

14/ In addition to the commodities listed, the following are presumably produced but available information is inadequate to reliably estimate output: clay and/or shale for cement manufacture (normally about 0.4 ton clay and/or shale per ton of finished cement); gypsum for cement manufacture (about 0.04 ton gypsum per ton of finished cement) and plaster; limestone for cement manufacture (normally at least 1.25 ton limestone per ton of finished cement), agriculture, lime manufacture, and construction aggregate and fill; and other locally used construction materials (clays, sand and gravel, stone, et al.). Also production of manganese ore (48% to 50% manganese) was reported for 1990 at 60,000 metric tons.

15/ Presumed to be ores and concentrates with an estimated average grade of about 48% chromic oxide.