

# THE MINERAL INDUSTRY OF MOZAMBIQUE

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In recent years, the mineral industry of Mozambique has produced gold and such industrial minerals as bauxite, bentonite and other clays, gemstones, graphite, and salt. The country also has produced coal, natural gas, and such building materials as cement, gravel, marble, and sand. Deposits of asbestos, copper, diatomite, feldspar, fluor spar, guano, gypsum, iron ore, limestone, manganese, mica, nepheline syenite, perlite, phosphate rock, rare earths, silica sand, tantalum, and titanium also are known to occur in Mozambique.

The International Monetary Fund (2001a, p. 34) estimated that Mozambique's gross domestic product (GDP) grew by 3.8% in 2000 compared with 7.3% in 1999 and 11.9% in 1998. In 2000, the economy suffered from the effects of flooding and higher oil prices. After growing 15.1% in 1998 and 19.9% in 1997, the value of output in the mining sector contracted by 4.1% in 2000 and 33.7% in 1999 owing to decreased production of coal and the closure of Mozambique's only graphite mine (table 1). In 1999, manufacturing accounted for 9.6% of the GDP; construction, 8.6%; electricity and water, 2.7%; and mining, less than 1% (International Monetary Fund, 2001b, p. 70).

The U.S. Central Intelligence Agency (2001) estimated that Mozambique's GDP in 2000 amounted to about \$19.1 billion at purchasing power parity. In the same year, the per capita income was \$1,000.

The value of exported minerals fell to \$3.6 million in 1999 from \$6 million in 1995. During the same period, exported petroleum products fell to \$4.4 million from \$4.5 million, and coal exports fell to \$300,000 from \$500,000 (International Monetary Fund, 2001b, p. 97).

## Commodity Review

### Metals

**Aluminum.**—The Mozal aluminum smelter, which used bauxite imported from western Australia as raw material, began operation in the third quarter of 2000. The plant was jointly owned by Billiton plc (47%), Mitsubishi Corp. (25%), Industrial Development Corp. of South Africa Ltd. (IDC) (24%), and the Government of Mozambique (4%). During 2000, a \$970-million plant expansion was discussed that would double Mozal's output to 506,000 metric tons per year (t/yr) from 253,000 t/yr (Africa Energy & Mining, 2000b).

A small bauxite mine in Manica Province was operated by E.C. Meikles (Pty.) Ltd. of Zimbabwe. Domestic bauxite resources were estimated to be about 6 million metric tons (Mt) (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 21). Mozambique's bauxite production was exported in 2000 (Mabica, 2001).

**Gold.**—Mozambique's gold resources were located in lode and placer deposits throughout the country. The Chimezi, the Chua, the Mangota, and the Penhalonga/Revue lode mining

areas have resources of at least 3.5 Mt at an average grade of 6.7 grams per ton (g/t) gold. The main placer deposits were found in the Chimezi, the Inhamurra, the Muza, and the Revue Rivers with combined resources of 112 million cubic meters at an average grade of 0.2488 gram per cubic meter (Ruffini, 1998a). Contained gold amounted to nearly 28 metric tons (t) in the placer deposits; and 23 t in the lode deposits.

Recent exploration work by Kenmare Resources plc in Niassa Province identified resources of about 570,000 t at an average grade of 9.9 g/t gold. These resources were found in one vein to a depth of 200 meters. Kenmare suspended exploration pending support from a joint-venture partner (Mining Journal, 2000, Mozambique—Current exploration and development projects, accessed August 31, 2001, at URL <http://www.mining-journal.com/MOZAMBIQUE/file7.htm>). CODMAT Lda explored for gold at Camulaumba near the Luenha River in southern Tete Province.

Most of Mozambique's gold production was artisanal and not included in official figures. Basic panning and digging operations in Niassa produced 4 t/yr to 5 t/yr of gold. Official exports of gold amounted to 17.4 kilograms (kg) in 2000 and 8 kg in 1999 (Mabica, 2001).

**Iron and Steel.**—The Maputo Iron & Steel project was a joint venture between Enron Corp. and five steel and engineering companies to build a steel plant in Maputo. Enron held a 50% stake in the project, and the remaining 50% was shared by Duferco SA of Switzerland; Kobe Steel Ltd.; Midrex Technologies, Inc.; Tecnica Internazionale SpA of Italy; and Voest-Alpine Industrieanlagenbau GmbH & Co. of Austria. The plant would produce semimanufactured steel slabs from imported iron ore and have a capacity of 2 million metric tons per year (Mt/yr). The cost of the project was reported to be \$1.1 billion; construction was scheduled to start in 2002 (Metal Bulletin, 2000). No plans have been announced to exploit Mozambique's domestic iron ore resources, which were reported to be 254 Mt (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 22).

**Titanium and Zirconium.**—The Corridor Sands project was based upon 10 deposits of heavy mineral sands near Chibuto in southern Mozambique. Total resources were estimated to be 14 billion metric tons (Gt); the largest deposit has an estimated 8.7 Gt that contains about 300 Mt of ilmenite. Southern Mining Corp. of South Africa (the owner of the project) estimated that the total heavy-mineral grade exceeded 8%. In 2000, Western Mining Corp. of Australia (WMC) acquired majority control of Corridor Sands and a 20% share of Southern Mining; IDC held a 20% interest in Corridor Sands. Production was expected to start in August 2001; WMC hoped to produce 375,000 t/yr of titania slag and high-grade pig iron, rutile, and zircon (Africa Energy & Mining, 2000e).

Resources in the Moma area were reported to be 2,133 Mt containing 63.2 Mt of ilmenite and 15.6 Mt of zircon and rutile;

the ilmenite graded 52% to 55% titanium oxide. In 2000, Kenmare signed a mining licensing agreement with the Government of Mozambique to exploit the Moma mineral sands. The company's feasibility study showed the Moma project to be technically feasible and commercially viable. Kenmare purchased the concentrator and separator plants needed for the mine, which was scheduled to begin production in early 2003. The company planned to produce 625,000 t/yr of ilmenite, 24,000 t/yr of zircon, and 12,500 t/yr of rutile (Kenmare Resources plc, 2001, p. 2, 4-5, 7).

Exploration work by Billiton plc found that the heavy mineral sands at Moebase have a resource of 1.5 Gt that contains 47.3 Mt of ilmenite (Williams de Broë, 1997, p. 5).

### **Industrial Minerals**

**Bentonite and Other Clays.**—The Boane bentonite deposit was mined by Companhia de Desenvolvimento, which was recently privatized and operated by a group of local investors. Exports of processed bentonite amounted to 480 t in 1999 and 172 t in 2000 (Mabica, 2001). Resources of bentonite were estimated to be about 8 Mt; kaolin, 4.4 Mt; and other clays, 18.3 Mt (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 21).

**Cement.**—The International Cement Review (2001, p. 214) estimated that Mozambique's consumption of cement grew to 400,000 t from 320,000 t in 1998. Cimentos de Portugal, SGPS, SA, held a 51% stake in Cimentos de Mocambique SARL, which was the country's only cement producer. The Dondo, the Matola, and the Nacala plants had a combined production capacity of 600,000 t/yr clinker and 540,000 t/yr cement. Mozambique's cement capacity was expected to double by 2002, and its demand for cement was expected to reach 1 Mt/yr by 2005.

**Fluorspar.**—Deposits of fluorspar were known to occur at Djanguire and Monte Muambe. Resources at the Djanguire deposit were estimated to be about 698,000 t at an average grade of 65% fluorite (CaF<sub>2</sub>). Proven resources amounted to 71,000 t; probable resources, 95,000 t; and possible resources, 532,000 t (Afonso and Marques, 1998, p. 68). Grupo Madal SARL and MCM Trading Lda. jointly held a prospecting license for the Monte Muambe deposit. In 1999, Grupo Madal completed detailed field mapping, stream-sediment sampling, mapping of the entire carbonatite complex, and standard mineralogical and metallurgical testing. The company planned to drill and construct trenches and to evaluate such costs as water, power supply, and transportation. Earlier studies estimated resources at Monte Muambe to be 1.42 Mt at a grade of 75% to 81% CaF<sub>2</sub> (European Union and Southern African Development Community, 2000, Project profiles—Mozambique—Monte Muambe fluorite, accessed October 3, 2001, at URL [http://www.mines2000projects.com/html/frame\\_project.htm](http://www.mines2000projects.com/html/frame_project.htm)).

**Gemstones.**—Mozambique was known to have resources of precious, semiprecious, and ornamental stones, such as agate, amethyst, aquamarine, emerald, garnet, jasper, morganite, rose quartz, tigereye, and tourmaline, particularly in the Mozambique Orogenic Belt. In recent years, the country has produced amethyst from Alto Ligonha; high-quality aquamarine from Macula, Mocuba, Monapo, and Muiane; emerald from

Alto Ligonha and Maria; garnet from Cuamba; rose quartz from Alto Ligonha; and tourmaline from Muiane, Nacala, and Naipa. MGM Minerais and Gemas THC Mocambique Ltda. was exploring the possibility of cutting gemstones and opening a gemstone mine (Kane, 1999; Shigley and others, 2000, p. 311, 318, 320-322).

**Graphite.**—The Ancuabe Graphite Mine in Cabo Delgado Province was placed on care and maintenance in October 1999 by Kenmare owing to a tax dispute between the company and the Government. Kenmare has been attempting to secure the working capital needed to reopen the mine. Graphite resources in Cabo Delgado were estimated to be 30 Mt at a grade of approximately 9.5% graphite. Other graphite deposits were located at Satemua, which has a resource of 5.6 Mt at a grade of 6% graphite (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 32). Mozambique exported 4,084 t of graphite in 1999 (Mabica, 2001).

**Limestone.**—Resources from the Muanza, the Nacala, and the Salamanga limestone deposits have been exploited for cement production at the Dondo, the Nacala, and the Matola cement plants, respectively. Mozambique's limestone resources were reported to be nearly 39.8 Mt in 1995 (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 32).

**Marble.**—Marmonte E.E., which was recently privatized, produced and exported marble from Montepuez in Cabo Delgado. Mozambique's marble resources were estimated to be 83 Mt (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 22).

**Phosphate Rock.**—Phosphate rock resources were estimated to be 274 Mt. Norsk Hydro ASA engaged in exploration at the Evate phosphate deposit in northeastern Mozambique. Evate, which was the country's largest deposit of phosphate rock, has estimated resources of 155 Mt at a grade of 9.8% phosphorus pentoxide (P<sub>2</sub>O<sub>5</sub>). A residual concentration of apatite ore near Evate has estimated resources of about 9 Mt at a grade of 14% P<sub>2</sub>O<sub>5</sub>. Other deposits occur at Monte Muambe and Monte Cone N'gose (Mozambique Ministry of Mineral Resources & Energy, 1995, p. 21, 24, 34).

### **Mineral Fuels**

**Coal.**—Mozambique was reported to have 2.28 Gt of proven bituminous coal reserves and more than 15.8 Gt of identified coal resources. The Moatize deposit has proven reserves and other identified resources of 7,246 Mt; Minjova, 7,080 Mt; Mucanha-Vuzi, 3,561 Mt; and Maniamba, 228 Mt (Ruffini, 1998b). Small amounts of coal were mined from Moatize by state-owned Carbomoc and exported to Malawi. Exports of coal amounted to 29,010 t in 2000 and 20,502 t in 1999 (Alfonso Mabica, Mozambique National Directorate of Mines, written comm., 2001). Coal production at Moatize has been far below capacity owing to the destruction of the rail link between the Moatize Mine and the port of Beira during the civil war. The Government has planned to restore production at the Moatize Mine.

**Natural Gas.**—The Pande and the Temane gasfields had original gas in place of 85 billion cubic meters and 57 billion cubic meters, respectively. Reserves at Pande, Temane, and

Buzi were reported to be 74 billion cubic meters, 51 billion cubic meters, and 15 billion cubic meters, respectively. The Pande field was exploited on a small-scale basis for domestic consumption. In October, Sasol Ltd. of South Africa signed a contract to build a pipeline between the Pande and the Temane fields. The company would hold a 50% stake in the project, and the Governments of Mozambique and South Africa would hold 25% each. Production of gas would reach a rate of 5.7 million cubic meters per day in 2004; the Temane field would be the first field to go into large-scale production. Roughly 10% of the gas produced from the Pande and the Temane fields would be consumed domestically (Africa Energy & Mining, 2000a, d; Matthews and others, 2001).

**Petroleum.**—Mozambique produced neither crude petroleum nor refined petroleum products and relied on imports, which were sourced mainly from South Africa. The country consumed an estimated 3.29 million barrels of petroleum products in 2000. Mozambique was promoting offshore exploration for petroleum and natural gas. Recently obtained seismic data indicated that the Mozambique Basin might have notable resources of petroleum (Africa Energy & Mining, 2000c). The Governments of Malawi, Mozambique, and Zimbabwe made plans for a joint fuel refinery in Mozambique with a capacity of 10,000 barrels per day. The project was to be funded by the Government of Iran (Mbendi Information Services, 2000, Mozambique—Oil and gas industry—Overview, accessed August 31, 2001, at URL <http://www.mbendi.co.za/indy/oilg/af/mz/p0005.htm>).

## Infrastructure

In 1999, Mozambique generated 2,300 gigawatt-hours (GWh) of electricity, of which 87% was provided by hydroelectric power sources, and 13%, by fossil fuels. In 1999, Mozambique imported an estimated 70 GWh of electricity. In the same year, the country exported 1,900 GWh valued at \$62.9 million (International Monetary Fund, 2001a, p. 97). Mozambique had installed capacity of 2,313 megawatts (MW); the Cabora Bassa Dam accounted for 2,075 MW. Another dam was to be built on the Zambezi River with a capacity of 1,200 to 2,400 MW. Mozambique's exploitable potential hydroelectric energy has been estimated to be 14,000 MW (Africa Energy & Mining, 2000d).

Mozambique had about 30,400 kilometers (km) of roads, of which approximately 5,700 km was paved. The rail network covered about 3,100 km. The country had 306 km of crude petroleum pipelines and 289 km of petroleum products pipelines; the pipeline from Beira to Harare carried petroleum products to Zimbabwe. Ports and harbors were Beira, Inhambane, Maputo, Nacala, Pemba, and Quelimane. Navigable waterways covered about 3,750 km (U.S. Central Intelligence Agency, 2001).

## Outlook

The International Monetary Fund (2001a, p. 34) predicted that the mining sector would grow by 10% in 2001 and by 15% per year from 2002 to 2005. Construction sector activity was also expected to increase; growth was predicted to be 2% in 2001 and 7% per year from 2002 to 2005. Mozambique's economy was expected to receive a significant boost from the heavy-mineral sands projects, the Maputo Iron & Steel project, and the Mozal smelter. Rising demand for cement would probably lead to greater exploitation of domestic limestone resources. Coal production could increase significantly if the rail link between the Moatize Mine and the port of Beira were restored.

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TABLE 1  
MOZAMBIQUE: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity 3/	1996	1997	1998	1999	2000
<b>Aluminum:</b>					
Bauxite	11,459	8,218	6,130	7,883 r/	8,130
Metal, refined	--	--	--	--	53,800
Cement, hydraulic thousand tons	180	220	260 r/	270 r/	310 e/
<b>Clays, bentonite:</b>					
Crude	11,051	12,625	10,448	10,828 r/	16,144
Processed	NA	NA	NA	360	274
Coal, bituminous	40,000	60,000 r/	60,000 r/	8,573 r/	16,115
<b>Gemstones, semiprecious:</b>					
Cut stones, all types carats	2,663	5,168	5,303	3,500 r/ e/	3,400 e/
Rough stones kilograms	1,862	1,091	1,465	1,000 r/ e/	1,000 e/
Gold 4/ do.	67	6	17	19 r/	23
Graphite, concentrates	3,283	5,125	5,889	4,007 r/	--
Gravel and crushed rock e/ cubic meters	120,000	123,532 5/	282,832 5/	290,000 r/	285,000
Limestone, for cement e/ thousand tons	240,000	290,000	340,000	360,000	410,000
<b>Marble:</b>					
Block do.	744	251	117	120 r/ e/	120 e/
Slab square meters	18,232	13,820	2,736	2,800 r/ e/	2,800 e/
Natural gas e/ million cubic meters	--	--	60 5/	55	55
Salt, marine e/	60,000	60,000	60,000	40,000 r/	38,000

e/ Estimated. r/ Revised. NA Not available. -- Zero.

1/ Estimated data are rounded to no more than three significant digits.

2/ Data available through August 31, 2001.

3/ In addition to the commodities listed, construction materials (other clays, sand and gravel, and stone) were produced. Output, however, is not reported quantitatively and information was insufficient to make reliable estimates.

4/ Does not include artisanal gold, which was estimated to be roughly 4,000 to 5,000 kilograms per year.

5/ Reported figure.