

THE MINERAL INDUSTRY OF MOZAMBIQUE

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The Republic of Mozambique is located on the southeast coast of Africa and has an area of 749,090 square kilometers. In 1997, the area supported a population of 18.2 million and a gross domestic product (GDP) of \$670 per capita, based on purchasing power parity estimates in 1995. Following nearly 30 years of internal civil strife, which ended with the establishment of a freely elected government in 1994, Mozambique has been striving to rebuild its economy. In 1997, the economy began to show the turnaround hoped for under the rigorous International Monetary Fund and World Bank structural adjustment program that began in the late 1980's—the GDP grew by 14%, inflation was single digit, and export trade increased. The country's high foreign debt load, however, remained a problem.

The minerals and energy sectors played secondary roles to agriculture and fishing in the economy but were the targets for several major new foreign investment proposals. Efforts to rebuild the economy have placed major emphases on mineral-resource development and regional economic integration. By 1997, nearly \$12 billion in new mineral and infrastructure development projects were under consideration by Government and private foreign investors. However, only a few firm project commitments, such as the Mozambique Aluminum Co. (Mozal) project, had been made by 1998. Development plans to date depended heavily on the energy potential of the underutilized Cabora Bassa hydroelectric dam; the Pande, the Temane, and the Buzi natural gasfields; the coal resources at Moatize; and the modernization of the Indian Ocean export harbors at Beira, Maputo-Matola, and Nacala and associated transportation infrastructure. In the metals sector, work began in 1998 on a \$1.3 billion aluminum smelter, and studies were underway to determine the feasibility of developing a second aluminum smelter and major coal, iron, and titanium projects. Resources of dimension stone, gemstones, gold, niobium, petroleum, phosphates, rare-earth minerals, and tantalum were also known (Mozambique Ministry of Mineral Resources and Energy, 1995). Mozambique continued to be an important source of labor for the South African gold industry, with about 60,000 Mozambican miners employed in the Witwatersrand gold mines. Repatriated wages from this workforce provided a significant contribution to the Mozambican economy.

The national mining and petroleum policy was directed at promoting foreign investment and exports, thus increasing the supply of raw materials for domestic industries and minimizing direct Government participation in mineral activities. The minerals industry is regulated by the Mining Law No. 2/86 of April 16, 1986, as amended by Law 5/94 of September 18, 1994, and by the Mining Law Regulations (Decree 13/87 of

February 24, 1987). The mining law is administered by the Minister of Mineral Resources and Energy through the National Directorate for Mines. Tax and other fiscal matters for the mining sector are regulated by the Mining Tax Code (Decree 53/94 of November 9, 1994). Petroleum rights and licensing are regulated by the Petroleum law (Decree No. 3/81) of 1981. Under this law, the national oil company, Empresa Nacional de Hidrocarbonetos (ENH), has statutory responsibility for the exploration and development of natural gas and petroleum resources and can enter into joint ventures and other forms of contractual relations with private companies. Petroleum licensing usually takes the form of a production-sharing agreement with ENH, and natural gas exploration and development takes the form of profit-sharing joint ventures.

The mining industry was chiefly noted for its production and export of bauxite, bentonite, gemstones, graphite, and marble. In addition to these minerals, small quantities of gold along and some industrial mineral commodities, including cement, marine salt, and sand and gravel were produced. Mineral commodity production, as reported by the Ministry of Mineral Resources and Energy, is listed in table 1. Official exports were dominated by bauxite, gemstones, graphite, and marble.

Commodity Review

Metals

Aluminum.—Construction of the Mozal aluminum smelter, 17 kilometers (km) west of Maputo, began in July 1998 with production expected to start up by mid-2000. Mozal was a joint venture of Billiton Plc of the United Kingdom (47%), Mitsubishi Corporation of Japan (25%), the Industrial Development Corporation of South Africa (IDC) (24%), and the Government of Mozambique (4%). The 245,000-metric-ton-per-year (t/yr) aluminum smelter was being built at a capital cost of \$1.34 billion, which included a \$70 million agreement with Portos e Caminhos de Ferro de Mocambique, E. P., enabling Mozal to develop and operate a dedicated berth and other port terminal facilities at Matola, the port of Maputo. Feedstock for the smelter will be sourced from Billiton-owned alumina plants in Australia, Brazil, and Suriname. Modeled after Billiton's Hillside smelter at Richards Bay, South Africa, the project was designed to double the capacity of the smelter in the future. Detailed descriptions of the project, financing, and construction schedules are available at the company web site (URL <http://www.mozal.com>).

The Government and the U.S. Trade and Development

Agency, in cooperation with the engineering firms, Asea Brown Boveri AG of Switzerland, Fluor Daniel Inc., and Kaiser Aluminum Corp. of the United States, signed a memorandum of understanding for a feasibility study on developing a second aluminum smelter in Beira. Funding and a timetable for the study were not discussed (Pickard-Cambridge, December 15, 1998, Beira smelter project mooted, accessed January 30, 1999, at URL <http://www.bday.co.za/98/1215/news/n10.htm>).

Gold.—Such Canadian companies as Greenhope Resources Inc. and Trillion Resources Ltd. at the Muende, the Chifunde, the Chifumbazi, the Chicamba, the Chimeze, and the Zambuzi properties; the joint-venture partners Harambee Mining Corp. and Tan Range Exploration Corp. on the Chowalo and the Machinga gold concessions in the Archean greenstone belts of northwestern Mozambique; and Adamas Resources Corp. on the Niassa concession were actively exploring for gold during the year. Kenmare Resources Plc of Ireland also held a gold exploration license in the Niassa area. Other companies active in the country included Anglo American Corp., Gencor Ltd. and Lonrho Corp. of the United Kingdom, Ashanti Goldfields Co. Ltd. of Ghana, and Broken Hill Proprietary Ltd. (BHP) of Australia.

Iron and Steel.—JCI Ltd. and IDC were moving ahead with plans to develop a \$660 million, 2.5-million-metric-ton-per-year (Mt/yr) hot-briquetted iron (HBI) ore plant in the free trade zone near the port of Beira. Capital cost included \$190 million to build new port facilities. The plant would use 3.8 million metric tons (Mt) of iron ore fines from Brazil and low-cost gas from the Temane or the Buzi-Divinhe natural gas fields south of Beira. JCI also had an option to purchase iron ore from Iscor Ltd.'s of South Africa Sishen Mine. IDC was also examining the feasibility of building an adjacent \$300 million, 3.6-Mt/yr electric arc furnace steel plant to produce long steel products. JCI secured options, at less than \$0.75 per gigajoule, on the Temane gas with Atlantic Richfield Co. (ARCO) of the United States and Sasol Petroleum International (Pty.) Ltd. of South Africa and on the Buzi gas with the two Canadian companies holding the production-sharing agreement with ENH, Leopardus Resources Ltd. and Scimitar Hydrocarbons Corp. JCI held a 52% interest in the HBI project, the Mozambican Government, 20%; the Zimbabwean Government, 3%; and others, 25% (Reuters News, August 13, 1997, Mozambique iron plant vital for JCI future, accessed August 8, 1998, at URL http://www.leopardus.com/related_stories5.html; Mbendi Information Services, July 2, 1998, Mozambique—Direct iron reduction plant, accessed January 30, 1999, at URL <http://mbendi.co.za/indy/ming/mingmzfe.htm>). Feasibility studies for the project will also look at the potential impact of high carbon dioxide emissions from the proposed plant on nearby prawn fishing and air quality (Josey Ballenger, February 5, 1998, Iron project talks to be held in Beira, accessed February 9, 1998, at URL <http://bday.co.za/cgi-bin/post-query.perl>).

Following prolonged negotiations between the Mozambican

Government and Enron Development Corp. of the United States, two agreements were signed. The first “Heads of Agreement” signed in September 1998 established the basis upon which the Government would approve and assist in the implementation of the gas-fueled Maputo Iron and Steel Project (MISP). The second, signed in March 1999, committed to develop the \$2.5 billion MISP. Capital costs would include the iron and steel project and the gas development. Under the agreement, the MISP will use all of the gas from the Pande field in southern Mozambique and would include construction of a 610-km pipeline from the Pande gasfield to Maputo and a slurry pipeline to transport iron ore from 270 Mt of stockpiled byproduct titaniferous magnetite ore from the Palabora copper mine in South Africa to the Maputo plant. Railing the ore from the town of Phalaborwa was still an alternative. Enron and the IDC held 50-50 equity in the MISP, and Enron and ENH have the gas concession and will install the gas pipeline. The MISP was expected to produce approximately 3.5 Mt/yr of steel slabs for export from the Port of Maputo. Arrangements for project financing were pending approval by the Government. The project would take 42 months to build and generate about \$750 million in annual revenues. Mitsui Corp. of Japan and Duferco Steel Processing Ltd. of Switzerland were front runners to join as partners in the project (Alexander's Gas and Oil Connections, June 11, 1999, Enron to develop a gas, iron and steel project in Mozambique, accessed January 12, 2000, at URL <http://www.gasandoil.com/goc/company/cna92498.htm>).

Tantalum.—Harmony Gold Mining Co. of South Africa was developing a tantalum deposit at Morrua in Zambezia Province. Reserves were estimated to be 4.4 Mt containing 5.6% tantalum oxide. An open pit mine producing 450,000 t/yr of ore was planned (Mbendi Information Services, July 1, 1998, Mozambique—Mineral sands and rare earths mining, accessed August 12, 1998, at URL <http://mbendi.co.za/indy/ming/mingmzot.htm>).

Titanium.—In titanium developments, several projects were under investigation. Billiton conducted a \$3.9 million first-phase prefeasibility study in 1997 to examine the technical merits of developing the TiGen mineral sands project at Moebase, Zambezia Province, 500 km north of Beira. Billiton held a 100% interest in the project after acquiring the remaining minority equity interests of Edlow Resources Ltd. of Bermuda in 1996. According to Gencor (1997), exploration results indicated a resource in excess of 1 billion metric tons of sand containing some 4% heavy minerals. The contained titanium dioxide content was approximately 22 Mt. Ilmenite ore would be treated to produce 400,000 t/yr of titania slag at a plant at the port city of Nacala at a cost of \$500 million by 1999-2000. A source of power supply for the plant remained a problem. However, by yearend 1998, Billiton decided to delay proceeding to the final feasibility stage for 2 years pending an improvement in global market conditions and to reduce its country investment risk until the Mozal aluminum project was completed.

The joint venture between BHP International Minerals (Pty.) Ltd. (BHP) of Australia and Kenmare Resources PLC of Ireland

was examining the feasibility of investing more than \$300 million to develop the Moma-Congolone titaniferous sands concession near Angoche/Quinga, Nampula Province. The Congolone project would produce 35,000 t/yr of zircon, 418,000 t/yr of ilmenite, and 8,000 t/yr of rutile by 2000. Under a July 1996 joint-venture agreement, BHP had the right to earn a 75% interest in the project by spending \$24.4 million on further exploration and development. However, in April 1999, BHP withdrew from the project, with full ownership reverting to Kenmare. Kenmare will seek other partners for the project. During 1997, BHP performed more than 10,000 meters of drilling on the Moma-Congolone titanium project. This allowed them to increase the identified resource to more than 1 billion tons of mineralized sand containing about 35 Mt of ilmenite; or if the lower grade Quinga zone is included, 2 billion tons of sand containing more than 50 Mt of ilmenite. Work by BHP in 1998 established the Namalope resource of 13 Mt of ilmenite as an indicated resource; included the adjoining Tupuito and Tebani areas into BHP's resource category; prepared a mine plan demonstrating the minability of these three contiguous resource areas by low-cost dredge mining as a single mine containing more than 30 Mt of ilmenite; discovered a new high-grade zone at Pilivilil containing large volumes of titanium minerals with a grade of around 8% ilmenite plus associated rutile and zircon (more than twice the average grade for the rest of the deposit); and conducted metallurgical testwork which demonstrated that the mine would generate products which fit within the specifications of the major consumers (Kenmare Resources Plc, 1999, Projects—Titanium (Moma-Congolone), accessed January 11, 2000, at URL <http://www.kenmareresources.com/congolone.html>).

Southern Mining Corporation of the Netherlands was exploring the Corridor Sands titanium project during 1998. The project is 200 km south of Maputo and 40 km inland. The company announced that by using a cutoff grade of 7% total heavy minerals, it had established a measured resource of 974 Mt at grades of more than 8.5% total heavy minerals. The total inferred resource was estimated to be 10 billion metric tons containing more than 500 Mt of heavy minerals, including smelter-feed-quality ilmenite, zircon, and rutile byproducts. An \$18 million feasibility study of the project by Bateman Minerals & Industrial Ltd. of South Africa of the project was initiated in October 1998 (Janet Parker, March 16, 1999, Southern gets a R117m injection, accessed December 30, 1999, at URL <http://www.bday.co.za/99/0316/company/c6.htm>).

The titanium project in the Limpopo River delta just north of Xai-Xai was being undertaken by Aquater S.p.A. of Italy, which spent \$3 million on exploration of the deltaic and inland extensions of the deposit in 1997 (African Mining, 1998).

Industrial Minerals

Cement.—Stimulated by major infrastructure development projects, production of cement has been on the rise, increasing to 290,000 t in 1998 and accounting for about 94% of domestic consumption. The country's sole producer, Cimentos de Moçambique, S.A.R.L., controlled by Cimentos de Portugal, SGPS, SA (Cimpor) of Portugal (51%) and by the Government

(48%), had an annual capacity of around 300,000 metric tons (t) by 1998. In 1995, Cimentos de Moçambique had initiated a 10-year, \$100 million program to upgrade its plants at Matola, Dondo, and Nacala and to increase capacity to almost 900,000 t/yr of cement (International Cement Review, 1998).

Graphite.—Grafites de Ancuabe s.a.r.l (GDAS) was a joint venture among Kenmare Resources, the Government of Mozambique, and the United Kingdom's Commonwealth Development Corp. Kenmare increased its equity control of the company from 65% to 77% in 1997. GDAS was the world's leading producer of high-quality natural flake graphite. The Ancuabe graphite mine is in northern Mozambique, 100 km inland from the port of Pemba. The ore body was in a slightly inclined graphite-bearing gneiss with an average grade of 10% graphite. A reserve of 1 Mt of ore grading 10% graphite was defined by diamond drilling for the feasibility study and additional very extensive, near-surface resources remain to be explored. Mining was by open pit method. Ore processing was by flotation and grinding to produce a standard 98% carbon graphite product. The processing plant had a nominal capacity of 10,000 t/yr of graphite product. During 1998, Kenmare was forced to run the operations at a higher level than designed for increase production to compensate for a 60% drop in graphite prices, leading to some mechanical failures that affected production and costs. A solution to plant power problems was developed in mid-1998 with the installation of larger alternators on which air filters to filter out conductive graphite dust were mounted. This improvement resulted in a satisfactory power supply. The Mozambican Government also responded by fast-tracking the extension of grid power to Ancuabe with connection expected in 2000. This allowed GDAS to conclude in 1998 a nonexclusive arrangement with Superior Graphite Co. of Chicago, one of GDAS' largest customers. This agreement allowed Superior to acquire 15% of the common stock of GDAS by investing approximately \$1.3 million (Kenmare Resources Plc, 1999, Projects—Ancuabe graphite mine, accessed January 11, 2000, at URL <http://www.kenmareresources.com/ancuabe.html>).

Other Minerals.—The Government-owned Companhia de Desenvolvimento Mineiro was actively pursuing exploration and development opportunities at the Boane bentonite deposit in Maputo Province, rare earths and tantalum prospects at Morrua with Grupo Madal s.a.r.l., and tantalum, kaolin, and rare-earth deposits in Muiane, Zambezia Province, with African Mining and Trust Pty. Ltd. of South Africa.

Fuels

Coal.—The Government gave a development priority to reopening the Moatize coal mine in Tete Province. The mines, which have been essentially inoperable for 10 years, were once the country's major export earner. Exploration by Companhia Vale do Rio Doce (CVRD) of Brazil and others in the 1980's and early 1990's identified coal resources of 15.8 billion tons in the Karroo sediments of the Province. Of the total proven coal reserves in the country of 2.28 Mt, 1.8 Mt of low-sulfur, high

ash, bituminous coking coal reserves were located in the Moatize coalfield (Ruffini, 1998). In January 1997, the Government gave JCI an option to lead the development of Moatize. In March 1998, the South African coal companies, Ingwe Coal Corp. and Duiker Mining Ltd., took out options to join JCI and Austral Coal Ltd. of Australia to finance the \$750 million redevelopment of the Moatize Mine. The project would include a powerplant that would use steam coal produced as a secondary recovery product of the predominantly coking coal seam JCI was hoping to develop (David McKay, March 23, 1999, Two companies have options in JCI project, accessed January 30, 1999, at URL <http://www.bday.co.za/98/0323/e6.htm>). With no further public news, the project appeared to be on hold by yearend 1998. JCI planned to export the bulk of the coal to Brazil on the return run of ore freighters bringing in CVRD iron ore for JCI's HBI plant at Beira.

Petroleum and Natural Gas.—The foreign investment interest in the petroleum and natural gas sectors was primarily for natural gas with three major gasfields, Buzi-Divinhe, Pande, and Temane, being considered for development. There were no known oilfields. Enron held an exclusive production-sharing agreement with ENH to invest at least \$1 billion to develop the estimated 70 billion cubic meters (2.5 trillion cubic feet) of reserves in the Pande gasfield and associated pipelines needed to feed other industrial projects (Africa Energy & Mining, 1999). The agreement was subject to Enron's ability to arrange project financing, which was also tied to proposed new iron and steel projects at Maputo. The September 1998 agreement for the MISP included the supply of natural gas from the Pande Field, which included the development of Pande Field in central Mozambique and the construction of a 610-km pipeline to transport natural gas from the Pande Field to the MISP in Maputo.

ARCO held the rights to natural gas reserves at the Temane field, south of Pande, along with two offshore blocks off the coast of Sofala Province. In May 1998, ARCO signed a production-sharing agreement with ENH for the Temane Gas Field, with an exploration commitment of \$10 million. The Temane Group partners were ARCO (47.62%), Sasol (47.62%), and Zarara Petroleum Resources Ltd. (4.76%). ARCO was negotiating a potential gas-marketing agreement with JCI Ltd. and Sasol, the latter for its Secunda synfuels plant in South Africa. A dedicated pipeline for the gas into South Africa would cost \$600 million. An aggressive drilling program by ARCO and Sasol on the Temane Field during 1998 increased estimates of gas reserves from 34 billion to 42 billion cubic meters (U.S. Embassy, Maputo, Mozambique, 1999).

The same partners signed similar production-sharing agreements on the Sofala and M 10 offshore blocks with ENH in May 1998 committing to spend \$30 million in exploration during 7 years. Scimitar Production International Ltd. of Canada and joint contractor Leopardus Resources of Canada, which have corporate ties to Zarara Petroleum Resources and Bin Ham Oil Group of the United Arab Emirates, held the rights from ENH to exploit the known gas resources of the Temane and the Buzi-Divinhe gas permit areas and to explore the Sofala and the M-10 offshore permit areas. Other

companies actively exploring for natural gas and oil included BP Exploration Operating Co. Ltd. and Lonrho Petroleum Ltd. of the United Kingdom, Canop Worldwide Corp. of Canada, and Norbay Oil Corp. of the United States.

Infrastructure

Because the country's infrastructure suffered major damage and neglect during the prolonged war years, infrastructure development projects have been given a major priority. Spinoffs from the Mozal aluminum smelter project will include completion of high voltage transmission lines between the Cabora Bassa hydroelectric dam and South Africa; construction of the new \$1.5 billion, 2,500-megawatt Mepanda Uncua hydroelectric dam on the Zambezi River and an associated \$500 million, 1,500-km transmission line to Maputo; and renovation of the Maputo Harbor to handle up to 10 Mt/yr of cargo, 800,000 t of which will be dedicated to Mozal aluminum project imports and exports. The joint Mozambique-South African Maputo Corridor Project between Johannesburg and Maputo will upgrade 500 km of road and rail links and dredge and improve Maputo Harbor to stimulate agricultural, industrial, and tourism development projects in both countries. The Maputo Corridor Project was expected to cost more than \$1 billion with 90% of financing coming from the private sector (Richard Meares, August 1, 1997, Reuters—Maputo Corridor boosted by smelters, ministers say, accessed August 1, 1997, at URL http://biz.yahoo.com/finance/97/08/01/gcor_y000_1.htm). To accommodate the HBI project, the port at Beira will be upgraded to handle 250,000-t ships with a 4-km-long pier. The 2,000-MW capacity of the Cabora Bassa dam and hydroelectric plant, which had been inoperable since 1982, was back in operation by 1998.

Outlook

With the development of the Mozal project well underway, the Mozambican economy appeared to be poised to undergo a major recovery based substantially on proposed new energy- and mineral-related investment and export-oriented industrial development. Although the outlook is optimistic, the full realization of the nearly \$12 billion in new investment is still contingent on several political and market factors. These include continued internal political stability and external regional cooperation, especially with neighbors, South Africa and Zimbabwe; continued positive market conditions for aluminum, coal, iron and steel, and titanium; and the ability of project management to attract the necessary development capital in competition with similar projects elsewhere in the world. The country's strong coal, gas, and hydroelectric energy base, however, remained a strong magnet for attracting the needed capital and industrial development.

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Major Sources of Information

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TABLE 1
MOZAMBIQUE: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity 2/		1994	1995	1996	1997	1998 3/
Bauxite		9,620	10,700	11,459	8,218 r/	6,130
Cement, hydraulic e/	thousand tons	60	60	180	220	290
Clays, bentonite		3,350	3,500	11,051	12,625 r/	10,448
Coal, bituminous		58,190	40,000	40,000	100,000 e/	100,000 e/
Copper, concentrate:						
Gross weight		1,240	--	--	--	--
Cu content e/		259	--	--	--	--
Gemstones, semiprecious:						
Cut stones, all types	carats	6,450	6,000	2,663	5,168 r/	5,303
Rough stones e/ 4/	kilograms	7,000	8,000	1,862	1,091 r/	1,465
Gold 5/	do.	6,804	6,800	67	6 r/	17
Graphite, concentrates		430	3,019	3,283	5,125	5,889
Marble:						
Block	cubic meters	1,500	1,500	744	251	117
Slab	square meters	52,300	52,300	18,232	13,820 r/	2,736
Salt, marine e/		40,000	40,000	60,000	60,000	60,000
Stone, sand and gravel						
Gravel, and crushed rock	cubic meters	100,000 e/	100,000 e/	120,000 e/	123,532	282,832

e/ Estimated. r/ Revised.

1/ Data available through November 1999.

2/ In addition to the commodities listed, construction materials (other clays, sand and gravel, and stone) were produced, as was a small quantity of natural gas. For these commodities, output is not reported quantitatively, and information was insufficient to make reliable estimates.

3/ Reported data.

4/ Artisanal production of rough gemstones include, in order of importance, garnet, tourmaline, dumortierite, aquamarine, emerald, and morganite.

5/ Does not include artisanal gold, for which there were no data, but for which the Government has estimated about 4,000 kilograms per year.