

THE MINERAL INDUSTRY OF MOZAMBIQUE

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The Republic of Mozambique is located on the south-east coast of Africa and has an area of 749,090 square kilometers (km²). In 1997, the area supported a population of 18.2 million and a gross domestic product (GDP) per capita, based on purchasing power parity estimates in 1995, of \$670. Following nearly 30 years of fighting prior to gaining independence from Portugal in 1974 and then, to resolve a prolonged internal civil war, 1994 finally brought peace and a freely elected government to Mozambique. In 1997, the economy began to show the turnaround hoped for under the rigorous International Monetary Fund and World Bank structural adjustment program began in the late 1980's—the GDP grew by 14%, inflation was a 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. Nearly \$12 billion in new mineral and infrastructure development projects were being considered by Government and private foreign investors in 1997. Priority also continued to be given to the removal of land mines around the major transportation routes and population centers. Development plans to date depend heavily on the energy potential of the underutilized Cabora Bassa hydroelectric dam; the Pande, the Temane, and the Buzi natural gas fields; and the coal resources at Moatize; and on modernization of the Indian Ocean export harbors at Beira, Maputo-Matola, and Nacala and associated transportation infrastructure. In the metals sector, studies were underway to determine the feasibility of developing major aluminum, 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 Witswatersrand gold mines. Repatriated wages from this workforce provided a significant contribution to the Mozambican economy.

The national mining and petroleum policy is 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 shown in table 1. Official exports were dominated by bauxite, gemstones, graphite, and marble.

Billiton Plc's South African subsidiary, Alusaf, Ltd., in partnership with Industrial Development Corp. (IDC) of South Africa, has formed the Mozambique Aluminum Co. (Mozal). Billiton is the United Kingdom based, offshore arm of Gencor Ltd. of South Africa. Following completion of a \$5 million feasibility study, Billiton announced plans to develop a 245,000-metric-ton-per-year (t/yr) aluminum smelter 17 kilometers (km) west of Maputo. Construction is expected to begin near mid-1998 and to be completed by yearend 2000. Feedstock for the smelter will be source from Billiton-owned alumina plants in Australia, Brazil, and Suriname. The company was targeting a 50-50 debt-to-equity ratio to finance the \$1.2 billion project. Additional American, Brazilian, or Japanese investors were being sought. Provision has been made at the site to double capacity size to 490,000 metric tons (t) in the future. An engineering, procurement, and construction management contract has been awarded to the joint venture company comprising SNC Lavalin of Canada and Murray and Roberts Engineering Management Services of South Africa. This is the same group that recently built the 466,000 t/yr Alusaf aluminum smelter in Richards Bay, South Africa. The Government approved an environmental impact assessment of the project conducted by the Council for Scientific and Industrial Research of South Africa, the Mozambique Ministry of Environmental Affairs, and the World Bank. The competitive position of the Mozal smelter has been aided by an electricity tariff agreement between the South African power company, Eskom, and the Mozambique electricity supply authority and by the granting of a tax-free industrial zone status

to the project by the Mozambican Government. The tariff agreement will allow power sharing between South African coal-based electricity and Mozambican hydroelectric-based power, with power costs to Mozal linked to the world market price for aluminum. The project is expected to be a major stimulus to economic development in Mozambique by creating 5,300 construction jobs and 2,600 permanent smelter and related service jobs, bringing in more than \$430 million in foreign exchange earnings annually and expanding road, port handling, and new hydropower infrastructure capacities (U.S. Embassy, Pretoria, South Africa, 1997; Mining Journal, 1997; African Mining, 1998a).

A number of Canadian companies, including 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. Other companies active in the country included Anglo American Corp., Gencor and Lonrho Corp. of the United Kingdom, Ashanti Goldfields of Ghana, and Broken Hill Proprietary Ltd. (BHP) of Australia.

JCI Ltd. and IDC were considering development of a \$660 million, 2.5-million-metric-ton-per-year (Mt/yr), hot briqueted iron (HBI) ore plant near the port of Beira. The plant would use iron ore from Brazil and low-cost gas from the Temane or the Buzi-Divinhe natural gas fields south of Beira. JCI has secured options, at less than \$0.75 a gigajoule, on the Temane gas with Atlantic Richfield Co. (Arco) of the United States and Sasol 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. Leopardus also has corporate ties with the Bin Ham Oil Group of the United Arab Emirates. JCI holds a 52% interest in the HBI project, and the Mozambican Government holds 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). 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 on air quality (Josey Ballenger, February 5, 1998, Business Day (Johannesburg)—Iron project talks to be held in Beira, accessed February 9, 1998, at URL <http://bday.co.za/cgi-bin/post-query.perl>). High-quality iron ore near Mutare, Zimbabwe, with a resource estimated to range from 100 million to 200 million metric ton (Mt), could become an alternative source of iron ore for the project within the next 5 to 8 years. A decision to proceed with the project was expected to be made in March 1998 (Ruffini, 1998b), with project completion targeted for 2001.

IDC is examining the feasibility of combining Pande gas with hematite ore from Sishen, South Africa, and from 270 Mt of stockpiled byproduct titaniferous magnetite ore from the Palabora copper mine, also in South Africa, to build a \$1-billion, 4-Mt/yr direct-reduced-iron plant near Maputo. Construction of an adjacent 3.4-Mt/yr slab steel plant is also being considered by

IDC. Mitsui & Co. Ltd. of Japan and the Swiss steel trader, Duferco Group, were reported to be possible equity partners in the \$2 billion project with IDC and Enron Development Corp. of the United States. The proposed project feasibility study prepared by Enron will be evaluated by the National Directorate for Coal and Hydrocarbons in early 1998. 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. It would include construction of a 700-km pipeline from the Pande gas field to the capital city of Maputo and of a slurry pipeline for the magnetite ore from Phalaborwa, South Africa under or around the Kruger National Game Park, which will raise additional environmental concerns in South Africa. (Metal Bulletin, 1998; Simon Barber and Fernando Lima, December 29, 1997 Business Day (Johannesburg)—Enron, IDC hand iron and steel plant blueprint to Mozambican government, accessed January 7, 1998, at URL <http://bday.co.za/cgi-bin/post-query.perl>).

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 from which 1,700 t of tantalum oxide could be recovered. An open-pit mine producing 450,000 t/yr of ore was planned (Mbendi Information Services, 1998, Mozambique-Mineral sands and rare earths mining, accessed August 12, 1998, at URL <http://mbendi.co.za/indy/ming/mingmzot.htm>).

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.

In titanium developments, three separate 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. Exploration results reported in Gencor's 1996 annual report indicated a resource in excess of 1 billion tons of sand containing some 4% heavy minerals. The contained titanium dioxide content is approximately 22 Mt. Ilmenite ore would be treated to produce 400,000-tons-per-year (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. Billiton holds a 100% interest in the project after acquiring the remaining minority equity interests of Edlow Resources of Bermuda in December 1996 (Gencor, 1997). The joint venture between BHP International Minerals of Australia and Kenmare Resources Plc. of Ireland planned to invest more than \$300 million to develop the 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. During 1997, exploration increased the total resource of contained ilmenite at Congolone to 58 Mt with a titanium dioxide content of 52% to 55%. BHP will earn a 75% interest in the project following their expenditure of \$24 million on exploration and feasibility studies. 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, 1998b).

Stimulated by major infrastructure development projects, consumption of cement has been on the rise, increasing to 230,000 t in 1996. The country's sole producer, Cimentos de Mocambique, controlled by Cimpor of Portugal (51%) and by the Government (48%), had an annual capacity of around 100,000 t in 1996. Cimentos de Mocambique had initiated a 10-year, \$96 million program to upgrade its plants at Matola, Dondo, and Nacala, and to increase capacity to 850,000 t/yr (International Cement Review, 1997).

The Ancuabe graphite mine north of Montepuez has been in production since July 1995. The operating company was Grafites de Ancuabe s.a.r.l., a joint venture among Kenmare, 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. The mine's plant capacity for coarse flake graphite concentrate grading more than 98% carbon was being expanded from 7,500 to 10,000 t/yr (Industrial Minerals, 1997). Most of the production is exported to Canada, Germany, Japan, and the United States for the production of refractories. Development of the Ancuabe mine was based on 24 Mt of ore reserves grading from 3% to 11% graphite identified during pre-1995 exploration.

The Government has given a development priority to reopening the Moatize coal mine in Tete Province. The mines, which have been essentially inoperable for almost 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 Tete 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 are located in the Moatize coal field (Ruffini, 1998a). In January 1997, the Government gave JCI an option to lead the development of Moatize. Negotiations were still underway at yearend to form a consortium, including JCI and Austral Coal Ltd. of Australia, to finance the \$480 million redevelopment of the Moatize Mine. In addition to the mine development, plans call for a \$30 million upgrade of the harbor at Nacala to permit the export of 3.2 Mt/yr of coking coal and a \$300 million rehabilitation of the Moatize to Beira railroad (Business Day Online (Johannesburg), February 2, 1997, Mozambique plans to revive Moatize coal mines, accessed August 14, 1998, at URL <http://www.bday.co.za/97/0228/world/w7.htm>). 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. Reopening of the railroad will immediately permit the export of more than 200,000 t of coal stockpiled at the mine. JCI was also considering building a \$1 billion thermal powerplant that would use Moatize residual steam coal at the Beira or the Nacala harbor. In other coal developments, African Portland Industrial Holdings of Namibia acquired a 95% interest in the Matola coal terminal in Maputo harbor.

The foreign investment interest in the petroleum and natural gas sectors has been primarily for natural gas with three major gasfields, Buzi-Divinhe, Pande and Temane being considered for

development. There are no known oilfields. Enron held an exclusive production-sharing agreement with ENH to invest at least \$1 billion to develop the estimated 85 billion cubic meters of reserves in the Pande gasfield and associated pipelines needed to feed other industrial projects. 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. Financing and gas marketing arrangements for the Pande gas project were still pending at yearend 1997 (Indian Ocean Newsletter, 1998). Arco held the rights to the estimated 17 billion cubic meters of proven natural gas reserves at the Temane field south of Pande along with an offshore block of the coast of Sofala Province. Arco was negotiating a potential gas marketing agreement with both JCI and Sasol Petroleum International (Pty.) Ltd., the latter for its Secunda synfuels plant in South Africa.

Scimitar Production International Ltd. of Canada and joint contractor Leopardus Resources of Canada, which have corporate ties to Zarara Petroleum Resources Ltd. 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. On the basis of existing geologic and geophysical data, Leopardus reported reserves of 14 to 140 billion cubic meters of natural gas at Buzi-Divinhe and in excess of 51 billion cubic meters of gas at Temane (Leopardus Resources Ltd., 1998, Overview of the company, accessed August 8, 1998 at URL <http://www.leopardus.com/over.html>). In June 1997, Leopardus and Scimitar signed a \$500,000 agreement with JCI giving JCI the option to purchase 34 billion cubic meters of Buzi gas during a 30 year period. Leopardus has also been given access to a 100-km² tax-free zone at Beira to attract additional industrial development and financing for the Buzi gas project. Leopardus was to acquire Zarara's rights to the Temane gasfield in February 1998 along with their 4.76% development interest. Arco and Sasol each held a 47.62% interest in Temane. Arco will be the initial operator, with Sasol taking over after 5 or 6 years. Other companies actively exploring for natural gas and oil included, British Petroleum, Lonrho Ltd. of the United Kingdom, and Norbay Oil of Norway.

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 (MW) 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 is expected to cost more than \$1 billion with 90% of financing coming from the private sector. Construction contracts were to be issued in 1998 (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 continuing dispute between the Portuguese and the Mozambique Governments on the repayment of the \$3.2 billion debt on the Cabora Bassa hydroelectric dam, which was built during Portuguese rule, could impact power swapping agreements with Eskom, if increased tariffs to Eskom are imposed (Business Day Online (Johannesburg), January 8, 1998, Eskom seeks to settle power dispute through talks, accessed August 12, 1998, at URL <http://www.bday.co.za/cgi-bin/post-query.perl>). Eskom had rights to purchase the full 2,000-MW capacity of the dam, which has been inoperable since 1982. The Cabora Bassa hydroelectric plant is expected to be operational again around mid-1998. Also during 1997, as part of a Zambezi Valley development study, Portugal provided \$700,000 to finance a study on the feasibility of increasing the capacity of Cabora Bassa capacity to 3,200 MW (Indian Ocean Newsletter, 1997).

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/	1993	1994	1995	1996	1997 e/
Bauxite	6,000	9,620	10,700	11,459 r/	10,700 3/
Cement, hydraulic e/	thousand tons	20	60 r/	60 r/	100 r/
Clays, bentonite	100 e/	3,350	3,500	11,051 r/	13,799 3/
Coal, bituminous	48,400	58,190	40,000 r/	40,000 r/ e/	30,000
Copper: concentrate:					
Gross weight	--	1,240	--	--	--
Cu content e/	--	259	--	--	--
Gemstones: semiprecious:					
Cut stones, all types	carats	7,690	6,450	6,000	2,663 r/
Rough stones e/ 4/	kilograms	560	7,000	8,000	1,862 r/
Gold 5/	do.	149	6,804	6,800	67 r/
Graphite, concentrates		10	430	3,019 r/	3,283 r/
Marble:					
Block	cubic meters	1,380	1,500	1,500	744 r/
Slab	square meters	34	52,300	52,300	18,232 r/
Salt, marine e/		35,000	40,000	40,000	60,000

e/ Estimated. r/ Revised.

1/ Data available through July 31, 1998.

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

3/ Reported data.

4/ Artisanal production of rough gemstones include, in order of importance, tourmaline, garnet, 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.

TABLE 2
MOZAMBIQUE: RESERVE BASE OF MAJOR MINERALS

(Million metric tons unless otherwise specified)

Commodity	Reserve base
Apatite	274
Asbestos	thousand tons
Bauxite	500
Bentonite	6.13
	8.5
Coal	9,750
Copper	thousand tons
Diatomite	382
Feldspar	3
Fluorite	thousand tons
Gold	12
Graphite	thousand tons
Gypsum	1.5
Iron ore	thousand tons
Kaolin	47
Limestone	40
Marble	thousand tons
Natural gas	million cubic meters
Nepheline syenite	billion cubic meters
Perlite	122
Tantalite	thousand tons
Titanium ore	4,300
	thousand tons
	945
	7.5
	348

Source: Mozambique Ministry of Mineral Resources, Mineral Resources Develop and Investment Opportunities, 1995, p. 21-22.