

THE MINERAL INDUSTRY OF MADAGASCAR

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The Republic of Madagascar, which is the world's fourth largest island, is located about 420 kilometers (km) east of Mozambique in the Indian Ocean. Madagascar had an area of 587,040 square kilometers and a population of more than 16 million. Its mining industry has been chiefly noted for the production and export of chemical- and metallurgical-grade chromite ore, high-quality crystalline flake graphite, and mica. In addition to these minerals, small quantities of beryllium, gold, rare earths, and such industrial mineral commodities as cement, feldspar, ornamental stones, precious and semiprecious gemstones, quartz, and salt have been produced. Madagascar was also known to have resources of bauxite, coal, cobalt, copper, lead, manganese, nickel, platinum, tin, titanium, zinc, and zirconium.

In 2002, Madagascar's gross domestic product (GDP) amounted to about \$16 billion at purchasing power parity. Industry accounted for about 12% of the GDP in 2001. Madagascar's GDP fell by 12.7% in 2002 after rising by 6% in 2001, 4.8% in 2000, and 4.7% in 1999. The sharp decline in GDP in 2002 was attributable to the civil unrest that followed the disputed elections in December 2001. Although the political crisis ended in July 2002, Madagascar still incurred substantial costs, such as decreased national income, lost investor confidence, foregone direct investment, foregone exports, and damaged infrastructure, including bridges (International Monetary Fund, 2003b, p. 46; 2003c, p. 180; 2003§¹; World Bank, 2003, p. 3).

The civil unrest had a severe effect upon Madagascar's mining sector. From 1997 to 2001, output in the mining sector had already been highly volatile; this was probably the result of fluctuating production of chromite and graphite. In 2002, mining activity fell by 34% because of domestic instability (International Monetary Fund, 2003a, p. A-III-4; 2003b, p. 53).

Government Policies and Programs

The International Monetary Fund and the World Bank proposed a \$38.65 million program to assist Madagascar in reforming its mining sector. The Mineral Resources Governance Project would decentralize tax collection procedures to increase revenues from royalties; finance geologic and geochemical mapping and airborne geophysics; improve environmental conditions at small-scale mines; promote private investment in the mining sector; and increase declared production from small-scale gemstone and gold mines. In the gemstone sector, the project would also establish a certification program for gemstones, create a gemstone exchange, train miners in gem-processing techniques, and increase domestic gemstone cutting and polishing (World Bank, 2003, p. 28-31, 37). Approval of \$32 million in World Bank funding for the project was still on hold at the end of 2002.

Commodity Review

Metals

Cobalt and Nickel.—Phelps Dodge Corp. planned to develop the Ambatovy nickel and cobalt deposit into a 36,000-metric-ton-per-year (t/yr) nickel and 3,000-t/yr cobalt mine and to refine the nickel and cobalt using high-pressure acid leaching. The World Bank (2003, p. 41) estimated that development of the project would result in exports of \$185 million per year. At the end of 2002, the project was on hold pending the resolution of permitting and regulatory issues and an evaluation of the company's strategic options (Cope, 2002; Phelps Dodge Corp., 2003, p. 14).

Gold.—Numerous deposits of gold occur in Madagascar, which include those at Ampanihy, Andavakoera, Farafangana, Maevatanana, and Miandrivazo. National Mineral Development Corp. of India has been exploring for gold in the northern part of the country. In recent years, small mining companies and individual miners have produced about 3,000 to 4,000 kilograms per year (kg/yr) of gold from small high-grade deposits. Officially reported gold output has been minimal in recent years (table 1; Crankshaw, 2002). The World Bank (2003, p. 41) estimated that the value of reported gold output could rise to from \$10 million to \$20 million in 2008 from \$150,000 in 2000 if the Mineral Resources Governance Project were implemented.

Industrial Minerals

Cement.—Société Malgache des Ciments (90% owned by the Holcim Group of Switzerland) and SA Nouvelle Cimenterie Amboanio (66% owned by the Lafarge Group of France) operated cement plants with capacities of 150,000 t/yr and 40,000 t/yr,

¹References that include a section mark (§) are found in the Internet References Cited section.

respectively. National cement production increased to 51,882 metric tons (t) in 2001 from 36,217 t in 1997. In 2002, the production of construction materials fell by 36.3% after rising by 6.3% in 2001 (International Monetary Fund, 2003a, p. A-III-4; 2003b, p. 54).

Chromium.—Kraomita Malagasy produced chromite concentrates and lumpy ore from its mines at Ankazotaolana and Bemanevika. In 2001, production fell to 23,637 t from 131,293 t in 2000 (table 1); the decrease may have attributable to low prices in the world market for chromite. Madagascar's chromite exports amounted to 33,500 t at a value of \$1.5 million in 2001 (International Monetary Fund, 2003b, p. 57).

Gemstones.—Madagascar is known to have deposits of such precious gemstones as emerald, ruby, sapphire, and tourmaline. Many types of semiprecious and ornamental stones were also mined. Most of Madagascar's gemstones were produced by artisanal miners. Only small quantities of emerald, ruby, and sapphire were cut locally; precious stones tended to be exported as rough. However, large quantities of ornamental stones were cut in Madagascar.

In early 2002, political turmoil prevented the transportation of fuel to gemstone mining areas; many mines were forced to shut down. Before the unrest, rough gemstones from Madagascar accounted for nearly 50% of the gemstones cut in Sri Lanka (Jewellery News Asia, 2002).

In December, Americana Gold and Diamond Holdings Inc. (AGDM) completed its due diligence on its North Fork 14 alluvial sapphire properties in the Ilakaka area. AGDM held a majority interest in the North Fork 14 joint venture. The value of the gemstone resources at North Fork 14 was estimated to be \$716 million. Capital expenditures for North Fork 14 were estimated to be \$8.8 million, with projected annual operating expenses of \$33.4 million and projected annual revenues of \$73.7 million. AGDM planned to start mining in October 2003 and reach full production by the end of the year (Americana Gold and Diamond Holdings Inc., 2003).

In September 2002, American Benefits Group Inc. announced plans to develop its sapphire properties in northern Madagascar (American Benefits Group Inc., 2002). Other companies mining sapphire included Compagnie des Gemmes de Madagascar, Radiant Gems International of Sri Lanka, and Société Mining Discovery.

The World Bank (2003, p. 41-42) estimated that the value of reported artisanal gemstone output could rise to from \$40 million to \$80 million in 2008 from \$21 million in 2000 if the Mineral Resources Governance Project were implemented. The increase would result from greater value added.

Graphite.—The largest producer of graphite was Etablissements Gallois, which accounted for two-thirds of Madagascar's graphite output. Other companies mining graphite included Etablissement Izouard, Etablissements Rostaing, Société Arsene Louis et Compagnie, and Société Minière de la Grande Ile. After rising to 40,328 t in 2000, national production of graphite fell to 2,013 t in 2001. Output was limited in 2002; fuel shortages forced Etablissements Gallois to shut down its mines. Madagascar's reserves of graphite amounted to 940,000 t; the reserve base was 960,000 t. In 2001, graphite exports were 11,300 t at a value of \$4.7 million (Africa Mining Intelligence, 2002; Crankshaw, 2002; International Monetary Fund, 2003b, p. 57; Kalyoncu, 2003).

Mica.—Madagascar produced small amounts of mica; production has fallen sharply in recent years (table 1). The fall in output was partially attributable to improved technology in other mica-producing countries, such as Canada and the United States, and the development of substitutes for mica in electronic applications (Fonds d'Appui au Secteur Prive, 2001§).

Titanium and Zirconium.—Phelps Dodge held an exploration license for an ilmenite deposit near Moramanga. Madagascar Resources NL explored for titanium minerals in southwest Madagascar. Quebec Iron and Titanium-Madagascar Minerals SA (a subsidiary of Rio Tinto) planned to produce about 700,000 t/yr of ilmenite and 33,000 t/yr of zircon from deposits near Tolagnaro. The construction work was expected to last for 3 years. The World Bank (2003, p. 41) estimated that development of the project would result in exports of \$80 million per year. In 2002, Rio Tinto indicated that any development was unlikely before 2007 (Cope, 2002; Gooding, 2002§).

Mineral Fuels

Petroleum.—In 2002, Madagascar did not produce crude petroleum and relied on imported petroleum products; the country's only refinery shut down in 2001. Madagascar's refinery production was 3.86 million barrels in 2001 compared with 3.31 million barrels in 1997. The value of petroleum imports amounted to nearly \$168 million in 2001, which was 15% of total imports. Exports of petroleum products amounted to \$25 million (Ford, 2003; International Monetary Fund, 2003b, p. 54, 84-85).

Since 1997, Gulf Stream Madagascar, Hunt Oil Co., Triton Energy Ltd., Vanco Energy Co., and Xpronet Resources Inc. have signed petroleum exploration contracts with the Government. In 2002, Vanco held a license for the deepwater Majunga block, which is off the northwestern coast of Madagascar (Vanco Energy Co., 2003).

Infrastructure

The International Monetary Fund (2003b, p. 59) estimated that Madagascar produced 833.9 gigawatthours (GWh) of electricity in 2001; this was an increase from 779.8 GWh in 2000 and 616.3 GWh in 1997. Hydroelectric power sources provided 67.6% of the country's electricity, and fossil fuel sources accounted for the remaining 32.4%. In 2002, national consumption of electricity was 592.2 GWh compared with 644.2 GWh in 2001 and 485.4 GWh in 1997. Lower consumption in 2002 was attributable to the decline in industrial production (Ministere de L'Economie des Finances et du Budget, 2003).

Madagascar had about 50,000 km of roads, of which approximately 5,800 km was paved; the rail network covered nearly 900 km. The country's infrastructure was in need of major repairs and expansion; its inadequacy has been a key factor in preventing the development of Madagascar's bauxite, coal, iron ore, and other mineral deposits.

Outlook

The International Monetary Fund (2003c, p. 180) predicted that Madagascar's GDP would rise by 6% per year in 2003 and 2004. High rates of GDP growth may lead to increased demand for such local construction materials as cement, gravel, limestone, and sand. One development that was likely to encourage growth was the approval of \$2.3 billion in funding for Madagascar's recovery by the International Monetary Fund, World Bank, and other donors (World Bank, 2002).

Madagascar's beryl, chromite, gemstone, gold, graphite, and mica industries depended heavily upon world market conditions and political stability; the same held true for such unexploited mineral commodities as titanium and zirconium. The demand for chromite is tied to the stainless steel market, which was expected to experience strong demand in 2003. Demand for titanium dioxide pigment is expected to increase by about 3% per year from 2002 to 2006. However, increases in supply from new projects are likely to offset the rise in demand (Gambogi, 2003, p. 79.6; Metal Bulletin, 2003).

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TABLE 1
MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES¹

(Kilograms unless otherwise specified)

Commodity ²	1998	1999	2000	2001	2002 ^e
METALS					
Beryllium, beryl in quartz concentrates, industrial and ornamental ^e	30,000 ³	20,000	1,696 ³	1,000	700
Chromium, marketable output:					
Chromite concentrate, gross weight metric tons	19,000	--	24,922 ^r	6,599 ^r	4,400
Chromite ore, lumpy do.	85,300	--	106,371 ^r	17,038 ^r	11,200
Total do.	104,300	--	131,293 ^r	23,637 ^r	15,600
Gold, mine output, Au content ⁴	12	8 ^e	5	(5) ^p	--
INDUSTRIAL MINERALS					
Abrasives, natural (industrial only) ^e	1,500	900	1,300	1,300	850
Cement, hydraulic metric tons	44,327	45,719	50,938	51,882 ^r	33,000
Clay, kaolin ^e do.	200	120	170	170	110
Feldspar ^e	5,600	3,400	7,300 ³	2,800 ^p	1,800
Gemstones: ⁶					
Amethyst	57	100 ^e	156	75 ^p	50
Emerald	1	2 ⁷	6 ⁷	6 ^e	4
Ruby	31	6 ⁷	3	941 ^p	620
Sapphire	2,874	3,810 ⁷	471	8,470 ^p	5,600
Tourmaline ^e	1,286 ³	1,400	1,989 ³	800	500
Graphite, all grades, shipments metric tons	20,629	16,137	40,328	2,013 ^p	1,300
Mica, phlogopite do.	1,232	54	66	90 ^p	60
Ornamental stones: ⁶					
Agate	117,250	75,000 ^e	49,675	25,000 ^e	17,000
Rose quartz ⁸	127,182	30,000 ^e	6,200	10,792 ^p	7,100
Salt, marine metric tons	26,746	26,131	25,530	25,928 ^r	17,000
Stone:					
Dimension ^e do.	1,878 ⁷	138 ⁷	200	200	130
Marble do.	NA	NA	1,222	5,600 ^p	3,700
MINERAL FUELS AND RELATED MATERIALS					
Petroleum refinery products:					
Gasoline thousand 42-gallon barrels	583	617	771	807 ^r	-- ³
Kerosene and jet fuel do.	474	409	410	472 ^r	-- ³
Distillate fuel oil do.	697	749	946	945 ^r	-- ³
Residual fuel oil do.	1,370	1,251	1,420	1,555 ^r	-- ³
Other do.	49	61	75	80 ^r	-- ³
Total do.	3,173	3,087	3,622	3,859 ^r	-- ³

^eEstimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. ^pPreliminary. ^rRevised. NA Not available. -- Zero.

¹Includes data available through January 15, 2004.

²In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (other clays, sand and gravel, and stone) and industrial calcite presumably were produced, but output was not reported quantitatively, and available information was inadequate to make reliable estimates of output levels.

³Reported figure.

⁴Does not include smuggled artisanal production, which was estimated to be 3,000 to 4,000 kilograms per year.

⁵Less than 1/2 of one unit.

⁶Does not include smuggled artisanal production.

⁷Exports.

⁸In recent years, Madagascar has also produced industrial quartz.

TABLE 2
MADAGASCAR: STRUCTURE OF THE MINERALS INDUSTRY IN 2002

(Metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity
Cement	Société Malgache des Ciments (Holcim Group, 90%)	Ibity	150,000 mill; 120,000 kiln.
Do.	SA Nouvelle Cimenterie Amboanio (LaFarge Group, 66%; Moustansir Ibaramdy Family, 34%)	Mahajanga	40,000 mill; 40,000 kiln.
Chromite	Kraomita Malagasy (Government, 100%)	Ankazotaolana	250,000 run of mine.
Do.	do.	Bemanekiva	40,000 run of mine.
Graphite	Etablissements Gallois	Brickaville	4,800.
Do.	do.	Vatomandry	3,600.
Do.	Etablissement Izouard	Andasibe-Perinet	NA.
Do.	Etablissements Rostaing	NA	NA.
Do.	Société Arsene Louis et Compagnie	Tamatave	NA.
Do.	Société Minière de la Grande Ile	Ambatomitamba	6,000 mine; 10,000 processed.
Mica	Société des Mines d'Ampandranhava	Tolagnaro	2,000 processed.
Petroleum, refined ¹	thousand 42-gallon barrels Galana International, Groupe Trimeta, Gulf Oil Corporation, and Petroleum India International	Tamatave	5,475.

NA Not available.

¹Shut down in 2001.