



2013 Minerals Yearbook

MADAGASCAR

THE MINERAL INDUSTRY OF MADAGASCAR

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In 2013, Madagascar played a significant role in the world's production of cobalt, ilmenite, nickel, rutile, and zirconium. The country's share of world mine production of ilmenite amounted to about 4%; mined cobalt, 2%; and mined nickel, rutile, and zirconium, 1% each. Madagascar became a globally significant producer of cobalt and nickel for the first time in 2013. Other domestically significant minerals produced included chromite, gemstones, and ornamental stones. Madagascar was not a globally significant consumer of minerals in 2013; most or all the country's chromite, cobalt, gemstone, graphite, ilmenite, mica, nickel, rutile, and zircon production was exported (Bedinger, 2015a, b; Kuck, 2015; Shedd, 2015).

Minerals in the National Economy

Based on provisional data for 2013, the manufacturing sector accounted for 8.9% of the gross domestic product; the mining sector, 1.2%; and the construction materials sector, 0.3%. The value of output in the mining sector increased by 83% in 2012 and by 128% in 2013. In 2012 (the latest year for which data were available), employment in artisanal mining was estimated to be about 500,000 workers (Ministry of Economy and Planning, 2013, p. ix–x; World Bank Group, The, undated, p. 17).

Production

In 2013, the production of beryl increased by an estimated 369%; refined nickel, by 342%; refined cobalt, by 323%; mined cobalt, by an estimated 228%; mined nickel, by an estimated 225%; quartz, by an estimated 122%; graphite, by an estimated 49%, and amazonite, by an estimated 23%. Mica output decreased by an estimated 23%, and chromite, by an estimated 18%. Crude petroleum production started in 2013. Data on mineral production are in table 1.

Structure of the Mineral Industry

Most of Madagascar's mining and mineral processing operations were privately owned, including the gemstone, graphite, mineral sands, nickel, and salt mines and the cement plants. Artisanal miners produced gemstones, gold, and mica. State-owned Kraomita Malagasy S.A. (KRAOMA) was the country's only chromite producer. Table 2 lists major mineral industry facilities in Madagascar.

Commodity Review

Metals

Bauxite and Alumina.—Resources at the Manantenina project in southeastern Madagascar were estimated to be 10.1 million metric tons (Mt) of bauxite at a grade of 34.1% Al_2O_3 . Aziana Ltd. of Australia engaged in drilling

at Manantenina and acquired the Soanomeiny license near Manantenina in 2013 (Aziana Ltd., 2014, p. 13–14).

Chromium.—KRAOMA produced chromite from the Bemanevika Mine, which had an estimated remaining life of 7 years. The majority of KRAOMA's production was exported to China. Output was constrained by poor infrastructure; the company produced an estimated 91,000 metric tons (t) of chromite in 2013 compared with 111,500 t in 2012. Asia Thai Mining Ltd. of Thailand explored at its Beriana Chromite project in Mahajanga Province (Industrial Minerals, 2014).

Cobalt and Nickel.—Sherritt International Corp. of Canada and its joint-venture partners mined nickel-cobalt laterite deposits at Ambatovy. Lateritic slurry from the Ambatovy ore-processing plant was processed into mixed cobalt and nickel sulfides at a pressure-acid-leaching plant at Toamasina. The sulfide product was processed at a refinery with a capacity of 60,000 metric tons per year (t/yr) of refined nickel and 5,600 t/yr of refined cobalt (Sherritt International Corp., 2014, p. 8).

In 2013, production of nickel and cobalt in mixed sulfides amounted to 29,248 t compared with 8,973 t in 2012. Refined nickel production increased to 25,148 t in 2013 from 5,695 t in 2012, and refined cobalt, to 2,083 t from 493 t. Sherritt and its joint-venture partners planned to produce between 40,000 and 45,000 t of refined nickel in 2014; refined cobalt output was likely to be between 3,300 and 3,800 t. The life of the mine was estimated to be 29 years (Sherritt International Corp., 2014, p. 8, 38–39).

Copper and Gold.—Artisanal miners produced gold at Aziana's Alakamisy project. Drilling programs by Aziana revealed that gold deposits were too widely dispersed for a large-scale mine to be viable. Aziana also engaged in drilling and other exploration at the Anosivola copper-gold project in 2013 (Aziana Ltd., 2014, p. 3, 7–12).

Titanium and Zirconium.—QIT Madagascar Minerals SA (QMM) [QIT Fer et Titane of Canada (a subsidiary of Rio Tinto plc), 80%, and the Government of Madagascar, 20%] mined ilmenite, rutile, and zircon at Mandena in southeastern Madagascar. By 2013, QMM had planned to reach its full capacity of 750,000 t/yr of ilmenite and 60,000 t/yr of zircon, which is composed of quartz, sillimanite, and zircon. The company, however, suspended production in November because of weak demand for titanium dioxide in world markets. At yearend, it was unclear when production would restart (Eisner, 2013, p. 36, 120; Cann, 2014).

World Titanium Resources Ltd. (WTR) of Australia planned to start production at the Ranobe Mine, which is part of the Toliara Sands project in southwest Madagascar, in the second half of 2014. The company planned to produce 407,000 t/yr of ilmenite and 43,000 t/yr of rutile and zircon concentrate over the estimated 21-year life of the mine. In March 2013, WTR signed a joint-venture agreement with Sichuan Lomon Titanium of China for the development of Ranobe. Sichuan Lomon

withdrew from the agreement in August because of an internal dispute in WTR's management. At yearend, it was unclear when production would start (Cann, 2014; Lismore-Scott, 2014).

Industrial Minerals

Gemstones.—In recent years, Madagascar has produced a variety of gemstones that included aquamarine, emerald, and other types of beryl; demantoid, tsavorite, and other types of garnet; amethyst, citrine, and other types of quartz; and agate, amazonite, cordierite, jasper, labradorite; ruby, sapphire, and tourmaline. Most gemstones were exported prior to cutting and polishing.

National sapphire production was reported to be 2,606 kilograms in 2012. Sapphire and other gemstones including alexandrite, garnet, spinel, and zircon, were mined at Ilakaka and Sakaraha. In August 2012, between 10,000 and 20,000 miners were estimated to be involved in gemstone production near Ilakaka and Sakaraha, which included about 6,500 in the Taheza River Basin, about 2,500 in the Fiherenana River and Malio River Basins, between 500 and 1,000 in the Benahy River and Imaloto River Basins, and 300 in the Ilakaka River Basin. Most of the mining operations were artisanal in 2012; mechanized operations produced at Ankaboka, Ambinany, and at Amabrazy in the Ilakaka River Basin. The mechanized operations in the Benahy River Basin ceased between 2010 and 2012 (Ministry of Economy and Planning, 2013, p. 55; Pardieu, 2013).

EUROMAD S.A. and Marbres et Granits de Madagascar SARL (MAGRAMA), both of Italy, and SQNY International of India had royalty agreements with Malagasy Minerals Ltd. (MML) of Australia to mine labradorite from the anorthosite intrusives at Ianapera and Maniry. Norcross Madagascar Group of the United States mined agate, amazonite, amethyst, apatite, calcite, jasper, labradorite, rhodonite, rose quartz, and other quartz. In December 2010, Norcross was producing amazonite in the Amboasitra region at the rate of 20 metric tons per month (t/mo). By June 2013, the company had increased amazonite production and was producing beryl as a coproduct at the rate of 10 t/mo (Norcross Madagascar Group, 2010; 2013).

Graphite.—Madagascar's graphite production was limited in recent years by competition from Chinese producers, the depletion of near-surface deposits, high energy costs, and problems with infrastructure. At the beginning of 2013, Etablissements Gallois S.A. was the only remaining producer that regularly mined and exported graphite. The increase in graphite output to an estimated 4,300 t in 2013 from 2,885 t in 2012 was mostly attributable to Etablissements Gallois. National production was still far below the levels of the 1990s (National Institute of Statistics, 2000, p. 12; Syrett, 2012; Industrial Minerals, 2014).

In 2013, Graphmada Equity Pte Ltd. (Stratmin Global Resources plc of the United Kingdom, 100%) sold about 200 t of graphite from its new mine at the Loharno project, which had a capacity of nearly 2,200 t/yr. Stratmin planned to increase its capacity to 3,600 t/yr in 2014 by upgrading its processing plant and subsequently to 7,200 t/yr by adding another shift. Indicated

resources at Loharno were estimated to be 421,000 t at a grade of 5.15% carbon and inferred resources, 5.23 Mt at a grade of 4.04% graphite (Chadwick, 2013; Industrial Minerals, 2014).

Societe Malagache du Graphite held a mining license for the Ambatomitamba Mine, which closed during the 2000s. The company planned to restart production at the rate of 1,500 t/yr of graphite initially before increasing production to 2,500 t/yr in the second phase and the mine's full capacity of 4,000 t/yr in the third phase. At yearend, it was unclear if mining had restarted (Industrial Minerals, 2014).

In February 2013, Energizer Resources Inc. of Canada estimated that resources at its Molo graphite deposit were 124 Mt at a grade of 6.34% graphite. Energizer completed a preliminary economic assessment on a new mine at Molo and planned to complete a feasibility study by the fourth quarter of 2013. Depending on favorable results of the study, Energizer could start construction at Molo in the second quarter of 2014 and mining by the fourth quarter of 2015. Production was likely to be 84,000 t/yr of graphite. By yearend, the completion of the feasibility study had been rescheduled for 2014 (Reed, 2013; Industrial Minerals, 2014).

MML engaged in sampling at the Ianapera and the Maniry projects in the second half of 2012 and the first half of 2013. The company hoped to identify a resource of more than 5 Mt at a grade of at least 15% graphite. Aziana engaged in channel sampling at Antanisoa and drilling at Belanitra in the second half of 2013 (Malagasy Minerals Ltd., 2013, p. 6–9; Aziana Ltd., 2014, p. 15–17).

Mica.—Societe des Mines d'Ampandrandrava produced about 1,000 t/yr of mica from mines in southeastern Madagascar. Increased production between 2009 and 2012 probably was attributable to artisanal miners near Analamaria in the Anosy Region (Chamber of Commerce and Industry of Antananarivo, 2011).

Rare Earths.—In 2013, Tantalus Rare Earths AG of Germany was engaged in the construction of a pilot leaching plant at its TRE project on the Ampasindava Peninsula in northwestern Madagascar. In April, the company revised its resource estimate to 435 Mt at a grade of 0.08% rare-earth oxides, of which 19% was heavy rare earths. Tantalus planned to complete a prefeasibility study on a new mine at TRE in the first half of 2014 (Scholes, 2013, p. 12–13).

Mineral Fuels

Coal.—Lemur Resources Ltd. of Australia held the Ianapera, the Imaloto, and the Sakaraha projects in the northern part of the Greater Sakoa basin. In September, Lemur completed a scoping study on a new mine at Imaloto with positive results. In the first 9 years of the mine's life, the company could produce 410,000 t/yr of coal for use in a new coal-fired power station adjacent to the mine and 78,000 t/yr for export. In the remaining 10 years of the mine's life, production could be 530,000 t/yr for use in the power station and 990,000 t/yr for export. Resources at Imaloto were estimated to be 136 Mt. The development of the mine depended on favorable results of further studies (Lemur Resources Ltd., 2013).

Petroleum.—In 2013, Madagascar Oil Ltd. of Bermuda started production at its pilot plant at the onshore Tsimiroro heavy oil project (located in Block 3104). By yearend, the company had produced more than 36,000 barrels of crude petroleum. Resources at Tsimiroro were estimated to be 1.7 billion barrels. Madagascar Oil planned to farm out Blocks 3105, 3106, and 3107 in 2014 (Madagascar Oil Ltd., 2014, p. 6–7, 9).

Outlook

In 2014, growth in the value of the mining sector from increased cobalt, graphite, and nickel production is likely to be offset by the suspension of ilmenite, rutile, and zircon mining. The mineral industry of Madagascar is likely to grow between 2015 and 2017 because of further potential increases in cobalt, graphite, and nickel production. Madagascar could become one of the world's leading graphite producers with the development of the Molo project. Further growth in the mineral industry could result from the development of coal, petroleum, and rare-earths projects. The development of the mineral industry will depend on world market conditions and domestic political stability.

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TABLE 1
MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	2009	2010 ^e	2011 ^e	2012 ^e	2013 ^e	
METALS						
Beryllium, beryl in quartz concentrates ^e	kilograms	12,000	12,000	12,000	16,000	75,000
Chromite, marketable output		133,000 ³	134,500 ³	66,700 ³	111,500 ^{r,3}	91,000
Cobalt:						
Mine output, Co content		--	-- ^{r,4}	-- ^{r,4}	670 ^r	2,200
Refined		--	-- ⁴	-- ⁴	493 ⁴	2,083 ⁴
Gold, mine output, Au content ^{e,5}	kilograms	17 ^r	46 ^{r,4}	1 ^{r,4}	157 ^{r,4}	--
Nickel:						
Mine output, Ni content		--	-- ^{r,4}	-- ^{r,4}	8,300 ^r	27,000
Refined		--	-- ⁴	-- ⁴	5,695 ⁴	25,148 ⁴
INDUSTRIAL MINERALS						
Cement, hydraulic ^e		140,000 ^r	160,000 ^r	150,000 ^r	150,000 ^r	150,000
Gemstones: ^{e,6}						
Amethyst ⁷	kilograms	19,000 ^r	90,000 ^r	90,000 ^r	90,000 ^r	90,000
Cordierite	do.	60	80	80	100 ^r	100
Emerald	do.	10 ³	2	70 ^r	140 ^{r,3}	140
Garnet	do.	200	300	300	400 ^r	400
Ruby	do.	2 ³	90	50 ^r	24 ^{r,3}	25
Sapphire	do.	428 ³	2,300	2,500 ^r	2,606 ^{r,3}	2,600
Tourmaline ⁷	do.	15,000 ^r	20,000 ^r	25,000 ^r	25,000 ^r	25,000
Graphite, all grades		3,437 ³	3,783 ³	3,573 ³	2,885 ^{r,3}	4,300
Gypsum		156	127 ⁴	130	130	130
Kaolin		90	259 ⁴	260	260	260
Mica, phlogopite		358 ³	2,069 ³	3,411 ³	12,532 ^{r,3}	9,600
Ornamental stones: ^{e,6}						
Agate	kilograms	50,000 ^r	80,000 ^r	100,000 ^r	100,000 ^r	100,000
Amazonite		--	120	180	220	270
Labradorite		4,100 ^r	4,600 ^r	5,700 ^r	6,700 ^r	6,700
Quartz		104 ³	407 ³	214 ³	221 ^{r,3}	490
Salt, marine ^e		75,000	78,000 ^r	85,000	85,000	85,000
Stone:						
Granite		1,239 ³	1,543 ^{r,3}	3,701 ^{r,3}	2,519 ^{r,3}	2,500
Limestone ^{e,8}		180,000 ^r	210,000 ^r	200,000 ^r	200,000 ^r	200,000
Marble		3 ³	-- ³	1 ^{r,3}	-- ³	--
Other		2,445 ³	670	-- ^r	-- ^r	-- ^r
Titanium:						
Ilmenite concentrate:						
Gross weight		160,000	287,000 ⁴	464,000 ^{r,4}	529,790 ^{r,4}	560,000
TiO ₂ content		96,000	172,000	278,000 ^r	318,000 ^r	340,000
Rutile concentrate		3,200 ^e	5,700	9,300 ^r	11,000 ^r	12,000
Zirconium, zircon concentrate		4,755	7,490 ⁴	13,075 ⁴	15,000 ^r	16,000
MINERAL FUELS AND RELATED MATERIALS						
Petroleum, crude	thousand 42-gallon barrels	2 ^e	-- ⁴	-- ⁴	-- ⁴	36 ⁴

^eEstimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. ^rRevised. do. Ditto. -- Zero.

¹Table includes data available through February 27, 2015.

²In addition to the commodities listed, crude construction materials (other clays and sand and gravel), ornamental stones in addition to those listed (apatite and rhodonite), industrial abrasives, and calcite presumably are produced, but available information is inadequate to make reliable estimates of output.

³Reported exports.

⁴Reported production.

⁵Does not include smuggled artisanal production, which is estimated to be from 1,000 to 2,000 kilograms per year.

⁶Does not include smuggled artisanal production.

⁷Includes both gem and ornamental quality.

⁸Cement producers only.

TABLE 2
MADAGASCAR: STRUCTURE OF THE MINERAL INDUSTRY IN 2013

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Cement		Madagascar Long Cimenterie (Maloci)	Plant at Ambohimambola	360,000.
Do.		Holcim (Madagascar) S.A. (Holcim Group, 90%)	Plant at Ibity	160,000.
Chromium		Kraomita Malagasy S.A. (KRAOMA) (Government, 100%)	Mine at Bemanevika	200,000. ^e
Cobalt				
Mine		Ambatovy Minerals S.A. (Sherritt International Corp., 40%; Sumitomo Corp., 27.5%; Korea Resources Corp., 27.5%)	Mine at Ambatovy	6,500. ^e
Refined		do.	Refinery near Toamasina	5,600.
Gemstones:				
Rough:				
Amazonite		Norcross Madagascar Group (NMG)	Mine in Amboasitra region	270. ^e
Amethyst		do.	Mines at Ambatonrazaka	90. ^e
Aquamarine		Small-scale miners	Mine at Tsaramanga	NA.
Emerald	kilograms	Artisanal and small-scale miners	Mines at Mananjary	150. ^e
Garnet		do.	Mines at Antetazambato	NA.
Do.		do.	Mines at Behara	NA.
Labradorite		Marbres et Granits de Madagascar SARL (MAGRAMA) and EUROMAD S.A.	Mines at Ianapera and Maniry	3,000. ^e
Do.		SQNY International	do.	2,000. ^e
Do.		Norcross Madagascar Group (NMG)	Mines at Maniry	2,700. ^e
Quartz		do.	Mines at Ramaratina	NA.
Do.		Small-scale miners	Mine at Tsaramanga	NA.
Ruby	kilograms	Artisanal and small-scale miners	Mines at Andilamena and Vatomandry	100. ^e
Sapphire	do.	Various producers, including the following: Artisanal and small-scale miners Tany Hafa S.A. Nantin Ltd. and artisanal miners	Locations: Mines at Ilakaka, Manombe, Marosely, and Sakara Mines at Sahambano Mines at Ankazoabo	2,600. ^e
Tourmaline	do.	Artisanal and small-scale miners	Mines at Alatsinainuy Ibity	NA.
Polished ¹	do.	Dream Stones Trading	Plant in Antananarivo	15.
Graphite		Etablissements Gallois S.A.	Artsirakambo Mine near Brickaville	4,800.
Do.		do.	Marovinsty Mine near Vatomandry	3,600.
Do.		do.	Ambalafotaka Mine	NA.
Do.		Graphmada Equity Pte Ltd.	Mines at Antsirabe and Loharano	2,200. ^e
Do.		do.	Plant at Loharano	2,200.
Gypsum		Compagnie Salinere de Madagascar	Antsahampano	500.
Mica		Societe des Mines d'Ampandandrava (SOMIDA)	Mines in Anosy Region	1,000.
Do.		Artisanal and small-scale miners	do.	NA.
Nickel				
Mine		Ambatovy Minerals S.A.	Mine at Ambatovy	60,000. ^e
Refined		do.	Refinery near Toamasina	60,000.
Petroleum, crude	thousand 42-gallon barrels	Madagascar Oil Ltd.	Tsimiroro ²	90. ^e
Salt		Compagnie Salinere de Madagascar	Antsahampano	80,000.
Titanium minerals		QIT Madagascar Minerals S.A. [QIT Fer et Titane of Canada (a subsidiary of Rio Tinto plc), 80%, and Government, 20%]	Mine at Mandena ²	750,000 ilmenite; 15,000 rutile.
Zirconium		do.	do.	40,000 zircon.

^eEstimated. Do., do. Ditto. NA Not available.

¹Includes amethyst, aquamarine, emerald, sapphire, tourmaline, and other gemstones.

²Not operating at the end of 2013.