



2015 Minerals Yearbook

MADAGASCAR [ADVANCE RELEASE]

THE MINERAL INDUSTRY OF MADAGASCAR

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In 2015, Madagascar played a significant role in the world's production of cobalt, ilmenite, nickel, and zirconium. The country's share of world refined production of cobalt amounted to nearly 4%; mined cobalt, 3%; ilmenite and mined nickel, 2% each; and zirconium, 1%. Other domestically significant minerals produced included chromite, gemstones, and ornamental stones. Madagascar was not a globally significant consumer of minerals in 2015 (Bedinger, 2017a, b; Cobalt Development Institute, 2016; Schnebele, 2017; Shedd, 2017).

Minerals in the National Economy

In 2015, the manufacturing sector accounted for 8% of the gross domestic product (GDP). The share of the mining and quarrying sector in the GDP increased to an estimated 4.8% in 2015 from 4.2% in 2014 and 0.4% in 2011; the increase was primarily attributable to increased production at the Ambatovy nickel-cobalt mine (Ministry of Economy and Planning, 2015, p. xx; World Trade Organization, 2015, p. 13).

In 2014, total exports were valued at \$2.2 billion, of which nickel accounted for 27%; cobalt, 3.9%; and other minerals, including chromite, gemstones, graphite, ilmenite, mica, ornamental stones, rutile, and zircon, 5.1%. Exports amounted to 21% of the GDP in 2014. In 2007, total exports were valued at \$1.3 billion, of which minerals accounted for 2.9%. Increased mineral exports were attributable to the startup of ilmenite, rutile, and zircon production in 2009, and cobalt and nickel production, in 2012 (Ministry of Economy and Planning, 2015, p. 26; World Trade Organization, 2015, p. 17).

The United States imported nickel from Madagascar valued at \$91.5 million in 2015 and \$72 million in 2014. Other mineral imports from Madagascar included nonferrous metals other than copper and gold, which were valued at \$24.3 million in 2015 and \$23.3 million in 2014. Imports of gemstones other than diamond increased to \$15 million in 2015 from \$9 million in 2014 (U.S. Census Bureau, 2016).

In 2014, total imports were valued at \$3.3 billion, of which mineral fuels accounted for 22.1%, and mining and quarrying products, 3.4%. In 2007, total imports were valued at \$2.4 billion, of which mineral fuels accounted for 16.6%, and mining and quarrying, 0.3% (World Trade Organization, 2015, p. 17).

In 2014, formal employment in the mining and quarrying sector was reported to be 5,583 workers compared with 4,600 workers in 2013. Between 100,000 and 500,000 additional workers were estimated to be employed in artisanal mining (PricewaterhouseCoopers Madagascar, 2016, p. 25, 89).

Madagascar's mining and quarrying sector was governed by the Mining Code and its implementing decree (law No. 99-022 of August 19, 1999, as amended by law No. 2005-021 of October 17, 2005, and Decree No. 2006-910 of December 19, 2006). Exploration and production of petroleum was governed by the Petroleum Code and its implementing decree (law No. 96-018 of September 4, 1996, and Decree No. 97-740 of June 23, 1997).

In December 2015, the Government announced that new mining and petroleum laws would not be passed before yearend. The Government expected to pass the laws in early 2016. The most recent draft of the new mining law had provisions to increase royalty rates and to give the Government a 10% free-carried interest in all new mining projects (Mellersh, 2015).

Production

In 2015, quartz production increased by an estimated 151%; chromite, by an estimated 137%; ruby, by an estimated 64%; mica, by an estimated 55%; ammonium sulfate, by 40%; graphite, by an estimated 37%; mined and refined nickel, by 28% each; refined cobalt, by 19%; mined cobalt, by an estimated 18%; and sapphire, by an estimated 10%. The production of rutile decreased by an estimated 30% in 2015; ilmenite, by an estimated 28%; zircon, by an estimated 27%; garnet and tourmaline, by an estimated 19% each; cordierite and crude petroleum, by an estimated 18% each; amazonite, by an estimated 17%; agate and amethyst, by an estimated 16% each; labradorite, by an estimated 15%; and calcite, by an estimated 13%. 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, mica, and salt. State-owned Kraomita Malagasy SA (KRAOMA) was the country's only chromite producer. Table 2 lists major mineral industry facilities in Madagascar.

Commodity Review

Metals

Chromite.—KRAOMA produced high-grade chromite from the Bemanevika Mine in the Betsiboka Region. In 2015, the company's production increased to an estimated 230,000 metric tons (t) from 97,250 t in 2014 and 134,500 t in 2010; output was at the highest level since at least 2000. Increased production was attributable to the opening of new mines (Institut National de la Statistique de Madagascar, 2016).

Cobalt and Nickel.—Sherritt International Corp. of Canada and its joint-venture partners Sumitomo Corp. of Japan and Korea Resources Corp. mined nickel-cobalt laterite deposits at Ambatovy. SNC-Lavalin Group Inc. sold its 5% share in the Ambatovy project to Sumitomo in September 2015. 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 cobalt (Sherritt International Corp., 2016, p. 12).

In 2015, production of nickel and cobalt in mixed sulfides amounted to 48,995 t compared with 39,968 t in 2014. Refined nickel production increased to 47,271 t in 2015 from 37,053 t in 2014, and refined cobalt, to 3,464 t from 2,915 t. Nickel and cobalt production were at record levels in 2015. The recovery rate for nickel was 86% in 2015. Sherritt and its joint-venture partners planned to produce between 48,000 and 50,000 t of refined nickel in 2016; refined cobalt output was likely to be between 3,300 and 3,800 t. The remaining life of the mine was estimated to be 28 years (Sherritt International Corp., 2016, p. 12, 24, 30).

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. In 2015, QMM produced an estimated 240,000 t of ilmenite and 20,000 t of zircon compared with 333,736 t of ilmenite and 27,275 t of zircon in 2014 and 530,421 t of ilmenite and 31,345 t of zircon in 2013. The company's production decreased because of weak demand in world markets (EY, 2015, p. 64; Jorgic and Rabary, 2015).

World Titanium Resources Ltd. (WTR) of Australia was considering the development of the Ranobe Mine, which is part of the Toliara Sands project in southwestern Madagascar. The company had planned to produce 407,000 t/yr of ilmenite and 44,000 t/yr of rutile and zircon concentrate at Ranobe. Depending on financing, WTR could start production in 2021 and reach full capacity in 2023. In 2015, WTR was engaged in a scoping study with a new production plan because of oversupplies of ilmenite on world markets (World Bank Group, 2015, p. 15, 18; World Titanium Resources Ltd., 2015).

Industrial Minerals

Gemstones.—In recent years, Madagascar 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 to cutting centers in other countries, including Thailand.

Sapphire was mined at Ilakaka, Manombe, Marosely, Sakara, and other locations. Between 2012 and 2014, sapphire production increased to 4,534 kilograms (kg) from 2,606 kg. In 2015, sapphire production increased to an estimated 5,000 kg because of the discovery of new deposits at Andrebabe (Ministry of Economy and Planning, 2013, p. 55; PricewaterhouseCoopers Madagascar, 2016, p. 67).

Ruby was mined at Andilamena; production increased to 73 kg in 2014 from 24 kg in 2012. In 2015, ruby production increased to an estimated 120 kg because of the discovery of new deposits near Ambodivoangy in July. The Government shut down the mines, which were located in Zahamena National Park, in August. The closure was only temporarily successful because of the remoteness of the mines (Ministry of Economy and Planning, 2013, p. 55; Pardieu and others, 2015; PricewaterhouseCoopers Madagascar, 2016, p. 66).

Emerald was mined at Kianjavato; production decreased to 15 kg each in 2015 and 2014 from 140 kg in 2012. Amethyst was mined in the Ambatondrazaka District and tourmaline at sites including Ambatonapetraka (Ministry of Economy and Planning, 2013, p. 55; PricewaterhouseCoopers Madagascar, 2016, p. 66).

Graphite.—Madagascar's graphite production increased to an estimated 7,800 t in 2015 from 5,705 t in 2014 and 3,783 t in 2010. Etablissements Gallois S.A. produced 3,833 t of graphite from the Ambalafotaka, the Antsirakambo, and the Marovintsy Mines in 2013; the company's production was likely to have increased substantially by 2015 (EY, 2015, p. 64; Institut National de la Statistique de Madagascar, 2016).

In April 2014, Graphmada Equity Pte Ltd. (Stratmin Global Resources plc of the United Kingdom, 100%) was producing at the rate of about 1,400 t/yr with a grade of 92% graphite at the Loharno Mine. Between September and November 2015, the company produced at the rate of 2,800 t/yr. Stratmin planned to increase production to at least 4,800 t/yr starting in January 2016 and to more than 7,200 t/yr starting in the second quarter of 2016. Depending on financing, Stratmin could build a new processing plant at Loharno with a capacity of 12,000 t/yr in 2016 (Lismore-Scott, 2014; Stratmin Global Resources plc, 2015).

Stratmin and its joint-venture partner Tirupati Carbon & Chemicals Pvt. Ltd. of India planned to build a new graphite mine and processing plant at the Vatomaina project. Depending on financing, construction could start in the first quarter of 2016 and mining, in the second quarter of 2017. Planned production was 12,000 t/yr (Stratmin Global Resources plc, 2015).

By the first quarter of 2016, Stratmin planned to start exploration near Andranombolahy, which is about 30 kilometers north of the Loharno Mine. The company hoped to discover resources capable of supporting a new mine with a capacity of 12,000 t/yr (Stratmin Global Resources plc, 2015).

In 2015, Energizer Resources Inc. of Canada completed a feasibility study on a new mine at its Molo graphite deposit, with favorable results. Energizer planned to produce 53,000 t/yr of graphite concentrate at a grade of more than 97% graphite during the estimated 26-year life of the mine. Production could start at Molo in 2017. Reserves were estimated to be 22.4 million metric tons (Mt) at a grade of 7.02% graphite (Energizer Resources Inc., 2015).

Malagasy Minerals Ltd. of Australia (MML) engaged in drilling at the Fitia, the Haja, the Ivan, and the Razafy prospects, which were part of the Maniry project. The company hoped to identify resources of more than 5 Mt at a grade of at least 15% graphite (Malagasy Minerals Ltd., 2015, p. 3, 11).

Mica.—Groupe AKESSON Mineragrex S.A. produced more than 1,500 t/yr of mica from its five mines in southeastern Madagascar. Artisanal miners also produced mica near Analamaria in the Anosy Region. In 2015, national mica output increased to an estimated 19,000 t from 12,280 t in 2014 and 2,069 t in 2010 (Institut National de la Statistique de Madagascar, 2016).

Nitrogen.—Sherritt and its joint-venture partners consumed ammonia in the production of cobalt and nickel at Ambatovy. Ammonium sulfate fertilizer was produced as a byproduct; output increased to 137,325 t in 2015 from 97,780 t in 2014. The ammonium sulfate production capacity at Ambatovy was 210,000 t/yr (Sherritt International Corp., 2016, p. 30).

Rare-Earths.—In March 2015, Tantalus Rare Earths AG of Germany announced plans to start pilot production at its rare-earths project on the Ampasindava Peninsula in northwestern Madagascar. Tantalus planned to start large-scale rare-earths mining by the end of 2016. In October, however, the company announced plans to file for bankruptcy. In December, Tantalus agreed to sell 60% of its Madagascan operations to Apphia Minerals SOF PTE Ltd. of Singapore. Tantalus planned to withdraw its bankruptcy application after the sale. The company also announced plans to sell the remaining 40% of its Madagascan operations to Apphia (Cornish and Kotze, 2015; Tantalus Rare Earths AG, 2015a, b).

Salt.—Compagnie Salinière de Madagascar (CSM) was Madagascar's leading salt producer. The company produced 80,000 t/yr of salt near Antsiranana, which was about 67% of national production. CSM, Grands Salins du Menabe, Les Salins du Menabe, and SABEMER produced about 23,000 t/yr in the Menabe Region. In Tulear Province, artisanal miners produced about 13,000 t/yr (table 2).

Mineral Fuels

Coal.—In September 2013, Lemur Resources Ltd. of Australia 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, which is located in the northern part of the Greater Sakoa Basin, were estimated to be 136 Mt. The development of the mine depended on favorable results of further studies. In September 2015, Lemur was acquired by Bushveld Minerals Ltd. of the United Kingdom (Lemur Resources Ltd., 2013; Bushveld Minerals Ltd., 2015).

Petroleum.—Madagascar Oil Ltd. of Bermuda continued production at its pilot plant at the onshore Tsimiroro heavy oil project (located in Block 3104). If the company is able to obtain financing, find a joint-venture partner, and convert resources to reserves, large-scale production could start in 2018. Madagascar Oil could increase production to about 20,000 barrels per day (bbl/d) by 2019, 80,000 bbl/d by 2022, and to the planned peak of 160,000 bbl/d by 2025. Petroleum from Tsimiroro was expected to be consumed domestically in power stations initially; an export pipeline would be constructed as output increased. Resources were estimated to be about 1.7 billion barrels (Madagascar Oil Ltd., 2015, p. 7, 9–11, 17).

Outlook

Ammonium sulfate, cobalt, and nickel production is likely to increase in 2016 after reaching record levels in 2015. Madagascar could become one of the world's leading graphite producers with the expansion of the Loharno Mine in 2016 and the development of the Molo and the Vatomaina projects in 2017. Ilmenite, rutile, and zircon production output could increase in the future with the development of the Ranobe Mine. 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	2011 ^e	2012	2013	2014	2015 ^e
METALS					
Beryllium, beryl in quartz concentrates ^c	12,000	16,000	85,000 ^r	135,000	140,000
Chromite, marketable output:	66,700 ³	111,500 ³	88,000 ³	97,250 ^{r,3}	230,000
Cobalt:					
Mine output, Co content	-- ⁴	830 ^e	2,600 ^e	3,400	4,000
Refined	-- ⁴	493 ⁴	2,083 ⁴	2,915 ⁴	3,464 ⁴
Gold, mine output, Au content ⁵	1 ⁴	157	--	-- ⁴	-- ⁴
Nickel:					
Mine output, Ni content	-- ⁴	9,600 ^e	31,000 ^e	43,000	55,000
Refined	-- ⁴	5,695	25,148	37,053 ⁴	47,271 ⁴
Titanium minerals:					
Ilmenite concentrate ⁶	521,627 ⁴	620,700	530,421	333,736 ^{r,4}	240,000
Rutile concentrate ^c	9,000	12,000	11,000	6,900 ^r	4,800
Zircon concentrate	18,242 ⁴	31,242	31,345	27,275 ^{r,4}	20,000
INDUSTRIAL MINERALS					
Ammonium sulfate	-- ⁴	15,823	65,410	97,780 ⁴	137,325 ⁴
Cement, hydraulic ^c	160,000	230,000	230,000	240,000	240,000
Clay:					
Kaolin	260	230	200	221 ^{r,4}	220
Other	NA	24,085	29,751	26,797 ^{r,4}	27,000
Gemstones: ^{e,7}					
Amethyst ⁸	90,000	90,000	90,000	90,000	76,000
Cordierite	1,600 ^r	730 ^r	880 ^r	1,100 ^r	900
Emerald	70	140 ³	80 ^r	15 ^{r,3}	15
Garnet	2,500 ^r	1,100 ^r	1,300 ^r	1,600 ^r	1,300
Ruby	50	24 ³	50 ^r	73 ^{r,3}	120
Sapphire	2,500	2,606 ³	3,500 ^r	4,534 ^{r,3}	5,000
Tourmaline ⁸	660,000 ^r	290,000 ^r	360,000 ^r	430,000 ^r	350,000
Graphite, all grades	3,873 ^{r,3}	2,842 ^{r,3}	4,297 ^{r,3}	5,705 ^{r,3}	7,800
Gypsum ^c	130	130	130	130	130
Mica, phlogopite	3,950 ^{r,3}	12,556 ^{r,3}	9,782 ^{r,3}	12,280 ^{r,3}	19,000
Ornamental stone: ^{e,7}					
Agate	1,000	1,000	1,000	800	670
Amazonite	240	240	280	420	350
Calcite	NA	175 ^{r,4}	200 ^{r,4}	150 ^{r,4}	130
Labradorite	7,000	8,500	11,000	13,000	11,000
Quartz	306 ^{r,3}	221 ³	347 ^{r,3}	243 ^{r,3}	610

See footnotes at end of table.

TABLE 1—Continued
MADAGASCAR: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity ²	2011 ^e	2012	2013	2014	2015 ^e	
INDUSTRIAL MINERALS—Continued						
Salt ^c	110,000 ^r	110,000 ^r	110,000 ^r	120,000 ^r	120,000	
Stone:						
Dolomite	NA	2,540	3,730	4,153 ^{r,4}	4,200	
Granite	3,701 ⁴	2,519	3,078	3,100	3,100	
Limestone ^{e,9}	110,000 ^r	164,183	164,718	164,218 ^{r,4}	170,000	
Marble	1 ³	--	--	--	--	
Pozzolanic material	NA	54,979	65,000	42,129 ^{r,4}	43,000	
MINERAL FUELS AND RELATED MATERIALS						
Petroleum, crude	thousand 42-gallon barrels	-- ⁴	--	40 ^r	116 ^{r,4}	95

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

¹Table includes data available through February 2, 2017.

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

³Reported exports.

⁴Reported production.

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

⁶TiO₂ content of ilmenite was previously reported, but available information was inadequate to make reliable estimates of output.

⁷Does not include smuggled artisanal production.

⁸Includes both gem and ornamental quality.

⁹Cement producers only.

TABLE 2
MADAGASCAR: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(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 Ambohimanambola	360,000.
Do.	LafargeHolcim (Madagascar) S.A. (LafargeHolcim Ltd., 90%)	Plant at Ibity	200,000.
Chromium	Kraomita Malagasy S.A. (KRAOMA) (Government, 100%)	Mine at Bemanevika and three other mines	300,000. ^e
Clay	LafargeHolcim (Madagascar) S.A.	Mine in Manjakandriana Region	30,000. ^e
Cobalt:			
Mine	Ambatovy Minerals S.A. (Sherritt International Corp., 40%; Sumitomo Corp., 32.5%; Korea Resources Corp., 27.5%)	Mine at Ambatovy	6,500. ^e
Refined	do.	Refinery near Toamasina	5,600.
Gemstones:			
Amazonite	Norcross Madagascar Group (NMG)	Mine in Amboasitra region	420. ^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 Behara	NA.
Labradorite	Norcross Madagascar Group (NMG)	Quarries at Maniry	3,600. ^e
Do.	Red Graniti Madagascar SARL	Quarry in Atsimo-Andrefana Region	3,600. ^e
Do.	Marbres et Granits de Madagascar SARL (MAGRAMA) and EUROMAD S.A.	Quarries at Ianapera and Maniry	3,000. ^e
Do.	SQNY International	do.	2,000. ^e
Do.	Societe Labrador Madagascar	Quarry in Atsimo-Andrefana Region	600. ^e

See footnotes at end of table.

TABLE 2—Continued
MADAGASCAR: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Gemstones:—Continued				
Quartz		Norcross Madagascar Group (NMG)	Mines at Ramaratina	NA.
Do.		Small-scale miners	Mine at Tsaramanga	NA.
Ruby	kilograms	Artisanal and small-scale miners	Mines at Andilamena and Vatomandry	160. ^c
Sapphire	do.	Various producers, including the following: Artisanal and small-scale miners Tany Hafa S.A.	Locations: Mines at Andrebabe, Ilakaka, Manombe, Marosely, and Sakara Mines at Sahambano	5,000. ^c
Tourmaline	do.	Artisanal and small-scale miners	Mines at Alatsinainuy Ibity	NA.
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.	Mine at Loharano	6,000.
Do.		do.	Plant at Loharano	2,200.
Gypsum		Compagnie Salinere de Madagascar	Antsahampano	500.
Mica		Groupe AKESSON Mineragrex S.A.	5 mines in southeastern Madagascar	1,500. ^c
Do.		Artisanal and small-scale miners	Mines near Analamaria in Anosy Region	NA.
Nickel:				
Mine		Ambatovy Minerals S.A.	Mine at Ambatovy	70,000. ^c
Refined		do.	Refinery near Toamasina	60,000.
Nitrogen		do.	do.	210,000 ammonium sulfate.
Petroleum, crude	thousand 42-gallon barrels	Madagascar Oil Ltd.	Tsimiroro	180.
Pozzolanitic material		LafargeHolcim (Madagascar) S.A.	Quarry in Vakinankaratra Region	170,000. ^c
Salt		Compagnie Salinière de Madagascar	Mine near Antsiranana	80,000.
Do.		Grand Salines du Menabe and other companies	Menabe Region	23,000. ^c
Do.		Artisanal miners	Tulear Province	13,000. ^c
Stone:				
Dolomite		PROCHIMAD	Quarry in Amoron'i Mania Region	4,200. ^c
Granite		Granitex SARL	Quarry in Manjakandriana Region	3,300. ^c
Limestone		LafargeHolcim (Madagascar) S.A.	Quarry in Vakinankaratra Region	170,000. ^c
Titanium minerals		QIT Madagascar Minerals S.A. [QIT Fer et Titane (a subsidiary of Rio Tinto plc), 80%, and Government, 20%]	Mine at Mandena	750,000 ilmenite; 15,000 rutile.
Zirconium		do.	do.	40,000 zircon.

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