

## MADAGASCAR

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According to official figures, Madagascar's chief mineral export is chromium ore and concentrate (166,096 t in 1998); but it is the unofficial production of gold - estimated to be about three or four tonnes per year - which represents the allure of Madagascar's mineral potential. Gold is mined by some 100,000 artisanal miners from small, high-grade occurrences, too small to have yet attracted any major company to explore or mine there.

The style of mining is matched in the trading of gold, which is also carried out in the informal sector, making tracking of gold sales and their value difficult. Figures in the British Geological Survey's annual publication, 'World Mineral Statistics', reflect only estimates (10 kg per annum) of gold in Madagascar.

Such is the extent and environmental impact of artisanal mining that the country's Ministry of Mines & Energy has been prompted to embark upon normalising the small-scale mining sector, part of a US\$5 million World Bank-funded Mining Sector Reform Project. Centred around the town of Antsirabe, the project began in 1999 and will end next year.

According to the late Australia-based geologist Camillo Premoli, more than 2.3 Moz of gold have been produced from nine known goldfields since the early 1900s. "Madagascar's auriferous potential is grossly under-evaluated, roughly comparing to Western Australia in the 1950s - a lot of small, abandoned mines worked for higher grade ore and only to the water table," he said. "It stands to reason that if modern exploration is applied, a few of these old workings could lead to much larger resources."

While much of the gold has come from alluvial operations, potential investors would mainly be interested in primary gold. Madagascar's lode gold deposits occur mostly in sulphide-bearing quartz veins systems. With the exceptions of the Betsiaka district in the extreme north - probably an epithermal system - all the other auriferous districts are in Precambrian terrains and seem to belong to the mesothermal lode gold type.

Precambrian metamorphic terrain constitutes two-thirds of Madagascar's surface area, and it is here that most of the country's mineral occurrences have been found. Among the larger discoveries have been chromite, bauxite, graphite, mica and kaolin.

Ranking among the top ten chromite producers worldwide, Madagascar boosted production from 134,000 t in 1997 to over 160,000 t of chromium ores and concentrates in 1998; about 140,000 t came from Kraomita Malagasy's Andrianema mine - 40,000 t of concentrates (49% Cr<sub>2</sub>O<sub>3</sub>), 80,000 t of lumpy ore (42% Cr<sub>2</sub>O<sub>3</sub>) and 20,000 t of fines from the Behandrinana mine. (Figures for 1999 were unavailable at the time of going to press.) Chromite reserves at Andrianema are sufficient to support production for decades, and several promising but untested chromite prospects occur throughout northern Madagascar.

The Manantenina bauxite deposit is located in the south-eastern coastal area, to the north of Taolagnaro. According to the Office des Mines Nationales et des Industries Strategiques (Omnis), it covers an area of 151 km<sup>2</sup>, and the average thickness of the mineralised bed is 5-6 m. With an average grade of 30% bauxite (containing 41% removable alumina and 1.4% active silica),

the calculated reserve of the deposit is 165 Mt (dried-washed).

The Malagasy graphite industry is over a century old, with most production coming from the Gallois mine. The country's output climbed steadily from 1996 (11,295 t) to 1997 (15,397 t) and 1998 (18,690 t), but dropped in 1999 to 14,516 t. The product is premium quality flake graphite, exported mainly into refractory applications in the UK, the US and Germany. Observers suggest that new capital is now required to rejuvenate this ageing sector.

Production of brown mica (phlogopite) is centred around the district of Taolagnaro in southern Madagascar; hundreds of small pegmatitic deposits are worked in a semi-artisanal way, generating for export about 300-400 t/y.

About 1,500 t/y of kaolin is estimated to be produced in Madagascar. The primary deposit area is in the southwest, where over twenty kaolin locations have been identified; one of these - Andraraka - has been developed by Omnis which estimates the probable reserve at 3 Mt.

High-quality gemstones, particularly beryl (production is estimated at about 30 t/y) and more recently sapphires, are mined by locals. Like gold, the sapphire industry has proved difficult to police, and sales of the stones to informal middlemen are the norm.

The rare earth mineral monazite is also produced in limited volume - about 100 t/y - but statistics are not confirmed since 1997. The country also records a dwindling salt-mining sector, output decreasing steadily from 51,907 t in 1995 to 26,746 t in 1998.

While there has been little apparent progress on Phelps Dodge Mining Co.'s nickel-cobalt discovery since it was announced three years ago, the future of this deposit is likely to be very important to Madagascar's image on the global investment scene. The discovery, 80 km east of Antananarivo, was described by Phelps Dodge as "potentially significant" after two years of exploration, 20,000 m of drilling and the construction of seven exploration shafts. The company defined an area of laterite mineralisation more than 45 metres thick, with data indicating an overall resource of 168 Mt at a grade of 1.11% Ni and 0.10% Co.

At the time, the company said it would be monitoring the Malagasy Government's efforts to develop a new mining investment code. Other world-class mining companies will no doubt be encouraged when conditions become suitable for the development of significant deposits in Madagascar by foreign investors.

The liberalisation of mineral laws was set in motion in 1995, with revisions that extended the exploration/mining area and duration granted by permits, as well as liberalising mineral resources previously monopolised by the state. In line with government economic policy, the future of mining is expected to be dominated by the private sector.

Infrastructural weakness and difficulties in the process of obtaining the necessary mineral licences, however, continue to discourage potential new entrants. The main effort in Madagascar will be directed to reinterpretation of existing exploration data; but new data, particularly in geochronology and modern analysis, will enormously facilitate this task.