

MADAGASCAR

*By Paul Crankshaw
Brooke Pattrick Publications*

The most significant mineral-related event in Madagascar in the past year was undoubtedly the government's granting of an environmental permit for Rio Tinto's proposed mineral sands project near the town of Fort Dauphin on the island's southeast coast. The permit comes after a three-and-a-half-year environmental permitting phase comprising social and environmental studies, followed by a government review process that included wide public consultations and a technical review.

The project has already faced major delays due to environmental considerations, including the prospect that coastal forests and traditional fishing villages may be flooded. But QIT Madagascar Minerals (QMM) - owned 80% by Rio Tinto and 20% by the Government of Madagascar - is patiently working through all the required process ("in a manner that will respect and enhance the unique local social and natural environment while providing responsible economic development"), well aware of how closely it will be watched and how much its conduct will represent the image of the industry as a whole.

While there is no shortage of ilmenite resources world-wide, Rio Tinto recognises a relative shortage of quality resources that can be delivered economically into the marketplace. It is in the context of expected future demand growth in high-grade feedstock that the Madagascar project is so significant, both for the company and the country. If progressed to mine-stage, it could deliver 600 jobs for people employed on the mine, improved infrastructure and US\$21 million in annual revenue for the state.

The three deposits at the Mandena site contain the largest free-flowing, high-grade body of chlorinatable ilmenite in the world. The ilmenite contains 62% TiO_2 , a feature that makes the

ore suitable for the production of either slag, synthetic rutile, or directly as a pigment feedstock. This flexibility makes Madagascar very competitive in TiO_2 markets.

QMM will operate the project and is engaged in market and engineering studies to determine the overall feasibility ahead of an investment decision. If the project goes ahead, mining of the resource could start by 2005 and could continue for as long as 40 years (some reports put mine-life at 20-25 years). The company is expecting production levels to reach more than 500,000 t/y of ilmenite. The surface deposits are 15-18 m thick and contain no slimes. Heavy minerals content is 4.5%-5.5%, but while the material is rich in ilmenite it is poor in rutile and zircon.

Generally speaking, the formal mining sector in Madagascar is not significant. Excluding gold and gem production by artisanal miners, mining contributes less than 1% of GDP and employs just 1% of the workforce. If the informal sector is included, however, the contribution to GDP is around 3%.

Madagascar is the world's tenth largest chromite producer. The state-owned Societe Kraomita Malagasy (Kraoma) - Madagascar's main chromite producer - extracts around 40,000 t of concentrates and 80,000 t of lumpy ore annually from the Andriamana complex, and a further 20,000 t/y from the Behandrinana mine.

The country also produces graphite, 66% of which comes from the Gallois mine near Toamasina. It exports up to 15,000 t/y, mostly to the UK, the US and Germany. Graphite is widespread throughout the country with important and still unexplored resources in a number of localities. Mica in the form of phlogopite (or brown mica) occurs in very large sheets with production averaging from 300 to 500 t/y.

Gold production, although unofficial, is probably superior in value to the products exported in the formal sector. More than 2.3 Moz are said to have been produced historically from nine known goldfields; present output is an estimated 3-4 t/y, mainly from an artisanal sector numbering some 100,000 individual miners and small syndicates. Although the government tolerates this form of mining, it is concerned about its ecological effects (which include a high level of mercury being leaked into streams and rivers); in 1999, to combat the environmental destruction, the government set up the Mining Sector Reform Project. It is hoped that this will lead to better control of the sector.

Madagascar's gold potential relates largely to new explorers' ability to apply modern exploration technology and techniques to the number of small, abandoned mines worked only for higher-grade ore, and then often only down to the level of the water table. Larger resources, some amenable to open-pit exploitation, could host the historical operations.

The country's lode gold deposits occur mostly in sulphide-bearing quartz veins systems, with the exception of the Betsiaka district in the extreme north (probably an epithermal system); all the other auriferous districts are in Precambrian terrains and are said to belong to the mesothermal lode gold type.

As for gemstones, the country is an important producer, particularly of the beryllium-group varieties. The world's largest known emerald cluster was discovered in Madagascar in

1996. Small quantities of semi-precious stones (garnets and amethysts) are mined for export. Sapphire mining started in southern Madagascar in 1998.

Overall, Madagascar possesses sizeable deposits of a number of minerals, including industrial minerals, precious and semi-precious gemstones, chrome ore, mica, graphite, gold, bauxite, uranium, iron ore, ilmenite/titanium, quartz, nickel, copper, lead, platinum, labradorite, rock-crystal, rhodolite, marble, garnets, emeralds, rubies and sapphires. There are known deposits containing 400 Mt of iron ore. A major impediment to development of these resources is a lack of infrastructure, although the major nickel-cobalt resource discovered by Phelps Dodge in 1998 is close to the main Toamasina-Antananarivo railway.

The country's coal is located at Sakoa in the southeast of the island where the total deposit is probably in excess of 500 Mt, bituminous shales are located at Bemolanga and the mineable resource is reported to be 3 Mt, part of it accessible by open pit. The largest bauxite resource is at Manatenina in the southeast. This has been estimated to be at least 100 Mt by French and Russian experts, although the quality is not exceptional. The biggest kaolin deposit is at Ampanihy. The estimated size of the resource, which is believed to be of good quality, is in excess of 2 Mt.

There is confirmation that oil and gas reserves exist in Madagascar, but not in sufficient volumes to attract further exploration.