

Abstract

The Dabolava region is an area of approximately 600 km² and is situated on the western edge of the Precambrian in west-central Madagascar. The geology mainly consists of Proterozoic amphibolite facies metavolcanic rocks, inter-layered with minor metasedimentary rocks, crosscut by granodioritic to gabbroic plutons. The country rocks of the granodiorite and gabbroic plutons are composed of 50% amphibolites, 30% quartzofeldspathic gneisses and 20% metasedimentary rocks, mainly carbonates. The amphibolites consist dominantly of hornblende with plagioclase and minor quartz groundmass, although orthopyroxene, clinopyroxene, chlorite, and biotite are present in certain samples. They have tholeiitic affinities and may have been derived from basaltic lavas. They contain felsic segregations of tonalitic composition that possibly represent migmatitic leucosomes, with hornblende concentrated in associated melanosomes. The amphibolites are highly deformed compared to the plutonic rocks. Meta-quartzofeldspathic rocks of dominant rhyolitic compositions are interlayered within the amphibolites; these may represent felsic volcanics coeval with the metabasalt. Metamorphosed carbonates are also interlayered within the amphibolites. This assemblage of supracrustal rocks is intruded by Neoproterozoic granitoid and gabbroic plutons, and granodiorite dykes. The composition of the majority of the plutons in the area of study is mainly granodioritic, with minor quartz diorite and quartz monzodiorite. They are metaluminous and contain quartz, plagioclase, with minor K-feldspar (microcline); biotite and hornblende constitute the ferromagnesian minerals. The granodiorites have a prominent foliation defined by biotite and hornblende. According to their chemical and mineralogical composition, the granodiorites are classified as I-type in origin.

Gold mineralization is associated with the Neoproterozoic granodiorite plutons, mainly the Dabolava and the Ambatomiefy plutons. It is hosted within quartz veins that are generally oriented parallel to the foliation of the host rock. A limited degree of alteration is observed within the granodiorite, with the alteration assemblages consisting of biotite, pseudomorphic chlorite, calcite, and sericite. Gold is associated with hydrothermal biotite and sulphide assemblages consist of pyrrhotite, arsenopyrite with minor pyrite and chalcopyrite, magnetite and ilmenite. The chemistry of analysed gold grains from the Dabolava pluton shows that they mainly consist of 95-97% gold with the remainder composed of Ag, Hg and Cu. A gold concentration of up to 2232 ppm was observed in one of the gold excavations within the Ambatomiefy pluton. Microthermometric studies reveal three fluid types, including a high

salinity fluid (type 4), a CO₂-rich fluid (type 1-a), and an aqueous type (type 3). It is suggested that the CO₂-rich and high salinity fluids were exsolved from the magma. With decreasing temperature a low salinity CO₂-H₂O-NaCl fluid (type 1-b, type 2) (T_h ranges from ~ 220-350° C) resulted from heterogeneous mixing of a CO₂-rich fluid and a low salinity aqueous fluid. Therefore, fluid inclusion studies indicate a magmatic origin of the mineralizing fluid(s). A porphyry-type deposit is suggested for the gold mineralization in the study area, as it is associated with I-type granitoid plutons, the mineralizing fluid (s) are of magmatic origin, and gold is associated with chalcopyrite, albeit in minor amounts.

Based on the rock associations observed in the field, which consist of metabasalts interlayered with minor coeval metarhyolite, with associated intrusive plutonic rocks, as well as trace element discrimination diagrams, an active continental margin tectonic setting is inferred for the rocks in the study area. Two samples from the granodiorite plutons and one sample from a gabbro body were dated using U-Pb single zircon geochronology. A sample from the Ambatomiefy pluton yielded an age of $\sim 1002 \pm 3$ Ma, which is interpreted to represent the crystallization age of the pluton. The Dabolava pluton has also been dated, and a similar age of 1008 Ma has been obtained. A gabbro sample from a smaller mafic body in the area has been dated at 982 ± 2 Ma. This defines a ~ 26 m.y. period of Neoproterozoic magmatic activity. An age of 982.3 ± 2.9 was also reported from a gabbro body located in the southern part of Madagascar (Amborompotsy-Ikalamavony). These provide evidence of the presence of 1000 Ma magmatic activity in Madagascar. The extent and the significance of this magmatic event are not yet understood although it could be related to the Mesoproterozoic event associated with the assembly of the supercontinent Rodinia. The identification of granitoids of similar age and character in Madagascar and within Gondwana has economic significance regarding the potential of these granitoids for porphyry-type gold mineralization. Therefore, this is useful for future gold exploration.