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Geology of bastnaesite and monazite deposits in the Ambatofinandrahana area, central part of Madagascar: An overview

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ABSTRACT

Bastnaesite and monazite deposits of the Ambatofinandrahana region of Madagascar are closely associated to an alkaline to peralkaline complex of Panafrican age (~540–570 Ma; Ambalavao suite), composed essentially of syenite and granite that intrude Paleoproterozoic Itremo Group metasediments, orthogneiss and metagabbro of the ~800 Ma Imorona-Itsindro suite. The peralkaline syenite is characterized by aegirine-augite and Na-amphiboles. Primary REE mineralization consists of monazite, allanite and chevkinite, however, economically exploitable mineralizations contain secondary bastnaesite and monazite that formed by late- to post-magmatic hydrothermal processes. Evidence includes silicification of microsyenite; chalcedony–barite–fluorine–bastnaesite and/or monazite veins; phlogopite–bastnaesite veins; alteration of chevkinite to bastnaesite; monazite-bearing marble. Bastnaesite, monazite and chevkinite have similar REE spectra, which are comparable to those obtained from other hydrothermal occurrences of these minerals and from carbonatites. Phlogopite associated to bastnaesite has a particular chemical signature (Si > 6 pfu and high X_F) that resembles that of phlogopite from the Bayan Obo REE deposit in China. These observations, and the similarities of these mineralizations with deposits such as Gakara (Western Rift Valley, Eastern Africa) and Mountain Pass (California), incite to better define the geodynamic and magmatic context of the alkaline magmatism in this region, and to prospect for the presence of carbonatite.

1. Introduction

The Ambatofinandrahana area is located in the Southern limits of the central part of the Western high plateau of Madagascar (Fig. 1a). Rare Earth Element (REE) mineralization in this region occurs within an E–W oriented band, about 50 km long by 20 km wide (Besairie, 1965). From West to East the main showings and deposits include Ifasina, Marovoalavo, Ankazohambo, Andrinda, Andoharano and Andakatany (Fig. 1b). These sites have been known since the description of bastnaesite and chevkinite by Lacroix (1912, 1915; 1922–1923); other REE-bearing minerals include monazite and less common species such as ampangabeite (uranium and REE niobo-tantalate) and ambatoarinite (Sr and REE carbonate) (Behier, 1960). Lacroix's observations, followed up by those of geologists such as Obelliane (1950) and Orloff (1952; cf., compilation by Guigues, 1954–1955) evidenced the spatial relationship of these mineralizations with a peralkaline syenite complex, which led to their association with pegmatites (*pegmatites fluo-carbonatées* of Guigues, 1954).

After a very detailed description of the different deposits, Fournié (1968) showed that these mineralizations are not related to pegmatites. He pointed out that although peralkaline syenites represent the source of the metals, bastnaesite and monazite mineralizations are likely issued from two hydrothermal alteration episodes, which differ from one deposit to the other: a first, late magmatic process (albitisation and amphibole replacement of pyroxene; biotitite veins), and a second process, involving low-temperature precipitation of chalcedony and barite. In addition, Fournié and Trottereau (1968) described briefly the bastnaesite and monazite prospects of Antomia, near the contact with Mont Tomy granite, North-West of the Vohimavo granite (Fig. 1).

During the first half of the twentieth century, the Malagasy Society of Beryl, then the "Le quartz" and Germadco companies, mined bastnaesite from the Ifasina and Marovoalavo deposits, whereas during the 1950s, the French Commissariat à l'Energie Atomique (CEA) worked on the Andakatany deposit. In 1983, the Malagasy organization "Office Militaire National des Industries

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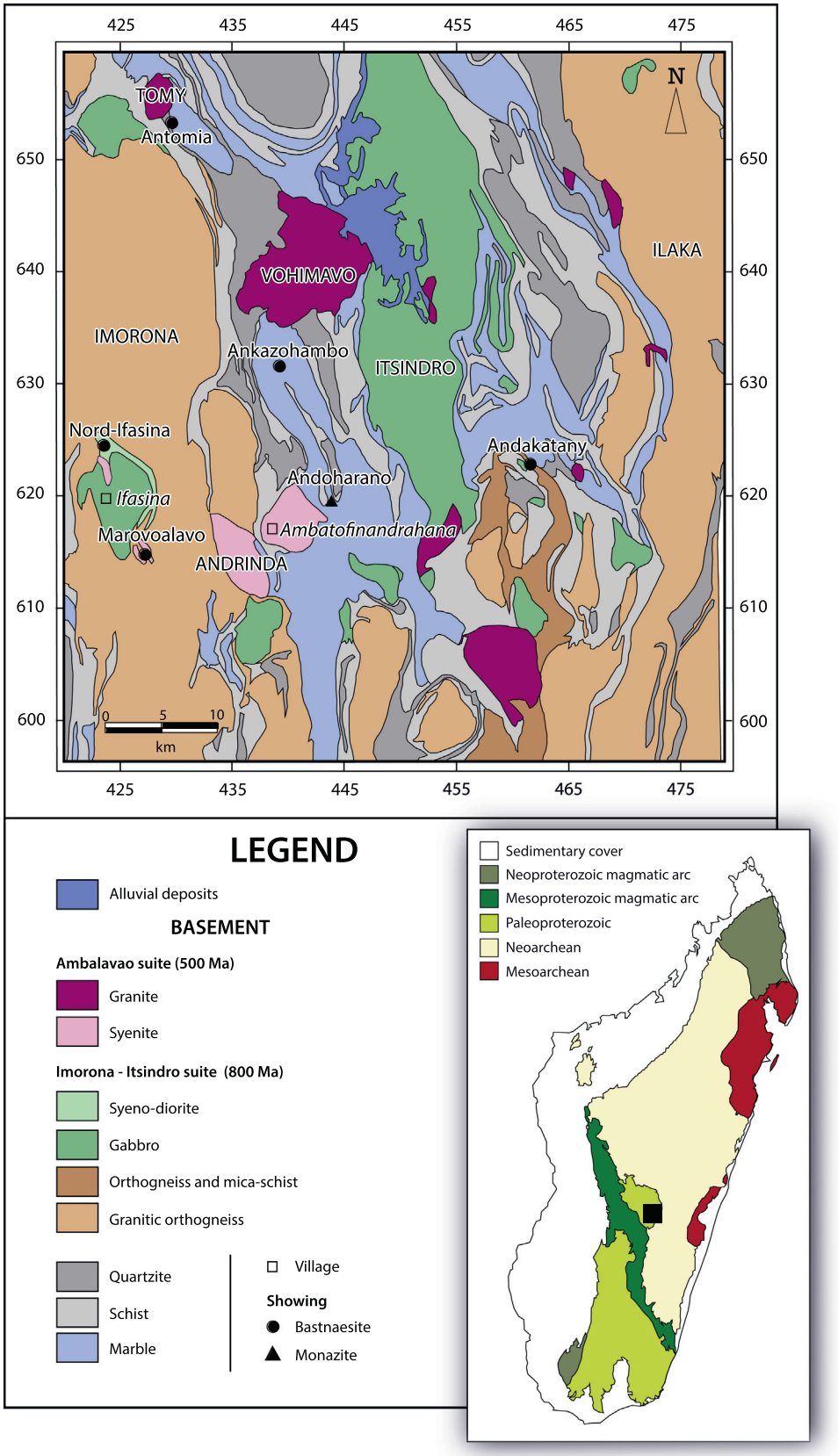

Fig. 1. Simplified geologic map of the Ambatofinandrahana area drawn from the 1:200,000 map of the Paleoproterozoic Itremo Group by Moine (1968). Main occurrences of bastnaesite and monazite mineralizations are shown, after Fournié (1968). The Laborde geographic coordinates are given in km units. The index map shows the main terranes boundaries of Madagascar, and the location of the 1:200,000 map, as a black square.