Significance of REE-mineral inclusions in aegirine from an alkali syenite, Negev, Israel

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Abstract: The mineral assemblage of a sub-volcanic alkali syenite in the Negev, Israel, has been modified by late-stage Na-enriched fluid, also leading to relatively high REE, Y and Nb contents. Three rare earth element minerals (lanthanum monazite-(Ce), neodymium synchysite-(La) (bastnasite group) and lanthanite-Ce occurring mainly as inclusions within the aegirine and formed from these fluids. Sr and Ba were removed from the system with escaping volatiles.

Key-words: REE-minerals, aegirine, arfvedsonite, syenite, Israel. Running title: REE-mineral inclusions, alkali syenite, Israel

Introduction

Late Jurassic to Early Cretaceous magmatism related to intraplate hot-spot activity (Garfunkel, 1989) resulted in the emplacement of several small syenite intrusions (1.2 km²), exposed within the Makhtesh Ramon erosional cirque in the Central Negev of Israel (Bentor, 1952). The syenite intrudes sedimentary rocks and has been dated at 127±4 Ma (Lang & Steinitz, 1989).

Most occurrences of the syenite show considerable and heterogeneous variations in the modal abundances of the main minerals (e.g., 5-30% quartz, 0-10% pyriboles), apparently related to widespread hydrothermal alteration (ltamar, 1988). In the field, this alteration is reflected by iron oxide fracture filling and staining, as well as kaolinization (Weissbrod & Bogoch, 1979). However, at the western edge of the largest exposure (Shen Ramon), the rock is least affected by alteration, and quartz is either absent or present as traces; this outcrop was sampled for the present study. It is composed of 65-70 vol.% alkali feldspar, 10-15 vol.% sodic pyroxene, 10-15 vol.% sodic amphibole, and accessory opaque minerals (mainly magnetite).

Three rare earth element minerals, lanthanum monazite-(Ce), neodymium synchysite-(La) and lanthanite-Ce are present, largely as inclusions within the pyroxene. Possible constraints on the origin of these minerals are presented, based on the mineralogy, petrography and geochemistry of the syenite.

Mineralogy and Petrography

The syenite is miarolitic, trachytic, and fine to medium-grained. Feldspar occurs as sub- to euhedral phenocrysts (1-5 mm) or crystal clusters, forming up to 15 vol.% of the rock, and as fine-grained laths (0.08-0.4 mm) with a linear orientation, in places deflected around the phenocrysts. All are alkali feldspars with a wide range of compositions (Or 28-85; Table 1). Perthite was not observed. Most of the feldspar is fresh with only minor alteration to clay, sericite and Fe-oxides) near cleavage cracks or crystal boundaries.

The pyroxene is compositionally an aegirine (Table 1) with no significant variations within or between grains. It is pleochroic from dark green