Fenite as a rare earth and niobium exploration indicator

H. A. L. ELLIOTT*, F. WALL

Camborne School of Mines, University of Exeter, Penryn Campus, Cornwall, TR10 9FE (*correspondence: h.elliott@exeter.ac.uk)

Carbonatites and alkaline rocks are the most important source of rare earth elements (REE) and niobium (Nb), metals imperative to technological advancements and also associated with large supply risks [1,2]. Metasomatically altered aureoles of country rock, termed fenite, are typically found temporally and spatially associated with intrusions of these alkaline magmas. Multiple pulses of alkali-rich aqueous fluids are expelled from the cooling melts, altering the surrounding country rock [3]. These fenitizing fluids contain complexing anions such as Cl^-, F^- and CO_3^{2-} that greatly enhance the solubility of REE and Nb [4], mobilizing and precipitating micro-mineral assemblages enriched in these elements within the fenite [5].

Alteration patterns have been used with great success as a tool to find ore deposits associated with igneous intrusions, such as porphyry copper. However in comparison, description and interpretation of fenite has been rather neglected in the literature, especially with regards to exploration of their associated alkaline and carbonatite intrusions. REE are typically concentrated in later, more evolved magma generations due to their incompatibility [1]. Therefore the complexity of a fenite and brecciation, associated with release of fluid and volatiles from a crystallizing melt, could reflect the evolution of the magma and enrichment of REEs. The presence of REE and Nb micro-mineral assemblages in addition to spatial mineralogical and textural fenite zonation [6,7], indicates a great potential as exploration indicators.

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References:

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