

Magmatic Evolution of the REE-rich, Strange Lake A-type Peralkaline Granite

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Abstract

A-type granitic peralkaline complexes are widely distributed in anorogenic tectonic settings; however their evolution and the processes controlling the concentration of the REE/HFSE, are still poorly understood. The 1240 Ma Strange Lake peralkaline granitic pluton in northern Québec-Labrador, Canada, is an extraordinary example of hyper-enrichment of the REE, Zr, and Nb in an A-type granite. At least four intrusive phases are distinguishable in the six km diameter cylindrical pluton, based on grain-size, mineralogical composition, and crystallization sequence deduced from petrographic examination. The first and least evolved phase, a hypersolvus granite, is characterized by a high proportion of early crystallizing perthite and subordinate proportions of late crystallizing arfvedsonite and quartz. The subsequent subsolvus granite is distinguished from the hypersolvus granite by early crystallizing arfvedsonite and quartz, and the occurrence of discrete albite and microcline crystals rather than perthite. A third, transsolvus granite type occurs as a quenched zone between the hypersolvus and subsolvus granites, and it shows features of both granite types. Pegmatites, emplaced as sheets at the top of the pluton were the last igneous phase to form and are of special interest because they host the bulk of the mineralization. A model is proposed in which the first step was evolution of the hypersolvus granite by crystallization of alkali feldspar, as proposed previously by Boily and Williams-Jones (1994). This evolution is manifested by increasing whole-rock concentrations in REE, HFSE and F with Al_2O_3 . The second step was marked by a change in the magma evolution due to the appearance of arfvedsonite as a liquidus mineral in place of perthite. The hyper-enrichment in REE/HFSE in the pegmatites has been due to the incompatible nature of these elements, the small proportion and extreme alkalinity of the residual liquid forming the pegmatites, and the complexation of the REE and HFSE with fluorine.