Subsolidus processes in arfvedsonite granite and associated felsic veins, and the relation to HFSE-mineralization in the eastern Cobequid Highlands, Nova Scotia, Canada

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The Late Devonian-Early Carboniferous arfvedsonitebearing granite from the Hart Lake-Byers Lake Pluton in the eastern Cobequid Highlands, Nova Scotia, represents the late stages of crystallization of an evolved felsic melt enriched in alkalis and iron. Hypersolvus alkali feldspar, quartz, and arfvedsonite comprise the main mineral phases of the granite. Petrographic observations reveal the subsolidus transformation of the original homogeneous alkali feldspar to perthitic K-feldspar and albite, and the gradual breakdown of the sodic amphiboles to produce predominantly Feoxides and quartz. Electron microprobe analyses of selected samples show that silicates and oxides enriched in high field strength elements (HFSE) often accompany the Fe-oxides and quartz as replacement products, forming veinlets that crosscut the arfvedsonite crystals and/or aggregates in close proximity to the sodic amphiboles. Felsic veins of granitic composition that incorporate HFSE-enriched minerals have also been documented in the Eastern Cobequid Highlands, and are interpreted to have been genetically related to the arfvedsonite granite of the Hart Lake-Byers Lake Pluton. In the veins, the HFSE-enriched minerals are spatially associated with Fe-oxides, zircon, and fluorite. This mineral assemblage is often surrounded by remnants of sodic amphiboles, where the orientation of the Fe-oxides appears to follow the cleavage planes of the replaced arfvedsonite crystals.

The enhanced solubility of water and HFSE in iron- and alkali-rich melts postponed the formation of HFSE-enriched minerals until the late stages of crystallization. Petrographic evidence suggests that a hydrothermal fluid was involved in the remobilization of HFSE in the felsic veins. The spatial distribution of the HFSE-enriched granitic veins and their crosscutting relationships with the plutonic and volcanic lithologies in the area suggest that they originated from an evolved silicate liquid characterized by low viscosity and increased mobility. It is plausible that this liquid was internally derived and genetically related to the last melt fraction that generated the arfvedsonite-bearing granite.

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