New evidence for fluoride-silicate liquid immiscibility in the Strange Lake granites

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The Mid-Proterozoic peralkaline Strange Lake pluton (Québec-Labrador, Canada) shows extreme enrichment in high field strength elements (HFSE), including the rare earth elements (REE), in pegmatites. Based on a study of melt inclusions we have recently proposed that, in addition to fractional crystallization and magmatic-hydrothermal activity, a third process, namely melt immiscibility, played a crucial role in concentrating the REE within the pluton[1]. Here we present further evidence for silicate-fluoride immscibility in the Strange Lake granites based on a globule in hypersolvus granite, composed almost entirely of REE and HFSE minerals.

The globule (~5 cm in diameter), has three distinct zones. The outermost zone (narrow) is afrvedsonite (± astrophyllite) rich. The next zone contains chevkinite and zircon in a fluorite matrix and the core (much of the globule) is cerite- fluorite-rich. Hydrothermal alteration is evident by the replacement of chevkinite and cerite by quartz and parisite (or locally fluocerite and bastnasite), which in turn were altered to a fine-grained aggregate of parisite, gagarinite and fluorite.

We propose that silicate-fluoride immiscibility occurred early, probably as a result of pressure drop during magma emplacement. Chevkinite and zircon crystallized shortly after, nucleating on the boundary between the two melts. Crystallization of chevkinite caused depletion of the rim zone in REE, which drove a second phase of immiscibility, i.e., separation of REE-fluoride melt from Ca-fluoride melt. Crystallization of feldspars in the surrounding granite followed; feldspar crystals squeezed the fluoride melts into the interstitial space. Finally, cerite and then fluorite crystallized (coevally with quartz and arfvedsonite in the host granite). Aqueous fluid exsolved from the residual silicate melt caused alteration of both the granite and globule.

This globule represents the first macroscopic example of silicate-fluoride immiscibility in nature. We propose that globules of fluoride melt were initially dispersed within the silicate melt and preserved only rarely in unaltered hypersolvus granite. They accumulated mainly in pegmatites, concentrating REE, but were destroyed by later exsolving magmatic-hydrothermal fluids.

[1] Vasyukova, O and Williams-Jones, A.E. *Geochimica et Cosmochimica Acta* (in review).