

## Hydrothermal REE Transport at Strange Lake

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The Strange Lake granites and pegmatites experienced extreme enrichment in high field strength elements (HFSE), including the rare earth elements (REE). Much of this enrichment was associated with the most altered rocks and expressed as secondary minerals, indicating that hydrothermal fluids played an important role in HFSE concentration. Vasyukova et al., (2016) documented an evolutionary path for the fluids. They showed that hydrothermal activity was initiated by fluid exsolution during crystallisation of border zone pegmatites (at ~450-500°C and 1.1 kbar). This early fluid comprised a high salinity (25 wt.% NaCl) aqueous fluid and a CH<sub>4</sub>+H<sub>2</sub> gas. During cooling, the gas gradually oxidised to CO<sub>2</sub> and the salinity decreased to 4 wt.% (at ~250-300°C), before increasing to 19 wt.%, due to fluid-rock interaction at ~150°C. Here we present crush-leach data on the composition (major and trace elements, including ligands) of the fluid at different stages of its evolution.

The data show that the chondrite-normalised REE profiles change from LREE (La-Nd)-enriched for the early high temperature fluid (~400°C, Stage 1) to MREE (Sm-Er)-enriched at 250-300°C (Stage 2) and finally to strongly HREE (Tm-Lu)-enriched at low temperature (150°C, Stage 3). The changes in the REE distribution were accompanied by changes in the concentrations of major ligands, i.e., Cl<sup>-</sup> was the dominant ligand in stages 1 and 3, whereas HCO<sub>3</sub><sup>-</sup> was important at Stage 2. Concentrations of other components also varied. The Stage 1 fluid had high concentrations of Be and Pb, whereas the Stage 2 fluid had the highest content of Zr and the Stage 3 fluid was enriched in Li, Fe, Al, K, Sr and Nb. Fluorine content decreased from 0.38 wt.% in Stage 1 to 0.29-0.33 wt.% and 0.32 wt.% in Stages, 2 and 3, respectively.

We propose that the composition of the early fluid was in equilibrium with the late pegmatitic melt. This fluid had high pH and likely transported the REE as hydroxyfluoride complexes. The composition of the fluid evolved by cooling-induced oxidation to lower pH, and through reaction with elpidite and REE-rich minerals (Stage 2). During Stage 3 HREE were released to the fluid as chloride complexes during alteration of arfvedsonite to hematite and/or aegirine at very low pH. Other elements in this fluid came from alteration of feldspar and pyrochlore.