An integrated stable isotopic and textural study of the Little Nahanni rare-metal pegmatite system, NWT

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Located in the Northwestern Territories, the Little Nahanni Pegmatite Group (LNPG) is a rare-metal pegmatite swarm of the LCT-type that is strongly enriched in Li and Ta, both strategic metals of great relevance in the new high tech era. Similar to other zoned LCT-type pegmatites (e.g., Brazil Lake, NS; Greenbushes, Australia; Tanco, MB), Ta (± Nb, Sn) mineralization is mostly found in “albite zones”, where it is associated with secondary saccharoidal albite. This aspect of LCT pegmatites remains poorly understood, thus investigating how it relates to rare-metal mineralization, as well as identifying the origin of the metasomatizing agent, will further advance the current models for LCT pegmatites and potentially provide insight to better understanding of other deposits globally. This project integrates bulk and in situ $\delta^{18}O$ and δD isotopic analysis of the different paragenetic stages (i.e., primary vs. secondary) of quartz, K- and Na-feldspars, micas and accessory minerals, using conventional TIMS and SIMS methods, with a comprehensive textural study of these phases at the macro- and micro-scale. Preliminary stable isotopic data yielded $\delta^{18}O$ values ranging from +0.4‰ to +14.9‰ in albite (n=12), from +10.2‰ to +14.9‰ in quartz (n=9), from +6.8‰ to +13.8‰ in K-feldspar (n=6), from +8.8‰ to +13.2‰ in micas (n=10) and δD values ranging from -67‰ to -182‰ in micas (n=10). The large range in isotopic values indicates a strong local isotopic disequilibrium within the pegmatite and suggests the influence of meteoric fluids and pegmatite-wall rock interaction during the evolution of these pegmatites, although their exact role has not yet been determined. In addition to studying the internal evolution of the pegmatites, further $\delta^{18}O$ analysis of primary quartz will assess the potential regional isotopic variation along the entire length of the swarm. Preliminary analysis on the primary magmatic textural features of the LNPG established three significant observations: 1) the absence of graphic and granophyric textures; 2) extensive skeletal growth of primary K-feldspar and spodumene and other minerals through the entire swarm; and 3) the scarcity of miarolitic cavities and pocket zones, which are often present in pegmatites. These preliminary observations suggest that the melts were H_2O-undersaturated and underwent a particularly high degree of undercooling, which favoured the skeletal growth of K-feldspar and spodumene over the formation of graphic and granophyric textures.