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Application of Apatite Chemistry in LCT Pegmatite Exploration in the Late Archean Yellowknife Pegmatite Province, NWT Canada: A Preliminary Analysis

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Primary apatite has been proven to record the evolution of granitic magmas and can thus be used in lithium pegmatite exploration. The Slave Craton in the Northwest Territories of Canada is host to numerous Archean LCT pegmatites, which occur as dykes, commonly in clusters, in granitic and metasedimentary host rocks. Variably mineralized pegmatites occur together in the same clusters, thereby necessitating individual assessment.

Detailed petrography aided by microXRF-EDS elemental mapping of polished sections followed by compositional analysis *in situ* of magmatic apatite by LA-ICP-MS was performed to assess the mineralization potential of five pegmatite dykes (Best Bet, Hidden Lake, Moose II, Pancho, and Riber) from the Yellowknife Pegmatite Province in the southern Slave Craton. All the dykes, except Riber, have reported spodumene mineralization.

A total of 121 spots on 117 apatite grains in polished sections of the pegmatites were analyzed by LA-ICP-MS. Median Y values increase from 0.4, 15, 52, 116 and 995 in Pancho, Moose II, Best Bet, Hidden Lake, and Riber, respectively. All samples reported positive Eu anomalies, except Riber. Median ΣREE, Th, U, Fe, and Mn concentrations in Best Bet (123 ppm, 5.2 ppm, 20 ppm, 254 ppm, 469 ppm), Hidden Lake (243 ppm, 22 ppm, 485 ppm, 2174 ppm, 6855 ppm), Moose II (24 ppm, 1.2 ppm, 27 ppm, 417 ppm, 1316 ppm), Pancho (3.5 ppm, undetected, 32 ppm, 31,768 ppm, 38,546 ppm), and Riber (888 ppm, 5.9 ppm, 174 ppm, 3317 ppm, 13,871 ppm), respectively. Results reveal low Fe/Mn and Th/U values, generally below 1 and 0.05, respectively, suggesting these pegmatites are very highly fractionated. This is supported by K-Rb-Cs-Li-Sn-Ta systematics in muscovite-K-feldspar, which revealed Best Bet as the most fractionated and Riber as the least.

These findings confirm the suitability of using apatite chemistry to evaluate LCT pegmatite fractionation, Li-Ta-Sn-Cs prospectivity, and U-Pb geochronology.