Mineralogy and Geochemistry of the Yellowknife Lithium Pegmatite Field

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In this study, the lithium pegmatite dikes and local intrusive suites are investigated to better understand spatial geochemical gradients that may be useful for exploration targeting on the regional-, district- and deposit-scale. We obtained multi-element whole rock geochemical data derived from bore holes, surface composite rock chip samples and channel samples collected from multiple field campaigns. The geochemical data is screened for spatial trends using x-y element plots, GIS and 3D modelling software. Magmatic and hydrothermal muscovite related to Li pegmatites are currently being analyzed for Rb-Sr muscovite dating using LA-ICP-MS. Spodumene-bearing pegmatites at Yellowknife seem to be spatially related to locally enriched intrusive stocks within the large voluminous body of the parental batholiths. These intrusions are characterized by a high abundance of apatite and are strongly enriched in Li, Cs, Rb, Be and other incompatible elements. However, the background Li concentrations of intrusives in the area is generally high, which disqualifies Li for use as a pathfinder element. Apparently, fertile intrusions are characterized by exceptionally high 1/(K/Rb), P and Cs/(Cs+Li+Be). Preliminary field and microscopic observations suggest that the Yellowknife pegmatite field shows a concentric zoning around locally highly fractionated intrusions. A spatial trend from proximal barren pegmatites to more distal spodumene-bearing dikes is recognized. Across the examined dike field, systematic spatial trends of decreasing Nb/Ta and high Sn/W toward the spodumene-bearing dikes are observed. The dikes do not exhibit strong intra-dike zoning but typically are composed of an aplitic border zone and a medium to coarse-grained pegmatitic internal zone. The border zone is composed of primarily quartz, muscovite and accessory phases such as tourmaline, apatite, garnet and columbite-tantalite minerals, whereas the interior zone is primarily composed of quartz, albite, k-spar and spodumene (up to 20 vol.%). Various degrees of greisen and sodic-potassic alteration overprinting the pegmatites can be recognized.