

REE Mineral Distribution and Genesis of LREE Mineralization, of the Nechalacho Rare-Earth Element Deposit, NWT

JWB Hoyle¹, IM Samson¹

¹Earth and Environmental Sciences, University of Windsor, Windsor, Ontario

The Nechalacho rare-metal (REE, Y, Nb, Ta, Zr) deposit, located in the Northwest Territories, is hosted by an altered layered nepheline syenite. Three distinct whole-rock geochemical signatures are evident. Two of these signatures have high phosphorous (P), of which, one has high heavy REE (HREE) (type 1) and one has low HREE, but high light REE (LREE) (type 2). The third signature has low P and high HREE, LREE and Zr (type 3). The type 1 and 2 signatures were found to represent abundant xenotime ((Y, HREE)PO₄) and monazite (LREEPO₄), respectively. The type 3 signature represents zircon and a variety of non-phosphate REE minerals, such as allanite ((REE,Ca)₂ (Al, Fe²⁺, Fe³⁺)(SiO₄)₃(OH)), fergusonite ((Y, REE)NbO₄), or bastnäsite (REECO₃F). The results support the hypothesis that the ore mineralogy can largely be predicted from whole rock geochemistry. Phosphates are an important reservoir for the LREE at Nechalacho. Two main textural types of monazite have been recognized; one that is rod shaped and another that is blocky. Xenotime also occurs in various habits, such as rods, anhedral patches, radial blades with zircon rims, euhedral rods with anhedral xenotime rims. Cathodoluminescence (CL) imaging has revealed the presence of apatite (Ca₅(PO₄)₃(OH, F, Cl)) associated with monazite. The deposit is divided into Upper and Basal zones, the Basal Zone having a higher HREE/LREE ratio than the Upper Zone. It has been proposed that the LREE were transported from the Basal Zone to the Upper Zone by hydrothermal fluids and precipitated there as LREE minerals. To test this model the geochemistry of monazite grains from different depths in the deposit were examined. Monazite was selected for study because it is one of the few REE minerals that has sufficient thermodynamic data available for modeling. A recent geochemical model predicted that a series of pulses of aqueous fluid transporting REE and P, passing through a nepheline syenite would precipitate monazite crystals that were progressively more depleted in HREE (relative to the starting fluid) with increasing distance from the source (height in the system). Preliminary Laser Ablation Inductively Coupled Mass Spectrometry (LA-ICP-MS) data for monazite does not support this model because the concentrations of HREE in monazite increase upwards in the intrusive body, which suggests, along with the textural variability of the phosphates, that the genesis of the LREE mineralization is more complex than the proposed models imply.