Whole Rock Geochemical Signatures and REE Mineralogy of the Nechalacho Rare-Earth Element Deposit, NWT

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Abstract

The Nechalacho rare-earth element (REE) deposit, located in the Northwest Territories, represents a significant resource of REE outside of China. This study examines the relationship between whole rock assay data and REE mineralogy of the Nechalacho deposit. Three distinct geochemical signatures are evident in the whole rock geochemistry of the Nechalcho deposit. Three drill holes that contain representative examples of the various signatures, and which are spatially distributed throughout the deposit, were sampled. Predictions regarding the mineralogical character of the whole rock signatures have been tested using optical microscopy and Scanning Electron Microscope Energy Dispersive Spectroscopy (SEM-EDS). Two of these signatures have high phosphorous (P), of which, one has high heavy REE (HREE) (PHlzn) and one has low HREE, but high light REE (LREE) (PhLzn). The third signature has low P and high HREE, LREE, Zr, and Nb (pHLZN). Both of the high P signatures are characterized by low Zr, such that these rocks were predicted to contain insignificant zircon ($ZrSiO_4$), an important host for the HREE in the Nechalacho deposit. The PHlzn and PhLzn signatures were predicted to represent the minerals xenotime ($(Y, HREE)PO_4$) and monazite ($LREEPO_4$) respectively. The pHLZN signature was hypothesized to represent zircon and a variety of non-phosphate REE minerals, such as allanite ($(REE,Ca)_2(Al, Fe^{2+},Fe^{3+})(SiO_4)_3(OH)$), fergusonite ($(Y,REE)NbO_4$), or bastnäsite ($REECO_3F$). For the three drill holes analyzed, the results of optical microscopy and SEM-EDS support the hypothesis that the ore mineralogy can be determined on the basis of whole rock geochemistry. This information can help develop mineralogical distribution models for the deposit, which is important for understanding its geometallurgy.