Impacts of till stratigraphy on surficial boron dispersal patterns in the drumlinized terrain of the McArthur River uranium mine area in the eastern Athabasca basin

S Scott[1], M Ross[1], JE Campbell[2], H Chen[3], D Quirt[4], T Kotzer[5]

[1]Department of Earth and Environmental Science, University of Waterloo, Waterloo, Ontario; [2]Geological Survey of Canada, Ottawa, Ontario; [3]Department of Geography and Environmental Management, University of Waterloo, Ontario; [4]AREVA Resources Canada Inc, Saskatoon, Saskatchewan; [5]Cameco Corporation, Saskatoon, Saskatchewan

The high-grade uranium deposit at McArthur River, in northern Saskatchewan, is located at a depth of approximately 550 m. Alteration products related to uranium mineralization have been dispersed along structures in the overlying sandstones up to the bedrock surface where the sandstone, and contained alteration products, was eroded and dispersed by glacial processes during the Quaternary glaciations. However, glacial sediments are relatively thick in the McArthur River area (ranging from 0 to 100 meters) and the surface is characterized by large drumlins, which can obscure the surface expression and dispersal patterns of alteration products (e.g. clay minerals and related geochemical pathfinders). Boron is a pathfinder element that is found in the alkali-deficient dravitic tourmaline mineral ("dravite") that is part of the primary alteration halo around the deposit, resulting in boron enrichment in the altered sandstone rocks relative to the regional sandstone signature. Here we show discontinuous boron patterns from 130 surficial till samples from around McArthur River. An analysis of till stratigraphy and overall till provenance shows that different till units are exposed at surface, possibly due to erosional processes during drumlin formation, and appear to control the surficial boron patterns. Specifically, two end member tills (one local and one distal) and a range of hybrid tills were identified at surface based on pebble counts, geochemistry and airborne radiometric data. Because boron anomalies in the bedrock are locally associated with the P2 fault and increased hydrothermal alteration, the overlying glacial sediments, with the more locally-derived altered sandstone associated with uranium mineralization, are elevated in boron relative to the other tills. This study shows that complex interplay of glacial erosion and till deposition can produce discontinuous surficial geochemical dispersion patterns which, through careful and detailed till mapping, can be understood and applied to surficial exploration for mineral deposits in thick till areas. NSERC-CMIC-Footprints Exploration Project Contribution #129