

Quaternary stratigraphy and till provenance across the drumlinized terrain of the McArthur River Uranium Mine area in the eastern Athabasca Basin: Preliminary results

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The McArthur River uranium mine is located in northern Saskatchewan within a corridor of elongated drumlins and long dispersal trains that have been associated to a major ice stream of the Laurentide Ice Sheet. The high-grade uranium deposit is associated with the intersection of reactivated basement faults and the unconformity between sandstones of the Athabasca Group and the underlying basement rocks. It is located at an approximate depth of 500 m. The alteration footprint extends above the deposit but the depth of the deposit, combined with the complex Quaternary geology, makes it challenging to apply drift prospecting successfully. A new study aims at describing and analyzing the Quaternary stratigraphy and till composition in the vicinity of the mine. One of the main goals is to develop an understanding of till provenance and production in the study area and to get insights into the potential role of fast-flowing ice, which could have implications for drift prospecting in that and other similar prospective regions.

Erosional ice flow indicators were measured at the few sandstone outcrops and compared to the orientation of drumlins. In addition, more than 70 till samples have been collected to date at several sites across the study area. One section through the side of a large drumlin was studied in detail for stratigraphy. So far, grain size analysis involving dry sieving and laser diffraction, and pebble lithological counts on both the 4-8mm and the >8mm size fractions have been completed. Preliminary results show that the study area contains at least one sub-till fluvial unit consisting of medium to coarse sand with abundant iron and manganese oxides, and the presence of diamictic clastic dykes provides evidence of subglacial hydro-fracturing. This distinctive unit has also been identified in geotechnical boreholes in another nearby drumlin. Overlying this unit there is a stiff till with a relatively high silt content and proportion of basement clasts. Higher up the stratigraphy, the till sheets become more sandy and increasingly rich in local sandstone lithologies. These hybrid and more 'local' tills are widespread at the surface throughout the study area. The basement-rich till and the underlying oxidized sand unit could possibly form the core of many drumlins, but this will need further investigation. From these preliminary results, the sequence of events include 1) a till production event that first brought distal lithologies to the study area, 2) partial erosion and re-entrainment of that till and mixing with local lithologies. Interestingly, the most 'local' till is found at the top of the sequence suggesting that the glacier had access, probably in the drumlin swales, to fresh and altered sandstone bedrock. This local till could thus be related to the drumlinization phase and possibly to fast-flowing ice despite its 'local' signature in the coarse fractions. CMIC-NSERC Exploration Footprints Network Contribution 049.