Fingerprinting and Tracing Unconformity-Type Uranium Alteration Haloes Through Thick Quaternary Sediments: An Example from the Thelon Basin, Nunavut

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Abstract

The Thelon Basin of Nunavut shows great potential for the discovery of unconformity-type uranium deposits. However, mineralization in the area rarely intersects the bedrock surface which limits the use of indicator mineral and traditional geochemical exploration methods. The large alteration haloes typically associated with unconformity-type uranium deposits may subcrop and are promising exploration targets. The present study aims to fingerprint and trace the signature of these alteration haloes through the thick till that covers much of the area. The comparison of bedrock geochemistry with that of till sampled from drill core and surficial mudboil samples allows for mapping the dispersal of alteration pathfinders in three dimensions. Multivariate statistical analysis of the dataset, including principle component and factor analysis, may reveal subtle geochemical patterns related to alteration. Geochemical data is complemented by mineralogical information from X-Ray Diffraction and Shortwave Infrared Spectroscopy. The bedrock alteration halo signatures of Na_2O depletion and B enrichment represent the strongest geochemical signatures in the till samples collected from drill core at this time. However, surficial geochemical patterns are more elusive, as B values in the mudboil samples are typically an order of magnitude lower than borehole samples. The discrepancy may be due to the presence of a different till unit <5 m thick that is not observed in boreholes, or the removal of clay-sized particles and B as a result of mudboil processes. Preliminary results indicate that care must be taken when surficial geochemical surveys are carried out in areas with thick multi-till stratigraphy and in permafrost terrain, since material collected at the surface may have distinctly different characteristics than underlying sediments. Ongoing research aims to discover additional trends, relate them to the till stratigraphy and glacial dynamics evolution, and develop innovative techniques for use in mineral exploration.