Beyer SR, Kyser TK, Kotzer TG, Ansdell K, Wasyliuk K, Quirt DH, 2017, Expression of the McArthur River U deposit footprint in diverse surficial sampling media, Abstract, GAC-MAC, Kingston, ON

A conspicuous geochemical footprint is present at the surface above the McArthur River high-grade uranium deposit in the Athabasca Basin of northern Saskatchewan, Canada based on results from a multi-media orientation survey. Pine tree cores, multi-horizon soils, and boulders of local bedrock (Manitou Falls D Member sandstone) contained within glacial cover were collected on four 400x400-meter grids with 50 m station and line spacings. Three grids were placed along the NE-SW-trending P2 fault over weak to high-grade U mineralization that lies over 500 m below the surface along the fault, and one grid was placed 2 km away from the P2 fault trace in the non-U-mineralized hanging wall of the structure. Clay alteration minerals in angular sandstone boulders determined by shortwave infrared (SWIR) spectrometry resemble those in sandstone in the subsurface, indicating the boulders are locally derived. Additionally, the boulders collected over the high-grade ore body contain the highest proportion of mobile radiogenic Pb ($^{207}Pb/^{206}Pb$ ratios as low as 0.29) and U (as high as 140 ppb) based on the results of 2% nitric acid leach, suggesting that both primary and secondary dispersion products are present throughout the thickness of the Manitou Falls Formation. Pine tree cores also record secondary dispersion of radiogenic Pb and U over the high-grade ore body, with $^{207}Pb/^{206}Pb$ ratios as low as 0.57 in tree cores older than 1985. By comparison, $^{207}Pb/^{206}Pb$ ratios average 0.83 in trees collected away from the P2 fault. Na pyrophosphate leach of the organic-rich A1 soil horizon samples are similar to those of the tree cores, with $^{207}Pb/^{206}Pb$ ratios as low as 0.36 over the high-grade ore body, and around 0.85 away from the P2 fault. The results of both weak acid leach and aqua regia digest on B- and C-horizon soil separates reflect control by detrital minerals in the till, which mask geochemical contributions from secondary dispersion from the deposit. The results of this study demonstrate the utility of compact, tightly-spaced surficial sampling grids as an effective and relatively low-cost exploration tool for deposits at depths in excess of 500 meters and attest to the possible role that the biosphere-geosphere interface can play in exploration geochemistry.

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