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THE “SURFACE” EXPRESSION: WHAT DO GEOCHEMICAL ANOMALIES IN SURFACE MEDIA AND SHALLOW SANDSTONES OVERLYING THE PHOENIX URANIUM DEPOSIT, ATHABASCA BASIN, SASKATCHEWAN, TELL US?

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Many mineral deposits are buried below younger rocks and glacial sediments. We initiated this project to examine whether surficial geochemical anomalies exist for such a deeply buried uranium deposit. For our study, we selected the Phoenix deposit on Denison Mines’ Wheeler River Property in the Athabasca Basin. The deposit, situated near the southeastern rim of the Basin in northern Saskatchewan, was originally thought to have no surface expression of any kind. Discovered in 2008, the deposit currently has an indicated resource of approximately 35 million lbs U_3O_8. Mineralization occurs as mainly monominerallic uraninite within four pods termed the A, B, C and D ore zones. This deposit has no surficial expression, and occurs near the unconformity between the crystalline basement rocks and overlying Athabasca sandstones at approximately 400 meters depth. The surficial environment, within the region of discontinuous permafrost, consists of gently rolling hills covered by glacial till and moraines, with overburden varying in thickness from 25 to 100 m. In September 2011, we initiated a study to evaluate whether geochemical anomalies related to such a deeply seated deposit exist in surface media or the overlying sandstones. A total of 226 soil samples (humus, B, E, and C-horizon) from 59 sites along 3 transects over the “A” and “B” ore zones were collected approximately 10 meters apart. In addition, traverse sampling was done to determine “background values” in the study area setting.

Geochemical analyses of the samples revealed the presence of strong U, Mo, Co, Ag and W anomalies in humus, B-horizon soil and uppermost sandstones not only overlying the A and B zones, but also over a nearby northeast-trending “WS Hanging Wall” Shear Zone. Peak to background ratios were up to 6 times (5.7 ppm) for U, 5 for Mo (4.8 ppm), 4 for Co (5.2 ppm) 20 for Ag (0.98 ppm) and 18 for W (100 ppm), respectively, in the various surface media. The geochemical anomalies in the surface media and the uppermost sandstones over the shear zone suggest that the fault is acting as a conduit for upward movement of fluids from the deposit. This fluid movement and resulting geochemical expression in surface media provides excellent exploration tools for deeply seated unconformity-related uranium deposits in Proterozoic sedimentary basins.

The 5.7 ppm U anomaly by aqua regia digestion method of the humus layer yielded among the strongest and most robust geochemical anomalies, and therefore is recommended as the leach of choice in this well-drained area of the Basin.