Joyce NJ, Layton-Matthews D, Kyser TK, Ansdell K, 2016, Alteration mineralogy of the McArthur River uranium deposit, Athabasca basin, Canada, Abstract, PDAC-SMC, Toronto, ON

Characterization of the chemical, modal, and textural variability of interstitial minerals using a combination of SWIR, SEM, EPMA and LA-ICP-MS techniques was used to determine the residence sites of pathfinder trace elements showing elevated concentrations in the sandstone around the McArthur River unconformity-related uranium deposit, Athabasca Basin, Saskatchewan, Canada. The deposit is located below ~ 550 m of quartz arentic sandstones, of which the basal ~ 200 m are strongly silicified. Altered sandstones contain complex assemblages of Mg-chlorite, alkali-deficient dravite, APS minerals, kaolinite, 1Mt illite, and oxide minerals that overprint diagenetic background assemblages of 1Mc illite, dickite, earlier APS minerals, and oxide minerals. Beneath the silicified layer – defined also by the presence of diagenetic dickite – and in fracture zones, fine-grained florencitic APS minerals and Mg-sudoite chlorite characterize the sandstones that have been affected by diagenetic-hydrothermal host-rock alteration. Overall, in the altered sandstones, APS minerals account for the majority of the Sr and LREE concentrations, whereas chlorite, containing up to 0.1 wt.% Ni and 0.01 wt.% Co, accounts for the majority of Ni and a significant fraction of Co. Cu, Mo, and Zn occur predominantly in cryptic sub-micron inclusions in clay mineral aggregates. U occurs predominantly in cryptic micro-inclusions associated with pyrite in late-stage quartz overgrowths, and with paragenetically late Fe-Ti oxide micro-inclusions in kaolinite. Additionally, up to 0.2 wt.% U is cryptically distributed in post-ore Fe-oxide veins. Heavy mineral bands consisting of detrital monazite, apatite, and zircon also contribute significant U and HREE. The innovative approach to the study, based on detailed LA-ICP-MS chemical mapping of entire interstitial assemblages, detrital grains, and overgrowth quartz, provides critical insight to the mineralogical distribution of pathfinder trace elements in the deposit footprint. This forms part of a larger study designed to characterize the 3D footprint of the McArthur River deposit through the integration and analysis of geological, geochemical, mineralogical, petrophysical, and geophysical datasets.

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