

## **Crystal Chemical Variability of Alteration Minerals Distal to Unconformity-Related Uranium Deposits**

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### Abstract

Unconformity-related uranium deposits in the Athabasca basin, Canada, occur along large-scale fault structures that exhibit a history of significant hydrothermal alteration. The Millennium and McArthur River deposits, which lie within the CMIC Footprints Project U site area, are surrounded by extensive illite alteration within the Athabasca Group sandstone and underlying basement complexes. Proximal to mineralization, altered host rocks are overprinted by chlorite. However, historic drilling at Wheeler River shows that similar alteration patterns may also occur within barren hydrothermal systems. It is therefore proposed that the mode, trace element content and crystal chemistry of illite and chlorite may exhibit meaningful variability proximal and distal to uranium deposits. Core samples from the Millennium deposit will be examined along transects that crosscut and parallel the main structural corridor in order to define the mineral chemical features of the deposit footprint, with the emphasis on the distal parts of the alteration halo in the basement rocks and the overlying sandstones. This study aims to identify the sites within the chlorite and illite crystal structures where pathfinder elements (which may include Ag, As, Au, Co, Cu, Ni, Mo, Pb isotopes, Se and Zn) are most likely to reside. Environmental Scanning Electron Microscopy used in conjunction with Mineral Liberation Analysis (ESEM-MLA – Queen's University) will be used to characterize the mineralogy and textures of the samples. Major element mineral chemistry of representative chlorite and illite clusters will then be analysed by Electron Microprobe (JEOL 8230 – Queen's University) whereas trace element mineral chemistry will be determined using LA-ICP-MS (Excimer 193nm or Femto 266 nm and X-Series 2 or Element XR – Queen's University). The results of the study at Millennium could then be compared to samples from the Wheeler River alteration system to effectively differentiate mineralized from barren systems. Documenting the crystal chemical variability of alteration minerals and identifying cryptic expressions of pathfinder element-rich phases within altered core have significant implications for future uranium exploration in the Athabasca basin.

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