



Crystal chemical variability of alteration minerals distal to unconformity-related uranium deposits

N. Joyce¹, D. Layton-Matthews¹, K. Kyser¹, K. Ansdell²

¹Queen's University, Department of Geological Sciences and Engineering, Kingston, Ontario, ²University of Saskatchewan, Department of Geological Sciences, Saskatoon, Saskatchewan

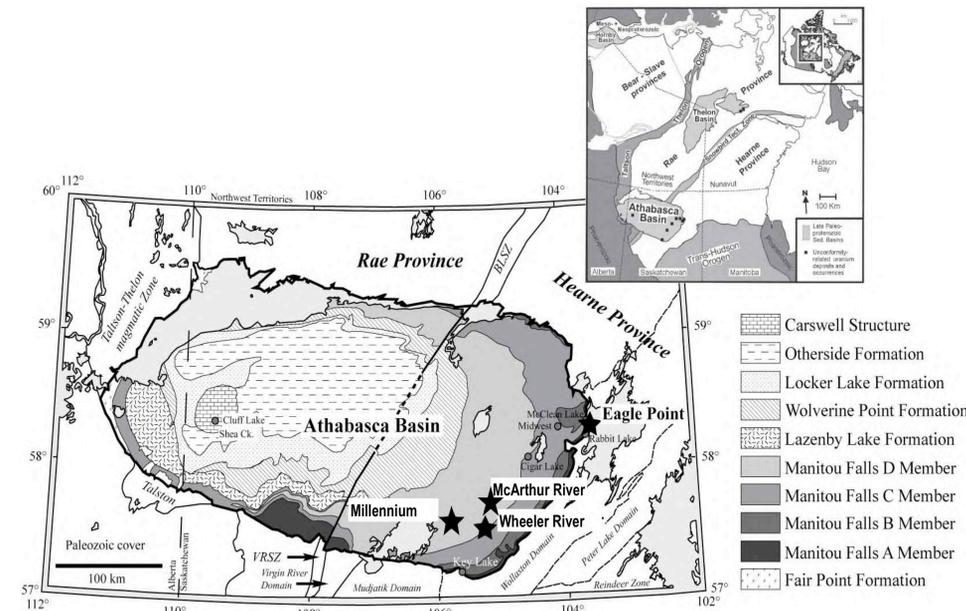


Fig 1. Simplified geologic map of the Athabasca basin in northern Saskatchewan, Canada. Modified after Cloutier et al. (2009).

Background

Unconformity-related uranium deposits in the Athabasca basin, including the Millennium deposit which lies within the CMIC Footprints Project U site area, occur along large-scale fault structures that exhibit a history of significant hydrothermal alteration. Previous research provides a detailed paragenesis of the mineralogy and alteration characteristics of the Millennium deposit and identifies pathfinder trace-elements in the surrounding basement complexes and overlying sandstones.

Introduction

Documenting the crystal chemical variability of alteration minerals and identifying cryptic expressions of pathfinder element-rich phases within core have significant implications for future uranium exploration in the Athabasca basin. This study will determine whether the mode, trace element content and crystal chemistry of illite and chlorite exhibit meaningful variability proximal and distal to uranium deposits and 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.

Research Methods

Core samples from the alteration halo around the Millennium deposit will be examined along transects that crosscut and parallel the main structural corridor to define the mineral chemical features of the deposit footprint. This study will focus on samples from the distal parts of the alteration halo in the basement rocks and the overlying sandstones.

- Mineralogy and sample textures will be characterised using Environmental Scanning Electron Microscopy used in conjunction with Mineral Liberation Analysis (ESEM-MLA).
- Major element mineral chemistry of representative chlorite and illite clusters will then be analysed by Electron Microprobe (JEOL 8230)
- Trace element mineral chemistry will be determined by LA-ICP-MS (Excimer 193nm or Femto 266 nm and X-Series 2 or Element XR).

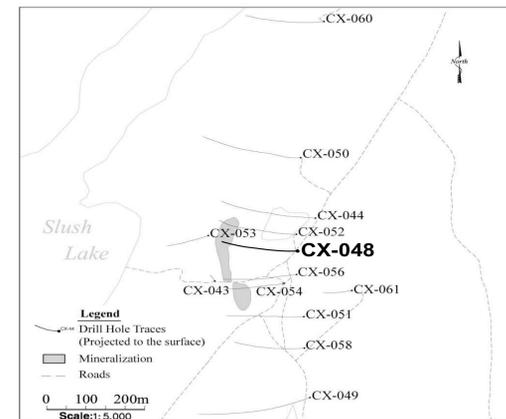


Fig 2. Historic drilling at the Millennium deposit. Modified after Cloutier et al. (2009).

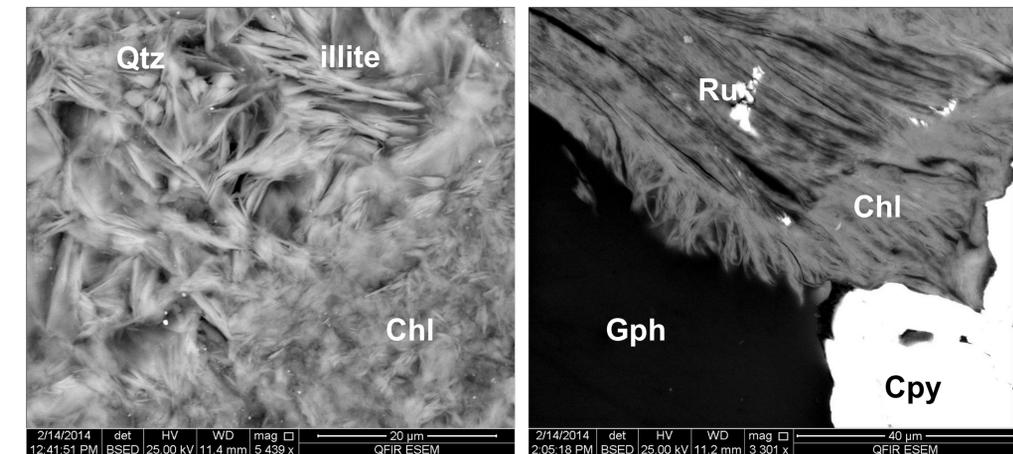


Fig. 4 CX-048 807m. ESEM image of chlorite and illite textures within the Millennium alteration halo below the main zone of mineralization. Chl = Chlorite, illite = Illite, Qtz = Quartz

Fig. 5 CX-048 690m. ESEM image of chlorite associated with other reductant species above the main zone of mineralization. Chl = Chlorite, Gph = Graphite, Cpy = Chalcopyrite, Ru = Rutile

Application to Uranium Exploration

The Millennium and McArthur River deposits 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 can also occur within barren hydrothermal systems. Further research comparing the results of the study at Millennium to samples from the Wheeler River alteration system could lead to the development of methods for effectively differentiating mineralized from barren systems using alteration mineral crystal chemistry. In addition, this study will provide a better definition of the characteristics of the alteration minerals in the distal reaches of the Millennium footprint.

Acknowledgements

Special thanks to the CMIC and the NSERC CRD Program for providing the funding for this research and to Cameco Corporation for sponsoring field work components. In particular, Dan Brisbin, Gerard Zaluski, and Tom Kotzer from Cameco Corporation are thanked for their input into the project thus far.

References

Cloutier, J., et al. "The Millenium Uranium Deposit, Athabasca Basin, Saskatchewan, Canada; an Atypical Basement-Hosted Unconformity-Related uranium deposit." *Economic Geology and the Bulletin of the Society of Economic Geologists* 104.6 (2009): 815-40. Print.

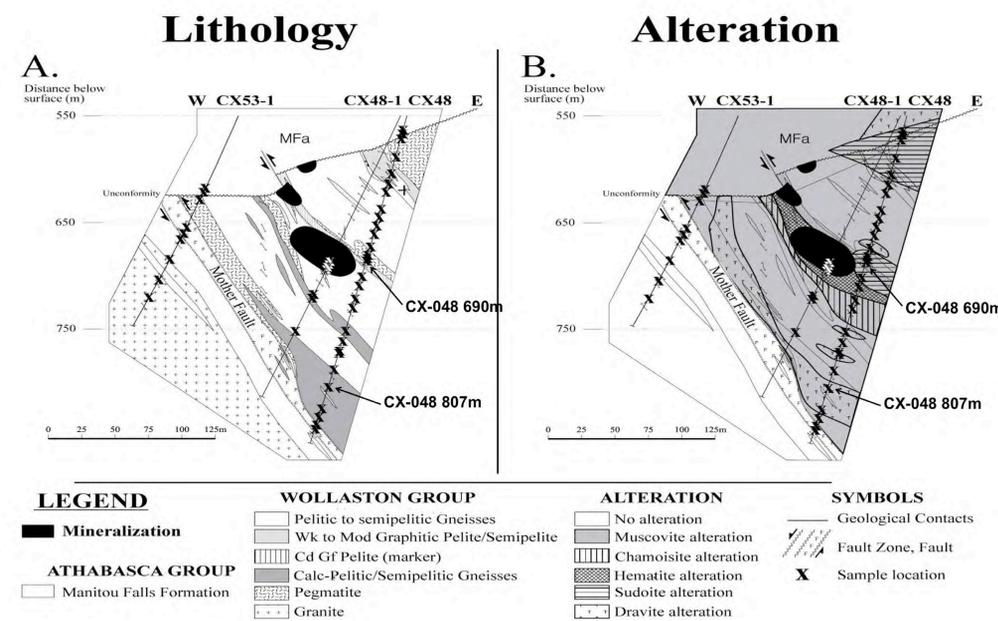


Fig 3. Lithology and alteration surrounding the Millennium deposit. Modified after Cloutier et al. (2009).