Alteration associated with basement faults in unconformity-related uranium deposits: Case studies at the McArthur River and Fox Lake deposits, Athabasca basin, Canada

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A detailed analysis of the alteration halos surrounding basement-hosted U deposits will be used to characterize geochemical and mineralogical gradients, and the physicochemical properties of basement-derived fluids. Better constraints on the nature of these fluids will provide new insights on how unconformity-related U deposits are formed.

Fieldwork entails graphic logging and sampling of drill core at the McArthur River and Fox Lake deposits. Thin section petrography will establish the primary mineralogy of basement rocks, and the sequence of mineral alteration. These data will permit interpretation of fluid-rock interactions; and combined with whole-rock geochemical data, help explain alteration-induced changes in rock composition. Micrometer scale textures will be studied using a SEM. CL imaging of quartz and feldspar from altered basement rocks will identify compositional zonation, overgrowth features, or evidence for a hydrothermal overprint or alteration-induced incorporation of trace elements. XRD analysis will focus on clay polytypes in altered and unaltered basement rocks, which can be used for geothermometry. The composition of secondary minerals formed by interactions between basement rocks and reduced fluids will be characterized using EMP analysis. Pyrite will be analyzed using BSE, EMP, and LA-ICP-MS. The composition and texture of pyrite will be used to evaluate the physicochemical properties of alteration events. Whole-rock compositions will be determined using ICP-OES, and ICP-MS. Analyses will include major and trace elements. If present, fluid inclusions will be analyzed. Isotopic analysis of secondary minerals in altered basement rocks will be used to isotopically characterize the reduced fluids. Emphasis will be on S in pyrite, and H and O in clays to constrain the origin of ore-related fluids. Geochemical modeling of alteration-related fluids will be performed. These models, combined with analytical data will refine knowledge of the physicochemical conditions of fluid-rock interactions along basement faults.