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Alteration systems in the Shea Creek deposit (Athabasca, Canada): Vertical variability of clay alteration

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Shea Creek is the most advanced uranium exploration project in the western Athabasca basin (Saskatchewan, Canada). It is an unconformity related deposit and the major discoveries were made at depths ranging from 700 m to 900 m below surface.
In this project the three types of mineralization reported in different unconformity deposits of the Athabasca basin are found together with 1) perched mineralization in sandstone, 2) mineralization at the contact between sandstone and basement, and 3) mineralization located within the basement up to 200 m below the unconformity. Shea Creek can be considered as a reference for the exploration of deep seated uranium deposits in the Athabasca basin.
These various types of unconformity mineralization are surrounded by large alteration haloes used as pathfinders in exploration. The ongoing work's objective is to improve the knowledge of the spatial and temporal relationships between mineralization and host rocks alteration. The study of a reference drillhole intersecting mineralization and alteration at different levels in the Kianna prospect (central part of the Shea Creek project) reflects mineralogical heterogeneity in alteration of both basin sandstone and basement rocks.

In the sandstone, a broad vertical heterogeneity is noted in the compaction rate and pressure solution associated with sediment diagenesis, in particular at the basin basis where an under compacted zone is developed. Kaolinite (not dickite) is the diagenetic mineral marker of the under-compaction zone while illite is the marker of later hydrothermal alteration. Hydrothermal alteration in sandstone is observed up to the present erosion surface.
In the basement rocks, the alteration is guided by intense fracturing and faulting (brecciation) and is characterized by the development of clay gouges. Such structures can be traced to the deepest drilled level (934 m). Illite, sudoite and trioctaedral chlorite are the main markers of alteration. Illite and sudoite were formed prio to trioctaedral chlorite.
Smectite and aluminium phosphate- sulfate minerals (APS) are present on both sides of the unconformity.
The average concentration of light rare earth elements increases strongly close to the mineralized bodies. In the sandstone, this chemical signature can be detected up to 200 m above the perched mineralization.
The model of clay mineral distribution and associated mineral phases (APS) will be used as a reference for ongoing alteration study ($\sim$50 drillholes) at the Shea Creek project.