THE ROLE OF ORGANIC MATTER ON URANIUM PRECIPITATION IN THE CRETACEOUS SAND DEPOSITS OF ZOOVCH OVOO, MONGOLIA

Dimitrios Rallakis[1], Raymond Michels[1], Catherine Lorgeoux[1], Marc Brouand[2], Olivier Parize[2], Richard. Paul Philp[3] & Michel Cathelineau[1]

[1]GeoRessources CREGU, CNRS- Université de Lorraine, UMR 7359, Vandoeuvre-les-Nancy, France
[2] ORANO Mining, Tour AREVA, 1, place Jean Millier, 92084, Courbevoie, France
[3] School of Geology and Geophysics, University of Oklahoma, Norman, Oklahoma, USA

The Zoovch Ovoo uranium deposit is located in East Gobi Basin, Mongolia. It is hosted in the Sainshand Formation, a Late Cretaceous siliciclastic reservoir, upper part of the post-rift infilling of the Mesozoic East Gobi Basin. The Sainshand Formation corresponds to unconsolidated medium-grained sandy intervals and clay layers deposited in fluvial-lacustrine settings. Within this formation, the uranium deposit is confined within a 60-80 m thick siliciclastic sequence inside aquifer driven systems assimilated to roll-fronts.

Samples were collected right after drilling in air tight aluminum lined bags vacuumed and sealed as to insure protection from air oxidation. Bags inflated during storage and lead to the collection of gas samples.

Petrography was conducted as to study organic matter particles with special care to their relationship to uranium using reflected light optical microscopy, scanning electron microscopy, electron microprobe. Kerogen was also investigated by Rock-Eval, PyGCMS while rock extracts were studied by GCMS. The gas samples collected at ambient P-T conditions were analyzed by GCIRMS.

The macerals contents (telohuminite, corpohuminite, fusinite, semifusinite, funginite, cutinite) as well as molecular geochemistry assess that the organic matter is land plant derived and occurs as small detrital elements located within clay and sandstones layers. Rock-Eval indicates that it belongs to kerogen type III and IV while PyGCMS reveals the presence of mostly aromatic and oxygenated compounds suggesting a poor state of chemical preservation. %Ro=0.3%, Tmax<430°C are indicative of low maturity, supported by basin modelling which suggests that temperature never exceeded 40°C.

Gas samples composition is dominated by more than 92 mol% CO_2. However, other gases are also present, in decreasing order of amount: iso-butane, methane, ethane, propane, butane, pentane, iso-pentanes, hexane, iso-hexanes, ethane, propene, butene.

In regards to uranium 1) macerals can contain up to 40wt% uranium without any mineral phase expression. Uranium enriched zones are observed at the rims of organic particles, along fractures and in porous parts of macerals with decreasing concentration gradients from rim to center 2) uranium expressed as UO_2 mineral phase is observed at rims and internal fractures of particles 3) partial to full replacement of organic matter particles by UO_2 occurs with preservation of plant tissue structures (epigenetic replacement).

All the data combined allow the proposal of a macerals-fluids interaction scheme at low temperature that implies uranium trapping, progressive enrichment of particles leading to expression of a uranium mineral phase and progressive destruction of organic carbon until full

replacement of macerals par UO_2. The origin and significance of the unusual gas composition will also be addressed.

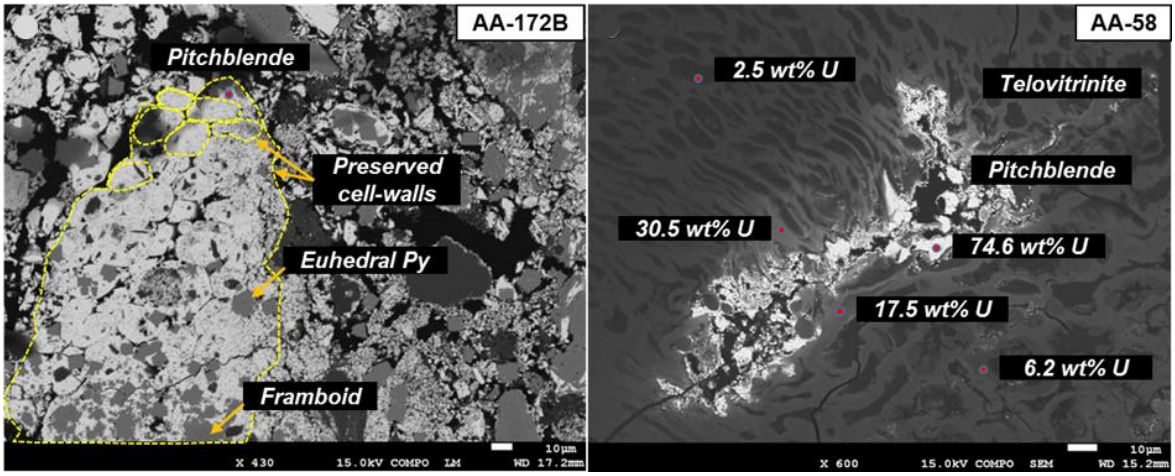

Fig. 1: SEM view of polished section. Left: kerogen type III particle fully replaced by uranium oxide with preserved maceral morphology (corpohuminite). Right: Uranium gradient concentration pattern from an internal fracture (74.6wt U, uranium oxide expressed,) towards the intact parts of the particle (2.5 wt% U, no mineral expression).