Contribution ID: **706** Type: **Verbal**

Use of Digital Autoradiography to characterize the effect of acidic leaching on mobilisation of 238U series radionuclides in ISR context.

Friday, 18 May 2018 14:30 (15 minutes)

This work is based on a comparative analysis of 2 sand samples from the ISR (in situ recovery) experimental site of the Dulaan Uul uranium prospect (Mongolia). Both sample were polished thin-sections. The first sample (raw ore) come from the untreated ore body and the second (leached sand) is from a part of the ore body which was leached during 6 months. Previous chemical analysis [1] indicate U-concentration and U-Ra ratio of 400 ppm and near 1 (secular equilibrium) respectively in the untreated ore sample. U-concentration of 6 ppm and U/Ra ratio of 29 were measured in the sample of leached ore.
Three techniques were used in this work: i) alpha digital autoradiography was used as a mapping tool to locate radioactive regions on the thin-section at micrometric scale, ii) QuemScan chemical mapping was used to obtain a large chemical/mineralogical map of the samples at micrometric scale and iii) a scanning electron microscope coupled with focused ion beam (SEM-FIB) was used to produce transversal nanometric cross sections directly from the thin sections. Alpha autoradiographs (i) were coupled with the elementary chemical maps (ii) to precisely locate radioactive regions of interest. The MEB-FIB (iii) was used to study the mineralogy, petrography and chemistry.
Alpha maps of both samples display high active spots, diffuse radioactive and inactive zones. This heterogeneity illustrates that, for both samples, the alpha activity location is related with the mineralogy and the petrology of the sample even after acidic leaching. Using the autoradiograph/QuemScan maps coupled we observed on the raw ore sample an association between U-rich phases and Fe-Ti minerals, mainly Ilmenite (FeTiO3). Two types of Fe-Ti minerals were identified: the type 1 is composed by strongly altered minerals with dissolution holes sometimes filled by clay minerals. Nanocrystals of uraninite (UO2) coat the dissolution surfaces of Fe-Ti minerals. The type 2 show little trace of alteration and is not associated with clays or uraninite. The same approach was applied on the leached sample. The remaining U was associated in zircon crystals. Hot spots of alpha activity were located in zones containing Fe-Ti minerals and more rarely barite. The barite shows two specific morphologies. The first is dendritic and often associated with clay minerals. The second one shows overgrowth on a needle-shaped core.
These results bring new information about the fate of intermediate radionuclide in ISR conditions. The relationship between the alpha activity and the mineralogy of the leached samples indicate that daughters'elements appear to be immobile during the leaching process. Intermediate elements seem to be still associated with Fe-Ti minerals. Mineralogical observation may also indicate others process like adsorption on clay phases or co-precipitation with barium sulphates. This work uses digital autoradiography as a rapid and powerful tool to localize and to have an overall understanding of the mobility of the alpha radio-isotopes. Coupling with the uranium content is fundamental to locally deduce the radioactive equilibrium state in the thin-sections.

Primary author: Mr ANGILERI, Axel (IC2MP)

Co-authors: Prof. SARDINI, Paul (IC2MP); Prof. BEAUFORT, Daniel (IC2MP); Mr DESCOSTES, Michael (AREVA); Ms PATRIER, Patricia (IC2MP); Mr AMIARD, Guillaume (PPRIME)

Presenter: Mr ANGILERI, Axel (IC2MP)

Session Classification: RER 6

Track Classification: Radionuclides in the Environment, Radioecology