



Post-doctoral proposal:

Assessment of natural attenuation as remediation strategy for mining sites operated by In-Situ Recovery in acidic conditions

Research area: environmental mineralogy and geochemistry.

Background and Description of the project: world mining uranium production is mainly accomplished by In Situ Recovery (ISR), with nearly 50% of world production. This mining method, targeting mostly roll-front deposits, consists of dissolving the uranium contained in permeable, mainly sandstone, geological formations “in situ” using leaching acidic solutions. The solubilized ore is then pumped to the surface and the uranium extracted. Compared to more traditional mining methods, ISR has attractive investment costs due to the absence of ore extraction and mechanical processing but is also considered to result in a limited environmental impact on the surface compared to other mining techniques with the absence of mill tailings and wasterocks. The main environmental impacts associated to ISR mining are related to water quality in the mineralized aquifer and the risk of contaminating adjacent aquifers. Remediation of these aquifers relies either on natural attenuation with a dedicated monitoring and an associated geochemical modelling, either on enhanced natural attenuation (notably via biostimulation), or pump and treat solutions.

This postdoctoral position will aim at evaluating the natural attenuation of impacted aquifers several decades after the end of the Uranium production from a mining site operated by acidic ISR. For this achievement, the post-doctoral candidate will have to carry out a detailed mineralogical, petrographical and geochemical characterization of rock samples cored from the mining site and differently impacted by acidic conditions. Particular attention will be paid to the role played by the clays minerals and newly formed minerals in the immobilization of ^{226}Ra , U(VI), SO_4 , as well by the role of these processes on the regulation of water chemistry as pH. Finally, note that the mining site focused for this study has been monitored during thirty years period providing exceptional data sets to follow the natural attenuation over decades.

These results will allow to better deciphering the main geochemical processes involved in the natural attenuation remediation solution. Coupled to aqueous monitoring, these results will feed reactive transport modeling to better constrain the long-term evolution of the mined site.

Place of employment and place of work: this study, funded by ORANO, will be held in the University of Poitiers at the **IC2MP Institute** (team E2, HydrASA) under the supervision of Emmanuel Tertre and Patricia Patrier (IC2MP) and Michael Descostes (ORANO Company). Furthermore, the post-doctoral fellow will be required to undertake regular visits at ORANO Company (Paris).

Available techniques in the IC2MP laboratory include XRD, IR spectroscopy, SEM-EDS, alpha autoradiography, ICP MS-OES, Raman spectroscopy. Applicants mastering other characterization techniques, as X-ray Absorption Spectroscopy, are welcome.

Required profile: the candidate should have a PhD in Earth Sciences and/or Materials Sciences, with **a solid background in mineralogy and geochemistry**. Experience with mining environments is an advantage. The candidate is expected to write scientific publications in English and to present its results in international conferences.

Duration: Post-doc of **18 months** (renewable). Expected date of employment: **1 June 2021**.

Remuneration: between 2600 and 2900 € gross monthly according to experience.

How to apply: as a minimum, all applications must include (pdf-files only, max. 10 MB, no zip):

- Personal information and academic background.
- Curriculum vitae including list of publications.
- Motivation letter for the proposal (max. 2 pages).
- The letters of two references.
- PhD Diploma(s) and PhD thesis reports. If the original documents are not in English or in French then copies of the original documents as well as a certified English translation must be attached.
- Documentation of language skills if required.

Applications will be sent to emmanuel.tertre@univ-poitiers.fr and patricia.patrier@univ-poitiers.fr. After submission of the application, you will receive a confirmation e-mail.

Application deadline: no later than May 15th 2021.

Relevant references linked to the scientific project:

- Angileri, A.; Nicolai, J.; Sardini, P.; Siitari-Kauppi, M.; Beaufort, D.; Amiard, G.; Beaufort, M.F.; Descostes, M. (2020). Mobility of daughter elements of ²³⁸U decay chain during leaching by In Situ Recovery (ISR) technique: new insights from digital autoradiography. *Journal of Environmental Radioactivity* **220-221**, 106274.
- de Boissezon, H.; Levy, L.; Jakimyw, C.; Distinguin, M.; Guérin, F., Descostes, M. (2020). Modelling the U and ²²⁶Ra mobility during and after an acidic In Situ Recovery test (Umnut, Mongolia). *Journal of Contaminant Hydrology* **235**, 103711.
- Robin, V.; Beaufort, D.; Tertre, E.; Reinholdt, M.; Fromaget, M.; Forestier, S.; de Boissezon, H.; Descostes, M. (2020). Fate of dioctahedral smectites in uranium roll front deposits exploited by acidic In Situ Recovery (ISR) solutions. *Applied Clay Science* **187**, 105484.