Postdoctoral or engineer 1 year position

Reactive transport simulation of in situ recovery in fractured deposits

Contacts:

- MINES ParisTech (chair ISR-U): Vincent Lagneau – vincent.lagneau@mines-paristech.fr
- ORANO (project leader ISR): Anthony Le Beux – anthony.lebeux@areva.com

Funding:

- Industrial chair ANR "uranium exploitation by in situ recovery"

Context

In 2016, ORANO and MINES ParisTech (through its contractual research operator ARMINES) joined their efforts to launch an industrial chair on uranium exploitation by *in situ* recovery. The technique, suited for confined, high- permeability ore bodies, consists in the injection of dissolving fluids (*e.g.* sulfuric acid) through a series of injection wells. Solutions enriched in dissolved uranium are recovered through producing wells. The dissolved uranium is separated in a treatment plant, then the stripped solutions are adjusted and sent back to the well field.

Previous work performed at MINES ParisTech and AREVA with the reactive transport code HYTEC reached the point where the coupled hydrodynamics and geochemical behaviors of the exploitation can be simulated at the block scale. 3D simulations, over several 10^5's grid cells, rely on the description of processes (hydrogeology, geochemical reactions), exploitation scenarios (well-field design, flow rates and injected fluid compositions), and the geometric description of the system (block model for facies and uranium grade).

This project aims at extending these methods (initially developed on high porosity high porosity deposits) with a view to estimating ISR feasibility in more complex, fractured, ore bodies.

Proposed work

In a first time, the project will focus on a case study built on the Imouraren mine. Ample data is available on this site, although they were acquired in an open pit development perspective. Previous work allowed creating a consistent model following an equivalent medium approach (*i.e.* averaging the effect of fractures): geological block model, geochemical model and 3D reactive transport model of ISR exploitation at the scale of a production cell.

A description model of the fracture network will be created, based on hydrogeological data (well tests, tracer tests) and structural data. The model should be consistent with the reactive transport goals, *i.e.* 10's to 100's m. This description will then be used to update the 3D reactive transport model. Depending on the constraints, different approaches could be recommended: equivalent homogeneous medium with anisotropic permeability, double medium, or (limited number of) discrete fractures. The model will then be used to test different configurations of exploitation, provide quantitative

elements to assess the feasibility of the ISR method on this site, and identify key parameters to imprive the predictive capacity of the model.
Other applications might be proposed, depending on the work progress and opportunities.

Profile
Young PhD or engineer, with experience reservoir engineering, fractured medium hydrogeology. Experience in reactive transport simulation is a plus. Knowledge in geochemistry and or geostatistics are appreciated.
Teamwork is essential, in a project between the academy and industry.

Praticality
The work is funded by the industrial chair ANR ISR-U, under contact with ARMINES, for a duration of 1 year. Salary depending on diplomas and previous experience.
Located in Châtillon (South Paris), within ORANO MINING direction of R&D.