

Postdoctoral or engineer 1.5 year position

Numerical simulation of the impact of uranium exploitation by *in situ* recovery in the vicinity of the production zone (near field)

Contacts

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Funding

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Context

ORANO Mining *via* its subsidiary KATCO exploits uranium ore deposits in Kazakhstan by acidic *In Situ* Recovery (ISR). The technique, suited for confined, high- permeability mineralized reservoir, consists in the injection of dissolved fluids (*e.g.* sulfuric acid) through a series of injection wells. The pregnant solution, enriched in uranium, is recovered through producer wells. The dissolved uranium is separated in a processing plant, and the stripped solutions is sent back to the well field for re-injection.

The rehabilitation method considered by KATCO for ISR exploited aquifers is based on the ability of the aquifer to buffer the salt and acid plume generated by the exploitation. This process, called (monitored) natural attenuation, has been evidenced by *in situ* observations. In parallel, reactive transport modeling approach are used to better understand the phenomenology.

The Geosciences Department in MINES ParisTech and ORANO Mining have been collaborating for several years on reactive transport simulations around *in situ* recovery (Lagneau et al, 2019, *Reviews in Mineralogy and Geochemistry* **85**, 499-528). Studies performed with the code HYTEC (van der Lee et al, 2003, *Comput Geosci* 29:265–275) allow to simulate the exploitation in 3D at a production block scale (*approx.* 15 pumping wells for 45 injector wells) and, in 2D at a multi-kilometer scale. 3D and 2D 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).

The behavior of the plume in the vicinity of the production blocks during and after exploitation is depends largely on the local geology. The proposed study aims at deploying the modeling methodology previously used for far-field modeling (high time-scale, wide scale, few calibration data available) to modeling the behavior of a production block and its close vicinity (near filed approach) in order to compare these models with environmental monitoring data.

Proposed work

After an adaptation phase to the simulation tools (HYTEC and its environment), hydrogeochemical simulations will be performed of a post-closure area of the mine, using available data: geological block model, exploitation scenarios, production data, environmental monitoring. The model will be adjusted initially to the production data and in a second step to available environmental survey data.

The simulation results will be exploited with several tools, in order to evaluate the spatial and temporal behavior of the plume near the production block.

If necessary, a simplification study of the modeled system may be conducted.

Profile

PhD with experience in reactive transport simulation, hydrogeological simulation or reservoir engineering. Previous experience or knowledge in geochemistry and/or geostatistics is appreciated.

Teamwork is essential, in a project between the academy and industry.

Practicality

The work is funded by ORANO, under contact with ARMINES, for a duration of 1.5 year. Salary depending on diplomas and previous experience.

Located in ORANO Mining, direction of R&D (Chatillon, France) and MINES ParisTech, Centre de Géosciences (Fontainebleau, France). One or several missions to the KATCO mines in Kazakhstan possible, depending on the needs and acquired results.

Part of the work may be published in peer-reviewed scientific journals.