Postdoctoral position at the University of Lorraine (France)

GeoRessources Laboratory

Title: Coupled thermo-hydro-mechanical (THM) modeling of structurally-controlled deposits at basement– basin interface: application to unconformity-related U deposits.

Context: A better understanding of structurally-controlled deposits formed by hydrothermal processes requires a fair knowledge of the geological structures in terms of geometric and topological features, of the hydraulic and mechanical behaviors of faults and of their damage zones [Sheldon and Micklethwaite, 2007] and of the regional stress field controlling their overall response. Numerical modeling is surely one of the most suited tools to investigate thermo-hydro-mechanical (THM) processes participating to the circulation of mineralizing fluids within geological structures and hence to the formation of mineral ore deposits [Raffensperger and Garven, 1995a; Raffensperger and Garven, 1995b; Hobbs et al. 2000].

Objectives and work summary: This postdoctoral project will aim at modeling THM processes that drive mineral deposit formation at the basement-basin interface, with a focus on unconformity-related uranium-ore deposits. The study will be based on the case of the world-class Cigar Lake ore deposit (Saskatchewan, Canada). The ultimate goal will be to provide a more accurate overview of the space and time evolution of the fractured network governing the hydrothermal processes. Uranium mineralization, indeed, occurs along preferential fluid flow circulations highly controlled by petrophysical and structural heterogeneities. These deposits have been studied and even modeled in the past but at the cost of significant geometric simplifications that directly affect fluid channeling and flow conditions [e.g., Cui et al., 2010, 2012; Li et al., 2016].

The 3D Distinct Element code 3DEC (Itasca consulting group) will be considered for this purpose. Time and space changes of the fracture network geometry due to stress-state variations and the related impact on local permeability and porosity will be particularly investigated. Different scenarii with different levels of complexity will be considered and numerical predictions will be compared to in situ observations. In a second step, impact of thermal couplings will be also considered. The work

will rely on existing analytical data and in situ observations (including the 3D geological model) provided by Orano. This academic project will be done in close collaboration with the geologists and scientists of ORANO, the French nuclear company (www.orano.group/en/orano-home).

Applicant profile: The candidate must be a highly-motivated and self-directed person with a recent PhD degree in computational mechanics, reservoir engineering, geology, civil engineering, or other relevant fields. A solid background in rock mechanics and fluid flow in porous media with a strong interest for THM processes are required. He or she may demonstrate fundamental knowledge of solid and fluid mechanics principles governing the behavior of porous and fractured media and motivation for work at the interface between disciplines. An experience in numerical programming and computational methods in general and in discrete element methods in particular is required. Previous experience with 3DEC would be a very strong asset. The candidate will need to be fluent in English.

Funding: This Postdoc will benefit from a joint funding between ORANO, the French nuclear company and the LabEx RESSOURCES21 which was selected by the French Ministry of Research and Education in the framework of the "Laboratoires d'Excellence" initiative. RESSOURCES21 proposes an integrated scientific and educational approach to the understanding, exploitation and environmental management of strategic metal resources for the 21th century. This postdoctoral project is funded for 18 months, starting as soon as possible and no later than **September 1st, 2019** (net salary, including social security: between 2000-2300 €/month depending on experience).

Applicants should send via email before **July 1st, 2019** a Curriculum Vitae with cover letter and the names and email addresses of two references to:

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