

Postdoctoral position in biogeochemistry and modelling of trace metal elements

Type of contract: 18-month position

Keywords: arsenic, leaching, argillite, lysimeter, flux, transfer, modelling, mineralogy, stockpile

Presentation of the recruiting organization:

Created in 1979, the French National Radioactive Waste Management Agency (Andra) is a public body in charge of the long-term management of all radioactive waste, under the supervision of the Ministry of Ecology, Energy and Sustainable Development, and the Ministry of Research. The three basic missions of the agency are:

1. a R&D mission to propose a safe long-term solution for the disposal of radioactive waste,
2. an industrial mission concerning, on one hand, waste acceptance criteria and control and, on the other hand, siting, construction, operation, closure and monitoring of repositories. This mission includes as well a public service mission in terms of i) collection of waste of the "small-scale nuclear activities" producers and ii) clean-up and rehabilitation of orphan polluted sites,
3. an information mission through the regular publication of the National Inventory of radioactive materials and waste, and an active policy of dialogue with the stakeholders both at national and local level.

Andra is located in four different places:

- The Headquarters sited near Paris (Châtenay-Malabry, Hauts-de-Seine),
- The CSM surface repository officially under post-closure monitoring phase since 2003 and located in the Manche district near the AREVA La Hague facility,
- the CSFMA surface repository dealing with low- and intermediate-level short-lived radioactive waste and the nearby CSTFA surface repository dealing with very low level radioactive waste, both operating in the Aube district,
- The Meuse/Haute-Marne Centre CMHM with the Underground Research Laboratory LSMHM located in Bure (Meuse district at the border of the Haute-Marne district) and the nearby Technological Exhibition Facility ETe located in Saudron.

Description of the position to fill:

Context

Cigéo (Industrial Centre for Geological Disposal) is a French project of deep geological disposal of spent fuel and of high-level (HL) and intermediate level long-lived (IL-LL) radioactive waste. If accepted, this centre will be located at CMHM in north-eastern France, in the Meuse district at the border of the Haute-Marne district.

Cigéo will include surface installations for controlling and conditioning waste packages, as well as underground installations for waste-disposal purposes and connecting infrastructures between surface and underground. The storage of nuclear waste will be located at a depth of 500 m in a clay layer (the Callovo-Oxfordian argillite, COx) chosen for its remarkable properties (retention capability, low permeability and homogeneity of the formation), which delay and mitigate the migration of the radioactive substances. Approximately 10 million m³ of COx will be removed during the gradual excavation of the facility (over 100 years) and a specific stockpile area will be formed in surface to store this clay material. The environmental impact of such pile must therefore be monitored, which means that the alteration processes must be well characterized.

Scientific objectives

A mineralogical and chemical characterization of stockpile materials must be performed in the context of the impact study. The dynamics of trace element migration will be monitored by means of column and lysimeter experiments in order to model mass transfers. The general objective of this work is the prediction of the leaching of trace elements (As and/or other trace elements) due to the alteration of stockpile materials. Alteration is due to physico-chemical and biological processes affecting Callovo-Oxfordian argillites during their storage in oxidizing conditions (at the surface). The following scientific questions will be addressed:

1. What are the mineral and organic phases bearing the considered trace element in the argillites and how does its speciation evolve during argillite alteration?
2. How do the abiotic/biotic processes of pyrite alteration influence the mineralogical, physical and chemical characteristics of the stockpile materials? What is the kinetics, how do they affect mineralogy and porosity? What are the consequences on the mobility of the considered trace element?
3. What are the dynamics (in terms of reactive transport) of the trace elements present in the argillites during the pedogenesis of stockpile materials submitted to alteration at t=0, 1 and 10 years? Is it possible to model the concentrations of trace elements at the outlet of laboratory columns?
4. Comparison between the breakthrough curves obtained by column experiments (elution-frontal chromatography) and the results monitored at the lysimeter station located in Osnes-le-Val (Meuse department) in real climatic conditions?

Organization

The post-doctoral fellow will be a member of the Laboratoire Réactions et Génie des Procédés (LRGP, UMR 7274 CNRS/Université de Lorraine). He/she will have to work in strong partnership with two other labs of Nancy: Laboratoire Sol et Environnement, UMR 1120 INRA/Université de Lorraine and Laboratoire Interdisciplinaire des Environnements Continentaux, UMR 7360 CNRS/Université de Lorraine. He/she will have to go regularly to the lysimetric station located close to the ANDRA laboratory located in Meuse/Haute-Marne (80 km from Nancy).

During his/her contract, the post-doctoral fellow will spend several months in a foreign laboratory to investigate the knowledge on the bearing phases of the trace element and their evolution during the first steps of alteration. He/she will use X-ray absorption spectroscopy techniques (EXAFS-XANES) and X ray fluorescence and microfluorescence (XRF, μ XRF) on the light beam ANKA.

Profile of the candidate:

The candidate will have a master degree and a doctorate in geoscience or equivalent, with a very high level in modeling and knowledge in biogeochemistry, mineralogy and/or hydrogeology. Apart from scientific skills, he/she must be dynamic and have good skills in creativity, communication, redaction and a high adaptation capacity.

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Application deadline: May 15th, 2013

Annual gross salary: between 25000 and 350000 €