Ph.D. Fellowship on 'Redox reactivity of Selenium in environmental geomedia' – Grenoble (France) and Dresden (Germany).

We are looking for candidates for a Ph.D. fellowship application in the field of redox reactivity of selenium, in a collaboration between the Earth Science Institute (ISTerre, CNRS & Univ. Grenoble Alpes), and the Surface Processes department of the Institute of Resource Ecology at HZDR (Institute of Resource Ecology - Helmholtz-Zentrum Dresden-Rossendorf, HZDR). The project is part of a collaborative research with ANDRA, the French National Agency for Nuclear Waste Management.

Research supervisors
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Context
Production of electricity by nuclear power plants inevitably generates radioactive waste. Concerning the high-level and long-lived radioactive waste, a solution considered by the French and German nuclear waste management agencies is to store them into deep underground repositories. The principle of such a concept is to provide a multi-barrier system with several matrixes to avoid the release of the radioactive waste through the biosphere for very long time scales (up to hundred thousand of years). Long-term safety assessments require a characterization at both macroscopic and molecular level of the different processes (retention, reduction, surface precipitation, etc.) that can take place onto the involved solid surfaces and the considered radioactive pollutants. Among them, the ^{79}Se isotope (~3.27×10^5 a) is considered as one of the main radionuclides contributing to the dose-to-man after final disposal.

Selenium can have different oxidation states (-II, -I, 0, +IV, and +VI). The -II, -I and 0 states are commonly predominant in "reducing" anoxic environments, while the +IV and +VI states predominate in "oxidizing" environments. In the reducing geochemical environment of the Callovo-Oxfordian (deep clay formation selected for the location of the French deep geological repository Cigeo), selenium is thus expected to be thermodynamically stable in solution in redox states ranging from 0 to -II. The solubility of selenium depends on the oxidation state: (a) Se(+VI) and Se(+IV) highly soluble (solubility not controlled by a mineral phase); (b) Se(0), extremely poorly soluble native selenium; and (c) Se(-I) and Se(-II): poorly soluble but significantly more soluble than Se(0). The transition from one oxidation state to another may therefore be accompanied by changes in solubility.

The thesis research will focus on the redox reactions and coupled precipitation of selenium (VI) and selenium (-II) under the conditions of the Callovo-Oxfordian pore water and, namely, in the presence of steel corrosion products such as magnetite, which are also widespread environmental minerals. These reactions will be characterized by means of batch sorption experiments, and lab-based and synchrotron-based scattering and spectroscopic methods.

Benefits

The student is expected to spend periods of time both in Grenoble (France) and Dresden (Germany). At the end of the Ph.D. period, the candidate will acquire a detailed experience on the environmental molecular geochemistry of selenium, on detailed studies of mineral/fluid interfaces as well as a strong ability to work alone in the laboratory. She/He will increase her/his knowledge on analytical chemistry, inorganic chemistry, and spectroscopy. The candidate will participate to several national and international conferences, and is expected to publish its results in peer-reviewed international scientific journals.

Requirements

The candidate must have a degree in Engineering or have a Master or Diploma of Chemistry, Physical-chemistry or Geochemistry obtained before the beginning of the Ph.D. thesis (October to December 2021). She/He must come from a country member of the European Union. The candidate will be offered a competitive salary. The duration of the Ph.D. thesis is 3 years. Candidates must have experimental capabilities for laboratory experiments, and must be able to work within an international and multidisciplinary team. She/He must have good communication skills and speak English fluently. Applications including curriculum vitae and statement of interest should be sent **before the end of June 2021** to:

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