Looking for a 3 year postdoctoral researcher with strong experience in mass spectrometry.

Project MOANA : « Role of dissolved and particulate natural organic matter on the sorption of metals in the Pacific Ocean.

Context : The proposed work deals with understanding the coupled cycles of organic matter and radionuclides (RNs) in the Pacific Ocean. Transport processes of RNs and other metallic pollutants is a major issue for the assessment of environmental risks in order to anticipate and manage a potential impact. The behaviour of RNs in the environment (from natural or anthropogenic sources) is governed by a set of complex physicochemical and microbiological reactions (redox, complexation, sorption, precipitation). For a certain number of RNs and trace metals, recent environmental speciation studies revealed the major role played by NOM on their environmental migration, through specific adsorption and chelation reactions. Indeed, the "hydroxamate" functional groups of some organic compounds (e.g. siderophores) produced in the water column and present on particles or in sediments can complex RNs and trace metals (via their oligodentate ligands) and thus play a role in their transport in the water column and their retention in marine sediments.

The MOANA project contains three parts:

- **1 -** Design and validation of a pre-concentration and purification protocol for dissolved organic matter (DOM, by solid phase extraction / ultrafiltration), particulate organic matter (MOP, filtration on McLane pumps) and sedimentary organic matter (SOM). These sampling protocols should allow the isolation of a sufficient quantity of organic matter, with an optimized extraction yield and guarantee the best conservation conditions of the organic matter for their molecular level analysis.
- **2 -** Molecular characterization of NOM, metallophores and metal complexes of the DOM, POM and SOM samples using two approaches :
  (i) non-targeted approach by ultra-high resolution mass spectrometry (HRMS, Orbitrap Lumos 1M) and
  ii) targeted approach by "metabolomic" profiling by using liquid/gas chromatography to high resolution mass spectrometry (Orbitrap, ion-mobility Q-TOF)
- **3 -** Chemical speciation experiments of RNs (actinides) in the laboratory. This part will be devoted to the study of the effects of sorption fractionation of DOM, POM and SOM on the competitive retention of RNs of interest on the surface of various types of mineral phases (sedimentary particles collected in-situ, chlorite, montmorilonite and kaolinite). Sorption isotherms of actinides on mineral phases will be obtained from competitive sorption experiments of metals in closed reactor carried out in the absence and presence of OM, as a function of pH, and at different initial OM/mineral ratios.

In order to carry out this research project, sampling campaigns will take place in 2023/2024/2025 to collect DOM, POM and SOM samples in the Pacific Ocean.

Objective: The primary objective of this postdoctoral project is analytical. It aims to develop a sampling protocol to isolate, purify and characterize dissolved, particulate and sedimentary organic matter from marine environments for their molecular characterization. These analyses should allow drawing up an inventory of the different types of organic matter, metals, metallophores and metal complexes (RNs) from the various samples. The expected analytical developments will be based on the coupling of ultra-high performance liquid chromatography or capillary electrophoresis to (i) the latest generation of ultra-high resolution mass spectrometry (Orbitrap Lumos 1M) which the laboratory has recently acquired and (ii) an ICPMS. This double detection should allow determining the chemical speciation of metals and RNs of interest on samples collected from the Pacific Ocean.

Furthermore, the combination of macroscopic metal sorption data and molecular-scale OM sorption fractionation data will allow the study of the mechanisms and identity of specific organic compounds involved in metal sorption on different mineral surfaces. The innovative approach proposed here will provide crucial information on the mechanisms and molecular parameters that govern the sorption fractionation of organic materials on mineral surfaces, and the importance of this fractionation in the retention behavior of metals/RNs at solid-solution interfaces.

Skills required: MOANA is an interdisciplinary project at the interface of several disciplines (analytical chemistry, organic geochemistry, oceanography,…) which requires a strong experience in characterization of complex samples at the molecular scale by ultrahigh resolution mass spectrometry (Orbitrap Lumos 1M; FT-ICRMS,

UPLC/Orbitrap MS and GC/Q-TOF MS). Numerous trips between the CEA (Commissariat à l'Energie Atomique) center of Bruyères-le-Châtel (approximately 20 kms south of Paris, FRANCE) and the School of Oceanography (University of Washington in Seattle) are to be expected. The candidate must be fluent in English both orally and in writing.

The position is for a 36 months postdoctoral contract

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