Practical work/Master thesis

Period : 2013; 5-6 month (upon discussion)
Profile : Biogeochemistry, environmental sciences, microbiology
Topic : "C*opper isotope fractionation upon sulphate-reduction: a mechanistic approach"*
Laboratory : Laboratory of Hydrology and Geochemistry of Strasbourg (LHyGeS, CNRS-University of Strasbourg, http://lhyges.u-strasbg.fr/)
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Key-words : copper isotope fractionation, sulphate-reduction, biogeochemistry, microcosm

Framework

Copper is an essential micronutrient for living organisms, however, it can be a contaminant due its accumulation in soils and its transfer into aquatic ecosystems. Agriculture is one of the major sources of environmental copper contamination due to the intensive application of copper-based fungicides. **The mobilization and the transfer of copper by surface runoff** can pose a risk to downstream aquatic ecosystems due to copper toxicity for aquatic organisms. **Wetlands** can be active buffer zones between contaminated terrestrial and vulnerable aquatic ecosystems. These systems have the potential to **retain copper due to various biogeochemical processes**, such as sedimentation, sorption to organic matter or mineral phases, (co-)precipitation as minerals or plant uptake.
Sulphate-reduction has been identified as one of the major processes affecting copper under anaerobic conditions, such as those found in wetland sediments. Sulphate reduction consists in the bacterial reduction of sulphate into sulphur and sulphide species, which eventually results in the precipitation of insoluble metal-sulphides, such as covellite (CuS). Copper can precipitate as Cu-sulphide or can co-precipitate with Fe-sulphide species, which may cause an uneven distribution of copper isotopes between the reactant phases and chemical components and thus results in copper isotope fractionation. Copper isotope fractionation upon sulphate-reductive process occurs **between the solution and the precipitated phases**. However, the extent of fractionation varies according to the specific process causing it, and thus may help to decipher the copper biogeochemistry in complex environments, such as wetlands. In this framework, we are looking for a **highly motivated student to investigate copper isotope fractionation due to sulphate reduction** in a microcosm experiment. The study will be carried out within a dynamic and interdisciplinary team, in a well-equipped laboratory.

Objectives

This study aims at **elucidating the copper isotope fractionation during bacterial sulphate-reduction and its precipitation as insoluble Cu-sulphide species**. The main objective is to carry out a microcosm experiment with a selected sulphate-reducing bacterium and observe the evolution of copper isotope composition between the solution and the precipitated phases.

Description

The study consists in setting-up a microcosm experiment, following-up the on-going processes and analyzing copper concentration, isotope composition, sulphate and sulphide concentrations. The study includes five steps:

(i) Gathering the literature and background regarding copper isotope fractionation;
(ii) Preparing and implementing the microcosm experiment;
(iii) Planning and organizing sampling of the microcosm;
(iv) Sample analysis;
(v) Analyzing and interpreting the obtained results (fractionation rate calculations and modeling);
(vi) Wrapping up the results in a scientific report and an oral presentation (possibly in English).