

## What is the influence of episodes of intense rain on the speciation of remobilized metals and their fate?

### Background

Demographic growth, the energy transition and the increase in living standards result in an exponential increase in the quantities of metals extracted, while technological developments lead to a diversification of the metals necessary for industrial development, causing an unprecedented increase in releases of metals in the environment. Metals are considered toxic (e.g., Cd) or as micronutrients (e.g., Cu), but increasing their concentrations beyond certain thresholds degrades the quality of ecosystems and threatens human and animal health (concept “One Health”) in contaminated areas.

Climate models predict that the frequency, intensity and number of short-term extreme precipitation events and flood variability will increase as the global climate changes. This state of affairs no longer makes it possible to precisely constrain the fate and source-sink balance of metals in the Earth critical zone (ECZ) and consequently, the overall contributions of the continent to the oceans. In the ECZ, soils are metal sinks, especially wetlands. Their hydrological cycle (high water/low water) favors the formation of chemical gradients and biogeochemical processes controlling the metal cycle. Extreme floods are characterized by water levels and flows significantly higher than the oscillatory levels observed over time. The source-sink balance of metals in wetlands is then unbalanced, increasing the metals exported in very short periods of time (“flash pollution”) and in partially known physicochemical forms, possibly toxic and in quantities and concentrations that we have to estimate.

### Keywords

- Global changes
- Earth critical zone
- Geochemistry
- Metal contamination
- Isotopes systematics



### Objectives

- Characterization of material exported from wetlands during extreme rains (metal speciation),
- Influence of the origin of organic matter and Fe speciation for the remobilization of metals through abiotic and biotic processes,
- Distribution of metals, speciation and isotopic composition. Hypothesis: The remobilization of metals is mainly controlled by the redox process during precipitation and associated flooding.

## Methods

The subject will include

- Field experiments with several sampling campaigns and in situ and laboratory characterization of samples.
- Laboratory experiments to mimic observed conditions to work under controlled conditions and identify metal remobilization processes. The basic tools of geochemistry and mineralogy will be coupled with isotopic geochemistry, speciation at the molecular scale (spectroscopic techniques at Synchrotron facility) and microbiology.
- Analytical platforms: Elemental geochemistry, Controlled cultures, soil/bacteria/plants (<https://lpg-umr6112.fr/plateformes-angersnantes/>), and isotopic platform.

## Candidate profile

The candidate will have a Master 2 level or equivalent in a specialty in geosciences, thus integrating into the themes of the 3MG doctoral school (<https://ed-3mg.doctorat-paysdelaloire.fr/>). He/she will have knowledge of geochemistry of surface environments (water, soil), means of experimental analysis (ICP AES, ICP MS) and a strong appetite for the field (sampling campaigns) and work in precision laboratories in a controlled environment (clean room). The candidate will be attached to the LPG laboratory in Nantes (France). Good English language skills are expected in order to ensure exchanges with foreign partners, to ensure bibliographic monitoring as well as for the promotion of scientific results (conference and article writing).

## PhD supervision

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## Collaborators

- Daniel F. Araujo, IFREMER Nantes (France)
- Diego Baragaño, Carbon Science and Technology Institute (University of Oviedo, Spain)
- Veronika Veselská, Czech Advanced Technology and Research Institute (Palacky University Olomouc, Czech Republic)

## How to apply

Contact the supervision teams with a detailed CV and a cover letter. After our selection process, the candidate will defend his PhD topic to a scientific committee for obtaining the funding.