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Arsenic-rich mining residues phytostabilisation: impact of microbial activities on arsenic and metals mobility and bioavailability for plants

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Abstract:

Securing mining residues represents a major environmental challenge, and phytostabilisation is a moderate cost option for mitigating erosion and contaminated-particles dispersion. Within the interdisciplinary oMIMo project (ANR-22-CE04-0012-0), a controlled scenario of assisted phytostabilisation was set-up in 20-L pots on two As-rich residues from former mines of Ag-Pb (Pontgibaud) and Sn (Abbaretz). Residues were amended with compost and limestone to provide organic nutrients to plants and buffer pH, planted or not with a herbaceous plant *Festuca rubra* found on both sites, and watered regularly with spring water mimicking natural rain. Experiment will last for two years in a greenhouse, and experimental data, acquired monthly then every six months, combined the evolution of geochemistry (pore water pH, Eh, conductivity, and chemistry, including speciation (AsIII and AsV) of As), microbial processes (most probable number of soil prokaryotes oxidising or reducing As, Fe and S, active community diversity), and bioavailability and toxicity of As and metals for plants (As and metal content in leaf, Omega-3 index). After seven months of monitoring, results showed the development of *Festuca rubra* on both amended residues and the establishment of an active prokaryote community in the pots. Increased numbers (as MPN) of heterotrophs, FeII oxidisers, and AsIII oxidisers were found. The later especially increased in Abbaretz pots in which Fe and As, mostly as AsV, were leached from the residue, while they both remained trapped in the Pontgibaud solid compartment.

One year monitoring of geochemical and biological (microbiology and plants) parameters, including taxonomic diversity of active prokaryotes, will be discussed according to their evolution. A deeper understanding of mechanisms (notably microbial) influencing the fate of As and metals in the residues is expected, with the final aim to develop a reactive transport model to predict As and metals mobility and availability to plants in phytostabilised As-rich mining wastes.

Keywords: microbial processes, arsenic and metals fate, mining residues, phytostabilisation

Please precise on your abstract if the presenting author is:

PhD student

post-doc (< 5 years after PhD)

senior researcher