Biogeochemistry of Zn and Cd in a phytostabilized mining soil

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Mining soils, highly contaminated with metals, have a low plant cover, and are strongly affected by water and wind erosion, thus dispersing metals in the surrounding environment. Due to their large surface area and high contamination, conventionnal soil remediation is not suited, and phytoremediation techniques are promising alternatives [1]. In particular, phytostabilization is used to immobilize metals in the rhizosphere and limits their dispersion, but its success depends on the ability of plant to develop in such environments. A native pioneer legume plant has been identified in mine tailings from South of France [2], and our objective was to evaluate its ability to stabilize Zn and Cd based on a 10-years in-situ field experiment. For that, we used a combination of synchrotron techniques to locate metals in the rhizosphere (micro X-ray Fluorescence, μXRF) and to identify the Cd and Zn chemical species (micro and non-focused X-ray Absorption Spectroscopy including XANES and EXAFS).

Results showed that phytostabilization homogenized Cd and Zn contents in the soil compared to the unvegetalized soil, and the upper rhizosphere was enriched with organic matter. Cd and Zn were mainly present as metal carbonates in the unvegetalized soil, and their chemical forms did not change significantly in the vegetalized one. However, at the micrometer scale in the upper rhizosphere, both metals were also associated with various types of organic phases, attesting a recycling of metals via plant decomposition and/or adsorption on organic matter. At the vicinity of the roots, Cd and Zn carbonates were still present, suggesting a weak impact of the plant on the mineral phases.

[1] Lottermoser (2011) *Elements* **7**, 405-410. [2] Mahieu *et al*. (2011) *Plant and Soils* **342**, 405-417.