SUITMA 11
11 th Conference on Soils of Urban, Industrial, Traffic and Mining Areas
Soils and the food, water, energy nexus
05.09.– 09.09 2022 Berlin, Germany

Ecodynamics of metals (Pb, Zn, Cd) and metalloids (Sb, As) in carbonated soils contaminated by mining waste (Northern Tunisia)

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Abstract (max. 400 words)

Mining activities, which have intensified in the last century in northern Tunisia, have generated significant amounts of fine discharges rich in potentially toxic elements (PTE) such as Pb, Zn, Cd, As and Sb that are a potential source of soil contamination. Depending on their mobility, these PTE can enter the various compartments of terrestrial ecosystems and therefore pose a risk to human health through contamination of the food chain.

The main objective of this work was to study the ecodynamics of metallic elements (Pb, Zn, Cd) and metalloids (As and Sb) in soils developed on carbonate source rocks in the vicinity of several abandoned mining sites in the north of Tunisia (Jebel Hallouf-Sidi Bouaouane, Jebel Ressas). The aim is to understand the fate of PTE (speciation, mobility, bioavailability) in soils and the resulting changes for soil ecotoxicity.

Surface agricultural soil samples of cultivated or wild plant species were collected around tailings piles. Control samples were taken from uncontaminated areas in all districts. Laboratoty plant growth experiments with barley and bean were conducted for 3 weeks. Rhizospheric soil pore water (SPW) pH, dissolved organic carbon (DOC) concentration, metal(loid) concentrations in SPW and their uptake by plants were determined.

Pot experiments with peas and barley grown in the studied soils showed an accumulation of varying amounts of PTE in the primary tissues of both plants, with the exception of Pb, which was not fully absorbed. The order of accumulation of PTE in these plants is Zn > As > Cd > Sb for barley and pea, indicating that Zn is the most plant-available and absorbed metal by the plants. Despite the high concentrations of the other elements (As, Pb, Cd, Sb) in the soils, their phyto-availability is low. The mobility of Zn, Pb and Cd was thought to be controlled by both the solubility of their carrier minerals (*e.g.* sphalerite, hemimorphite, cerusite, jordanite) and the high pH characterizing the carbonated settings. In contrast, As and Sb mobility was dependent on secondary carrier phases such as iron oxyhydroxides.