



Potential toxic element fractionation and phytoavailability assessment in technosoils from former smelting and mining areas

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High metal and metalloid concentrations in soils have negative effects on terrestrial ecosystems and generate potential health risk. Mining and smelting activities are the major source of metal contamination by release a huge amounts of these potentially toxic elements (PTE) into the environment. Since the determination of the total concentration of PTE in soils does not give sufficient information about their mobility and toxicity, additional information on their bioavailability and their chemical speciation is required.

Our study aimed at reporting the chemical fractionation and phytoavailability assessment of several PTE (Zn, Pb, Cd, As and Sb) in contaminated technosoils of two former smelting and mining areas.

Soil samples were taken from a metallophyte grassland contaminated with Zn, Pb and Cd located at Mortagne – du – Nord (MDN) (North France) and from a former mining settling basin contaminated with As, Pb and Sb located at la Petite Faye (LPF) (Limoges district, France).

Two sequential extraction schemes were used to evaluate the PTE speciation in various technosoils as operationally defined fractions. The extraction schemes used in this study were the Tessier's scheme and a modified BCR scheme. The fractions were rearranged into four equivalent fractions defined as acid soluble, reducible, oxidisable and residual fraction.

To assess the metals and metalloids phytoavailability a series of selective single extraction procedures (CaCl₂, NaNO₃, NH₄NO₃, DTPA and EDTA) were used together with short-term germination tests with dwarf beans whose primary leaves were analyzed for their PTE concentration after 21 days of sowing under controlled conditions (16h light/8h darkness regime, 25°C/21°C, relative humidity of 55 – 65% and photon flux of 150 μE m⁻²s⁻¹).

Our results indicates that Zn, Cd and Pb were mainly associated with the acid soluble and reducible fractions for the MDN site, while As, Sb and Pb were mostly associated with residual fraction for the LPF site.

The extraction capacity of the PTE followed the order: EDTA>DTPA>NH₄NO₃>CaCl₂> NaNO₃ for both studied locations. Pearson correlation coefficient analysis between the concentrations of PTE accumulated in the bean primary leaves with their extractable concentrations showed a positive significant correlation with dilute CaCl₂ and unbuffered nitrate solutions extraction procedures. In contrast, for all studied elements, except for Pb, the complexing and chelating extractants (e.g. EDTA and DTPA) exhibited poor correlation with the dwarf bean leaves concentrations.