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Bioaccumulation of thallium in an agricultural soil as affected by solid-phase association

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The work focused on the biogeochemical behavior of synthetic Tl modified phases, namely birnessite, ferrihydrite, and calcite, in a neutral soil Leptosol. The data presented here clearly demonstrate a strong relationship between the mineralogical position of Tl in the soil and its uptake by the studied plant (Sinapis alba L.). All tested Tl phases behaved as potential Tl sources in the rhizosphere, with a maximum for ferrihydrite and minimum for birnessite. Therefore, it can be concluded that Mn(III,IV) oxides, if present in the soil system, may reduce biological uptake of Tl to a substantial degree, including the case of Tl-accumulating species (i.e. Brassicaceae). It was proven that even Tl-enriched calcite present in the carbonate-rich soil is an important precursor for further contaminant mobilization, despite its relative resistance to degradation. Our data indicate that the fate of secondary Tl phases in the rhizosphere might be significantly influenced by the pH of the soil matrix, i.e. soils with lower pHs reduce their stability, making them more susceptible to further degradation by root exudates. Bulk soil mineralogy and the content and quality of SOM are thus suggested to be critical parameters controlling the bioaccumulation potential for Tl.

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