Geophysical Research Abstracts
Vol. 17, EGU2015-1322, 2015
EGU General Assembly 2015

Thallium contamination of soils as affected by sphalerite weathering: A model rhizospheric experiment

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The environmental stability of Tl-rich sphalerite in two contrasting soils was studied. Rhizospheric conditions were simulated to assess the risk associated with sulfide microparticles entering agricultural (top)soils. The data presented here clearly demonstrate a significant effect of 500 μM citric acid, a model rhizospheric solution, on ZnS alteration followed by enhanced Tl and Zn release. The relative ZnS mass loss after 28 days of citrate incubation reached 0.05 and 0.03 wt.% in Cambisol and Leptosol samples respectively, and was up to 4 times higher, compared to H_2O treatments. Incongruent (i.e. substantially increased) mobilization of Tl from ZnS was observed during the incubation time. Generally higher (long-term) stability of ZnS with lower Tl release is predicted for soils enriched in carbonates. Furthermore, the important role of illite in the stabilization of mobilized Tl, linked with structural (inter)layer Tl-K exchange, is suggested. Thallium was highly bioavailable, as indicated by its uptake by white mustard; maximum Tl amounts were detected in biomass grown on the acidic Cambisol. Despite the fact that sulfides are thought as relatively stable phases in soil environments, enhanced sulfide dissolution and Tl/trace metal release (and bioaccumulation) can be assumed in rhizosphere systems.