



Thallium isotopes in soils impacted by metallurgy

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Thallium (Tl) concentration and isotope data have been recorded for contaminated soils and a set of industrial wastes that were produced within different stages of Zn ore mining and metallurgical processing of Zn-rich materials. Despite large differences in Tl levels of the waste materials (1–500 mg kg⁻¹), generally small changes in $\epsilon_{205}\text{Tl}$ values have been observed. However, isotopically lighter Tl was recorded in fly ash ($\epsilon_{205}\text{Tl} -4.1$) than in slag ($\epsilon_{205}\text{Tl} -3.3$), implying partial isotope fractionation during material processing. Thallium isotope compositions in the studied soils reflected the Tl contamination ($\epsilon_{205}\text{Tl} -3.8$), despite the fact that the major pollution period ended more than 30 years ago. Therefore, we assume that former industrial Tl inputs into soils, if significant, can potentially be traced using the isotope tracing method. We also suggest that the isotope redistributions occurred in some soil (subsurface) horizons, with Tl being isotopically heavier than the pollution source, due to specific sorption and/or precipitation processes, which complicates the discrimination of primary Tl. Thallium isotope analysis proved to be a promising tool to aid our understanding of Tl behavior within the smelting process, as well as its post-depositional dynamics in the environmental systems (soils). To gain further insight into Tl isotope fractionation due to chemical and biological processes, laboratory experiments under well-defined conditions need to be carried out in the future.

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