An Isotopic Dilution Approach for Quantifying Mercury Lability in Soils

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The accurate estimation of soil mercury lability is crucial for risk assessment. In comparison to chemical fractionation and speciation, isotopic dilution (ID) offers precise definition of labile mercury fractions while maintaining the natural equilibrium. We developed and applied an ID protocol with Hg-199 to estimate the soil mercury (Hg) isotopically exchangeable (labile) pool or HgE using a range of industrially contaminated soils in Switzerland. The measured HgE values were consistent for the same soil against different spike levels (50, 100, and 200% of native Hg-199), indicating that the spiked and soil isotopes achieved required dynamic equilibrium at the soil-water interface. Total soil Hg (THg; mg kg(-1)) was the best predictor of HgE (mg kg(-1)) and %HgE and accounted for 96 and 63% of the variance, respectively. Nonetheless, despite the wide range of THg values (0.37-310 mg kg(-1)) in the studied soils, Hg lability spanned a narrow range (similar to 12-25% of THg), highlighting the large capacity of soils to sequester Hg in a very stable form. The ”exchangeable pool” of Hg extracted by CH3COONH4 and MgCl2 (<0.25 and <0.32% of THg, respectively) largely underestimated Hg lability in comparison to ID, suggesting the potential usefulness of the ID approach.
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