Sorption kinetics of isotopically labelled divalent mercury (196Hg2+) in soil

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Understanding theă sorption kinetics of Hg 2+ is the key to predicting its reactivity in soils which is indispensable foră environmental risk assessment . The temporal change in theă solubility ofă 196 Hg 2+ spikes (6/mg/kg −1) added to a range of soils with different properties was investigated and modelled. The sorption ofă 196 Hg 2+ displayed a biphasic pattern with a rapid initial (short-term) phase followed by a slower (time-dependent) one. The overallă reaction rate constants ranged from 0.003 to 4.9 h −1 and were significantly correlated (r/=/0.94) to soilă organic carbon (SOC). Elovich and Spherical Diffusion expressions compellingly fitted the observedă 196 Hg 2+ sorption kinetics highlighting their flexibility to describe reactions occurring over multiple phases and wide timeframes. A parameterized Elovich model from soil variables indicated that the short-term sorption is solely controlled by SOC while the time-dependent sorption appeared independent of SOC and decreased at higher pH values and Al(OH) 3 and MnO 2 concentrations. This is consistent with a rapid chemical reaction of Hg 2+ withă soil organic matter (SOM) which is followed by a noticeably slower phase likely occurring through physical pathways e.g. pore diffusion of Hg 2+ into spherical soil aggregates and progressive incorporation of soluble organic-Hg into solid phase. The model lines predicted that in soils with >4% SOC, Hg 2+ is removed from soil solution over seconds to minutes; however, in soils with <2% SOC and higher pH values, Hg 2+ may remain soluble for months and beyond with a considerable associated risk of re-emission or migration to the surrounding environments.
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