Reactivity and Bioavailability of Mercury Sorbed to or Coprecipitated with Iron Sulfides

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The potential for inorganic mercury (Hg) to be converted to methylmercury depends, in part, on the chemical form of Hg and its bioavailability to anaerobic microorganisms that can methylate Hg. In anaerobic settings, sulfides play an important role in controlling Hg speciation and bioavailability. Likewise, sulfide speciation can be dominated by ferrous iron sulfide (FeS), which can sorb or coprecipitate with Hg. The objective of this study was to determine if the aging state of FeS alters the reactivity and bioavailability of sorbed and coprecipated Hg species. FeS particles were synthesized and aged in anaerobic conditions for multiple time frames spanning from 1 hour to 1 month. Divalent Hg was subsequently sorbed to the FeS (33 ug Hg per g FeS) for 1 day. A similar set of samples were prepared via coprecipitation of Hg with FeS and aged for up to 1 month. The desorption potential of the Hg associated with FeS was assessed by exposing the particles to a solution of dissolved glutathione (a thiolate-based Hg chelator). The results indicated that more than 99% of the Hg sorbed to FeS, regardless of the FeS aging state, but in the Hg-Fe-S coprecipates Hg uptake was 56% in the 1 h-old precipates and to 76% in the 1 month precipitates. Freshly precipiated FeS appeared to reduced a portion of the added Hg(II), based on purging the solutions with nitrogen. When the sorbed Hg-FeS particles were exposed to dissolved glutathione, more Hg desorbed from the 1 month-old FeS than from the 1-h old FeS. For the coprecipitates, the desorption potential of Hg decreased with Hg-Fe-S aging time. Analysis of Hg speciation by X-ray absorption near edge spectroscopy revealed qualitative differences between sorbed and coprecipitated Hg-FeS forms that may indicate subtle differences in Hg coordination states that are relecnat for its reactivity. In future work, these various forms of Hg-FeS will be exposed to cultures of methylating bacteria in order to compare bioavailability and Hg desorption potential from FeS particles.