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Grain-size dependence of mercury speciation in river suspended matter, sediments and soils in a mercury mining area at varying hydrological conditions

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Abstract

Suspended matter (SM) plays an important role in the transport of mercury (Hg) in aquatic systems. Information about Hg-species in this material is crucial to understand risk potential, especially for Hg methylation and bioavailability. In the Idrija Hg mine (Slovenia) cinnabar (α-HgS) was mined and processed for centuries. These activities caused contamination of the Idrijca river system by dumping of ore roasting residues, as well as atmospheric Hg deposition in soils attributed to excessive Hg emissions from the roasting plant. Cinnabar is the dominant Hg-species in the coarse-grained sediments of the Idrijca river where Hg methylation is generally low, whereas natural-organic-matter-bound Hg (NOM-bound) has caused intense Hg methylation in the Gulf of Trieste (GT), the final sink for Hg released from the Idrijca catchment. Hydrology of the Idrijca river is characterized by high discharge events during heavy rains and snowmelt, which transports large amounts of SM towards the GT. However, the dominant Hg-species transported in SM and their specific source under varying hydrological conditions is largely unknown, yet crucial to predict future transport of bioavailable Hg forms from the mining area to the GT.

We analyzed Hg concentrations and Hg-species (Hg-thermo-desorption) in SM and different grain size fractions of soils from the Idrijca catchment to evaluate changes in solid phase Hg-species under low and high flow conditions. Concentrations of dissolved Hg did not change significantly during low and high flow (median: 21.3 to 28.1 ng L^{-1}, respectively). Hg concentrations in SM in tributaries decreased with distance (~ 30 km) from the mine from 32.7 to 0.47 mg kg^{-1} related to Hg concentrations in fine