

Mercury isotope and species analyses as a tool to trace processes in contaminated soils and sediments

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Mercury (Hg) release from former industrial sites can represent a significant local and regional environmental threat even long after the initial contamination. Since different Hg species (e.g., Hg⁰, HgCl₂, HgS) exhibit a wide range of physico-chemical properties, knowledge of their respective occurrence and transformation processes is essential to understand fate, mobility and bioavailability of Hg at such legacy sites. Characteristic Hg isotope ratios of environmental samples influenced by mass-dependent (MDF) and mass-independent fractionation (MIF) [1] provide a tool to trace processes during Hg species transformation.

We combined Hg speciation analyses, using pyrolytic thermo-desorption (PTD) and selective extractions, with Hg isotope analyses by CV-MC-ICP-MS. Isotope ratios of total Hg and separated Hg pools of surface soils, soil cores, and creek sediments collected at two former wood treatment facilities in SW Germany were investigated. At these sites several tons of Hg were released into the environment over several decades in the 20th century during the process of preserving timber by HgCl₂ treatment (kyanisation).

Sequential extractions as well as PTD analyses revealed significant differences in Hg species composition among the samples. Most soil core depths were dominated by matrix-bound Hg(II) species. However, significant amounts of elemental Hg(0) were present at some depths, indicating the occurrence of reduction processes in the subsurface despite the prevailing oxic conditions.

First results of isotope analyses displayed significant MDF variations among the different samples and also between different extracted Hg pools. Creek sediment samples for example showed significant MDF variations between contaminated (-0.98‰ to +0.01‰, δ²⁰²Hg) and background samples (-3.09‰ to -1.23‰, δ²⁰²Hg).

Our results indicate that the behavior of Hg at these sites is not only controlled by direct leaching of HgCl₂ from the industrial source, but that Hg species transformation processes have influenced Hg pools and Hg isotope signatures in the subsurface to a significant extent.

[1] Wiederhold (2015), *ES&T* **49**, 2606–2624.