



Mercury stable isotope variations in soils and sediments from an industrial contamination site in Switzerland

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Mercury (Hg) is a toxic element that has been widely used in many industrial processes. Large releases of Hg from industrial sites, for example with wastewater, occurred over decades in many places worldwide resulting in Hg contamination of soils and sediments. Recent research revealed that Hg stable isotope ratios, that are influenced by mass-dependent (MDF) and mass-independent fractionation (MIF)[1], may help identifying contamination sources and tracing Hg species transformations in the vicinity of industrial contamination sites. The goal of our study was to investigate whether Hg transport and transformation processes at such a site can be traced using Hg isotope analysis.

We present Hg isotope data measured by cold vapor multicollector inductively-coupled plasma mass spectrometry (CV-MC-ICP-MS)[2] from soils and sediments collected within an industrial facility in SW-Switzerland and downstream along a contaminated drainage canal. Relevant industrial processes conducted at the facility since 1917 include the use of Hg(II) salts as catalyst in acetaldehyde production and elemental Hg(0) in the chlor-alkali process. Previous work revealed elevated Hg contents in canal sediments and nearby soils to which dredged sediment had been added as soil amendment.

Soil material collected within the industrial facility showed relatively large $\delta^{202}\text{Hg}_{\text{NIST-3133}}$ variations ranging from -0.80‰ to $+0.25\text{‰}$ ($\pm 0.14\text{‰}$ 2SD), indicating either the use of different source materials or fractionation during industrial processing. In contrast, soils and sediments collected downstream exhibited a very narrow $\delta^{202}\text{Hg}$ range of -0.47‰ ($\pm 0.11\text{‰}$ 1SD, $n=19$), representing an averaged mixture of Hg sources from the facility. This value was in good agreement with published data from Hg ores, liquid Hg(0), and contaminated sediments yielding a $\delta^{202}\text{Hg}_{\text{NIST-3133}}$ average for “industrial Hg” of about -0.5‰

The lack of significant Hg isotope variations (MDF and MIF) in downstream samples was not only observed on total digests, but also in sequential extracts, targeting different operationally defined Hg soil pools. Thus, our results reveal the absence of significant fractionation processes after Hg release. This finding stands in contrast to previous studies reporting significant Hg isotope variations between different extracts of contaminated soils[3,4]. Our results indicate that Hg at the field site resides in relatively stable soil pools which record an averaged isotope signature of the industrial sources, allowing to perform source tracing studies with Hg isotope signatures at larger spatial scales further downstream.

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