

Mercury isotope signatures as tracer for industrial Hg contamination

JAN G. WIEDERHOLD^{1*}, ANDREW R. C. GRIGG^{1,2},
ROBIN S. GILL², RUBEN KRETZSCHMAR²

¹ Environmental Geosciences, University of Vienna, Austria
(*correspondence: jan.wiederhold@univie.ac.at)

² Soil Chemistry, Institute of Biogeochemistry and Pollutant Dynamics, ETH Zurich, Switzerland

Due to the historical use of mercury (Hg) in industrial applications, many Hg-contaminated sites exist worldwide. Understanding the long-term fate and mobility of Hg at such legacy sites requires knowledge of the occurrence and transformations of various Hg species exhibiting a wide range of physico-chemical properties. Hg isotope ratios influenced by mass-dependent and mass-independent fractionation [1] may help identifying contamination sources and tracing Hg species transformations in the vicinity of industrial facilities.

We present Hg isotope data measured by MC-ICP-MS [2] of soil and sediment collected at different locations within an industrial facility in SW-Switzerland and downstream along a contaminated drainage canal. Relevant industrial processes conducted since 1917 include using Hg(II) salts as catalyst in acetaldehyde production and elemental Hg(0) in the chlor-alkali process. Previous work revealed elevated Hg contents in drainage canal sediment and nearby soils to which dredged sediment had been added as soil amendment, increasing the spatial extent and complexity of the contamination case.

A literature survey on data from Hg ores, liquid Hg(0), and contaminated sediments yielded a $\delta^{202}\text{Hg}$ average for “industrial Hg” of about -0.5‰ relative to NIST-3133 but with considerable variability. Soil material collected within the industrial facility showed large $\delta^{202}\text{Hg}$ variations ranging from -0.8‰ to +0.3‰, indicating either the use of different source materials or fractionation during industrial processing. In contrast, soil and sediment collected downstream exhibited a very narrow $\delta^{202}\text{Hg}$ range of $-0.47\text{‰} \pm 0.11\text{‰}$ (1SD, n=19), presumably representing an averaged mixture of Hg sources from the facility and demonstrating the absence of significant fractionation processes after Hg release. This was not only observed for bulk samples, but Hg isotope data of sequential extracts were also mostly identical to the total digest within analytical uncertainty, contrasting previous studies that reported significant Hg isotope variations between different extracts of contaminated soils. The results of our field study suggest that Hg resides in relatively stable soil pools which record an averaged isotope signature of the industrial sources.

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

[2] Wiederhold *et al.* (2015), *ES&T* **49**, 177–185.