Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.9941

Mercury Isotopic Compositions in Deep-sea Fauna Living Surrounding Hydrothermal Vents and Cold Seeps

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The discharges of mercury (Hg) from deep-sea hydrothermal vents and cold seeps to the ocean are poorly constrained at present. This limits our understanding of marine Hg cycling and methylmercury (MeHg) accumulation in marine biota. We measured total Hg concentrations and Hg stable isotopes in surface layer sulfides from the Indian Ocean Ridge hydrothermal vents and their indigenous benthos (mussel, snail, shrimp, etc.), as well as benthos (mussel) from South China Sea cold seeps. MeHg concentrations were additionally measured for aforementioned benthos. We find that the benthos at the hydrothermal vents had elevated total Hg concentrations of 931 ± 1884 ng g^{-1} (1SD, n = 16), in contrast to the benthos at the cold seeps with low total Hg concentrations of 105 ± 84 ng g^{-1} (1SD, n = 2). MeHg concentrations in this benthos were quite low (53 ± 160 ng g^{-1}, 1SD, n = 14), accounting for only 3% of total Hg on average. The Hg isotopic compositions were quite variable in this benthos, with δ^{202}Hg and Δ^{199}Hg ranging from -0.91 to 0.52‰ and 0.04 to 0.48‰, respectively. δ^{202}Hg (-0.66 to -0.42‰) and Δ^{199}Hg (0.18 to 0.20‰) values in benthos from cold seeps were within the range of hydrothermal benthos, and correspond closely to the published values of seawater and ocean sediments. In comparison, the sulfides had total Hg concentrations as high as 2511 ± 4571 ng g^{-1} (1SD, n = 15), and were characterized by lower δ^{202}Hg (-1.17 to -0.34‰) and Δ^{199}Hg values (-0.06 to 0.17‰). The clear δ^{202}Hg difference between sulfides and hydrothermal benthos indicates that significant Hg isotope fractionation might occur during precipitation of sulfides from circulated hydrothermal fluids and/or during in vivo metabolic processes of hydrothermal benthos. The slightly higher Δ^{199}Hg of benthos implies that the small fraction of MeHg produced in the upper oceans of high Δ^{199}Hg values might be incorporated into the food chains of the hydrothermal ecosystem. Our results indicate that hydrothermal vents are significant sources of inorganic Hg to indigenous benthos, but additional measurements of co-located hydrothermal fluids and seawater are needed to elucidate the Hg cycling in this geo-biosphere.