Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12817

Examining Mercury Abundance and Isotopic Fractionation During Chemical Weathering of Organic-Rich Shales

DAN L. SULLIVAN[1], WANG ZHENG[2], BRANDON HASTY[1] AND ARIEL ANBAR[1]

[1]Arizona State University
[2]Tianjin University
Presenting Author: dan.sullivan@asu.edu

Organic-rich shales (aka black shales) are a large repository of mercury (Hg) at the Earth's surface. The fate of Hg during weathering of black shales is currently poorly understood. Mercury isotopes provide a means to investigate the factors controlling Hg mobility and speciation during weathering.

We examined the Hg abundance and isotopic composition (δ^{202}Hg, δ^{201}Hg, δ^{200}Hg, δ^{199}Hg, δ^{201}Hg, δ^{200}Hg, δ^{199}Hg; 2σ = 0.08, 0.09, 0.07, 0.07, 0.04, 0.04, 0.05, respectively) of black shales from the well-studied late Devonian New Albany Shale outcrop [e.g., 1,2]. The samples cover a weathering profile that transitions from heavily weathered to well-preserved. Previous studies from this outcrop found that the abundance of TOC and some redox sensitive metals (e.g., Re) are lower in the weathered section and higher in the well-preserved section [2,3]. Our preliminary data show Hg abundances ranged from 60 – 91 ppb with no clear relationship to the degree of weathering or TOC content, similar to the trends observed for Mo and U [3]. There is a shift in mass dependent fractionation (MDF) values with the lightest MDF at the most heavily weathered location (δ^{202}Hg = -1.59, uncertainty listed above), a shift to heavier values as the amount of weathering decreased (δ^{202}Hg = -0.66) then a shift back to lighter values in the well-preserved portion (δ^{202}Hg = -1.16). Mass independent fractionation values for δ^{201}Hg, δ^{200}Hg, and δ^{199}Hg range from -0.24– -0.11, -0.02 – 0.07, and -0.11 – -0.01, respectively. Within the uncertainties, only δ^{201}Hg shows significant fractionation.

Negative δ^{202}Hg values with near zero δ^{199}Hg are plausibly explained by 1) microbial methylation, 2) thiol-ligand binding Hg, and/or 3) Hg sorption to Fe-oxides. Upcoming work will provide more information to sort through these possible explanations.

[1] Petsch, S. T., Eglinton, T, I., and Edwards, K. J. (2001) Science 292, 1127-1131. [2] Jaffe, L. A. Peucker-Ehrenbrink, B., and Petsch, S. T. (2002) EPSL 198, 339-353. [3] Miller, C.A., Peucker-Ehrenbrink, B., and Schauble, E. A. (2015) EPSL 430, 339-348.