Biological Hg isotope fractionation

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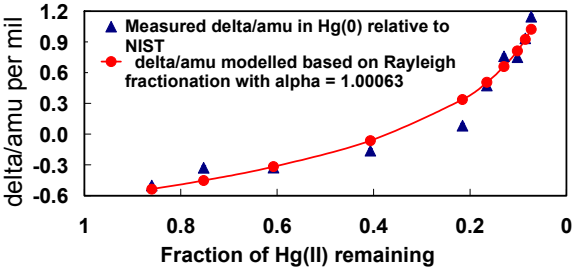
The extreme toxicity of mercury (Hg) compounds warrants the search for new methods that can be used to track sources of Hg and dominant pathways leading to formation and bioaccumulation of methylmercury. Since Hg has seven stable isotopes (0.15 – 30% abundance; mass spread of 4%) and its compounds have a high degree of covalent character, it may undergo stable isotopic fractionation, and if so, the isotopic signatures of Hg may attest to its origin and/or redox history.

The purpose of this study was to determine the extent of mercury isotopic fractionation during the reduction of Hg(II) to Hg^0 by the mercuric reductase, an enzyme found in a broad range of Hg resistant bacteria from diverse environments. We measured the isotopic composition of Hg^0 formed by pure cultures of *Escherichia coli* and *Bacillus Cereus*, as a function of the extent of Hg substrate utilized using MC-ICPMS (Lauretta et al., 2001). We found that Hg(II) supplied as NIST 3133 undergoes Rayleigh fractionation with a fractionation factor (α) of ~1.0006 per amu during its reduction by *E. coli* (see graph below) and *B. cereus* at 37^0C. α values of similar magnitude were observed when Hg^0 was produced by a natural microbial community following enrichment of Hg(II) reducing microbes.



This is the first evidence of biologically induced mass dependent fractionation of Hg, the heaviest metal for which biological fractionation has been detected to date. This report opens up the possibility of use of Hg isotope fractionation for identifying its sources and sinks in the environment, in situ pathways leading to its toxicity and the nature and evolution of redox reactions in both modern and paleo environments.

Reference

Lauretta, D.S., Klaue, B., Blum, J.D. and Buseck, P.R. (2001) *Geochim.Cosmochim. Acta* **65**, 2807-2818.

Mercury in the Wabash River, Indiana: A preliminary assessment

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Unlike in the neighboring states, there is very little information on mercury (Hg) in streams in Indiana. Current research has focused mainly on the industrialized northern part of the state, close to Chicago, and on the Ohio River valley at the southern end of the state, which is impacted by numerous coal-fired power plants. For the other rivers draining Indiana, including the Wabash River, numerous Hg-based fish advisories are posted, but very little to no data on Hg in water or sediments exist.

In this paper, we present the first Hg data for the Wabash River in western Indiana. The river section under study extends from just upstream of Lafayette to Terre Haute in western Indiana. This section of the river has no input from tributaries that drain reservoirs, as encountered upstream of this section. Potential sources for Hg are the two cities along the river, as well as a power plant upstream of Terre Haute. Our first results suggest that concentrations vary between ~0.57 and 1.7ng/L for dissolved Hg, and total mercury (THg) concentrations range from ~1.6 to 5.0 ng/L. Hg concentrations are lowest in Lafayette, increase further downstream, and then decrease again towards Terre Haute. These values observed by us are similar to those reported for streams in neighboring states. We will discuss the connections between dissolved Hg, particulate Hg, and Hg in Wabash River sediments, determine potential local sources for Hg, and link our findings with the fishing advisories currently posted along the Wabash River. Finally, we will also discuss our results in connection with water data from neighboring, well-investigated states such as Wisconsin.