

Collaborative Research: GEOTRACES Atlantic Section: Mercury Speciation Along a Zonal Section in the North Atlantic

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We propose to participate in the upcoming GEOTRACES North Atlantic cruise in order to construct a full depth, zonal section of mercury (Hg) species across an important ocean basin for which almost no Hg data exist currently. This effort will continue the development of data sets of Hg species in the ocean and will aid in hypothesis testing regarding the marine biogeochemistry of this element. There are important additional benefits to studying Hg in the ocean, including increased understanding of the source and bioaccumulation dynamics of a toxic metal, the formation of organometallic compounds (including those of Ge, Se, Po, As) in the ocean, assessing the impact of an anthropogenically mobilized element, and the possible development of a paleoproductivity/circulation proxy.

Hg is present at very low concentrations in the open ocean (fM–pM) and is subject to a complex biogeochemical cycling. To understand this cycling, determination of the four principal species of Hg found in the ocean (mercuric ion, elemental Hg, monomethylmercury and dimethylmercury) is required. Some of these forms (elemental Hg and dimethylHg) are volatile and have no “shelf life.” Thus, a small Hg team is needed on board to process and analyze the samples immediately following collection. Such a group would also participate, as needed, in general sampling and processing activities of samples destined for other analyses.

We hypothesize some of our findings will include:

- Hg will exhibit hybrid-type metal distributions across the section, with high concentration at the air-sea interface from atmospheric deposition, lower concentrations below the surface due to uptake and particle scavenging and a subsurface maximum associated with particle regeneration.
- Maxima in methylated Hg species concentrations will be found either near the sediment-water interface in relatively shallow water, or in the oxygen minimum associated with organic matter respiration.
- This methylated Hg maxima will comprise a greater fraction of total Hg under areas of higher productivity, as inferred from chlorophyll concentrations.
- High Hg concentrations will be found associated with some of the unique stations occupied on the transect such as the TAG hydrothermal plume, the Mediterranean Overflow water mass and inputs from the Rio Tinto in the Gulf of Cadiz.
- Although surface total Hg concentration maxima will be observed, a west to east increase in this maxima as might be predicted from dust deposition will not be seen. Instead, a general decrease in surface water Hg moving west to east will be seen due to biological uptake.

The broader impacts of this work include a greater understanding of a serious human and ecosystem health threat in the form of methylated Hg accumulation in fish. Finally, this effort includes support for graduate students at both our institutions, and will provide them with an opportunity to participate in the cruise, form new collaborations and develop professionally, and test new analytical methods and explore metal/organic interactions under a number of ocean conditions.