GEOTRACES: Mercury Speciation and Cycling in the Tropical Eastern Pacific Ocean

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We intend to propose to investigate mercury (Hg) cycling in the open ocean in the context of the upcoming GEOTRACES cruise to the Tropical Eastern Pacific. This region is of particular interest for studying the cycling of this toxic trace metal on a global scale. This is because the proposed cruise track is designed to investigate (among other things) the impact that oxygen minimum zones have on TEIs through high resolution spatial sampling along an upwelling/redox gradient starting near Peru and ending in Tahiti. This track will therefore represent an excellent opportunity for us to test some of the putative controls behind the formation of $CH_3Hg(I)$ in the ocean, which is observed to peak at the same depth as local oxygen minima. Sunderland and colleagues observed that in the temperate North Pacific this peak in apparent net production of $CH_3Hg(I)$ correlates with the rate of heterotrophic activity, and which is in turn controlled by a complex group of other variables (e.g., particle flux rate and composition, water temperature, presence/absence of important bioinorganic co-factors). Though still in the early stages of data analysis, our results from the first leg of the US GEOTRACES cruise to the North Atlantic suggest that the appearance of $CH_3Hg(I)$ in that location does not correlate with AOUR (apparent oxygen utilization rate) the way it does in the North Pacific. This finding urges us to make similar observations in a range of locations to explore exactly what the connection between low oxygen and $CH_3Hg(I)$ might be.

Our initial hypotheses include:

- As in other locations, we will observe that $CH_3Hg(I)$ concentrations peak in local OMZs.
- As the OMZ strength (degree of oxygen subsaturation) decreases westward on this cruise track, we will also observe a decrease in the concentration of $CH_3Hg(I)$ moving westward. This decrease will be apparent in $CH_3Hg(I)$ and not in the % of total Hg that is methylated.
- The poorly understood species $(CH_3)_2Hg$ will be evident in similar distribution to $CH_3Hg(I)$, both vertically and laterally. The $(CH_3)_2Hg/CH_3Hg(I)$ ratio will also decrease from east to west as the relatively transitory $(CH_3)_2Hg$ will be made at slower rates in the west.
- Total Hg depletion at the surface in the east will be greater than in the east and correlate with mixed layer productivity.
- Elemental Hg, as on the North Atlantic cruise, will be a significant contributor to total Hg in the eastern part of the basin at depth and correlated with nutrients. This trend will weaken as the cruise progresses westward.

We would be interested in receiving samples of water and particulates, aerosols and rain and also be interested in operating an underway system for dissolved gaseous Hg species and atmospheric Hg.