

US GEOTRACES Arctic Letter of Intent – Air-Sea exchange of Mercury
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I am interested in participating in the US Arctic Geotraces cruise to collect and analyze samples to ascertain the air-sea exchange of mercury in the Arctic. Understanding the cycling of mercury at the air-sea interface in the Arctic is important to understanding the net transfer of mercury inputs from the atmosphere and rivers to sites where methylation and subsequent bioaccumulation of methylmercury is occurring. There is some controversy about the relative importance of riverine versus atmospheric inputs of mercury to the Arctic (e.g. Fisher et al, 2012) and the debate could be better resolved with more detailed understanding of the net flux of mercury at the air-sea interface. While air-sea exchange is complex in most ocean ecosystems it is especially so in the Arctic given that the presence of ice which dynamically impacts this process, and the potential for direct exchange between the ice surface and the atmosphere, and the dramatic seasonal dynamics of atmospheric mercury in this region. So-called mercury depletion events (enhanced oxidation of atmospheric elemental mercury) in “polar spring” lead to enhanced dry deposition to the terrestrial surface and to sea ice and the fate of this mercury during snow and ice melting is poorly understood. The extent of net transfer of mercury to the water column (atmospheric deposition minus gas evasion) impacts the extent of water column methylation. I therefore propose to deploy both atmospheric mercury speciation sampling equipment for the measurement of gaseous elemental and ionic gaseous and particulate mercury as well as a continuous underway surface water dissolved gaseous mercury sampling device to continuously measure gaseous mercury in the water along with the air measurements, to provide detailed gas exchange estimates (e.g. Soerensen et al., 2013). In addition, in collaboration with Bill Landing and the atmospheric sampling group, I propose to analyze wet deposition and aerosols collected on the cruise for total mercury and mercury speciation, supplying my own sampling equipment if necessary. The proposed work may not need a dedicated researcher on board as long as someone in the atmospheric or mercury group can maintain the instruments. Additionally, through collaboration with the researchers involved in water column sampling (Lamborg and Hammerschmidt have submitted a Letter of Intent), we will obtain additional samples to do process studies examining the drivers of mercury oxidation and reduction in Arctic surface waters. I have discussed these ideas with Landing, Lamborg and Hammerschmidt and the work would be done in the most synergistic fashion with their sampling. Note that underway atmospheric/surface water gaseous mercury measurements are being done on the current Pacific Geotraces cruises in an ad hoc fashion through collaboration with Lamborg’s group with my equipment. Doing such measurements on the US Geotraces cruise will also compliment similar mercury air-sea exchange studies which I have been told are proposed for the Swedish and German Geotraces cruises. Finally, such work would compliment, if funded, process-focused research and Arctic mercury modeling, a collaboration of researchers at UConn, Harvard and MIT (Sunderland, Mason and Dutkiewicz), that will be submitted in early December 2013 to the NSF Arctic program.

References:

- Fisher, J. A., D. J. Jacob, A. L. Soerensen, H. A. Amos, A. Steffen, E. M. Sunderland, 2012a. Riverine source of Arctic Ocean mercury inferred from atmospheric observations, *Nature Geoscience*. 5, 499-504.
- Soerensen, A.L., R.P. Mason, P.H. Balcom and E.M. Sunderland. 2013. Drivers of surface ocean mercury concentrations and air-sea exchange in the western Atlantic Ocean. *Environ. Sci Technol.* 47: 7757-7765.