

Biogeochemical cycling of essential and toxic metalloid elements in the Arctic Ocean  
Gregory Cutter, Dept of Ocean, Earth, and Atmospheric Sciences, Old Dominion University,  
Norfolk, VA 23529; gcutter@odu.edu

The metalloid elements have very diverse biogeochemical cycles that include inputs from the atmosphere, active biological uptake and transformations of their chemical speciation, and sediment deposition/remobilization. Chemical speciation in both the dissolved and particulate phases plays an important role in metalloid bioavailability and even toxicity. In the Arctic Ocean virtually nothing is known about their cycling, but recent studies have shown that Asian fossil fuel combustion and subsequent atmospheric transport and deposition are elevating surface water selenium concentrations in the high latitude North Pacific Ocean (Ranville et al. 2010), and exceptionally high Se concentrations accumulate in spectacled eiders (sea ducks) that winter in the northern Bering Sea (Lovvorn et al. 2013). Eiders in the Bering Sea forage on the benthos and for this area the only likely source of this selenium is atmospheric deposition. It is likely that arsenic is also transported northward into the Arctic region. Thus, it seems appropriate to investigate the inputs and cycling of both arsenic and selenium in the western Arctic Ocean as a part of the US GEOTRACES Arctic cruise.

In order to examine Se and As cycling in the Arctic, dissolved (1 liter for Se, 0.25 liter for As from GO-FLO bottles) and particulate samples (ideally splits from in-situ pump filters by collaborators, but GO-FLO membrane filter samples would also be suitable) would be taken at all stations and depths. Selenium speciation (Se<sup>IV</sup>, VI, Org Se-II) is stable with storage, but arsenic speciation (As<sup>III</sup>, V, methylated As) must be determined on board using well-established, sea-going methods. Dissolved arsenic speciation is strongly affected by photooxidation, and given recent reports of very high CDOM in Arctic surface waters (Hill, 2008), measurements of CDOM in 250 mL samples from the conventional rosette would be made along the transects to compute oxidative As<sup>III</sup> loss rates.

Samples of surficial sediments from multicores would be taken at all shelf stations (relevant to benthic feeders like eiders) for analyses of solid phase As and Se concentrations and speciation (along with measurement of C, N, S), and if sufficient multicore tubes are available, in porewaters extracted via whole core squeezing. We would also collaborate with investigators collecting atmospheric aerosols and wet deposition. To accomplish this work, we would require 2 berths. Ideal collaborations would be with groups using in-situ pumps, those studying sediment/water exchange, and groups collecting atmospheric samples and measuring atmospheric deposition.

Hill, V. 2008. The Impacts of Chromophoric Dissolved Organic Material on Surface Ocean Heating in the Chukchi Sea. *J. Geophys. Res.* (113) doi:10.1029/2007JC004119.

Lovvorn, J.P., M.F. Raisbeck, L.W. Cooper, K.R. Chamberlain, G.A. Cutter, M.W. Miller, M.L. Brooks, J.M. Grebmeier, and C.M. Schaefer. 2013. Wintering eiders acquire exceptional Se and Cd burdens in the Bering Sea: physiological and oceanographic factors. *Mar. Ecol. Prog Ser.*, 489: 245–261.

Ranville, M.A., G.A. Cutter, C.S. Buck, W.M. Landing, L.S. Cutter, J.A. Resing, and A.R. Flegal. 2010. Aeolian contamination of Se and Ag in the North Pacific from Asian fossil fuel combustion. *Environ. Sci. Technol.*, 44: 1587-1593.