Comparative estimates of the flux of bioactive trace elements to the upper water column in the Pacific Ocean

ANGELA MILNE[1], CLIFTON BUCK[2], CHRIS MEASURES[3] AND WILLIAM LANDING[1]

[1]Department of Oceanography, Florida State University, Tallahassee, FL 32306-4320 USA
[2]Ocean Sciences, UC Santa Cruz, Santa Cruz, CA 95064 USA
[3]Department of Oceanography, University of Hawaii, Honolulu, HI, 96822

Phytoplankton productivity in the oceans is partly controlled by the input of biologically-required trace elements to the photic zone. For bioactive trace elements like Fe and Mn, atmospheric deposition can be the dominant input pathway, and can be estimated from aerosol and rainfall sampling. For others, like Co, Ni, Cu, Zn, and Cd, vertical mixing from below the photic zone can be the most important source. This can be estimated from advection/diffusion modelling of the vertical profiles of these elements. Finally, the distribution of dissolved Al can be used to infer atmospheric deposition rates of mineral dust. The P16S (2005) and P16N (2006) cruises of the CLIVAR/Repeat Hydrography program yielded a complete meridional transect along 150°W across the eastern Pacific Ocean from Antarctica to Alaska. This transect passes through a variety of biogeographic regimes, from the Antarctic frontal zones, through the southern subtropical gyre, across the equatorial upwelling region, through the northern subtropical gyre, and into the highly productive waters of the Gulf of Alaska. Daily-integrated aerosol samples (64 days) were analyzed for soluble and residual trace elements, while 84 vertical profiles of dissolved trace elements were collected (12 depths to 1000 m). These data will be used to compare and contrast the atmospheric fluxes of soluble Mn, Fe, Co, Ni, Cu, Zn, and Cd with their corresponding vertical fluxes in the water column.

Molecular scale transformations of Hg(II) during coupled biotic and abiotic processes

BHOOPESH MISHRA, MAXIM BOYANOV, EDWARD O'LOUGHLIN AND KEN KEMNER

Biosciences Division, Argonne National Laboratory (bmishra@anl.gov, mboyanov@anl.gov, OLoughlin@anl.gov, kemner@anl.gov)

Hg (II) has been shown to form stable complexes with natural organic matter (NOM), Fe (III) minerals and Al/Si minerals. Studies have also shown that Hg (II) can be reduced to Hg (0) by mixed Fe (II)/Fe (III) reactive phases. Building on recent results that ellucidated the formation of strong and stable Hg (II) complexes on bacterial cell surfaces at environmentally relevent Hg (II) concentrations, we have studied the redox reactivity of different bacterially-bound Hg (II) species with Fe (II)-containing phases.

A combination of laboratory-based approaches and synchrotron X-ray techniques were used to study the molecular mechanisms involved in the interaction of bacterially-bound Hg complexes with Fe mineral phases and NOM. Our results indicate significant differences in the reactivity of surface-bound Hg (II) towards Fe mineral phases with changes in Hg:biomass ratios. While Hg (II) is highly reactive towards reduction in low density biomass systems, the reactivity of Hg (II) gets severely limited by the abundance of biomass. Similarly, availability of Hg (II) for interaction with NOM is also severely limited by the abundance of biomass. Since there is a significant gradient in the density of biomass from the surface to sub-surface geomedia, these results shed new light on the mobility and bioavailability of Hg. Implications of our findings on the fate and transport of Hg and global Hg cycle will be discussed.