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Speciation of Particulate Zn in the Southern Ocean: Implications for Zn-cycling

SATISH MYNENI[1], JIANSHU DUAN[1], RYAN CLOETE[2], DANIEL M. SIGMAN[1], PHOEBE J. LAM[3], ANTONIO LANZIROTTI[4], MATTHEW NEWVILLE[4], ALFREDO MARTINEZ-GARCIA[5] AND ALAKENDRA ROYCHOUDHURY[6]

[1]Princeton University
[2]Stellenbosch University
[3]University of California, Santa Cruz
[4]University of Chicago
[5]Max Planck Institute for Chemistry
[6]Univ Stellenbosch

Presenting Author: smyneni@princeton.edu

Zinc plays an important role in many biogeochemical processes, and knowledge on Zn speciation in soluble and particulate pool is central to understanding the role of Zn different processes. Although Zn exists primarily in the +II oxidation state, it can form strong interactions with both soft and hard Lewis bases, and thus modify the Zn solubility and bioavailability, and cycling based on the abundances of different ligands in the environment. Here we present speciation of Zn in the particulate pool of the Southern Ocean, and how this changes with location, water column depth, seasons, and its fate as particulates are incorporated into sediments.

Particulate samples for this study come from the zero meridian in the Atlantic sector, and 30^{o}E in the Indian sector. Collected particulates were analyzed using the conventional Zn X-ray absorption near-edge structure (XANES) spectroscopy, and the novel high energy-resolution XANES spectroscopy (HERFD-XANES). The spectral datasets were collected from the micron scale regions of particulates. Nano Zn-XANES spectra were also collected from diatoms grown in seawater under different Zn-loadings to evaluate the pools of Zn in the diatom cells, and its contribution to Zn in particulates. Using a combination of synchrotron X-ray methods (large database of Zn-XANES standards, and elemental composition of particulates and their association with Zn), we developed a robust Zn speciation methodology.

The results suggest that Zn is present in many different pools, and its speciation varies with depth, location and seasons. The primary pools of Zn are in the form of organic Zn-phosphoryl complexes in the photic zone. As the depth increases and based on the source waters, we find more Zn-phosphoryl, Zn-silica and Zn-Fe-oxide complexes. The Zn-Fe-oxide pool is also more common in samples from the Indian Ocean sector. However, Zn in sediments at the sediment-water interface suggest that Zn is present mostly in Zn-clay/silica and Zn-carbonate pools. Details of these observations and the implications for Zn-cycling in ocean will be presented.