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Saito Lab Marine Bioinorganic Chemistry: Connecting Trace Elements and Metalloenzymes Across Marine Biogeochemical Gradients

Collaborators

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PROJECT SUMMARY

In this project we are studying trace metals and metalloenzymes along a biogeochemical gradient in the Tropical North Pacific. The goal of this effort is to gain a greater understanding of the importance of enzymatic activity on the cycling of trace metals in the ocean in general, and our unique profiles of dissolved, suspended and sinking particle samples will provide numerous opportunities to further this goal. Of particular interest to us are a few focused, process-oriented research questions for which these samples will be well suited:

1. Degradation of sinking particulate organic material in the Tropical North Pacific can be influenced by the ability of microbes to synthesize zinc proteases, which in turn is controlled by the abundance or availability of zinc.
2. Methylation of mercury is controlled, in part, by the activity of cobalt-containing enzymes, and therefore the supply of labile cobalt to the corrinoid-containing enzymes or co-factors responsible for methylation.

To address these hypotheses, we will occupy 3 stations along 150°W from 18°N to the equator and collect trace metal clean samples of water using a rosette, suspended particles using in-situ, battery operated pumps, and sinking particles using metal clean sediment traps. Furthermore, we will use this material to perform shipboard incubation experiments using amendments of metals, metal-chelators, B_{12}, and proteases to examine the sensitivity and metal limitation of heterotrophic, enzymatic degradation of organic matter within the oceanic “Twilight Zone” (100-500 m). This degradation works to lower the efficiency of the oceanic biological pump, which moves fixed carbon from the surface ocean/atmosphere to deeper in the ocean, sequestering that material on century to millennium timescales. Furthermore, the degradation process sets a number of biogeochemical processes in motion, which can affect the cycling of other metals, such as cobalt and mercury. These novel metaproteomic/metalloenzyme datasets should provide significant insights into the biogeochemical cycling of metals, as well as co-limitation of primary productivity, and controls on the export of carbon from the photic zone. The proposed research will be important in the development of metalloenzyme studies that could be used on future GEOTRACES cruises studying the distribution of trace elements and isotopes.

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