Trace Element Analysis of Suspended Particulate Matter Samples from the 2002 Intergovernmental Oceanographic Committee (IOC) Intercalibration Cruise in the Northwestern Pacific Ocean

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Introduction
The Intergovernmental Oceanographic Committee (IOC; a subcommittee within UNESCO) has helped sponsor oceanographic research cruises to study the “baseline” distribution of trace elements and organic pollutants throughout the world’s oceans. The latest of these cruises was in 2002, from Japan to Hawaii, and emphasized the impact of Asian dust and pollutants on the chemistry and biology of the northwestern Pacific Ocean. Suspended particulate matter samples were collected on Nuclepore polycarbonate track-etched filters and stored frozen for later analysis. Trace elements of interest include Al, Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb. Al and Pb are good tracers for aerosol input; Mn can indicate riverine input as well as input from organic-rich coastal sediments; Fe and the other elements are all affected by biological uptake and recycling, since they are required for phytoplankton photosynthesis. Combining the observed trace element distributions with models of physical water mass mixing, it is possible to estimate the rates of biological uptake and recycling. Those rates are important to quantify in order to validate more complicated general ocean circulation models that strive to simulate the oceanographic distributions of bio-active trace elements.

Results and Discussion
Atmospheric deposition of Asian dust has been suspected as a major source of some trace metals to the Western North Pacific. However, the surface and vertical profile distributions of some trace metals do not always follow the distribution of mineral dust tracers, suggesting alternative sources, including continental margin inputs, industrial aerosols, upwelling, and advective transport from seas neighboring the Pacific. To investigate the inputs from these sources, filtered water samples and water column particulate samples collected on the Intergovernmental Oceanographic Commission 2002 North Pacific expedition were analyzed for Fe, Mn, Co, Ni, Cu, Cd and Pb using ICP-MS. In addition to these trace metals, the particulate samples were also analyzed for REE and other elements (P, Si, etc.) as tracers.

A low salinity/low temperature intrusion at 450m was observed off the coast of Japan. This water mass is distinguishable within the water column by high oxygen concentrations and enrichments in particulate REE and a Mn:Fe ratio greater than crustal abundance. The high oxygen values suggest recent entrainment of surface water, while the high REE values indicate dust loading from the Asian desert. However, the elevated Mn:Fe ratio above crustal abundance at this depth suggests that at least some material is being remineralized from the shelf during transport. The origin of this water mass is yet to be determined. In the Western Subarctic Gyre (WSG), dissolved Cd:P in vertical profiles suggest that deep water is being upwelled to near surface depths. While the vertical profiles of dissolved Ni, Cu, and Cd exhibit nutrient-like behavior, the surface concentrations are 3-50 times higher than typical open ocean values outside the WSG. In contrast, Co shows a surface maximum, suggesting an atmospheric source. The absence of mineral dust elements (Al, Ga) at the surface Co maximum suggests that industrial aerosols are the most likely source. Also within the WSG, particulate REE values indicate that continental margin material is being transported to the open ocean not only off the coast of the Kuril Islands, but also further north (50 N, 167 E).

Conclusions
Our conclusions are still being developed, and several journal articles are anticipated after the data interpretation has been completed in 2008.

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References
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