Distribution of Eight Trace Elements from a North–South Transect of the Pacific Ocean during a CLIVAR / Repeat Hydrography Cruise

A. Milne and W. Landing (FSU, Oceanography) and C. Measures (Univ. Hawaii, Oceanography)

Introduction

The Climate Variability and Predictability (CLIVAR)- CO2 Repeat Hydrography program is engaged in studying the world’s oceans in order to describe and understand the physical processes responsible for climate variability. An integral part of this program is the investigation of biochemically-required trace elements and their distributions in the upper water column (1000m) where the majority of trace metal uptake and recycling occurs.

Sampling during two CLIVAR cruises (P16 north and south transects) has produced high-resolution data for a suite of trace elements in the upper 1000m of the Pacific Ocean between 55.8°N and 71.0°S from Kodiak, Alaska to Antarctica along 150°W. Total dissolved Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb were extracted from stored (acidified) samples (after UV oxidation) using imido-diacetic acid chelating resin and determined using isotope dilution ICP-MS (Mn and Co were calibrated by the method of standard additions).

Experimental

Seawater samples were acidified to 0.024M HCl using ultrapure acid. An extraction scheme was developed to take advantage of the technique of isotope dilution analysis using the Finnigan Element-I in the Geochemistry group at the NHMFL. A 12mL subsample of acidified seawater is placed in a plastic tube and spiked with a mixture of isotopes of Fe, Ni, Cu, Zn, Cd, and Pb. For Al, Mn, and Co analysis, a set of 12 mL samples is spiked with 3 different levels of each element to generate standard additions calibration curves. The sample are allowed to equilibrate overnight, then buffered to pH 5.5 with 2M ammonium acetate and passed at 2mL/min over a 200 µL column of polymer-immobilized imido-diacetic acid. This functional group is selective for transition elements and does not concentrate alkali or alkaline earth elements. The column is rinsed with 1 mL of ultrapure water, then eluted with 2 mL of 1.5M HNO3. The first 1mL of this eluent contains the majority of the eluted trace elements, and is collected preferentially in autosampler vials for ICPMS analysis.

Results and Discussion

With the exception of Pb and Mn, the elements presented are known to be linked with biological cycling in the water column and typically exhibit nutrient type behaviour (i.e. depleted concentrations in surface waters which increase with depth). In general, this behavior is demonstrated for the six metals - Ni, Cu, Cd, Zn, Fe and Co. The data for Ni, Cu, Cd, and Zn correlate well with the nutrient plots. The high nutrient waters of the Southern Ocean are evident in the nutrient data set and are also apparent for these four elements. The low surface concentrations of Fe, Pb and Mn in this region are reflective of low aerosol deposition, a major source of trace metals and nutrients to open oceans. The higher surface values observed for Mn north after 40°S were also reflected in Al analyses (data not shown) and we believe are a result of aerosol deposition. The higher concentration of all metals in the north of the transect could be a result of lateral transport (e.g. Pb) and/or sediment redox processes (Mn).

Conclusions

Our conclusions are still being developed since many samples remain for analysis, and several journal articles are anticipated after the data interpretation has been completed in 2009.

Acknowledgements

This research was funded by NSF awards OCE-0223378, OCE-0550317 and OCE-0649639 (to WML).

References