

Systematic importance of scavenging on cadmium, nickel, zinc, and copper in the North Pacific Ocean observed during ocean-section study of GEOTRACES Japan

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Trace metals (Ms) in seawater are critical parameters in oceanography as trace nutrients for organisms, tracers in the modern ocean, and proxies in paleoceanography (1). The international study programme GEOTRACES based on intercalibrated methods is revealing global distributions and temporal variations of trace metals in the ocean (<http://www.geotraces.org>). We have developed a method for multielemental determination of Al, Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb in seawater using NOBIAS Chelate-PA1 resin (2), and revealed basin-scale and full-depth sectional distributions of the trace metals in the North Pacific during three GEOTRACES Japan cruises of R/V Hakuho Maru: a 160°W section during KH-05-2, a 165°E section (GP18) during KH-11-7, and a 47°N section (GP02) during KH-12-4. The fraction of labile particulate (lp) species was calculated as the difference between the total dissolvable (td) species and dissolved (d) species. The data of Al, Mn, Co, Pb, and Fe have been reported elsewhere (3, 4). The data indicated that the distribution of Cd is controlled by biogeochemical cycling and water mass circulation. Although Ni, Zn, and Cu are also controlled by biogeochemical cycling, they are affected by scavenging. Due to the internal formation of Pacific Deep Water in the North Pacific Ocean and its long residence time, the effects of scavenging for these metals can be detected. Each metal has a unique relationship with the major nutrients Si(OH)_4 and PO_4 , whereas the dMs vs. nutrient plots strongly differ from those reported in other oceans. The dMs/ PO_4 ratio, the fractionation factor of dCd, the preformed dCd, and the enrichment factor of dMs can improve the understanding of the effect of biogeochemical cycles, scavenging, and redissolution on the distribution of the metals. Therefore, we revealed that among the four metals, Cu is the most affected by scavenging, whereas Cd is the least affected, and scavenging plays a significant role also on Ni and Zn.

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