

Seasonal variation of trapping efficiency in the western and central equatorial Pacific

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The natural radionuclide Th-230 is produced at a known rate by radioactive decay of U-234 in the ocean. Th-230 is rapidly adsorbed on settling particles and scavenged from the water column into the underlying sediments. The residence time of Th-230 in the open ocean is less than 100 years, which is much shorter than its half-life. Its flux to the seafloor should approximate its production rate in the water column. These characteristics have led to a wide range of applications as tracers of particle scavenging. Direct evidence for trapping efficiencies of sediment traps used in particle flux investigation comes from natural radionuclides. Trapping efficiency can be estimated for moored sediment trap by comparing the predicted and measured flux of Th-230. The aims of this study are to measure the concentrations of Th-230 in settling particles collected in the western and central equatorial Pacific, and to observe the fluxes of scavenged Th-230 to the 1000 m-depth and 2000 m-depth, or 3000 m-depth, and to discuss the seasonal variation of trapping efficiency by comparing differences in the predicted and measured fluxes of Th-230.

Sediment trap experiments were carried out in the western and central equatorial Pacific (Stn.1: 4-02.9N, 135-00.0E; Stn.2: 5-03.6N, 140-06.3E; Stn.3: 0-00.8N, 145-01.6E; Stn.9: 0-02.3N, 174-56.4E). Settling particles were collected by using conical time-series sediment traps and analyzed for Th isotopes. Two sediment traps with a collecting area of 0.5 m² and 26-cup collectors on each were deployed at depths of 1000 m and 2000 m, or 3000 m from January to November 1999.

The Th-230 fluxes showed large seasonal variations, similar to the trend of the total mass fluxes. The predicted fluxes of Th-230 to the 1000m trap, 2000 m trap, and 3000 m trap from production in the overlying water column are 0.067, 0.138, and 0.203 dpm/m²/day, respectively. The flux-weighted annual mean fluxes of Th-230 at 3000 m depth were 18 % and 29 % excess to the predicted flux of Th-230 at Stn.1 and Stn.9, respectively. The annual mean trapping efficiencies of moored sediment trap at 3000 m depth were estimated to be approximately 118 % in the western equatorial Pacific (Stn.1) and 129 % in the central equatorial Pacific (Stn.9). The trapping efficiencies of moored sediment trap estimated from the Th-230 fluxes showed large seasonal variations, ranging from 39 % to 170 %. Larger trapping efficiencies were observed in spring (January to April). These results could be explained as scavenging from the water column and transport of Th-230 by settling particles in spring.