Trapping efficiency of moored sediment traps estimated from the Th-230 fluxes in the western equatorial Pacific

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1. Introduction

Th-230 (T1/2= 75,600 years) is produced uniformly in seawater from radioactive decay of U-234. 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. Trapping efficiency can be estimated for moored sediment trap by comparing the predicted and measured flux of Th-230.

The aims of this study were to measure the concentrations of Th-230 in settling particles collected in the western equatorial Pacific, and to observe the fluxes of scavenged Th-230 to the 1000 m-depth and 3000 m-depth, and to discuss the trapping efficiency by comparing differences in the predicted and measured flux of Th-230.

2. Materials and methods

Sediment trap experiments were carried out in western 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). 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 3000 m from January to November 1999.

3. Results and discussion

The Th-230 concentrations in settling particles ranged from 0.73 to 2.64 dpm/g at 1000 m depth and 2.37 to 6.71 dpm/g at 3000 m depth at Stn.1. The flux-weighted mean concentrations of Th-230 were 1.05 and 4.29 dpm/g at depths of 1000 m and 3000 m, respectively. The Th-230 fluxes showed large seasonal variations, similar to the trend of the total mass fluxes. The maximum Th-230 fluxes occurred from late February to early March at 1000 m depth.

The predicted fluxes of Th-230 to the 1000m trap and 3000 m trap from production in the overlying water column are 0.067 and 0.203 dpm/m2/day, respectively. The Th-230 fluxes in early March at 1000 m depth were 2.3 times larger than the predicted flux of Th-230 in the 1000 m water column. Larger Th-230 fluxes were observed in March and June at 3000 m depth. The flux-weighted mean flux of Th-230 at 3000 m depth was 18 % excess to the predicted flux of Th-230. The trapping efficiency of moored sediment trap at 3000 m depth in the western equatorial Pacific (Stn.1) was estimated to be approximately 118 %.