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MERCURY DISTRIBUTION IN THE NORTHWEST PACIFIC OCEAN NEAR JAPAN ISLANDS

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Mercury in the seawater collected from the Northwest Pacific Ocean was determined by a sensitive mercury analyzer set on the shipboard, where the mercury resonance line at 185.0 nm was used for atomic absorption measurement. The horizontal and vertical distributions of mercury will be reported in this communication.

From the beginning of 1970s, the determination of mercury in seawater has been extensively investigated by many workers (1-12). Such studies have been considered to be important to understand the natural background level and environmental pollution of mercury in the oceans. However, the mercury levels reported so far have scattered over the wide range. In addition, there are only a few reports on the vertical distribution of mercury in the open oceans. Therefore, further investigation in terms of the mercury level and vertical distribution in the ocean is still required in order to know the behavior of mercury in seawater.

In the determination of mercury in seawater, the most serious problems may be the preservation of seawater samples. Mercury in the sample is prone to be adsorbed on the wall of the sample container or the sample is apt to be contaminated by the polluted atmosphere during the storage (13). Therefore, the rapid analysis of seawater on shipboard is desired to eliminate the chance of contamination.

Recently, the present authors have developed a new sensitive mercury atomic absorption analyzer which utilizes the resonance line of mercury at 185.0 nm instead of the conventional analytical line at 253.7 nm (14). The detection limit of mercury by the new system was 0.8 ng/l, and the relative standard deviation was less than 10 %, when the standard solution of 4 ng Hg/l was measured. The analyzer

developed was thus sensitive and also compact. Therefore, the convenient shipboard analysis of mercury in seawater was attempted in the Northwest Pacific Ocean during July - August, 1979.

Seawater samples were taken with a plastic bucket for surface seawater and a Niskin bottle for deep seawater, and stored in 500 ml glass bottles, where seawater was immediately acidified after the sampling with 10 ml concentrated sulfuric acid to avoid adsorption losses onto the container wall (13). Mercury in seawater sample (10 - 50 ml) was reduced with 5 ml of 10 % tin(II) chloride for 3 min, and gaseous mercury generated from seawater was trapped on the gold wire amalgamator. Then, amalgamated mercury was released by heating the gold wire at about 700°C, and introduced into the absorption cell together with nitrogen gas at the rate of 500 ml/min for atomic absorption measurement. In the experimental procedures described above, the analysis time for one sample was about 7 min. All samples collected were analyzed within 40 hrs after sampling.

The sampling locations and the mercury concentrations of the surface seawater at each location were shown in Figure 1. The values for the mercury concentration of the surface seawater in the Northwest Pacific Ocean were in a range from 6 to 46 ng/l. As can be seen in Figure 1, the highest concentration was found at the location B (29°59.9'N, 144°09.8'E), which was farthest from the Japan Islands in this cruise.

In this experiment, vertical distribution of mercury was also measured at the three sampling locations including the center of water cold mass (location A). The results are summarized in Figure 2. As shown in Figure 1, the mercury concentration of the surface water at the three locations were 14, 24, and 46 ng/l. On the other hand, it seems noteworthy that the mercury concentration

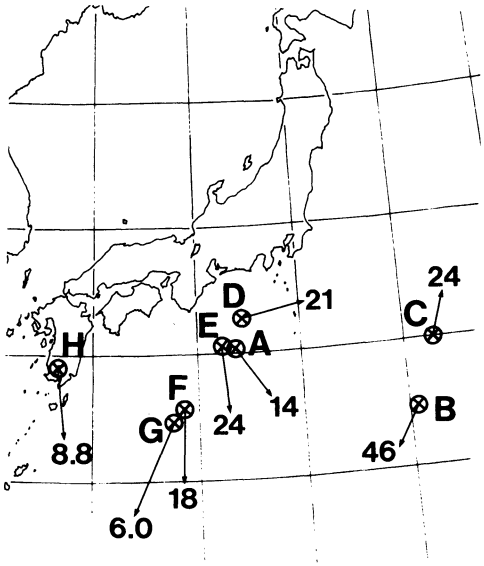

Figure 1. Mercury concentrations (ng/l) of surface seawater in the Northwest Pacific Ocean near Japan Islands. Sampling locations were as follows: A(the center of water cold mass, 32° 19.3 N, 137° 33.5 E), B(29°59.9 N, 144°09.8 E) C(32°00.4 N, 144°59.1 E), D(33°09.0 N, 137°41.9 E), E(32°15.5 N, 136°57.0 E), F(30°22.0 N, 135° 20.6 E), G(29°58.2 N, 134°59.8 E), H(31°40.3 N, 130°46.7 E).

of the middle and deep waters below several hundred meter depth was almost constant at all the sampling locations. The mean mercury concentation obtained for the samples below 400 m depth was 6.3 ± 2.7 ng/l. The mean value is fairly close to those reported recently (9-11). The depth at which mercury concentration becomes constant is shallower in the center of water cold mass (location A) than in other locations. This fact suggests that in the water cold mass area the middle water is rising up to near surface by convection.

Mukherji and Kester indicated some correlation between vertical variations in mercury and silicates in the Northwest Atlantic Ocean (11). The present data for mercury were attempted to find some correlation with hydrographic properties. In the Northwest Pacific Ocean, silicate concentrations increase gradually from surface down to about 1500 m. That is, variation of silicate with depth was different from that of mercury. Then, such correlation suggested by Mukherji and Kester was not found in the Northwest Pacific Ocean. Mercury variation with depth is somewhat similar to temperature variation, as shown in Figure 2, but variations of mercury and temperature were not strictly consistent with each other.

In Figure 2, mercury concentrations and variation with depth for non-filtered and filtered (with 0.45 μm Nuclepore filter) seawaters are also shown with respect to seawater at the location B. According to the data, mercury concentrations of filtered seawater were almost the same as those of non-filtered seawater, while mercury concentration of the filtered surface seawater was about half of the non-filtered one. This fact suggests the existence of mercury adsorbed on the particulates

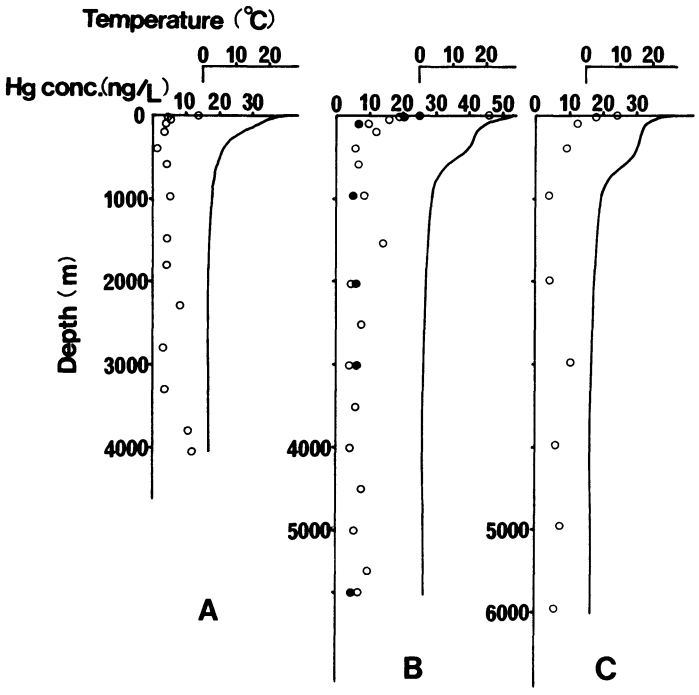

Figure 2. Vertical distributions of mercury concentrations in non-filtered seawater (○) and in 0.45 μm filtered seawater (●) and of seawater temperature (—). The sampling locations were the same as those shown in Figure 1. The depths of sea floors were 4076 m (A), 5777 m (B) and 5940 m (C), respectively.

or planktons in the surface water.

Matsunaga et al. reported that the mercury concentration in the Northwest Pacific Ocean is 5.0 ± 0.5 ng/l (9). The present results support their value, which may be the background level of mercury in the Northwest Pacific Ocean. The present results suggest that it should be careful to discuss the oceanic background concentrations of mercury only from the analysis of the surface seawater.

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