Microplastics in the surface layer of Tokyo Bay

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In the oceans, only 1% of all plastic waste is detected and the remaining 99% remains unaccounted. This remaining waste is called the “missing plastic” problem. The fate of missing plastics (MPs, <5 mm) has been investigated. The candidates for the final destination of marine debris are the bottom sediment and/or invisible floating pieces that break down into very small pieces known as microplastics (MPs, <5 mm). Matsuguma et al. (2017) reported that the number of MPs in sediment cores is greater than that in the water samples in an estuary of the Tokyo Bay. In our study, we focus on a semi-closed bay as a candidate location for an MP hot spot to reveal the nature of the MPs. We collected water samples using a Neuston net and collected sediment samples using an Ekman dredge. In this paper, we report the results from the Neuston net observations.

Investigations were conducted in May 2019 from the ship T/V Seiyo–Maru. Observation points were located on the inner side (3 points) and outer side (2 points) of the bay. A Neuston net with a 350 μm mesh was towed for 10–20 min at two knots.

After extracting the seawater, we added a 30% H_2O_2 and 0.05M Fe (2) solution and the samples were heated to 60˚C to eliminate contaminants. After two weeks, density separation was conducted by adding NaI to the samples to adjust the specific gravity to 1.5. The floating candidates were collected on multiple plates. The infrared spectra of the candidates were measured by the attenuated total reflection method using a Fourier transform infrared spectrometer (IR/FT-6600 of JASCO Inc.).

The MPs in the inner bay were larger than those found outside of the Tokyo Bay. The maximum amounts were several thousand particles at St. 03. This trend was similar to the results obtained in September 2015 (Isobe et al. 2016). We thus concluded that the southwestern side of the Tokyo Bay (between offshore Haneda and Kannonzaki) is a hot spot for MPs during summers.

The histogram of the fragments exhibited a mode at 800 μm and its shape was the same as that reported by Isobe et al (2017). In contrast, the histograms for the other shapes (e.g., expandable plastics, fiber, and sheets) exhibited nearly Gaussian distributions. The reason for this difference in the size distributions is that the shapes of small MP pieces could not be identified, but the shapes of expandable plastics, fiber, and sheets could be identified.

Approximately 60% of the MPs were fragments of polyethylene (PP) and polypropylene (PE). The expandable plastics consisted PP, PE, and polystyrene. Heavier plastics such as polyvinyl chloride were not detected, and such heavy plastics must have rapidly sunk to the bottom near coastal regions such as the Tokyo Bay.

As mentioned above, we suggest that MPs accumulate in semi-closed areas such as the Tokyo Bay. The nature of the MPs revealed by this study and the sediment results will contribute to determining the plastic transportation system.

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