Studies on Advanced Monitoring of Marine Plastic Debris

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[Abstract]

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Recently, there has been concern regarding marine litter, particularly marine plastic debris (MPD) and microplastics (MPs). However, scientific data and information concerning MPD are still insufficient. Until now, MP surveys have primarily relied on neuston net sampling, and thus have focused on MPs floating on the sea surface, particularly those larger than the net mesh size. Besides, there is no efficient survey method to estimate the exact amount of MPD accumulated on beaches and reefs, where people cannot approach. To solve these issues regarding MPD including MPs, we have developed new monitoring and measurement methods for collecting and detecting MPs of finer size floating on the sea surface and in the water column of the ocean (Subtheme 1) for detecting MPs in marine sediments (Subtheme 2) and estimating volumes of MPD accumulated on the coast (Subtheme 3).

Subtheme 1 developed a method for collecting fine MPs distributed on the sea surface to a depth of 800 m using a multiple open/close net and a deep-sea pump, as well as a pretreatment process for the collected specimens and an efficient microscopic Fourier transform infrared operation method for detecting fine MPs. Furthermore, the effectiveness of coumarin as a fluorescence index was clarified in detection using optical characteristics of MPs, and a detection method based on polarization parameters of MPs was suggested to be effective for detecting MPs in water.

Subtheme 2 successfully collected samples from deep seafloor using a newly developed aluminum tube device for push and multiple corers and a density separator and concentrator to simplify the pretreatment process for MPs detection in sediment. Notably, this subtheme found MPs in sediment samples of the trench-trench-trench type triple junction in the Japan Trench and suggested that MPs may have been supplied to the trench via sediment flow from shallower waters close to the coastlines of Japan. In addition, an automatic MPs detection method was developed to clarify particulate or fibrous material and measure the number and length of MPs.

Subtheme 3 proposed and developed a method for estimating MPD volumes on beaches by combining unmanned aerial vehicle surveys and image processing based on deep learning. This method can be used to improve the efficiency of MPD beach surveys and identify beaches that require preferential cleaning.

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