Development of monitoring by image analysis and sampling methods for deep-sea biodiversity

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[Abstract]

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In 2020, marine protected areas were established on the deep-sea floor to safeguard the biodiversity in Japanese waters. However, as deep-sea ecosystems are likely to be exposed to deep-sea fisheries and resource development, managing marine protected areas while monitoring deep-sea ecosystems is necessary. Currently, deep-sea surveys use large dedicated facilities and are expensive. Management of deep-sea marine protected areas requires continuous research using low-cost, simple methods for monitoring deep-sea ecosystems. Therefore, we developed an In-situ Free-Fall Deep-Sea Ecosystem Observatory (Lander) to monitor deep-sea ecosystems without the use of human-occupied vehicles, large deep-sea remotely operated vehicles (ROV), or research equipment that requires large winches.

The lander can collect seawater, sediment, and particles filtered from seawater, enabling environmental DNA and metagenomic analyses of deep-sea organisms with a maximum depth of 2000 meters. Moreover, it can also measure environmental parameters, including water temperature, salinity, pressure, turbidity, and current direction and velocity. In fact, the lander was successfully deployed in deep-sea marine protected areas to obtain samples and environmental data. The collaborative research team was able to analyze samples and obtain biodiversity data on deep-sea fishes, invertebrates, meiobenthos, and prokaryotes. Therefore, this lander-based survey is effective for deep-sea ecosystem monitoring in deep-sea marine protected areas. This lander is smaller, lighter, and inexpensive than the previous large-scale dedicated facilities, so it can be operated using smaller vessels (e.g., hundreds of ton-class), enabling deep-sea ecosystem monitoring without using large research vessels.

The biodiversity of mega- and meiobenthos is a suitable indicator for assessing ecosystem change in the deep-sea bottom of marine protected areas. Therefore, we developed an image analysis method that can analyze the taxa and populations of these benthos from video and still images.

In addition, a rare and large deep-sea fish Narcetes shonanmaruae, which is known as a top predator in the deep-sea food chain and a key species of deep-sea ecosystem, was discovered in a marine protected area. This species is an appropriate indicator for evaluating the soundness of deep-sea floor marine protected areas. Eight new species were discovered from the marine protected area through the research cruises in this project. The deep-sea ecosystem monitoring methods developed in this project will contribute not only to the management of marine protected areas, but also to the promotion of scientific research on deep-sea ecosystems.

[References]

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