

Deep-sea tests of a geomagnetic field vector exploration system using AUV and deep-towed vehicle

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As the global demand for natural resources has increased, it has been more important to maintain a stable supply of them. In this situation, undeveloped seabed resources like methane hydrate and sea-floor hydrothermal deposits have also focused attention recently. Exploration techniques are, however, not good enough to estimate accurate abundance of them. From these viewpoints, we have been developing an exploration system of the deep-sea geomagnetic field vector using AUV and deep-towed vehicle.

The magnetic exploration system consists of two 3-axis flux-gate magnetometers, an Overhauser magnetometer, an optical fiber gyro, a main unit (control, communication, recording), and an onboard unit. These devices except for the onboard unit are installed in pressure cases (depth limit: 6000m). Thus this system can measure three components and intensity of the geomagnetic field in the deep-sea.

We have tested the magnetic exploration system during four cruises so far. In 2009, the first test of the system was carried out in the Kumano Basin using AUV Urashima and towing vehicle Yokosuka Deep-Tow during the R/V Yokosuka YK09-09 cruise. In this test, we sank a small magnetic target to the seafloor, and examined how the system worked. As a result, we successfully detected magnetic anomaly of the target to confirm the expected performance of that in the sea.

In 2010, the magnetic exploration system was tested in the Bayonnaise Knoll area both using a titanium towing frame during the R/V Bosei-maru cruise and using AUV Urashima during the R/V Yokosuka YK10-17 cruise. The Bayonnaise Knoll is a submarine caldera with an outer rim of 2.5-3 km and a floor of 840-920 m, which is located in the Izu-Ogasawara arc. A large hydrothermal deposit, Hakurei deposit lies in the southeast part of the caldera. In the R/V Bosei-maru cruise, we observed three components of magnetic anomalies at depths of 400-570 m along SE-NW and WE tracks across the caldera. In the R/V Yokosuka YK10-17 cruise, we observed three components and intensity of magnetic anomalies at altitudes of 60-100 m around the Hakurei deposit and at depth of 500 m over the caldera.

In 2011, the magnetic exploration system was tested in Suruga Bay using a titanium towing frame during the R/V Bosei-maru cruise. In this test, an acoustic system of positioning (SSBL) and data communication was newly added to the system. We observed three components of magnetic anomalies at depths of 420-480 m and distances of 300-400 m behind the ship along an NS track parallel to the axis of Suruga Trough.

From these tests, we have succeeded in measuring the geomagnetic field vector and intensity using the AUV and the deep-towed vehicle, and also have obtained detailed magnetic anomaly in the Hakurei deposit area (the analysis of AUV magnetic data will be presented by Isezaki et al. in the same session). We will here present the outlines of the measurement system and the results of the tests in the sea. Note that this study has been supported by the Ministry of Education, Culture, Sports, Science & Technology (MEXT).

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