AUV「うらしま」と「よこすかディープ・トゥ」を用いた磁気探査システムの性能評価

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Evaluation of magnetic exploration system with using the AUV Urashima and Yokosuka Deep-tow

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We have developed new precise exploration tools for seabed resources by magnetic method in order to estimate abundance of those resources. The exploration tools will be mounted underwater platforms such as deep-tow (DT) system and autonomous underwater vehicle (AUV). In July 2009, we carried out the R/V Yokosuka cruise in Kumano-nada, off Kii Peninsula, Japan. One of the aims of cruise was to investigate the performance of developed equipments for magnetic explorations. The developed equipments including one Overhauser (OVH) and two flux-gate (FG) magnetometers and gyrocompass were set up on the AUV and DT systems.

To inspect the efficiency of equipments, it is better to measure the magnetic anomaly which is caused by known magnetic source. In this aim, we made a magnetic target which is consisted of 50 neodymium magnets (size 50.8x50.8x12.7mm; surface magnetic flux density 380mT) and 25 iron bars (size 50x50x225mm; material SS400). The size and weight of magnetic target is 40x40x25 cm, and 120 kg, respectively. Before the AUV and DT experiments, the magnetic target was put into under water and its position was measured by the acoustic method. The depth of magnetic target was about 2,058 meters.

We carried out the AUV dives for two times. In each dive, 8-shaped navigation was practiced at the depth of 1,000 meters to eliminate the effects of the magnetization of platform. The AUV was navigated in two types of measurement line; (1) gridlike line, and (2) flower leaf-fashioned line. The altitude of AUV was in the range of 20 ˜30 meters, and its velocity was about 1.5 ˜2.5 knots. The position of AUV was measured by SSBL at every 8 seconds.

We carried out the DT measurements for two times. In the first dive, OVH sensor was detached from DT, and DT was towed at the altitude of about 1 ˜5 meters. In the second dive, OVH sensor was towed under the DT. The height of OVH sensor was about 5 ˜6 meters from the seafloor. The DT was towed along North-South lines for three times by the velocity of about 1 ˜2 knots. The position of DT was measured by SSBL at every 8 seconds.

We could obtain the three-component magnetic field and gyro data in the whole processes of AUV and DT experiments. After the effects of permanent and induced magnetization of platform were eliminated (Isezaki, 1986), magnetic anomaly generated from the magnetic target was clearly visualized. The maximum intensity of each experiment was about 50 nT for AUV and 290 nT for DT experiments. Such magnetic anomalies were detected in the most of measurement lines. Therefore, we calculated the spatial distribution of three-component magnetic anomaly. Since the position of platform was measured by SSBL, accuracy of the estimated position was about 10 meters. To correct the tracks of platforms, we modified the positions by comparing the magnetic data and position of target. We also calculated the three-components of magnetic field anomaly and the properties of the magnetic target by solving the forward and inverse problems. The spatial distribution of magnetic field and its intensity are well represented by assuming the magnetization of the target as 200,000 A/m.

We also could understand the efficiency of our system, restrictions of navigation and their suitable operation, and technical problems which are related to some kinds of noise components.

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