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Performance test of magnetic exploration tools for ocean bottom resources -Results of R/V YOKOSUKA YK09-09 cruise-

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Detailed information on subsurface structure under seafloor is necessary for the estimation of seabed resources such as the hydrothermal deposit and methane hydrate. Although advantages of geophysical exploration near seafloor are expected for the seabed resource survey, efficient method has not been well-established. The authors started a project to develop exploration tools for seabed resources under the financial support of MEXT-Japan. We carry out research and development mainly regarding measurement of the magnetic field with high-resolution and high-sampling rate electric exploration devices with accurately controlled active source signals. Developed tools will be mounted underwater platforms such as deep-tow system, ROV (remotely operated vehicle), and AUV (autonomous undersea vehicle).
We carried out the research cruise (vessel: JAMSTEC R/V YOKOSUKA YK09-09, period: 19-29 July 2009, area surveyed: Kumano Basin, off Kii Peninsula, Japan) to investigate the performance of developed equipments for magnetic exploration. One Overhauser and two flux-gate magnetometers were mounted on the AUV URASHIMA and Deep-tow (hereafter, DT) system. To inspect the efficiency of equipments, it is better to measure the magnetic anomaly which is caused by known source. Hence, we made a magnetic target which is consisted of 50 neodymium magnets (size 50.8x50.8x12.7mm, magnetic flux density 380mT) and 25 iron bars (size 50x50x220mm). The magnetic target was put under water in the area where topographically flat and the magnetic anomaly is small. The position and depth of magnetic target was measured by acoustic method. The depth of target was estimated as about 2,058 meters. The vehicles were navigated at heights of 25 meters for AUV and 15 meters for DT, and the measurements were performed in the circle of a radius of about 300 meters. The velocity of AUV and DT was about 2 knots. Each of underwater navigation was practiced for two times; (1) routes for DT were set along N-S and E-W lines, and (2) routes for AUV were set in flower leaf and gridlike fashions. Additionally, 8-shaped and wavy navigations were performed to calculate the 12 constants of the vehicles' induced and permanent magnetic moment. We also measured the feature of noise component. Both performances were carried out successfully, which means that we detected the significant magnetic anomalies caused by the target. The amplitude of magnetic anomalies were +120nT/-170nT in OVH of DT and +55 nT in vertical component of AUV. Positions of AUV and DT were estimated from the USBL (Ultra-Short-Baseline Positioning method) and INS (Inertial Navigation System). We clarify the feature of magnetic target, and evaluate the performance of magnetometers, gyro compass, and all systems which include platforms.

Keywords: ocean bottom resource, magnetic exploration, magnetic anomaly, magnetometer, autonomous underwater vehicle, deep-tow system