

The first observation of a newly developed underwater gravimeter by using autonomous underwater vehicle

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We developed an underwater gravimeter for exploration of a seafloor hydrothermal deposit. Our hybrid gravimeter system consists of an underwater gravimeter and an underwater gravity gradiometer, and we present the system of the underwater gravimeter and first observation by using autonomous underwater vehicle. Gravity survey is one of powerful method to obtain density structure in crust. In marine area, surface ship gravimeter and ocean bottom gravimeters are often used. For survey of a seafloor hydrothermal deposit, they are required to survey a wide area quickly and to have a higher resolution than that obtained by the surface survey. On the other hand, because technology of autonomous underwater vehicle (AUV) is been developing, there is a possibility to measure the gravity by using AUV's.

To obtain a position and amount of seafloor hydrothermal deposit that has a diamond shape with a diameter of 400m, 20m thick at the center and density difference of 1 g/cm³, a resolution of gravity measurement should be less than 0.1 mgal. In addition, measurement must be carried out 50m above a seafloor. AUV is suitable for such measurement near seafloor.

We adopted Micro-g LaCoste S-174 as a gravity sensor. The sensor is mounted on a gimbal mechanism with a fiber gyroscope (IXSEA PHINS). A titanium sphere contains the sensor system. For acquisition of high resolution gravity data, the gravity sensor must keep a constant temperature (60.4C) and avoid effect of magnetism. The sensor is heated and is totally covered with thermal insulation and sheet of permalloy. Maximum depth rating is 4,200 m. The data are sent to a recording system housed in another cylinder-shape capsule. The whole system is controlled and monitored via acoustic link of the AUV. During test measurement on land, the resolution was estimated to be 0.02 mgal after compensation of tilt, acceleration and low-pass filtering.

In September 2012, the first practical measurement in marine area was carried out by using JAMSTEC's AUV Urashima to evaluate performance of the system. The gravimeter and gravity gradiometer were simultaneously mounted on the Urashima. The first measurement was performed in Sagami-Bay. One profile was laid on smooth seafloor and another has rough seafloor topography. From these surveys, we obtained the gravity data and supplemental data for compensation of the gravity data with good quality. From preliminary analyses, the resolution of the gravity data from the first practical measurement is estimated to reach 0.1 mgal.