Ocean bottom electromagnetometers of Earthquake Research institute

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Ocean bottom electromagnetometers (OBEMs) are utilized to measure electromagnetic field variation at seafloor for investigating electrical conductivity structure of the Earth’ s interior. Earthquake Research Institute has 21 OBEMs at the present and six of them are new type ones developed in 2012. The OBEMs are commercial products by Tierra Tecnica, Co, Ltd., which consist of a package of three-component fluxgate magnetic sensors and two-component tilt sensors, a unit of a magnetometer, a potentiometer, a tiltmeter, and a data logger, an acoustic transponder system, and batteries in pressure cases, two electric dipoles, float, weight, weight release system, a radio beacon, and a flashlight. The OBEMs are launched from a ship and descend to seafloor, and then start measurement by a timer. After the observation, they release the weight by an acoustic command sent from a ship and ascend to the sea surface to be recovered.

The new type OBEMs are characterized by compactness in size (width: 951 mm, depth: 895 mm, and height: 640 mm for the main frame and 4.6 m horizontal electric dipoles), low power consumption (~1.8 W in average), and low running and maintenance costs, compared to conventional type OBEMs. The OBEM can measure the data with continuous sampling of 8 or 1 Hz for more than 20 days, or intermittent sampling of 60 seconds for more than 8 months with 14 DD-size lithium batteries. The sampling rate can be changed during observation by a timer. The electric and magnetic field can be resolved with 1.2 nV in the range of ±10mV and 0.1pT in the range of ±65,000 nT, respectively.

The instrumental attitude during descending in the deployment, and descending/ascending speed were measured in a test cruise in 2013. A long-run (about one year) test was then conducted in 2013 - 2014 and the recovered data were compared with those collected by a conventional type OBEM that deployed in the same time in the same position. Although small drift in the magnetic field was observed, the magnetotelluric response estimated from the two OBEM data agrees well in the estimate errors. The new type OBEMs are now in practical use. Since 2016, total number of 9 new type OBEMs have been successfully deployed around Nishinoshima island volcano and recovered with useful data.

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