# ROV で設置するタイプの地球電場観測装置

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# A new type of EFOS (Electric Field Observation System) installed by ROV

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We conduct a research program in 5 years from 2010 to 2014 toward understanding of the mantle dynamics from an innovative observational approach by answering two fundamental questions in Earth science:

(a) What is the physical condition for the lithosphere-asthenosphere boundary (LAB)?

(b) Is the mantle transition zone (MTZ) a major water reservoir of the Earth?

We aim to answer these two questions by combining seismic and electromagnetic observations. The **normal** ocean floor is the best window to approach these questions as it allows us to see the inside of the Earth through it without the disturbance due to the thick and heterogeneous continental crust. However, any approach, if ever attempted, has not yet been successful because of technological difficulties in obtaining high-quality geophysical data in the ocean. Recently, we developed further advanced instruments (BBOBS-nx: broadband ocean bottom seismometer next generation; EFOS: Earth electric field observation system). The present paper introduces the EFOS which measures the electric voltage difference at the seafloor by using a long cable of order of 1-10 km.

Accurate and precise measurement of the electric field at ocean bottom provides us important information on the deep interior. For better data quality, voltage difference has to be measured by using as long electrode separation as possible, because signal is nearly proportional to but noise is almost independent on the separation. Several years ago, we developed (Utada et al., 2006) an observation system with a 10 km cable, which was deployed for one year in the Philippine Sea by using the JAMSTEC's deep-tow system (DT-4000). Result indicated that the long term drift can be about 10 times as large as that of measurement by using retired submarine cables of 1000 km scales. It was also shown that noise spectrum of the electric field is about 1/10 of that obtained by OBEM, measuring the electric field with an electrode spacing of only 5 m, for the period ranges longer than 1 day and shorter than 1000 sec. Improved data quality at shorter periods will help in resolving conductivity at the shallowest part of the mantle conductor that is usually interpreted as the electrical asthenosphere. On the other hand, the high quality data at longer periods will provide better resolution to the mantle transition zone conductivity.

Thus, our previous study demonstrated the capability of EFOS for detecting both long and short period signals. In order to extend the applicability of the system, we are now modifying the EFOS so that cable is installed by using ROV Kaiko7000II (instead of a deep-tow system). There are two major reasons for this modification: (1) Installation depth is limited up to 4000 m for DT-4000, while it is up to 7000 m after modification, and (2) ROV is rather a common technology so that the modified system may be handled by ROV of other institutions.

In the new system, the weight of cable bobbin is reduced to less than 100 kg in the water so that the cable is installed by using ROV, The bobbin and recorder are deployed with a buoy system. The ROV picks up the bobbin at the sea floor and then installs the cable. The whole installation procedure was successfully tested at the KR10-08 cruise (June 10-25, 2010), although the cable installation had to be terminated on the halfway (at 3 km of total 6 km) due to the rough weather.

As for seismic observation, a new instrument BBOBS-nx enables us to record the horizontal ground motion on the ocean bottom with a noise level comparable to that at land observatories so that various kinds of modern seismic analysis methods are applicable. Therefore, we are now capable of providing strong constraints to answer the two questions (a) and (b) listed above by applying our advanced seismic and electromagnetic observational technologies to the **normal oceanic mantle** (as opposed to the mantle beneath subduction zones, hot spots or mid-oceanic ridges).