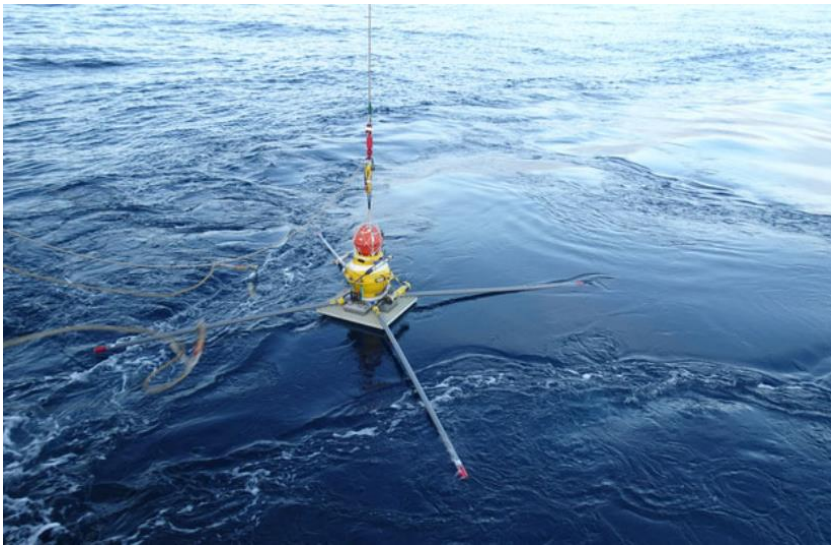
Application Note: Fluxgate in OBM/OBEM



OVERVIEW

Ocean-bottom magnetometer (OBM) and electromagnetometer (OBEM) are ocean-based instruments that are used to monitor both the electric and magnetic field at the sea or ocean-bottom. These are typically used for geophysical research to better understand the Earth's structure, but can also have some application in understanding shallow crustal structures such as underwater volcanoes.

The same measurements are also used in oil and mineral exploration. Hydrocarbon deposits usually have a resistivity contrast compared to the surrounding host rock. The electric and magnetic field measurement can be used to determine the underlying resistivity structure.

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Equipment

- Low Power/Low Noise Three-axis Fluxgate Magnetometer

Applications

- Determine the resistivity structure of the ocean crust and upper mantle
- Identify resistivity contrasts associated with hydrocarbon

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OBEM for deep MT soundings

OBEMs are used to record the natural variations of the Earth's electric and magnetic fields. Combining the two measurements allows the user to determine the underlying resistivity structures. This method known as magnetotelluric (MT) can be used to explore both shallow resistivity structures (sub-volcanic structure for example), and deeper depth that help further our understanding of plate tectonics and the general structure of the Earth.

An OBM will record the magnetic field only and can be used as a temporary station to better understand the fluctuation of the magnetic field in areas which are otherwise not surveyed.

In both cases the requirement is for these instruments to be deployed over prolonged periods of time (months to years), with low power consumption being the primary requirement. Bartington's low power and low noise Mag649L offer both very low power consumption and low magnetic noise. Without the low power consumption sensors such as the Mag-03 or Mag-13 would be switched on and off at periodical interval which would have detrimental effect on data noise and stability.

The sensor's analogue output can then be digitized and the whole electronics included into a pressure vessel (with care required to ensure magnetic hygiene) (Ogawa et al, 2018).

OBEM for exploration

In some geological settings (e.g. basaltic cover), seismic imaging is not always providing very good results, whilst resistivity yield much better results in imaging underground structures. OBEM are used to perform MT measurements on the seafloor over the area of interest. The equipment can also be used as part of CSEM surveys (controlled-source electromagnetic) where an active electromagnetic source is used (rather than relying on the Earth's natural variations used in MT).

Unlike the OBEM used for long term deployment, the systems used in the Oil & Gas industry are deployed for short period of times. Therefore, the emphasis shifts from low power to the lowest noise and the highest possible sensitivity. Here Mag-13 low noise will be better suited for integration in OBEM for EM exploration work as these offer noise of <6pTrms.

Literature:

Ogawa, K., Matsuno, T., Ichihara, H., Nakahigashi, K., Seama, N., 2018. A new miniaturized magnetometer system for long-term distributed observation on the seafloor. Earth, Planets and Space 70:111.