DELIVERING SEISMIC DATA FROM ULTRA-DEEP UNDERWATER ENVIRONMENTS

INTRODUCTION

Conducting underwater seismic surveys can be an extremely challenging task, requiring the deployment of specialized equipment such as ocean-bottom seismometers in hostile environments, often several thousand meters beneath sea-level.

Such equipment needs to be able to operate with reliability and longevity, providing highly-accurate seismic data which is used by scientists and engineers to gain new insight into the condition of underwater sedimentary and crust layers.

From August to October 2018, the IPGP (Institut de Physique du Globe de Paris) carried out an oceanographic mission in the mid-Atlantic Ocean, using 85 MicrOBS ocean bottom seismometers developed in partnership between the Ifremer (French Institute for Marine Research) and Sercel Underwater Acoustics.

The aim of the oceanographic mission was to acquire data along two seismic refraction profiles off the coast of Libera in the middle of the Atlantic Ocean. In addition, bathymetry, gravity, magnetic and sediment sounder datasets were also acquired. The high-quality seismic data needed to be acquired in a flexible manner, with quick set up, deployment and retrieval helping to reduce operational costs.

THE CHALLENGE

Acquiring seismic data at water depths of between 4,000 to 6,000 metres on the seabed requires equipment that can operate for extended periods in extreme working conditions. The high cost and logistical complexity of oceanographic missions, which are often carried out in hostile weather conditions, means in-water equipment such as seismometers need to be deployed quickly and effectively. This requires ultra-reliable installation and retrieval from the ship's deck.

OPERATIONAL CHALLENGES:

- Acquiring high-quality seismic data with long offsets
- Minimising the time and effort to deploy and recover the equipment
- Recovering 100% of the equipment
- Handling and storing a large number of devices

TECHNICAL CHALLENGES:

- Minimising instrument noise to detect low amplitude seismic signals
- Allowing quick and simple configuration of equipment
- Having a reliable release system to allow 100% recovery to surface
- Integrating efficient localization means to reduce recovery time
- Minimising the size and weight of equipment

THE SERCEL SOLUTION

MicrOBS is an autonomous deep ocean bottom seismometer, which can be operated from any vessel, having the capability to dive by itself to reach the sea floor. Integrating a combination of three component low distortion 4.5 Hz geophones plus a hydrophone, it will record pressure (P) and shear (S) waves for up to 24 days. At any time, by sending a specific acoustic signal from the vessel, MicrOBS will release its anchor to get up to the surface. Sending a radio signal and activating a flashlight, it can be quickly located and retrieved.

Sercel - France
16 rue de Bel Air - B.P. 30439 - 44474 CARQUEFOU Cedex
Téléphone: (33) 2 40 30 11 81 - Fax: (33) 2 40 30 19 48 - www.sercel.com

IMPRESSIVE PERFORMANCE

HIGH-QUALITY DATA ACQUISITION

MicrOBS is designed for deep water refraction seismic surveys, offering significant performance advantages over other data acquisition techniques such as seismic reflection. These advantages include a better signal to noise ratio, due in part to the relatively quiet environment on the sea floor and the ability to achieve very large offsets between the acoustic source and the instrument allowing the imaging of deep reflectors. With 4 component recording, MicrOBS allows for the highly accurate characterization of P & S velocities in deep crustal layers.

RECHARGEABLE BATTERIES

MicrOBS uses a proven rechargeable Li-Ion battery pack whose performance avoids the need for opening and resealing the MicrOBS instrument at sea. The battery pack combined with highly-efficient electronics delivers very low power consumption.

DATA DOWNLOAD BY CABLE

External connectivity has also been a prime consideration, with seismic data downloaded quickly and effectively via an external cable connector.

SIZE REDUCTION

A substantial size reduction of the MicrOBS compared with conventional ocean bottom seismometers means it is possible to fit the complete instrument into a 17" glass sphere, substantially smaller than typically used in competitors's devices. The complete weight of the instrument is only 36 kg in air and 11.5 kg in water (incl. anchor). In addition, the use of a glass sphere allows the installation of a flashlight, radio beacon and antenna, which ensures easy identification and recovery day or night.

DELIVERING RESULTS

The IPGP project delivered some very impressive results, with the MicrOBS having recorded excellent quality data from the geophones and the hydrophone at depths of up to 6,000 metres. IPGP scientists and engineers confirmed that data acquired during the mission could be observed up to an offset distance of 700 km from a small energy source (5,000 cubic inch).

The relatively small space requirement of the devices allowed for ease of handling, which helped reduce operational constraints. The devices were also deployed with speed and flexibility, at a rate of one device every hour, with recovery of each device every two hours. There was zero loss of equipment during the mission.

"The mission was a real success, and the data collected by the MicrOBS was exceptional, and should lead some fundamental discoveries. Having acquired seismic data for the last 30 years, I found that the MicrOBS are best seismometers I have used for active source experiment."

Satish Singh of IPGP, Chief Scientist of the experiment

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