CASE STUDY - ENERGY

Deep Water Seismic Exploration

The Güralp Liber OBS provides a valuable add-on to offshore seismic surveys for sharp subsurface imaging

Summary

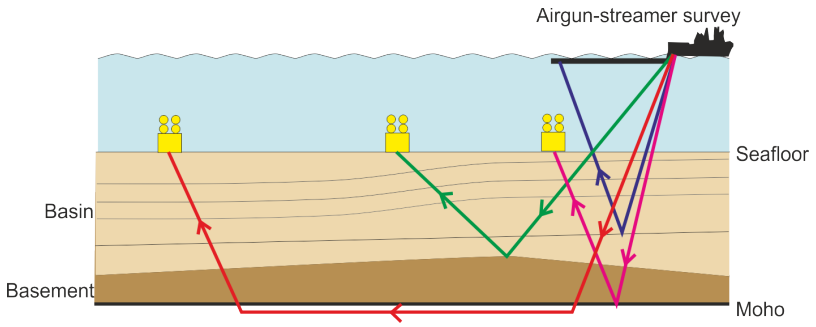
Standard approaches used in marine seismic imaging have limited lateral coverage and depth penetration. In 2014, Geoscience Australia teamed up with major international oil and gas companies to deploy an array of Güralp broadband ocean-bottom seismometers (OBS) off the north-west coast of Australia with the aim of better understanding internal stratigraphy of sedimentary basins and crustal-scale structure. Reflections and refraction arrivals from the airgun source were clearly recorded on the broadband sensors at very wide offsets, allowing for unprecedented imaging of complex geological phenomena in the deep crust.

"Australian National OBS Fleet instruments that were built by Güralp have proven their capability to record high quality data from commercial seismic surveys airguns to very large offsets. Nothing comparable in data quality and coverage exists anywhere in the world at the moment."

Alexy Goncharov
Geoscience Australia

Need for truly broadband seismic in oil & gas exploration

Knowledge of the deep subsurface is required to accurately constrain basin subsidence history and hydrocarbon maturation. Traditional offshore seismic profiling methods involve arrays of high-frequency streamers. However, streamer surveys have limited lateral coverage, leading to reduced imaging capability of the deep subsurface



Portable OBS nodes placed at large offsets from airguns can record a range of seismic phases from the deep subsurface

An array of Liber OBS nodes placed on the seafloor during an airgun survey can record a range of subsurface seismic phases over a very wide band of frequencies.

The portability provided by the Liber OBS nodes allows stations to be easily deployed and recovered. OBS arrays can also image the subsurface using passive seismic sources. Thus, OBS arrays are an economical add-on for hydrocarbon exploration with dramatic results.

Güralp Solution

In 2014, Güralp supplied 20 Liber ocean-bottom seismometers, fitted with 3-component 6T broadband sensors to the Australian Government to develop the Australian National OBS fleet. The nodes were

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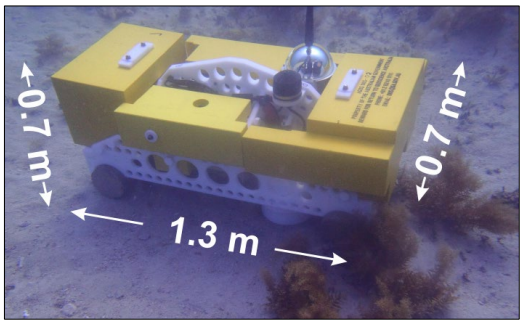


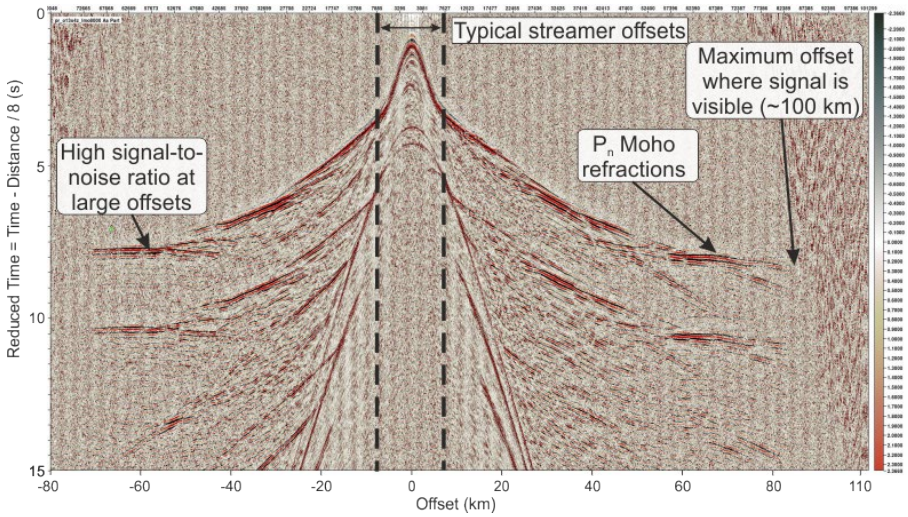
Guralp Liber OBS on the sea floor of the Australian continental shelf

deployed on the Australia continental shelf, where water depths exceed 2000 m. The frequency response of these sensors is 0.0167-100 Hz

The Güralp Liber comprises a high-precision real-time clock, which minimises time drift to less than 1 ms per day. The nodes were deployed underwater for 47 days, although instruments can stay under water for up to 12 months. The OBS package includes an acoustic mechanical release system with launch springs for recovery.

Outcome

Compared to industry-standard streamers and ocean-bottom hydrophones, recordings showed that the broadband Liber instruments were less sensitive to water-column multiples, an inherent problem in marine seismic surveying.



Example seismic common receiver gather from a broadband OBS component showing crisp reflected and refracted seismic signals at high offsets from the source airgun. Image from Goncharov et al. (2015).

The wide lateral coverage provided by the Liber OBS nodes allows for clear recording of subsurface reflections at much wider offsets than is available from a traditional streamer survey. This improvement allows for the deeper, more complex subsurface to be imaged.

At wide offsets, refracted arrivals were recorded from sharp geological discontinuities, mid-crustal reflectors and the crust-mantle boundary (the Moho discontinuity). These seismic arrivals allow for accurate velocity models of the entire crust, improving depth migration. The low frequencies recorded by Güralp Liber OBSs has the potential to allow sharper images of the subsurface using full-waveform inversion. Extensive opportunities exist for using Guralp broadband OBS nodes to record passive seismic sources, such as local seismicity and ambient noise, for inexpensive subsurface imaging, and reservoir monitoring during well production.

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