

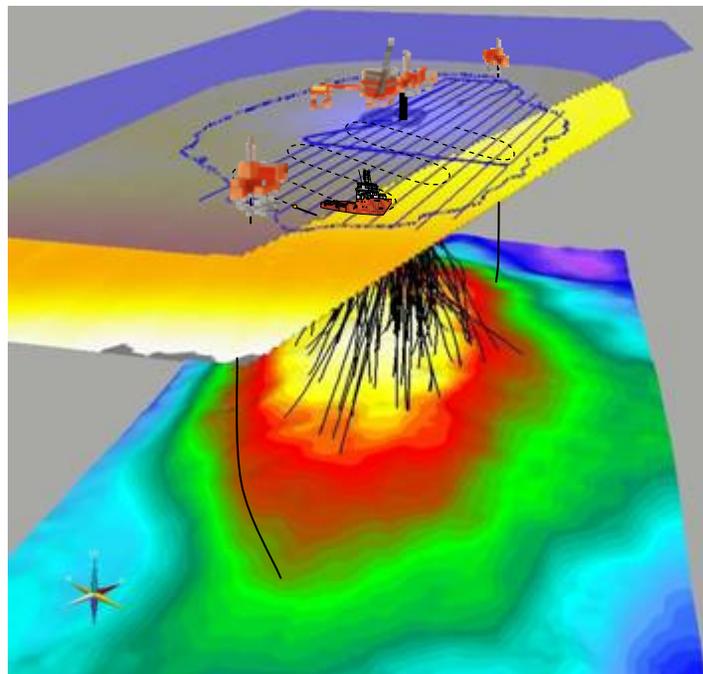
# Life of Field Seismic Technology

Author: L. A. Walter  
Chief Geophysicist  
GEOSPACE Engineering Resources International, LP

OYO Geospace Corporation and their subsidiary, GEOSPACE Engineering Resources International, LP, developed a permanent SubSea seismic system in collaboration with a major oil company. This system was designed for the “Life of Field Seismic” (LoFS) technology, a permanent seafloor deployment that monitors the long-term performance and development of SubSea producing reservoirs.

The world’s first LoFS system was deployed in the North Sea in the fall of 2003, and has been monitoring and recording repeated marine sourced surveys since that time. In addition to conducting repeated 3D sourced surveys at approximately 3 month intervals, the nearly 10,000 channel SubSea seismic system monitors all seismic activity in the vicinity of the reservoir continuously and in real-time.

This reservoir scale seismic system is composed of more than 120 Km of GEOSPACE SubSea cables covering 40 Km<sup>2</sup> of the Valhall Field in the North Sea. The continuous armored cable segments incorporate 4-component (x, y, z, P) seismic sensor stations at 50 meter intervals. Deployment consists of installing the cable in parallel lines over most of the imaging volume of the Valhall Field’s producing formations (see illustration below).



**Figure 1:** SubSea cable deployment in relation to the Valhall Field producing structure.

The GeoRes-SubSea systems on the production platform are configured for high capacity data storage and completely un-manned operations. High speed fiber-optic

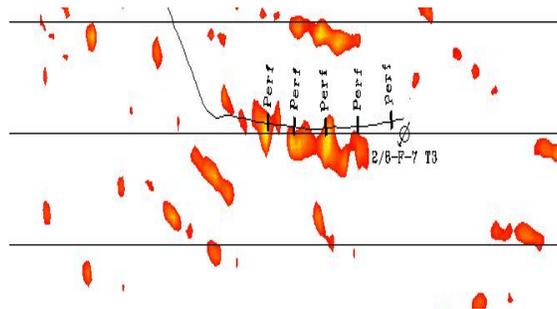
telecommunication links to Norwegian offices, and secure network communication to Houston, Texas USA, enables remote monitoring operations year-round and results in significant cost savings and Health and Safety risk reductions for these operations.

The permanent placement of these SubSea systems is simpler and more accurate than conventional seismic methods in all the following aspects:

- **Receiver positioning methods and accuracy**
- **Survey design**
- **Receiver repeatability (and vector fidelity)**
- **Receiver signal and noise characteristics**
- **Source repeatability**
- **Data management**

These key system features insure that the “time-lapse” imaging technology, showing seismic response differences in the producing formations over time, yield valuable information about the properties and resource potential of the reservoir. The Valhall system managing these critical features and the information it provides is expected to return an overall **VALUE of \$800-\$900mm** to the field.

To date there have been four air gun sourced 3D surveys completed over the Valhall LoFS array. The array continues to perform “time-lapse” reservoir imaging as designed yielding exceptionally stable and repeatable data. Early images shared by BP conclusively demonstrate the extraordinary image resolution that this method and technology offers (fig.2).



*Figure 2: The amplitude difference with the resolution of response near well perforations.*

Recently, OYO Geospace’s SubSea Systems were recognized in an award given to BP by the ONS Innovation 2004.

*“The world’s first permanent seabed seismic array was installed on BP’s Valhall field in the North Sea. A BP team supervised 10 specialist contractors delivering required products and services to this life of field seismic (LoFS) facility.*

*These deliveries include the installation of 120 kilometers of seismic cables, operating seismic source, logistics to handle huge data volumes and the capability to produce high-end four-dimensional images.*

*The aspiration of being able to acquire “seismic on demand” has been demonstrated, and delivering 60 million stock tank barrels of additional reserves is now a realistic expectation. 4-D images revealing changes in the reservoir over periods of months are already in use by the well delivery teams.”*

### **Critical System Features**

All GeoRes Systems are designed for; continuous, real-time, high bandwidth, and very large channel capacity (10,000 channels plus). These systems integrate geophones, hydrophones, long-period seismometers, tide-gauges, and other sensitive marine environment measurement devices.

The GeoRes system’s integrated network management enables continuous and event-detection monitoring of all reservoir seismic activity as well as global scale seismology events. These systems are capable of precise common time-base recording and GPS time-stamping of recorded events needed for any world-wide network of seismology monitoring locations. High speed network services allow collection and global redistribution of valuable seismic data to various “data centers” at major universities and government sponsored monitoring centers.

GeoRes Seismic systems are integrated with a range of wellbore deployed sensors as well as aerial deployments of multi-component sensors on land or at sea. This true “acoustic volume” imaging geometry allows unparalleled opportunities for comprehensive interpretation of the physical properties of the earth and producing reservoir, as well as the dynamic properties of the changing rock mass.

The combined static and dynamic property measurements of the earth/reservoir volume provide a new and improved understanding of these properties, significantly improving the capabilities of conventional seismic methods.

### ***OYO Geospace***

OYO Geospace was organized in 1994. We have been in the seismic instrument and equipment business since 1980, marketing our products primarily to the oil and gas industry worldwide. We also design and manufacture thermal imaging equipment and distribute dry thermal film products to the commercial graphics industry. We have been serving the commercial graphics industry since 1995.

OYO Geospace is headquartered in Houston, Texas. Our international sales locations include Canada, China, Russia, and the United Kingdom with international manufacturing facilities located in Canada and Russia.

*OYO Geospace Corporation would like to acknowledge BP and the Valhall Partners for sharing some of the early project images.*

\*\*\*