



'Given the patchy industry response so far, it's anyone's guess how quickly OBN technology will develop. Just don't bet against it.'

## The nodes have it

One of the most surprising recent developments in the marine seismic acquisition business has been the resurfacing of interest in ocean bottom services using node technology inspired by a modest Norwegian outfit.

Andrew McBarnet says it's a Cinderella tale worth telling.

**R**ecession worries are now rampant in the marine seismic community, reinforced by the first ripple of redundancies. All the more intriguing that a relative minnow in the big pond, which is the market for marine geophysical services, has in the space of nine months landed three significant deepwater acquisition projects from three different supermajors – Total, BP and Chevron.

It was April last year when Total

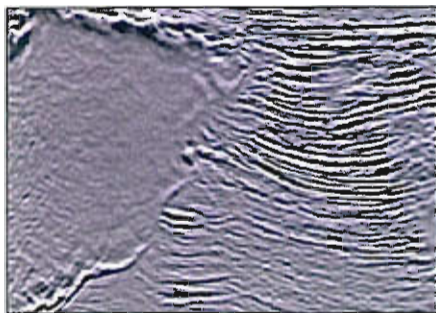
awarded a \$25 million contract to Norwegian company SeaBed Geophysical, the Trondheim-based subsidiary of Oslo Børs-listed SeaBird Exploration. The project called for a single vessel ocean bottom nodes (OBN) seismic acquisition survey in 1300m water depths offshore Angola in Total's block 17 where it is partnered by industry heavyweights ExxonMobil, BP and StatoilHydro along with state oil company Sonangol as concessionaire.

In December SeaBird Exploration's seabed seismic division (the rebranded SeaBed Geophysical) got the nod from BP for a two-vessel three month OBN survey in 1300-2300m water depths in Green Canyon, Gulf of Mexico at the company's Atlantis field. SeaBird beat out Fairfield Industries, the company which in 2006 had carried out a node-based survey in the same field.

Then, just last month, Chevron ordered a large scale OBN survey for its Agbami field offshore Nigeria scheduled to last six to nine months, at rates said by SeaBird to exceed its previous guidance for two-vessel projects of around \$265,000 a day. Tim Isden, chairman and CEO of Seabird, not unreasonably claimed that the project was another milestone for the company's autonomous node acquisition system in ultra deepwater and congested areas. 'We



Batch of SeaBird seismic receiver nodes being lowered to the seabed for placement by ROV.

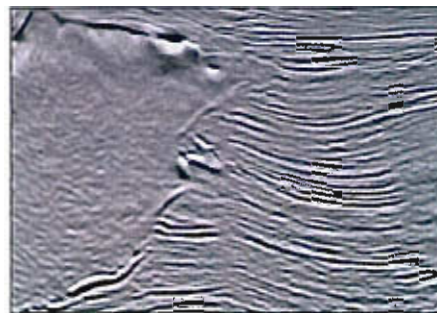


*Node data improvement from Shell's Deimos field survey.*

Left: Best result from narrow azimuth streamer.

Right: Early node acquisition imaging with better signal to noise, multiple content and structural definition.

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see great potential for the future in reservoir imaging and 4C/4D applications and strong industry support for our technology.'

## Leaps of faith

These successes look like welcome vindication for a number of leaps of faith that date back to the late 1980s. At that time Statoil research geophysicists led by Eivind Berg were pioneering the SUMIC (SUBsea SeisMIC) system. The team was the first to explore in the E&P oil and gas context the idea of planting nodes in the seabed in order to record multi-component (4C) compressional (p) and shear (s) waves. The idea was to better image complex geologies and to provide improved data on rock properties and fluid prediction for known reservoirs. Later the benefits of node technology for 4D seismic would be recognised.

A pilot study carried out in 1993 over Statoil's Tommeliten field was, thanks to the shear wave data, able to image through and below gas chimneys previously not clearly visible using conventional seismic. This provided the green light for further work by this time being undertaken by Subseaco, a specially formed company staffed by Berg and other colleagues, which was soon taken over by Compagnie Générale de Géophysique (CGG). By 1996 CGG-Subseaco had developed a 4C/3D seismic acquisition system with sparse receiver and dense shooting. The nodes combined in one casing three geophones – two orthogonal horizontal and one vertical (3C) plus a hydrophone laid on the seabed to record 4C vector wavefield. The complication was the nodes were linked by cable and the data retrieval hard-wired to a dynamic positioning (DP) vessel, which proved a rather cumbersome arrangement.

Berg and Claude Vuillermoz, former CGG chief geophysicist, were by 1997 part of a new company, SeaBed Geophysical in Trondheim, dedicated to developing CASE, a cableless seismic system deploying fully autonomous battery-powered nodes with no cables or surface telemetry. It was being designed to have excellent seabed coupling of the receivers, thereby maintaining vector

fidelity with regard to received seismic energy. SeaBed combined with SINTEF, Statoil, Norsk Hydro and TotalFinaElf to form DEMO 2000, which was behind the IMPREDO project ('improved prediction and delineation of hydrocarbon filled reservoir zones using high quality 4C seismic data acquired in 3D at the seabed').

In July 2002 the consortia was able to trial its proposed system over Statoil's Volve field during a conventional ocean bottom cable (OBC) survey being undertaken by WesternGeco. A total of 128 units were deployed by crane from a DP vessel and positioned by remotely operated vehicle (ROV) in a 400m grid covering an area of 6km x 2.8km. In a post-op review it was noted that the OBC shooting grid required six overlapping swaths which only provided narrow azimuth data whereas the same shots with nodes in place provided wider cross-line offsets due to a larger active receiver area. The comment foreshadowed what is becoming some of the perceived wisdom with respect to the relative merits of OBC versus node technology, ie practicality of laying retrievable cable to be weighed against more elaborate node placement providing potentially better data options.

At the time CASE had made a case for itself as a valid option for specific reservoir seismic survey requirements. An apparent breakthrough into the big time seemed to have arrived in 2003 when SeaBed was contracted by Pemex to carry out a major 4C OBN survey over the Cantarell field offshore Mexico. The objective was to improve the structural definition of the deeper Sihil field which underlies the giant Adil field. This geologically complex challenge had already been subject of an OBC survey in 1996, so there was plenty on the line for



*Hugin Explorer: customised for SeaBird's OBN operations.*

SeaBed. It turned out to be a substantial operation. Some 250 CASE units were deployed into seven swaths in a 400m x 400m grid covering a total of 230km<sup>2</sup>. In all some 1500 node positions were involved in the survey.

## Favourable verdicts

The consensus was that the Cantarell survey, by far the largest of its kind ever undertaken at that time, was successful in better defining the structure of the deeper Sihil field, while processed shallower data was an improvement on previous results. The cableless feature of node technology was shown to be operationally valuable in enabling a reservoir seismic survey to be carried out in an area heavily obstructed by platforms, subsea structures and pipelines, also subject to considerable non-repeatable noise from field operations and vessel traffic.

A further benefit agreed by SeaBed and Pemex in review was the accurate positioning of shots and receivers to obtain 'optimum coverage of the target with respect to fold and offset and full azimuth distribution in the bins'. Using the vessel's ROV, nodes could be individually placed on the seabed to within 1m of deviation from its original placement design. A specially designed skirting on the node also ensured good coupling with the seafloor which is vital for vector fidelity. Last year Berg and some colleagues at a presentation at the Offshore Technology Conference (OTC) in Houston made clear that well planted nodes could prove to be the optimum choice for life of field seismic to monitor reservoir performance, particularly in deeper water.

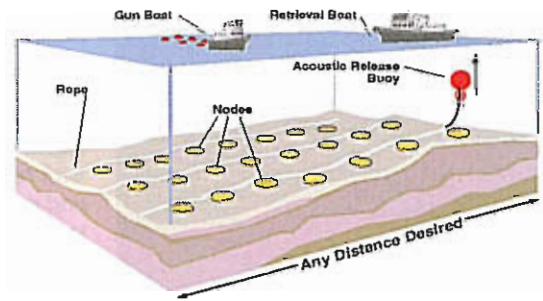
Along with stable and consistent measurements, the ROV-positioned node could be very accurately located on a repeatable basis. By contrast there would always be concern about the durability and performance of any permanently buried cable system, although it was conceded that emerging fibre optic technology was addressing some of the issues such as the removal of in-sea electronics.

Despite the apparent technical success of the Cantarell survey, the phone stopped



LEFT: Business end – Z3000 node containing three geophones and a hydrophone.

RIGHT: Layout for Fairfield Z700 OBN seismic acquisition, no DP vessel required.



ringing at SeaBed Geophysical. The CASE units were essentially put into storage with no sales inquiries converting into projects. This was partly a matter of bad timing. By 2004 the towed streamer seismic market was picking up rapidly as oil companies sought to make up for lost time in assessing their assets to see how they could rebuild reserves. Even the more established OBC survey option was largely ignored by oil companies as exploration seismic took priority. Also a number of new towed streamer techniques such as single sensor recording offered by WesternGeco's Q-Marine and wide-azimuth acquisition, together with improved 4D seismic reservoir monitoring, were seen as cost effective alternatives to ocean bottom surveys of any kind, even if there was some compromise in the data results.

It may also have been the case that SeaBed Geophysical, which evolved from a scientific research background, was under-resourced to make more of an impression in a competitive market. The oil industry probably still needed some convincing that node technology was going anywhere, and there was precious little other activity, as we shall see. In June 2006 SeaBird Exploration, a relative newcomer to the seismic market specialising in 2D seismic and the supply of seismic source vessels, quietly took the company over at a base price of Nkr68 million. It was part of an expansion programme which saw SeaBird also bid unsuccessfully for Norwegian competitor Global Geo-Service (GGS).

SeaBed founder Eivind Berg tacitly acknowledged the company's previous vulnerability when he extolled the advantage of a new owner that 'supplements us on QHSE, operational experience and business development . . . and has ambition and industry understanding as well as access to vessel capacity in a very tight market'. As it happened, SeaBird definitely had a plan, perhaps the one which SeaBed could not raise the money for. In December 2006 it agreed with Siem Offshore on a five year bareboat charter with options for the *Siem Mariner*, a DP2 platform supply vessel of MT 6000 mk II design, from the Kleven yard in Norway. SeaBird's

intention was to convert the vessel to a state-of-the-art seabed seismic vessel at an estimated cost of \$17 million.

Inevitably the conversion programme took longer than expected, but the rechristened *Hugin Explorer* has been operational offshore Angola on the Total job for some months. The company hinted at some teething troubles. In its January vessel utilisation report it said that recovery of nodes from the first of two survey areas was completed in November. Some nodes recovered were said to have experienced challenges with the electronics, and adjustments were made before redeploying the nodes for a reshoot. It was also concluded that a source vessel working with the *Hugin Explorer* would for future projects be more efficient enabling a more continuous operation.

### Interested spectators

Probably the most interested spectator of SeaBed's revival under the management of SeaBird Exploration is Fairfield Industries, based in Houston. The company conducted the most high profile deepwater, OBN seismic survey to date for BP over its Atlantis field in the Gulf of Mexico in 2006 using its Z3000 technology.

In essence the company's technique is broadly similar to SeaBed's in that a DP vessel deploys ROVs to place the nodes on the ocean floor and a second vessel acts as the seismic source. BP has noted that the autonomous performance of the nodes and the ability to record seismic data from all directions were the critical factors enabling the appraisal and development of deepwater subsalt reservoir. In the Atlantis case, 900 nodes were coupled to the seabed at 1628 locations spread over 240km in water depths between 1400-2200m. It must be considered an achievement that the nodes were recovered from all locations and that positional accuracy was better than 3m on average. Fairfield is especially pleased with this performance considering the water depth and the fact that 2000ft of scarp slope with gradients of up to 30° made correct node placement and retrieval very challenging.

Fairfield followed the Atlantis project with a survey in 1000m water depths at Shell's Deimos field in the Gulf of Mexico

covering 134km<sup>2</sup>. Both the Atlantis and Deimos OBN surveys are believed to have delivered the results expected by the oil company clients, yet Fairfield has won no further work. This could be the result of aggressive marketing by SeaBird which has an expensive vessel to keep in the water, but may also be the reality for what is acknowledged to be a niche market restricted to larger, well financed oil companies.

Even so the Gulf of Mexico, offshore Brazil and West Africa look like regions where the special attributes of OBN should prove attractive.

Aware that deepwater OBN may be a slow earner, Fairfield is introducing its Z700 node system which is intended to go head-to-head with conventional OBC survey technology in shallower water. The main difference is in the node deployment which does not require the expense of a DP vessel. Fairfield also says that only two vessels and about half the crew of an OBC survey are needed. The autonomous nodes are deployed via a high tensile strength rope and, according to Fairfield, the reliability of contemporary electronics positions the battery-powered nodes well ahead of the bulky wire-filled cable used for OBC data collection.

The company intends to begin the first speculative survey in the Gulf of Mexico with the Z700 units next month if manufacturing goes to schedule.

Beyond Fairfield and SeaBird's seismic seabed division, few companies seem to be convinced that there is a future business in OBN surveys. For example, latest word from CGGVeritas subsidiary Sercel is that its ARMSS (autonomous reservoir monitoring seismic system) is being worked on at the group research facilities in Bergen with no sign of any immediate announcements. Two German companies K.U.M and GeoPro are makers of ocean bottom seismic measuring equipment for deepwater geophysical research, but although GeoPro particularly has flirted with E&P oil and gas applications, no major steps have been taken.

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