

Q-Technology – moving into the mainstream

WesternGeco's marine seismic solution is gaining acceptance among E&P companies for its high definition images and vast improvement in repeatability

Q-Marine, the suite of advanced marine seismic technologies from WesternGeco, was first offered commercially in 2001. The technology was focused primarily on minimising the noise content of recorded seismic data and improving survey repeatability. While it was well received, take up was relatively restrained, with some of the larger companies adopting a wait-and-see approach.

[] The *Western Neptune*, one of the WesternGeco Q-Marine vessels

To date, WesternGeco has conducted over 20 Q-Marine surveys and the technology continues to gain recognition for addressing real reservoir problems. Q-technology is now becoming 'mainstream', with a host of majors, independents, and major national resource holders applying it at all stages in the life of a reservoir.

Q-technology is the basis of the proprietary WesternGeco acquisition and processing technologies with marine, land, and



seabed applications.

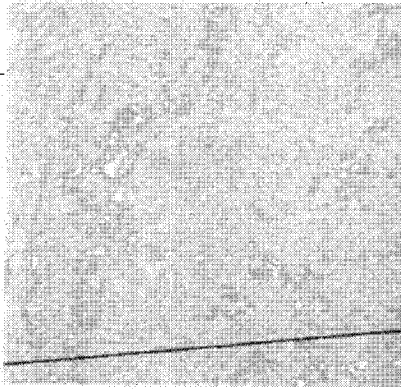
Q-Marine has four main elements: calibrated point-receivers, calibrated sources, a positioning system that deploys a full acoustic network along the entire streamer length and steerable streamers. Compared with conventional acquisition, Q-Marine surveys have achieved a 40% improvement in bandwidth and a

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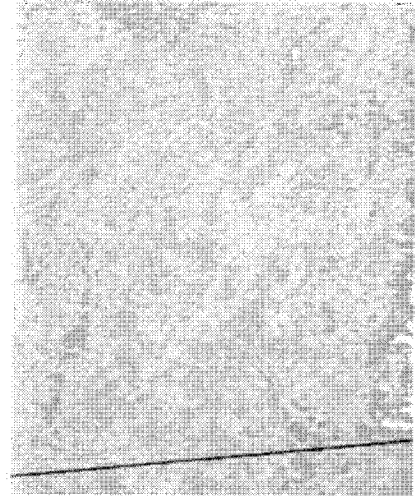
300% improvement in repeatability. These factors are keys to accurately locating and defining reservoirs, as well as enabling truly successful 4D projects, and active reservoir management.

【】 Time slices from the Magnus field taken from just below the base cretaceous unconformity in a relative acoustic impedance (RAI) volume. The much improved resolution and continuity provided by Q-Technology is clear

Conventional RAI volume



Q RAI volume



EXAMPLE Q-MARINE PROJECTS

STATOIL - NORNE FIELD

Statoil was involved in the development of Q-technology and was among the first to use it commercially. Seeking to improve production from their Norne field, they recently contracted WestemGeco to acquire the world's first Q-on-Q 4D survey.

One Q-Marine element that was very important for Norne was the ability of the steerable streamers to pass safely much more closely to the rig infrastructure than is possible with conventional seismic acquisition – thereby reducing the size of the 'hole' in the resultant data volume.

WestemGeco completed the fast track processing of the new survey two weeks after the completion of acquisition, and two weeks ahead of schedule. 4D time-lapse information must be delivered rapidly to maximize the benefits in managing reservoir drilling and production. Data processing included reprocessing of the 2001 Q survey and the generation of a difference cube between the 2001 and 2003 data sets that will be used for identification of the 4D effect from the reservoir development. Statoil said that they can see subtle 4D signals on the on-board processed fast-track difference cube.

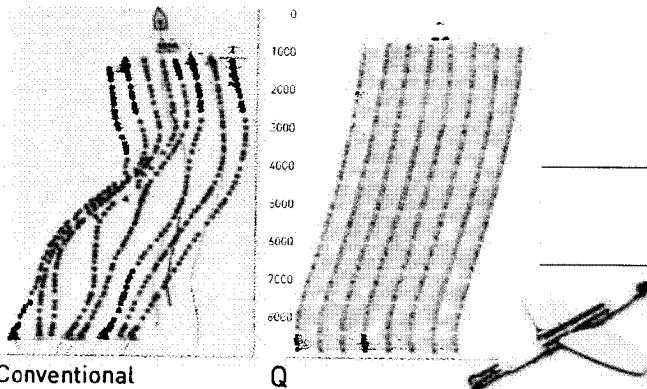
BP – MAGNUS FIELD

A Q-Marine survey over the Magnus field was aimed at addressing key business drivers for BP in the North Sea: increasing near- and long-term cash flow from existing assets and prolonging viable field life.

The survey was undertaken as part of an improved oil recovery (IOR) project that involves importing gas from fields located West of Shetland. The IOR project is expected to increase recoverable reserves and extend field life by several years.

BP's immediate objectives were to test the acquisition potential of Q-technology, obtain enhanced vertical and lateral resolution images of the reservoir, and produce a baseline 4D survey. Enhanced seismic information was needed to help the asset team image smaller faults, define flow barriers, and identify unmapped fault blocks.

Q-Marine data showed significantly improved fault definition and reservoir delineation when compared with previous conventional seismic data. A higher fidelity seismic image, along with accurate well ties, allowed greater confidence in the interpretation, and the improved bandwidth enabled BP to generate a much more detailed picture of the reservoir. When compared to previous conventional acquisition over the field there were significant improvements in resolution, signal to noise ratio, and repeatability.



THE BRENT PROVINCE - NORTH SEA

A Q-Marine survey was performed over a mature field in the Brent Province of the northern North Sea. The field is operated by a large independent oil company and has been in production since the 1980s. The operator wanted to use newly acquired seismic data to

【】 Q-Marine streamer steering is vital in 4D projects

improve their characterisation of the interwell region and so target bypassed pay. This approach would help to maximise recoverable reserves and extend the economic life of the field.

The field structure is a tilted and eroded horst block in which the dipping Jurassic Brent reservoir is trapped against a sealing fault. Lateral closure is provided by a series of faults that lie perpendicular to the main fault. The operator believed that there was bypassed pay in thin sand units located within narrow fault blocks. These small blocks could not be identified from conventional seismic data because they lacked high-frequency content. An integrated project design

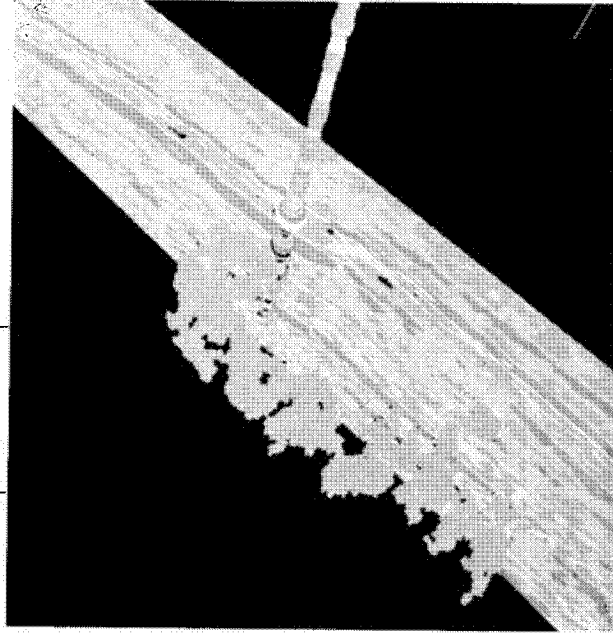
Q-Technology delivered results that allowed the operator to delineate individual sand bodies within the Brent formation for the first time

effort showed that resolving the various intra-Brent formations would require frequencies in excess of 80 Hz and peak frequencies of around 40 Hz from the reservoir depth of 3500m.

The improved spatial and temporal resolution, and signal to noise ratio, achieved by Q-Marine, allowed the operator to map fine geological details in intra-Brent formations, and enabled, for the first time, mapping of individual sand bodies. This has given the operator a better understanding of fluid flow, improved confidence in well planning, and may help extend the economic life of the field.

Recently, a number of Q Marine contracts have been awarded. ExxonMobil awarded WesternGeco a multiproject Q-Marine contract to cover three ExxonMobil assets in West Africa, the Gulf of Mexico, and the North Sea. The North Sea and Gulf of Mexico surveys have been acquired, with the West Africa survey scheduled for later in the year.

ChevronTexaco Upstream has awarded a Q-Marine contract for the ChevronTexaco-operated Captain field in the outer Moray



Firth, UK North Sea. The survey is expected to cover more than 200 square kilometers across block 13/22a.

Commenting on the contract award, Steve Smith, Captain asset manager, said: 'We expect Q-Marine to deliver a much clearer picture of Captain's internal reservoir architecture. This is critical to identifying further drilling targets that may lead to increased economic oil recovery from this significant field.'

The need to precisely define reservoir dimensions, to right-size reservoir infrastructure, to accurately monitor reservoir changes as production proceeds, and to extend the economic life of fields are key drivers for the E&P business over the next 10 years. Q-Technology has been designed and engineered to help operators address these drivers and maximise the probability of technical and commercial success. **Q**