

EVOLUTION THROUGH NEW FUNCTIONALITY AND APPLICATIONS

## Q-Marine gets even better

Since its introduction in 2000, demand for Q-Marine technology has grown exponentially. This year, WesternGeco celebrated completion of its 100<sup>th</sup> Q-Marine survey and successful results have been achieved in every major offshore hydrocarbon province around the world. Rather than sit back on this success, WesternGeco is continuing to evolve and improve the technology, and is applying the system to solve several old and new industry challenges.

The launch of Q-Marine followed years of analysis to identify the key sources of noise and error that impact seismic data quality and repeatability. The result was a fundamentally redesigned acquisition system with four key components: calibrated sources, calibrated positioning, calibrated single sensors and steerable streamers. This combination has consistently delivered high resolution data for reliable processing and inversion results, enabling enhanced reservoir characterization and commercially successful 4D surveys. According to WesternGeco, Q-Marine surveys have typically resulted in a 40% improvement in bandwidth and a 300% improvement in repeatability relative to conventional systems. The 100<sup>th</sup> survey was the 4th generation of Q-on-Q 4D surveys over Statoil's Norne field in the North Sea, where Q-Marine has successfully imaged the 4D signal of changes in the reservoir over production intervals less than 15 months.

In addition to meeting the objectives of enhancing resolution and repeatability, Q-Marine has enabled the potential of several advanced imaging techniques to be realized. The benefits of the dual towed-streamer over/under technique have been known since the mid 1980's, but until recently it has been impossible to achieve the necessary vertical pairing of the two streamers. Streamer steering and fine spatial sampling of sensors has now enabled the method to be properly implemented. Following successful field trials, WesternGeco has acquired several commercial 2D and 3D surveys using the technique. The method and results of a test in the Gulf of Mexico combining dual over/under streamers with dual over/under sources are presented in paper ACQ 1.3 at 2:20 p.m. Monday. Results of the broader signal bandwidth, deeper penetration and higher signal-to-noise achieved by the method are being presented daily on the WesternGeco booth.

Q-Marine technology has enhanced the quality and efficiency of several other imaging techniques, such as rich-azimuth towed-streamer surveys. In regions of complex overburdens, this approach can illuminate underlying reservoirs and geohazards much better than conventional single-azimuth source-receiver geometries. Streamer steering reduces stress-induced noise recorded by the sensors during vessel turns and remaining noise can be effectively removed thanks to finely sampled receivers. This combination enables recording to continue throughout line turns and facilitates some innovative acquisition programs. The results of several successful rich-azimuth Q-Marine projects are being presented daily on the WesternGeco booth. The company is

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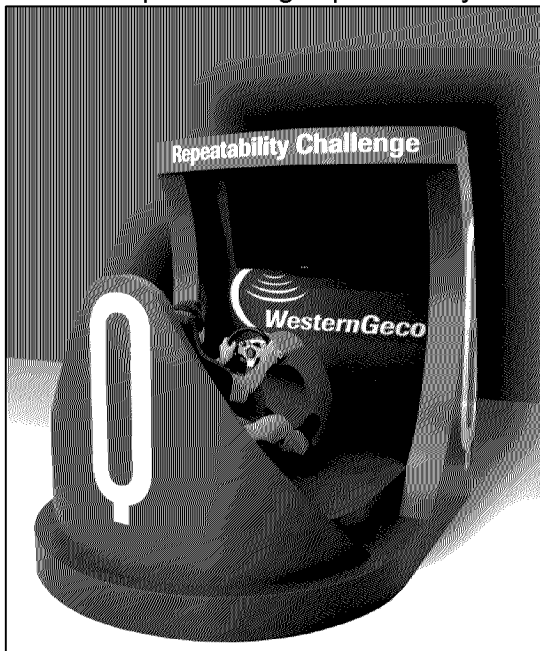
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currently acquiring a wide-azimuth towed-streamer survey to better illuminate the geology beneath complex salt bodies in an area covering more than 200 Outer Continental Shelf blocks in the Gulf of Mexico.

Another example where Q-Marine has enhanced acquisition techniques is in maximizing subsurface coverage for 3D surveys in obstructed areas. Its benefits were well demonstrated during acquisition of a survey over the Marlim complex of fields operated by Petrobras in the Campos basin offshore Brazil. This heavily obstructed area is known for unpredictable currents and sea states. Innovative utilization of a remote source vessel, continuous recording, and streamer steering enabled subsurface coverage and offset distribution to be optimized while adhering to stringent safety regulations such as close-approach limits around platforms and other infrastructure.

WesternGeco is continuing to add new functionality and evolve existing Q-Marine technology to deliver even better resolution and repeatability by further reducing the noise behind the seismic signal. Several data processing steps once considered as marginal “fine-tuning” have now become standard, such as receiver motion and tidal static corrections. Correction for source height variation will soon be introduced, removing the shot-to-shot effects of swell and tide based on dynamic measurements from GPS units on the floats.

An upgrade to further improve positioning repeatability will also soon be introduced. Today, a Q-Marine equipped vessel is steered so that source positions follow pre-plot positions and feathering is controlled using the Q-Fins – a system that has delivered excellent positioning repeatability in areas of good current conditions. The new system



adds an automated 4D position controller and independent steering of the sources to dynamically adjust source and streamer steering based on comparison of realtime position data for the in-sea equipment with planned 4D positions from the previous survey. The whole process is complimented by new planning and evaluation software. A complex simulator has been developed to safely test in an office environment the steering algorithms and hydrodynamic models of the acquisition system used on the vessels. The WesternGeco booth features a game based on this simulator that enables players to steer a vessel through a congested oilfield with and without the new advanced spread control, demonstrating how optimizing the whole system delivers even better repeatability. 800 words.

Experience steering through a congested oilfield on the WesternGeco booth