obvious shift in emphasis has come from WesternGeco, the joint venture between Schlumberger and Baker Hughes which holds the lion's share of the marketplace. The company has become increasingly upfront about committing its seismic capabilities to reservoir delineation and production monitoring. It's a business decision as much as a technology one.

Dalton Boutte, new president of WesternGeco who replaced Gary Jones earlier this year, has repeated his predecessor's disillusion with the overcapacity in the main business of seismic exploration. Boutte has publicly complained that the company's competitors did not follow WesternGeco's lead in cutting the size of their seismic fleets, and he is also unhappy that a whole bunch of newcomers have showed up on the scene introducing extra streamer capacity which inevitably depresses the market. WesternGeco is not giving up on conventional streamer-based marine seismic, but you can be sure that it will avoid the speculative scene that has caused so much grief and instead stick to profitable contract work and properly funded multiclient projects.

WesternGeco's answer is to concentrate as much of its effort as possible on what it calls differentiating technologies such as Q-Marine and Q-Reservoir, which it believes can give the company a measurable edge over the competition. Q technology is the outcome of a huge R&D effort within Schlumberger begun nearly 10 years ago in anticipation of oil

industry interest in a next generation seismic acquisition system which could deliver more accurate, higher resolution imaging data.

Q introduces improvements in receiver sensitivity and positioning accuracy, steerable streamers, enhanced source control and point-receiver acquisition, which is the real innovation distinguishing Q-Marine from other acquisition systems. Q is based on the principle of measuring every single recording sensor rather than taking the conventional route of summing traces from groups of sensors. No one in the industry seriously doubted that Qtechnology would offer better, more repeatable images. Shell geophysicists in the 1980s were the first to seriously moot the idea, but concluded it was not feasible at that time. Only the step changes in hardware and processing capability of recent years have enabled the vision of one receiver channel per hydrophone to be realised.

Predictably the launch of Q technology in 2000 was met with a certain amount of scepticism, some of it competitor inspired, but also fuelled by doubts about the cost benefits which linger today and also by the perceived lack of examples of successful applications.

Three years on, Q technology has begun to win some important advocates as its relevance to reservoir characterisation and monitoring is being realised, particularly in the 4D time lapse environment where survey repeatability is key, and in 4C projects where data imaging improvements need to be commensurate with the extra cost and effort of an ocean bottom survey.

Most heartening for WesternGeco has probably been its contract from Statoil for the first aptly named 4D Q-Reservoir survey over the Norne field in the North Sea. WesternGeco carried out a baseline survey using Q technology in 2001 and this summer repeated the survey over the Norne reservoir to enable a Q-on-Q comparison. Following the survey the job of the geoscientists and engineers has been to analyse any visible changes in the reservoir since the first survey. The information should reveal how the reservoir is being drained and point to where new production wells should be drilled. First reports out of WesternGeco are that the operation went well.

Ole Magnar Droenen, Statoil's petroleum technology manager for the Norne field, explained at the time of the contact award last April that a 4D survey was needed if oil recovery from Norne was to increase above 50%. He said Q technology was chosen because of the repeatability provided by streamer steering and minimum azimuth variation between base and monitor survey. In addition the survey team was able to get closer to the Norne production vessel than would have been possible with conventional equipment thanks to streamer steering. This reduced the area where no coverage was possible.

WesternGeco has four Q technology vessels, of which the Geco Topaz and Western Neptune have been earmarked for surveys this year on three ExxonMobil assets in West Africa, the Gulf of Mexico and the North Sea. Most recently, in July, WesternGeco undertook a 200km2 3D survey using

achieved with its Ramform class vessels using a single as opposed to a dual source acquisition system, can produce results comparable to Q technology and well able to satisfy the stringent parameters being set for 4D surveys projects.

It's not necessary to benchmark the merits of the two approaches to conclude that the focus of some significant seismic business is moving towards smaller surveys over known reservoirs, particularly in the more mature provinces where operators are under pressure to identify and recover every last possible drop of hydrocarbons. Smaller scale has in fact encouraged the emergence of start-up Norwegian companies like MultiWave Geophysical and Inseis Terra to offer specialised survey services in the 4C domain and in MultiWave's case 4D.

Chris Usher, PGS vice president market systems and support, says that the company has had its eye on the reservoir services side of the business for some time. 'People probably thought the migration of services into the reservoir would go more quickly. There is definitely a transition of reservoir engineers using seismic much more as a reservoir analysis tool than they did previously.' Usher points out that PGS is part of the team involved in BP's Valhall Life of Field Seismic (LoFS) involved in the processing of 4D data (OE July).

team including reservoir engineers.

Rock Solid Images practises what Cooper preaches and specialises in the application of rock-physics for integrating and calibrating seismic and borehole data to provide geologic insight and reservoir understanding at all stages of the oilfield lifecycle. It is a young company, founded in 1998 though the merger of the Discovery Bay Company, Seismic Research Corporation and PetroSoft, which has enjoyed considerable growth. Since its inception, it has performed in excess of 200 service projects for a broad range of customers including national oil-companies, majors, super-majors and larger independents. The company has a close relationship with the Stanford Rock Physics group and technology partnerships with Magic Earth, Seismic Micro-Technology, and VoxelVision for the distribution of its ATTRIB3D software.

Cooper is a little perplexed by the fact that the market for his company's style of reservoir characterisation is much stronger in Europe, even though the number of potential customers is much smaller. About the only other company in the inversion business in North America is Hampson Russell, recently acquired by VeritasDGC, which then last month sold at a substantial loss its Reservoir Characterization Research & Consulting (RC)2 subisidary to Seismic Micro- Technology.

combines seismic, and well log data with geological, petrophysical and geostatistical information to generate reliable lithology and rock-property models. It is intended to allow companies to make realistic estimates of reservoir volume and hydrocarbon distribution and to make appropriate reservoir management decisions based on the analysis.

The last word goes to Paul de Groot of dGB (de Groot-Bril Earth Sciences) based in The Netherlands, another of the companies which is in the business of predicting rock properties, inverting seismic volumes to acoustic and elastic impedance, process and interpret seismic object probability cubes. From a university research background, the company has been gradually building its client base, mainly in the North Sea. The company has worked closely with Statoil and other industry groups while developing some of its signature software.

De Groot says there is a general trend toward taking the possibilities of seismic inversion more seriously, especially in the North Sea where the geology is relevant and companies want to maximise the return on their investment in what is regarded as a high cost area. 'People want to believe in the technology and there are enough case studies out there to prove it. A problem we have is that the technology is complicated, and it requires a balanced understanding of geophysical and geological issues. We are beginning to find that oil companies just don't have the expertise

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