A BRIGHT SPOT FOR THE FUTURE

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It's a story that's been told many times over the past 75 years: the one constant in a changing world is the fact that the oil and gas industry will experience boom and bust cycles. As the cycle repeats itself today in the midst of the global financial crisis, exploration is once again at the forefront of consequential cuts.

In the quest to create shareholder value, investors are keenly focused on the potential returns in the exploration sector both in the short term and in the future. Luckily, there are opportunities in this space, driven by key technologies that promise future successes.

Building on seismic

Seismic imaging technology has long dominated the oil and gas exploration sector. However, as markets continue to fluctuate, companies are finding that seismic alone is not enough. Successful companies must look beyond single technology solutions to the broader practice of true 'geophysical' exploration.

Exploration geophysics uses the practical application of physical methods (such as seismic, gravitational, magnetic, electrical and electromagnetic) to measure the physical properties of rocks, and in particular, to detect the measurable physical differences between rocks that contain ore deposits or hydrocarbons and those without. Seismic imaging technology has proven to be one of the most promising and efficient means for geophysical exploration, and it will continue to be a central component of exploration spending.

In 2002, Energy Ventures established a technology advisory board of industry experts to analyse and understand key trends within the E&P industry over the next five to 10 years. An important question in this effort has been, 'what role will technology play within each trend?' The advisory board now tracks 15 trends and has ranked each according to its ability to make a financial impact from a technology perspective. Subsurface mapping and exploration is one of the top five trends as geophysical technologies have moved to the forefront in recent years.

Understanding the market potential

There are certainly compelling reasons for the long term viability of exploration, despite the recent pullback. As shown in Figure 1, Enskilda's 2008 Annual E&P survey noted organic reserve replacement ratios in the industry have been below 100% for many years.

British Petroleum's annual reserve report released in June also shows that global oil reserves went down 3% in the last year, the first drop since 1998. Exploration spending today is decreasing globally because E&P companies shift their focus to development and production of existing reserves during down cycles. Exploration will inevitably recover, but uncertainty remains in the timing.

From a financial perspective, it is important to

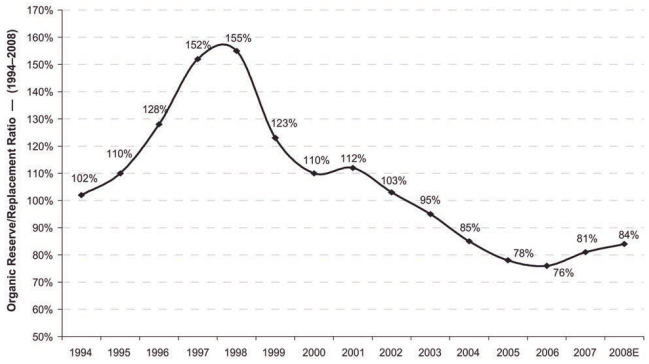

Figure 1. Trends in the organic reserve/replacement ratio (RRR). Enskilda's 2008 E&P survey shows organic reserve replacement ratios have long been below 100%, clearly illustrating the long term viability of exploration technologies (source: SEB Enskilda).

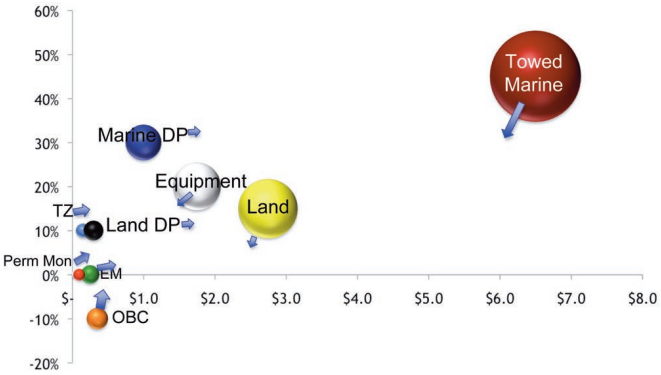

Figure 2. Subsurface mapping and exploration. Estimates of market size and operating margin >US$ 14 billion last year. To fully understand seismic technology's place in the current market and its future potential, analysts must be familiar with the entire market landscape. This figure shows an estimate of the market size of each subsurface process and hints at where it is expected to go in the next few years (source: Energy Ventures, compiled from Spears Oilfield Market Report, public filings and internal estimates).

understand the market size and profitability of the technology segments within this space, as well as how the value may be migrating. Figure 2 shows current market estimates for subsurface exploration processes.

Venture capital analysts evaluate issues such as size and fragmentation of the market, barriers to entry, and the role technology will play in creating a competitive advantage. One of the key uncertainties for the adoption of new technology is market timing. To fully understand seismic technology's place in the current market, analysts must be familiar with the entire market landscape.

- The towed marine market has experienced a step change in profitability for high end vessels due to an increasing demand in the offshore arena and a lack of supply. However, with more boats coming online and a drop in demand, pricing pressure will inevitably lower margins. New technology will continue to play a key role in maximising value from the increasingly complex deepwater reservoirs.
- Marine data processing has become an interesting segment as new algorithms and computing capacity improve, making the reprocessing of older datasets a cheaper alternative to new acquisition.
- Land acquisition hasn't experienced the profitability of the marine segment - most likely because of the lower cost environment onshore, more competition and lower barriers to entry. As many of the world's reserves lie on land, technology will play an increasingly important role in developing those fields in the future.
- Permanent monitoring is in its infancy, and the key question lies in the rate of market adoption. We do know, however, that the technology will play a key role in delivering real value to end users.
- The electromagnetics segment experienced dramatic valuation increases and declines in the last three years, but has yet to deliver profitability from an industry perspective. However, the technology remains very interesting, and this market will continue to grow in a more linear fashion.
- Ocean bottom seismic has struggled to be consistently profitable. The industry has invested millions in multi-component data over the past 10 years and that investment has yet to prove financially viable for many of the companies. Computing power and technologies continue to improve, increasing the possibility of full wave imaging that produces value at an economic level for both end users and the service companies.

Venture capitalists are always on the hunt for technologies that will either fundamentally change the unit cost of a service and/or provide a step change in understanding reservoirs.

Integrating non-seismic to reduce risk and uncertainty

From the financial perspective of the companies offering these suites of geophysical services, seismic has long been the dominant player. However, over the past few years seismic service providers have started to evolve into true geophysical providers.

With exploration leading us to increasingly complex areas such as pre-salt, sub-basalt and carbonates, the geophysical challenges continue to grow. The industry will continue to rely on technology breakthroughs to meet global energy needs.

The use of exploration technologies has always been driven by an intense pressure to reduce risk and minimise the chance of a dry hole. The power of utilising the full geophysical offering lies in the integration of these multiple measurements, cumulatively reducing the uncertainty inherent in each individual measurement.

One non-seismic exploration player is ARKeX, a geophysical service company utilising its BlueQube technology to provide a high resolution, accurate picture of subsurface geology. The key technology in BlueQube is gravity gradient imaging (airborne or mounted on a vessel) that measures the gradient of the earth's gravity field, effectively logging density variations in the underlying rocks. With this technology a structural geological picture is developed for use in lease decisions, overcoming seismic uncertainty, prospect generation and drilling locations. Gravity gradiometry will also undoubtedly have a role to play in the huge exploration acreage in the arctic, and ARKeX has commenced the first marine gravity gradiometry survey in Greenland.

Incorporating data from not only the gravity gradient imaging but also magnetic gradiometry and digital terrain mapping (LiDAR), BlueQube enhances these datasets with

patented processing, inversion and interpretation services. The company has also built its own proprietary gravity gradiometer, the EGG (Exploration Gravity Gradiometer). The EGG, which is in final testing, is more sensitive than current instruments allowing a wider range of geologies to be surveyed in greater detail.

Another growing business is Stingray Geophysical, a specialist in permanent reservoir monitoring (PRM) solutions. Seismic imaging of oil and gas reservoirs using sensors permanently installed on the seabed enables the monitoring of fluid and pressure changes over time. This helps companies increase production and total recovery from their assets. The company's Fosar® system uses unique fibre optic sensing technology to deliver a step change in reliability and stability that will make cost-effective seismic PRM solutions a reality. Furthermore, four component data and the improved repeatability of permanent systems deliver additional reservoir information to optimise production.

Seismic PRM solutions are challenging traditional business models. Compared to streamer or OBC surveys, upfront costs are high, but, with the reliability of optical systems, through life costs will be lower and significantly more predictable. They offer the opportunity for high fidelity 'seismic on demand', allowing operators to manage their reservoirs in near real time. This has an impact on other disciplines, with marine operations teams being closely involved in the installation of such systems and a broad range of subsurface technical disciplines using the time lapse surveys to understand reservoir behaviour. While E&P companies are experts at managing risks in long term investments and projects, both seismic service providers and the traditional buyers of such services are not accustomed to permanent reservoir monitoring capital purchases of this type or structuring services over 10 or 20 years. However, many large fields around the globe with significant remaining reserves will benefit from effective monitoring of production over time, so changes to business practices and innovative contractual arrangements within the industry will be needed.

Having successfully completed a thorough development and qualification process with the close involvement of four major oil companies, the Fosar system is now commercially available from Stingray and its installation and acquisition partners.

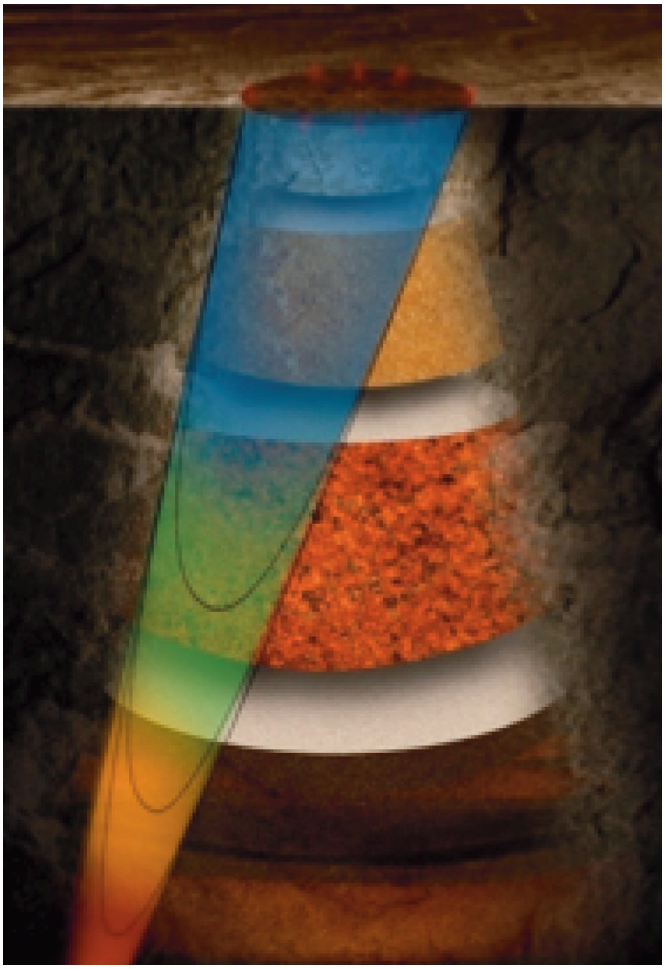

Figure 3. PanGeo Subsea's Acoustic Zoom technology is an example of the next generation of geophysical technologies. The deep earth telescope is theoretically capable of generating high resolution acoustic images five to 10 times greater than conventional 3D and 4D seismic (source: PanGeo Subsea).

Next generation technologies

So, what are the key opportunities for the future? One is unconventional gas, specifically shale gas. In these types of resource plays, currently receiving significant attention in North America, seismic continues its traditional role of delineating the extent of the producing shales and providing an image of the faulting. Because the drilling and completion requirements are intense in shale gas, seismic is being pushed to the limits of resolution to improve attribute analysis and find pockets of anisotropy and potential areas of natural fracture clusters.

Inducing permeability by stimulation is a very large market and seismic is also continuing to play a more important role in increasing the recovery and decreasing the unit costs for these completions over time. The industry is demanding a step change in seismic resolution. This type of breakthrough will enable geoscientists and engineers to fully realise new solutions that are in their infancy today.

As a final example of what may lie ahead, PanGeo Subsea is developing a revolutionary new technology called Acoustic Zoom, illustrated in Figure 3. It is a deep earth telescope, analogous to a radio telescope, theoretically capable of generating high resolution acoustic images from surface to reservoir, five to 10 times greater than conventional 3D and 4D seismic. It is designed to coherently capture the off-specular scattered signals as well as the specular normal incidence returns via high frequency dynamic beam steering on receive and on transmission.

Summary

The geophysical industry has a stellar track record of innovation and development of some of the most valuable new technologies in the industry, such as 3D seismic. While there will always be openings for new technology in exploration, the future offers a multitude of opportunities to develop new and more useful geophysical technologies in the production domain.

Dealing with uncertainty is an everyday occurrence in the geophysical industry. But it is safe to say that the future importance of geophysical technology within the E&P industry is very certain. OT