Moving forward - fast


Photo: Hafdan Carstens

"Acceptance of the e-Core technology by Statoil is a quantum leap forward," says Ivar Erdal, Managing Director of Numerical Rocks. Based on samples from cuttings, sidewall cores and cores, it is now possible to get digital analyses of key reservoir parameters, thus saving both time and money for the impatient oil companies.

It is well known that core analyses are done in the laboratory using sophisticated equipment.. And this was certainly the truth until new technology based on thin section analyses and computer modelling was introduced last year, making it possible to get the same analytical data based on a single thin section.

Last year, Numerical Rocks introduced the e-Core technology in which petrographical data from thin sections are used to model important reservoir parameters like relative permeability, formation factor, capillary pressure, resistivity index and residual saturations. All of these are crucial for doing a proper reservoir simulation with the purpose of planning optimal reservoir performance during production (GEO ExPro No 4, 2005).

This all sounds like science fiction, but the new methodology is now about to be approved by Statoil and will be used extensively by the company. "This is a breakthrough for Numerical Rocks," says Managing Director Ivar Erdal to GEO ExPro. "Up to now, Statoil has been using it as an R&D tool in selected projects only whereas now they plan to use it in their everyday operations."

"The e-Core technology is in the process of being introduced as an official tool in core analyses in Statoil," says Wibeke Thomas, advisor in Core Analysis in the company. "So far, we look upon this innovative technology as a supplement to laboratory measurements. We will continue to use the lab while at the same time we gather experience with the digital analyses. In particular, we need to calibrate results based on the e-Core technology with real values," she says.

"Another aspect is that we can do many more analyses in a short time once the "stone" has been built in the computer. Whilst measurements may take weeks and months, digital analyses take only minutes and hours. There is a huge potential for getting a lot more information from the well samples because of this."

Statoil has recently drilled a well in which only sidewall cores were taken in certain parts of the reservoir interval. "We have decided to use Numerical Rocks to analyse these zones based on thin sections from the sidewall cores. In addition, we will calibrate these analyses against laboratory measurements in intervals where cores have been taken. In this way we also get reliable data from parts of the reservoir where we were not able to retrieve core samples," says Wibeke Thomas.

Statoil is not, however, the only user of the e-Core technology. "We are doing R&D while at the same time commercializing the product. Our client list is therefore not very long yet, but we have succeeded in getting more customers in recent months. Because we have experience in building the reservoir rocks on the computer, some clients will prefer this to be done by Numerical Rocks. We offer both a software package to be installed by the clients and the possibility of doing all the work for them as a technical service, or a combination of these," Erdal explains, and refers to several successful tests and projects in which the digital analyses replicate the core analyses.

"One main argument for using this technology is to save time. While conventional core analyses may take weeks and months, we can do the same thing on the computer in a matter of days. This is, of course, an enormous advantage to the reservoir engineer who can start his modelling only a few weeks after the well samples have been made available," Erdal says. "We also have to remember that the laboratories have little or no capacity these days, meaning that there is a long time to wait to get data. Using e-Core technology and services from Numerical Rocks is therefore an attractive option for oil companies in need of fast and reliable reservoir data.

Numerical Rocks is now moving forward fast. "We have four major tasks; to build a market for the products, get more customers, continue to develop the technology and to build the organisation, which at the moment only consists of ten people," Ivar Erdal says.

"The Digital Core Laboratory" (GEO ExPro No. 4, 2005) is available on www.geoexpro.com [Reservoir Management].

ABBREVIATIONS

Numbers
(U.S. and scientific community)

M: thousand	= 1 x 10^3
MM: million	= 1 x 10^6
B: billion	= 1 x 10^9
trillion	= 1 x 10^{12}

Liquids
barrel = bbl = 159 litre

boe:	barrels of oil equivalent
bopd:	barrels (bbls) of oil per day
bcpd:	bbls of condensate per day
bwpd:	bbls of water per day

Gas

mmscfg:	million ft^3 gas
mmscmg:	million m^3 gas
tcfg:	trillion cubic feet of gas

NGL
Natural gas liquids (NGL) include propane, butane, pentane, hexane and heptane, but not methane and ethane.

Reserves and resources
STOOIP:
Stock Tank Oil Originally in Place

Oilfield glossary:
www.glossary.oilfield.slb.com

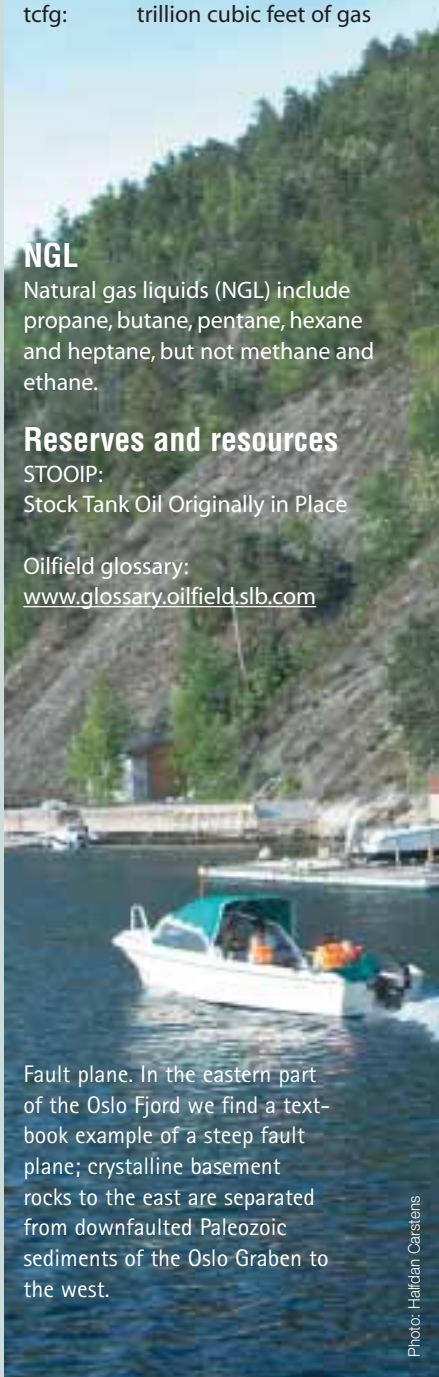
Fault plane. In the eastern part of the Oslo Fjord we find a textbook example of a steep fault plane; crystalline basement rocks to the east are separated from downfaulted Paleozoic sediments of the Oslo Graben to the west.

Photo: Hafdan Carstens

Low-impact Seismic

Low-impact seismic now offer the possibility to run seismic surveys in environmentally sensitive as well as hostile environments.


Photo: Tore Karlsson

Doug Gibson, Vibtech CEO, is pleased with the fact that low impact, cable free seismic data acquisition is now a reality.

"Slainte!" says John Flavell Smith, co-founder of Vibtech, toasting in Scottish for successful testing of their new system on the island Islay, famed for its world class malt whisky, before the equipment *is* shipped to Texas for the first production trials with a major oil company.

With an increasing focus on protection of the environment there are many areas where seismic surveys are prohibited. "Low impact seismic operations" - using lightweight systems with correspondingly low personnel number crews - may enable some surveys to go ahead that otherwise would not have. Lightweight seismic systems are also the solution to hostile environments like dense jungles and for areas where security of crews *is* a critical issue and large conventional crews are exposed.

"We truly believe that Un*ite* *is* the answer to the explorationist's prayers, which have gone un-answered for too long," says Doug Gibson, Vibtech CEO.

Bill Park and John Flavell Smith founded Vibtech in 1996 with the belief that broadband cellular radio network would be able to handle massive data volumes acquired during a seismic survey. Both recognised the need to rid land and transition zone seismic systems of the messy and problematic cables and connectors, which are responsible for huge logistical, troubleshooting and HSE issues. Bill and John wanted the system to work in real time, but be cable free, handle an infinite number of channels, to be free of radio licensing restrictions and to overcome the interference and slow transmission rates that have historically plagued VHF-based radio frequency systems in the past.

The it System (Infinite Telemetry System) patented Cellular Seismic system was launched in 2003. It works by dividing the seismic spread up into a series of cells, with adjacent cells operating at different frequencies. "We use the same frequency band that microwave ovens operate in, so as long as we continue to heat our TV dinners in the microwave the band *is* unlikely to become licensed," comments John Flavell Smith.

The first system was sold to China Coal and used on a high density 3D survey in the Shandong Province southwest of Beijing in a mixed arable and urban area with homes, major roads and broad rivers throughout the prospect – an environment where it would have been very difficult to operate with a cable system.

BHP-Billiton operates an 800 channel it System in New South Wales, Australia under rigorous HSE regime in a highly environmentally sensitive area. The lightweight of the system enables it to be operated by a field party of only five personnel!

A detailed system design review of the it System was carried out in late 2004 and a new system was designed to harness the latest technology and to address user suggestions of features and benefits that they would like to see in the system. This resulted in the Un*ite* System, which was announced at the Houston SEG Convention in 2005. One of the improvements with the Un*ite* System *is* the elimination of the fibre-optic backhaul in the it System using a radio network. This means that the Un*ite* *is* a true cable less system altogether.

"We are all extremely encouraged by the results from these initial tests which have proved to the world that cable free seismic data acquisition *is* now a reality," concludes Doug Gibson.

Tore Karlsson


Photo: Vibtech

Cellular SeismicTM – Vibtech testing and performing production trials with Unite, their cable free seismic system, using mobile networking technology.

Marketing agreement

Global Geo Services (GGS) and Rock Solid Images have entered into a multi-year agreement under which Rock Solid Images will develop multi-well rock-physics and seismic model studies to be marketed by GGS in conjunction with their regional seismic programs.

"The move from qualitative to quantitative seismic interpretation methods is fueling a rapid increase in demand for high quality well-based calibration data. By providing integrated seismic and well-data studies, our customers will benefit from a significant reduction in cycle time and improved risk assessment decisions," says Richard Cooper, President of Rock Solid Images.

"This agreement builds upon our existing successful relationship developed through marketing the East Timor/JPDA regional well and seismic study. A significant number of additional integrated programs are currently under development including West Florida, GOM and East Java, Indonesia." added Trond Christofferson, CEO of Global Geo Services.

GGS is a public company producing 2D and 3D non-exclusive seismic data on a worldwide basis. GGS also develops non-exclusive programs and provides seismic services at multiple centers around the world through its wholly owned subsidiary Spectrum Energy and Information Technology ltd.

Rock Solid Images provides solutions for seismic reservoir characterization, and specializes in the integration of surface seismic and borehole data to build seismic-scale models of reservoir properties such as porosity and fluid saturation.

Inventing a New Device for S-wave generation

VibroPile is a seismic source that generates S-waves that can be used in soft sediments where conventional shear wave sources have problems.

Almost 1.5 million euros have been spent in development thus far, including a field test in France in 2003. For reservoir monitoring a typical configuration would have 25 installed piles with one moveable S-wave source. Each pile is approximately 0.6m in diameter and has a length of about 2m. The vibrator itself weighs around 1.5 tonnes. Total weight with the submerged power unit is 6 tonnes.

"VibroPile is a newly developed seismic technique that can give more detailed images of reservoirs using shear waves from a source placed in the seabed," explains Jon Tore Lieng, Managing Director of GeoProbing Technology AS.

While ordinary marine seismic surveys are usually conducted using airgun arrays towed on long cables behind a vessel, the VibroPile technology is based on an entirely different principle. VibroPile is placed *down* into the seabed itself. Here it vibrates horizontally, thereby generating shear waves (S-waves).

The idea came from Associate Professor Egil Tjåland at NTNU, Trondheim, Norway, back in 1997. Lieng, who was doing work on lateral excitation of piles at the time, thought it was a bright idea and was put in charge of the development. Funding from the Norwegian Research Council and several oil companies helped give it a quick start.

"S-waves have slower velocities and shorter wavelengths than P-waves of the same frequency. This means they produce higher resolution images. In addition, S-waves (together with P-waves) can determine important physical characteristics (lithology) and fluid content in reservoirs. Also, while P-waves are absorbed, S-waves penetrate gas-filled sediments, making it possible to study reservoirs under gas clouds, However, these waves are also useful for monitoring fracture development and in helping to optimise production in producing fields," says Lieng.

The VibroPile technology does not yet lend itself to traditional oil exploration, since it does not cover vast areas cost-effectively. While traditional seismic waves can provide relatively low-resolution images of vast areas, the S-waves instead provide high-resolution close-ups of smaller areas. In consequence, the technology is good for exploration in areas with existing infrastructure e.g. reservoir monitoring. However, VibroPile can also help in determining where that all-important first exploration well should be placed and minimize risk.

Jon Tore Lieng has other inventions to his credit. Now he is ready to supply the seismic industry with an S-wave generator in order to undertake better reservoir characterization.

S-waves alone have not previously been used for seismic analyses in connection with exploration and production of hydrocarbons offshore, because it has been difficult to generate waves that can propagate down into the substrata with sufficient strength. Lieng considers that VibroPile solves this problem. The system has already been tested in a decommissioned onshore oil field in France with excellent results.

Further development of this technology awaits an eager investor. Jon Tore Lieng needs additional funding to conduct offshore tests to demonstrate its capacity, strengthen the signal, do some redesign and make the source more user friendly.

"In short, we need more funding to prove that this is a tool that the oil industry can use with confidence," says Jon Tore Lieng. "A couple of million euros would do!".

VibroPile is forced into the seabed where it vibrates horizontally and generates S-waves. The instrument is now patented in several countries. There is no explosion, only a 10-120 Hz vibration, which generates a similar amount of energy as an airgun.

Geologic Time Scale