Photo: Halfdan Carstens

"We are both very stubborn"

Only some eight years after the idea stroke on a flight out of Houston, two innovative physicists can claim that seabed logging has been fully accepted by the conservative oil industry.

Halfdan Carstens

"We believe electromagnetic surveying eventually will rival the size of the seismic industry."

Not at all modest on behalf of the technology he has co-invented, Terje Eidesmo, president of emgs (Electromagnetic Geoservices AS), is looking into the future, something he has been doing together with his experienced management team and highly qualified board of directors. Their aim is to define a strategy for further growth in a market that seems to believe in both the company and the innovative technology it has introduced in an exceptionally expeditious manner.

"That may be the very limit," he admits. "But if we believe this technology will be useful not only in exploration, but also in reservoir monitoring, there is no reason we shouldn't see considerable growth in the years to come, not only for our company, but for the entire seabed logging industry."

Results match drilling

Less than four years ago, nobody had ever heard of seabed logging (SBL). Wireline logging, ok, but seabed logging, the concept was totally new to the oil industry when it was first introduced early 2002 (GEO 01/2002, GEO ExPro, no. 1, 2004).

Predictably, many geoscientists with solid background in geophysics and hydrocarbon exploration were sceptical, and so where the conservative oil industry at large. There were a good number of theoretical reasons why the technology should not work. But, to the great surprise of many self-acclaimed experts, a series of successful surveys have since then shown that it has a merit. In fact, several major oil companies already at this stage take exploration decisions based on SBL results and, in all instances to date, the results of SBL surveys have matched that of the actual drilling

Through more than 120 surveys, seabed logging has demonstrated its ability, and the methodology is on the lips of most explorationists dealing with offshore exploration. Customers include a long list of companies that is topped by supermajors like BP and Shell.

The geographical range of their operations is also impressive. Having been in regular operation only since late 2002, surveys have been carried out in the North Sea, the Norwegian Sea, the Barents Sea, the Mediterranean, offshore West Africa and Brazil and in the South China Sea. In other words, the company is already operating on a global scale.

The market demand has also grown in such a way that two ships are now in operation. "We are now in the process of evaluating if we need a third ship," says Terje. That should by itself take the wind out the sails of many sceptics.

The first attempt

Terje Eidesmo and Svein Ellingsrud, invented seabed logging. We all know that, but it is now also corroborated by the UK Patent Office in a hearing published on 21 July as of this year (GEO ExPro No. 4, 2005). Svein Ellingsrud is the other half of the invention team, and now serves as vice president for research and technology.

Both Terje and Svein have a profound background in physics with, first a Masters Degree, and then a PhD from the Norwegian University of Science and Technology in Trondheim, and, as it happened, their thesis had to do with electromagnetic waves. In the early 1990's they joined Statoil, Terje first, then Svein, as research scientists and soon became involved in petrophysics and well logging. Their first encounter with electromagnetic waves when working for Statoil was in a project concerning geosteering. The idea was to use electromagnetic waves to measure the distance to the oil-water contact.

"This was our very first attempt to use electromagnetic signals for long range detection. Up to then such tools had normally been used in wireline logging with penetration depths in the order of one meter or less," explains Svein.

"We were then faced with the same problem as we would meet later. We had to reduce the frequency of the signal to reduce attenuation, but that also meant that we would get lower resolution. In hindsight, what we learned in that project was very useful at a later stage, even if the project was not successful."

However, the geosteering project triggered other downhole monitoring ideas and projects. A conclusion was that with knowledge about the resistivity in a well, electromagnetic tools outside the casing could monitor approaching waterfronts. Several patents were applied, and later granted, and a downhole resistivity monitoring system (WMR, Water Monitoring Radar) was designed and built in cooperation with NGI and Roxar. Another monitoring radar project was run in cooperation with Kongsberg offshore and NASA in Houston.

Flying high

"We had been in a meeting in Houston and were on our way back to Norway. In the meeting we got to know about an electromagnetic source that was extremely powerful. While sipping a glass of wine or two during dinner, we probed the possibilities: If this source could be strong enough so electromagnetic signals could be used on a much larger scale? Was there any particular reason why we couldn't reduce the frequency even more so equipment on the seafloor could measure the subsurface resistivity? Why not use a large distance between the source and the receiver in a kind of scaled logging approach to "see" really deep? These were the crucial questions at that time.

"The thoughts we made on this flight triggered the whole idea about sea bed logging," explains Terje.

"This was in 1997, and it should take only a few years before the technology would prove its value," says Svein. Already in 2000 a SBL survey was carried out offshore Angola to demonstrate the technical viability of the method. Another survey in 2001, carried out offshore Norway, confirmed that they were on to something big.

The next year, emgs was established as an independent service company with Statoil as a majority shareholder. That was a

Svein Ellingsrud (left) and Terje Eidesmo, both with a PhD and a strong background in physics, have the word of the UK Patent Office that they are inventors of seabed logging, a technology that is now gaining worldwide acceptance in offshore exploration for oil and gas. In 2002 they founded emgs together with their employer Statoil, and in less than three years the company has done surveys in key hydrocarbon provinces around the world.

major turning point for the two scientists who left secure jobs with a sizable oil company, but also, it should turn out later, a decisive moment for the entire oil industry that has always been looking for a tool that can detect hydrocarbons before making a decision to drill.

SBL options

Several results have since then been published that serve to prove that the technology works. Most noteworthy is a story told by Statoil in their annual report for 2004. Seabed logging was instrumental in discovering a small field in the Norwegian Sea. Using SBL data, the company's belief in the prospect was strengthened and it was thus put high up on the priority list for drillable prospects. As a consequence, Statoil now uses SBL regularly in exploration.

Several other companies are now also using SBL for the purpose of screening and maturing prospects. In the last licensing round offshore Norway, work programs have been suggested in which positive results from SBL-surveys will be a prerequisite before a decision to drill is made. Seismic options are well known to the industry. SBL options are entirely new and certainly reflect that the oil industry has accepted this technology in a surprisingly short time.

"For us, this is major and important step forward," says Terje. "It is a good measure of the acceptance level we have reached. Seabed logging is now a tool that not only explorationists are using in preliminary analyses. The methodology has been lifted to the management level."

"In fact, we have learned that economists and managers without a geoscientific background have met the new situation with an open mind. They are also able to see the economic potential, while geophysicists believe they have other tools that can assist them in finding oil, making seabed logging unnecessary.

"The number of opponents is decreasing. They may still be able to halt single projects, but they are not in a position to stop a fast-moving train," says Terje. "Nevertheless, we certainly welcome critical comments because projects are better founded that way."

Stubborn and strategic

Terje and Svein have spent almost the entire working carrier together, or at least close by. They were not exactly student colleagues at the university, as Svein is Terje's senior by a couple of years, but they had the same professor and were both heavily involved with electromagnetic waves during their thesis work.

This background is possibly why they easily made good friends and had an exceptionally good working relationship when they had both ended up as research scientists in Statoil almost 15 years ago. They are different in many ways, but they have some things in common. Both are technical experts but have divided their tasks: Officially, Terje more took a managerial role and Svein the technical role, but in all practical aspects both have contributed.

"We are both very stubborn, a quality that has been very necessary when developing the technology and challenging a system which was dominated by scepticism," says Svein. "In addition, we have both diplomatic skills as well as the moving power that has been essential in the elaborate process it is to develop new ideas."

"A milestone was achieved in 2003 when the SBL technique was awarded the World Oil Award for "Best Exploration Solution"

"Even more important, we believe that we have been able to take advantage of our differences," adds Terje. "We have had an open mind as to the personal quality of the other. We both also understood soon that we had to build a team. Without the teamwork, including a glass of beer in an English pub as well as long evenings in the office, this thing would never have happened. It has definitely not been a "one-man job." As we fought conservative opinions several times we thought it would have been much easier to do something else."

"As we went along, we had to involve the sceptics, we had to avoid getting enemies that later could put a spoke in the wheel. It was necessary to be strategic," Terje emphasizes.

Having been able to convince Statoil that the company should stake on this project, the next phase was to get the industry to commit itself to use this technology. Also here they seem to succeed. One of the remaining obstacles is in fact that the oil companies now lack enough qualified staff to interpret the data.

"The next step is therefore to get the universities to introduce electromagnetic surveying as a separate class," says Terje.

The future

Having acclaimed fame in the exploration departments, the next step for emgs is to prove their worth in reservoir monitoring.

"Logging the reservoir with a resistivity tool will always be necessary. It gives the reservoir engineer the necessary knowledge of saturation and net/gross of a reservoir. The third parameter would be to know the areal extent of the hydrocarbons. And this we can get by using SBL," claims Svein. Different from Terje, who has chosen a management carrier in the new company, Svein is still heavily involved in developing and manufacturing the technology. For a long time he has been advocating SBL's future in reservoir monitoring.

"A survey carried out over the giant Troll gas field shows that SBL is well suited for reservoir delineation," Svein says.

"I thus firmly believe that we will soon be able to acquire 3D SBL surveys for the purpose of mapping the extent of an accumulation, not only proving or disproving the existence of hydrocarbons in the reservoir. The next step after that would be to do repeated surveys that can be used for monitoring the production."

"4D SBL will soon be a product," says Svein. "I wouldn't be surprised if we have the first repeated survey in five years."

"Our long term vision is that SBL should be equally important as seismic when exploring for and producing hydrocarbons," Terje says. "It is a long way to go, and for this to happen we need to invest heavily in technological development," he admits.

The future looks bright for emgs. Thanks to emgs, the future also looks bright for the oil exploration and production industry.