De-risking exploration with CSEM

Recent electromagnetic surveys carried out offshore the Falkland Islands demonstrate once again the value of this new innovative technology that is now about to be accepted by the conservative oil industry.

Ross Bethell

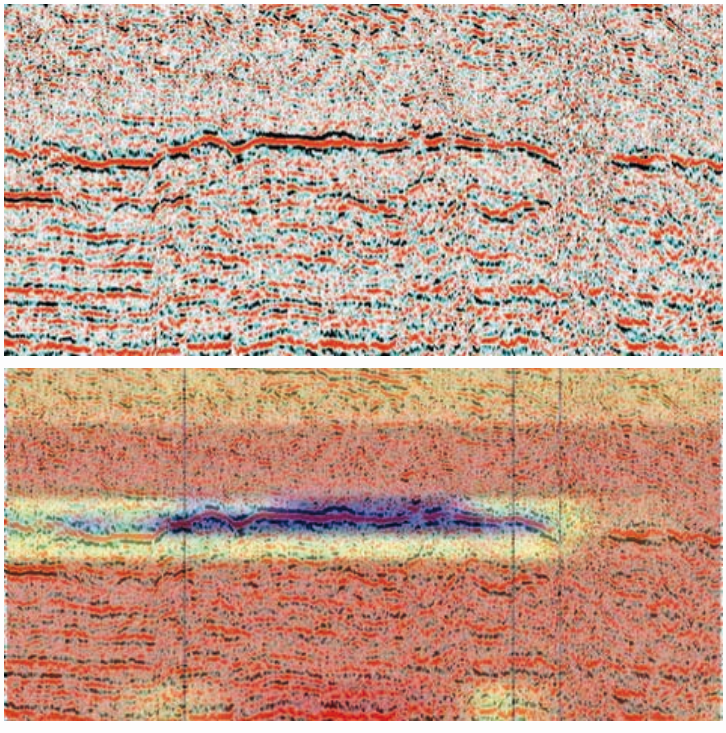
Over the last few years, Offshore Hydrocarbon Mapping (OHM) has been beating the drum within the offshore exploration world about how the Controlled Source Electromagnetic Imaging (CSEM) technique is a game-changing exploration tool. Despite its huge de-risking potential, this has until recently been a tough sell, as the E&P industry has a reputation as a slow-adopter of novel technologies.

OHM has, however, not been easily dissuaded from their task of talking to companies to first educate them about the possibilities and then sell them the survey. As recently as 2005, OHM's sales managers, Larry Scott and Anthony Greer, would appear in the offices of worldwide upstream oil companies, large and small, to be greeted politely, listened to and sent on their way. Now, those same oil companies are calling Larry and Anthony to ask them to come in to talk seriously about what CSEM and OHM can do for them.

Drill-ready structure

This change of dynamic can be attributed to a number of things including OHM pounding the streets and spreading the message. A large tick in the CSEM credibility box is that the supermajors, ExxonMobil and Shell, who have been quietly using CSEM (ExxonMobil calls it R3M) for a number of years are beginning to talk openly about the changes CSEM has made to their exploration economics. There is also a growing body of understanding within the industry and details about some of the completed surveys are becoming more widely known.

More recently, in October 2006 Rockhopper Exploration released the results of an OHM survey in the North Falkland Basin. The results were integrated with 2D seismic, and suggested considerable hydrocarbon accumulation within the structure. Rockhopper declared one prospect to be drill-ready, and used the survey to target an alternate second structure based on the OHM survey work completed.



Seismic data identifies structures that might trap oil and gas, but gives almost no information on the fluids within these structures.

CSEM data detects resistive bodies in the earth. Hydrocarbon saturated reservoirs are much more resistive than water saturated ones.

Curiously, OHM have found farmout data rooms to be a really useful marketing tool. Dave Pratt, OHM's Chief Executive Officer explains: "If a company is attempting to farm out exploration prospects, the data room usually contains all the necessary data to put the acreage or prospect in the best possible light. The presence of CSEM data, especially when it has been interpreted and presented in a meaningful fashion has been a big hit. We have had very positive feedback, from highly experienced explorers who have seen what we have provided and how it has influenced farm-in decisions."

Finds resistive bodies

So what are the key selling points of Controlled Source Electromagnetic Imaging? CSEM is ideally suited to studies of fluid dominated geological systems, and gives complementary information to that obtained from seismic surveys. It is sensitive to the properties of fluids within a defined structure. For the budget holders, CSEM saves exploration dollars and can create enormous value.

Controlled Source Electromagnetic sounding has been around in academia for many years, where originally it was applied to understand, among other things, ocean volcanic and hydrothermal systems. In an exploration context, Controlled Source Electromagnetic sounding is used to identify resistive bodies, which can be indicators of the presence of hydrocarbons. .

OHM's survey method transmits an electromagnetic field into the earth, which is modified by the presence of subsurface resistive layers. These changes in the field are measured and the resulting data is processed to provide interpretable images of the resistive structure of the subsurface. Because hydrocarbon accumulations are generally very resistive, this method can indicate the presence of oil and gas in certain circumstances and can detect and map the edges of such accumulations. This reduces the risk of drilling non-commer-

cial exploration wells and can reduce the need for appraisal drilling, thereby creating considerable value for oil explorers.

The North Falkland Basin

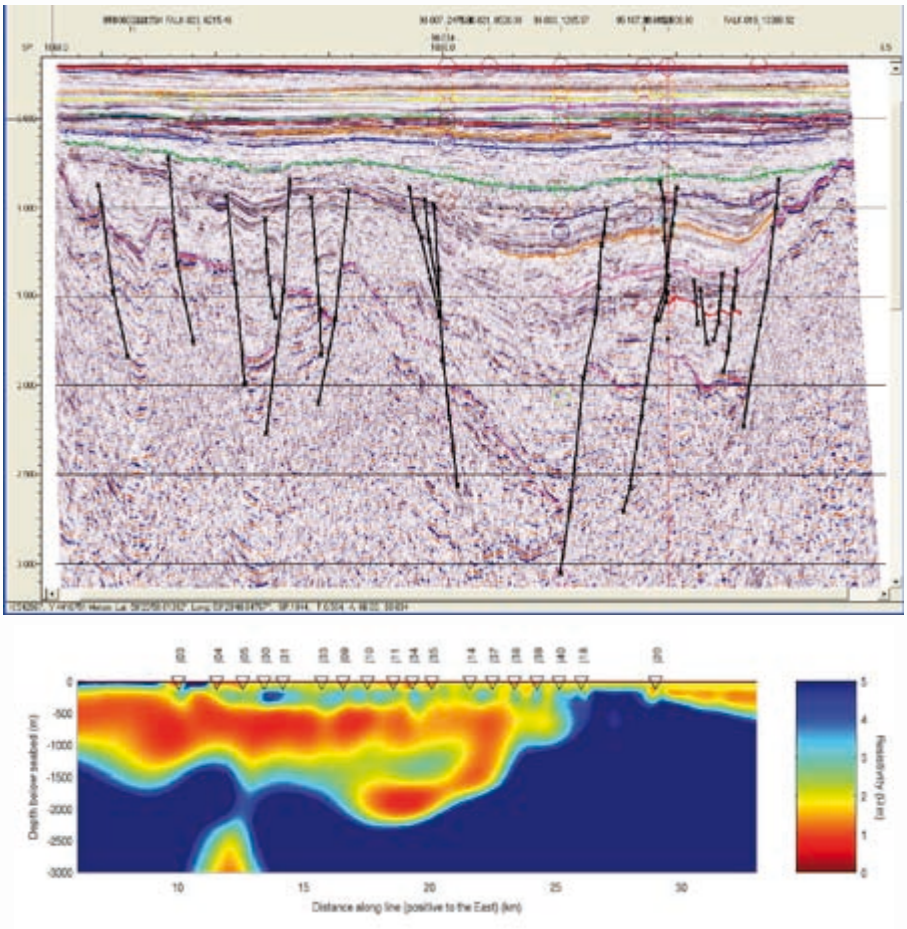
Until recently, airwave interference from signals interacting with the atmosphere (the 'airwave') made the application of CSEM impossible in water depths of less than about 300 metres. After working on the problem for the best part of three years, the research team at OHM solved the problem, and a proof of concept test conducted over the Nuggets gas field in the UK sector of the North Sea in 116m of water was a resounding success.

The first commercial shallow water survey soon followed. In early 2006, OHM conducted two surveys in water depths of under 200 metres in the North Falkland Basin on behalf of UK based Rockhopper Exploration plc. The final results of those surveys were published in October 2006. Rockhopper said that when 2D seismic data was integrated with CSEM data the results greatly improved clarity on the structures surveyed and significantly de-risked the acreage.

Such is the clarity of the data that Rockhopper has declared one prospect, named Ernest, drill-ready because the CSEM data indicates the presence of resistors within the structure. On both the survey lines acquired over Ernest, a discreet resistive body is observed within the bounds of the 4-way closure. That resistor, according to Rockhopper, when combined with information from recently acquired seismic data, is suggestive of the presence of a hydrocarbon accumulation trapped within the structure.

The second structure examined for Rockhopper brought into sharp focus the benefits of using CSEM to avoiding drilling in the wrong place. The CSEM data showed a resistive body coincident with a structural closure. However, it was not the original structure targeted in the survey, but a flanking structure to the northeast. As Rockhopper put it: "This is an interesting and encouraging result and further investigation is required in the area."

Combining all the data Rockhopper estimates Ernest could contain approximately 312 million barrels of oil, of which approximately 100 million could be recoverable. Rockhopper will take great encouragement from prospect Ernest as the company looks to evaluate and mature a number of other leads into drillable prospects during 2006/07.



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A robust structure associated with a clearly visible resistor offshore The Falkland Islands.

The use of CSEM in a remote area such as the Falkland Islands was an eminently sensible choice. The seas around the Falkland Islands are one of the few remaining places in the world where exploration to date has been minimal. The cost of mobilising a rig to the Falklands is high and investors in the exploration companies need to be assured that all avenues to de-risk the acreage ahead of drilling have been pursued.

Also for enhanced recovery

Following Rockhopper's lead, Falkland Oil and Gas, has commissioned OHM to conduct broad surveys over a large number of leads in the waters south of the Falkland Islands in order to allow the company to then focus in on the most interesting ones.

Offshore Hydrocarbon Mapping and Rock Solid Images of Houston are working together to advance the integration of seismic and well log data with CSEM. The co-operation means that, for the first time explorers will be able to evaluate their exploration prospects using a fully integrated data set incorporating seismic, controlled source electromagnetic imaging and well log data. The fully integrated data will provide clients with a heightened level of information on likely rock and fluid properties and improve upon the direct detection of hydrocarbons.

Offshore Hydrocarbon Mapping believes that the global market for CSEM as a direct hydrocarbon indicator for exploration is around $1 billion and there is a very much larger $10 billion market for services throughout the lifecycle of an oil- or gasfield. In addition to applying CSEM to exploration, OHM is working on applying adapting it for accurately placing appraisal wells through to reservoir monitoring, fairway detection and enhanced recovery.

It will not be long before investors will be asking the top management of oil companies to explain why they have not commissioned a CSEM survey ahead of drilling as a matter of routine.

Furher information on CSEM is available in GEO ExPro No. 4/5, 2006 and No. 1, 2004. See also www.geoexpro.com.

Significant Gas Potential in an

The Bristol Bay is a frontier basin with very limited seismic and well data available to the public. Preliminary analyses of the limited subsurface data coupled with surface outcrop data indicate the existence of a Tertiary petroleum system and possibility of an underlying Mesozoic petroleum system. The basin is considered as primarily a gasprone province.

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The Bristol Bay Basin, also known as the North Aleutian Basin, is one of a series of structural sag features located in the southeastern part of the Bering Sea continental shelf, underlying the waters of Bristol Bay and northern coastal plain of the Alaska Peninsula. Water depths range from 5-220m in the offshore portion.

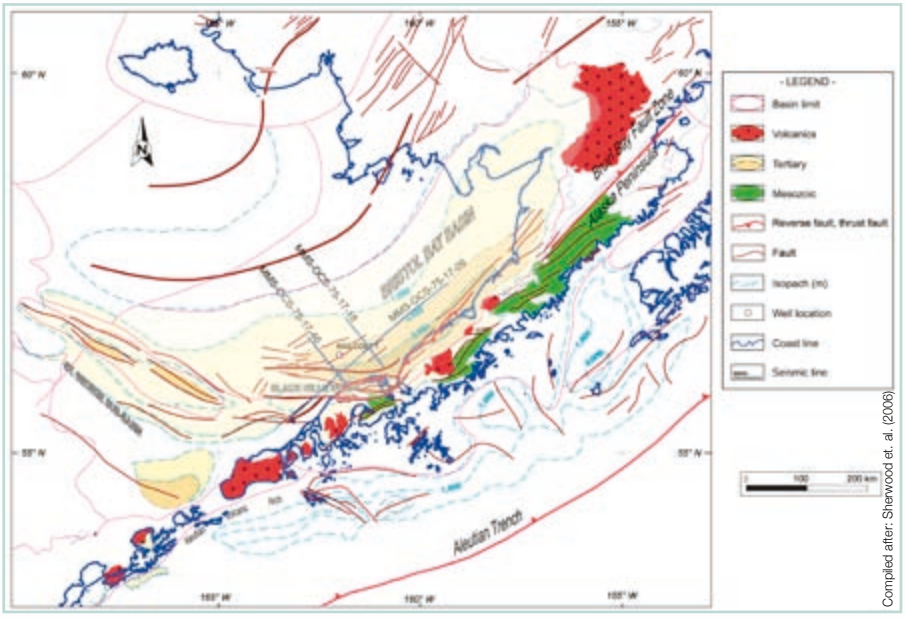
Only one offshore well

The basin is in the early stage of hydrocarbon exploration with limited geological and geophysical data and very few wells drilled to date.

Since 1903, a total of 27 onshore wells have been drilled in the Bristol Bay Basin and its surrounding areas in the Alaska Peninsula. At least 11 of them, all drilled between 1959 and 1985, are within the basin limit and a few of them have encountered oil and gas shows.

The only offshore well in the basin, OCS-Y-8218 (NAS COST 1), is a stratigraphic well that was financed by 18 companies with Arco as the operator. The well, drilled during 1982-83, bottomed in the Palaeocene-Middle Eocene Tolstoi Formation at a TD of 5,229 m. Minor gas peaks appeared on the mud log and drilled cuttings showed some oil stain below 4,663 m. The well has been used in defining seismic sequences which are assigned to onshore formation equivalents, based on biostratigraphic ages, lithology and petrophysical attributes.

Seismic acquisition in the basin and adjacent areas commenced in the 1940's. Approximately 172,400 line-km of 2D seismic acquired since the 1970's have been processed and made available by 2005. Out of the total 2D seismic data available, 36,000 line-km are in the public domain, while the rest is being marketed by vendors.



The Bristol Bay Basin is bounded on the northeast by metamorphosed Palaeozoic and Mesozoic rocks (Iliamma subterrane), the southwestern boundary of the basin is defined by the offshore extension of the Black Hills, an anticlinal structure composed of Mesozoic sedimentary rocks (Chignik subterrane), the southeast margin is defined by the northern limit of the compressional deformation that formed the core of the Alaska Peninsula, while the northwest boundary, lying beneath the Bering Sea shelf, is believed to consist of Mesozoic sedimentary, igneous and metamorphic rocks.

A total of four lease sales were held in the area, including the federal offshore portion of the Bristol Bay, between 1968 and 1988. However, tracts that were awarded were later repurchased by the Federal government in 1995, following a congressional moratorium executed in October 1989. The moratorium was a result of a widespread protest to protect the fishing industry in the Bristol Bay by Native organizations.

Since then, the Bristol Bay region has been off limits for some time as local communities feared potential environmental effects from an oil spill would ruin the areas' salmon fishing industry. However, the fishing industry has been in decline over the last few years and some local communities lobbied and approached the government in 2002 to open the area for leasing as a potential source of revenue.

37 blocks awarded

On 22 March 2003, Alaska Government signed two bills into law that will facilitate oil and gas exploration in the Bristol Bay area. Subsequently, on 26 October 2005, the State of Alaska Department of Natural