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BP: value from connectivity

Can seismic be improved?

Robots in the well

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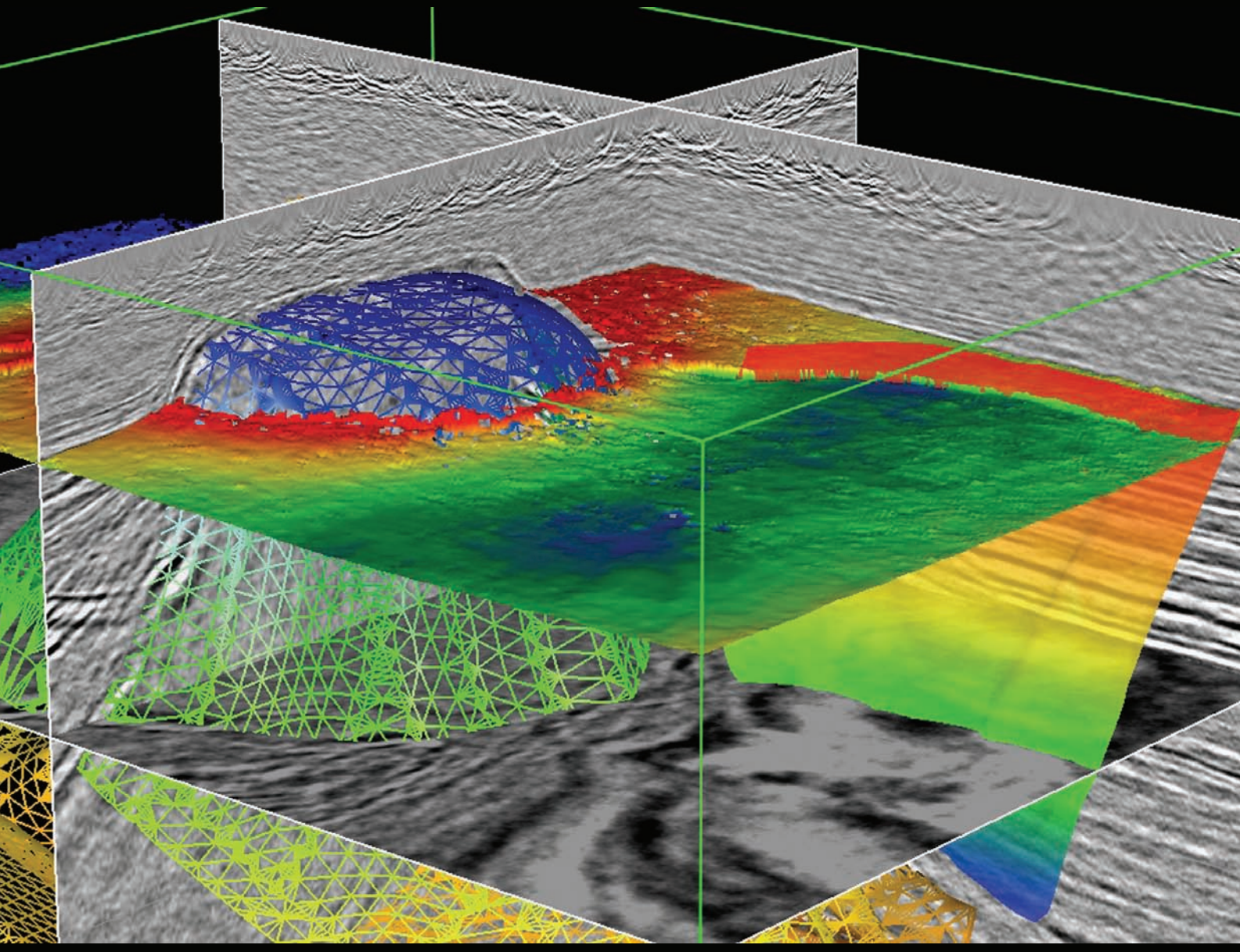

Finding Petroleum

Can seismic be improved?

There's no better tool than seismic for finding oil. But can it be done any better? The fourth OilVoice / Finding Petroleum Forum, in London in June 24 2009 looked at some of the possible ways.

Ian Jack, a past subsurface R+D manager at BP and instigator of its 'life of field seismic' project, believes that the best way to improve seismic is to increase the speed seismic surveys are done.

If seismic surveys could be done faster, they could be done cheaper; and both the increased speed and lower price would make it easier to approve decisions to undertake a survey. So more surveys would be done, and both oil companies and vendors would be happy.

One relatively easy way to increase the speed of land surveys, he suggests, would be to get rid of the cables between data recorders which are spread out over the field. This would mean much less weight to carry around (so a much faster survey) – and a lower capital cost for the overall equipment.

With the cables, there can be 20 to 60 tons of equipment that has to be moved in a day, he says. So overall costs can be reduced by 35 to 40 per cent by using lighter equipment.

The recorded data can either be sent wirelessly, or just stored it together with the data recorder and downloaded it later.

Meanwhile Stuart Papworth, global account manager with WesternGeco looking after BP and Shell, believes that the most important thing is to drive efficiencies over the whole process of gathering and processing seismic data, and how the data is communicated in the field (cables, wireless or stored in receivers and downloaded later) is of secondary importance.

WesternGeco has managed to make enormous improvements to the overall seismic process by reducing noise, and can get the same quality of signal from 4-8 receivers as can normally be achieved with 12-48 receivers.

Current success

It is important to acknowledge that many parts of the world are currently seeing astounding success rates with the current technology. For example, BP and its partners have had successes for 18 out of its past 19 wells drilled in DW Block 31 in Angola, said conference chairman David Bamford (a past head of exploration with BP), and in its one failure, "they kind of ignored the regional geological message". Similarly, Tullow Oil in deepwater Ghana had had 8 out of 8 successes, he said.

The story is not so exciting in the North Sea, he said, where oil companies are currently seeing a success rate of around 23 per cent.

However the North Sea success rate did increase from 15 per cent to 35 per cent over the period 1996 to 2000, a factor Mr Bamford mainly attributes to the increasing use of 3D seismic. Clearly, oil companies would love to see a new technology which could get North Sea success rates back to 35 per cent again.

Meanwhile there is a growing gulf between marine and land seismic surveys – because doing 3D surveys at sea has (so far) proved much easier than 3D surveys on land.

Selling equipment

A crucial factor with new seismic technology is that the companies who rent out seismic equipment or do seismic surveys don't necessarily have an incentive to spend millions of dollars on new equipment, particularly if it hasn't been tested.

It is easy to believe that if you invent new, better technology there will always be a big market for it, because this is how the consumer goods market works. But it isn't necessarily true.

Some oil companies are starting to purchase equipment themselves rather than wait for their contractors to buy it. "I think that's brilliant," said I-Seis' Mr Heath.

Jack Caldwell from Oyo Geospace said the thought that the costs of marketing new technology and getting it accepted are so high there will probably only be 2 or 3 wireless seismic suppliers by the end of it.

Mr Caldwell said he thought that now many oil companies have closed their research centres, it gets very hard to find someone at oil companies you can talk to about new technology. "It's difficult to find someone to talk to," he said.

Cutting the costs

There was a discussion about how the costs of seismic equipment can be cut. The most important components – batteries, memory, microchips, have been steadily (or rapidly) decreasing in cost.

Ian Jack said he thought reducing the number of wireless seismic equipment suppliers would be a good step to reducing the costs of wireless seismic, because the more products individual companies were manufacturing, the lower the manufacturing costs should be. "There should be just 2 suppliers," he said. "Volume is the key."

The land seismic market needs someone similar to Anders Farestveit, he said. Mr Farestveit, as managing director of Norwegian seismic company Geco in 1972 to 1992, can take a lot of the credit for making marine seismic surveys viable, by getting the first vessels specially built for seismic surveys, replacing vessels which were not very suited for the task – expensive and unreliable.

Mr Jack said he has heard that any microchip can be manufactured for $5 each, no matter how complicated it is, so long as there are enough of them being made.

Mr Jack asked if it might be possible to use more off the shelf products in seismic equipment, for example, microchips for consumer audio equipment are made for $5 and can handle 24 bit audio.

These chips would not work for seismic equipment because people want a dynamic range of more than 100 decibels, said i-Seis's Mr Heath.

One obstacle to getting the costs down is that customers expect to see a complex list of specifications for new products and this all costs money to make. "If you try to sell a system that doesn't have them, the door can get stuck in your face," Mr Heath said. "But we don't need a huge series of specifications."

Mr Jack said he believed efforts were currently underway to reduce the costs of 4D seismic with receivers on the ocean bottom.

The current costs of this technology is a big obstacle, he says, because it is normally paid for out of an asset manager's budget, although the rewards for it don't come for many years, when someone else will probably be in the job.

Getting rid of cables

Bob Heath, technical marketing manager with International Seismic Corporation (I-Seis), a wireless seismic data company set up by Seismic Source Company, believes that seismic exploration will be cheaper, safer and more environmentally friendly if it is done without cables.

"If you were inventing land seismic today there is no way you would use cables. But that's not what's happening, cables haven't gone away, and cable free systems are not really yet successful," he said. "The largest crews are with cable. The cable sys-

tems do rule, but I don't think it's OK."

Cable manufacture and disposal, not including transportation before, during and after use, is responsible for 250,000 tonnes of CO2, he said. "The biggest cost with a cabled system is the plastic and copper that goes into the system."

"The biggest problem is actually changing your attitude – getting you to accept the new technology," he said, addressing the audience. "We'll solve it only if you encourage it more."

"You're all addicted to cables and you don't admit it," he said. "You like the feeling of security with cables, be honest. And you're probably not worried about the maintenance cost and downtime."

The weight of equipment per channel is just 3kg if there are no cables, compared to 6.5kg per channel if it is cabled, he said.

Meanwhile there is a steady increase in the number of channels being used in seismic survey (for the same number of crew) – Mr Heath reckons that over the past 40 years, the number of channels per crewmember has roughly doubled every four-five years.

Tough seismic nuts

Ian Jack, a past subsurface R+D manager at BP and instigator of its 'life of field seismic' project, talked about the range of difficult problems which are often encountered doing seismic surveys in shallow waters and on land, or as he put it, "tough nuts to crack."

For shallow waters, towed streamer surveys are not very practical – with potential damage to both the cable and the seabed. Making a source for the seismic wave – setting off explosives in shallow water – is not very easy. "Shallow water surveys are slow and expensive," he said.

On land, the sources are normally vibrator trucks, which are "generally slow, heavy and expensive," he said. But they can be half the cost of explosives – which need to be drilled into the ground, requiring the transportation of drilling equipment to the location.

BP has an interesting project to improve the efficiency of vibration trucks – where the receivers are kept recording all day, and the drivers autonomously go to the different locations and set off shots, without co-ordinating their shots with the other trucks, which slows everything down. He noted that WesternGeco recently announced a world record of 13,315 vibrator points in one day while conducting a survey for BP in Libya.So things are improving.

There are plenty of other challenges with land seismic. Mr Jack told stories of when explosives set off in a rainforest caused tree kangaroos to fall out of trees; when a bridge was built across a river in Papua New Guinea for a survey, which enabled two tribes who had never spoken to each other to meet, leading to various cultural problems.

WesternGeco's UniQ

Stuart Papworth, global account manager with WesternGeco, looking after BP and Shell, talked about WesternGeco's UniQ seismic survey system. Analysis from potential exploration projects in North Africa show that the system could be used to cover in excess of 30 km2 per day using a combination of point-receiver super-spreads and simultaneous source techniques that use multiple vibrator groups shooting simultaneously at different locations

One of the key requirements to fast and efficient acquisition is enabling the deployment of huge spreads with low sensor density. The UniQ acquisition system enables equivalent noise reduction with between 1/3 and 1/6 the sensor density of a conventional acquisition and processing approach. This is achieved by processing developed specifically for individual point-receivers.

WesternGeco calls the initial processing for noise suppression and signal preservation on point-receiver data "Digital Group Forming" (DGF). The high channel capacity of UniQ, combined with an overall reduction in sensor density, provides the perfect platform for large spreads within which simultaneous source techniques can be used effectively.

"A typical UniQ exploration scenario has 4-8 sensors distributed over each 50 m of receiver line. Combining the data from 4-8 receivers with DGF will give you an equivalent data to a conventional geophone array with 12-48 geophones," he said.

The system is equally good for doing both full-azimuth high-resolution reservoir surveys (with higher sensor density) and fast and efficient exploration surveys (with a low receiver density), he said. The 150,000 channels capacity makes the acquisition of full-azimuth point-receiver surveys a commercial reality.

The sensors are managed within an acquisition grid rather the traditional linear arrangement. The data can take any route through the grid to the recording truck. So if any part of the cable is cut, the data has an alternative path to the recording truck. Having such multi-path capabilities also enables flexible deployment to get around obstacles. These features ensure that such a high channel count system can be used reliably.

However, it's not all about channel capacity and efficiency, the system also uses the latest WesternGeco broadband sensor and source technology to get low and high frequency data, which are important for resolution, deep imaging (low frequencies) and reliable inversion to rock properties.

The UniQ Geophone Accelerometer (GAC) can be part of a network of up to 150,000 channels and provides an improved low frequency response and an essentially perfectly flat response curve throughout the normal range of seismic frequencies

So what about cables vs. cable-less? The system uses cables, as this was seen as the most effective way of handling both the required data capacity and point-receiver distribution. "It's all about deciding on the desired geophysical approach to solving tough seismic problems, both in terms of quality and efficiency, and then selecting the most appropriate technology to support it. It's not about selecting a technology and then trying to figure out what you can do with it," he said.

Oyo – store but don't communicate

Jack Caldwell from Houston seismic instrumentation company Oyo Geospace talked about a new system his company has developed for seismic data recording, called Geospace Seismic Recorder (GSR) which just has a geophone, a data recorder and a battery – so the seismic data is not communicated at all from the recorder, until it is stored and collected at the end of the survey.

The data recorder has a GPS system inside, so it can record its exact location and keep accurate time. It can also keep accurate time for several hours if it loses communication with the GPS.

It can store 4 gigabytes of data on each channel (up to 4 channels). This gives it 740 hours or 1480 hours of recording time (depending on the size of battery used).

The devices can communicate critical data a short distance – for example to a truck or helicopter, so you can drive or fly around the survey area periodically to check that they are all functioning properly and the batteries are charged.

The recorder uses one highly sensitive geophone, instead of using 6 geophones and

summing the output from them (which is the standard practise).

The system is designed to be easily portable. A 1,000 channel system can easily be handled by a 12 person crew, he said. You can install 40 to 60 complete stations (recorder, battery, and geophone) in a mini pick-up truck. Equipment carried in a 20 foot container can service 2,000 channels.

The unit has been tested at -40 degrees C, under 3 feet of snow, and the GPS reception still worked fine, and the communications by line viewer worked fine, he said. It has also been used in desert and brush. Units have also been buried 6 to 8 inches deep and worked fine – it can be useful to bury them to avoid the batteries getting stolen, he said.

I-SEIS - wireless

Bob Heath, technical marketing manager with International Seismic Corporation (I-Seis), a wireless seismic data acquisition system company set up by Seismic Source Company, a manufacturer of seismic source controllers, talked about his company's seismic recorders, which communicate "health" information via a proprietary mesh radio network using the 2.4 GHz radio band, but otherwise store the data rather than immediately sending it to the recording truck.

This can provide information that the unit and geophones are still functioning properly, along with their location, the battery voltage – everything you need to know to know that it is working as a seismic system. So you can quality control the data, although you're not sending the data back to the recording truck as it is being recorded.

The advantage of the 2.4 GHz radio band is that no license is required to use it.

Many people have had bad experiences with 2.4 GHz radio, he acknowledged; they say that the data can get absorbed by foliage; this can be true, but the data communications is more reliable at lower bandwidth and when it only needs to go a short distance, as is the case with mesh radio networks, he said.

The I-Seis sigma seismic receivers

The system has a highly accurate time clock, so can still keep recording for a few hours even if it loses connection to the clock from the GPS (GPS lock). It has the option to use GPS time retransmission for where GPS lock may be marginal, and is about to offer its SynchroSeis™ technique for the Sigma system meaning no radio communications at all is required to provide timing to remote ground units, allowing units even to be submerged.

Along with Sigma's "Smart Harvest" techniques, the Sigma system solves the three major issues associated with first generation able free systems (shootblind, timing distribution, and intelligent downloading) making Sigma a much more universal acquisition system.

Finally, given Sigma's parentage, Bob Heath states that source controllers are having to change to cope with the new ways in which land data can be acquired using second generation cablefree systems.

John Doherty, Tullow Oil

John Doherty with Tullow Oil, talked about his company's experience exploring for oil in Uganda using seismic.

The company has acquired license blocks in the Albertine Graben, much of which is under Lake Albert in Uganda. It has 12 oil fields discovered in the past 3 years. It is comparable in size to the South Viking Graben in the North Sea, which has over 50 fields. "It's a new and exciting frontier province we've opened up," he said.

The area has been a target for oil exploration for many years, because there are abundant oil seeps coming to the surface.

Licenses to explore for oil were held by the Anglo Persian company (which later became BP) as far back as the 1920s.

Tullow acquired 2D data in the area between 2001 and 2005. In 2006 it found oil in two different blocks, which was "very encouraging," he said. Lately, it has been successful with 24 out of the last 27 wells drilled.

The terrain has proven very challenging, with a big escarpment (cliff) leading down to a level area of land, next to the lake. All of the equipment for surveying and drilling needed to be carried over the escarpment.

Tullow had to build its own roads, bridges, runways and jetties.

There were plenty of hazards to the seismic survey. The area being surveyed has 20m high cliffs in it, and frequent bush fires in summer. There are alligators and hippos. There was also a firing range. Tullow needed to work closely with the Ugandan Wildlife Authority and the Ugandan Army on the project.

Storing seismic data with no cables using the i-Seis system

Combating the threat of disease was a big challenge, with cholera outbreaks being reported twice close to where crew were working.

The oil reservoirs were at depths of 500 to 1200m, so they could be drilled "really quickly," he said.

The seismic survey team worked very closely with the company's geological and geophysics groups, with software tools which could enable them to look at the same images.

One project, the initial seismic survey did not show up a fault, although it was known to be present. The company was very keen to find out more about where the fault was, so it did not end up drilling through it. A closer look at the seismic data was necessary.

The company thought it would be better to process the seismic data in house. "It would be hard to ask a seismic contractor to just process the central bit first," he said.

Tullow modelled the ray paths where they were bouncing from the surface rock, then up to where the fault was thought to be, and up to the surface; and as a result got a much better image. This work was made over a period 9 months from May 2008 to March 2009.

You can watch a video and presentations from the conference at:
www.findingpetroleum.com
– click on half day forums (top left), tough problems in geophysics (top left)