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Using chemical sampling to decide where to drill

Geochemical sampling gives you an alternative view about whether your chosen drill site is likely to lead to hydrocarbons, said Dirk Hellwig, regional director of exploration with Gore Surveys

By using Gore Amplified Geochemical Imaging service, you can get an alternative view about whether or not your chosen drill site is likely to hit oil, said Dirk Hellwig, regional director of exploration with Gore Surveys, talking at the Feb 15 Finding Petroleum London Forum "advances in exploration technology".

The results of a Gore geochemical survey are to be integrated with other G&G and are able to derisk drilling decisions significantly, he said.

From more than 600 exploration surveys, Gore was able to obtain validation data on 179 drillsites where the system was used, and a well was consequently drilled.

For drill sites where the Amplified Geochemical Imaging predicted prospectivity for hydrocarbons, hydrocarbons were found 93 per cent of the time. So the operators achieved a 93 per cent success rate from drilling, something any exploration company would be pleased with.

The sampling units (GORE Modules) let vapour pass through but block liquids, like the membrane on your Gore-Tex jacket

For drill sites where the geochemical imaging predicted that there wouldn't be any hydrocarbon, and yet the well was still drilled, it turned out to be dry 92 per cent of the time.

The system can be used for reservoirs below salt: it successfully showed the location of hydrocarbons in Egypt beneath 3.5km of salt, using sample modules with 250m spacing.

It can also be used on stacked reservoirs, differentiating the signal from the different reservoirs, provided calibration by tested wells. However the system cannot tell anything about the depth of a reservoir or volumetrics.

Over the past 18 years GORE Surveys have carried out over 600 surveys, in a range of different terrain, from desert to permafrost soil and swamps, onshore and offshore.

Wide area survey

The system can also be used to survey a wide area, and get a low resolution idea of which regions are worthy of deeper study, with sampling units placed every few km.

For sampling macroseep sites, Gore works together with satellite company Astrium, which maintains a global database of seeps which is continually updated.

Once the geochemical samplers have been analysed, Gore draws probability maps, showing the likelihood of hydrocarbon presence in different areas of the map.

Sampling units

Gore has developed a special sampling unit which can detect a much broader range of hydrocarbons than conventional soil gas sampling, and therefore more useful information about the likely presence or absence of hydrocarbons beneath a specific spot on the earth's surface. Also the sensitivity of the method is orders of magnitude higher than in conventional sampling.

The Gore Module captures hydrocarbon compounds from 2 up to 20 carbon atoms long, compared to conventional soil gas geochemistry which can capture C1 to C5.

The presence or absence of C6 to C20 molecules is very important in working out if there are hydrocarbons below.

Gore is famous for making the Gore-Tex membrane, used for waterproof clothing and which allows vapour to go through, but not water. This means that the clothing can breathe while keeping the wearer dry.

The chemical sampling devices feature a similar membrane technology – so gases can pass through the fabric into the sample device, but not liquids.

The sampler contains adsorbent materials which capture the hydrocarbons from the gas.

For land surveys, the sampling units are long narrow tubes, which are dropped into a hole 1cm diameter and 50cm deep. They are left in the soil or seabed for about three weeks.

For offshore slick surveys, the sampler can be dragged through an oil slick for a few minutes to see what it can collect.

Alternatively, you can use a coring tool to collect about 100cm3 of seabed sediment, put it in a jar and put the sampling module inside the jar for 3 weeks.

Sample units are normally laid out in grids, at 200-250m distance for high resolution surveys and 2km distance for low resolution surveys.

The sampling units are subsequently shipped to Gore's laboratory for high definition chemical analysis, on a nanogram scale. They are first put through a thermal desorption process, to remove the hydrocarbons from the adsorbent material, before the gas is analysed by Gas Chromatography and Mass Spectrometry.

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Geochemical imaging
Watch Dirk Hellwig, Regional Director of Exploration GORE Surveys, talk about how nano scale geochemical imaging can make a big contribution to reducing dry wells, by detecting and analysing tiny samples of different types of hydrocarbons at the earth's surface, which have travelled up from reservoirs.
Findingpetroleum.com/video/199.aspx

Future of land 3D seismic
Watch Ian Jack, former head of subsurface R&D with BP and initiator of the first "life of field" seismic monitoring system, talk about how land 3D seismic surveys are about to get much better, providing a much better understanding of the subsurface.
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Doesn't need seeps

Because the sampling units are so sensitive, they are not restricted to only sampling oil which has travelled from subsurface reservoirs through faults (Macroseepage).

Miniscule quantities of hydrocarbons can also find their way through a seal rock up to the surface.

This process is known as Microseepage, with microbubbles of gas moving up through grain boundaries in the rock, driven by pressure and buoyancy. "This occurs in every type of lithology," Mr Hellwig said.

Signal from noise

One challenge with the system is detecting signal from noise – ie it is not enough just to have a sample from above a possible reservoir, you also need a sample which is nowhere near a reservoir and compare them.

There is also a possibility that hydrocarbons collected from the sampling unit have come from another source than a subsurface reservoir.

Mr Hellwig emphasises that conventional soil gas sampling can only normally detect C1 to C5, and there can often be similar geochemical responses for C1 to C5 whether there is a reservoir below or not. "So if you restrict yourself to the C1 to C5 you might not be accurate," he says.

Gore also has an idea what typical hydrocarbon signatures above different types of reservoirs (gas / oil) look like based on its experience so far, and that is helpful when trying to understand the information.

Gore's system does not measure methane (C1) at all, because methane is ubiquitous and a differentiation between thermogenic and biogenic methane is needed. This involves isotopic analysis, an additional and complex process, he says.

Ideally, you would have a well control – a producing well in the region – so you can compare the hydrocarbon signature in the zone of interest with the signature around the producing well.

If there is no producing well, then you can analyse the data to look for similarities in the geochemical patterns, aided by Hierachical Cluster Analysis, to develop geochemical calibration points.

Helping you detect hydrocarbons from sampling tiny amounts in the surface soil gas - Dirk Hellwig, GORE Surveys for Exploration, W.L. Gore & Associates

Santos sponsors Open Source software for better reservoir visualization

Australian energy company Santos is sponsoring Open Source technology that is improving collaboration between its geoscientists, who can now work on their subsurface data models from just about anywhere

In 2010 Santos became a major sponsor of VirtualGL and TurboVNC to enable employees to use their laptop PCs to interpret geoscience data visualized by servers running Paradigm software. Paradigm is a leading supplier of exploration and development software to the oil and gas industry.

Whether in a regional office, at home or in an airport lounge, users can reconnect to the same high-performance 3D graphics session that had been running at their regular desk.

It enables real-time national and international collaboration and peer support between remote geoscience colleagues, irrespective of the number of participants or their locations.

Feedback from geoscientists shows that using this new technology via laptops easily rivals the performance of more expensive workstations, Santos says. This has led to many users swapping their traditional geoscience hardware in favour of running TurboVNC on their laptop to display data and application images produced by Paradigm and VirtualGL in Santos' Adelaide headquarters.

The company's users across Australia and south-east Asia now have shared access to more processing power than was previously provided by individual high-end workstations at the users' desks, Santos says.

Use reservoir visualisation software wherever you are: in this photograph, a Santos geoscientist is running TurboVNC from his docked laptop

Benefits

The software is used to locate new oil and gas reserves and optimise production from discovered reservoirs by creating dynamic digital models of the Earth's subsurface.

The Open Source technology being pioneered by Santos displays seismic data from prospective oil and gas fields, as well as models of existing fields, to Santos' offices in Australia and Asia.

Significant investments in data are de-