# showingtheway

## NEW LARGE-AREA SURVEY TECHNOLOGY NARROWS THE SEARCH FOR OIL AND GAS

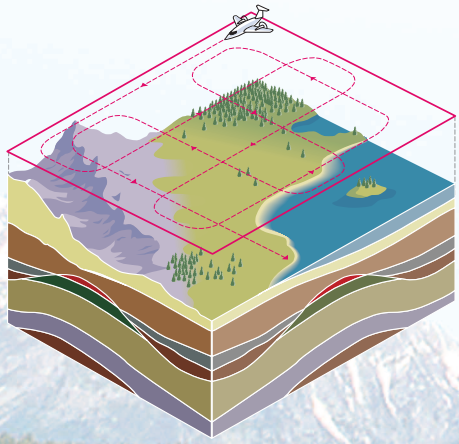
BY MAURICE SMITH

The long and often bumpy road to respectability for any inventor's new creation follows no predictable pattern. But surely George Liszicasz's would rank as more unusual than most. The journey began in 1994 with the discovery of the principles underlying stress field detection. A decade later, the fall of 2004 saw the Hungarian-born scientist flying through Syrian airspace, under the watchful eyes of the Syrian air force, conducting an airborne survey comprising almost 24,000 square miles, one-third of the country, for the Syrian Petroleum Company (SPC). With windows covered over and on co-ordinates unknown to them, his engineers tended to his complex instruments — based on the latest in quantum mechanical principles — meticulously taking readings of stress changes in the subsurface below.

Once completed, Liszicasz holed up in a Damascus hotel room processing reams of data few outside of a tight circle of quantum physics specialists could comprehend. Emerging almost a month later, even he could not have guessed the accuracy of the results — flying blind, the company identified, it was later confirmed by SPC, 108 of 137 known structures flown over for a 79% success rate. The company has identified 17 major prospect areas of which 11 were in production, one was dry, three were seismically verified but not drilled and two are still unknown. According to Nimr Arab, geophysicist and former exploration manager for Shell-Syria, one of the unknown prospect areas was recently verified by 3-D seismic and is being drilled by a major oil company.

For Liszicasz, president and CEO of Energy Exploration Technologies Inc. (NXT), this was among the biggest milestones in his 13-year effort to bring the radically new exploration technology to market. Others were no less salient. In early tests in North America, NXT unearthed anomalies that, after not being followed up, would independently be drilled as major discoveries, including the giant Ladyfern natural gas strike in northeast British Columbia and the East Jonah gas field in Wyoming's Green River Basin.

NXT's proprietary Stress Field Detection (SFD) remote sensing technology measures changes in subsurface stress fields associated with structural and stratigraphic hydrocarbon traps and reservoirs, Liszicasz says, providing a low-impact, cost-effective method of rapidly surveying large areas. "We can identify subbasins, faulting, fracturing, geological domain changes and most of the major hydrocarbon systems within the sedimentary basin. The most important deliverables are the ranked prospect areas."



**FLIGHT PATTERN**
The SFD surveys are typically flown in a grid pattern to maximize the probability of encountering significant anomalies.

He says that even with a grid as wide as 30 by 30 kilometres, SFD will identify major hydrocarbon systems and prospect areas within the area surveyed as long as the flight path crosses the feature, while a 10 by 10 kilometre survey grid will identify 75% of all major prospect areas, irrespective of basin depth. The "deepest" change the SFD detects will always relate to the Precambrian, below which the crust becomes much less influenced by tectonics and therefore stress regimes are less pronounced.

Once prospect areas are identified NXT ranks them according to their potential to the precision level required for planning detailed seismic programs. If required, NXT will conduct infill flights over prospective areas to obtain further definition. The SFD inter-

pretation complements the focused seismic interpretation of depth to structure, closure and an estimate of the timing of structural development, says Liszicasz.

## Lookback analyses

Early trials and written reports of recommendations arising from the technology, reexamined years later, appear to back up company claims, according to an independent report authored in 2005 by GLJ Petroleum Consultants Ltd. A survey in northeast B.C. recommended 16 prospect areas totalling four per cent of the survey area. Eighty-eight per cent have since been drilled, with 252 billion cubic feet of natural gas produced to date from them, the company says. Similarly, from 20 recommended prospect areas identified in the Green River Basin, 65% have been drilled, producing 84 bcf of gas.

It was such results that brought Charles Selby into the NXT fold. A petroleum engineer, lawyer and vice-president of Pengrowth Energy Trust, Selby is an NXT board member. "On the basis of my observations of the company over a number of years and the technical reports that have been generated, that led me to have a high degree of confidence that this is a valuable tool and will be demonstrated to be one in the future," he says. "To our knowledge, it is the only technology available that can remotely identify changes in stress regimes associated with geological events."

Selby describes the technology as a wide area reconnaissance tool that will point explorationists in the right direction. "I've heard it described as a pointer dog tool for seismic. It allows you to identify anomalies that have a high prospectivity. We don't claim that they are drillable prospects at that point — they are SFD anomalies that we would recommend for further work. You could then confirm those with 2-D and 3-D seismic as appropriate and drill them. SFD anomalies appear to correlate very strongly with eventual reservoir development, so I would say that the technology has enormous potential to reduce the time and expense and risk associated with early exploration," he says.

Selby points to the Ladyfern and Green River Basin discoveries, found independent of early SFD surveys. "An anomaly was identified at that time [1997] which was then shown subsequently to overlay the [2000] Ladyfern discovery. NXT actually attempted to acquire lands in the region and was unsuccessful. People did not drill on the basis of the SFD, but it was shown subsequently that the anomaly identified by the SFD coincided with the actual discovery area, which is a startling result.

"And there was also a very interesting identification of an anomaly in the Green River Basin in Wyoming that ended up being the East Jonah field. That was identified by NXT as being highly prospective, and the company that commissioned the study also didn't drill on it. Others went in independently and drilled it later and discovered exactly what NXT had said would be there," Selby says.

## How it works

The existence of stress associated with geological events is well documented and used by industry. It's employed, for instance, to characterize the in-situ stresses that are used for geomechanical applications such as borehole stability analysis, reservoir stimulation and well placement in fractured reservoirs. The difficulty is that stress magnitude and orientation cannot be measured remotely with conventional sensing techniques. SFD technology offers the unique capability, the company says, to remotely measure subsurface stress variations.

"What's revolutionary about this technology is the ability, through a passive transducer, to recognize the changes in stress regimes remotely," says Selby. "What it's looking for is change in geology from one stress signature to another, the change that shows the presence of faulting or fracturing or the potential for the presence of fluid. It doesn't claim to be able to distinguish the type of liquid, that is whether it's oil, water or gas, but it does appear to be able to see the presence of 'reservoir' potential, since rocks containing fluid exhibit very different co-efficient compressibility."

During each survey NXT employs an array of 12 SFD sensors that can respond to different types of stress regimes generated at various depths, allowing it to distinguish a num-

ber of geological features in the sedimentary basin. Conducted between 300 and 1 000 metres altitude at speeds of up to 450 kilometres per hour — too fast and too wide a grid for aeromagnetic or gravitational systems — the surveys use self-contained equipment (put on the aircraft in place of two seats and deployed with no external sensors) capable of sampling at 2,000 cycles per second.

"All exploration methods rely on the existence of 'physical contrast' that arises between the deposit and the surrounding rocks. For the detection of physical contrast the SFD relies on the redistribution of stress regimes caused mainly by tectonic activities that are also the primary cause of hydrocarbon trap development," says Liszicasz. "These stress variations will affect certain processes within the sensor element and ultimately will cause a change of the preset electronic conductance. We can conduct SFD surveys in any sensor orientation, in normal weather conditions. Furthermore, SFD sensors are unaffected by changes in vertical acceleration, or electromagnetic or nuclear radiation."

By monitoring background stress levels NXT can also determine if the basement is getting shallower or deeper or if the sedimentary column thickness varies substantially over any flight line. The technology can determine with a high degree of certainty whether the structural trap and reservoir is shallow or deep, Liszicasz says, though it cannot determine the exact depth. Multiple structures and reservoirs stacked at different depths can be identified individually providing there is sufficient separation. If separation is not sufficient they will appear as structures and a single reservoir will be registered, he says.

According to experienced geophysicist Geoff Carrington, who authored a 2006 report on the technology, one reason the SFD is able to differentiate between shallower and deeper structures is the apparent difference in the degree of compactability of Cretaceous and Jurassic age sandstones versus deeper Mississippian and Devonian age limestone structures found throughout the Western Canadian Sedimentary Basin. Although the geometry of depositional systems may differ, sandstone is more compactable than limestone, which allows limestone structures to retain higher stress levels. "These stress discrepancies will result in identifiable SFD signatures pertaining to these events, allowing us to make assessments of the relative depths," Liszicasz says.

## Stress energy enigma

Liszicasz concedes that stress cannot be measured in-situ or remotely with any conventional techniques. Stress, he says, is expressed as a mathematical entity known as a second-order tensor that describes stress in all directions in all planes (shear stress) and at right angles to all planes (normal stresses).

"The analysis of these entities cannot be described by vectorial decomposition. We can describe general stress in terms of three principal stress tenors [first order tenors] that are known to have a predictable empirical relationship to faults. These we can treat as vectors and describe with an equation or describe using Mohr's graphical simplification," he says.

"The theory we put forward proposes that when 'rocks' in confinement are subject to increased mechanical pressure the result is the production of a naturally occurring energy form that is inherently tied to anomalously stressed subsurface geological structures and the proposed energy has no relation to electromagnetic energies. Although we are not yet able to provide a full account of the underlying physics relating to stress energies, the existence of stress is inherent to the 'make-up' of the universe [all its dimensions, matter and energy forms] and without stress no 'physical system' can exists, at any level. From our perspective, we apply a technology in the exploration for oil and gas whose theoretical principles are not well understood, but it demonstrably works."

The introduction of NXT's fourth generation of SFD sensors last year brought about a significant improvement in signal definition and repeatability, making the interpretation process more understandable to clients and reducing training time for SFD interpreters, Liszicasz says.

## Competitive advantage

NXT generally keeps clients' identities confidential to preserve their competitive edge in the surveyed area, Liszicasz says. "At about 10% of the cost and time of seismic, we have several happy customers in the early stages of formal commercialization of the tool," he says, noting one of NXT's clients successfully competed against several other companies at a number of land sales.

"Our client relied on SFD data for the acquisition of key land positions. Our client did not spend millions and years on developing the geological play, neither did it spend tens of millions on 3-D seismic. Our client spent less than $1 million on surveying [a] 5 000-square-kilometre area and was provided SFD information starting within weeks following the completion of the survey flights."

NXT's technology became commercial last year, when it signed $1.2 million and $3 million contracts, each including a gross overriding royalty interest on any production from lands acquired by the clients based on the SFD survey results. Another contract was signed in February to conduct a preliminary SFD survey for a junior explorer to image specific hydrocarbon trapping mechanisms in Western Canada.

Nexstar Energy Ltd. and an undisclosed partner conducted "high impact" prospecting in the Swan Hills area of north-central Alberta using SFD for what Nexstar called rapid and economic evaluation of large land areas. The region contains some of Alberta's biggest oilfields with production from deeper Devonian formations well established. Some 30 anomalies were identified over the 6 000-square-kilometre survey area, Nexstar says, and the partners anticipate evaluating some of the anomalies and potential prospects with conventional seismic and drilling later this year.

Peter Carwardine, Nexstar president and CEO, says he was involved in an SFD trial while with a previous company that has since been sold. "I have been familiar with the technology for about 10 years and it has matured to the point where we thought it was a worthwhile project for us to pursue with a partner," he says, noting it is too early to determine how successful the survey might be. "In our case, what we use the technology for is essentially a wide area tool. Once we are presented with anomalies we then do conventional geology and geophysics to determine if the anomalies are real."

NXT is also actively pursuing international deals, Selby says. "We are looking at the international domain where you would think it would be particularly applicable, where there are large tracks of land in areas that we believe to be highly prospective and that have very limited seismic, where it is expensive, difficult and time-consuming to gain access. We have the ability to survey those areas and then direct seismic to it, so we have been approached by a number of governments and recognizable, mid-size to senior oil and gas companies that are interested in exploring the opportunity of working with the SFD to gain entry into different countries that have concessions available, to use the SFD to drive that."

Still, Calgary will remain the focal point for the company for the time being, he says. "We are certainly in a position now where, as we have expanded the commerciality of the SFD, we are getting more and more inquiries. We don't have to go beyond the borders of this city to build a significant business." ntm

**CONTACT FOR MORE INFORMATION**

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