New Seismic Being Studied

Labrador Looks to Retrieve Gas

GSI Admiral seismic vessel off the East Coast of Canada

Building on a long history of seismic data acquisition in the harsh North Atlantic, a Calgary-based geophysical company is taking the plunge to explore for oil and gas in the icy waters of offshore Labrador.

After a hiatus of more than 20 years, Geophysical Service Inc. (GSI) has returned to Labrador's continental shelf, investing US $23 million to purchase and equip a seismic vessel, and to acquire more than 10,000 kilometers of 2-D seismic data.

In early October, GSI completed this year's program of approximately 9,000 kilometers of 2-D seismic data off the Labrador coast. Labrador's continental shelf is about 250 kilometers wide and extends 2,000 kilometers from the northern tip of Newfoundland to Baffin Island. The area is characterized by rough seas and sporadic iceberg traffic.

"We're the pointy tip of the exploration stage," said Paul Einarrson, GSI's chief operating officer, chairman and executive vice president. "We're very little, but very important.

"We've been working here (Atlantic Canada) longer than anyone else," he added. "We understand the geology, the players and their level of interest in the oil and gas basins."

During the late 1970s and early 1980s, the oil and gas industry drilled 27 wells off the Labrador coast, resulting in five significant discoveries totaling 4.2 Tcf of natural gas and 123 million barrels of natural gas liquids. Because the industry was looking for oil, the gas discoveries were deemed a technical success but a commercial failure. Accordingly, Labrador's stranded gas reserves have languished for more than 20 years.

But rising natural gas prices -- combined with a North American gas market that is becoming increasingly constrained by supply -- make Labrador's stranded gas reserves all the more attractive.

According to Einarrson, recent developments in production technologies have finally caught up to the remote areas of offshore Labrador, including:

- Liquefied natural gas.
- Compressed natural gas.
- Floating Production, Storage and Offloading (FPSO) facilities like the one being installed at the White Rose Field, offshore Newfoundland, which offer possible options for the harsh Labrador environment.

"We want to figure out how to get this gas to Boston," Einarrson said.

The Magic Bus

Steven Campbell, president of Trans Ocean Gas, hopes to deliver stranded gas to southern markets from the White Rose oil field by 2011, and from the Labrador Shelf within 10 years' time. Campbell, a native of Newfoundland, intends to supply markets that don't have existing pipelines or liquefied natural gas (LNG) facilities. St. John's-based Trans Ocean Gas has patented the concept of using ships to transport compressed natural gas (CNG) in fiber-reinforced plastic (FRP) pressure vessels. According to Campbell, FRP cylinders are already used as fuel tanks for applications ranging from fighter jets to city buses.

In 1999, Campbell, a petroleum engineer with both onshore and offshore facilities experience, began researching the numerous technologies that might be suitable to produce the stranded gas reserves of offshore Newfoundland and Labrador. Campbell's epiphany came shortly thereafter, on a street corner in Calgary: He observed a city bus drive by, equipped with a FRP pressure vessel on the roof, and advertising that it was fueled by CNG.

The rest, as they say, is history.

Earlier this year, Trans Ocean was one of nine companies invited by Husky Energy to submit proposals on how to produce White Rose's 2.7 Tcf of associated natural gas.

"We know that we're on the verge of creating a multi-billion dollar a year industry," Campbell said. At a cost of US $1 billion, Trans Ocean's proposal contemplates the construction of three container ships, each capable of carrying 1 Bcf of natural gas to market. Each ship would be equipped with 690 cassettes (large racks) that, in turn, each house 24 pressure vessels or cylinders -- a whopping 16,560 pressure cylinders per ship. Trans Ocean's ships would connect to a FPSO unit, transferring gas into the pressurized cylinders at 3,600 psi (pounds per square inch).

According to the Canada-Newfoundland Offshore Petroleum Board:

- The Grand Banks contain 5.4 Tcf of stranded gas reserves and 313 million barrels of natural gas liquids (NGLs).
- The stranded reserves of the Grand Banks and Labrador total 9.6 Tcf and 436 million barrels of NGLs.
- Oil production on the Grand Banks is approximately 350,000 barrels per day from the Hibernia and Terra Nova fields.
- By late 2005 or early 2006, the South Korean-built Sea Rose FPSO will commence production at White Rose, at an estimated peak production rate of 92,000 barrels per day.

"CNG is all about weight," Campbell said, adding that one cubic meter of natural gas -- compressed at 3,600 psi -- weighs about one-third of the equivalent volume of water. Container ships can therefore transport CNG more efficiently and cost-effectively than bunker crude tankers.

Trans Ocean asserts that its FRP pressure vessels are one-sixth of the weight of comparable high-strength steel pressure vessels, are corrosion resistant and unlikely to rupture from a side impact collision.

"Because the FRP vessels are 100 percent corrosion resistant, we can take unprocessed gas right out of the wellhead," Campbell explained. "Corrosion is the Achilles' Heel of the oil and gas industry."

CNG technology is preferable to LNG, he continued, because the liquefaction process gobbles up 25 percent of the natural gas. An additional 5 percent loss occurs when LNG is re-gasified and compressed before going into pipelines.

The Failure Was a Success

Steven Millan, chief executive officer and chairman of Newfoundland-based Canadian Imperial Venture Corporation (CIVC), sees CNG as a technical option for producing Newfoundland's onshore gas reserves (see the EXPLORER March 2004, Trenton-Black River play).

According to Millan, an AAPG member, the hydrocarbons produced to date in the Trenton-Black River play of western Newfoundland are rich in gas and liquids. In 1995, Hunt Oil and PanCanadian Energy (now EnCana) tested the Cambro-Ordovican age hydrothermal dolomite play with the Port au Port #1 well. On an extended production test, the well flowed a total of 5,012 barrels of oil and 9.2 mmcf of natural gas over a nine-day period.

During the next couple of years, CIVC will continue drilling the Trenton-Black River play on the Port au Port Peninsula, situated on Newfoundland's remote west coast. Millan can envision the day when a CNG ship from Labrador -- en route to distant markets -- stops at his ocean-bounded concession to load natural gas and associated NGLs.

Twenty years ago, during the heyday of the drilling on the Labrador Shelf, Millan was Petro-Canada's vice president of frontier and international exploration.

"A gas well was deemed a failure," he said. "Generally speaking, there was disappointment. But, geologically speaking, it was a technical success."

During the early 1980s, he said that all sorts of "far out" ideas were discussed for gas production and transportation in an area prone to iceberg traffic and scours. Some of the more creative ideas included constructing caves below the seabed and depth of ice scour

for offshore production, and using dirigibles and submarines to transport the gas to southern markets.
Today, Millan points to the acute energy needs of northern communities in Labrador, the Canadian Arctic and nearby Greenland, and he questions the current wisdom of where to market Labrador's gas.

"Perhaps the market for some of this gas is north and not south," he said. "Perhaps we need to turn things upside down."

A Lot of Data

According to Einarrson, several large oil and gas companies participated in GSI's Labrador speculative seismic programs in 2003 and 2004. With almost 300,000 kilometers of 2-D and 3-D seismic data in its library, GSI bills itself as the largest owner of "non-exclusive" seismic data in Canada's offshore frontiers (the Beaufort Sea, the Arctic Islands, Hudson Bay, Baffin Bay, Labrador, Newfoundland and Nova Scotia).

Founded in 1930 in the United States, the original GSI was widely credited with the development of digital acquisition systems and 3-D seismic data acquisition and processing methods, leading to the formation of Texas Instruments in 1950. GSI was subsequently purchased by Halliburton Energy Services. In 1992, Davey Einarrson, a longtime executive of the original GSI, purchased the proprietary rights to GSI's speculative data in the Canadian offshore, launching the new GSI in Calgary.

Between 1971 and 1983, GSI acquired 32,000 linear kilometers of data off the Labrador coast, or about 25 percent of all data acquired by industry. Before embarking on its 2003 and 2004 acquisition programs, GSI reprocessed 20,000 kilometers of its in-house 2-D seismic data, using modern processing techniques.

The improvements in imaging deep geological formations were amazing, said Michael Enachescu, an associate professor of geosciences at the Memorial University of Newfoundland. Enachescu, also an AAPG member, is the Senior Husky Research Fellow at Memorial University.

Enachescu knows his way around the Grand Banks and the Labrador Shelf -- before joining the Memorial University last year he spent 20 years as an exploration geophysicist with Sun Oil (now Suncor Energy) and Husky Energy.

Enachescu praises GSI.

"They are discovery driven, and they have the fire of exploration in their bellies," he said.

Enachescu is confident that the oil and gas industry has only touched the "tip of the iceberg" on the Labrador Shelf. He points to the industry's historical track record of a 20 percent success rate, and he's optimistic that the new 2-D seismic data will position the industry for additional discoveries. In fact, Memorial University was the recent recipient

of a multi-million-dollar donation by GSI -- the company donated all of its historical data, as well as its recent data acquisitions, for offshore Newfoundland and the Labrador Shelf.

"I have access to more data than most of the oil companies," Enachescu boasted.

What about the fact that there have been no exploration licenses nominated yet on the Labrador Shelf?

"I'm impatient," he said. "I trust the geology -- if you step out from the significant discoveries, you'll easily double the reserves."

Finding a New Play

Mark Groves Gidney concurs. He is a director of Exploration Geosciences, a UK-based, independent consultancy firm that earlier this year completed a Labrador Shelf Atlas -- that followed on the heels of a series of circum-Arctic G&G studies.

EG's studies all include the integration of well, seismic, gravity and aeromagnetic data; basin modeling; burial modeling; reservoir and source rock distribution; and the generation of play fairways.

"The idea was to come up with new plays, as opposed to the one that had already been drilled," explained Groves Gidney, an AAPG member.

The study identified many stratigraphic leads that remain undrilled today, he said, including Tertiary and Cretaceous age delta and shoreface sands.

"On a continental shelf on a passive margin, you don't find the large structures that you would find in a rift basin," explained Groves Gidney. However, he described "the kitchen areas as huge -- the Labrador Shelf has as good potential as the Scotian Shelf."

The 200 wells drilled to date on the Scotian Shelf have resulted in approximately 25 significant discoveries, or a 12.5 percent success rate.

The Labrador Shelf includes the Saglek and Hopedale basins, which are separated by an east-west trending basement high. To date, the significant discoveries are situated in the Hopedale Basin, which contains a thin Mesozoic age sedimentary section.

There are two main trapping mechanisms:

- Drape of Cretaceous and Lower Tertiary age sands over popped up basement fault blocks.
- Stratigraphic pinchouts of sands against the flanks of the fault blocks.

In the Hopedale's southernmost part, two wells tested gas from an interpreted erosional remnant of the Cambro-Ordovician carbonate platform (Trenton-Black River equivalent) -- the Hopedale E-33 well flowed at 19.5 mmcf/d and the Gudrid H-55 well at 8.1 mmcf/d.