Challenging conditions overcome

Ice No Longer Ices Seismic Acquisition Crews

By LOUISE S. DURHAM, EXPLORER Correspondent

The Arctic holds an estimated 25 percent of the world's undiscovered hydrocarbon resources, making the cold, largely barren region a hot target for the E&P industry.

It's not an easy target, for a number of reasons.

The most obvious one is the frigid climate.

Snow and ice accumulations pose problems for people and equipment alike, particularly the seismic data gatherers who need to work offshore in ice-capped waters.

But frigid conditions don't tell the whole story.

ION Geophysical first began acquiring modern seismic data near the ice in 2006, using traditional open water methodology working in the Canadian Beaufort Sea and the U.S. Chukchi Sea. Additional programs followed in 2007 and 2009, during the usual open water season of August and September, in general.

"With traditional acquisition we were at the mercy of the ice and the limited operating window and geography it imposed. We knew we'd have to actually work in the ice to more effectively evaluate the prospectivity of the area," said Shawn Rice, vice president of operations for GeoVentures at Ion.

"We conducted our first commercial under-ice acquisition in the summer of 2009 off the northeast coast of Greenland," Rice noted. "It was considered a success with just over 5,200 kilometers of long-offset, high-quality 2-D seismic data acquired without incident to crew or the environment, and only 2 percent technical downtime."

Photos courtesy of ION Geophysical

The seismic vessel Geo Explorer acquiring data behind the icebreaker boat Oden.

Real Time

It took considerable planning and effort to accomplish this.

A diverse project team was assembled, comprising individuals with varying expertise, such as marine seismic operations experts, geophysicists, vessel captains and ice pilots – as well as engineers. These experts came together to customize the technology and optimize all aspects of the workflow.

"The team determined that operations would best be conducted by two vessels: an ice-class seismic vessel and an Arctic-class icebreaker," Rice said. "The icebreaker opens a fairway in the ice for the seismic vessel to safely operate."

Although traditional ice-breaking practices allow the trailing vessel to stop and wait for the icebreaker to clear a path, this can't be done when towing a seismic streamer because of potential damage to the in-water equipment. Advanced planning and constant communication and cooperation between the vessels' senior maritime crew were critical to the operational success, according to Rice.

An integrated technology and communications protocol was established that allowed the vessels to share views and images from both bridges to manage vessel actions in real time and to plan movements days and weeks in advance based on ice scenarios.

"To improve real time positioning for the start of line, the navigation system considered the set and drift of the ice and the position and speed of the icebreaker relative to the seismic vessel," Rice said. "This allowed the crew to break an offset track in the ice, enabling the seismic vessel and streamer to be in position over the pre-plotted seismic line when they reached it."

More Time to Work

Under-ice deployment negated the use of all surface-referenced equipment because the ice could damage equipment and compromise data quality. As a result, ION developed a number of custom under-ice technologies.

First and foremost, ION needed to deploy and tow streamer and source systems through the ice without damaging them.

An ice "skeg" was developed as a protective channel and submerged tow point for the streamer lead-in and source umbilicals to travel from the vessel to a position below the ice to ensure uneventful towing.

In addition, submerged floats allowed seismic sources to be towed at a specific depth under the ice.

Lastly, underwater tail buoys were developed to provide GPS positioning in open water.

Arctic seismic programs often introduce unique noises. Ice multiples and sounds generated from the icebreaker or ice collisions with the vessel(s) all have the potential to contaminate the seismic records.

The DigiSTREAMER™, the acquisition system used on the project, continuously recorded data to capture all these noises for proper removal from the desired earth response during processing.

"We can now significantly extend the traditional working seasons in the Arctic," Rice noted. "In the Beaufort Sea, for example, the traditional working season in open waters is principally August and September. With this technology, we now have the ability to almost triple operating time, from the mid-July to December time frame."

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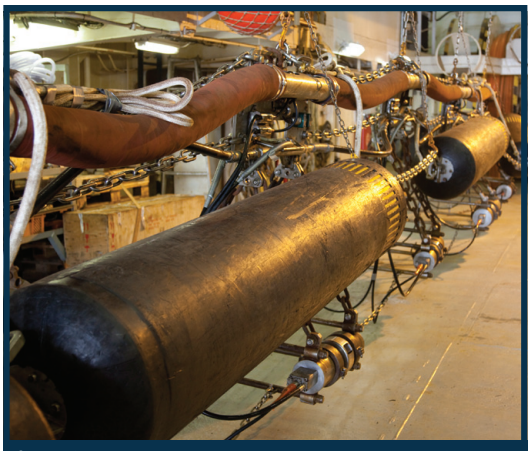
Cold climes, hot action: The MV Geo Explorer at work in the Arctic ice.



Source floats allow seismic sources to be towed at a specific depth under the Arctic ice.

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Environmental Concerns

A caveat: It's not just about the technology.

Besides the usual array of regulatory permits, the authorities must authorize work during non-traditional time frames.

At press time, ION was awaiting approval for seismic operations to kick off in mid-October and likely continue into December, depending on ice conditions.

One of the big concerns in the Beaufort Sea is environmental protection of the whales and to ensure that the whalers can maintain their lifestyle and line of work.

"We must be careful to not interfere with the whale migration and also not interfere with the whalers' traditions and rights," Rice said. "By us using this technology to operate outside of traditional open water seasons, ION can acquire data when the majority of the whales have migrated out of the area and completely avoid impact to the whales or the fishing industry.

"Whaling can start as early as August and traditionally runs through September or mid-October," he said. "When we get ready to start, the season should be complete.

"One of the unique advantages ION provides in its multi-client data is connecting vast basins to better evaluate prospectivity," he added. "We have acquired data in the Canadian Beaufort and the U.S. Chukchi Sea, and part of this current effort will be an attempt to connect those so we can get a contiguous profile."

The ability to extend the seismic acquisition season with under-ice technology and eliminate impact to whale migration and hunting is a significant mitigation measure.

Even so, permits of any kind are a challenge in this region, according to Rice. There are many regulatory hurdles, which require considerable time and effort.

The companies work not only with the regulators but also the communities. Trust and relationship building plays a big role. ION said that its representatives travel to various towns and villages and meet with community leaders and whaling captains to help all parties to better understand one another and mitigate potential issues in advance.

"A lot is asked of us, and we must comply," Rice noted. "This includes having marine mammal observers on boats, who have the authority to shut us down if they sight a marine mammal in the area.

"Because the visibility isn't very good, they even use infra-red radar to actually spot the heat source from the animals," he added.

Rice stated they have expended much effort advancing from where they are in 2-D space into being able to acquire 3-D data under the ice.

"This is another step change in the technology," he said, "and something we're very focused on."

Shawn Rice, with ION Geophysical, will present the paper "Under-Ice Seismic Acquisition in the Arctic," at 2:20 p.m. Tuesday, Dec. 4, during the Arctic Technology Conference in Houston.

High-tech ice navigation systems make Arctic exploration a bit easier – and more efficient.