UNL drillers help make new Antarctic discoveries

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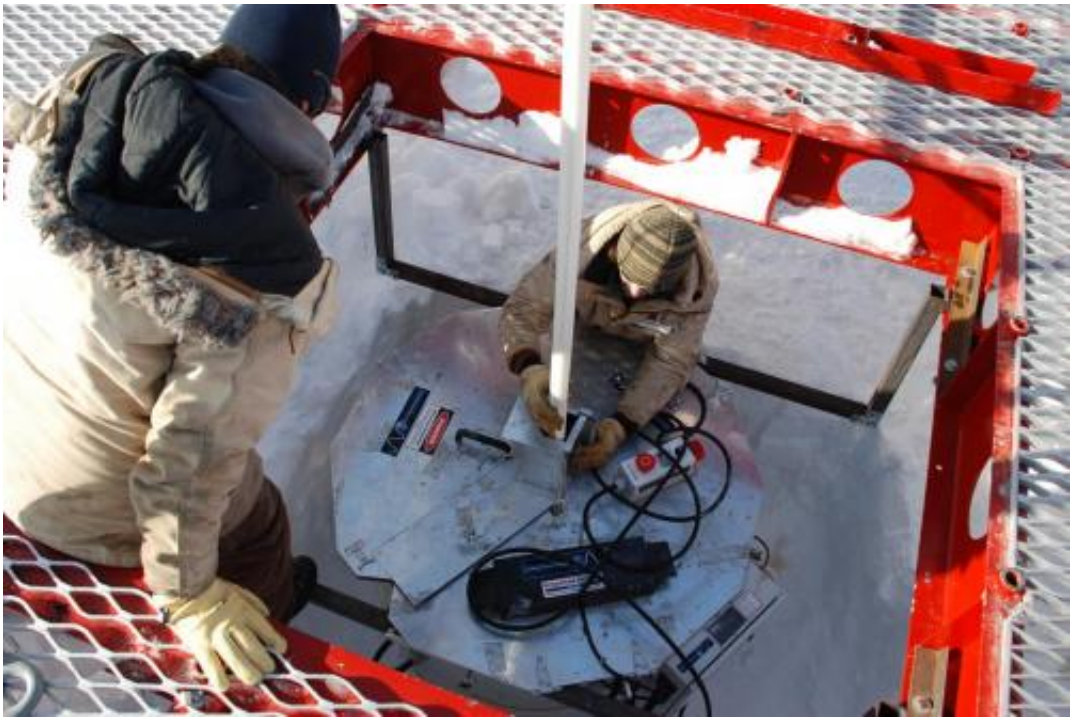

WISSARD drillers set in place an ultraviolet light collar, used for purification, at the borehole site near the Whillans Ice Stream grounding zone in Antarctica. Credit: Frank Rack, UNL Science Management Office

Using a hot-water drill and an underwater robotic vehicle designed, built and operated by a University of Nebraska-Lincoln engineering team, scientists have made new discoveries about Antarctica's geology and biology.

In addition to new observations about how Antarctica's ice sheets are affected by rising temperatures, the expedition also uncovered a unique ecosystem of fish and invertebrates living in an estuary deep beneath the Antarctic ice.

"UNL team members once again demonstrated their engineering and operational expertise by providing clean access to a challenging, unexplored sub-ice environment," said Frank Rack, executive director of the ANDRILL (Antarctic Drilling Project) Science Management Office and UNL's principal investigator for the project.

The latest discoveries come in the final year of the Whillans Ice Stream Subglacial Access Research Drilling (WISSARD) project. The project was delayed last year because of the U.S. federal government shutdown in October 2013, the start of Antarctica's summer field research season. After they leave Antarctica at the end of January, most of the drillers will be laid off until a new research project and additional funding are identified.

Earlier this month, a National Science Foundation-funded team of researchers bored through nearly 740 meters of ice at a point where the Whillans Ice Stream oozes off the coastline of West Antarctica to feed into the Ross Ice Shelf, a slab of glacial ice the size of Texas that floats on the Ross Sea.

It was scientists' first look at what's known as the grounding zone, where the ice shelf meets the sea floor.

"This season we accessed another critical polar environment, which has never been directly sampled by scientists before: the grounding zone of the Antarctic ice sheet," said Slawek Tulaczyk, a glaciologist from the University of California, Santa Cruz, and a chief scientist on the project.

Working around the clock, more than 40 scientists, technicians and camp staff from the WISSARD project gathered as many samples and as much data as they could while the borehole remained open.

On Jan. 16, eight days after piercing the ice, the UNL team deployed "Deep SCINI," a remotely operated vehicle or ROV, to explore the marine cavity around the borehole.

The camera-equipped vehicle detected a variety of fish and invertebrates in an ecosystem that may provide new insights into how creatures survive and thrive in a brutally cold and dark environment.

It was the first deployment of Deep SCINI, a prototype ROV developed at UNL for combined ice and water depths of greater than 1,000 meters. It was built by Bob Zook, an ROV engineer recruited by UNL, and Justin Burnett, a UNL graduate student in mechanical engineering. UNL received grant funding from the NSF and NASA to develop Deep SCINI and other technology used in the expedition.

Other members of UNL's team are: Dennis Duling, lead driller; Daren Blythe, Dar Gibson, Jeff Lemery, Graham Roberts and James Roth.

"This is the first time that Deep-SCINI ROV has been used in the field and it passed this test with flying colors," Rack said, "collecting video of fish living under the ice shelf in this extremely hostile environment far from the front of the ice shelf."

In previous expeditions, the UNL team drilled through the Ross Ice Shelf in 2010, discovering a previously unknown species of sea anemone that lives in the ice; and as part of the WISSARD project in 2012-13, used the hot water drill system to cleanly access a subglacial lake located about 60 miles inland from the grounding zone.

Rack and eight drillers were flown to the grounding zone site by ski-equipped LC-130 aircraft on Dec. 28. They needed time to get the drill ready for operation after it had been stored for two Antarctic winters on snow berms near Subglacial Lake Whillans, site of the 2012-13 project. A traverse team of tractors and drivers had moved the drill containers to the grounding zone and began setting up camp before the UNL team's arrival. Among other things, the UNL drillers needed to reinstall and test sensors and network components that had been stored at McMurdo Station so they would not freeze.

Rack said the drill system works like an industrial-scale water-treatment plant on skis, which pumps filtered hot water at moderately high pressures of 500 to 800 pounds per square inch through a hose that is equipped with a weighted drill head and nozzle. It took about three days to drill through the ice, with the hose advancing slowly downward as the nozzle and drill head melted the ice.

Preliminary findings offer interesting clues about how climate change might affect Antarctic ice, according to a recent report on the expedition published by *Scientific American*. Ross Powell, a glaciologist from Northern Illinois University and WISSARD chief scientist, pointed to a layer of pebbles strewn on the bottom of the seawater cavity. They appear to have dropped from the ice as it melted and indicate a fairly recent change in the environment. They might help measure how fast the ice is melting and the stability of the ice shelf. A weakening or collapse of the Ross Ice Shelf would allow glaciers to flow more rapidly into the ocean, raising global sea level.

More information: Three papers describing the WISSARD hot water drill system were published in the journal *Annals of Glaciology* in December (www.igsoc.org/annals/55/68/published.html). More information about the WISSARD project can be found at www.wissard.org.