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The Antarctic Sun



Photo Credit: WAIS Divide Ice Core Project

Image from the borehole camera at the WAIS Divide field camp in West Antarctica. The first deviation for replicate coring can be seen in the top center of the image. Scientists are collecting ice parallel to the main hole to study abrupt climate change events.

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WAIS Divide team drills historic replicate ice core in West Antarctica

BY PETER REJCEK, *ANTARCTIC SUN* EDITOR
Posted January 4, 2013

A team of scientists and drilling engineers performed the Antarctic equivalent of pulling a rabbit out of the hat deep under the ice sheet in December.

They retrieved a one-meter-long ice core from about 3,000 meters down a borehole drilled through the West Antarctic Ice Sheet (WAIS). That in itself isn't unusual. Thousands of meters of ice have been extracted from Antarctica over the last half-century, and are one of the most reliable sources for reconstructing past climate.

The difference this time around involved reentering the 3,405-meter-deep hole the team completed last season, and collecting additional core along a path that is parallel to the existing borehole. The success of the new [Replicate Coring System](#) was a reason for celebration on Dec. 17.

"This allows us to collect additional core from depths of high scientific interest at any depth in the borehole, while still maintaining the ability for logging tools to make measurements in the entire borehole," said [Kendrick Taylor](#), chief scientist of the [WAIS Divide Ice Core project](#).

The really tricky part of the operation was to deviate from the main hole in a direction that would allow other instruments that measure properties of the ice to slide down the wall of the main borehole without entering the shorter new side path.

"To our knowledge, this has not been done before. Accomplishing this unprecedented effort so early in the field season is way beyond anyone's expectations," added Taylor, a research scientist at the [Desert Research Institute](#) in Reno, Nev.

The multiyear WAIS Divide project recovered the deepest ice core ever drilled by an American-based team. The ice core represents a window about 62,000 years back in time on the Earth's climate. [See previous article — [Deep core complete: WAIS Divide project finishes five-year effort to retrieve 3,331 meters of ice.](#)]



Photo Credit: Tom Johnson

Scientists can analyze bubbles of various gases trapped in the ice — particularly the important greenhouse gas carbon dioxide — to get a sample of the ancient atmosphere. Dust and chemicals found in the ice can also provide details about past climate.

Photo Credit: Jay Johnson

*The first ice from the
Replicate Coring System.*

The WAIS Divide paleoclimate record is particularly valuable because of the thick annual layers found throughout most of the core. Thick layers offer scientists an opportunity to learn about past climactic and atmospheric conditions in much greater detail than has been possible before. This information is used to improve and test the models that are used to predict how the increasing amount of atmospheric carbon dioxide will alter climate.

Scientists hope to extract about 250 meters of additional ice cores this season with the new system. Their targets are known time periods when abrupt climate changes occurred, such as one 38,000 years ago during the last cold glacial period when temperatures suddenly turned mild. An abrupt climate change is an event that occurs on a timescale measured in decades or less. [See previous article — [Repeat experiment: New replicate ice core system will target abrupt climate change events.](#)]

The major WAIS Divide drilling operations were completed during the 2010-11 field season, with the hole deepened by about 75 meters during the 2011-12 season. That still left about 50 meters of ice above the bedrock to avoid accidental contamination of the subglacial water system that may exist below. [See previous article — The last core: [WAIS Divide deepens borehole for research into climate change.](#)]

Also last year, components of the Replicate Coring System were first tested. Lessons learned from attempts to penetrate the ice by deviating from the borehole were addressed in the off-season by engineers at the [Ice Drilling Design and Operations \(IDDO\)](#) group at the [University of Wisconsin-Madison](#), where the drill was designed and built.

“The replicate coring success is the result of a long journey in engineering development, working toward the attainment of very aggressive and sometimes seemingly impossible goals,” said Alex Shturmakov, IDDO project manager for the Replicate Coring System. He was also the project manager for the development and construction of the [Deep Ice Sheet Coring \(DISC\) Drill](#) used for the WAIS Divide ice core.

Taylor noted that the new replicate coring technology not only has implications for the WAIS Divide project.



Photo Credit: POLENET

An aerial view of the WAIS Divide field camp. The drill arch is in the center of the photo.

"It opens the possibility of going back into holes made on previous projects and collecting ice from locations of high interest where previous measurements have consumed all the core," he said. "It [also] opens the door for using fast drilling methods to drill down through low-interest zones to zones of high interest, and then quickly collecting large volumes of core from the high-interest zones."

"There was a bit of uncertainty after we drilled the first replicate core whether we had actually recovered it in the core barrel," said Jay

Johnson, the lead drilling engineer for the WAIS Divide project.

It took about a half-hour for the drill to be brought back to the surface from 3,000 meters down, according to Johnson. The hushed silence that greeted the return of the drill head was broken by a loud cheer at the sight of the core, he said.

"It was a surreal moment for the drill team and especially for the IDDO engineers, Nicolai Mortensen, Chris Gibson, and myself, who developed the technology and hardware for the world's first robotic ice coring drill," Johnson said. "This is truly an engineering marvel and a new chapter in ice core drilling that will lead to new scientific discoveries."

Other ice-coring teams have deviated from the main hole and collected additional core parallel to the main hole, but they started the process by plugging the main hole, according to Taylor. That eliminated the ability to access the main borehole below where the deviation was made, he noted. [Read more about the [Replicate Coring System](#).]

"The ability of this system to collect additional core from zones of high scientific interest without blocking access to the lower part of the hole is a major advance," Taylor said.

For a complete list of all NSF-funded projects related to WAIS Divide, see the WAIS Divide [webpage of funded projects](#) .



