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The Antarctic Sun



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Photo Credit: Don Voigt/WAIS Divide

Scientist Don Voigt logs the last meter of WAIS Divide ice core from a depth of 3,404 meters. The research team deepened the borehole by more than 70 meters over last year, when project personnel had completed major coring operations after five years of drilling. The project represents the deepest core ever drilled by the U.S. ice-coring community.

The last core

WAIS Divide deepens borehole for research into climate change

BY PETER REJCEK, *ANTARCTIC SUN* EDITOR

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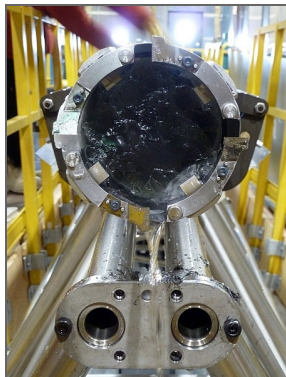
A different sort of countdown was under way on New Year's Eve at a remote field camp in West Antarctica.



In this case, the count literally went down to near the bottom of the West Antarctic Ice Sheet (WAIS), where drillers extracted about 72 more meters of ice cores in five days, reaching a final depth of 3,405 meters for the multiyear WAIS Divide Ice Core project.

Last year, project personnel had completed major coring operations after five years of drilling, stopping at about 3,331 meters, representing the deepest core ever drilled by the U.S. ice-coring community. [See previous article — [Deep core complete: WAIS Divide project finishes five-year effort to retrieve 3,331 meters of ice.](#)] Russians have the record for the deepest ice core, which they drilled in the 1990s at Vostok Station in East Antarctica, to a depth of 3,701 meters.

"The core quality has been beyond excellent; the warm ice surprisingly presented no obstacle at all, and the speed with which the drilling was completed was astounding," wrote [Jeff Severinghaus](#), chief scientist at the WAIS Divide field camp and a professor of geosciences at [Scripps Institution of Oceanography](#).



"All this suggests to me that the engineering for warm-ice drilling that went into DISC has really paid off," he added, referring to the high-tech drill that was developed by engineers with the [Ice Drilling Design and Operations \(IDDO\)](#) group at the [University of Wisconsin-Madison](#).

The ice core represents a window back in time on the Earth's climate. 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: Kristina
Dahnert/WAIS Divide*

*Final core from the WAIS
Divide borehole.*

Scientists like [Kendrick Taylor](#) are eager to start seeing results after years of planning and organizing the massive project, which began in earnest in 2000. Chief scientist for the [WAIS Divide Ice Core project](#) from the [Desert Research Institute](#) in Nevada, Taylor said it would take researchers about two years to finish their measurements on the ice, and another year to interpret and publish the data.

“I am really thankful for Julie Palais, our program manager at NSF, for pushing this project along all these years,” Taylor said. “Besides improving the ability to predict how human activity will change climate, the best part of the project is working with my science and support colleagues, many of whom have become great friends during the project.”

Researchers had expected to recover ice as old as 100,000 years, but preliminary indications from processing the ice last year at the [National Ice Core Laboratory](#) in Lakewood, Colo., suggest it is may be about 62,000 years old at the bottom of the ice sheet.

[See previous article — [Getting to the bottom: NICL team processes deepest ice from WAIS Divide project.](#)]

While some ice-core records reach back more than 800,000 years into the past, the WAIS Divide ice core will boast the most high-resolution record to date, thanks to the high snow accumulation in the region that produces thick annual layers throughout much of the core.

Taylor and his graduate student, [T.J. Fudge](#) from the [University of Washington](#), have used seasonal changes in the chemistry of the ice to determine the age of the ice at different depth. So far, they have counted 30,366 annual layers, like counting tree rings.

“Additional measurements might push the annual dating back further, but it is already the most detailed record from Antarctica of the changes that occurred during the transition from the last ice age to the current warm period,” Taylor said.



*Photo Credit: Don Voigt/WAIS
Divide*

*The drill and core handling
crew in front of the DISC
Drill.*

That sort of detail will help provide for an unprecedented reconstruction of carbon dioxide concentrations in the atmosphere over that time.

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Photo Credit: Kristina Dahnert/WAIS Divide

Ice Drilling Design and Operations driller Josh Goetz drills a hole in the roof of the WAIS Divide operations arch for the borehole logging cable. WAIS Divide scientists will send instruments into the open borehole below to collect additional information and samples.

WAIS Divide ice core may resolve CO₂, temperature debate

CO₂ is one of the primary greenhouse gases that most researchers believe is causing the planet to warm and the climate to change. They are particularly interested in determining whether natural increases and decreases in CO₂ in the past preceded or followed temperature changes. That would help scientists better understand the relationship between temperature and CO₂ today.

Other ice core climate records have shown that CO₂ lags temperature, but there is uncertainty about the timing because the age of the ice is different from the age of the trapped gases, sometimes on the scale of centuries or millennia. The WAIS Divide core should be able to constrain much of that uncertainty because the annual layering offers such a highly detailed view of the past.



Photo Credit: Kristina Dahnert/WAIS Divide

The high snowfall that makes the WAIS Divide region appealing to scientists also makes it a difficult place to work. A tractor moves snow from the drilling arch.

“The ice core has more time resolution than we expected at the bottom, which is great because it allows us to really get into the details of how changes in greenhouse gases influence climate,” Taylor said. “There is more resolution than expected because the ice is melting at the bottom, and that results in less thinning of the ice by ice flow.”

The extra ice collected this year contains ice from a time when CO₂ was increasing rapidly, according to Taylor. Each meter of ice represents about 50 years of time.

“We want to have another record that shows how natural increases in CO₂, which were slower and smaller than what is occurring today, influenced climate,” Taylor said. “This will help us understand how the current human-caused increase in CO₂ will influence our climate.”

There is still about 50 meters of ice between the bottom of the hole and the environment below. The [National Science Foundation \(NSF\)](#) , which funded the research, did not want to risk contaminating the subglacial environment, which has been isolated for millennia.

“We don’t know exactly what type of material is under the ice, but it is likely to be soft-water-saturated ocean sediments,” Taylor explained, adding that there is not a subglacial lake under the drill site. Several U.S. and

international projects are currently pursuing research elsewhere in Antarctica to access such lakes, which play a role in ice sheet flow.

The final core was collected from the ice sheet at 9:16 a.m. on Dec. 31, according to Krissy Dahnert and Jay Johnson, [DISC Drill](#) lead drillers.

“This moment has been a long time in the making, and words cannot describe the pride we feel in having completed this considerable task,” they wrote on the [WAIS Divide Ice Core project website](#) . “We could not have asked for a better reason to celebrate the New Year.”

But the job isn’t over yet.

WAIS Divide scientists now plan to send instruments into the open borehole to collect additional information and samples. For example, volcanic ash layers in the surrounding ice detected by what scientists call borehole logging will be useful for helping date the core.

In addition, testing will begin this season of the replicate-coring drill system designed and built by IDDO. The smaller drill will fit into the original borehole, which is about 13.5 centimeters wide, and core into the side, retrieving more ice for analysis from layers of particular interest.

The replicate-coring component of the project is expected to be finished by the 2012-13 field season. The field camp and all of the associated equipment, including a large arch facility that houses the drill, will then be broken down and removed.

“We are on schedule for starting the logging of the extended borehole tomorrow morning,” Severinghaus wrote on the WAIS Divide website on Jan. 1. “Replicate coring looks likely to start on schedule, too.”

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



Photo Credit: Kristina Dahnert/WAIS Divide

IDDO driller Elizabeth Morton assists with borehole logging operations.

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