



United States
Antarctic Program

The Antarctic Sun



"News about the USAP, the Ice, and the People"

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Photo Credit: Maria Banks/WAIS Divide

The WAIS Divide Ice Core field camp in West Antarctica under a cloudy sky during the 2009-10 field season. While the site is ideal for recovering an ice core with a high-resolution record of past climate, horrendous weather makes it a difficult place to work.

Core truths

WAIS Divide ice records past environmental changes with implications for the future

BY PETER REJCEK, *ANTARCTIC SUN* EDITOR
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Twenty years ago, [Kendrick Taylor](#) and his colleagues first conceived of drilling for a deep ice core in the middle of the West Antarctic Ice Sheet (WAIS) while working to extract one in Greenland.



Ten years ago, he wrote the science plan for the [WAIS Divide Ice Core](#) project.

“And now we’re halfway through the ice sheet 10 years later after finding the perfect spot to take an ice core, building a highly advanced drill, and constructing a camp to support the work,” said Taylor, ruefully shaking his head, during an interview at the [National Ice Core Laboratory \(NICL\)](#) in the Denver Federal Center where processing sections of the ice core is under way. [See related story: [On the line.](#)]

“I’ll feel really good when we get to the bottom and can fully focus on to the next phase — cranking through the data,” added Taylor, a research scientist at the [Desert Research Institute](#) in Nevada and the chief scientist for the WAIS Divide project, which is funded by the [National Science Foundation](#).

Ice cores contain a wealth of information about regional and global climate, from the bubbles of gas trapped in the ice to microscopic particles of dust and perhaps even bits of biological material. From ice cores, scientists have been able to draw a correlation between carbon dioxide and other greenhouse gas concentrations in the atmosphere with the rise and fall of temperature.

The WAIS Divide ice core is particularly special because of the high-resolution climatic and atmospheric record Taylor and others believe exists in the first 40,000 years of history contained in the ice. The final 3,330-meter-long core is expected to yield a climate record covering about 100,000 years — the entirety of the last glacial period when atmospheric carbon dioxide levels were much lower than they are today. [See previous article: [Deep into WAIS Divide.](#)]

“The project is not studying Antarctica; it just happens WAIS Divide is the best place on the planet to get a record of how greenhouse gases have influenced climate over the last 100,000 years,” Taylor said. “It is like

going to a library, but this library is cold, and makes it difficult to read the books that contain the old climate records.”

The upcoming 2010-11 field season in Antarctica is scheduled to be the last for the deep-coring phase of the project. Last year, the team reached a depth of 2,564 meters using the [Deep Ice Sheet Coring \(DISC\) drill](#) designed and built at the [University of Wisconsin-Madison](#) . Drilling with the DISC drill began during the 2006-07 season. [See related story: [Core of drilling.](#)]

Taylor said to reach this year’s goal, about 100 meters above where the ice meets bedrock, everything must fall into place. “The schedule is really tight. We will stop before we reach the bottom of ice, because we don’t want to contaminate the thin water layer that is under the ice and which has never been exposed to the rest of the planet,” he said.



Photo Credit: Peter Neff

An ice core pokes out of the end of a drill barrel.



Photo Credit: WAIS Divide

Tractors buried in snow after sitting at the WAIS Divide field camp over the winter.

The main menace is weather. What makes the WAIS Divide site so appealing — lots of snow every year, which produces thick annual layers of climate history — also makes it a notoriously difficult place to reach.

“It’s exciting and frustrating to work on the project,” said Mark Twickler, manager of the WAIS Divide Science Coordination Office (SCO), based at the [University of New Hampshire](#) , which manages the day-to-day operations of the project. “The weather controls what happens and you can’t control the weather.”

The scientists and engineers in the project have been able to control to a large extent the quality of the core that’s emerged from the borehole once they reach the field camp. That was especially significant two years ago when the drill team hit a zone of about 700 meters of so-called brittle ice. The air bubbles in brittle ice are so compressed that pressure is intense enough to shatter the core once it reaches the surface.

Using a technique first developed by the [British Antarctic Survey](#) , the ice curatorial team at NICL, which oversees the handling of the core, employed the green plastic netting used to protect wine bottles. The

webbing helped maintain the integrity of the brittle ice as it was pushed out of the drill tube at the surface. It served as a sort of cast to keep the ice intact.

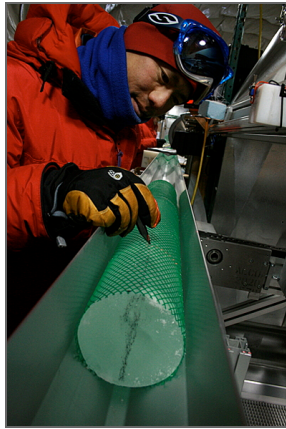


Photo Credit: Anais Orsi/Scripps

Science technician Gifford Wong marks the azimuth of an ice core section encased in the green webbing that helped secure the brittle ice during the 2008-09 field season.

“That trick worked really well. We didn’t have any problems with the brittle ice,” Taylor said. “It was pretty easy to work with, and we’re going to be able to get good records out of it because it was in such good shape.”

Added [Logan Mitchell](#) , a PhD student at [Oregon State University](#) with principal investigator [Ed Brook](#) , whose work involves studying the gases trapped in the core’s tiny bubbles: “This core is going to make a huge contribution to brittle ice core records.”

That’s a stark change to how the brittle ice emerged from a related but different ice-coring project in Antarctica at Siple Dome more than 10 years ago when the cores shattered and cracked. “A lot of It came out looking like ice cubes,” Taylor recalled.

Taylor credits not only the green netting but also improvements in drilling technology and technique with the success on the WAIS Divide brittle ice. For instance, the drill is able to cleanly fracture the core into convenient 1-meter-long lengths while under high pressure deep in the

hole. The old method used a saw on the surface that would shatter the brittle ice.

In addition, the room temperature where the core comes to the surface is kept at a chilling minus 25 degrees Celsius.

“It was so cold that people would go outside, to the middle of Antarctica, to warm up. That minimized the thermal shock to the ice, but maximized the thermal shock on the field staff,” Taylor said.

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Photo Credit: Tommy Cox

John Fegyveresi, Tommy Cox, Ryan Banta and Heidi Roop, from left, pack ice cores for transport back to the United States during the 2009-10 WAIS Divide field season.

Next up: Ice core at the South Pole?

The end of drilling this year isn't the end of the fieldwork.

WAIS Divide scientists hope to have at least two more field seasons before the camp is removed. In the first year, they will send instruments into the borehole that can, for example, detect volcanic ash layers in the ice that will be useful for helping date the core.

Next year they also plan to drop down a new type of instrument called a replicate coring drill that the engineers at UW-Madison's [Ice Drilling Design and Operations](#) group are now designing and building. The following year they hope to continue with this instrument.

That system will send a drill down the WAIS Divide borehole to areas of special interest to scientists, such as sections of ice that contain a record of how changes in greenhouse gases influenced changes in climate. The smaller drill will fit into the original 17-centimeter-wide hole and will bore into the side of the original borehole to collect additional ice.

"It is like copying the most interesting sections of a book so more people can study it. Nobody has really done that before," Taylor said.

And after that?

"We're already talking about where to take the drill next," Taylor said.

Next up could be the South Pole, where the [U.S. Antarctic Program](#) recently completed building a new [research station](#) 📷 that could allow the next ice-coring project to be completed in 18 months instead of four years, according to Taylor.

The site could also offer an ice core as old as 120,000 years, from the last warm period when temperatures were slightly warmer than they are today but atmospheric levels of carbon dioxide were lower.

Scientists in Greenland just completed the [North Greenland Eemian Ice Drilling](#) project that recovered a 2.4-kilometer-long ice core that covers a similar period. But Greenland ice cores can not be used to



Photo Credit: Andrew Williams/[Antarctic Photo Library](#)

South Pole Station

reconstruct CO2 records because there is so much dust in the Northern Hemisphere ice that it reacts with acids in the ice and compromises the CO2 records.

Taylor said the extreme cold at South Pole, where temperatures average about minus 50 degrees centigrade, are particularly good for preserving the gases trapped in the ice. By comparing the gas records from different ice cores, researchers can ensure the data truly reflect atmospheric conditions and were not influenced by how the gases are preserved in the ice.

Taylor said he expects the research community will begin submitting proposals for such a project by next year.

But that effort is still years down the road. Taylor is focused on getting to the bottom of the West Antarctic Ice Sheet before the WAIS Divide camp closes in January 2011.

"The finish line is essentially there," he said. "It feels great."

NSF-funded research in this story: Kendrick Taylor, Desert Research Institute, [Award Nos. 0944191](#), [0440817](#), [0440819](#), [0944348](#), [0739780](#) and [0230396](#). For a complete list of all funded projects related to the project, see the WAIS Divide webpage of funded projects at <http://waisdivide.unh.edu>.

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