



United States
Antarctic Program

The Antarctic Sun



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

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Photo Credit: Kendrick Taylor/WAIS Divide Web site

WAIS Divide drillers handle an ice core under the arch facility built at the camp for that purpose. This will be the second drilling season for the project, which will eventually recover a 3.5-kilometer-long ice core that will provide scientists a high-resolution climate record of the last 100,000 years.

Deep into WAIS Divide

Project continues major effort to recover high-resolution climate record of last 100,000 years

BY PETER REJCEK, *ANTARCTIC SUN* EDITOR

Posted October 31, 2008

Antarctica isn't known for its stellar weather. The vast continent boasts relentless, scouring winds that blow from the plains to the coast and wintertime temperatures below minus 70 degrees Celsius.



Although largely a polar desert, some spots receive relatively heavy snowfall. If you're a scientist who wants to study the past 100,000 years of climate in unprecedented detail, you head to one of these areas of high accumulation, where an ice core drilled through the 3½-kilometer-thick ice sheet will reveal fat layers of climatic history.

That's the impetus behind the [West Antarctic Ice Sheet Divide Ice Core \(WAIS Divide\) program](#), a multi-year project funded by the [National Science Foundation \(NSF\)](#) to improve the paleoclimate record of the last 100,000 years. The final 3,540-meter-long core will be particularly useful in reconstructing the last 40,000 years on an annual basis.

"The site was selected because it is the best place in the world to get a high-time resolution record of greenhouse gases that extends back about 40,000 years. It also is the best place in Antarctica to get a climate record to compare to the climate record from the Greenland ice cores," explained Ken Taylor, WAIS Divide chief scientist with the [Desert Research Institute](#) in Nevada.

"We wanted to get that high-time resolution so we could compare it to the Greenland ice cores," he added.

"We also wanted a high-time resolution so that we could understand the influence that changes in greenhouse gases have on changing the climate."

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,



Photo Credit: Steven Profaizer

A sign welcomes visitors to the WAIS Divide camp.

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.

Other ice cores go further back in time, such as the [European Project for Ice Coring in Antarctica \(EPICA\)](#). EPICA scientists reconstructed past climate for the last 800,000 years from ice extracted in a high-altitude area of East Antarctica called Dome C — but not in the detail proposed by the WAIS Divide core. Taylor likened the different approaches to using a wide-angle lens versus a telephoto lens in taking a picture.

The WAIS core focuses tightly on a smaller picture. “You can’t see as much of it, but what you can see you can see in greater detail,” he explained.

In addition, ice cores previously extracted in Greenland, with similar resolution and time scales, cannot be used to study atmospheric CO₂ because of the large amount of dust in Greenland ice. The dust essentially corrupts the CO₂ record through a chemical reaction that inflates the levels of carbon dioxide.

Nevertheless, the scientists can learn much about climatic influence between the hemispheres by comparing the cores.

“It’s going to tell us where major climate changes originate,” Taylor said.

In the last 100,000 years — even the past 800,000 years — levels of carbon dioxide haven’t been as high as today, when scientists have measured about 390 parts per million. That means there’s not a recent snapshot of the past that will mirror the future. Instead, the core may help to answer a chicken-and-egg question: Does CO₂ rise or fall and then climate changes or vice versa?

“We’re not able to use an ice core to point to an analogue for the year 2100 A.D. That would be nice,” agreed [Ed Brook](#), a professor of geosciences at [Oregon State University](#), who has several NSF-funded projects for studying the greenhouse gas concentrations in the WAIS core.

"Instead, what we'll see are lots of variations in atmospheric CO₂, albeit at lower levels than today, and those are linked pretty closely to the kinds of climate changes that we can also infer from the ice core record," he said. "Our major goal is to understand how the factors that control atmospheric carbon dioxide naturally are related to changes in climate."

In other words, by better understanding how the connection between greenhouse gases and climate work, researchers will be able to model or predict changes in the future as CO₂, methane and other pollutants enter the atmosphere.

"The measurements that really excite me the most are the measurements of the greenhouse gases," Taylor said.

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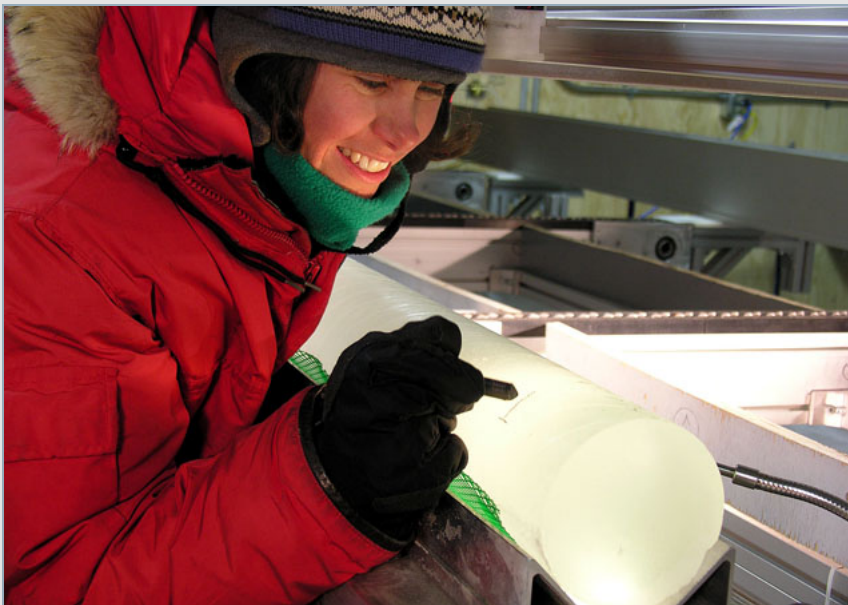


Photo Credit: Kendrick Taylor/WAIS Divide Web site

Rebecca Anderson, a scientist at the Desert Research Institute, examines an ice core.

Researchers will be able to produce an annual climate record for the last 40,000 years thanks to the high accumulation rate where they have chosen to drill the ice core.

Big operation

This will be the second of three drilling seasons for the project, which is supported by the largest field camp in Antarctica, about 1,600 kilometers from the [U.S. Antarctic Program's](#) logistical hub, [McMurdo Station](#) . About 90 support personnel passed through the camp last year, with a steady population of about 40 to 60 people, including scientists and drillers.

The camp was established during the 2005-06 field season. Its facilities include a communications tent, medical tent, galley tent, a recreational and wash tent, three Jamesways (MASH-type buildings), mechanics shop, generator module, science tent, and the drilling and core-handling arch built at the site. The camp also uses several pieces of heavy equipment such as a 953 Caterpillar, a Tucker Sno-Cat, a Pisten Bully and a Caterpillar D4 Bulldozer.

"It's a big industrial facility," Taylor said.

[Ice Core and Drill Services \(ICDS\)](#) , out of the [University of Wisconsin-Madison](#) , is responsible for the design, fabrication, testing, and operation of the deep-coring drill. After a successful test in Summit Greenland in 2006, operators fired up the drill for the first time in Antarctica last season.

"They just turned it on, and it worked — which was amazing," Taylor said, chuckling.

The season went well, he said, though the project fell short of its goal, drilling down 580 meters. Poor weather — one of the attractions of the site — and other factors conspired to shorten the amount of productive drilling time.

"Everybody did their job; just a combination of things slowed us down," Taylor said. "Whenever anything goes wrong, it comes out of the drill time."

The team faces an even tighter, time-sensitive schedule this year. Budget cuts by the NSF have shortened the drill season, and the goal is to drill through about 700 or 800 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, Taylor explained.

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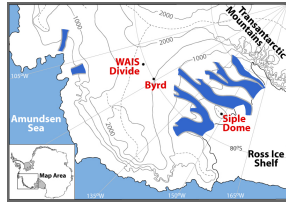


Photo Credit: WAIS Divide Web site

*Location of the WAIS Divide
field camp in West
Antarctica.*

"It starts breaking apart in front of your eyes," he said. "Our big goal is to get through the brittle ice this year because the brittle ice sits on site for one year. It's so brittle we can't even ship it back [right away]."

The drill is designed to be as gentle as possible, and will use special drill bits through the brittle zone, according to Charles Bentley, principal investigator for ICDS and a scientist who has been to Antarctica every decade since the 1950s. [See a profile on Bentley: [Practically home.](#)]

Past about 1,400 or 1,500 meters, the trapped air will have been squeezed into the ice crystals rather than into separate air bubbles, so the ice won't be as brittle, he explained during a previous interview before visiting the WAIS Divide camp in January.

"It no longer shatters that easily," he said.

Taylor said he is optimistic the drillers can get through the brittle zone in the few short weeks of scheduled drilling, an around-the-clock operation. "We should get a quicker start because the facility is in better shape, the drill is already up," he said. "If we don't get through the brittle ice, it really messes up the measurements back home in terms of the laboratories being fully occupied."

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Photo Credit: David Ferris/WAIS Divide Web site

Snowdrifts bury at building at the WAIS Divide field camp. The high accumulation rate makes the site ideal for taking an ice core because of the relatively thick annual layers. Scientists need for the layers to be at least 1 centimeter thick to see year-to-year changes in climate.

Many goals

In fact, most of the ice core research takes place off the ice, back in the researchers' home laboratories. It's simply too expensive to do the science directly in the field.

One of the few measurements made on site involves measuring the electrical conductivity of the ice, a characteristic controlled by its chemistry, which can tell the scientists the season in which the snow fell because different seasons have different chemical properties.

"We use that to identify the annual layers in the ice," Taylor explained. "We do that in the field because that's when the core quality is the best. It's pretty easy to make that measurement as well."

There are about 40 NSF-funded projects associated with the WAIS Divide program. Many involve analyzing greenhouse gases like carbon dioxide and methane. Together the projects will help answer not only questions surrounding what scientists refer to as climate forcing from greenhouse gases, but the role of Antarctica in abrupt climate change, as well as the stability of the marine-based ice sheet in the past.

For example, from an ice core drilled in Greenland in the early 1990s, called [GISP2](#), scientists determined there had been a series of abrupt climate changes, radical swings in the space of only a few decades. "We know we're not going to see anything that abrupt down there in Antarctica, but we're interested in getting a really good record so we can absolutely confirm that nothing that abrupt happened," Taylor said.

One of the key goals of the project — almost unique in glaciology — will be the study of biological signals in the ice. Scientists have found living organisms hundreds and thousands of meters down in the ice sheet

"We've published a series of papers now showing that the ice sheet is alive potentially. There's a lot of bacteria in it," explained [John Prisco](#), a professor at [Montana State University](#) in Bozeman and a veteran polar researcher who studies the microbial processes in the ice-covered lakes of the [McMurdo Dry Valleys](#)

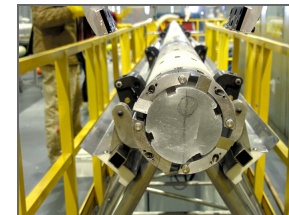


Photo Credit: Kendrick Taylor

*A closeup of an ice core
inside a drill barrel.*

The WAIS Divide program is the first glaciological project to include biology in its science plan, according to Priscu. "We're in our infancy for sure. We're the first biologists to be doing glaciology.

"We're still in a bit of the discovery phase from the biological perspective," he added. "We're not sure what we can learn yet. We know there's biology there, but we haven't linked it in any cohesive fashion with the paleoclimate or geochemical data."

The first meters of core were just reaching laboratories across the United States and around the globe this past summer in the northern hemisphere. Taylor said it would take several years of analysis and discussion before scientists start publishing their interpretations of the data.

"It takes a ridiculously long time to do these projects," he mused. "The questions we hope to answer four years from now were ones that we were asking five or 10 years ago."

NSF funded research in this story: Ken Taylor, Desert Research Institute, Award Nos. [0440817](#), [0440819](#), [0230396](#); Ed Brook, Oregon State University, Award Nos. [0739766](#), [0538578](#), [0440615](#); John Priscu, Montana State University, Award No. [0440943](#); and Charles Bentley, University of Wisconsin-Madison, Award No. [0003289](#).

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