

Scientist anticipates breakthrough in Antarctic search for planet's oldest ice

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It's summer in Antarctica, and scientists from all around the world are flying to research stations on the frozen continent as part of a now years-long campaign to uncover the world's oldest ice.

At stake is the ability to more accurately predict planetary warming from greenhouse gas emissions.

One of the foremost experts on the hunt is Jeff Severinghaus, a paleoclimatologist at the University of California, San Diego's Scripps Institution of Oceanography. He believes that, after several years of tests, he could now be just months away from a major breakthrough using an experimental drill of his own design.

"The more we learn, the harder it's apparently going to be to find the ideal, unbroken ice-core, but we're not giving up," Severinghaus said in a recent interview with the San Diego Union-Tribune a few days before leaving for Antarctica. He added: "We're getting close to overcoming all the problems."

The international search will likely culminate in an epic expedition costing tens of millions of dollars and spanning the better part of a decade—with researchers and technicians perched on a glacier 10,000 feet above sea level in [subzero temperatures](#), drilling down more than two miles into the ice to carefully extract long cylindrical samples.

While such costly and time-consuming projects have been undertaken in the past, scientists have yet to find an [ice sheet](#) that continuously extends back more than a million years.

Researchers are now trying to pinpoint exactly where the next drilling project is most likely to unearth the most ancient ice-core samples.

To that end, Severinghaus is hoping up to conduct reconnaissance

expeditions using a RAID or rapid access ice drill, which he has spent years building and testing. He first secured a \$10.5 million National Science Foundation grant to kick-start the project about a decade ago.

The 100,000-pound tool doesn't extract ice-cores for research but rather creates a narrow, deep hole that allows researchers to evaluate the age of ice buried far within a glacier.

Estimating the age of ice at the lowest depths of a glacier has proved extremely challenging for researchers. Previous ice-core drilling has relied on radar, ice-flow models and other geophysical observations to estimate the location of scientifically useful ice sheets.

"It's a whole new way of doing exploration of the interior ice sheet," Severinghaus said. "The old way was to drill down 10 feet bring up an ice-core and chips. It was like buck and rope mining."

Other scientists around the world have developed similar technologies, but many have yet to prove workable. In March, Chinese researchers celebrated after extracting rock core from beneath an ice sheet in East Antarctica.

However, before Severinghaus can explore the interior of Antarctica with his drill, he must first prove its worth. The RAID tool has gone through three previous years of tests, with numerous setbacks along the way.

"Ice is really different than solid earth," he said. "In earth if you get into trouble, you just crank up the torque. You can't do that in ice. If you put too much energy in the ice, it melts and refreezes, and then you're stuck."

Severinghaus is now taking a 15-person team on a 2 1/2-month

expedition to a location called Minna Bluff for the drill's latest and perhaps final test. The site is just south of McMurdo Station, where a collection of research facilities house about 1,000 people off the north coast of the continent.

On the bluff, the team will attempt to drill about 2,000 feet down to bedrock. If successful, Severinghaus believes he will be able to secure additional federal funding and begin reconnaissance of the interior in coming years.

"We're on the verge," said John Goodge, a geologist at the University of Minnesota in Duluth who's preparing to join Severinghaus on the expedition. "The main goal is to prove the drill can work. Then it's like the dam breaking. There's potentially a lot of important science that we can do with it."

While the work can be grueling, accommodations are not. Both Goodge and Severinghaus said the food is excellent and they will have access to the internet.

Skiing and riding snow machines are also a recreational option, although falling into a crevasse is a danger.

Other members of the team include a technical crew to work the drill and two polar explorers in charge of safety.

Still, things could get tenser in the future if the tests prove successful and the team moves into the interior of the continent.

"Many of the targets that people are interested in are very remote," Goodge said. "The Antarctic drilling season is about three months a year from November to January. Even in the summer time the surface temp is going to be minus 40 Celsius."

Trapped in the ancient glaciers are tiny air bubbles—time capsules that document changes in atmospheric carbon dioxide over hundreds of thousands of years.

The ice is dated by measuring argon isotopes, while ocean temperatures for any given period can be extrapolated based on oxygen isotopes, Severinghaus said.

The paleoclimatologist put himself on the map in 1997 after figuring out how to calculate historical ocean temperatures using ice cores.

"Air trapped in Antarctica's ice sheet contains a historic record of the atmosphere (from) when the ice was formed," said Helen Fricker, a glaciologist at Scripps Polar Center. "The deeper the ice, the older the ice and the older the trapped air.

"By going back further in time, we can collect ice cores that will allow us to disentangle the natural variability of Earth's climate system from human-induced warming," she added.

Scientists have studied ice cores since the 1950s, with the result having provided key data for establishing the link between fossil fuels and global warming.

However, experts have so far only been able to extract ice-cores dating back to roughly 800,000 years, and those samples haven't been ideal.

The challenge is that ice often folds in on itself and mixes like dough, creating an inconsistent record. The real prize for scientists would be to find a glacier with undisturbed layers of ice that date back over more than a million years.

"We have snapshot information, each only a few tens of thousands years

long," Olaf Eisen, a glaciologist at the Alfred Wegener Institute in Germany, said in an email.

"A continuous ice core—in fact, we need several ... to be sure we see a real signal and not just noise—would ... make it possible for us to understand the evolution of the gases and temperature with time," he added.

Severinghaus of Scripps was part of a North American team that in October published a study in the journal *Nature* analyzing an Arctic ice-core that was found to be more than 2 million years old. However, the sample was limited in scope, not providing the extensive timeline that researchers are hoping to uncover.

If a scientifically useful ice core can be recovered, analyzing the sample could help explain an ice age that started more than million years ago—and increase the accuracy of global warming predictions over coming decades.

The international scientific consensus has calculated that a doubling of atmospheric carbon dioxide will result in a warming of 1.5 degrees Celsius to 4.5 degrees Celsius.

Severinghaus has set his sights on making that prediction more precise.

"It's a scientific embarrassment because that number was proposed in 1975, and we still haven't managed to narrow that uncertainty," he said.

"If we could make better predictions about just how much things are going to warm that would probably help to push society," he added. "Right now, society is not doing much to curb its carbon dioxide problem."

To do so, Severinghaus hopes to better understand the shift between warm and cold cycles. Previously, the planet experienced ice ages on 41,000-year cycles, but about a million years ago that started to slow down to every 100,000 years.

Given that Earth is 4.5 billion years old, that change is a relatively recent phenomenon, one that Severinghaus calls an "unsolved mystery."

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