January 7, 2007

The Antarctic Sun

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Ben Smith lowers a video camera into a borehole on the West Antarctic Ice Sheet.
Steven Profaizer / *The Antarctic Sun*

Enhancing the snapshot

Two young scientists look to augment ice core project

By Steven Profaizer
Sun staff

For most of the year, the weather at WAIS Divide field camp blows … and blows and blows. Wind and snow are a regular part of life and science on the often-overcast West Antarctic Ice Sheet.

But very suddenly in mid-December, the wind stopped and the clouds cleared, the sun came out and the temperatures climbed to negative 10 degrees Celsius.

See ENHANCING on page 7

More stories about LIFE and SCIENCE at WAIS

Antarctic nuclear monitoring stations contribute to worldwide CTBT network

By Steve Martaindale
Sun staff

In the 60-plus years since the dawn of the Atomic Age, the specter of unreliable information has cast a thicker pall over the naturally gloomy subject of nuclear proliferation. Nations have not felt they could take the word of others to not build and test weapons. Nor did they feel that monitoring techniques could produce credible evidence of such tests.

Now, 10 years after the initial signing of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), monitoring stations aimed at producing reliable verification data are installed or are being installed by 89 countries at 321 sites. Several monitoring stations are in Antarctica, including a recently certified radionuclide sampler at Palmer Station.

"As you might guess, nobody is suspicious of Antarctica producing a nuclear weapon," said Erik Swanberg, whose business it is to build some of the monitoring stations. "But [member states of the treaty organization] want to make sure that nobody thinks, 'Maybe if we set it off in Antarctica, then nobody will know who did it.'"

Swanberg, principal investigator for the maintenance and operation of the Radionuclide Aerosol Sampler/Analyzer

See FOUR on page 15

INSIDE

Quote of the Week

"Sometimes you never actually see them again. They just end up as a squiggly line graph."

- Scientist discussing the future of his ice cores

Unexpected company

Peter Rejcek / *The Antarctic Sun*

A group of Adélie penguins lounge near a melt pool off of Hut Point near McMurdo Station on Jan 4. Wildlife sightings, particularly of penguins, have been more frequent this season than last year. A crewmember of the U.S. Coast Guard vessel Polar Sea *reported numerous killer whales near the sea ice edge and in the open-water channel where two icebreakers are currently operating.*

The Facts: Adélie penguins got their name in 1830 from French explorer Dumont d'Urville, who named them for his wife, Adélie. There are about 161 colonies in Antarctica with 10 million adults, half of which comprise breeding pairs, according to Adélie penguin research David Ainley's Web site. They typically lay two eggs, which take 34 to 35 days to hatch.

The penguins mainly subsist on a diet of small fish, krill and squid. During the summer, they will eat as much as 2 pounds a day and about a third of that in the winter.

Cold, hard facts

WAIS Divide Camp

The number of camp staff you will meet: **9**

The number of LC-130 flights planned for this season: **24**

The surface elevation of the site: **1,759 meters**

Actual ice thickness (keeping in mind that the base is below sea level): **3,485 meters**

One big reason why the site was chosen for ice coring: Scientists expect that annual layers with **one centimeter thickness** will be detectable for up to **40,000 years**.

Current ice accumulation rate: **24 centimeters per year**

Number of boreholes already at the site: **7**, including the **pilot hole** for the main core.

Source: waisdivide.unh.edu

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Senior Editor: Peter Rejcek
Editors: Steven Profaizer, Steve Martaindale
Copy Editors: Ben Bachelder, Rob Jones, Traci Macnamara, Melanie Miller, Bethany Profaizer, Travis Senor
Publisher: Valerie Carroll, Communications manager, RPSC
Contributions are welcome. Contact *The Sun* at AntSun@usap.gov. In McMurdo, visit our office in Building 155 or dial 2407.
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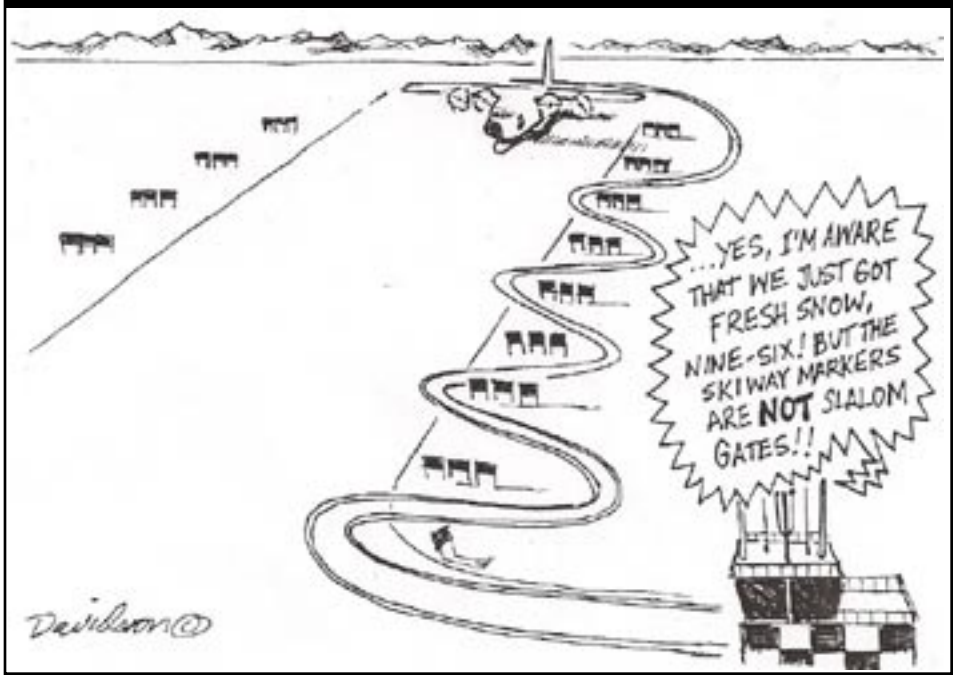
Level 1 Comix **Matt Davidson**



Ice core lab prepares for flood of new specimens

By Steven Profaizer
Sun Staff

The world's largest collection of ice cores is about to hit a growth spurt.

And while ice core drilling is not scheduled to begin at the West Antarctic Ice Sheet (WAIS) Divide field camp until next season, employees at the National Ice Core Laboratory (NICL) are preparing for the 20-percent increase in collection size they know is on the way.

"We expect 3,200 meter-long cores from WAIS. … And we have made sure we will have adequate shelf space here for the new cores," said Todd Hinkley, technical director for NICL and its collection of 15,000 ice cores. "After that, we'll have room for either one more deep core or several shallower cores, and then we'll be full."

The facility in Lakewood, Colo., is a joint venture between the National Science Foundation and the U.S. Geological Survey. The lab is housed in a small building, further dwarfed by the gargantuan warehouse in which it resides.

Hinkley said he has heard the warehouse has the largest footprint west of the Mississippi. Looking out from NICL at the endless rows of storage belonging to a USGS rock core laboratory and the Bureau of Reclamation, it's hard to rule out that possibility.

Inside the facility, four full-time employees and three student contractors clomp around the refrigerated workspace in bunny boots and other extreme cold weather gear familiar to all members of the U.S. Antarctic Program.

Typically, they busy themselves as caretakers and distributors of the cores. They host scientists from around the world who have been approved to obtain specific samples of the ice, and keep constant watch over the ice core collection that Hinkley said would cost an estimated $60 to $100 million to replace. An unattended mechanical failure would be disastrous.

But this is not a typical time at NICL, whose role has already been redefined by the work at WAIS. In addition to their normal duties, NICL employees are stepping up to help with the massive ice core drilling project in West Antarctica.

Two of the facility's employees will deploy to Antarctica multiple times through the coming years to manage the receiving, handling and logging of the cores.

Prototypes for a new logging and handling system lie around the ice core lab.

And a conspicuously empty shelf in the center of the main storage room has been prepared as the new home for the thousands of cylindrical containers that will hold the WAIS Divide cores.

"It keeps us hopping," Hinkley said. "Equipment and procedures have been completely redesigned and are greatly more sophisticated than at any drill site in the past. It has involved a great deal of vision, engineering, planning and implementation."

And the result of all the work in getting the WAIS Divide cores from West Antarctica to Colorado? A detailed look at what the world's climate has been up to for the last 100,000 years.

While this represents only a tenth of the potential historical record believed to dwell beneath the surface of Antarctica's icy covering, the WAIS Divide ice core is about quality more than quantity.

"Rather than go for the deepest ice, we picked a place where there is a high accumulation rate," Hinkley said. "So a given year of snow deposition would be relatively thick in the ice core."

Scientists read the layers of snow in an ice core like one would read the rings of a tree, and the thicker each layer is, the more information it can contain about its representative year.

But while a tree can only tell you what happened to it and its immediate surroundings, the ancient snows of Antarctica can bring global history to light.

Peter Rejcek / *The Antarctic Sun*

Jennifer Livermore examines an ice core at the National Ice Core Laboratory in Lakewood, Colo., in August. The laboratory is the world's largest repository for ice cores.

Steven Profaizer / *The Antarctic Sun*

Steve Martaindale / *The Antarctic Sun*

At right, NICL technical director Todd Hinkley shows visitor Mike Embree how the ice cores are stored at the laboratory. At left, ice core boxes destined for the Colorado lab await transport from WAIS.

"The cores can give us a lot of information about the past climate, the past composition of the Earth's atmosphere, and … the Earth's past biological systems," Hinkley said.

The records contained in ice cores have allowed scientists to identify the correlation between greenhouse gases and the Earth's temperature.

Further studies of ice cores have looked into whether current levels of greenhouse gases fall within the normal pendulum swing or if they represent a dangerous departure from the norm.

"In the almost million-year history of ice cores, the levels of greenhouse gases have never been as high as we have them artificially elevated to," Hinkley said.

This information has helped fuel the international debate on the extent of global warming and whether the increase of human-produced greenhouse gases, such as carbon dioxide, will indeed create a substantial temperature increase in the Earth's climate.

"[I] think the past is likely to guide the future," Hinkley said.

Perspectives

A week at WAIS

By Steven Profaizer
Sun staff

My voice was hoarse from trying to talk over the roar of the LC-130 aircraft's engines. I began to entertain myself by regularly checking in on the process of the water freezing in my water bottle and reading the labels on the boxes of ice cores that required the cold-deck flight.

By traditional standards, it was the worst flight of my life. But as I reflected on the previous week and looked back toward the boxes filled with ice taken from deep below the West Antarctic Ice Sheet (WAIS) Divide field camp, I couldn't have felt more fortunate to be on board.

Just a few days before, I was squeaking my way along the Styrofoam-like snow toward camp and away from the LC-130 that had just dropped me off for a week of reporting for *The Antarctic Sun*. It looked more like I had reached a void in the world than a destination. Low clouds hung as far as I could see, blending seamlessly with the horizon. The flat light seeping through the clouds bleached the snow of any contrast. I stumbled my way along, carrying bags stuffed with every piece of extreme cold weather gear I owned, unable to tell if I was about to fall into a pit or walk into a two-foot-high snow drift – I did a bit of both.

I was amazed that no matter how hard I stared at the snow as I walked, my eyes gave me no clues as to the terrain. My constant stumbling made it feel as though I was walking through the dark, but I could see my destination just fine – Tent City, a small grouping of tents on the blank landscape.

The experience of setting up my tent matched my walk out to Tent City in both slowness and level of embarrassment. I crawled into my sleeping bag that night hoping my tent would blow away before I was forced to break it down next week and perform whatever magic trick was necessary to get it back into the disproportionately small sack.

I woke up the next morning to a surprise – sweat. Somehow in the middle of Antarctica, in a tent that did not seem up to the job, I was hot and thankful for the geniuses at Sierra Designs. I got dressed in far too few layers (a mistake I fixed shortly after leaving the tent and realizing that Sierra-like weather had not come to all of Antarctica) and headed out for my first day at a field camp.

Photos by Steven Profaizer / *The Antarctic Sun*

Above, a subject's sunglasses catch Steven Profaizer's reflection at the WAIS Divide field camp. Profaizer, a journalist for The Antarctic Sun, *traveled to WAIS for one week to report on activities at the field camp.*

At left, Profaizer's tent sits on the snow at WAIS's Tent City. He lived in the tent for the duration of his stay on the West Antarctic Ice Sheet.

Life at WAIS is similar to the images first-year U.S. Antarctic Program participants dream about and the experiences they imagine their time in Antarctica will contain. Sure, WAIS residents have hot showers and (near-unbearably slow) Internet, but they also drink melted snow and are some of the only representatives of the human race on the West Antarctic Ice Sheet.

One of my favorite assignments of my stay was talking with the nine members of the camp staff for a story on life at WAIS. Each person reinforced my belief that USAP participants are the most interesting sampling of people in the world.

Where else can you find a MacGyver-like mechanic, a deep-field-experienced manager, a SCUBA-diving equipment operator, a spin doctor-turned-medic, a talented chef, a long-distance-hiking meteorological technician, a Mohawked fuels technician, a 57-year-old female equipment operator and an Italian-born sous chef all happily working and living together?

I came into this program not knowing what I wanted to do with my life, and I can honestly say that after two years, I am not one bit closer to figuring it out. But meeting the people at WAIS reminded me that there are options I still don't even know exist.

To a disillusioned college graduate almost two years out of school, it is encouraging to see some of the interesting options out there and know that I'm not necessarily doomed to serve a 40-year sentence as a cubicle-dwelling office slave.

As the door to the aircraft opened at the end of the cold-deck flight, I felt the relatively warm summer air of McMurdo Station rush into the plane and looked around at the plane's passengers – three scientists, a guy who helped with the construction effort at WAIS, a videographer, and a journalist for the world's southernmost publication.

Antarctica may be an amazing and interesting continent, but it's got nothing on us.

around the continent

PALMER

Yachties start to cruise in

By Kerry Kells
Palmer correspondent

Palmer Station welcomed the new year with an extra day off and a celebration on New Year's Eve.

The researchers continued ship-based sampling and visits to the local islands. The weather remained warm and sunny some days. These conditions are ideal for sampling and boating. However, the warmer weather also requires the glacier search and rescue team to re-flag the safe zone on the nearby glacier. Melting snow on the glacier causes the holes to soften and widen, making the flags fall out.

Adélie penguin chicks are getting larger every day and many nests show one or two chicks big enough to stand up on their own. The leopard seals have also begun to make an appearance around station and several have been spotted lounging on bergie bits of ice and hunting.

The cruise ship and yacht season here at Palmer has begun. Over the holiday period, Palmer first welcomed the expedition and support yacht, the *Spirit of Sydney*, with owners Cath Hew and Darrel Day.

The *Spirit* was designed for speed and strength by Ben Lexcen and built in 1986 for sailing the Southern Ocean. Refitted and remodeled in the past few years, the *Spirit* is based in South America and makes many expeditions to the southern tip of South America, the Antarctic Peninsula and the sub-Antarctic islands each year. On this visit, its 10 passengers were all Norwegian and had visited Port Lockroy before Palmer, with plans to continue on to Vernadsky Station, the Ukrainian station nearby.

The next ship to visit Palmer Station was the *Vaihere*, owned by Eric Dupois and Claude Derdos with crewmember Nicolas Lebugle also on board. They usually come to Palmer twice each summer season. Their yacht is a 24-meter-long cutter built in 1989 and registered in Belgium. Their charters take them to South Georgia Island, Brazil, Cape Horn, Tierra del Fuego and Mar de Plata, Argentina, among other locations in South America. Their passengers were French and Brazilian.

The owners of the *Vaihere* also brought their 14-month-old daughter, Mia, to Palmer Station, a treat to those on station, since we go so long without seeing children.

The New Year's holiday also brought two humpback whales within the two-mile boating limit of Palmer. They were spotted, from Jacob's Island, in front of Cormorant Island on Sunday and again on Monday.

Kerry Kells / Special to *The Antarctic Sun*

The yacht Vaihere *visited Palmer Station this week. The 24-meter-long cutter carried a special passenger – the owners' 14-month-old daughter. Children are a rarity in the Antarctic and the toddler was a welcome sight to the folks at Palmer Station.*

SOUTH POLE

New marker installed at Pole

By Katie Hess
South Pole correspondent

Happy New Year's from South Pole.

On New Year's Day, the annual geographic South Pole marker relocation ceremony took place.

The Pole is resurveyed each year to account for the movement of the ice sheet. This moves the marker about 25 to 30 feet during the course of a year, and the ceremony re-establishes the marker to the exact South Pole using the global positioning system. A small crowd congregated at the Pole to move the U.S. flag, the geo-

See CONTINENT on page 6

the week in weather

McMurdo Station
High: 45 F / 7 C
Low: 18 F / -8 C
Max. sustained wind: 40 mph / 65 kph
Min. wind chill: 10 F / -12 C

Palmer Station
High temperature: 47 F / 9 C
Low temperature: 32 F / 0 C
Max. sustained wind: 30 mph / 49 kph
Melted precipitation: 5 mm

South Pole Station
High: -1 F / -18 C
Low: -25 F / -32 C
Peak wind: 23 mph / 37 kph
Max. physio-altitude: 3,197 m

Continent From page 5

graphic South Pole sign, and place this year's USGS pole marker, which is redesigned each year. This year's marker was designed by Clayton Cornia and crafted by Allan Day. The design of this year's Pole marker commemorates the 50th full year of Antarctic science, an achievement stemming from the 1957 International Geophysical Year.

The new station's gymnasium saw its first party on New Year's Eve where many Polies rang in 2007. The party featured lots of dancing to the station-formed bands *Snow Blind* and *Frozen Chozen*. Special guest rock singer for the night was a member of a small team of British Royal Navy and Royal Marines which had just finished skiing to Pole from Hercules Inlet and was waiting for favorable winds to kite ski back to Patriot Hills.

Other Antarctic tourists arriving this week included 11 members of the Indian Navy; two men from New Zealand who had skied approximately 50 days en route to Pole from Patriot Hills; four British women on a 100-mile ski expedition called Shackleton's Unfinished Journey, led by Fiona Thornewill; and the United Kingdom's Hannah McKeand, who broke Thornewill's previous record of skiing solo to Pole from Hercules Inlet by more than two days.

Robert Schwarz / Special to *The Antarctic Sun*

2006 winterover Clayton Cornia designed this new geographic Pole maker, which celebrates the station's 50th anniversary.

VESSELS

NBP

Compiled from reports by Jim Dolan
Marine projects coordinator

The *Nathaniel B. Palmer* reached the Cape Adare research area this past week. Seas were exceptionally calm for most of the trip south from New Zealand, though some fog greeted the ship Dec. 28 as it first neared the study area.

The *NBP* arrived at the study area on New Year's Eve and conducted a reconnaissance survey of the polynya, an area of open water in sea ice, for the upcoming research. Scientists aboard the *Palmer* are studying geographic features in the Adare Basin.

LMG

Compiled from reports by Andrew Nunn
Marine projects coordinator

The *Laurence M. Gould* left Punta Arenas, Chile, on Jan. 1 for a trip to Palmer Station. Seas remained calm early in the trip despite a bit of rain.

Zina Deretsky, National Science Foundation

A long way from home

The illustration at left demonstrates the long logistical chain involved to haul cargo to South Pole.

As of Dec. 30, flights have delivered about 2.6 million pounds of cargo and 3.1 million pounds of fuel to Pole. That puts total cargo and fuel deliveries about a million pounds ahead of schedule.

The process of bringing in the re-supply and fuel vessels is already under way, with two icebreakers currently breaking a channel through the sea ice to McMurdo Station. The ice edge is about 10 miles from McMurdo Station.

Continental Drift — What is your favorite Antarctic fact?

"That no country actually owns Antarctica."

Bryan Fanning
McMurdo Station
rec materialsperson
Anchorage, Alaska
second season

"Palmer is warmer and sunnier at Christmastime than much of the U.S."

Ryan Burner
Palmer Station
research assistant
Alliance, Ohio
second season

"Antarctica, as a continent, is one of the most pristine and least-traveled places on Earth. My second favorite fact: I hear it is very cold."

Johnathan Owen
South Pole Station
fuels operator
Denver, Colo.
first season

Enhancing

From page 1

Under the summer sun, two scientists stood around a recently drilled ice borehole shedding their coats.

"I wonder if there will be a melt layer on record from this," said Jessica Drees, referring to the visible signs of melting that can be seen among the annual layers in the ice sheet.

Ben Smith brushed some melting snow from a piece of equipment and took his position over the CD-sized borehole. Drees threw a parka over her head so she could read the screen of a laptop sitting inside a red and white cooler.

"Ready for business," Drees said.

"Down we go," Smith answered as he activated a winch by flipping a switch on a panel duct taped to a battery and sent a pipe-like instrument down the borehole.

The two scientists are in Antarctica this season to collect information that will enhance the results of the WAIS Divide ice core project and conduct research that will help them to complete their respective academic programs at the University of Washington.

Major drilling operations will begin next summer on the WAIS Divide ice core project, which will take a 3,540-meter-long core from the West Antarctic Ice Sheet.

"All deep cores give one high-resolution snapshot of an area," said Drees, who is working on her doctorate. "Our project will help put the deep core at WAIS in context."

Smith and Drees are trying to learn how variable the snow accumulation is around the WAIS Divide drill site, so scientists can know how representative the core is of the region.

The deep core will give scientists the opportunity to study the climatic and atmospheric history contained in each year's snow accumulation on the ice sheet. Each year, more snow falls and further buries accumulation from previous years, compressing it and sealing away the information it contains.

Scientists look at ice cores in terms of annual layers. Without comparing the WAIS Divide core to surrounding areas, for instance, scientists would not know if they took it from the middle of an area where snow drifts cause unrepresentatively thick annual layers. This could

See ENHANCING on page 8

Photos by Steven Profaizer / *The Antarctic Sun*

Above, Jessica Drees and Ben Smith drill a borehole, which is pictured at the bottom right. In the bottom left photo, Drees takes notes on the two-person team's progress.

LIFE and SCIENCE at WAIS

Enhancing

From page 7

cause them to draw false conclusions about the region's history.

"Our goal is to look at the accumulation regime around the drill site and try to learn how variable the accumulation is there," said Smith, who is a post-doctoral researcher.

The team's primary method of going about this started with drilling 15 boreholes in the ice, which were strategically located in lines along the main wind direction, across the main wind direction and intermediately between those two lines.

The two scientists then logged the 18-meter-deep boreholes by lowering a video camera into them and recording the exposed cross section of annual snow accumulation. They will now be able to study the layers of the ice sheet and see how evenly the snow seems to be distributed across the region. The same information could be obtained by studying ice cores, but that would create the "logistical nightmare" of transporting the cores to the United States for study.

"The end result is a statistical description of how snow accumulates here," Smith said of his project that looks at the last 50 to 70 years of accumulation. "It will give us an idea of how typical the sample in the deep core is. The simplest case is that the snow has gone down like layers of flapjacks; in the more complex case, we'll see different things from hole to hole."

Leaving the lab behind

Much of science is not done with a test tube in a lab but with a crescent wrench in the field. It is not always pretty, but it is pure and pioneering, demanding constant creativity and ingenuity. This is especially true of low-budget projects like the one by Smith and Drees.

The method of using a camera to log boreholes was created by Bob Hawley, a former University of Washington graduate student. It is relatively new and not yet widely used. So, Smith had to put his resourcefulness to work long before he was in the field.

The camera he and Drees used to log the boreholes was originally designed to find leaks in sewer pipes. Smith modified it by installing hardware to make sure it always oriented straight down.

Photos by Steven Profaizer / *The Antarctic Sun*

Top, the team's camera hangs above a borehole as the scientists prepare to lower it down into the ice. The team will use the recorded images to study the ice sheet.

Left, Ben Smith rides on the back of a snowmobile as Jessica Drees drives back toward the WAIS Divide field camp.

Above, Drees talks with Smith as she prepares to cover one of the boreholes they drilled for their project.

He also built the circuit box for the winch, constructed a pulley that keeps track of the camera's depth and assembled the winch itself out of spare bike parts.

"The tools are never there exactly the way you need them," Smith said. "If they were, then someone probably would have already done what you're doing."

In the field, the duo used cardboard boxes to insulate some of their equipment and filled a cooler Smith found in storage at his university with hot water bottles to keep their electronics warm.

"You can tell it's an electronic cooler because it has ports on the side of it for wires to come out of, but I'm pretty sure it was also used to store fish at one point," said Smith, who enjoys big-picture science where innovation is the key to accomplishing goals.

"It's the process of getting new results," he said.

NSF-funded research: Ed Waddington, University of Washington.

Steven Profaizer / *The Antarctic Sun*

A drill mast sits next to the borehole that will be used for the WAIS Divide ice core project as two drillers and a scientist pull up the first sections of ice core from the hole. Major drilling operations will begin after the project's drill arrives at WAIS next summer.

The core of WAIS Divide field camp

Scientists round a significant corner in the 16-year road to a valuable ice core

By Steven Profaizer
Sun staff

The stack of non-descript white boxes rumbled across the ice on the forks of a bright yellow piece of heavy equipment.

Scientist Joe Souney stepped into a shuttle van and nervously watched as the cargo was lowered onto a flatbed truck.

As the shuttle made its way back to McMurdo Station from Williams Field Skiway, Souney kept glancing back toward the boxes he left behind. He knew they were safe but still fretted because of the value and significance of what they contained – the first payoff of 16 years of planning and research.

Souney had just returned from three weeks at the West Antarctic Ice Sheet (WAIS) Divide field camp, where he and a small team drilled two ice cores this summer. One of those cores he referred to as a "core of opportunity," which he drilled in an effort to make the most of his long journey to WAIS from his home in New Hampshire. But the other core, drilled just a few paces away from the first, represents the entire reason the WAIS camp exists and marked the beginning of the WAIS Divide ice core.

Major drilling operations for the project will begin next season when its ice core drill arrives at the site. But this season is packed with preparations for extracting the 3,540-meter-long cylindrical section of ice.

One of the major preparatory efforts was creating the 114-meter-deep pilot hole from which the deep core will be taken.

Drillers installed a polyethylene casing along the walls of the pilot hole to prevent hole closure and to contain drilling fluid when the deep drilling begins. To install this casing, the snow and ice in the way had to be removed, so Souney traveled to Antarctica and led the team to begin the deep core hole with a smaller drill. This got the ice out of the way without losing that section of the core for scientific purposes.

These first meter-long cores are pieces of the continuous deep ice core at WAIS.

See CORE on page 10

LIFE and SCIENCE at WAIS

Core

From page 9

"Today it really hit me," Souney said. "It's basically breaking ground on the deep core, and I feel very privileged to be starting the hole."

Scientists took a 300-meter ice core near the deep drill site last season, but this summer's core is as much an emotional victory as a scientific one.

"Scientifically, it's pretty much identical to the core we pulled out last year, but project-wise, it's significant," said Ken Taylor, principal investigator for the WAIS Divide ice core project who has been involved in it since its conception 16 years ago. "We're finally getting the first piece of that main core."

The roots of the project are not only old but deep, reaching all the way to the opposite end of the Earth.

Between 1989 and 1993, drillers and scientists completed an important deep ice core at Summit, Greenland. But before the last piece of the core was retrieved, a younger Taylor and some other scientists knew that core would not be the end of the project.

"The Greenland records have annual layers going back 100,000 years in time, which is really great resolution. But we always like to make a comparison," Taylor said. "The science of ice core work has changed a lot. It used to be to go out and drill a single ice core. … But now, our interpretations have become more sophisticated, and the questions we're asking are more challenging. So, we usually get multiple ice cores to address the questions and problems we're looking at."

The ice in polar regions is especially suited for comparison as the poles are significant parts of the Earth's climate system in terms of discovering where changes initiated. A northern and southern hemisphere comparison will help scientists look at the relative timing of climatic events.

"We'll be able to look and see if we see the same events in Antarctica as we do in Greenland," Souney said. "And if we do, we can look to see if they happen at the same time or if they happen first in one of the hemispheres."

Site selection of this bi-polar study was time consuming and crucial. Data such as snow accumulation rate, ice depth and air temperature were compared to ensure the cores would be parallel.

"For years, there has been site reconnaissance done to find exactly where the best place in Antarctica to get a comparison record was," Souney said. "WAIS Divide is a very good analog to the Greenland ice core site."

Scientists are hoping that the Antarctic ice core will also provide one important record where the Greenland core fell short – annual carbon dioxide levels. Science teams studying the Greenland core failed to obtain accurate historical measurements of CO_2, a key greenhouse gas that affects climate change. They learned that dust contained in the Greenland ice was reacting with acids and creating CO_2, artificially inflating the levels. The Antarctic core will not have that problem, as the continent has much less of the CO_2-creating dust than Greenland.

"The WAIS Divide core is expected to produce the best atmospheric gas record for the last 100,000 years ever obtained," Souney said.

See CORE on page 11

Photos by Steven Profaizer / *The Antarctic Sun*

Mike Jayred adjusts the ice core drill used this season to make the pilot hole for the WAIS Divide ice core project.

Scientist Joe Souney, right, receives a section of ice core as it is freed from the drill by Bella Bergeron and Mike Jayred. The ice is part of the "core of opportunity" that was drilled just outside of the arch that will house the deep drill operations next summer.

LIFE and SCIENCE at WAIS

Core

From page 10

And scientists are already clawing for a piece of the core. When sections of it start to come up next season, that ice will make the same pilgrimage this season's cores are currently taking around the world to the National Ice Core Laboratory in Lakewood, Colo., where they will await adoption by scientists. (See related story on page 3.)

Taylor has already received proposals from scientists requesting pieces of the core for their research.

"Now they're just waiting for the ice to get back," he said. "They're real anxious to start getting that deep core. I hope I'll have enough."

NSF-funded science in this story: Ken Taylor, Desert Research Institute, www.waisdivide.unh.edu.

Steven Profaizer / *The Antarctic Sun*

A set of stairs lead out of the ice core storage area beneath the snow at WAIS Divide field camp. The storage area shelters cores from the summer sun and keeps them at a constant temperature.

Steven Profaizer / *The Antarctic Sun*

An ice core drill lies on a table revealing the scoop cutters and collet (the metal ring just inside the drill). Both features are new to ice core drilling and were tested at WAIS this summer.

Innovations cut new benchmark in core quality

By Steven Profaizer
Sun staff

The "core of opportunity" at WAIS this summer afforded the drill team a chance to test some ice coring innovations without putting the deep core at risk.

Compared to the size of the drill, the two small pieces tested may seem insignificant, but they have a tremendous impact on core quality.

The first innovation involved tweaking the cutters that actually drill through the ice. The new curved and angled cutters are called scoop cutters and replace the normally straight and rectangular ones. This design is intended to be gentler on the core.

"They seem to be working really well," said Bella Bergeron, a driller with Ice Coring and Drilling Services (ICDS) who has been drilling since the early 1990s. "The cores have a beautiful surface with less nicks and fractures that can cause breaks."

The second innovation tested was a collet, a metal ring that grabs on to each section of the ice core and breaks it off from the remaining ice. The collet replaced the standard core dogs, which resemble metal teeth that sink into the ice and snap it off. Core dogs leave gashes and can cause breaks in the core from the force they use, which is less evenly distributed than with the new collets.

"These changes are pretty revolutionary," Bergeron said. "There hasn't been a lot of changes to dry drilling, and these two improvements are a couple of major ones in a short time period."

Breaks in the ice are a regular and troublesome part of drilling ice cores. It becomes even more of a problem in the deeper and more brittle ice.

"And the deeper you go, the more the annual layers are compressed," Bergeron said. "So, if there's a break, you're losing more information than further up in the ice."

The problem with testing new methods is that there is little room for experimentation when drillers are pulling up ice for science. This year's shallow core provided them the opportunity to test some newer drilling methods without endangering the cores coming out of the deep borehole.

"We're proving that we can use the same drills with slight modifications and get much improved results," Bergeron said. "It's easy to make a hole, but it's hard to produce good core quality."

While the ideas for these innovations have been around for a while, it was Jay Kyne, an ICDS field engineer, who came up with the methods to put them into practice over the last few years. Both the scoop cutters and the collet have been tested before this season, but the drilling at WAIS provided another opportunity to try out the "beta version" of these tools.

"Being able to test these ideas is a wonderful opportunity," Bergeron said. "It's great to have the chance to improve and not just be satisfied with what we have."

Photos by Steven Profaizer / *The Antarctic Sun*

Left, the midnight sun illuminates the drifted snow that has nearly buried the smaller part of the arch. The building will be used for the WAIS Divide ice core project.

Below (from top to bottom), two workers chip away snow inside the arch; a ladder sits outside the arch facility; and a sign on the approach to the arch warns of the construction activities.

WAIS arch nears completion

By Steven Profaizer
Sun staff

Just a short walk from the small collection of tent buildings and cargo lines that make up the West Antarctic Ice Sheet (WAIS) field camp sits an odd, airplane hanger-like structure.

When its construction is complete, this building will be home of the WAIS Divide ice core project and will house all the major operations associated with the drilling.

"This season will be the last major part of construction," said Billy Texter, construction coordinator senior. "We'll finish up at the beginning of next season. Then we'll hand it over to [the drilling and core handling teams]. They'll storm the building, install all their equipment and get started on coring."

The exterior of the building was constructed last summer and spent nine months alone on the ice sheet during the long, dark winter.

"The building wintered really well," Texter said. "It drifted pretty much like we expected. We had about 1.4 meters of snow accumulation. I'm expecting to see the short part of the arch completely buried next year."

Texter expects the building to resemble the South Pole Dome within two years, with snow ramps leading down to the entrances several meters below the surface.

"It's going to be interesting to see what happens over the course of the project," he said. "Both sides have to remain open throughout the project, and it's going to be a constant fight against the snow."

The larger side of the arch will house the ice core drill, and the smaller will contain the core handling operations. The two areas are connected to each other, which will allow the drilling crew to pass off each four-meter section of the 3,540-meter ice core to the handling crew that will prepare the cores for their long journey to the National Ice Core Laboratory in Lakewood, Colo.

The interior of the arches is the focus this season. Construction of the vent ductwork, floors, ice core storage ditch, electrical wiring and trench for the ice core drill are all on the schedule.

The eight-member crew arrived in October and will stay until February, when the camp will be shut down for the winter.

"We're going to be really busy until the very, very end to get all the tasks accomplished that were set for this season," Texter said.

LIFE and SCIENCE at WAIS

Camp staff gives a face to WAIS

By Steven Profaizer
Sun staff

The West Antarctic Ice Sheet (WAIS) Divide field camp is a speck of humanity on an ocean of snow and ice. But it is a colorful speck made of a diverse group living and working together at a small frontier community.

"We're all very different, but we work together really well. We all bring something different," said Devin Smith, a 26-year-old heavy equipment operator who can normally be found crawling around the small cluster of tent buildings and cargo pallets in the seat of a Caterpillar loader.

Smith is part of the nine-member camp staff that spends the summer supporting the science and operations at the camp.

The camp's main function this season is to enable the construction of an arch-shaped building that will house the deep ice core drill and core processing area, according to WAIS Camp Manager Ben Partan, who has spent his last four seasons on the Ice working in field camps.

"We make sure camp functions so that the arch can happen," Partan said.

WAIS is one of the U.S. Antarctic Program's most removed field camps. The only physical evidence that the rest of the world still exists arrives about once a week in the form of a ski-equipped LC-130 aircraft that brings supplies and personnel to and from McMurdo Station, if the notoriously bad weather of the region allows it.

The camp population hovers around 20 throughout the summer, with the arch construction crew and the camp staff making up the only long-term population.

"We kind of feel like the stewards of this place; we're here to help everyone out," said Smith. "I think we all feel like people are visiting our home when they visit. We want them to enjoy themselves and have a good time."

The WAIS field season started Oct. 26, when the nine camp staffers and one McMurdo fuels technician arrived to dig out the camp assets and get WAIS running again.

"I've never dug so much in my entire life," said Charles Kirkland, the

See STAFF on page 14

Photos by Steven Profaizer / *The Antarctic Sun*

Clockwise from top: Devin Smith, heavy equipment operator; Dave Anderson, mechanic; Judy Goldsberry, heavy equipment operator; Luci Pandolfi, sous chef; and Ben Partan, camp manager.

LIFE and SCIENCE at WAIS

Staff

From page 13

camp's jovial medic and a reformed political spin doctor. "I've liked watching it transform from just digging out the first few days to what it's become."

And what it's become is one of the most comfortable field camps in Antarctica – 24-hour power, running water, a washer and dryer, water heaters and even a bit of Internet access.

"There are a lot of improvements from last season, but that's how it's supposed to be. Every year it will get better in terms of infrastructure," said Luci Pandolfi, an Italian-born sous chef who runs a remote guest hut in the Alps for much of the off-season with her husband.

Some of the major convenience items added this year include kitchen shelving, mirrors in the washroom, a magazine rack, a DVD player and an electric water heater for the two showers.

"We've got everything we need here but landscape," said Luke Wagner, the camp fuels technician and Pandolfi's husband. "It's kind of like we're on a ship here, except that you can walk on the water."

And much like life afloat, the limited space indoors is a stark contrast to the emptiness all around.

"I haven't had the 'middle of nowhere' feeling yet, and I'm not sure I'm going to now that we have this booming metropolis," said Elizabeth Morton, camp meteorological technician who spent six seasons at McMurdo distributing gear to people heading into the field.

Despite its conveniences and an average summer population equal to almost half that of Palmer Station, WAIS is far from being another USAP station. Many aspects of field camp life remain in the tiny town.

Showers require shoveling one large trashcan full of snow into a melter.

The Internet connection is limited to about five hours a day, and the speed lends itself to doggy paddling through the Web instead of surfing it.

"I think it's better this way because everyone would have their head buried in a computer in the evenings," said Judy Goldsberry, a 57-year-old WAIS heavy equipment operator and member of the USAP traverse team that successfully completed a snow route from McMurdo to the South Pole in 2005.

All of the camp staff members who do not need to sleep inside for job-related duties live in tents. There are two tent buildings set up to serve as berthing units, but they do not have enough room for the entire camp population.

The small camping tents provide some elusive private space and can even be surprisingly warm on sunny days at WAIS.

"It's been so hot in there the last few nights," said John Wight, a chef who previously worked in the McMurdo and Long-Duration Balloon kitchens. "It wasn't always that way; it was getting down to 40 below zero when we first got here. I was cold."

Sleep was not the only thing the early season weather complicated. The camp staff worked outside for most of those long, cold days.

"Lying under equipment while it's snowing and blowing definitely sucks," said Dave Anderson, the tested and tried WAIS mechanic who has 30 years of experience. "I can think of a lot of better things to do."

Finding things to do at WAIS is never a problem for the staff that is always driving, shoveling and scurrying its way around the camp. Most staff members do the jobs they were hired for in addition to working as general assistants.

The camp medic said 95 percent of his time is spent doing camp chores unrelated to his job title.

"It's been a varied experience," Kirkland said. "Each day is almost like a new thing. … Each day is a new adventure."

Clockwise from top: Luke Wagner, fuels technician; John Wight, chef; Charles Kirkland, medic; and Elizabeth Morton, meteorological technician.

Photos by Steven Profaizer / *The Antarctic Sun*

LIFE and SCIENCE at WAIS

Four technologies combine to detect nuclear activity

Continued from page 1

(RASA) at Palmer, said such systems form one of four legs of technology that support what many people consider a "good system" of global detection.

Short history of CTBT

The CTBT was adopted by the United Nations General Assembly and opened for signatures on Sept. 24, 1996. Seventy-one nations, including the United States, signed the treaty that first day. Currently, 10 years later, 177 of 195 states have signed the agreement to not carry out any nuclear explosions.

After a state's proper representative signs the treaty, the agreement must be ratified according to that state's constitutional processes. So far, 137 have taken that final step. However, the key to putting the treaty into force lies with the 44 states known as Annex 2. They all formally participated in the 1996 session of the Conference on Disarmament and possess either nuclear power or research reactors.

For the treaty to take effect, those 44 must sign and ratify the treaty. To date, three have not signed the 10-year-old treaty (North Korea, India and Pakistan) and seven others have not ratified it (including the United States, China and Iran).

That fact, however, seems to have had little effect on the implementation of monitoring stations or the system of making their readings available to all signatory nations.

How it works

Following the adoption of the CTBT, the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) was set up in Vienna, Austria, to prepare for full implementation of the treaty.

Part of the agreement is a verification regime that stipulates that an International Monitoring System (IMS) be installed and its results be made available to any nation that has signed the treaty. The CTBTO will have no powers to enforce the treaty but will merely make the information accessible.

"The treaty organization is only responsible for saying, 'We saw something odd,' and from there the state signatories are the ones who are responsible for trying to determine if indeed it was a weapons test or perhaps it was something else," Swanberg said.

Like that, each state can see the same data and come to its own conclusion based on the data every nation has.

"Before this verification regime," he said, "different countries would look at whatever data they happened to have on an event and, since that was usually classified at some level or another, they were very unwilling to talk about it to other countries. This kind of opens it up a lot broader so that everybody can discuss and work off of the same page."

Courtesy of Christina Hammock / Special to *The Antarctic Sun*

Christina Hammock gathers data coming out of Palmer Stations's Radionuclide Aerosol Sampler/Analyzer in the TerraLab.

The RASA unit was installed at Palmer Station on the Antarctic Peninsula about a year ago and has been running since then. Swanberg said it was certified by the CTBTO on Aug. 22, 2006.

The RASA works by continuously drawing a large volume of air through a filter to collect particulates. The equipment is rather noisy, explains Palmer research associate Christina Hammock, which is why it has its own separate section in the TerraLab.

"Even on the outside of the building," she said, "it's pretty loud. ... The whole building kind of has this hum."

A gamma ray spectrometer is used to help determine which radioactive isotopes, or radionuclides, are present on the filter. A radionuclide is an atom with an unstable nucleus. It undergoes radioactive decay, emitting gamma rays and/or subatomic particles that are detected by the spectrometer.

Preliminary data are automatically transmitted to the CTBTO in Vienna every two hours and the final spectra is sent once a day. After that, any state signatory to the CTBT can request a copy of the data and analyze it.

Naturally occurring radionuclides are commonly detected, Swanberg said, and that opens up possibilities to use the data for scientific research, though Hammock said nobody was using the Palmer data for research at this time.

What happens if something suspicious is detected?

"If something is detected," Swanberg said, "then the next thing that happens is the CTBTO in Vienna will ask us to forward the actual sample – the physical filter with the particulates on it – to a radionuclide laboratory for a secondary analysis."

The handling of such requests, as well as the usual work with the machine and filters, falls to Hammock.

"They also can request that a sample be split up and sent to two different analysis labs," she said. She described one day's worth of the filters as about 30 inches by 6 inches with a thickness like that of several dryer sheets. It is covered and sealed with Mylar on each side.

The full regime

Palmer's RASA unit is one of 80 planned systems worldwide and one of four in Antarctica. The other units on the Ice are at Australia's Mawson Station, the United Kingdom's Halley Research Station and France's Dumont d'Urville.

The other three technologies that make up the IMS are seismic, hydroacoustic and infrasound.

The seismic network is used to locate events that vibrate the earth and to distinguish between an underground nuclear explosion and the numerous earthquakes that occur around the globe. It is composed of 50 primary stations, which send their data in real time to Vienna, and 120 auxiliary stations that make their data available upon request.

Palmer also hosts an auxiliary seismic station, as does Amundsen-Scott South Pole Station. There are two primary stations in Antarctica, one maintained by the United States in the McMurdo Dry Valleys.

The hydroacoustic network detects sound waves produced by natural and man-made phenomena in the oceans. Because of the effective transmission of acoustic energy in the ocean, only 11 stations make up the network. Southernmost of the stations is on France's subantarctic Crozet Islands, which lie between Antarctica and Madagascar.

The infrasound network includes 60 stations that use microbarographs (acoustic pressure sensors) to detect very low-frequency sound waves in the atmosphere. The data are used to locate and distinguish between atmospheric weapons tests and natural phenomena such as meteorites and volcanoes.

Swanberg said the four systems complement each other well. While the other three technologies are more reliable at pinpointing a time and location of an event, the RASA has its own strength.

"One of the unique aspects of the radionuclide monitoring systems that's different from the other three technologies is that all the other technologies can say you had a big boom, but you can't say for sure that it was nuclear," he said.

Profile Spin doctor turns his life around

By Steven Profaizer
Sun staff

Charles Kirkland's bedside manner extends well outside of his medical tent at the WAIS Divide field camp. His greeting to each new arrival may be the warmest thing on the entire West Antarctic Ice Sheet.

Sincere and instantly likeable, Kirkland will sit each person down long enough to get important medical information and extend an open invitation for medical advice and small talk in his tent.

Nothing about the medic's welcome betrays the ugliness of his work in a past profession he is happy to be away from – almost 15 years of mud slinging in the dirty trenches of politics.

"For years, my mentality was, 'What can I get from him or her? How can I manipulate this situation to my benefit?'" said Kirkland, who confessed to carrying a notebook to organize the partial truths he told people.

He worked with many politicians in his time including former presidents and other national leaders until he pulled a sudden U-turn and sped away from politics with as much vigor as he had pursued his career until that point.

"It was one of those paradigm shifts," Kirkland said. "I was tired of the lies I'd told and how the truth was like Play-Doh."

The life-changing event that caused his sudden about-face was the death of his younger brother, Ken, in 1996.

"When Ken died, I just said, 'That's it. I'm done with it,'" Kirkland said.

"My brother lived life to the max. Everybody knew how Ken felt," he continued in obvious admiration of the openness and honesty his brother exhibited. "I learned more from him than just about anyone else in my entire life."

It took Kirkland only 15 days to break down a life it took him 15 years to build. At his brother's funeral, he decided to fulfill a childhood dream he and his brother had shared. Born and raised in Texas, they took regular family canoe trips in northern Minnesota.

"We always swore one day we'd come back and become guides, and we never did it," said Kirkland, now 46. "At his funeral on July 5, I said, 'OK, I am going to do it.' And by July 20, I was living in Ely, Minn., and training to become a wilderness canoe guide."

He said it felt good to fulfill a dream, but fate soon gave him some more career advice when a man died of a pulmonary embolism on Kirkland's first 10-day trip. Although nothing could have been done to save the man, Kirkland still felt responsible.

Photos by Steven Profaizer / *The Antarctic Sun*

Above, Charles Kirkland teaches a class in first aid to the construction crew at the WAIS Divide field camp.

Left, Kirkland examines equipment in the medical tent at WAIS.

"I thought I'd missed something, that's how bad my ego was. I thought I could have saved him," said Kirkland, who had completed a Wilderness First Responder course as part of his training to be a guide. "That prompted me to go to EMT [emergency medical technician] school and then to paramedic school."

He worked as an ambulance EMT in Dallas for almost three years until he could no longer handle days filled with car crash victims and "frequent flyers," regular victims of domestic abuse.

"I got burnt out. I just hit a wall," Kirkland said.

In the end, Kirkland found professional happiness in a fusion of his work as a communicator, as an outdoor guide and as a paramedic by teaching and practicing wilderness emergency medicine.

"It was just such a natural route," said the spin doctor-turned-medic. "And I really felt like I got to give something back after I took for so long in politics. … I just see if I can make a difference nowadays."

Before coming to the Ice, he worked as a part-time medic and trainer for the National Park Service on Mount Rainier in Washington and as a lead instructor for Wilderness Medical Associates.

The last 10 years have been a time of growth, change and learning for Kirkland, who talks with great relief of his escape from his old lifestyle.

"As a medic, you're with a lot of people in their last moments, and it's really taught me to live my life without regrets," Kirkland said. "None of us know what's around the next corner. A lot of people didn't plan on being with me in their last moments."

The more straightforward life he lives now, without pretense or a notebook to track half-truths, has taught him a lot about people and made him really appreciate the Antarctic community.

"As people, we all put our pants on the same way. We all have our problems. Politics ingrained in me how to hide all that stuff and not be real," Kirkland said. "People down here are just themselves. For the first two weeks at WAIS, I had to wear the same clothes every day as we set up camp. I couldn't take a shower or even wash clothes. You see everybody as they really are. It's not some façade."

"I wish [my brother] was still around," Kirkland said. "I think he'd like the kind of person I am now versus the way I was 10 years ago."