field notes
The Polar Field Services Newsletter
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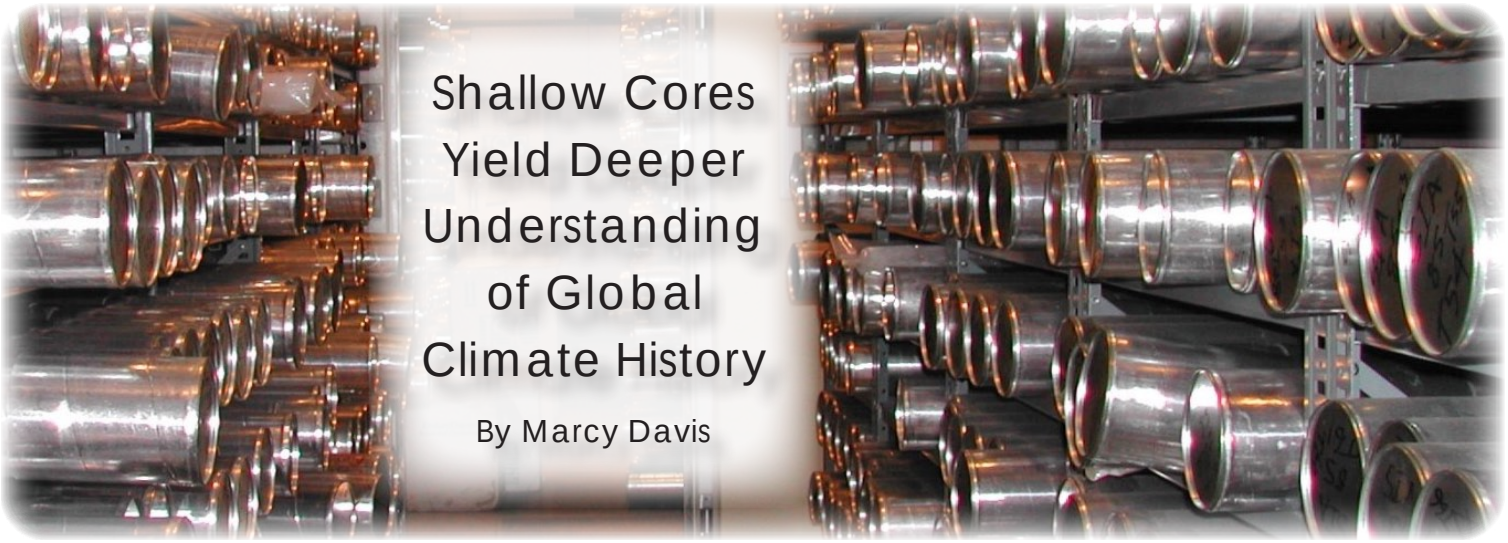

Shallow Cores Yield Deeper Understanding of Global Climate History

By Marcy Davis

In May 2007, polar veteran Ellen Mosley-Thompson led an international team on an intensive ice-core-drilling expedition in western Greenland. During a three-week trip, the team extracted cores, tested a Speedograph, and rode out a vicious storm that nearly buried the camp in snow.

"Clearly, at all times the weather has the upper hand and dictates what can be accomplished on any day," admits Mosley-Thompson, of The Ohio State University (OSU).

For this, her sixth Greenland field campaign, Mosley-Thompson's primary goal was to harvest multiple shallow cores. Data obtained from these will yield detailed information about annual accumulation rates (how much snow has fallen each year over the last 200 years) at Crawford Point in the Jakobshavn Glacier drainage basin. Because the area has experienced significant recent warming, the researchers also will examine the cores to "assess the history of melt intensity and frequency, . . . [which] has the potential to contribute to our knowledge of the longer-term warming trend in the region," explains Mosley-Thompson.

Ellen Mosley-Thompson processing an ice core. Photo: Natalie Kehrwald

They also contribute information to a larger data set. "The data that our team collects from ice cores around the world are integrated to paint a more comprehensive picture of the ongoing changes in climate on both regional and global scales," explains Mosley-Thompson.

Data obtained from ice cores are known as proxy data--non-climate data that are analyzed for clues about past climate. Proxies derived from glaciers and ice sheets include various physical properties, such as layer thickness, trace levels of numerous chemical species, stable isotopic ratios, and tiny particles of dust and volcanic ash. By analyzing paleoclimate proxy data, scientists can better understand climate variability over thousands, and in some cases hundred of thousands, of years. Mosley-Thompson and the members of OSU's Ice Core Paleoclimatology Group seek to acquire ice cores from around the world in order to better understand global climate history.

Above: Cores await analysis in the OSU cold room. Photo: Ellen Mosley-Thompson

Mosley-Thompson collaborates with other polar scientists from the University of Kansas-based Center for Remote Sensing of Ice Sheets (CReSIS, Prasad Gogineni, PI), a multi-disciplinary and multi-institutional research unit focused on developing new technologies and models for studying the Greenland and Antarctic Ice Sheets. CReSIS plans to outfit satellites, airplanes and unmanned autonomous vehicles with radar sensors able to image the GIS subsurface. Mosley-Thompson explains that data from harvested ice cores will provide ground truth information needed to help with radar sensor calibration. "The radar sensors require knowledge of the ice sheet's density structure and the physical and chemical properties of the near-surface firn layer," says Mosley-Thompson. "The cores provide the firn/ice density and stratigraphy [needed] for modeling anticipated CReSIS radar data."

Mosley-Thompson's spring 2007

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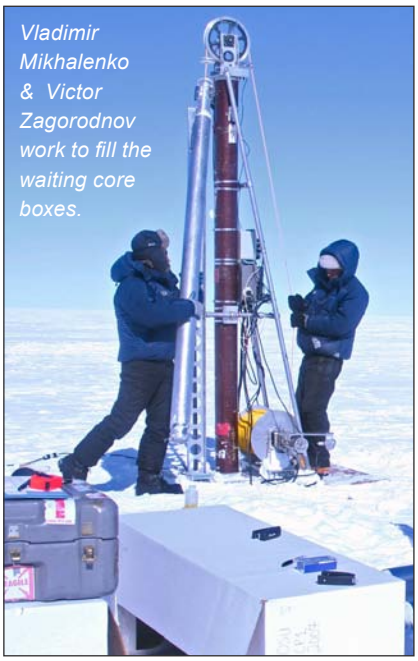
team included researchers Victor Zagorodnov (OSU) and Vladimir Mikhalenko (Moscow University, Russia). In addition, two graduate students, Natalie Kehrwald and Lijia Wei (OSU), had their first opportunity to work in Greenland.

From Kangerlussuaq the team traveled last spring via twin otter to their field site, about one km upslope from the Crawford Point Automatic Weather Station #1 (CP1) in the Jakobshavn Glacier drainage basin. Mosley-Thompson chose the site, in part, because two shallow cores previously taken from this site in 1995 and 1999 will contribute to the local data set. More importantly, since 1996, CP1 has recorded nearly continuous meteorological data, which will help the researchers interpret the core data.

Map of the Mosley-Thompson field site generated by armap.org


Vladimir Mikhalenko & Victor Zagorodnov work to fill the waiting core boxes.

The team employed a lightweight, portable OSU drill system to extract their shallow cores. Near CP1 they completed drilling a 152-meter ice core (two meters over their target depth). The scientists also extracted one 40-meter core, five 20-meter cores and one 27-meter core. They hoped to visit a new site about 50 km east and upslope from CP1, but decided to concentrate this year's efforts at CP1 following a very nasty storm that left much of their camp and equipment under heavy snow drift.

While the storm howled outside, the researchers spent a day huddled in their tents. "We were actually very lucky. There was only a day of extremely bad weather. The wind [blew] hard, and you could hardly walk. So we stayed in our tents, doing in-tent work or reading," said Wei, a graduate student originally from China. The team spent the day after digging their camp out of huge snowdrifts.

Core processing follows strict protocol. In the field, the team records the basic visible physical properties of the core, including length, diameter, and the major melt features. They measure the mass with an electronic scale. From the geometry of the core segments and their masses, a tentative density profile can be constructed to provide a rough calibration for the speedograph tool. However, to determine the annual layers with confidence they must return the cores to the OSU laboratory for analysis of physical and chemical properties that change over the course of the year. A number of the shallow cores will be used to further calibrate the speedograph that will be deployed through them in the OSU freezer.


A storm lashes tents at Crawford Point. Photo: Natalie Kehrwald

Once drilled and recorded as described above, one-meter core sections are carefully packed in a plastic sleeve, and placed in a cardboard cylinder that has a reflective paper coating. The field party wears clean gloves and packages sections quickly to avoid contamination. The tubes are placed in an excavated plywood-covered trench until the end of the season when the cores are placed in insulated boxes and flown to Kangerlussuaq for cold storage before they are flown to the National Guard base in Schenectady, New York, by C-130. Finally, the boxes are shipped back to OSU where they are stored at -30°F in the 7000-meter capacity freezer facility. The cores are placed on racks that extend from floor to ceiling where they await processing.

"We generally analyze the samples in the melted state. We measure stable isotopic ratios that provide an annual signal for dating and whose relative magnitude provides a rough indication of warmer and colder temperatures at the time the precipitation (snow) condensed in the atmosphere," explains Mosley-Thompson. "The concentrations of dust and major chemical constituents reflect the concentrations in the atmosphere and explosive volcanic events are recorded by elevated concentrations of excess sulfate."

"I believe that ice cores offer a unique window on the variability of Earth's climate and environmental systems. Without the contributions from the records preserved in ice caps, ice sheets and glaciers, our understanding of the key processes operating both today and in the past will be incomplete," says Mosley-Thompson. "My team and I are thrilled to have had the opportunity to add yet another important proxy history to this essential global collection of proxy histories. Our project results will also contribute to IPY as we are adding another important proxy history of the last few centuries to the polar ice core collection and we are providing *in situ* observations that may be useful in the future for change detection efforts." ●

Professors Martin Jeffries and Kim Morris explain heat transfer properties using a paper lantern. Photo: Marge Porter

alaska

As we write, dog-sled racing fans everywhere await news of the 2008 Iditarod winner. Two mushers, one the defending champ and the other a four-time winner, race virtually neck-and-neck to the finish in Nome.

Using snowmachines in lieu of sled dogs, scientist Kenji Yoshikawa (University of Alaska, Fairbanks, or UAF) is about to head out for his first traverse of the year. The seemingly tireless permafrost expert will travel mid-month from Emmonak to Kotzebue along Alaska's northwestern coast. Along the way, Professor Yoshikawa visits local schools to teach students about permafrost, and to establish simple permafrost observatories—or to maintain those established previously. This is the first trip of many Yoshikawa has planned this year as part of the UAF permafrost outreach project. (This Ned Rozell profile of Kenji Yoshikawa captures his energy and enthusiasm, we think).

In other outreach news, Marge Porter (Somers High School, Connecticut) stopped by our offices last month to gear up for ALISON work, the (UAF) Kim Morris-led study of the insulating properties of lake ice and snow. A veteran teacher-participant, Porter brought with her nine students who had applied for and won the coveted spots on her field team. The group worked with Morris and Martin Jeffries (UAF), the founder of the program, to learn about lake ice and snow cover and associated heat flux, and to study the experiment protocols. "This trip is very popular and recognized throughout the district, but it's definitely not for everyone," writes Marge. "It's a lot of hard work, and kids have to like (and appreciate) science."

The nine students collected data at lakes and ponds around Fairbanks and met with UAF researchers Hajo Eicken and Katey Walter. The latter lit methane pockets trapped in lake ice ("Very cool!" noted Porter). The group also enjoyed moose chili with local hosts whose home-schooled students also participated in the research activities. Read the Somers students' comments on their experiences in their online journals.

Speaking of Hajo Eicken, the sea-ice expert visited Wales, near Nome, Alaska, with student Matt Druckenmiller late in February to monitor project instruments and collect ice samples. Through his Seasonal Ice Zone Observation Network (SIZONet), Eicken monitors and coordinates information about the seasonal sea-ice zone, expected to expand as multi-year, or perennial, sea-ice continues to diminish in the warming Arctic. This is the first of several trips Eicken will make this season to Wales. He also will visit Barrow several times for this research, and to conduct a related summer field course. Given 2007's record melt-off, we hope to watch Professor Eicken's research progress closely this season.

Team ALISON. Back row (from left): Andrew Thomas, Tom Gay, Alex Bych, Mike Hanna, Quinn Aslin, Martin Jeffries, Brian Coope. Front row: Marge Porter, Lauren Astone, Amanda Smith, Ashley Anderson. Photo: Matt Irinaga

field notes

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Returning from the hunt in Kangerlussuaq. Photo: Robin Davies

greenland

Kangerlussuaq

Who knew? Summit staff change-out in February turned out to be coincident with musk ox hunting season. The new team, waiting for weather to clear on the ice cap, watched an unusual spectacle (for non-locals, that is) as hunters came and went through town with dog teams on the hunt. "The muskox apparently know what's going on," new Summit manager Ken Jessen remarked. "So they're away from Kanger--out by the ice edge somewhere."

The snow flies at Summit Station. Photo: Patrick Cullis

Summit Station

Flight delays may have set records during the Summit Station crew change. First, poor weather at the station held the relief team in Kangerlussuaq for a week before they finally arrived at Summit on February 17th; then the departing crew had to hunker down for days longer than planned while storms lashed the cap until February 25th.

The new team is an experienced lot: manager Ken Jessen worked at Summit in the late 1990s and has the resume of a Renaissance Man; science technician Kat Huybers has experienced Summit from a researcher's point of view as a member of Eric Steig's (University of Washington) team; her work partner, science technician Patrick Cullis, has flown balloons for NOAA at the South Pole, and Robin Davies—well, Robin Davies is a force of nature.

The team experienced a power outage during a fierce windstorm a few nights in to their season. "I have remarked often here, as well as in emails to friends, how interesting it is to walk between the buildings when the snow is really flying," Ken mused. "There is just so much power, so much snow in motion." The storm may have added another element to his appreciation, as heat might be viewed as life support up on the ice sheet—especially in such weather.

Still, with backup power running, "Robin changed thermostats in one of the generators, and [CPS maintenance chief] Russ Howes gave us some advice over the phone, [and soon] all was well."

Read more about life at the top in Ken's *Notes from Summit* elsewhere in this newsletter.

Thule

Early this month, CPS staff visited Thule Air Base to collect information about a potential proof-of-concept traverse from Thule to Summit Station. Jay Burnside and Susan Zager led a CPS team reviewing Thule facilities, meeting with various officials to discuss the traverse, and studying the route itself. The group drove trucks from Thule out to the ice margin, and then hiked up the transition to the ice sheet to examine the feasibility of starting a traverse to Summit from there.

Weather conditions favored the group when they flew via helicopter over the traverse route to gather more information. In addition to calm, clear skies, "the relatively low light cast long shadows over the surface of the ice, giving us a lot of information about the conditions," Jay said. The reconnaissance work proved encouraging, he reported.

in the media

Several environmental groups are suing the US Department of the Interior for delaying a decision on whether polar bears should be listed as a threatened species under the Endangered Species Act.

The polar bear photo here is used with permission of photographer Patrick Endres, who captured the image. The Fairbanks resident maintains a blog, begun in December 2007, wherein he offers glimpses of life in Fairbanks, and of life elsewhere in Alaska (the price of a gallon of milk in Barrow, a midnight ballgame played in Fairbanks on the summer solstice, for example)—plus technical information on the photography itself. Armchair Alaska enthusiasts (and photography buffs!) can visit "The Last Frontier" state by visiting Patrick's site.

National Public Radio's *Earth & Sky* program has been featuring a number of noted polar researchers in an IPY series. Listen.

The return of the sun in February is a very big deal in Longyearbyen on Norway's Svalbard archipelago.

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Notes from Summit

Left: You'd "gawk" too: The aurora borealis rises behind Summit Station. Photo: Robin Davies.

The spring equinox approaches, but up at Summit, the only thing blooming is the fern frost on the windows. Still, signs of spring and the coming research season abound: brightening skies, a lengthy list of preseason tasking, and, above all, the arrival last month of the phase three winter crew. Like the few scouts who precede the swallows to San Juan Capistrano, this team focuses on readying the place for the coming legion.

We asked manager Ken Jessen to tell us how the team is getting along. He offers a glimpse of what it's like to be part of a foursome stashed away on the Greenland ice cap at the dawn of the second half of the fourth IPY.

We've been on the ground here almost a month, and our work is well underway. The science technicians (Kat Huybers and Patrick Cullis) have completed the ICESat traverse for this month in -50F temps and have launched several instrumented balloons (for NOAA's ongoing atmospheric measurements and the MATCH campaign) with great success.

Robin Davies, our easy-going team mechanic, has everything in good working order and has started pulling a drag around with the 933 to smooth out some of the drifts. He has a lot of horse sense, both from working here three times previously, and from working and traveling all over the world. He tells us great stories, and all without fanfare: climbing in India, working in the fierce heat of Saudi Arabia, riding a bus that caught on fire in Chile. In the mid-seventies, he ran dogs in Antarctica for two years for the British Antarctic Survey (Antarctica's Davies Cliffs are named after him), and later, he and some friends coaxed a shaky wreck of a van from Turkey to Great Britain on two cylinders. You just about can't name a place he hasn't been.

As for me, being at Summit is a lot different this time. I enjoyed the summers of 1997 and 1998, but I like winter operations better. It's quieter, closer, more relaxed. When I was here before, the Big House was at ground level. We went through the roof when we put-in on April 1, 1997. It's so much nicer to be up on stilts. The GISP drill dome, a real landmark here before, is gone. It's strange to think that the surface that we worked on ten years ago is 30 feet down. As for the weather, I get a kick out of the storms that bury the doors and force us to use the roof hatch on the Green House. It takes a lot of work to get the doors clear again, though, so I might be over it by phase-change in late April.

(L-R) Robin Davies, Ken Jessen, Patrick Cullis, & Kat Huybers head to Summit on the Twin Otter. Photo: Kathy Young

One of the best parts of being here this time of year is the low-angled winter light, the day and night, the aurora. And the cold has its own charm. Robin and I were out watching the eclipse a few weeks back, and I commented that it's funny how much we can like all of this, because standing around in night at -70F on top of an ice cap in winter is surely a lot of people's concept of Hell. But not for us. It feels special, and all the more so with such a good group.

When Patrick launched the ozonesonde the other day, you could see that he knew what he was doing. He has launched a lot of balloons in Colorado and at the South Pole for NOAA and it shows. The last one went up 30.57 km in –60F weather. That target altitude is hard to achieve in such bitter cold, as the balloons get brittle and burst. He and Kat make a great team, both as scientists, and as cooks. Together they work up miracles in the kitchen that Robin and I could never match.

Kat, who was here at Summit last summer, is a hard worker who's serious about her science, and she's my tech support when it comes to computers. She has a lot of energy, and uses every minute of the day. When not at work, she cooks, sews, reads, does yoga or rides the bike. In the mornings, she often makes us smoothies. She is cheerful, knowledgeable and generous, and her presence here at Summit is a great asset.

Sometimes in the afternoon we exercise together on the rowing machine and stationary bikes, and we always socialize after work. We cook in pairs, sit around talking, watch the TV and play games. Lately we've spent a lot of time outside after dinner, gawking at the auroras. Sometimes we lie on our backs looking up; sometimes we stand or mess around with cameras that quickly die in the cold.

We didn't know each other before meeting in the Copenhagen airport, but you would never know it. I don't think I could be up here with a better crew.

– Ken Jessen