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Message from the Director

As the International Polar Year continues we were honored to have Tony Gow visit us once again at the University of New Hampshire for our featured article on "Polar Ice Coring and IGY". I first met Tony in 1985 when he visited us to look at the stratigraphy of the Dominion Range ice core we had just collected. It's hard to imagine that Tony had 28 years of ice core experience when we first met. Working with Tony over the years has always been an engaging experience. Although Tony officially retired from CRREL ten years ago he is still active in ice core research and published two papers in the *Journal of Glaciology* last year. Ta Ta.

-MST ■

Polar Ice Coring and IGY 1957-58

An Interview with Dr. Anthony J. "Tony" Gow

From the early 1950's through the mid-1960's, U.S. polar ice coring research was led by two U.S. Army Corps of Engineers research labs: the Snow, Ice, and Permafrost Research Establishment (SIPRE), and later, the Cold Regions Research and Engineering Laboratory (CRREL). One of the high-priority research projects recommended by the U.S. National Academy of Sciences/National Committee for IGY 1957-58 was to deep core drill into polar ice sheets for scientific purposes. To this end, SIPRE was tasked with developing and running the entire U.S. ice core drilling and research program. Following the successful pre-IGY pilot drilling trials at Site-2 NW Greenland in 1956 (305 m) and 1957 (411 m), the SIPRE turned their attention to deep ice core drilling in Antarctica for IGY 1957-58. Dr. Anthony J. (Tony) Gow (CRREL, retired) was one of the scientists on the project. In March 2008, the NICL-SMO had the opportunity to sit down with Dr. Gow and talk about the ice coring at Byrd and Little America V during IGY 1957-58.

NICL-SMO (SMO): *How did you get involved in IGY?*

Tony Gow (TG): I was at a winter tournament in Auckland, New Zealand. I was a cross-country runner. They were having all kinds of winter sports and they call that the "winter tournament". There was a phone box; one of these big red boxes, and the phone rang in the box.

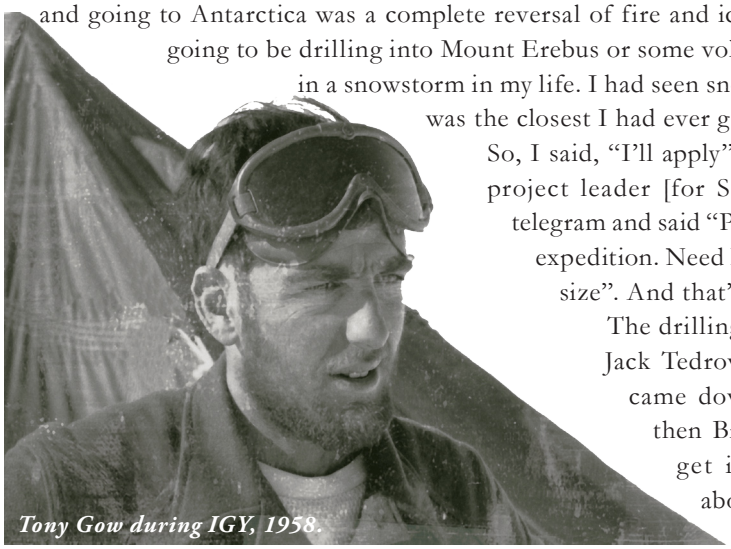
Somebody went over to the phone and picked it up and then came over to me and said "Professor Clark is on the phone for you" [from Victoria College in Wellington]. I picked up the phone and he said, "I got a call from Dick Goldthwait". Dick was on a Fulbright at Canterbury University at the time. And he had called Prof Clark up and said there was an American drill crew who were looking for some international flavor and they were seeking applications from people around the world.

And he said, "I think the outfit is called SPIRE". Well, what he meant was SIPRE: Snow, Ice and Permafrost Research Establishment in Wilmette, Illinois. So I answered the Prof's questions and he said, "Would you like to apply for the job?". And I said, "Well, yeah".

I had been working on volcanic rocks at that time. I had taken my Master's in Volcanology and going to Antarctica was a complete reversal of fire and ice. I thought they were going to be drilling into Mount Erebus or some volcano. I had never been in a snowstorm in my life. I had seen snow in the hills, but that was the closest I had ever got to snow.

So, I said, "I'll apply". Bill Marshall was the project leader [for SIPRE]. He sent me a telegram and said "Pleased to accept you for expedition. Need hat size, sock size, shirt size". And that's all the telegram said.

The drilling crew for Byrd (led by Jack Tedrow and Bob Patenaude) came down in September, and then Bill Marshall. We didn't get into Antarctica until about three months until


Tony Gow during IGY, 1958.

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In-Depth

In-Depth is published semi-annually by the National Ice Core Laboratory - Science Management Office (NICL-SMO).

We welcome your comments, suggestions and submissions.

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Masthead photos courtesy of
Lonnie Thompson and Michael Morrison.

Upcoming Meetings

26-30 May 2008
AGU Joint Assembly. Fort Lauderdale, FL
www.agu.org/meetings/ja08/

8-11 July 2008
SCAR-IASC IPY Open Science Conference, St. Petersburg, Russia
www.scar-iasc-ipy2008.org/

29 July-1 Aug 2008
AGU Western Pacific Meeting, Cairns, Australia
www.agu.org/meetings/wp08/

6-14 Aug 2008
33rd IGC - Arctic + Antarctic Records of Deglaciation since the LGM session, Oslo, Norway
www.33igc.org/coco/

2-5 Sep 2008
ITASE Synthesis Workshop, Castine, Maine
http://psp.tamu.edu/news-1/itase-synthesis-workshop.html

18-20 Sep 2008
2008 FRISP and WAIS Workshop, Derbyshire, UK
www.antarctica.ac.uk/frisp/2008/index.php

10-13 Nov 2008
Quaternary Climate: from Pole to Pole - EPICA Open Science Conference, Venice, Italy
www.epica2008.eu/

Polar Ice Coring and IGY 1957-58

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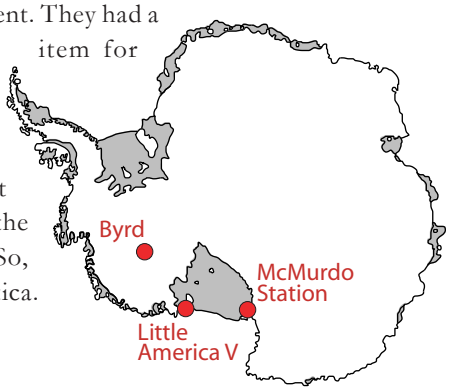
December, because we were assembling equipment. They had a parachute drop at Byrd that lost one fairly vital item for the drilling, but they were able to get around that problem. We were just shipping stuff down in duffle bags. These were tools and things like this. There were air force planes flying in and out of Antarctica, they were C-124s. These were the Globemasters. Big guys. Big front-end loaders. So, after three months we finally got into Antarctica. We got to McMurdo.



SMO: *So this is all in 1957?*
TG: This is all in '57, right. We arrived there [McMurdo Station] late December. They had already started drilling at the site, at Byrd. We stayed a night in McMurdo then we went off to Little America V in an R4D, a C-47 ski plane. They were not flying R4Ds directly from McMurdo to Byrd. They flew to Byrd via Little America V in those days. Spent a day at Little America V, then flew to Byrd Station in another R4D, and then began the drilling operation.

But the point was, I thought we were going to be drilling in rock. "No, no, no" Bill said. "We're going to drill in the ice". "What can you find in the ice?" I said. He said, "well, we got temperature and we can do stratigraphy and things like that on the core".

And I said, "well it [the ice core] must be at least 0 degrees C". That's how much I knew about glaciology. I was just dumped into this field. It was a serendipitous situation.

SMO: *Tell us a bit about the ice core drilling during IGY.*
TG: We did two drillings during IGY, one at Byrd and one at Little America V.

SMO: *So, you drilled at Byrd before Little America?*
TG: That's correct. We drilled at Byrd first. When we got to Byrd some core had already been pulled. We worked on that. Then, we finished drilling about...I think it was the end of January, beginning of February. We went down 308 meters. That was the first "deep drill core" ever drilled in Antarctica. And at that time that was the deepest hole ever drilled in the Antarctic ice sheet.

Then I came out at the end of the drilling program (February 1958). I was the last person out, and we came out on the last tractor swing of the season. The tractor swing consisted of Otaco sleds that were dragged behind very wide-tracked Caterpillar D-8 low ground pressure tractors. We cut the Byrd core in half, left one half at Byrd and brought the other half back on the tractor swing. It took about a week or ten days to get back to Little America V. We got onto the icebreaker *Glacier*, which was at Little America V at the time. We went around to McMurdo Sound and I rode all the way back to the States on the *Glacier*, through the Panama Canal to Norfolk. This is going into March of '58.

A U.S. Air Force C-124 Globemaster delivers an airplane to McMurdo Station, Antarctica, in 1956. Credit: Photo taken by Commander Jim Waldron USNR (Retired), National Science Foundation.

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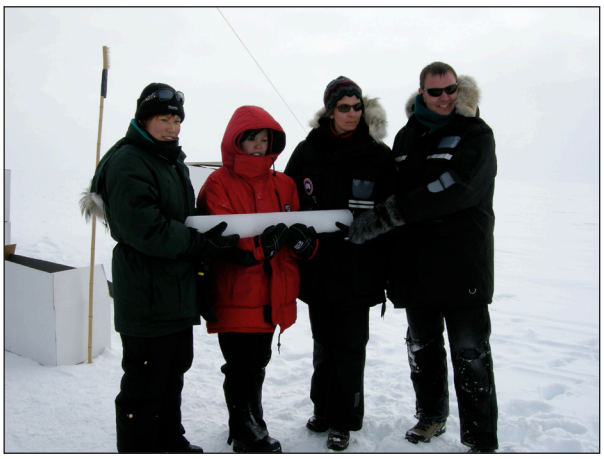
Greenland Science and Education Week

Under the auspices of the Greenland-Denmark-United States Joint Committee, the Nordic/Baltic Environment Science & Technology Hub--based out of the U.S. Embassy Copenhagen--sponsored a unique Arctic science trip for Danish, Greenlandic, and U.S. high school science students and teachers to Greenland's inland ice sheet. The trip was hosted by the National Science Foundation (NSF) in cooperation with the New York Air National Guard 109th Air Wing (NYANG 109th) and Embassy Copenhagen's Defense Attaché Office. Students and teachers, accompanied by members of the media and the Danish Polar Center spent five days learning firsthand about Greenland-based research and the logistics involved in supporting Arctic research. The trip took place June 18-22, 2007.

The group arrived in the western town of Kangerlussuaq, Greenland June 18th. There they toured the research infrastructure, which supports international research projects, and were outfitted in polar gear. The following day the group flew on NYANG 109th's Hercules C-130s to the Greenland Environmental Observatory at Summit (Summit Station). The group received a whirlwind tour of the ongoing research. They observed an ice core being drilled, released weather balloons, observed the different measurements being made, collected clean snow samples for further laboratory testing, drove a snowmobile, emailed their friends and ate with the scientists. Part of the group slept in tents. The weather was perfect – t-shirt weather for the Summit occupants—and the sun never set.

After their overnight stay at Summit Camp, the group returned to Kangerlussuaq where they spent two days observing the local environment under the excellent guidance of Henning Thing from the Danish Polar Center. They went to the edge of the ice cap and had a barbeque, observed the landforms carved by glaciers, visited a saline lake and took water quality measurements in the river that feeds Sondestrom Fjord.



From left: Karina Mathiassen (student, GU-Aasiaat High School), Pilu Olesen (student, GU-Aasiaat High School), Kigga Aae Christensen (chemistry and biology teacher, GU-Aasiaat High School) and Josua Jepsen (chemistry teacher, GU-Aasiaat High School) hold an ice core at Summit, Greenland. Photo courtesy of Mark Twickler.

It was a fantastic learning experience for students and teachers alike, which will be used in outreach work at their schools and institutions in connection with International Polar Year activities. Several of the teachers, Gerard Klimbal from Yosemite High, Oakhurst, CA and Josua Jepsen and Inge Margrethe Aae Christensen (Kigga) from Aasiaat High School, Greenland are working on a joint project for their schools. The Aasiaat High School website for the trip is: http://www.gu-aasiaat.gl/Summit/Summit-1.htm. Aaju Simonsen, an undergraduate at the University of Tromso, Norway, is hoping to come back and work at Summit next summer.

-- Martha Conklin (University of California - Merced)
Nanna Nyholm (U.S. Embassy Copenhagen, Denmark)

Ice Core Working Group

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Ian Baker
Dartmouth College
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Karl Kreutz
University of Maine
Stable Isotopes

Ryan Bay
University of California-Berkeley
Borehole Logging

Mark Skidmore
Montana State University
Biogeochemistry

Eric Steig
University of Washington
At Large

Kendrick Taylor
Desert Research Institute
At Large

In 1986, the National Academy of Sciences recommended developing an Ice Core Working Group of representatives from institutions prominent in ice coring activities. Administered by the NICL-SMO, ICWG is organized around scientific disciplines, rather than institutions. Members are elected to a three year term, with the committee chair serving two years.

Polar Ice Coring and IGY 1957-58

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Then I got up to Boston. Went across to Illinois, to SIPRE, which was in Wilmette, Illinois, which is just outside of Chicago. There were two offices. There was an engineering office and there was a research office, as part of SIPRE. One was in Evanston and one was in Wilmette. We were in Wilmette. Then we got the cores back and started working on the cores. Because they were placed on the (ice breaker) *Glacier* and they came back with us, we got to work on them later that year. And then time came to prepare for Little America V, for the drilling there, using the same kind of drill rig. It was called a "Failing 1500 rotary drill rig". It's used in the oil fields as an exploratory drill. It has a solid string. In other words, it is not a cable suspended drill.

A U.S. Navy R4D (C-47) airplane at Little America V in 1957. Credit: Photo taken by Commander Jim Waldron USNR (Retired), National Science Foundation.

SMO: *Not a wire line.*
TG: Not cable suspended with the working parts being rotated at the bottom of the drill hole. The solid drill string was rotated at the surface. A motor at the surface drove the drill, and then the rotary motion was transferred to a drill string, which consisted of drill pipes 20 feet long.

So, we were getting 6-meter long cores each run. It was a 20-foot long core barrel. After we drilled 20 feet, we then raised the drill to the surface by just taking the string of rods off and then raising it slowly every 20 feet etc until the entire thing was out of the hole.

SMO: *Tell us about the drilling at Little America V.*
TG: We got to Little America V in October 1958. We flew from McMurdo by R4D again. We used the same kind of drill rig as we used at Byrd. We drilled 257 meters at Little America V and we got through to the bottom and got into the seawater. And that was the end of that drilling. In fact, we didn't quite get the bottom core because a crack occurred, there was water coming up from the crack, and we just went right through and didn't recover that final bit of core at the bottom.

SMO: *Did you freeze the drill in when you were drilling?*
TG: No, we didn't freeze the drill in but the hole started to fill up with seawater and we had a pump to help pull the water out. We didn't go any further. We had gotten through and that was it. So, it was the first time that an Antarctic glacier had been penetrated all the way to bottom. This was on the Ross Ice Shelf. Even though it's an ice shelf, it's still a polar glacier and it was the first time anybody had penetrated to the bottom.

So that was completed and then I came back. I left Little America V on a cargo ship. We went around

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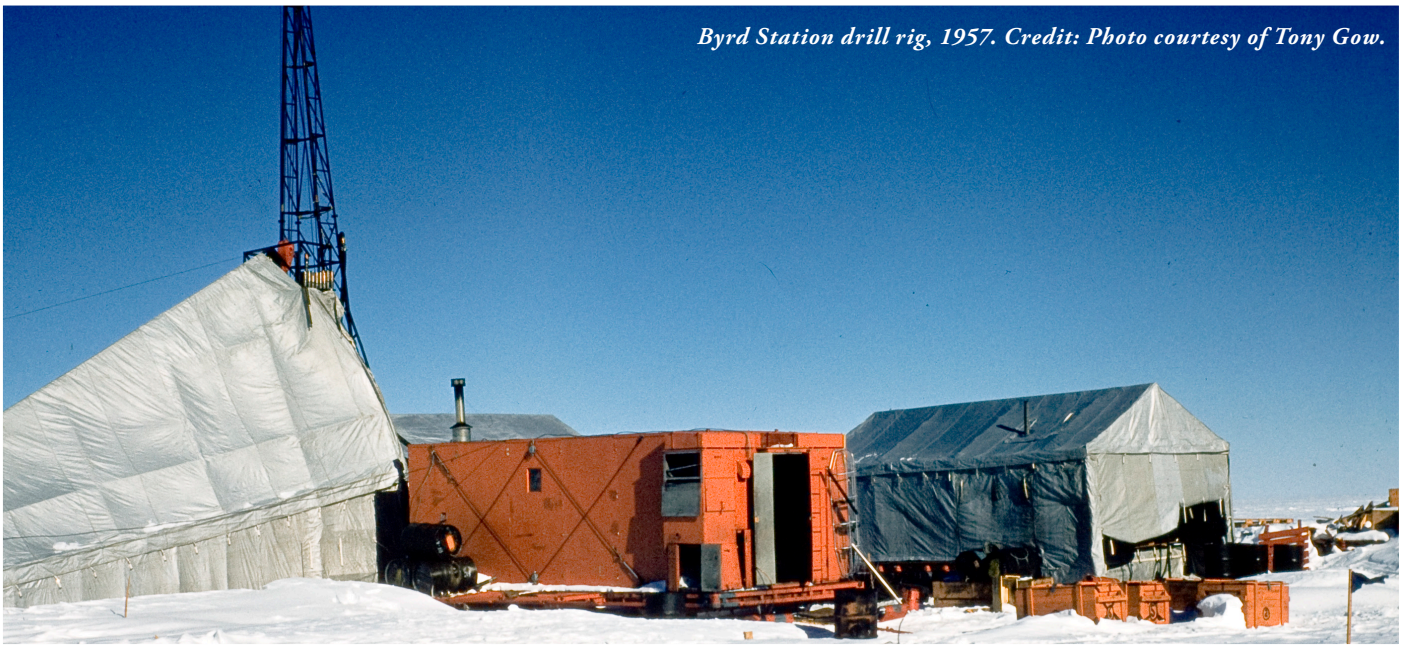

Byrd Station drill rig, 1957. Credit: Photo courtesy of Tony Gow.

Polar Ice Coring and IGY 1957-58

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to McMurdo, and then we came back on the USS *Arneb* (AKA-56) to New Zealand. And then we flew back from New Zealand to the United States. And then started working on the Little America V core.

Then after four years, CRREL was formed. It was a combination of essentially the two facilities in the Chicago area plus a facility called ACFEL (Arctic Construction and Frost Effects Laboratory) located near Boston, Massachusetts. We combined in Hanover, NH and we formed CRREL. That's how CRREL came about, from the consolidation of the two labs near Chicago and the one near Boston.

SMO: *What sort of measurements did you do on the Byrd and Little America V ice cores?*
TG: The regular kind of work. We were doing density measurements (density profiles), stratigraphy (for annual layer counting) as far as we could go, ice structure (grain size, grain shape, fabric), bubble structure. There was some work being done on gathering particles. These were particles taken from the core and examined by Bill Marshall, the leader of the first group (Byrd drilling). The leader of the second group, the Little America V drilling, was Dick Ragle. So, we worked on those things in the core. Those were the staple kind of measurements that people did in those days.

There wasn't much done on the Byrd core or the Little America V core, in terms of isotopes or any kind of chemistry. That came later on. It didn't really materialize until we got the '68 deep core drilling at Byrd, which went right through to the bottom of the ice sheet at a depth of 2,164 meters.

Little America V drill rig, December 1958. Credit: Photo courtesy of Tony Gow.

-JMS

WAIS Divide Ice Core Update

The third season for the West Antarctic Ice Sheet (WAIS) Divide Ice Core Project ended on 05 February 2008. The inaugural season of deep drilling with the Deep Ice Sheet Coring (DISC) Drill went very well and core quality was excellent. Full production coring began on 7 January with two shifts operating. A third shift was started on 10 January initiating 24 hour/day operations. Coring continued through 20 January with a total of approximately 466 meters of ice drilled giving a final bore hole depth of 580 meters. The core quality produced by the DISC Drill was excellent. Average drilled core length was 2.7 meters and average core production was about 37 meters per day with a total of 180 runs made. Due to weather issues and delayed power module materials, the amount of time available for production drilling was 9 days less than had been planned and the total depth drilled, therefore, was short of the 800+ meter goal for the season. If the number of

Lowering the DISC Drill's winch drum into place. Credit: Photo courtesy of Ice Coring and Drilling Services.

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Ice Cores - A "Cool" Addition to NSF- and NASA-Supported POLAR-PALOOZA Education and Outreach Tour

It's not every day that an actual segment of the GISP2 core from Summit, Greenland, goes on the road to excite and inform the public about polar research and the current IPY, but that's just what happened in March 2008, as POLAR-PALOOZA kicked off its continuing tour of more than 20 communities across America with a series of events at the National Geographic Society in Washington DC. Penn State's Richard Alley, who worked in Greenland on GISP2, explained how this piece of ice – approximately 130,000 year old – had helped researchers understand that Earth's climate could change abruptly. Alley was part of a 6-person team of presenters, which also included Andy Revkin (the *New York Times* environment reporter), Arctic sea ice expert Jackie Richter-Menge (CRREL, New Hampshire), Richard Glenn (geologist, Inupiat whaling captain, and president of the Barrow Arctic Science Consortium), marine biologist Mike Castellini and *NASA*'s Waleed Abdalati, a glaciologist from the Goddard Space Flight Center. Three student audiences of close to 1,000 youngsters, plus an evening public audience, gasped as the ice core entered in a cloud of smoke, and saw close-ups of layers and bubbles, which Alley likened to "bottles of fossil air."

Not every host site can accommodate and guarantee the safekeeping of a meter-long piece of ice core as rare as the one from Summit Station, Greenland. At other sites, such as Salt Lake City, Utah; Norman, Oklahoma; Anchorage and Fairbanks, Alaska; a smaller--but still 3,000 year old piece--of Antarctica's Newall Glacier has been making starring appearances. Presenters such as Julie Brigham-Grette (U. Mass Amherst), IGY veteran Charlie Bentley, and UC Boulder graduate student Atsuhiro Muto, just back from the Norwegian-US "Troll to Pole" Scientific Traverse of East Antarctica, explain the science of ice cores.

Richard Glenn parades the Newall core around the Fernbank Science Center planetarium, Atlanta, GA.

A video crew from POLAR-PALOOZA was also on location in January at the WAIS Divide camp. They taped the recovery of the first core of the 2008 season. Kendrick Taylor took our camera down into a snow pit to explain seasonal layering. There we saw first-hand the extremely bad weather, aka "high accumulation rates", that make WAIS Divide – with 2 days out of 3 characterized by falling or blowing snow or whiteouts – such a perfect site to try for a high-resolution Antarctic record as ancient as that from GISP2.

UC Boulder graduate student Atsuhiro Muto explains the science of ice cores using a piece of ice from the Newall Glacier, Antarctica.

Please visit the POLAR-PALOOZA website for dates and cities the tour will visit later in 2008. Once again it will be carrying a piece of ice core from NICL to engage audiences young and old: Raleigh, NC (May 24-25), Cleveland, OH (9/12-13), Chicago, IL (9/19-20), the SACNAS National Conference (Salt Lake City, UT 10/9-12), Richmond, VA (10/22-24), St Louis, MO (10/27-29), College Station, TX (11/5), Fort Worth, TX (11/6), Boise, ID (11/11-12), Denver, CO (11/14-15.) Final dates for Houston, TX, Brownsville, TX and New York City are still to be finalized.

For the most current tour information, visit:
http://passporttoknowledge.com/polar-palooza/pp04.php

POLAR-PALOOZA thanks the NICL Science Management Office (Mark Twickler) and Denver staff (especially Todd Hinkley) for their loan of the ice cores… and requests TSA to treat our insulated shipper, and its precious contents, gently as it travels from city to city!

-- Geoffrey Haines-Stiles, Project Director
PASSPORT TO KNOWLEDGE & the LIVE FROM specials
http://passporttoknowledge.com

NEEM Update – Plans for Field Season 2008

The goal of NEEM (North Greenland Eemian ice drilling) is to obtain a complete ice core record of the climate from the last interglacial period, called the Eemian, in Greenland. In Greenland, the Eemian was several degrees C warmer than today. Ss such, it is our best analog for a potentially warmer future climate (see previous In-Depth Spring 2007 NEEM story).

The main goal of the NEEM 2008 field season is to construct a fully operational ice drilling camp and to begin deep ice core drilling to about 400 meters depth. Activities will include the drilling, reaming, and casing of the pilot hole to 120 meters depth; installation of all camp infrastructures for the deep drilling operation (main building, weatherports, workshops, drilling trench, science trench); and installation of the deep ice coring drill (winch, tower, control cabin, ventilation, fluid handling system).

Upon the arrival of wet drilling equipment by ship in the beginning of July wet drilling to about 400 m will continue until the end of the season. A top slice of the ice core will be cut by band saw for 2.5 cm resolution isotope samples. It is planned to cut at least 12,000 isotope samples from the top 300m of the ice core. All core drilled during the 2008 field season will be logged and stored at NEEM for full core processing, including CFA (continuous flow analysis), during the 2009 NEEM field season. The cut isotope samples will be returned to Copenhagen during the 2008 field season for analysis. The deep drill being used for NEEM is a modified and updated version of the NGRIP deep drill.

Two teams, a United States led team and a Swiss/DK led team will also conduct firn air pumping in the vicinity of NEEM in two shallow boreholes this season. The DK shallow drill will perform pendulum drilling between the two holes. Both cores from the shallow boreholes will be logged, documented and stored at NEEM.

The main transport between NEEM camp and Kangerlussuaq will be by ski-equipped LC-130 airplanes from the U.S. Air Force, 109th Tactical Air Group, Scotia, N.Y. The planes are provided as part of the logistical contribution to NEEM from the U.S. National Science Foundation.

The 2008 NEEM field season is scheduled to take place from May 7 to August 18, 2008, allowing approximately 15 weeks of fieldwork at NEEM.

-JMS ■

WAIS Divide Ice Core Update

(continued from page 5)

planned drilling days had been available, drilling 800+ meters would likely have been achieved.

The core handling line (CHL) at WAIS Divide involved logging and documenting the core and preparing it for shipment back to the National Ice Core Laboratory (NICL) in Denver, CO. This year's CHL also involved cutting samples for physical properties and measuring the electrical properties of the ice. Twenty-one 10-cm samples taken at 20-meter intervals from 120 meters to 520 meters were cut for physical properties. Electrical properties were measured on all 466 meters of ice drilled this season. All ice drilled this season, except for the last three meters, has been shipped back to the NICL and will be worked on at this summer's core processing line.

Preparations for the 2008/2009 field season are already underway. The SCO has hired seven science technicians to work on the WAIS Divide core handling line. Ice Coring and Drilling Services is in the final stages of hiring their staff. Discussions with NSF and RPSC are underway regarding the anticipated schedule for the 2008/2009 field season. The goal is to reach at least 1400 meters depth by the end of next season.

-- Joe Souney, Operations Manager
WAIS Divide Science Coordination Office (SCO)
■

WAIS Divide ice coring arch facility. Credit: Photo courtesy of Ice Coring and Drilling Services.

National Science Foundation Projects Related to

Ice Cores or Ice Core Data

The table below shows projects related to ice core research that have been funded by the National Science Foundation (NSF) since the last issue of *In-Depth* was published. To learn more about any of the projects listed below, go to the NSF Award Search page (http://www.nsf.gov/awardsearch/) and type in the NSF Award Number. If you have a newly-funded NSF project that was omitted from this listing, please let us know and we will add it to the next issue of *In-Depth*.

Title of the Funded Project	Investigator	Award Number
Advanced Microstructural Characterization of Polar Ice Cores	Baker, Ian	0738975
Atmospheric Carbon Dioxide and Climate Change: The WAIS Divide Ice Core Record	Brook, Edward	0739766
Collaborative Research: Molecular Level Characterization of Organic Matter in Ice Cores using high-resolution FTICR mass spectrometry	Grannas, Amanda Hatcher, Patrick	0739691 0739684
IPY: Adding Continuous Black Carbon Analysis to the Norwegian-US Traverse Ice Core Measurements	Edwards, P. Ross	0733089
ITASE Synthesis Workshop	Mayewski, Paul	0829227
Operation and Maintenance of the U.S. National Ice Core Laboratory	Schumann, R. Randall	0637211
SGER - μ-Raman Analysis of Ice-Core Samples	Barletta, Robert	0828786
WAIS DIVIDE - High Temporal Resolution Black Carbon Record of Southern Hemisphere Biomass Burning	Edwards, P. Ross	0739780

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