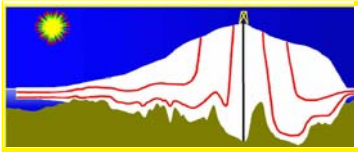


West Antarctic Ice Sheet Divide Ice Core

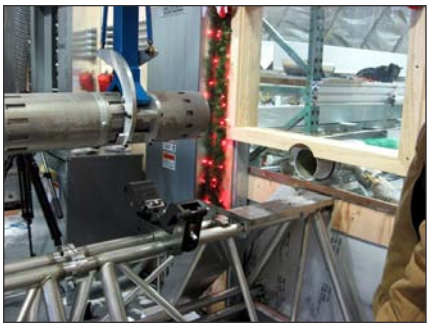
Climate, Ice Sheet History, Cryobiology

2008/2009 Field Season Overview

We had an extremely successful field season. It got off to a rough start when budget cuts and problems with the camp's forklift delayed the science and drilling teams by two weeks. The science and drilling crews arrived at the very comfortable camp during the first week of December. It took another two weeks to set up the core handling and drilling equipment, train the crew, develop procedures, and conduct safety drills. We started around-the-clock operations with three shifts on December 22. Thirty-one days later, with only 4 rest days, we met our goal for the season, and then ran out of time and space to store the core.

Most of the season we were drilling brittle ice, in which the gas pressure in the ice is sufficient to spontaneously fracture the core when it is brought to the surface. We used several new methods to maximize the core quality. The resulting core quality (see figure on page 2) is the best I have ever seen for brittle ice. By 1310 m the pressure was sufficient to push the air bubbles into clathrates and the ice was no longer brittle. Below this we pulled up clear unfractured 2.5 m pieces of ice.

Instead of the traditional approach of drilling and handling two meter long segments of brittle ice, we used a new drilling method. First, we drilled a one meter long piece of ice, and then pulled the drill up to snap the core off the bottom of the hole. Then, instead of bringing the drill back to the surface, we lowered the drill back down and drilled and snapped off a second one meter long piece of ice. Then we lowered the drill down a third time and drilled and snapped off a 0.5 m long piece of ice. Only after drilling 2.5 m, which is about the limit of the drill, did we bring the drill back to the surface. On alternate trips down the hole we would reverse the order so the 0.5 m long pieces would fill a single 1 m long core tray. This new drilling method allowed us to handle the core in 1 m long segments which reduced the size of the core handling and storage areas, provided higher quality core then would be obtained by cutting the brittle ice, and it allowed us to collect more core each trip down the hole.

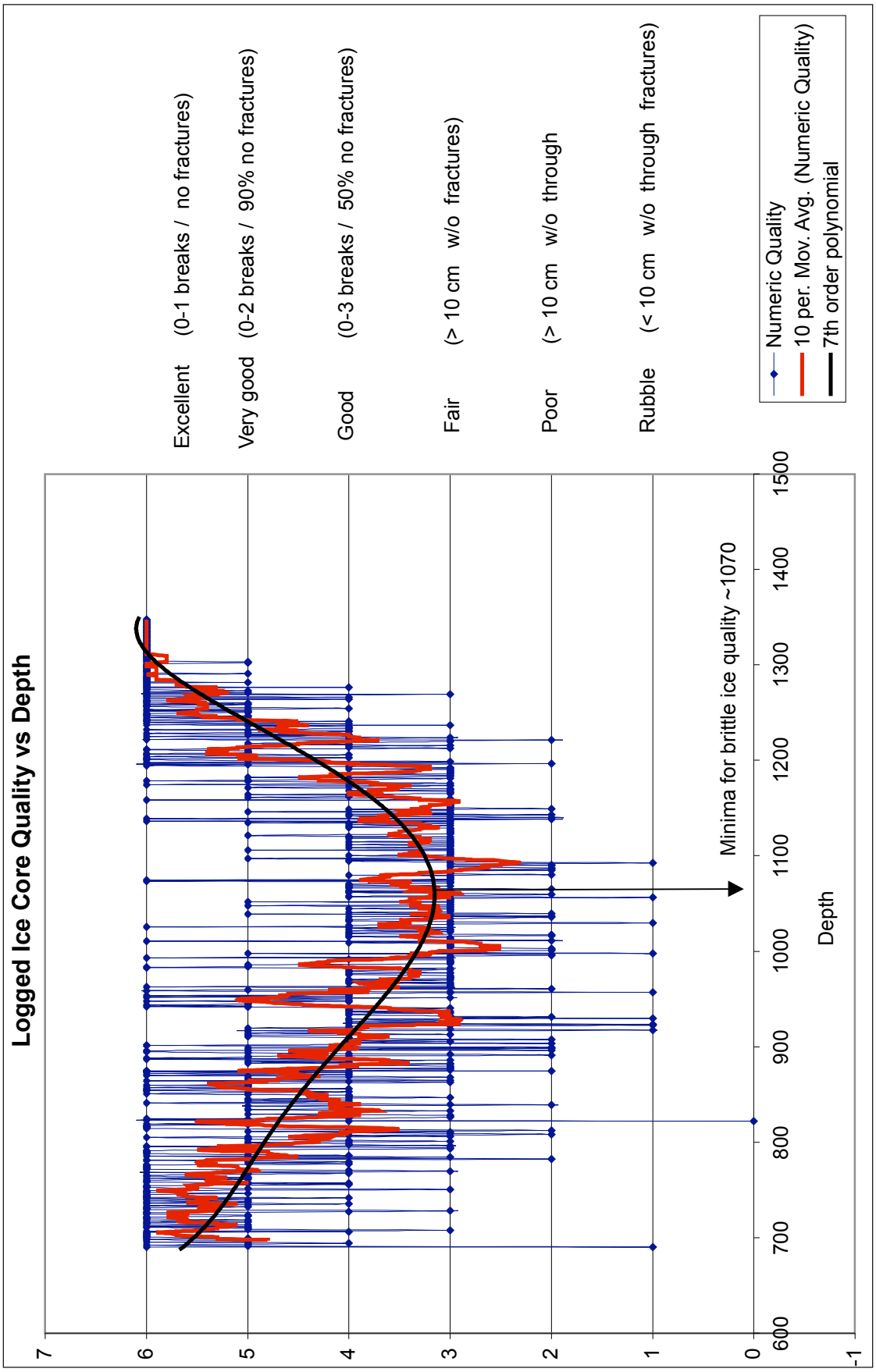


Once the core was on the surface it was pushed out of the drill onto a carefully aligned and rigid support system. The careful alignment of this system using survey equipment was critical. The core passed through a new and more effective vacuum system for removing fluid from the core. The core was extruded into plastic netting which held the core tightly together even after it had spontaneously fractured. To minimize the thermal shock to the core the core handling was done in an area that was refrigerated to a temperature of -30 C.

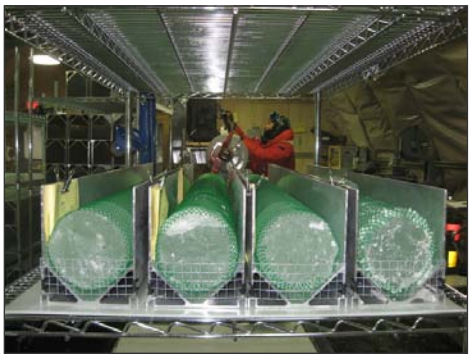
The combination of these new methods, breaking the core into the desired length while it was down hole and still under pressure, careful alignment of the core handling system, the netting, the low temperature in the core handling area, and a lot of really careful and focused people, all contributed to the high core quality.

None of this work came easily. On the drilling side of the arch, Jay Johnson and his crew spent tedious hours monitoring the drilling process on the control computers and making adjustments to the drill. Some of the adjustments were as small as 0.002 inches. You should think of the drill as a scientific instrument, not just a piece of drilling

Photographs courtesty of Dr. Julie Palais/National Science Foundation


Logged Ice Core Quality vs Depth
Excellent (0-1 breaks / no fractures)
Very good (0-2 breaks / 90% no fractures)
Good (0-3 breaks / 50% no fractures)
Fair (> 10 cm w/o fractures)
Poor (> 10 cm w/o through
Rubble (< 10 cm w/o through fractures)
Numeric Quality
10 per. Mov. Avg. (Numeric Quality)
7th order polynomial
Minima for brittle ice quality ~1070
Depth
7
6
5
4
3
2
1
0
-1
600
700
800
900
1000
1100
1200
1300
1400
1500

equipment. The drill crew had some down hole electrical problems, likely caused by just a few milliliters of ethanol that got in the hole as a result of deicing the drill. It was tricky but ICDS quickly figured out what was wrong and fixed it.



On the core handling side of the arch, NICL (Geoff Hargreaves and Brian Bencivengo) were diligent about establishing the core handling procedures. The core handling crew (mostly graduate students that were hired by the SCO) spent long hours in a noisy, windy, and cold environment doing the tedious job of documenting the core length and fractures. Anais Orsi and Bruce Vaughn organized lots of the details and filled in the occasional gaps.

Besides just collecting ice we also made science measurements. Natalie Kehrwald (hired by DRI but from OSU), John Fegyveresi (PSU) and Marie DelGrego (DRI) made electrical measurements on the ice cores. The measurements were made in the field instead of at NICL because the core quality is better in the field than at NICL. The measurements show strong well-resolved annual layers that will be used to determine the age of the ice. John also made vertical and horizontal thin sections of the ice below the brittle zone. Anais Orsi (Scripps) made borehole temperature measurements in a 300 m hole that will be used to help interpret the gas records. Bess Koffman (U-Maine) collected snow pit samples that will be used as part of the trace chemistry work.

The RPSC camp staff supported all of this work, lead by camp manger Ben Partan. There was a construction crew to set up camp at the beginning of the season, a crew to maintain the electrical, ventilation, cooling, and other systems at the arch, and another crew to do all the things typical of a small town (mechanics, communications, air craft transportation, waste disposal, cargo, medical, and of course food, really great food considering where we were). There was a big storm around Thanksgiving, then a month of gorgeous calm and clear skies. At the end of the season, when we were trying to move a lot of cargo and people, the weather closed in and we had the typical multi day waits for planes. No one likes to wait days for a plane, but as always, the 109th Air National Guard got our equipment and us in and out safely.

Along the way the entire camp crew pulled together into a tight community. Some of the highlights were the Christmas dinner and party, the New Years' Winter Olympics, a talent show, a traveling dance party held on a large and slow moving sled, and the occasional quite time with old and new friends. It takes a lot of personal effort and really positive attitudes to keep the energy high in a field camp, and this crew did that in style with seemingly endless ways to keep everyone engaged and in high sprits.

Looking forward to next season - Ken

Future Planning

Thanks to a lot of extra effort by our field crew, we finished the 2008/2009 field season at a depth of 1512 m in ice that is about 7,700 years old. We have 932 m of brittle ice stored in the arch basement. This ice will relax over the winter so it will be less susceptible to damage during shipment back to the United States. This leaves us with the task of recovering 2,040 more meters of ice and shipping 3,000 m of ice. We would like to complete the drilling in two additional drilling seasons. To achieve this will require three changes to the way we have been operating.

The first change is to increase the length of core that is recovered each time the drill goes down hole. To do this ICDS has to decrease the thickness of the drill head and barrel so that the volume of chips cut from the annulus around the core is smaller, and they have to pack the chips tighter into the chip storage chamber in the drill. Both of these tasks are under consideration.

Photographs courtesty of Dr. Julie Palais/National Science Foundation

The second change is to increase the amount of time available for science operations each season. During the 2008/2009 season, the camp was open for 14 weeks but we were only able to conduct science and drilling operations for 6 of those weeks. We are working with RPSC to develop a plan to get the science and drilling crews into camp sooner next season. The camp won't be very comfortable when we arrive, but a few extra weeks would really expedite the project.

The third change is to obtain two 40-foot shipping containers with redundant cooling systems for shipping the ice back to NICL. These are known as SafeCore containers. The core processing will always occur 18 months after the ice is drilled because we can only ship back 1024 m of ice each year and are storing the brittle ice on site. The ice that is waiting for shipment to NICL will be stored either on site or in refrigerated storage in McMurdo.

If we can make these three changes, the following describes what should happen during the next few years:

Summer 2009:	No core processing
2009/2010 Field Season:	Drill to 2,900 m
Summer 2010:	Process core at NICL from 580 m to 1,600 m (2,200 B.P to 8,500 B.P.). • From 580 m to 1,320 (2,200 B.P. to 6,800 B.P.) the ice is brittle and will be difficult to make continuous measurements on. • From 1,320 m to 1,600 m (6,800 B.P. to 8,500 B.P.) the core quality is excellent.
2010/2011 Field Season:	Drill to just above the bed at ~3,550 m. • We will not drill all the way to the bed because doing so could contaminate the basal environment. I expect we will not recover the bottommost 10 m of ice. • We will have to do geophysical work to determine the depth at which we stop drilling.
Summer 2011:	Process core at NICL from 1,600 m to 2,900 m (8,500 B.P. to 34,000 B.P.)
2011/2012 Field Season:	Do borehole logging and maybe start replicate coring
Summer 2012:	Process core at NICL from 2,900 (34,000 B.P.) to just above the bed
2012/2013 Field Season:	Continue borehole logging and replicate coring

2009/2010 Science Technicians

The SCO is now accepting applications for science technician positions for the 2009/2010 Antarctic field season. In March 2009 the SCO will start to review the applications and contact references. By June the SCO will select the science technicians.

Most of the science technicians will be USA graduate students or lab technicians who are working on projects that are part of the WAIS Divide Ice Core Project. However, students working on other climate, glaciology, or cryobiology projects will also likely be selected. We hope to include a non-USA student who is working on another ice core project.

In late October/early November 2009 we will travel to Antarctica, via Christchurch, New Zealand. At McMurdo Station we will complete additional training and preparation activities. We will then fly to the WAIS Divide camp where the majority of our time will be spent. At WAIS Divide there are heated areas for eating, relaxing, occasional showers, and office work. Most people will choose to sleep in mountaineering tents (which are not heated but are private), but it is also possible to sleep in a heated communal berthing structure. There is a small bandwidth link for personal email, but there is no Internet connectivity. A satellite phone is available for short and occasional personal phone calls.

Working in two person shifts, the science technicians will receive the ice core as it is removed from the drill, measure the length and quality of the core, and pack the core for shipping. The science technicians will also pack core that was collected during the 2008/2009 field season. The science technicians must be able to lift 20 pounds on a regular basis and occasionally 40 pounds. There are three shifts per day; each is ten hours long counting a shift overlap. Typically we work 6 days per week and usually take Sundays off, although we sometimes change the schedule around the holidays to avoid working on a holiday. This work takes place inside a building with an internal temperature of -30 C. Although there are ample opportunities for breaks in a warm building, you must be comfortable working in a very cold environment.

The field season will end in late January 2010 or early February 2010. Do not plan on being back to the USA before February 5, 2010.

The complete job advertisement, along with the link to the online application form, can be found at:
http://www.waisdivide.unh.edu/news/employment.html

A printable version of the job advertisement for posting is also available at the URL above.

Basal Sampling and Replicate Coring

The science and implementation plan for replicate coring was endorsed by the WAIS Divide Executive Committee and is available on the project website (http://www.waisdivide.unh.edu/science/replicate.html). Although planning has begun for replicate coring it is not certain that it will occur.

The science and implementation plan for the basal sampling is also available on the project website (http://www.waisdivide.unh.edu/science/basal.html). Planning for basal sampling is on hold due to environmental concerns associated with contaminating the basal environment.

Work on replicate coring and basal sampling will require additional proposals that have to be submitted by someone other than the SCO and should be submitted this coming June.

Annual Fall Science Meeting

This year's science meeting will be held at Scripps Institution of Oceanography in La Jolla, CA. The tentative dates for the meeting are October 1 and 2 (Thursday & Friday). There may be pre and post meetings for sub groups to work on more focused topics. We are in the process of finalizing arrangements and will send out complete details soon.

WAIS Divide Ice Core Project - Science Coordination Office (SCO)

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Joe Souney, University of New Hampshire
Mark Twickler, University of New Hampshire