

# West Antarctic Ice Sheet Divide Ice Core

Climate, Ice Sheet History, Cryobiology

## A GUIDE FOR THE MEDIA AND PUBLIC

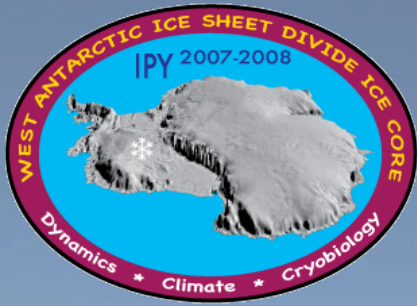
Field Season 2011-2012



WAIS (West Antarctic Ice Sheet) Divide is a United States deep ice coring project in West Antarctica funded by the National Science Foundation (NSF). WAIS Divide's goal is to examine the last ~100,000 years of Earth's climate history by drilling and recovering a deep ice core from the ice divide in central West Antarctica.

Ice core science has dramatically advanced our understanding of how the Earth's climate has changed in the past. Ice cores collected from Greenland have revolutionized our notion of climate variability during the past 100,000 years. The WAIS Divide ice core will provide the first Southern Hemisphere climate and greenhouse gas records of comparable time resolution and duration to the Greenland ice cores enabling detailed comparison of environmental conditions between the northern and southern hemispheres, and the study of greenhouse gas concentrations in the paleo-atmosphere, with a greater level of detail than previously possible. The WAIS Divide ice core will also be used to test models of WAIS history and stability, and to investigate the biological signals contained in deep Antarctic ice cores.





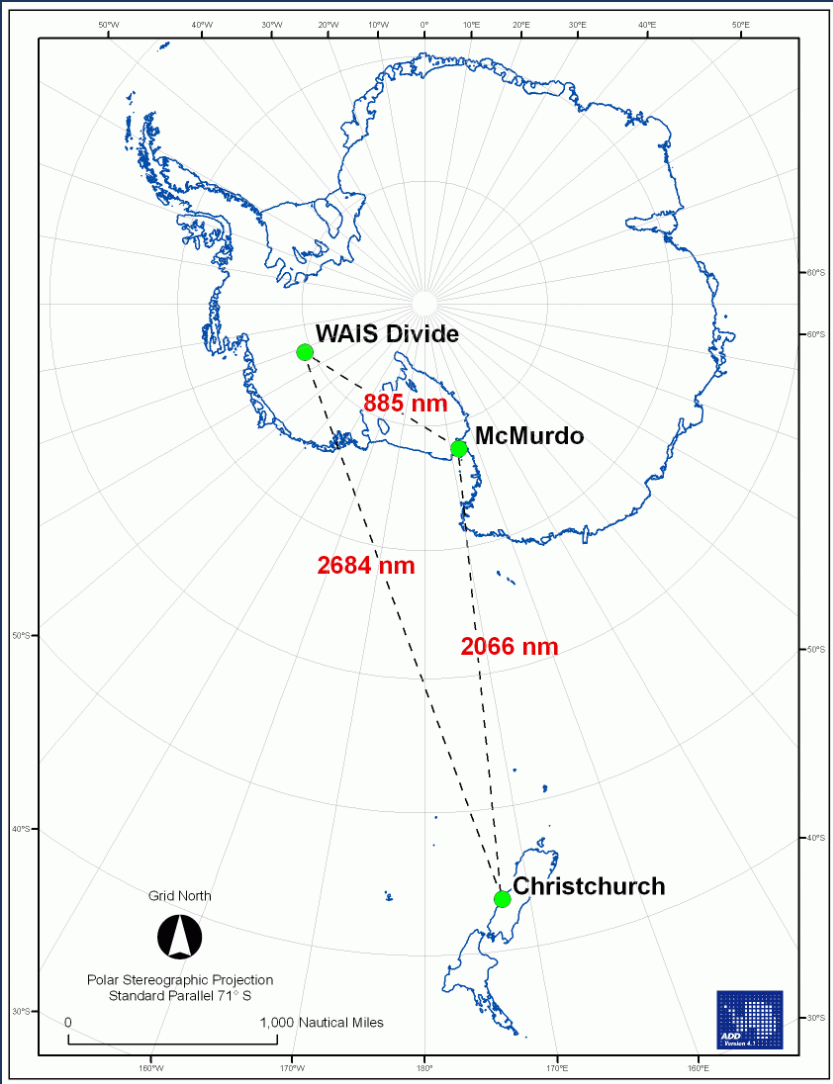
Additional copies of this document are available from the project website at <http://www.waisdivide.unh.edu>

Produced by the WAIS Divide Science Coordination Office with support from the National Science Foundation, Office of Polar Programs.



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## WAIS DIVIDE SCIENCE COORDINATION OFFICE

The WAIS Divide Science Coordination Office (SCO) is managed by the Desert Research Institute, Nevada System of Higher Education and by the Institute for the Study of Earth, Oceans, and Space at the University of New Hampshire. The Chief Scientist and head of the SCO is Dr. Kendrick Taylor. The SCO is managed by Mark Twickler.



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Please visit the WAIS Divide Ice Core website at [www.waisdivide.unh.edu](http://www.waisdivide.unh.edu)

WAIS Divide Ice Core

http://waisdivide.unh.edu/

## WAIS Divide

### West Antarctic Ice Sheet Divide Ice Core

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#### Quick Links

- Field Updates
- Involvement/Proposals
- Media & Public Guide
- Meetings
- Photo Gallery
- Quarterly Updates
- Sample Requests
- Schedule

#### A One-Meter Long Section of Ice Core with A Dark Ash Layer

Photo credit: Heidi Roop

## West Antarctic Ice Sheet Divide Ice Core

The U.S research community is conducting a deep ice coring project in West Antarctica for studies of climate, ice sheet history and cryobiology. This project is collecting a deep ice core from the West Antarctic Ice Sheet (WAIS) ice flow divide and integrating approximately 20 separate but synergistic projects to analyze the ice and interpret the records. [Learn more about WAIS Divide.](#)

### LATEST NEWS

#### Getting to the Bottom - NICL Team Processes Deepest Ice from WAIS Divide Project

Mick Sternberg had literally made the same measurement a thousand times before. But this meter-long ice core was perhaps just a little more special. He double-checked his numbers on the final length, stood back, and rechecked again. [More...](#)

#### Registration is Now Open for the 2011 Science Meeting

The 2011 WAIS Divide Ice Core science meeting will be held on September 28-29 (Weds-Thurs) at the Scripps Seaside Forum in La Jolla, California. [More...](#)

#### WAIS Divide 2011 Core Processing Line Underway

During the next 10 weeks the WAIS Divide ice core will be sampled and measured at the National Ice Core Laboratory during the 2011 core processing line (CPL). [More...](#)

#### Trucked In - WAIS Divide Ice Cores Arrive Safely at NICL

Three semi-trailer trucks, each pulling 20-foot-long refrigeration containers, rolled into Denver on March 15 after a 24-hr trip across the southwest corner of the country from Port Hueneme, Calif. [More...](#)

#### New Antarctic Sun Story Published About WAIS Divide

Deep core complete - WAIS Divide project finishes five-year effort to retrieve 3,331 meters of ice [More...](#)

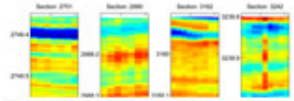
### FIELD & CPL UPDATES

#### August 19, 2011



Processing of the WAIS Divide ice core was completed on August 16th, 2011, to a bottom depth of 3331.369 meters!! [More →](#)

#### August 12, 2011



The WAIS Divide ice core has now been processed to a depth deeper than the EPICA Dome C ice core (3270 m), with just under 50 meters of ice left to

## Website

The WAIS Divide website ([www.waisdivide.unh.edu](http://www.waisdivide.unh.edu)) contains an enormous amount of information about the project, including funded science projects, project updates, a photo gallery, publications, field reports, and much more. Please visit the website often for the latest project news, images, and updates.

# PROJECT SNAPSHOT

## WAIS DIVIDE FACTS:

WAIS Divide = West Antarctic Ice Sheet Divide Ice Core Project

### Chief Scientist:

Dr. Kendrick Taylor (kendrick@dri.edu)  
Desert Research Institute, Nevada System of Higher Education

### Site characteristics:

- \* Latitude: 79.468° S
- \* Longitude: 112.086° W
- \* Surface elevation: 1,759 meters
- \* Distance from current flow divide: ~24 kilometers
- \* Current average annual surface temperature: -31° C
- \* Ice thickness: 3,465 meters
- \* Distance from McMurdo Station: 1,639 kilometers

### What are we doing at WAIS Divide?

The purpose of the WAIS Divide project is to collect a deep ice core covering approximately one glacial cycle from the ice divide in central West Antarctica. The WAIS Divide ice core will provide Antarctic records of environmental change with the highest time resolution for the last ~100,000 years and will be the first Southern Hemisphere climate record of comparable time resolution and duration to the Greenland NEEM, GISP2, GRIP, and North GRIP ice cores.

### What makes the WAIS Divide ice core special?

- The most significant and unique characteristic of the WAIS Divide project will be the development of climate records with an absolute, annual-layer-counted chronology for the most recent ~40,000 years.
- Due to the high snowfall rate at WAIS Divide, the ice core record will have a very small offset between the ages of the ice and the air (i.e., gases) trapped in the ice. Because of this small age difference between the gases and the enclosing ice, a decadal-precision climate chronology relative to the Greenland ice cores is expected.
- The combination of high-time resolution and the small age offset will allow us to study interactions between climate variations and atmospheric composition with a level of detail previously not possible in deep long Antarctic ice core records.
- Unlike the Greenland ice cores, an excellent atmospheric CO<sub>2</sub> record is expected to be obtained from the WAIS Divide ice core since Antarctic ice has an order of magnitude less dust than Greenland ice.
- Many other gases (both greenhouse and non-greenhouse) and their isotopes will be measured at unprecedented precision and resolution.

### What is an ice divide?

An ice divide is analogous to a watershed divide. An ice sheet divide separates opposing flow directions of ice on an ice sheet.

### Why do we want to drill near an ice divide?

Snow and ice that accumulates on an ice divide moves vertically downward with time. As you move laterally off of an ice divide the ice increasingly moves horizontally. Irregularities in the bedrock below the ice sheet can cause horizontally moving layers of ice to bend and fold thus disturbing the internal layering of the ice. Ice coring is typically made on top of ice divides to minimize these potential interferences in the stratigraphic record caused by horizontal ice movement. The WAIS Divide drill site is actually ~24 kilometers downslope of the current ice divide because ice divides can migrate over time. Drilling slightly off of the current ice divide helps ensure that no divide migration has compromised the stratigraphy of the ice core record.

### Why WAIS Divide?

The WAIS Divide site was chosen because it is an almost exact analogue to GISP2 in Greenland in terms of accumulation rate, temperature, gas age-ice age difference, and distance from the ice divide.

### How many people are involved?

More than 100 scientists, students, and technicians from the United States are involved in the project.

### Main science objectives:

- Develop the most detailed record of greenhouse gases possible for the last 100,000 years
- Determine if the climate changes that occurred during the last 100,000 years were initiated by changes in the northern or southern hemisphere
- Investigate the past and future stability of the West Antarctic Ice Sheet
- Investigate the biology of deep ice

### Executive Committee:

Dr. Kendrick C. Taylor (Desert Research Institute) - Chair  
Dr. Richard B. Alley (Pennsylvania State University)  
Dr. Edward J. Brook (Oregon State University)  
Dr. Joseph R. McConnell (Desert Research Institute)  
Dr. John C. Prisco (Montana State University)  
Dr. Jeffrey P. Severinghaus (Scripps Institution of Oceanography)  
Dr. James C. White (INSTAAR, University of Colorado)

### Funding:

The Office of Polar Programs at the National Science Foundation (NSF) funds the project with most of the science funding coming from the Glaciology Program managed by Dr. Julie Palais. Some additional science funding is provided by the Antarctic Organisms and Ecosystems Program. Logistical support is from NSF's Division of Antarctic Infrastructure and Logistics.

# PROJECT DETAILS

## WAISCORES

The WAISCORES project is part of the U.S. National Science Foundation's West Antarctic Ice Sheet (WAIS) initiative, which is aimed at understanding the influence of the WAIS on climate and sea level change. The WAISCORES project called for two deep ice cores to be collected from West Antarctica: one from a coastal location and one from an inland location near the Ross/Amundsen ice divide region. Siple Dome was selected as the coastal location and drilling began in November 1996 and finished in January 1999. WAIS Divide was selected as the inland location and drilling began in the 2006/2007 season. It is anticipated that bedrock will be reached by the 2011-2012 field season.

## WAIS Divide Site Selection

High-resolution, grid-based airborne geophysical surveys of the Ross/Amundsen ice divide region were conducted during 1994-1996 and identified several sites with favorable surface topography, ice thickness, accumulation rate, and bedrock topography characteristics. On-ice site reconnaissance started in 1995/1996 with exploratory traverses into the area and the drilling of three shallow firn cores to confirm the preservation of climatic signals in the snow and ice. Ice flow modeling and temperature calculations were applied to the candidate sites to predict time scales and annual layer resolution. This was then followed by two seasons of ground-based geophysical surveys to further investigate the candidate sites.

The WAIS Divide site was selected based on the following site requirements:

1. Relatively smooth bed topography and minimal horizontal ice flow.
2. Individually identifiable annual layers of at least 1cm thickness in ice 40,000 years old.
3. Ice-accumulation rate sufficient to reduce the age difference between the gases in the ice and the ice itself to less than 500 years.
4. Well-behaved stratigraphy to an age of at least 80,000 years.

## WAIS Divide Activities Already Completed

2005-2006 Field Season:

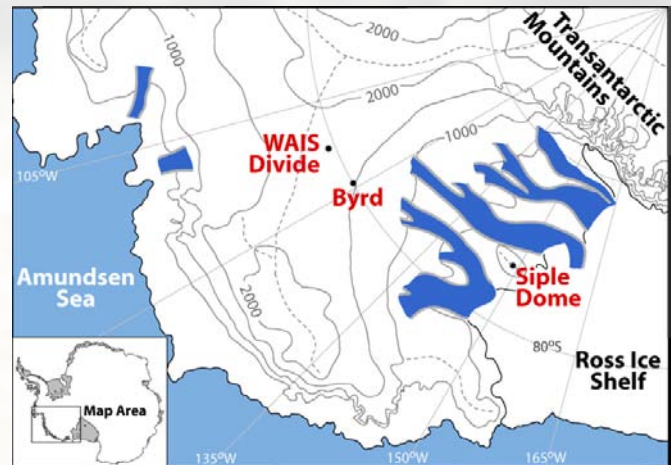
- Establishment of seasonal field camp at WAIS Divide
- Began construction and assembly of arch facility
- Drilled several shallow ice cores

2006-2007 Field Season:

- Began interior arch construction activities
- Drilled 130 meter ice core outside of arch facility
- Drilled and cased 114 meter pilot hole inside arch
- Installed two DISC Drill gantry cranes inside arch

2007-2008 Field Season:

- Installed DISC Drill and core handling equipment
- Began deep drilling with DISC Drill (114 - 580 meters)



2008-2009 Field Season:

- Deep drilling with DISC Drill (580 - 1514 meters)

2009-2010 Field Season:

- Deep drilling with DISC Drill (1514 - 2564 meters)

2010-2011 Field Season:

- Deep drilling with DISC Drill (2564 - 3331 meters)

## Projected Field Schedule

2011-2012 Field Season

- Borehole logging; deepen borehole with DISC Drill; replicate coring with DISC Drill

2012-2013 Field Season

- Repeat borehole logging; replicate coring with DISC Drill

2013-2014 Field Season

- Repeat borehole logging; remove arch

2014-2015 Field Season

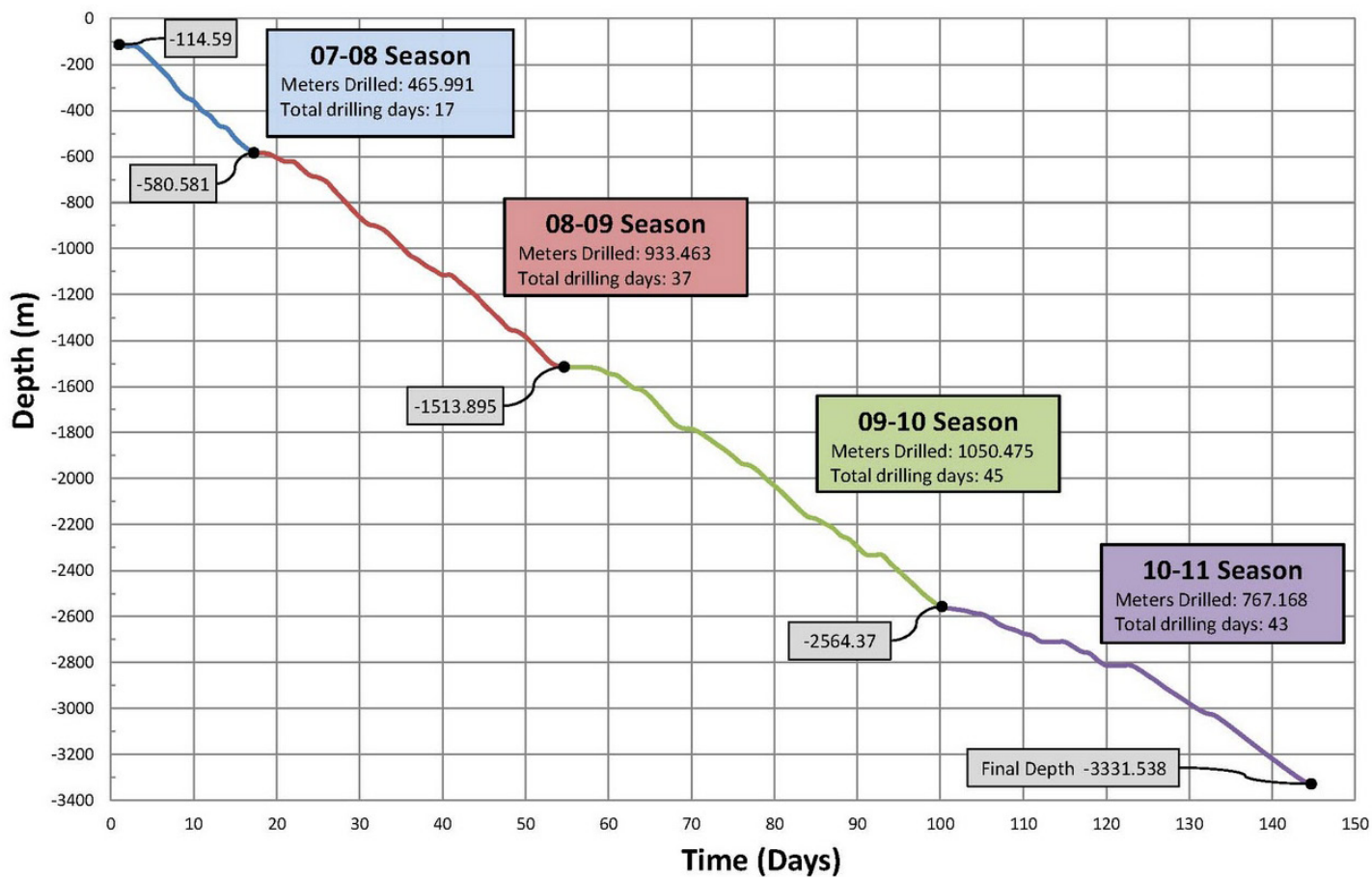
- Extend borehole casing to surface for future borehole logging

## WAIS Divide compared to other Antarctic ice cores

Other Antarctic ice coring programs focus on different time scales than the WAIS Divide project. The very high-time-resolution Australian work at Law Dome and the British Berkner Island work focus on the current warm period and the transition to the industrial era. The low-time-resolution EPICA ice cores from Dome C and Dronning Maud Land, the Japanese Dome Fuji ice core, the Italian Talos Dome ice core, and the Russian Vostok ice core focus on records of glacial-interglacial time scales (i.e., several hundreds of thousands of years). The WAIS Divide ice core will provide Antarctic records of environmental change with the highest time resolution for the last ~100,000 years.

# PROJECT DETAILS

## Drilling progress for bore hole WDC06A at WAIS Divide Antarctica IDDO - DISC Drill



FOR MORE INFORMATION ABOUT THE DRILL, READ *DRILLING DEEP* ON PAGE 12.

# SCIENCE PROJECTS

| PROJECT  | LEAD PI(s)                                   | AFFILIATION   |
|--|--|---|
| A Study of Atmospheric Dust in the WAIS Divide Ice Core Based on Sr-Nd-Pb-He Isotopes  | Kaplan, Michael                              | Columbia University   |
| Acoustic Logging of the WAIS Divide Borehole<br>(Collaborative Research)   | Anandakrishnan,<br>Sridhar<br>Waddington, Ed | Pennsylvania State University<br>University of Washington       |
| Anisotropy, Abrupt Climate Change, and the Deep Ice in West Antarctica<br>(Collaborative Research)   | Pettit, Erin<br>Waddington, Ed               | University of Alaska - Fairbanks<br>University of Washington    |
| Atmospheric Carbon Dioxide and Climate Change: The WAIS Divide Ice Core Record   | Brook, Ed                                    | Oregon State University   |
| Atmospheric, Snow and Firn Chemistry Studies for Interpretation of WAIS Divide Cores   | Bales, Roger                                 | University of California - Merced                               |
| Carbonyl Sulfide Measurements in the Deep West Antarctic Ice Sheet Divide Ice Core   | Aydin, Murat                                 | University of California - Irvine                               |
| Climate, Ice Dynamics and Biology Using a Deep Ice Core from the West Antarctic Ice Sheet Ice Divide<br>(Collaborative Research)                   | Taylor, Kendrick<br>Twickler, Mark           | Desert Research Institute<br>University of New Hampshire        |
| Climatology, Meteorology, and Microbial Metabolism in Ice with Dust Loggers and Fluorimetry  | Price, Buford                                | University of California - Berkeley                             |
| Climatology, Volcanism, and Microbial Life in Ice with Downhole Loggers  | Price, Buford                                | University of California - Berkeley                             |
| Completing an Ultra-High Resolution Methane Record from the WAIS Divide Ice Core<br>(Collaborative Research)                                       | Brook, Ed<br>Sowers, Todd                    | Oregon State University<br>Pennsylvania State University        |
| Constraining Englacial Temperatures Through Active Seismic Methods   | Peters, Leo                                  | Pennsylvania State University                                   |
| Constructing an Ultra-High Resolution Atmospheric Methane Record for the Last 140,000 Years from WAIS Divide Ice Cores<br>(Collaborative Research) | Brook, Ed<br>Sowers, Todd                    | Oregon State University<br>Pennsylvania State University        |
| Continued Study of the Physical Properties of the WAIS Divide Deep Core<br>(Collaborative Research)  | Alley, Richard<br>Spencer, Matthew           | Pennsylvania State University<br>Lake Superior State University |
| Cosmogenic Radionuclides in the Deep WAIS Divide Ice Core<br>(Collaborative Research)  | Caffee, Marc<br>Welten, Kees                 | Purdue University<br>University of California - Berkeley        |

(Continued on next page)



# SCIENCE PROJECTS




| PROJECT  | LEAD PI(s)  | AFFILIATION   |
|--|---|---|
| Cosmogenic Radionuclides in the WAIS Divide Ice Core (Collaborative Research)  | Caffee, Marc<br>Welten, Kees  | Purdue University<br>University of California - Berkeley  |
| Detection of Crystal Orientation Fabrics near the Ross/Amundsen Sea Ice-Flow Divide and at the Siple Dome Ice Coring Site using Polarimetric Radar Methods | Raymond,<br>Charles   | University of Washington  |
| Developing a Glacial-Interglacial Record of delta-13C of Atmospheric CO2   | Brook, Ed   | Oregon State University   |
| Establishing the Chronology and Histories of Accumulation and Ice Dynamics for the WAIS Divide Core (Collaborative Research)                               | Taylor, Kendrick<br>Waddington, Ed  | Desert Research Institute<br>University of Washington   |
| Gases in Firn Air and Shallow Ice at the Proposed WAIS Divide Drilling Site (Collaborative Research)   | Battle, Mark<br>Brook, Ed<br>Saltzman, Eric<br>Severinghaus, Jeff<br>Sowers, Todd<br>White, James | Bowdoin College<br>Oregon State University<br>University of California - Irvine<br>Scripps Institution of Oceanography<br>Pennsylvania State University<br>University of Colorado - Boulder |
| Glaciological Characteristics of the Ross/Amundsen Sea Ice-Flow Divide Deduced by a New Analysis of Ice-penetrating Radar Data                             | Raymond,<br>Charles   | University of Washington  |
| High Temporal Resolution Black Carbon Record of Southern Hemisphere Biomass Burning  | Taylor, Kendrick  | Desert Research Institute   |
| Histories of Accumulation, Thickness and WAIS Divide Location from Radar Layers using a New Inverse Approach   | Waddington, Ed  | University of Washington  |
| Integrated High Resolution Chemical and Biological Measurements on the Deep WAIS Divide Core   | McConnell, Joe<br>Priscu, John<br>Saltzman, Eric  | Desert Research Institute<br>Montana State University<br>University of California - Irvine  |
| Investigation of Climate, Ice Dynamics and Biology using a Deep Ice Core from the West Antarctic Ice Sheet Divide  | Taylor, Kendrick  | Desert Research Institute   |
| Investigation of the Stratigraphy and Timescale of the WAIS Divide Ice Core Using Electrical Methods   | Taylor, Kendrick  | Desert Research Institute   |
| Major Ion Chemical Analysis of Brittle Ice in the WAIS Divide Ice Core   | Cole-Dai, Jihong  | South Dakota State University   |
| Major Ion Chemistry of WAIS Divide Ice Core  | Cole-Dai, Jihong  | South Dakota State University   |
| Methane Isotope Variations Covering the Holocene from the WAIS Divide Core   | Sowers, Todd  | Pennsylvania State University   |

(Continued on next page)

# SCIENCE PROJECTS

| PROJECT   | LEAD PI(s)  | AFFILIATION   |
|---|---|---|
| Microparticle/Tephra Analysis of the WAIS Divide Ice Core (Collaborative Research)  | Dunbar, Nelia<br>Kreutz, Karl                       | New Mexico Inst. of Mining and Tech.<br>University of Maine   |
| Multiple-Isotope Analysis of Nitrate and Sulfate in the West Antarctic Ice Sheet Divide Ice Core (Collaborative Research)     | Steig, Eric<br>Thiemens, Mark                       | University of Washington<br>University of California - San Diego                                    |
| Nitrogen and Oxygen Gas Isotopes in the WAIS Divide Ice Core as Constraints on Chronology, Temperature, and Accumulation Rate | Severinghaus, Jeff                                  | Scripps Institution of Oceanography   |
| Noble Gases in the WAIS Divide Ice Core as Indicators of Local and Mean-Ocean Temperature                                     | Severinghaus, Jeff                                  | Scripps Institution of Oceanography   |
| Optical Imaging Support for the National Ice Core Laboratory  | McGwire, Kenneth                                    | Desert Research Institute   |
| Paleo Records of Biotic and Abiotic Particles in Polar Ice Cores  | Priscu, John  | Montana State University  |
| Physical Properties of the WAIS Divide Deep Core (Collaborative Research)   | Alley, Richard<br>Cuffey, Kurt                      | Pennsylvania State University<br>University of California - Berkeley                                |
| Preparation for a Deep Ice Coring Project in West Antarctica  | Taylor, Kendrick                                    | Desert Research Institute   |
| Replicate Coring at WAIS Divide to Obtain Additional Samples at Events of High Scientific Interest (Collaborative Research)   | Brook, Ed<br>Cole-Dai, Jihong<br>Severinghaus, Jeff | Oregon State University<br>South Dakota State University<br>Scripps Institution of Oceanography     |
| Record of the 17O-excess of H2O in the WAIS Ice Core  | Steig, Eric   | University of Washington  |
| Self-consistent Ice Dynamics, Accumulation, Delta-age, and Interpolation of Sparse Age Data using an Inverse Approach         | Waddington, Ed                                      | University of Washington  |
| Spatial Variability in Firn Properties from Borehole Optical Stratigraphy at the Inland WAIS Core Site                        | Waddington, Ed                                      | University of Washington  |
| Stable Isotopes of Ice in the Transition and Glacial Section of the WAIS Divide Deep Ice Core (Collaborative Research)        | Steig, Eric<br>White, James                         | University of Washington<br>University of Colorado - Boulder  |
| Stable Isotopes of Ice in the WAIS Divide Deep Ice Core (Collaborative Research)  | Cuffey, Kurt<br>Steig, Eric<br>White, James         | University of California - Berkeley<br>University of Washington<br>University of Colorado - Boulder |
| Trace and Ultra-Trace Chemistry Measurements of the WAIS Divide Ice Core  | McConnell, Joe                                      | Desert Research Institute   |
| Western Divide West Antarctic Ice Cores (WAISCORES) Site Selection  | Conway, Howard<br>Waddington, Ed                    | University of Washington<br>University of Washington  |

# ORGANIZATIONS INVOLVED

|   |   |   |
|---|---|---|
|     | <p><b>NSF</b><br/>National Science Foundation<br/><a href="http://www.nsf.gov">www.nsf.gov</a></p>                          | <p>Funding for WAIS Divide is provided by the NSF Office of Polar Programs (OPP).</p> <p><i>Science Contact:</i> Dr. Julie Palais, Antarctic Glaciology Program, NSF-OPP, <a href="mailto:jpalais@nsf.gov">jpalais@nsf.gov</a></p> <p><i>Logistics Contact:</i> Dr. Alexandra Isern, Antarctic Research Support, NSF-OPP, <a href="mailto:aisern@nsf.gov">aisern@nsf.gov</a></p> <p><i>Media Contact:</i> Mr. Dana Cruikshank, Public Affairs Specialist, NSF, <a href="mailto:dcruiksh@nsf.gov">dcruiksh@nsf.gov</a></p> |
|    | <p><b>DRI</b><br/>Desert Research Institute<br/><a href="http://www.dri.edu">www.dri.edu</a></p>                            | <p>The Chief Scientist and head of the Science Coordination Office (SCO) is Dr. Kendrick Taylor at the Desert Research Institute, Nevada System of Higher Education.</p>  |
|     | <p><b>UNH</b><br/>University of New Hampshire<br/><a href="http://www.eos.sr.unh.edu">www.eos.sr.unh.edu</a></p>            | <p>The Science Coordination Office (SCO) is managed by Mr. Mark Twickler at the Institute for the Study of Earth, Ocean, and Space at the University of New Hampshire.</p>  |
|  | <p><b>IDDO</b><br/>Ice Drilling Design and Operations group<br/><a href="http://www.icedrill.org">www.icedrill.org</a></p>  | <p>IDDO is the NSF-designated drilling contractor for the project. IDDO is responsible for the design, fabrication, testing, and operation of the Deep Ice Sheet Coring Drill. See page 11 for more information.</p>  |
|  | <p><b>NICL</b><br/>National Ice Core Laboratory<br/><a href="http://nicl.usgs.gov">nicl.usgs.gov</a></p>                    | <p>NICL is responsible for the fabrication of the core handling and core processing equipment, the design of the core handling process plan, and also for the long-term storage of the core when it is brought back to the U.S. See page 12 for more information.</p>   |
|   | <p><b>RPSC</b><br/>Raytheon Polar Services Company<br/><a href="http://www.rpsc.raytheon.com">www.rpsc.raytheon.com</a></p> | <p>RPSC is the Antarctic logistics provider for the NSF and provides all of the Antarctic infrastructure support and logistics for the project. RPSC designed, constructed, and operates the deep field camp at the WAIS Divide field site in West Antarctica. See page 13 for more information.</p>  |
|  | <p><b>USAP</b><br/>United States Antarctic Program<br/><a href="http://www.usap.gov">www.usap.gov</a></p>                   | <p>The United States Antarctic Program (USAP) supports scientific research in Antarctica and is funded by the NSF.</p>  |

## THE DEEP ICE SHEET CORING (DISC) DRILL

The DISC Drill is a electromechanical drill designed to cut and retrieve cores of ice 122mm in diameter to depths of 4,000 meters. The conceptual design of the DISC Drill was developed in 2002-2003 based on science requirements written by Kendrick Taylor, the U.S. Ice Core Working Group, and the U.S ice coring community and on engineering performance objectives. The DISC Drill utilizes many technologies proven on Russian and European ice coring drills, as well as several new innovations. The drill was designed and manufactured by a team consisting of engineers and technicians from the University of Wisconsin-Madison and various subcontractors. Assistance was also provided by the U.S. ice coring community, the European ice coring community, and the polar logistical support organizations in the U.S. The DISC Drill will be housed within the drilling arch (see photo below) at WAIS Divide.

The rotating drill head contains 4 razor sharp cutters that shave out an annulus of ice, which the 14 m long drill slides down into. As the drill slides down into the annulus it slides over the core, which is 12.2 cm in diameter and 2.7 m long. When a cable pulls up the drill, four cams grab the core and fracture it. After the drill is pulled back to the surface, it is lowered from a vertical to a horizontal orientation. An arrow is marked on the core to indicate which side of the core was facing north when the core was in the ice sheet.

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The DISC Drill consists of several major subsystems.

### Drill Sonde:

The sonde is the down-hole portion of the drill system that cuts the ice. The sonde consists of a cutter head, a core barrel in which the core is collected, screens to remove chips from the drill fluid, a motor and transmission to drive the cutter head, a pump to circulate ice cuttings in the drill fluid through the sonde, an instrumentation/control section, and an anti-torque section to stabilize the drill in the borehole. The top of the sonde connects with the drill cable.

### Drill Cable:

The cable is used to suspend the drill sonde in the borehole. The cable also provides electrical power and fiber optic communication to the drill. The cable diameter is 15 mm.

### Tower:

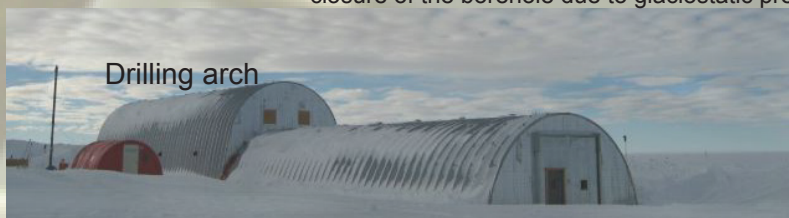
The tower consists of a mast (constructed of modular truss sections) at the top of the borehole with a number of pulleys to allow for the raising and lowering of the sonde. Once the sonde is out of the borehole, the tower tilts horizontally to allow for the removal of the ice core.

### Winch:

The winch provides the means of hoisting the drill from the borehole. The components of the winch system include the winch drum which can hold 4,400 meters of cable, a level-wind system which allows for the payout of cable from the winch drum with a single sheave, and a drive system.

### Drill Fluid:

The borehole fluid provides hydrostatic compensation, necessary to prevent closure of the borehole due to glaciostatic pressure of the surrounding ice.



Drilling arch

# NATIONAL ICE CORE LABORATORY

The National Ice Core Laboratory (NICL) was established in 1993 and is located at the Denver Federal Center in Lakewood, Colorado. NICL is a joint program funded by the National Science Foundation (NSF) and the U.S. Geological Survey. NICL's most important responsibility is for the safe and secure storage and curation of ice cores that are collected primarily by NSF sponsored projects.



## NICL's Involvement with WAIS Divide:

- \* Coordination with RPSC on core handling/ processing arch requirements and design
- \* Design and fabrication of core handling/processing system
- \* Design and support of core quality and sampling history database
- \* Support field operations with NICL staff at WAIS Divide
- \* Modify core handling/processing equipment as required based on field performance
- \* Provide input to SCO for modifications to handling/processing procedures if needed
- \* Long-term storage and curation of WAIS Divide core when it is brought back to the U.S.
- \* The main sampling of the ice core will be carried out at the NICL facility in Denver, Colorado

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Core handling/  
processing arch



WAIS Divide core handling/processing system



WAIS Divide  
core handling  
system

## THE NICL FACILITY IN DENVER, COLORADO:

- \* NICL's main archive freezer is 55,000 cubic feet in size and is held at a temperature of -36 degrees Celcius
- \* A second room for examination of ice cores, held at -25 degrees Celcius, is 12,000 cubic feet in size and is contiguous with the archive area
- \* There is also a Class-100 HEPA-filtered, cold clean room
- \* NICL also maintains space outside the freezer facility for material fabrication, storage, changing areas, offices, and visiting scientist workspace
- \* NICL currently stores over 17,000 meters of ice core collected from various locations in Antarctica, Greenland, and North America

# RAYTHEON POLAR SERVICES COMPANY

Raytheon Polar Services Company (RPSC) is the Antarctic logistics provider for the National Science Foundation. The main function of RPSC is to provide support to the United States Antarctic Program.

## WAIS Divide Involvement:

- Design, construction, and operation of the WAIS Divide field camp in West Antarctica
- Design and construction of drilling and core handling/processing arch facility
- Provide support to science parties operating at/from WAIS Divide
- All logistics of personnel and cargo movement

## WAIS DIVIDE CAMP FACTS:

- Established in the 2005/2006 field season
- Operational generally from first week of November through early February
- Camp staff consists of 10-12 people
- Camp population of 50-70 people (staff, scientists, visitors)
- Supported by LC-130, Twin Otter, and Basler Turbo 6 missions from McMurdo Station
- Camp structures consist of a communication tent, medical tent, galley tent, recreational/wash tent, 3 Jamesways, mechanic shop, generator module, science tent, and the drilling and core handling/processing arch
- Heavy equipment at camp consists of a 953 Caterpillar, a Tucker Sno-Cat, a Pisten Bully, and a Caterpillar D4 Bulldozer.
- Communications equipment consists of HF and VHF radios, Iridium satellite phones, and the GOES satellite system for internet, FTP and email connectivity
- All camp structures (except for the arch), equipment, and cargo is winterized outside on berms at the end of each field season
- Drilling arch is 100' (L) x 30' (W) x 27' (H)
- Core handling/processing arch is 84' (L) x 30' (W) x 16'5" (H)
- Core storage basement, located beneath the core handling/processing arch, is 60' (L) x 12' (W) x 12' (H)

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# WAIS DIVIDE ACRONYMS

|              |   |                  |                                      |
|--------------|---|------------------|--------------------------------------|
| <b>CO2</b>   | Carbon Dioxide                                | <b>NSF</b>       | National Science Foundation          |
| <b>DISC</b>  | Deep Ice Sheet Coring (Drill)                 | <b>OPP</b>       | Office of Polar Programs (NSF)       |
| <b>DRI</b>   | Desert Research Institute                     | <b>RPSC</b>      | Raytheon Polar Services Company      |
| <b>EPICA</b> | European Project for Ice Coring in Antarctica | <b>SCO</b>       | Science Coordination Office          |
| <b>GISP2</b> | Greenland Ice Sheet Project 2                 | <b>UNH</b>       | University of New Hampshire          |
| <b>GOES</b>  | Geostationary Satellite Server                | <b>USAP</b>      | United States Antarctic Program      |
| <b>GRIP</b>  | (European) Greenland Ice Core Project         | <b>USGS</b>      | United States Geological Survey      |
| <b>HEPA</b>  | High Efficiency Particulate Air               | <b>WAIS</b>      | West Antarctic Ice Sheet             |
| <b>IDDO</b>  | Ice Drilling Design and Operations group      | <b>WAISCORES</b> | West Antarctic Ice Sheet (Ice) Cores |
| <b>NICL</b>  | National Ice Core Laboratory                  |                  |                                      |

## ADDITIONAL READING/ INFORMATION

### **Getting to the Bottom - NICL team processes deepest ice from WAIS Divide project**

<http://antarcticsun.usap.gov/science/contenthandler.cfm?id=2501>

### **Trucked in - WAIS Divide ice cores arrive safely at NICL**

<http://antarcticsun.usap.gov/features/contenthandler.cfm?id=2391>

### **Deep core complete - WAIS Divide project finishes five-year effort to retrieve 3,331 meters of ice**

<http://antarcticsun.usap.gov/science/contentHandler.cfm?id=2349>

### **Core truths - WAIS Divide ice records past environmental changes with implications for the future**

<http://antarcticsun.usap.gov/science/contenthandler.cfm?id=2237>

### **On the line - Researchers spend summer in deep-freeze to slice and dice WAIS Divide ice core**

<http://antarcticsun.usap.gov/science/contenthandler.cfm?id=2233>

### **Biological pulse - WAIS Divide project searches for life in the ice**

<http://antarcticsun.usap.gov/science/contenthandler.cfm?id=1591>

### **Connecting the pieces - Antarctic ice core to improve greenhouse**

<http://antarcticsun.usap.gov/science/contenthandler.cfm?id=1590>

### **Deep into WAIS Divide: Project continues major effort to recover high-resolution climate record of last 100,000 years gas climate record**

<http://antarcticsun.usap.gov/science/contentHandler.cfm?id=1573>