West Antarctic Ice Sheet Divide Ice Core

Climate, Ice Sheet History, Cryobiology

Why do we study ice cores?

Ice cores help predict how climate will change in the future. Snow that falls on the ice sheet is buried by subsequent snow and forms the layers of ice that make up the ice sheet. The ice layers contain dissolved chemicals, insoluble dust particles, and atmospheric gases that were present when the snow fell. By drilling down into the ice sheet and recovering ice from ancient times, it is possible to determine the climate conditions when the snow fell. The ice layers contain a record of how the climate changed. This allows us to determine how and why climate changed in the past. By understanding how and why climate changed in the past, we are able to improve predictions of how climate will change in the future. Ice cores also help us understand how the size of the ice sheet has changed in the past in response to different climate conditions, which helps us predict how the ice sheet will respond to future climate changes.

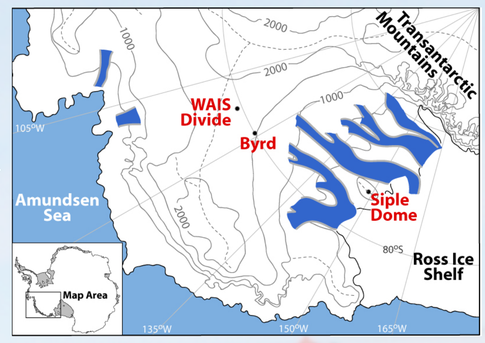
Photo: Kendrick Taylor (DRI)

Light shining through the wall of a snowpit at WAIS Divide highlights the layering in the upper two meters of the ice sheet.

Site Selection

The location for the West Antarctic Ice Sheet (WAIS) Divide ice core was selected to maximize the time resolution of the climate record during the last 100,000 years. We anticipate that we will recover a record of climate and ice sheet characteristics that extends 100,000 years into the past with annual resolution to 40,000 years. Because the drill site is located on an ice divide (similar to a watershed divide) the core is called the WAIS Divide Core (WDC). The ice is approximately 3,465 m thick at this location.

The drill site for the WAIS Divide ice core is at the site labeled WAIS Divide. Locations of other deep ice cores are also indicated (Siple Dome and Byrd). Surface elevations are shown in meters. The blue areas on the ice sheet are ice streams, regions of an ice sheet that move significantly faster than the surrounding ice.



Main Objectives

1. Examine the relationship between the changes in the atmospheric concentration of greenhouse gases and climate, to improve our understanding of how human induced changes in greenhouse gases have and will alter climate.

2. Examine the relationship between Arctic and Antarctic climate, to determine the role of the polar regions in future climate changes.

3. Examine the possibility that the size of West Antarctic Ice Sheet may decrease, to determine if a rapid rise in sea level might occur.

4. Examine the biology of ancient deep ice, to better understand how life adapts to extreme environments.

Photo: Ice Coring & Drilling Services

The Deep Ice Sheet Coring (DISC) drill is an electromechanical drill designed to cut and retrieve ice cores 122 mm in diameter to depths of 4,000 meters. The DISC Drill utilizes many technologies proven on Russian and European drills, as well as several new innovations.

Schedule

2005/2006: Established field camp and started construction of drill shelter
June 2006: Tested the drill and optimized our drilling methods in Greenland
2006/2007: Completed construction of drill shelter and drilled pilot hole
2007/2008: Install the DISC drill and start deep drilling
2008/2009: Second year of deep drilling
2009/2010: Third year of deep drilling
2010/2011: Last year of deep drilling, reach the bottom of the ice sheet. Basal sampling and borehole logging.
2011/2012: Collection of more ice from depths of special interest

The DISC Drill (see above) is housed in the tall arch shown in this photo. Once the ice core is pushed out of the drill barrel it goes into the lower arch where logging, analysis, and packing are performed before transport back to the U.S. Back in the U.S., additional measurements and analyses will be conducted on the ice.

Photo: Ice Coring & Drilling Services

Some Examples of Ice Core Data

The ice contains gases that are analyzed to determine the atmospheric concentration of greenhouse gases in the past.

Isotopes of the hydrogen and oxygen in the ice are used to determine what the temperatures were at the drill site and the ocean where the water evaporated and entered the atmosphere.

Calcium, aluminum, manganese, and the concentration, size, and mineralogy of insoluble dust particles are used to estimate the wind speed and direction when the snow fell.

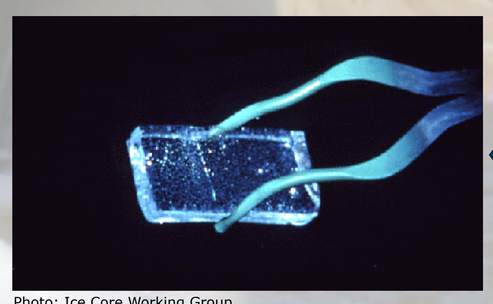


Photo: Ice Core Working Group

This thin section of ice from an ice core shows the bubbles of gas from the ancient atmosphere that are trapped in the ice. Many gases (both greenhouse and non-greenhouse) will be analyzed in the WDC to study how the chemistry of the atmosphere has changed over the last ~100,000 years.

Organizational Participants

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

Raytheon Polar Services Company is responsible for the field logistics including construction of the field camp and drill shelter, and general camp operations. Contact: Matthew Kippenhan (matthew.kippenhan@usap.gov)

Ice Coring and Drilling Services (University of Madison, Wisconsin) designed, built and operates the deep ice coring drilling that will recover the ice core. Contact: Dr. Alex Shturmakov (alex.shturmakov@ssec.wisc.edu)

The **National Ice Core Laboratory** (USGS) is responsible for development of the field core handling system, assisting investigators in sampling the ice core, and permanently archiving the ice core in Denver. Contact: Dr. R. Randall Schumann (rschumann@usgs.gov)

The **Science Coordination Office** (Desert Research Institute and the University of New Hampshire) coordinates the science aspects of the project. Contact: Dr. Ken Taylor (kendrick@dri.edu)

When the WAIS Divide ice core is brought back to the U.S. it is stored at the National Ice Core Laboratory (NICL) in Denver, Colorado. Each summer scientists and students meet at NICL and collect data and samples from the ice core for subsequent analysis at their home institutions.

Photo: National Ice Core Laboratory (NSF, USGS)

Currently Funded Projects

Project	Lead PI(s)	Affiliation
Physical Properties of the WAIS Divide Deep Core (Collaborative Research)	Alley, Richard Cuffey, Kurt	Pennsylvania State University University of California - Berkeley
Gases in Firn Air and Shallow Ice at the Proposed WAIS Divide Drilling Site (Collaborative Research)	Battle, Mark Brook, Ed Saltzman, Eric Severinghaus, Jeff Sowers, Todd White, James	Bowdoin College Oregon State University University of California - Irvine Scripps Institution of Oceanography Pennsylvania State University University of Colorado at Boulder
Atmospheric Carbon Dioxide and Climate Change: The WAIS Divide Ice Core Record	Brook, Ed	Oregon State University
Constructing an Ultra-High Resolution Atmospheric Methane Record for the Last 140,000 Years from WAIS Divide Ice Core (Collaborative Research)	Brook, Ed Sowers, Todd	Oregon State University Pennsylvania State University
Cosmogenic Radionuclides in the WAIS Divide Ice Core	Caffee, Marc Welten, Kees	Purdue Univesity University of California - Berkeley
Major Ion Chemistry of WAIS Divide Ice Core	Cole-Dai, Jihong	South Dakota State University
Stable Isotopes of Ice in the WAIS Divide Deep Ice Core (Collaborative Research)	Cuffey, Kurt Steig Eric White, James	University of California - Berkeley University of Washington University of Colorado at Boulder
Microparticle/Tephra Analysis of the WAIS Divide Ice Core (Collaborative Research)	Dunbar, Nelia Kreutz, Karl	New Mexico Institute of Mining and Technology University of Maine
High Temporal Resolution Black Carbon Record of Southern Hemisphere Biomass Burning	Edwards, Ross	Desert Research Institute
Atmospheric, Snow and Firn Chemistry Studies for Interpretation of WAIS Divide Cores	Frey, Markus	University of California - Merced
Trace and Ultra-Trace Chemistry Measurements of the WAIS Divide Ice Core	McConnell, Joe	Desert Research Institute
Optical Imaging Support for the National Ice Core Laboratory	McGwire, Kenneth	Desert Research Institute
Climatology, Volcanism, and Microbial Life in Ice with Downhole Loggers	Price, Buford	University of California - Berkeley
Paleo Records of Biotic and Abiotic Particles in Polar Ice Cores	Priscu, John	Montana State University
Detection of Crystal Orientation Fabrics near the Ross/Amundsen Sea Ice-flow Divide and at the Siple Dome Ice Core Site using Polarimetric Radar Methods	Raymond, Charles	University of Washington
Glaciological Characteristics of the Ross/Amundsen Sea Ice-flow Divide Deduced by a New Analysis of Ice-penetrating Radar Data	Raymond, Charles	University of Washington
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
Multiple-isotope Analysis of Nitrate and Sulfate in the West Antarctic Ice Sheet Divide Ice Core (Collaborative Research)	Steig, Eric Thiemens, Mark	University of Washington University of California - San Diego
Investigation of Climate, Ice Dynamics and Biology using a Deep Ice Core from the West Antarctic Ice Sheet Ice 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
Histories of Accumulation, Thickness and WAIS Divide Location from Radar Layers using a New 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

Additional Information

For more information, email Kendrick Taylor (kendrick@dri.edu) at the Desert Research Institute, or visit our website at
www.waisdivide.unh.edu