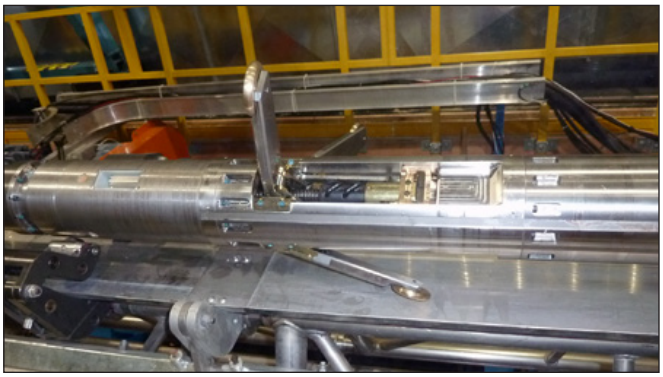
WINTER 2012-13

# Ice Bits Newsletter

U.S. Ice Drilling Program
Ice Drilling Program Office | Ice Drilling Design and Operations

*Quarterly update of Ice Drilling Program Office (IDPO) and Ice Drilling Design and Operations (IDDO) activities*

## Replicate Coring Ice Drilling Technology is Successful



*The actuator section of the replicate sonde is shown. Photo: Chris Gibson, UW-Madison, IDDO*

*The broaching head of the replicate sonde is shown. Photo: Chris Gibson, UW-Madison, IDDO*

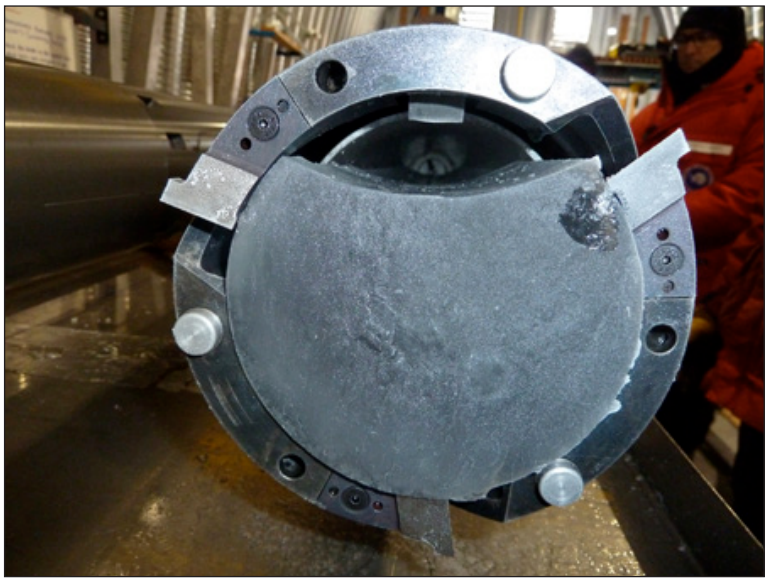
*The replicate sonde with the milling head is shown. Photo: Chris Gibson, UW-Madison, IDDO*

For the first time, significant innovations in ice drilling engineering are providing scientists with replicate ice cores from targeted depths and directions in the ice sheet!

The newly developed, state-of-the-art Replicate Ice Coring System was deployed in December 2012 to re-enter the 6.5-inch diameter deep borehole at WAIS Divide, Antarctica, and successfully allowed the researchers to drill through the wall of the 3,405 meter deep parent borehole and collect a total of 285 meters of additional core from five of the most interesting time periods in the WAIS Divide climate record.

The Replicate Ice Coring System is capable of retrieving additional ice cores from specific depths on the uphill side of the main (parent) borehole. The Replicate Coring technique, developed and tested by the IDDO engineers as part of the Deep Ice Sheet Coring (DISC) Drill, is a key advance, because it allows scientists to take samples from specific levels of a parent borehole without impeding the hole itself, leaving the parent borehole open for future logging of information.

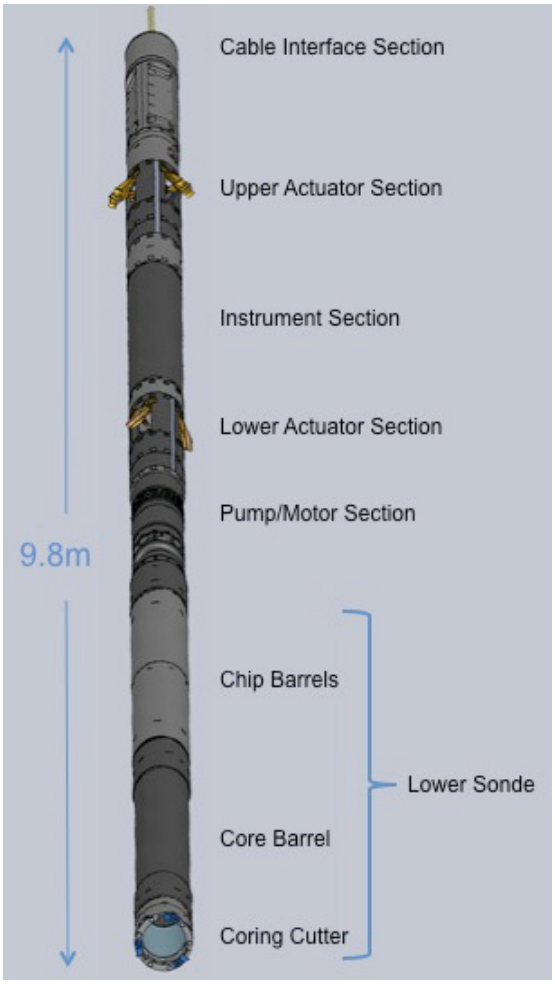
The Replicate Ice Coring System collects additional ice at depths of interest by deploying into an existing borehole and then deviating from



*The coring head with the first replicate ice core ever taken from the "uphill" side of an ice core borehole is shown. Photo: Jay Johnson, UW-Madison, IDDO*

it. The drill uses two steering actuator sections to tilt itself in the parent borehole by applying sidewards force against the borehole wall. In the first step of the process, the broaching cutter head is deployed to the target depth. Using the actuators, the drill is tipped to the high ("up hill") side of the borehole to engage the cutters. Ice is removed in repeated passes of approximately 15 meters in the up-stroke. In the second step of the process, a milling head is deployed and creates a landing for the coring head. In the third step of the process, a coring head removes a 20 mm kerf and allows a 108 mm diameter core to enter the core barrel. Two meters of core are removed per trip. The coring is repeated until all of the desired replicate ice from the target depth is obtained.

The Replicate Ice Coring System builds on the existing infrastructure of the DISC Drill and thus requires substantial logistics and infrastructure support. However, the design and engineering behind the system is such that it can be scaled down for use with smaller, more agile drilling systems as well. The downhole portion of the DISC Drill, the sonde, was significantly modified to meet the requirements of steering out of the parent hole. The major components of the replicate sonde are described below.




Cable Interface Section
The existing cable interface section of the DISC Drill provides the connection to 4km of fiber optic cable.

Upper Actuator Section
The upper actuator section steers the drill, and with the anti-torque levels extended keeps the drill from spinning during cutting operations.

Instrument Section
The instrument section provides power and communications to operate the drill.

Lower Actuator Section
The lower actuator is identical to the upper actuator, but is configured with discs on the levers to provide smooth navigation.

Pump/Motor Section
The pump/motor section has a powerful pump for chip transport and contains the cutter motor.

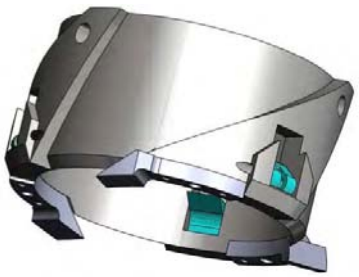
Lower Sonde
The lower sonde includes chip barrels that collect the chips that are cut during coring, a core barrel to collect the core, and the coring head. The lower sonde can be assembled in multiple configurations to meet the needs of the different stages of the replicate coring process

To see a demonstration of how the Replicate Ice Coring System works, visit:
http://www.youtube.com/watch?v=bYYwOkwl3vQ

## Intermediate Depth Drill

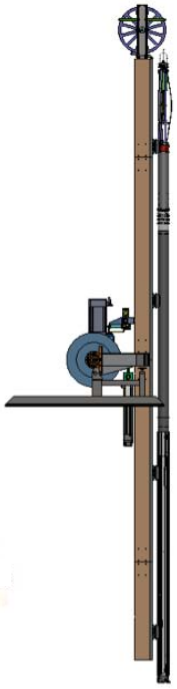
IDDO continues to work on the design and fabrication of the Intermediate Depth Drill (IDD).

The design of the IDD is similar to the Danish Hans-Tausen Drill and Danish Deep Drill, with upgrades including a 2-meter core length. The IDD will be sufficiently portable (e.g. transportable by Twin Otter or similar size aircraft) that it can be used for coring at a wide variety of sites, and capable of retrieving 98 mm diameter core from the surface down to 1500 meters depth. All surface equipment is being designed for operation to -40°C, and all sonde components are being



*The cutter head for the IDD is based on the Danish drill design, and has three cutters and three core dogs.*

designed for operation to -55ºC.

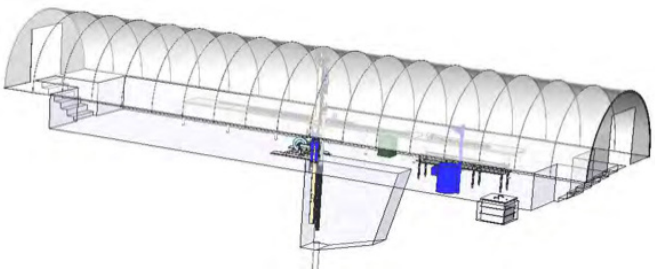


In addition to the drill itself, the IDD system will also include the following ancillary items: a core processing/handling system; a centrifuge to recover the drill fluid from the chips created by drilling the core; a drill fluid handling system; vacuums to clean the drill cable and the core; a pilot hole system (polyethylene casing and reamers); a 4.9 m (16 ft) x 22.0 m (72 ft) x 2.8 m (9 ft) un-insulated Weatherport for housing the drilling and core processing operations; and a 3.0 m (10 ft) x 4.9 m (16 ft) un-insulated Weatherport for housing the generators.

On October 17, IDPO-IDDO held a virtual meeting, Science Review of the Intermediate Depth Drill, with the South Pole 1500m Ice Core PIs, along with several members from the IDPO Science Advisory Board, and IDPO personnel. If you are interested in the details of the IDD, we highly recommend that you download the presentation and minutes from the meeting at:
http://icedrill.org/Documents/Download.pm?DOCUMENT_ID=866

The IDD design process will be completed during the 2nd quarter of FFY2013, with the IDD Final Engineering Review scheduled for March 20 in Madison, WI. Fabrication of the drill is expected to begin during the second quarter.

The IDD will be field tested in Greenland during the summer of 2014, and deployed to Antarctica for the 2014-15 field season in support of the South Pole 1500m Ice Core project (http://spicecore.org). While the drill is being designed to be compatible with existing ice drilling fluids, the drilling at South Pole is planning to use either Isopar-K or, more likely, Estisol-140 as the drilling fluid.



*The Weatherport for housing the drilling and core processing activities is shown above. The IDD system also includes a separate Weatherport for housing the generators.*

*The tilting tower and winch, shown above, is a brand new design by IDDO using a lot of new technological advances from the DISC Drill. The tower is modular allowing it to fit inside a Twin Otter, or similar sized, aircraft.*

## NSF Press Release on the Completion of Deep Drilling at WAIS Divide, Antarctica

The deep drilling at WAIS Divide, Antarctica has come to a close. It took eight field seasons to prepare the remote field camp, to drill the 3,405 meter deep ice core (the longest ice core in U.S. history), and to collect the 285 meters of valuable replicate core (see story above), but we did it. On February 5, the National Science Foundation (NSF) released a press release celebrating this historic accomplishment. In case you didn't see the press release, it is available at:
http://www.nsf.gov/news/news_summ.jsp?cntn_id=126761&org=NSF&from=news

In addition to the NSF press release, *The Antarctic Sun* also released a great story about the success of replicate coring at WAIS Divide this season. The story is available at:
http://antarcticsun.usap.gov/science/contenthandler.cfm?id=2788


*The WAIS Divide press release was featured on the NSF homepage (http://www.nsf.gov)!*

## 7th International Workshop on Ice Drilling Technology


The 7th International Workshop on Ice Drilling Technology, which is sponsored by IDPO-IDDO and is endorsed by IPICS, will be held at the University of Wisconsin, Madison, WI, USA, from 9-13 September 2013.

The workshop will take a comprehensive look at the latest technological innovations in ice drilling technology, including ice coring, borehole logging, subglacial sampling, core logging, handling and field logistics. The workshop will promote the exchange of knowledge, ideas, and experience among many countries and individuals who are involved in ice drilling projects. People active in the technical side of ice drilling are especially encouraged to participate, as are technical representatives from nations who have recently begun ice drilling programs for the first time.

The workshop will begin Monday evening with registration and an icebreaker. The main form of presentations will be oral sessions (approx. 20 min per talk) during the day on Tuesday through Friday. On Tuesday, from 3:00 pm to 8:00 pm, there will be a dedicated poster session. The posters will be displayed in their own room near the meeting room, and may remain on display for the duration of the conference. On Wednesday afternoon there will be an optional field excursion.

If you are interested in attending the workshop please complete the expression of interest form as soon as possible, but no later than 12 April 2013.
http://icedrill.org/7th-international-workshop-on-ice-drilling-technology/interest.shtml

Participants wishing to give either an oral presentation and/or present a poster are required to submit an abstract. Deadline for abstract submission is 30 June 2013.

The first circular for the workshop has already been released and can be download from the workshop's website. The second circular (early 2013) will give more information about travel and accommodation arrangements, registration, the general program, excursions, and guidelines for abstracts and papers.

For the latest information about the workshop, visit:
http://icedrill.org/7th-international-workshop-on-ice-drilling-technology/

## Deep Logging Winch

Acquisition of a deep logging winch capable of logging boreholes 4000 meters deep is one of the high-priority items identified in the Long Range Science Plan. Through many IDPO discussions with the borehole logging community and with IDDO, a set of science requirements for a deep logging winch have been developed and are available at:
http://icedrill.org/equipment/development.shtml#winchdeep

Erin Pettit, Ryan Bay, and Gary Clow will serve as the chief scientists for the deep logging winch development. The corresponding engineering requirements for the winch were developed by IDDO.

Three bids from manufacturers that are willing and capable of building the winch were received by IDDO and a "winner" identified. IDDO has started working with the manufacturer to ensure that the winch will meet the engineering and science requirements.

## IDPO Leads Community Events at AGU

IDPO was active in the American Geophysical Union meeting, December 3-7, 2012. Albert organized and Twickler participated in the AGU Town Hall on Scientific Drilling in the Polar Regions, an interdisciplinary event which included contributions from IDPO-IDDO (Albert), NICL (Twickler), IPICS (Brook), Oldest Ice (Severinghaus), RAID (Goodge), ANDRILL (Levy), and SCAR-PAIS (DeConto).

Linda Morris organized the AGU sessions on climate literacy challenges related to the emerging Next Generation Science Standards.

Linda Morris was Lead Convener for two oral and one poster sessions at the AGU fall conference. The full day strand, entitled Climate Literacy: Preparing K-12 Students to Address Next Generation Challenges, targeted educational leaders and scientists and offered presentations by national speakers involved with the changing science standards, their role in promoting climate change education and best practices for their implementation.

*Brian Reiser discusses changes in science standards at the Fall 2012 AGU Meeting.*

## Planning for the Future

During the first quarter of FFY2013, IDPO-IDDO personnel participated in the International Partnerships in Ice Core Sciences (IPICS) meeting in France, where they also advertised planning and invited contributions for the 7th International Workshop on Ice Drilling Technology. IDPO-IDDO also participated in the Oldest Ice international workshop and gave presentations on the RAID and WAIS Divide projects. IDPO worked with the Science Advisory Board to initiate planning of the spring 2013 meeting, which will occur on March 14-15, 2013 at the Hilton in Arlington, VA. IDPO and IDDO personnel worked on local arrangements and establishment of the website for the 7th International Workshop on Drilling Technology.

## Drilling Support to Science Projects

Current

- Beardmore Glacier Shot Holes, Antarctica (Conway; fieldwork completed)
- Roosevelt Island Ice Core Borehole Logging, Antarctica (Hawley; fieldwork cancelled due to weather)
- Taylor Glacier Shallow Cores, Antarctica (Schaefer; fieldwork completed)
- WAIS Divide Replicate Coring, Antarctica (Severinghaus; fieldwork completed)

Upcoming - Arctic 2013

- Cosmogenic Carbon-14 in Polar Firn, Greenland (Petrenko)
- Denali Ice Core Record, Alaska (Osterberg)
- Greenland Aerosols and Methane Records, Greenland (McConnell and Brook)
- Greenland Perennial Firn Aquifer, Greenland (Forster)
- Isotope Hydrology at Summit, Greenland (Noone)
- McCall Glacier Ice Cores, Alaska (Nolan)

Upcoming - Antarctic 2013-14

- Beardmore Glacier Shot Holes, Antarctica (Conway)
- WAIS Divide Optical Logging (Bay)
- WAIS Divide Fabric and Texture Logging (Pettit and Obbard)

For the latest information on our current and upcoming field projects, visit: http://icedrill.org/expeditions/index.shtml

**STAY CONNECTED WITH US:**

- http://icedrill.org/listserv.shtml
- http://facebook.com/USIceDrillingProgram
- http://twitter.com/#!/US_IceDrilling
- http://icedrill.org/news/subscribe.shtml
- http://youtube.com/user/USIceDrillingVideos

## REQUESTING ICE DRILLING SUPPORT

If you are preparing a proposal that includes any kind of ice drilling or ice coring support from IDPO/IDDO, you must complete a Field Project Requirement Form (www.icedrill.org/scientists/scientists.shtml) and submit it to IDPO/IDDO via icedrill@dartmouth.edu at least six weeks before your proposal deadline.

Once IDPO/IDDO receives your Field Project Requirement Form we will provide you with a Letter of Support and Scope of Work/Cost Estimate that MUST be included with your proposal. If you are submitting a proposal to NSF the Letter of Support and Scope of Work/Cost Estimate should be included as Supplemental Information in your proposal, and it is recommended that you also notify the relevant NSF Program Manager that your proposal requires support from IDPO/IDDO.

If you are preparing a non-NSF proposal, it is recommended that you familiarize yourself with the *Policy for Ice Drilling for Organizations other than NSF* available at www.icedrill.org/scientists/scientists.shtml#otheragencies.