



## PROJECT SITUATION REPORT DISC Drill 2012-13 Season

<b>Project:</b>	T-350-M				
<b>Project Principal Investigator:</b>	Dr. Charles Bentley				
<b>Report No:</b>	1	<b>for period</b>	11-11-12	<b>through</b>	11-18-12
<b>Prepared by:</b>	Kristina Dahnert	<b>Date:</b>	11-18-12		

<b>IDDO Personnel on Site:</b>	Kristina Dahnert Josh Goetz Mike Jayred Elizabeth Morton
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### ACTIVITIES DURING PERIOD

- Mike arrived in Christchurch on Tuesday, 11/13/12.
- Elizabeth and Krissy arrived in Christchurch on Wednesday, 11/14/12.
- Josh and Don Voigt (SCO) arrived in Christchurch on Thursday, 11/15/12.
- Everyone attended clothing issue at the CDC on Friday, 11/16/12.
- The four of us and Don Voigt flew to McMurdo (MCM) on Saturday, 11/17/12, via C-17 as originally scheduled and landed at the new location of the sea ice runway.
- Everyone attended the initial orientation briefing at the Chalet as well as our Science Inbrief at 5:00pm. Also in attendance were other science groups, Alex Isern (NSF), Scott Borg (NSF) and Cara Sucher (MCM Area Manager).
- Met briefly with Jessy Jenkins, our On-Ice Implementer.
- As of this report, all 4 of us are looking at flying to WAIS Divide on Wednesday or Thursday of the coming week.

### SAFETY

- Nothing to report

### COMMENTS

(Problems, Concerns, Recommendations, Etc.)

- Nothing to report

## PROJECT SITUATION REPORT DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No. 2 for period:** 11-18-12 **through:** 11-24-12

**Prepared by:** Kristina Dahnert **Date:** 11-25-12

### ACTIVITIES DURING PERIOD

- Built sleep kits for all T-350-M personnel.
- Organized all needed DNF cargo that had been stored in McMurdo (MCM) over winter.
- Located and re-TCNed all DISC Drill cargo currently in MCM. Five pieces remain in transit between Port Hueneme (PTH), Christchurch (CHC) and McMurdo (MCM). We do not expect any delays at this point.
- Completed Field Beverage Request Form for wave 1 of drillers.
- Attended an excellent Sunday Night Science Lecture in McMurdo presented by Don Voigt (SCO) entitled "WAIS Divide Ice Core Project: How Did We Do?" The lecture was well attended and received very positive feedback.
- Had fire extinguishers inspected and certified by the Firehouse; subsequently turned over to Haz Cargo for transport to WSD.
- Attended the Crary Lab Orientation, Environmental Briefing and Crary Walkthrough on 11/20/12.
- Attended FSTP (Snow School) Refresher course on Tuesday, 11/20/12. Also in attendance with us were Scott Borg and Brian Stone from NSF.
- Picked up all radio and Iridium phone equipment from Comms; labeled all pieces as T-350-M.
- Elizabeth, Josh and Krissy arrived at WAIS Divide (WSD) on Thursday 11/22/12 as originally scheduled and set up tents.
- Received and processed eight pieces of T-350-M cargo at WSD.
- Mike temporarily returned to Christchurch on Thursday, 11/22/12, for a follow up test requested by McMurdo Medical. We tentatively expect him back on the ice and out at WSD this week.
- Conducted an initial inspection of the Arch and took photos. The floor has again sustained substantial heaving, with several popped floor boards near the slot entry end of the Arch as well as at the end near the large doors. The carpenters are already in the process of repairing the floor. Large end doors on the Core Processing side of the Arch are fully accessible. The man door is accessible on the large door end of the Drill side. The large doors themselves have been cleared of snow, but the interior floor needs rework before the doors will be able to fully open.
- Installed VFD's in both gantry cranes and tested crane operation. The crane rails continued to move over winter, but safe travel for the blue gantry for large item installation has been verified. The yellow crane is operational and travel will be tested further upon completion of the floor work.

- Started up the tower hydraulic unit and were able to tilt the tower fully vertical! This is a testament to the excellent, time-consuming excavation of the slot walls performed by the Carp crew last season. The tower feet will be adjusted slightly toward the control room next week, which will determine if any footer rework or minor slot shaving will need to be done. Chipped away at snow near tower foot in anticipation of moving it over.
- Leveled the optical table
- Installed centrifuge PLC and timer
- Installed fluid tank batch controllers
- Leveled centrifuge
- Leveled screen cleaning table
- Leveled screen drying hot box
- Leveled winch cabinet base

## SAFETY

- Placed fire extinguishers in Core Processing side and Drill side of Arch.
- Verified drill fluid MSDS's are available in the drill control room and in the external eyewash station cabinet.
- Hung air monitor in control room (not yet in operation or calibrated).

## COMMENTS

### (Problems, Concerns, Recommendations, Etc.)

- There is an excellent camp staff crew in place this year under the direction of Camp Manager, Kaija Webster. Upon our arrival in camp, the Arch was already dug out and the 225kW generator was already up and running!
- Camp staff took off Saturday and Sunday for the Thanksgiving holiday. A Thanksgiving celebration was held at WAIS Divide on Saturday night, complete with five turkeys and all the fixin's.
- Weather in camp is reminding us of last year, with many windy days and a lot of blowing snow. Currently we are experiencing sustained winds of 20 knots with gusts to 26 knots and ¼ mile visibility. Visibility is expected to decrease to less than a ¼ mile over the next 24-36 hours. Welcome back to WAIS Divide!

## PROJECT SITUATION REPORT DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No. 3 for period:** 11-25-12 **through:** 12-1-12

**Prepared by:** Kristina Dahnert **Date:** 12-2-12

### IDDO PERSONNEL ONSITE

Kristina Dahnert  
Chris Gibson  
Josh Goetz  
Mike Jayred  
Jay Johnson  
Nicolai Mortensen  
Elizabeth Morton  
Patrick Cassidy (in MCM)  
Dave Ferris (in MCM)  
Jason Goetz (in MCM)

### ACTIVITIES DURING PERIOD

- Sunday was a day off for all of camp
- The 225kW generator was taken down for preventive maintenance on Monday. That combined with 25-40 knot winds and visibility less than ¼ mile kept us working in town for the day.
- Mike was re-PQed on Monday, 11/26/12
- Jay, Chris and Nicolai arrived in MCM on Monday, 11/26/12
- Dave, Patrick, Jason and Mike arrived in MCM on Wednesday, 11/28/12.
- Forwarded all remaining drill cargo on continent to WAIS Divide (WSD). Four non-critical items are still in transit to MCM as scheduled.
- Re-wired centrifuge PLC and tested system
- Cleaned fluid collection tank
- Moved tower base over approximately 3/4" and later raised the tower feet 4-3/8" to bring the tower-to-levelwind struts back into alignment.
- Re-installed truss at core transfer station
- Worked to repair and level drip pans on slot floor and around borehole casing pan
- Carpenter crew raised ventilation ducting on drill side of core processing bulkhead wall to allow for travel of the yellow gantry crane
- Adjusted floating crane rail on one side of the Arch and ensured proper travel of the yellow gantry crane
- Carpenter crew finished all floor modifications in the Arch, removed ventilation and air intake covers, relocated hand rail between winch pit and control room,

secured the winch pit ladders, raised the window above the core transfer truss and reworked the floor around the tower base to allow for movement.

- Placed and wired the winch cabinet
- Re-installed the 150 hp winch motor
- Re-leveled the optical table, placing blocks and shims under one side
- Installed computer equipment and the Glassman high voltage power supply in control room
- Jay, Mike, Chris and Nicolai arrived at WAIS on Friday, 11/30/12
- Received one pallet (12 drums) of Isopar K drilling fluid on Friday, 11/30/12
- Placed and set up the MECC machine shop
- Assembled drill on cable and began testing on optical table
- Completed software updates
- Machined parts for actuator sections
- Gave several tours of the Arch this week for both camp visitors and camp staff
- Jason attended the two day Happy Camper course in MCM on Friday and Saturday.
- Don Voigt gave his science lecture for all of camp on Thursday, 11/29/12, the same talk he gave in McMurdo a week earlier.

## SAFETY

- Placed the fire extinguisher in MECC
- Placed first aid kits and eyewash bottles in the Arch. Also mixed and installed the large eyewash station.
- Elizabeth, Krissy and Don Voigt attended the weekly camp staff safety meeting. This week's focus was on packaging and transporting patients in the event of injury or illness. Elizabeth and Krissy also demonstrated use of the special backboard/stabilization/extraction harness used in the event of a fall into the drill slot or core processing basement.
- Visitor Safety Analysis Forms filled out for all Arch tour participants

## COMMENTS

### (Problems, Concerns, Recommendations, Etc.)

- Weather in camp has steadily increased this week allowing clearing of snow to resume around the end doors of the Arch and cargo to be moved in on the drill side. Good progress was also made on digging out the 'Moose Door' (side entrance) of the Arch late this week.
- The borehole fluid level was measured three times throughout the week. At the end of the 2011-2012 season, the fluid level was brought up to 42.6m, but dropped to 36.3m by the next day, suggesting that either the casing was leaking or the depth was measured incorrectly. The fluid level was again raised to 36.3m and was found to have decreased to 36.7m overnight. This is where the level was left as of 1/30/12. Current measurements indicate the fluid level is at 69.2m, again indicating there is a leak. It has been verified that a casing seam exists at 69.8m depth, which is the likely trouble spot. This issue will be discussed further with the Chief Scientists.

## PROJECT SITUATION REPORT

### DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No. 4 for period:** 12-2-12 **through:** 12-8-12

**Prepared by:** Kristina Dahnert **Date:** 12-9-12

**IDDO PERSONNEL ONSITE:** Patrick Cassidy  
Kristina Dahnert  
Dave Ferris  
Chris Gibson  
Jason Goetz  
Josh Goetz  
Mike Jayred  
Jay Johnson  
Nicolai Mortensen  
Elizabeth Morton

#### ACTIVITIES DURING PERIOD

- Disassembled the winch clutch to investigate a noise at certain speeds. No issues were found, the clutch was reassembled with all original parts and the noise is no longer heard. The belt shroud over the clutch area was modified to cover only the clutch as the other half of the shroud was rubbing on the penetration drive pulley.
- Moved the floating crane rail to accommodate easier travel of the cranes
- Assembled borehole camera system. The new LED light ring was found to be too bright and was dimmed by adding a resistor in line on the power line.
- Did several test runs with the borehole camera. Battery life is approximately 2.5 hours and video footage was stunning during the first few runs when the fluid was relatively undisturbed. Also tilted the sonde in 90° intervals with the camera running to ensure the drill can reliably locate the high side of the hole.
- Aligned the core transfer truss
- Fabricated an additional sonde roller for the core transfer truss from spare cable drip pan shroud parts. An additional roller was needed so the core transfer truss could be set up for both one and two meter core barrel configurations.
- Checked bolt torque on the tower, centrifuge and gantry cranes
- Updated the LabView code
- Pulled the fluid hoses and mounted them on the exterior of the Arch.
- Dug out the fluid berm and bulk fluid tanks. Filled both the Isopar K and 141b tanks.
- Prepared the chip hopper pad, placed and hooked up the chip hopper.
- Completed actuator testing just inside the borehole casing to verify the actuators were positioning properly.

- Completed a wide range of bumper testing at 2000 meters depth, the area of the borehole with the highest inclination (approximately 5°). With the broaching cutter and bumper configuration, the drill experienced difficulty on ascent as the cutter is very aggressive and wanted to cut on the way up. This severely limited ascent tripping speeds. After each run, stiffer springs were installed in the bumper pads, ranging from 17N to 92N, but the broaching cutter still wanted to engage during ascent.
- When opening the hole cover during one run as the drill was nearing the surface, cable movement when being pulled away from the cover caused the drill to pendulum in the borehole, thereby causing the aggressive broaching cutter to bite off and recover a small piece of casing, approximately .3" x 3" at a depth of 34 meters. This location was verified by use of the borehole camera and the casing was not found to be compromised.
- To alleviate the ascent issues, a new aluminum cuff and a pump section were machined to hold the cuff up near the pump. The cuff is held in place near the pump section by 4 strings during descent and broaching operations. After broaching operations, the drill cutter motor is rotated, the strings are broken and the cuff slides down the length of the drill and lands on the face of the broaching cutter to shroud the upward facing cutter during ascent. This method proved successful and has greatly increased ascent tripping speeds. We are now able to reach the full 2.0 m/s on ascent.
- Completed the Seasonal Startup Checklist for Arch operations.
- The side entrance to the Arch (a.k.a. the Moose Chute) was fully excavated and is now a working point of entry/egress. Also removed a piece of flooring from immediately inside the Moose Door to allow the door to fully open. There is plywood below the piece removed and the transition in the floor was successfully covered by a large mat.
- Subsequent runs with the borehole camera were completed. While the fluid is now cloudier due to operations in the hole, we are still able to obtain good footage of the borehole wall and chips in the hole.
- Installed a new canvas bulkhead seal around the FED (Fluid Extraction Device) near the core transfer truss to keep the cold air on the refrigerated core processing side of the Arch and to prevent frost from forming on the lead-in cuff for the core barrel.
- Completed a borehole cleaning run with a six screen configuration. 1.75 screens of chips were recovered.
- Relocated tower rollers for ease of use with both the broaching and coring configurations of the drill.
- Instrument section L was replaced by Instrument section J, as there appeared to be a noise issue with section J as the cutter motor would not stay enabled if the pump motor was running. The swap seems to have alleviated the issue.
- Actuator section F was replaced by Actuator section G, as section F was leaking hydraulic oil. Actuator arm forces were recalibrated.
- Arms of the actuator were found to have a little play in them at the location of the nickel pins (fail safe mechanism). One arm was disassembled to ensure the pins were not starting to yield and they appear to be settling in fine.

- Placed nitrogen bottles in the Arch for use with the sonde purge and the centrifuge.
- Completed the first six broaching runs of the season at 3000 meters depth with good success. Cutting force is peaking at 9,000N, a definite increase from what was initially expected when compared with testing performed in Madison over the summer. However, this is not completely unexpected with consideration of the ice fabric encountered at such depths at WAIS Divide. We are now completing two broaching passes per drill run to save time spent tripping in and out of the hole.
- Descent speeds were also increased between runs by removing the upper and lower rings on the actuators. This increased descent speeds from .34 m/s to .76 m/s in the narrower portion of the hole and from .66 m/s to 1.0 m/s in the wider portion of the hole.
- Dave, Jason and Patrick were scheduled to arrive at WAIS on Tuesday, 12/4/12, but were delayed a few days due to weather at both WAIS and McMurdo, finally arriving on Friday, 12/7/12.
- Starting two shifts on Monday and Tuesday of the coming week and anticipate three-shift operations starting on Wednesday, 12/12/12.

## SAFETY

- Don, Elizabeth and Krissy held a meeting with Camp Manager Kaija Webster and Camp Medic Brian Ackerman to discuss Arch emergency evacuation procedures and outline everyone's expectations/roles in the event of an emergency.
- Installed and calibrated the DISC Drill air monitor. The monitor was successfully calibrated for Isopar K and 141b sensing. The oxygen sensor does not function, as was the case during the 2011-2012 season.
- The DISC Drill handheld oxygen monitor is also not functioning properly and a request has been made to McMurdo for two portable oxygen detectors that should arrive soon. Historical data shows that the drilling fluids do not displace oxygen in the Arch and we have a good ventilation and makeup air system in place.

## COMMENTS

### (Problems, Concerns, Recommendations, Etc.)

- The second 225 kW generator is still not operational after failure during the 2011-2012 season. While we only need one for drilling and core processing operations, there is no official backup at this time. Several repair parts arrived in camp this week, but additional parts are still en route from Germany to New Zealand.



## PROJECT SITUATION REPORT DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No. 5 for period:** 12-9-12 **through:** 12-15-12

**Prepared by:** Kristina Dahnert **Date:** 12-16-12

**IDDO PERSONNEL ONSITE:** Patrick Cassidy  
Kristina Dahnert  
Dave Ferris  
Chris Gibson  
Jason Goetz  
Josh Goetz  
Mike Jayred  
Jay Johnson  
Nicolai Mortensen  
Elizabeth Morton

### ACTIVITIES DURING PERIOD

- A few people worked on Sunday, 12/9/12, with a mid-morning start.
- Two shift operations started on Monday, 12/10/12, and continued through Tuesday, 12/11/12.
- Broaching passes were continued at a depth of 3001 meters. Between 4-8 passes of the target area can be completed per drill run in and out of the hole. Cable tension continued around 30kN for many of the drill runs.
- In an effort to reduce the cutting force during broaching, a 144mm diameter shoe was added above the broaching cutter. This reduced the depth of cut from 4mm to 2mm and decreased cutting force by approximately 1-2 kN.
- The Glassman high voltage power supply kicked out due to a short. Troubleshooting revealed the short was due to a loose m3 screw within the anti-torque section that holds the covers on the fiber optic termination cans. The screw had become lodged between the inner conductor of the cable and bore of the electrical slip ring. The screw was reattached to the cover.
- An old broaching head cuff was modified to improve the effectiveness of vacuuming runs. A length of a DISC Drill screen barrel segment was also attached to the end of the cuff. This will reduce the clearance between the barrel and borehole wall with hopes of achieving better pumping action and chip collection.
- The LVDT counts on instrument section K were found to be unstable due to data transfer rates when the drill was in the borehole. The weight-on-bit (WOB) reading was also exhibiting excessive noise in the signal, later found to be due to a circuit design problem. Both of these issues have been successfully resolved and instrument section J was modified for immediate use. The engineering

model was also updated. The WOB reading is now more stable than ever and only experiences fluctuation between 5-10 N.

- A cleaning run was done down to 3,200m with six screens available, but only one full screen was recovered. The chips were very fine and thus we may not be recovering all chips created during each broaching pass.
- A 142.5mm shoe was installed, producing additional positive results during broaching. With a 2.75mm depth of cut, this decreased cutting force, thereby decreasing cable tension.
- Completed the first logging tool test run combined with a camera run. The logging test passed by the deviation areas without any issues or concerns.
- Several camera runs have been completed, verifying the progress of broaching and the existence of any notches created by milling operations.
- Instrument section K was opened in order to diagnose an issue with the I2C bus. A small amount of drilling fluid was found in the section between the upper and lower bulkhead seals. One of the seals had a small nick on the outer edge which may have been the problem, however we are not sure if this is the point of entry for the fluid. The SAE plug o-rings were changed, the unit was reassembled and put back in service.
- The door on the control room was hyper-extended and the hinges were broken in half as the yellow gantry crane attempted to traverse by. The door was repaired by adding bar stock on the hinges. The door was re-installed and functions normally.
- Began three-shift operations on Wednesday, 12/12/12.
- When the desired depth notch of 100mm had been acquired through broaching, at least theoretically when calculating number of passes performed and accounting for theoretical depth per pass gained, milling operations were begun. The actuators were rotated into an inline configuration. Side push was initially tried as per the drill plan. The head was set up with a radial shoe for a 1.5mm deep cut and an axial shoe for 1mm feed per tooth.
- Stick-slip tests were done in side push mode with the camera running to determine our inability to create a ledge through milling. With upper and lower actuators set at 90% effort, the drill slips at a rate of about 1m/s. It was determined that this is the cause of why the milling cutter could not successfully form and maintain a ledge initially.
- Changing actuator arm efforts to 60%, changing feed rate to 0.15 m/s and changing cutter speed to 110 rpm proved successful during milling. After 20 passes were performed during one run between 2998 meters depth and 3001 meters depth, a ledge was formed as verified by WOB during a subsequent touch off. Through a camera run, the size of the ledge was estimated to be approximately 25mm.
- During milling, a few instances occurred where the winch would not stop slow speed payout upon command. The e-stop had to be used to stop the winch each time. This issue was witnessed during the 2011-2012 season, but its cause has not been determined.
- While the ability to produce a ledge via milling was verified, the initial notch produced by broaching was only found to be about 50mm, half the size of the

100mm depth notch desired for milling, so the drill was again reconfigured for broaching operations.

- The sonde control computer is rebooted periodically, as the LabView software stops communicating on occasion. This issue is manageable with computer restarts.
- The dowel pins that had been added to the pump section for use of the drop ring were found to be protruding .125" from the barrel. They were, in essence, acting like a shoe, which would hold the barrel off of the wall. The pins are now removed for milling operations and are reinstalled for broaching.
- Mike Jayred returned to McMurdo on Thursday, 12/13/12, for minor dental work and returned to WAIS Divide the next day on Friday, 12/14/12.
- Received 12 drums of Isopar K drilling fluid.
- Fabrication of a ratchet ring was completed and the ring was installed on the pump. This ring will allow the strings holding the drop ring during ascent to rotate one way (clockwise), thereby allowing for broaching with rotation, but will ratchet when the cutter motor is turned the other direction (counter clockwise), thereby cutting the strings and releasing the drop ring to slide down on top of the broaching cutter for smoother and faster ascent out of the hole. The ring was tied on with two strings during its initial drill run.
- Broaching with rotation was subsequently tested. This method stabilized crown sheave tension and WOB, though it appeared as though the strings were cut at some point during the third pass, as no additional cutting was experienced.
- The broaching cutter was moved to the lower position on the mandrel to allow for better chip clearance and the drop ring was subsequently attached to the ratchet ring with four strings.

## SAFETY

- Held brief safety meetings for all Arch staff on both Monday, 12/10/12, and Tuesday, 12/11/12. Locations of safety equipment were discussed as well as protocol for Arch emergencies. Also demonstrated use of the Kendrick extraction device used for patient extraction from the slot if necessary.
- Performed troubleshooting on large DISC Drill air monitor, as two lines were troubling. The line running to the screen cleaning area was pulled back into the control room for drying and should be re-installed on Monday. A backup handheld air monitor arrived from McMurdo, but the monitor is for CO and not O<sub>2</sub>. McMurdo has been contacted for a monitor swap.

## COMMENTS

### (Problems, Concerns, Recommendations, Etc.)

- The second 225 kW (backup) generator is still not operational, though additional parts were just received late this week. The 225 kW generator in use experienced two shutdowns this week. The first occurred on 12/12/12 when the main breaker on the generator partially melted down. Power was down for 1.5 hours while the breaker from the inactive generator was swapped in. The second power failure occurred on 12/15/12, registering an undervoltage condition. The causes of the two failures have not been determined. A

contingency plan was developed with camp staff to prepare a 40 kW generator for powering the Arch/drill operations in the event both 225 kW generators go down.

- Terry Wilson, the PI for the Polenet project, gave a Wednesday night science lecture that was well attended.

## PROJECT SITUATION REPORT DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No. 6 for period:** 12-16-12 **through:** 12-22-12

**Prepared by:** Kristina Dahnert **Date:** 12-23-12

**IDDO PERSONNEL ONSITE:** Patrick Cassidy  
Kristina Dahnert  
Dave Ferris  
Chris Gibson  
Jason Goetz  
Josh Goetz  
Mike Jayred  
Jay Johnson  
Nicolai Mortensen  
Elizabeth Morton

### ACTIVITIES DURING PERIOD

- Performed a cleaning run using the original DISC Drill screen barrel and 10 screens. Only 1.75 screens were filled. It appears as though the bottom 7 meters of the parent borehole is full of chips through which the DISC Drill screen barrel cannot penetrate. A full cleaning run with the conical tool attached to the end of the DISC Drill screen barrel will be completed at the end of the season. The conical tool, combined with barrel rotation, will loosen the chips so they can be collected.
- After additional broaching runs last week, the drill was reconfigured for milling operations. One run was performed, completing 50 passes while milling between 2995 meters and 3002.2 meters depth. A ledge was established at 3000.2 meters!
- Completed a second milling run, adding axial shoes to the milling head. The head cut as expected with the cutter torque increasing as the ledge was made wider. Adequate width and stability of the notch were verified by retracting the actuators and witnessing an increase in inclination with a constant hold on weight-on-bit (WOB).
- The drill was reconfigured with a 1 meter core barrel and 3 screens. The actuators were rotated in line. 218" rear shoes were added for a 1mm pitch per tooth.

**\*\*\* FIRST REPLICATE CORE RECOVERED on Monday, December 17, 2012! \*\*\***

- Coring operations showed chatter in the cutter torque, but penetration was good. While no core break was witnessed with regard to rise in cable tension, a

beautiful 1 meter core was recovered with a moon shaped cutout as was expected.

- After drilling a second 1 meter core, the drill was reconfigured with a 2 meter core barrel and five screens. With this setup, 1.75m could be drilled per run.
- Rollers on the tower were adjusted to accommodate both broaching and coring configurations of the drill.
- An issue was experienced with the cutter motor disabling during coring operations. This was attributed to either stick-slip or too aggressive of a cut. Cutter pitch was reduced from 1mm per tooth to .75mm per tooth.
- A 141mm diameter ring was installed on the upper actuator section to help support the upper sonde.
- Once the entire drill is in the deviation hole for coring operations, only the upper actuator arms are utilized during coring. The knife blade configuration on the upper arms provides anti-torque while coring.
- High core break tension was experienced this week, ranging from 23 kN to 35 kN. This was also experienced while drilling the parent borehole.
- A sixth screen was added to the screen barrel, allowing for the collection of full two meter cores.
- Fabricated a segmented broaching ring that mounts in place of the axial shoes on the milling head. This will be used starting with the next deviation.
- A scheduled power outage for generator maintenance occurred on Wednesday, 12/19/12.
- LVDT counts began creeping on the actuator arms throughout the week, with a couple of the arms remaining in the 20's after being commanded to retract (a 0 count signifies full retraction). Three shear pins have been changed this week due to either preventive maintenance or failure.
- 32 new shear pins were fabricated.
- Upper bulkhead pressure of the instrument section, as read between the two seals of the instrument section end cap, began reading borehole pressure during several runs this the week. On three occasions, the SAE plug was removed and 1-2 cups of fluid were drained from the instrument section each time. Instrument section K which is currently in use will likely be replaced along with leaking upper actuator section E after the first deviation is completed.
- A very visible ash layer was drilled at 3035.56 meters. This depth correlates well to the ash layer drilled in the parent borehole.
- The previous issue experienced with WOB and data rate transmission was repaired on Instrument section J. This section was reassembled and is ready for service. It will likely replace section K.
- Completed design of a trigger system for use with the drop ring and started fabrication. The trigger system will hopefully eliminate the need for strings to secure the drop ring during broaching operations.
- Drilled the second deepest U.S. ice core ever drilled, once again surpassing GISP 2 at a depth of 3056 meters.
- Added stabilizer pads to the top of the core barrel (147mm effective diameter) and relocated the 141mm diameter upper ring to the top of the upper actuator

section. These corrections were made to encourage the drill to continue away from the parent borehole, though no issues have been witnessed.

- Total number of drill runs this week: 46
- Total meters drilled this week: 86.067 meters
- Current drill depth: 3087.62 meters

## SAFETY

- High winds and blowing snow greatly restricted visibility for much of Thursday and Friday this week. The heavy equipment operators are going a good job of cleaning snow away from the Arch doors as weather permits. While the drilling end of the Arch and the side entrance sustained heavy drifting, the core processing end of the Arch remained relatively drift free.
- After each power outage this week, the Arch ventilation system was restarted and proper operation was verified.
- Jessy Jenkins, our POC in McMurdo, is continuing her search for a backup handheld O<sub>2</sub> monitor.

## COMMENTS

### (Problems, Concerns, Recommendations, Etc.)

- The replacement breaker arrived for the second 225 kW generator and was installed. The second generator was repaired and started up. One of the cores is not the correct part, but the mechanics believe it will suffice and should allow the unit to function until the correct part arrives in several weeks.
- An unscheduled power outage occurred when the second 225 kW generator overheated. This was most likely caused by the windy conditions late this week. Operations resumed on the other 225 kW generator.
- Happy Holidays from everyone at WAIS Divide!

## PROJECT SITUATION REPORT DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No. 7 for period:** 12-23-12 **through:** 12-29-12

**Prepared by:** Kristina Dahnert **Date:** 12-30-12

**IDDO PERSONNEL ONSITE:** Patrick Cassidy  
Kristina Dahnert  
Dave Ferris  
Chris Gibson  
Jason Goetz  
Josh Goetz  
Mike Jayred  
Jay Johnson  
Nicolai Mortensen  
Elizabeth Morton  
Tanner Kuhl (arrived in CHC)

### ACTIVITIES DURING PERIOD

- Coring continued and the first deviation was completed on 12/24/12. Depth of the first deviation was from 3001.549 meters (driller's depth) to 3100.256 meters for a total of 98.7 meters collected. Drill configuration for coring consisted of a 2 meter core barrel and 6 screens.
- Received the new broaching cutters and the actuator section engineering model.
- The final logging tool test of the first deviation was completed in conjunction with a borehole camera run. The 29.5 lb. dummy logging tool passed through the deviation area at 0.05 m/s with no issues, with weight-on-bit (WOB) only varying by 4 N. Excellent borehole footage was also captured by the camera.
- The drill was reconfigured for broaching of the second deviation starting at a depth of 2415 meters with upward broaching passes to 2402 meters. Initial broaching configuration of the drill included a 156mm upper ring, a 155mm lower ring, 3 screens, disk ends on the actuator arms, a new broaching cutter with a deep serrated edge and a 142.5mm shoe. As very little cutting was seen with this configuration, the rings were removed to allow for a more aggressive cutting angle. While cutting improved, it did not prove as successful as with the first deviation. This is likely due to the fact that the borehole was reamed a bit during the 2011-2012 season in the area of the first deviation, thus giving the drill more opportunity to tilt. The area near the second deviation is a tighter fit and also has the added challenge of higher inclination in the parent borehole.
- Replaced the disk ends on the upper actuator with knife edge rollers.
- Completed fabrication of parts for the drop ring trigger and installed them on the drill.



- Recalibrated the actuator arm forces. They averaged 10% lower than during the previous calibration. Max force was subsequently increased by 10%.
- Resumed broaching operations, now adding rotation of the cutter motor, generally between 40-80 rpm. The cutter engages very quickly and the cut is much smoother than without rotation.
- Cleaning runs have been completed with both the original DISC Drill screen barrel and check valve as well as with the Replicate Coring screen barrel and check valve, though each with little success. The borehole camera shows both fine chips and large ice chips created as a result of broaching. The replicate coring check valve did not seem able to collect these large chips, so the single disk inside of the valve was replaced by two half flaps from the DISC Drill check valve. While we are now able to collect large chips in the screens, chips are still being left in the hole from broaching operations. These chips have been mildly problematic, as many become lodged in the pump impellor, near the actuator arms or along side the drill as it is descending in the borehole. The WOB check limit is enabled to automatically stop winch payout should the drill travel be impeded by a wedged chip in the hole. Chips seem to be congregating between 850 meters and 1250 meters according to borehole camera footage.
- The cutter retaining bolt plate was removed from the broaching mandrel. It was replaced with a bar to provide less obstructive chip flow for the large chips.
- On several occasions, ice chips became lodged in the pump impellor, causing the pump spindle to bind and the pump motor driver to fail. In one instance of motor driver failure, the cutter motor could not be rotated and thus the drop ring was not deployed. Without the ring shrouding the upward facing broaching cutter on ascent, the cutter caught the bottom of the casing. The crown sheave tension reached 24,000N. This was a very high spike considering the drill depth. The end cap of the broaching head was dished and the draw bolt bar was severely bent. To rid the pump impellor of large ice chips and prevent future motor driver failures, compressed air is utilized between drill runs to blow out any obstructions within the pump housing.
- The broaching head was repaired and a redesigned mount for the draw bolt was fabricated and installed.
- Broaching operations continued for much of the week. The cutter engages well initially and seems to drop out of the cut 5-6 meters later in the 13 meter stroke length per pass.
- Instrument section L was opened to investigate issues with the cutter motor disabling itself. The section was found to unexpectedly contain nearly a liter of drill fluid. Repair on this section will be completed as time permits.
- Instrument section K has also experienced minor leaking issues, though this is easily monitored through the software.
- Instrument section K was replaced by section J while various repairs were completed. Once installed, section J was found to have a communications issue with the fiber optics. This caused the software to update very slowly and prevented the cutter and pump torque graphs from displaying. This section was quickly replaced by the seemingly repaired section K, though a WOB issue unrelated to the previous issues was discovered on section K. Troubleshooting

determined the issue was due to a loose connector pin on the WOB board. After securing the loose pin, the inclinometer was found to be dysfunctional. The inclinometer was replaced and the section was fully reassembled and put back in service. Troubleshooting of section J continues and the fix for the fiber issue has been identified.

- A borehole camera run down to the second deviation area showed the broaching notch to be about 80mm deep about 1.5 meters off of the start of the buffer coring area. This was deeper than the depth of the notch made during the first deviation, so the drill was reconfigured for milling operations.
- 25 milling passes were completed with the broaching inserts installed on the milling head in place of the axial shoes. Some care is needed during descent of this cutter configuration, as the downward facing broaching teeth are very aggressive and want to engage in the borehole casing as well as where there are diameter changes in the borehole. In such instances, the actuator arms were deployed to move the drill away from the borehole wall.
- 1mm axial shoes were then installed on the milling head in order to mill a pad needed for positioning of the coring head.
- The first coring run on the second deviation was completed on Friday, 12/28/12. The 1 meter core drilled well, but the diameter of the core was insufficient and the width of the crescent only varied by 2mm over the length of the core. In addition, large chips floating in the hole plugged the check valve on the way down, so the screens were empty when returned to the surface. In addition to the core itself, a good volume of the large chips were found in the core barrel followed by a pack of finer chips created during coring operations.
- In contrast to the first deviation, the ledge on the second deviation was not created to the full depth of the broaching notch, so milling operations were resumed. The milling/broach hybrid head was utilized along with a 1 screen configuration. Using initial angle for the actuator arms, a cutter speed of 110 rpm and a 0.05 m/s feed rate, numerous milling passes were completed between 2413.5 to 2414.5m. Inclination was recorded at the beginning and end of each run. Milling was stopped when little cutting was seen. The inclination rose from 4.3° to 4.5°. Milling was then continued to 2414.6 to ensure only one ledge had been created and not a stair step of smaller ledges. According to inclination readings, this work should have created a 23mm ledge.
- The milling head was again reconfigured with shoes (1mm cut/tooth) and the ledge milled down to the end depth of the previous coring run where creation of a full pad was then attempted.
- The drill was again reconfigured for coring and a second coring run was completed, with just under a meter drilled. Unfortunately the core diameter only increased by 2mm across its length, thus we were not securing a proper deviation angle out of the main borehole.
- A camera run was completed to investigate the deviation area, but the presence of chips in the borehole obscured viewing of the ledge.
- The drill was yet again reconfigured for broaching operations. Numerous passes were done to broach out the figure eight left by the previous milling and coring

attempts and to extend the length of the deviation. Pass length was from 2417.2m to 2398m.

- Instrument section K experienced a failure with the motor power supply and section J was again installed. Section J again experienced the WOB issue seen earlier, but this was later discovered to be a resistor that had been removed during testing.

## SAFETY

- Troubleshooting of two air monitor lines this week. Vapor levels in the Arch are well within acceptable limits and the ventilation system is working well.
- Jessy Jenkins, our POC in McMurdo, will procure a handheld O<sub>2</sub> monitor from Christchurch, as one cannot be located in McMurdo.

## COMMENTS

### (Problems, Concerns, Recommendations, Etc.)

- The backup 225 kW generator was load tested for a 24 hour period. The installed parts are not the exact replacement parts needed, but the generator still tested well and the correct parts are in transit.
- A delicious Christmas dinner was enjoyed by everyone in camp on Sunday night, followed by an exciting white elephant gift exchange. Drill operations were suspended for 24 hours over the holiday. Camp staff also enjoyed a well-deserved two days off.
- Happy New Year from everyone at WAIS Divide!

## PROJECT SITUATION REPORT DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No. 8 for period:** 12-30-12 **through:** 1-5-13

**Prepared by:** Kristina Dahnert **Date:** 1-6-13

**IDDO PERSONNEL ONSITE:** Patrick Cassidy  
Kristina Dahnert  
Dave Ferris  
Chris Gibson  
Jason Goetz  
Josh Goetz  
Mike Jayred  
Jay Johnson  
Nicolai Mortensen  
Elizabeth Morton  
Tanner Kuhl (arrived in MCM)

### ACTIVITIES DURING PERIOD

- Tanner Kuhl arrived in McMurdo on Sunday, 12/30/12.
- Broaching operations continued on the second deviation. The motor power supply in Instrument section J began cutting out several times per run due to an internal grounding issue. This section was replaced by Instrument section tube K containing the Engineering Model baseplate.
- Began broaching/milling hybrid operations. The shoes on the milling head were shimmed out .005" to reduce the cut per tooth from 1mm to 0.5mm.
- Removed the fail-safe pivot assemblies from the actuator section engineering model. These will be used as spares for the other actuator sections.
- After formation of an adequate landing pad was assumed to be completed, coring operations were again tried in the second deviation. The first core pulled up was again a crescent shape, but now displayed an acceptable increase in angle over the length of the core to continue with coring operations.
- The drill was tilted using the initial angle method and was run up and down several times between 2416.2 meters to 2416.7 meters in order to obtain the highest angle possible. Coring was then resumed and the first full diameter core of the second deviation was drilled on Monday, 12/31/12.
- A level wind fault was experienced on Monday, 12/31/12. After extensive troubleshooting, it was determined the encoder on the level wind motor had failed. The encoder was removed from the control loop, as it is not necessary for payout or critical positioning information. An order has been placed for a spare motor encoder.
- A camera run and logging tool test of the second deviation were completed after the borehole had sat undisturbed for 24 hours over the holiday. During the

logging tool test, WOB varied by only 6N in the deviation zone, thus the test was considered a success. Unfortunately, the borehole fluid was too cloudy to obtain good video footage.

- Coring operations again continued, though difficulty was experienced when trying to reenter the second deviation each run. This process often took over 45 minutes per run to enter the deviation. Offsets for the actuator arms were recalibrated. Arm E1 of the upper actuator section was found to be a bit sluggish. Ethanol was used to clean the ball nut, loosening travel of the arm. Five of six arms were within 10% of expected values, while one arm was 20 % out of range.
- Rotation of the coring head was used during descent in the deviation area in order to drill out the transition area. This expanded the entry point to the second deviation and it is now entered successfully on the first or second tries each run. Occasionally, the cutter requires a quick jog to disengage the drill from the remaining ledge at the transition, around 2418 meters.
- A new set of core dogs was installed, as the dogs were starting to slide up and gouge the exterior of the core on a regular basis. The original core dogs were resharpener and the springs were adjusted.
- A sixth screen was added to the coring drill configuration. This enables collection of a full 2 meter core per run.
- During one run on Thursday, 1/3/13, the cutter would not penetrate properly. After several attempts to initiate cutting, the drill was returned to the surface for inspection. Two cutters were found to be missing from the cutter head, the third cutter was severely chipped and the shoes were worn down. Flathead screws and cutter locating pins had also been sheared from the head.
- A square magnet commonly used for fishing small tools from the drill slot was attached to the interior lip of a barrel cuff from the old broaching mandrel in order to create a fishing tool. The magnet was recessed 5/8" to allow room for a cutter to attach to the magnet without getting pulled away during drill ascent. During the first recovery run attempt, only a few metal flakes were recovered that look to be from the cutters. The pins, screws, and two cutters were not recovered.
- A second magnet head configuration was fabricated. This configuration consisted of four magnets bonded to a metal disk. Though the piece was from a PoleNet wind generator, the diameter of the disk was a perfect match for a drill barrel and was welded to the end of a barrel cuff. Unfortunately, this configuration also failed to recover any missing hardware, as it is suspected the broken hardware had been compacted or slightly melted into the ice at the bottom of the deviation bore.
- Broaching operations were initiated for the third deviation, so as not to lose time while additional fishing and recovery tools were designed and fabricated. Broaching passes for the third deviation span from 2221 meters up to 2204 meters. The broaching stroke length for this deviation has been increased from the 13 meters used during previous deviations to 17 meters now. This will hopefully aid in our formation of an adequate notch and milling ledge.
- Good broaching continued on the third deviation accompanied by successful chip collection.

- A conical tool for the replicate bore was designed and fabricated and was deployed in the second deviation for one drill run. The idea was to counter bore the center of the bottom of the hole so that the hardware would fall into the depression and the coring drill could collect core around it.
- After the conical tool was deployed, the drill was reconfigured using the originally damaged head that had now been reworked. A one meter core was collected and all objects previously sheared from the cutter head were collected in the core barrel on top of the core, including 2 flatheads, 4 pins and 2 cutters!
- Upon inspection of the cutter head design, it was found that the back end of the cutters do not fit snugly against the pocket in the head. This fit puts the entire cutter load on the cutter locating pins and the cutter attachment screws, which may have been a contributing factor in the loss of hardware in the borehole. The back end of six cutters was built up with weld and then machined. The cutters now have a tight fit to the cutter head and coring operations resumed in the second deviation using the second new cutter head.
- The remaining two sets of cutters have been modified for a tight fit against the cutter head and the countersink has been replaced with a counter bore for use with a larger M4 screw as a cutter attachment (M3 screws were previously in use).
- Performed maintenance on and readied the spare core dog assemblies for use.
- Drilling operations continued through Saturday night into Sunday.
- Inventoried two electrical crates on the cargo line that had been shipped to WAIS with the original DISC Drill shipment in 2007-2008. Attempts are being made to retro cargo that will not be needed for the remainder of the project.
- Two sets of spare encoders for the winch motors and sheaves were located in one of the electrical crates. One set is an exact replacement for the encoders currently in use and the second set are units rated for a higher temperature range.
- Linda Morris (IDPO) left the U.S. on Friday, 1/4/13, bound for Christchurch, NZ.

## SAFETY

- Elizabeth Morton attended the weekly camp safety meeting. This week's meeting focused on back safety and prevention of repetitive stress injuries.

## COMMENTS

### (Problems, Concerns, Recommendations, Etc.)

- One of the Core Handlers, Brad Markle, and one of the Replicate Coring P.I.s, Jihong Cole-Dai, gave science lectures for the camp this week. Brad outlined the side project he is conducting while at WAIS Divide, which involves studying spatial variability of water isotopes in the area through the collection of firn cores and the sampling of snow pits. Jihong discussed "What is Replicate Coring and Why Are We Doing It?" Both lectures were well-attended and nicely showcased the excellent science happening at WAIS Divide this season.
- Power generation now alternates between the two 225 kW generators, and both are working well. Parts for the one generator are still in transit.

- Package mail is experiencing a severe delay in transit this season. While personal packages are not as critical, we have coordinated with Wisconsin, Christchurch and McMurdo to get some recently ordered electronics components out to WAIS as quickly as possible. The parts will be implemented in the instrument sections should the motor drivers experience additional failures.
- A delicious New Year's Eve dinner was enjoyed by everyone in camp on Monday night, followed by the dropping of the ball (an exercise ball wrapped in tin foil) at midnight. Drill operations were again suspended for 24 hours over the holiday. Camp staff enjoyed another well-deserved two days off

## PROJECT SITUATION REPORT DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No. 9 for period:** 1-6-13 **through:** 1-12-13

**Prepared by:** Kristina Dahnert **Date:** 1-13-13

**IDDO PERSONNEL ONSITE:** Patrick Cassidy  
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Jason Goetz  
Josh Goetz  
Mike Jayred  
Jay Johnson  
Nicolai Mortensen  
Elizabeth Morton  
Tanner Kuhl (arrived at WSD)  
Linda Morris (IDPO – arrived in MCM)

### ACTIVITIES DURING PERIOD

- Completed the second deviation on Sunday, 1/6/13 at a depth of 2469.488m.
- Installed bulkheads on Instrument Section J. This section is again ready for use.
- Installed a new encoder on the level wind motor.
- Repaired a grounding issue in Instrument Section L. Began cleaning the tube and bulkheads for this section.
- Chris Gibson departed WAIS Divide on Monday, 1/7/13, a few days later than originally scheduled. Tanner Kuhl arrived on the flight that Chris left on.
- Continued broaching operations on the third deviation. Broaching was continued until the inclination delta was over  $0.7^\circ$  as measured before the arms were actuated and again after actuation.
- The ratchet ring, trigger arm and trigger were left on the drill for mill/broaching operations. The head on the set screws for the ratchet ring and screws mounting the trigger arm were packed with ice indicating that these parts were rubbing on the bore wall. The parts were removed for the final milling runs. One ratchet pall, pin and two springs were also missing. They are assumed to be in the parent borehole and should be collected during cleaning runs at the end of the season.
- Started and completed mill/broach hybrid operations on the third deviation on Tuesday, 1/8/13. As with previous deviations, multiple passes are made with the milling head and the broaching shoes and a subsequent run is made with the milling cutter and axial shoes to prepare a pad for the coring drill.
- Fabricated new springs for the ratchet ring and added retaining screws to prevent the pins holding the ratchet palls from coming out.



- Replaced the shear pins on lower actuator arms G1 and G3.
- Performed maintenance on the pump that is set up for use with the drop ring. The grease pocket at the end of the shaft contained a small amount of drill fluid. The seal was replaced and the area on the shaft where the seal runs was polished.
- The first core of the third deviation was drilled on Tuesday, 1/8/13. The core was 0.7 meters long and displayed broaching cut marks on the inside of the crescent. The core was drilled with a 1-meter core barrel and 3 screen configuration.
- The second core displayed only a small amount of broaching marks for the first few centimeters and then increased to full diameter. The first few cores of the deviation were less than one meter long, as we were still collecting broaching and milling chips and thus packing the screens before a full meter was drilled.
- The coring drill was reconfigured to add a fourth screen. The screens again filled before a full meter of core was obtained.
- The coring drill was reconfigured for a 2-meter core barrel and five screens. A sixth screen was subsequently added to allow for collection of a full 2-meter. Approximately 2/3-3/4 of one screen continued to fill with broaching chips each run.
- Added sintered bronze breathers to the magnetic coupler cavity of motor sections X and Y. An issue has been experienced this season with ice/frost building up on the end of the magnetic coupler which then binds the pump, not allowing it to spin. Previously, black electrical tape had been used to cover the cavity, and the bronze breathers are now a more permanent solution.
- On Wednesday, 1/9/13, the coring drill experienced an inability to re-enter the deviation hole using a 2-meter barrel and 6 screen configuration. After all usual tricks were tested, a new method was tried. With the cutter set at 80 rpm and a feed rate of 0.01 m/s. the drill was lowered, stopping when the inclination became erratic or dipped below 4.5°. Descent continued between 2221 meters and 2223 meters with the idea being to enlarge the lead-in to the deviation. When the drill was returned to the surface, it was found to contain a 1.7m core that had a small, short crescent from the parent hole and a crescent from the deviation bore running full length. The taper was 9.8mm per 1.22m, or 0.457°. The new method used to re-enter the original deviation, in effect, created a second deviation in between the original deviation and the parent borehole. The original deviation is referred to as 3A and the secondary deviation (between 3A and the parent borehole) is referred to as 3B.
- Coring continued on deviation 3B, but was temporarily halted when a small crescent from the parent borehole appeared on the core. This signified that we had never fully diverged from the parent bore or had begun to reenter it.
- Broaching operations were resumed in an attempt to remove the figure eight between the parent bore and 3B and then land the 2m coring drill on the 3B ledge, but with more inclination so it would diverge further from the parent bore. After further analysis, this plan was abandoned as the upper actuator arms would not have enough travel to push the top of the drill to the high side of the deviation.

- A plan was formulated to broach from 2227 meters, which is the bottom depth of 3A, up to 2219 meters. The idea was to keep the upper arms above 2220m, so they would stay in the deviation notch. During execution of this attempt, shear pins in all three arms of the upper actuator section were found to have sheared. We believe the pins sheared because the upper arms were in the area that had been milled previously. The wall in this section of the parent hole has over 1° of inclination change from 2217 to 2221m. When the broach is pulled up at 0.04 m/s (0.03 m/s was also tried) the arms cannot react fast enough and become overloaded.
- Broaching resumed between 2221 meters and 2204 meters (the original broaching stroke length for this deviation) in order to remove the shoulder left by the milling operations. This was done in an attempt to aid the 2m coring drill in re-entering 3A, the original deviation at this depth.
- Fabricated 20 new nickel shear pins for the actuator arms
- Rebuilt three shear pin assemblies
- Emptied the chip hopper
- After attempts to reenter 3A with the coring drill were unsuccessful, additional broaching was performed to make the transition ramp into 3A more gradual, however, the drill would hang up on a ledge and not make the turn during each attempt.
- The pin on the trigger assembly used with the drop ring during broaching operations was found to have sheared when the ring did not deploy during one run. It appears as though the drop ring had bound up against the borehole wall during the previous run, causing the pin to snap due to cutter rotation.
- After all attempts to reenter 3A were exhausted, attempts were revived to reenter 3B and steer this deviation further away from the parent hole. This was initially begun using a 1m core barrel and 2 screen coring drill configuration. Initial angle was used and side cutters were mounted on the coring head in order to urge the drill away from the parent hole. While it took some effort to guide the shorter coring drill into 3B, a method was devised to travel down to a very specific depth in the parent hole and actuate over into 3B, above the figure eight between the parent hole and 3B, but just below the figure eight between 3B and 3A, thus preventing entry into 3A as desired. With figure eights now on both sides of 3B, the arms were now coarse aligned to a non-optimal angle, so as to send two arms out on each actuator section. This allowed the arms to straddle the punctured column of the figure eight between the parent and 3B.
- A 0.57 meter core was eventually acquired from 3B, with the crescent of the parent hole having faded out over the length of the core. The diverging angle was measured to be 0.11° (2mm/m). This coincides with the inclination change witnessed while coring. A third screen was subsequently added in order to obtain full 1-meter cores per run.
- Began fabrication of two new pins for the drop ring trigger. New bushings were also made for the trigger housing block.
- Received all motor driver components ordered by IDDO in Madison on 1/2/13.
- Filled fluid tanks with 11 Isopar-K drums and 7 141B drums.
- 2<sup>nd</sup> and 3<sup>rd</sup> shifts enjoyed a night off on Saturday, 1/12/13.

## SAFETY

- Elizabeth Morton attended the weekly camp safety meeting. This week's meeting focused on back safety and prevention of repetitive stress injuries.

## COMMENTS

### (Problems, Concerns, Recommendations, Etc.)

- Sridhar Anandkrishnan presented a well-attended science lecture on Thursday, 1/10/13, highlighting the science at WAIS Divide, PIG (Pine Island Glacier) Camp and POLENET sites around western Antarctica.
- NSF has approved a 3-day extension for drilling operations. Drilling operations will now continue until Thursday, 1/31/13, as opposed to Monday, 1/28/13, as was originally scheduled.

## PROJECT SITUATION REPORT DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No. 10 for period:** 1-13-13 **through:** 1-19-13

**Prepared by:** Kristina Dahnert **Date:** 1-20-13

**IDDO PERSONNEL ONSITE:** Patrick Cassidy  
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Dave Ferris  
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Josh Goetz  
Mike Jayred  
Jay Johnson  
Nicolai Mortensen  
Elizabeth Morton  
Tanner Kuhl  
Linda Morris (IDPO – arrived at WSD)

### ACTIVITIES DURING PERIOD

- Pinned the outer housing of the replicate coring check valve to the inner portion of the housing to prevent the parts from shifting during use.
- Completed a camera run and dummy logging tool test of the third deviation. WOB varied only 24N through the deviation area. From the camera footage, it looks like most of the variation is due to stick-slip of the drill.
- Efforts continued this week to re-enter deviation 3B and the hole was successfully directed further away from the parent hole.
- When video footage verified that the 3B deviation had fully diverged from the parent hole, coring with a 1-meter core barrel and two screen configuration was initiated at a depth of 2223 meters and the deviation had fully diverged from the parent by 2242.76 meters. A third screen was subsequently added to allow for collection of full 1-meter cores.
- Drill configuration was changed to a 2-meter core barrel with six screens. The core barrel was again fitted with stabilizer pads and the side cutters were installed on the head to promote deviation away from the parent.
- Due to the side cutters orbiting slightly in the hole, attempting to cut their way off to the side, the outer surface of the cores had a barber pole pattern and texture. Chips would often fill the grooves left by the barber poling, making the cores difficult to push out of the barrel. The side cutters and barber poling also increased core diameter from 108mm to 109mm in one direction. Core quality was still deemed excellent by the core handlers.
- After sufficient angle in the deviation bore was attained, the side cutters were removed and the regular coring cutters were installed. The cores were then easily removed from the core barrel and the barber pole finish was eliminated.

- Linda Morris (IDPO) arrived at WAIS Divide on Monday, 1/14/13, and has been busy filming and photographing various operations onsite.
- The replacement encoder for the level wind motor was installed and reinserted into the control loop.
- It was noticed this week that an I-beam face on the level wind frame was deformed by approximately 0.5" due to the level wind carriage having run into the hard limit at some point in time. We are unsure if this occurred during this season or a previous season. No other damage is evident. The hard limit switches have been tested and are working properly. The only way the level wind should be able to hit the hard limit, with everything working properly, is if the level wind is run with the manual control station and the limit switch override button is held down.
- Coring of the third deviation was completed on Tuesday, 1/15/13, at a drillers' depth of 2290.797 meters.
- Initiated broaching operations at the fourth deviation site. The high side of the parent bore was now found to be at 85°. Broaching operations were continued until a 0.7° change in inclination was seen in the broaching notch. Approximately 0.1° of inclination is gained for every 12 broaching passes.
- Four crates were packed for retro and were returned to McMurdo for vessel shipment back to the U.S. this spring. The crates contained DISC Drill core barrel sections and sleeves, a variety of cabling, a spare transformer, hose and pipe fittings and spare Arctic Flexwing fluid hose.
- Crates used for the original shipment of the DISC Drill to WAIS Divide in 2007-2008 were inventoried and were found to be in good condition. This inventory will give us an idea of how many new crates will need to be fabricated prior to next season when the entire drill is broken down and packed for future traversing out of WAIS Divide and eventual return to Madison.
- Rebuilt the pocket on the cutter head that was damaged when the cutters were lost in the borehole.
- Mill/broaching hybrid operations were completed on the fourth deviation between 1948 meters and 1951.2 meters until an additional inclination delta of 0.3° was attained over that length.
- The milling head was then reconfigured with shoes, and a pad for the coring drill was created at 1952 meters.
- An attempt was made to drill the first core of the fourth deviation with a 2-meter core barrel and 5 screen configuration. While the drill was able to land on a ledge several times, the drill head would rotate off of the ledge when the cutter was turned on and the drill would return to the parent bore. An inclination of 5.35° was expected, but the longer drill configuration was only able to attain an inclination of 5.1° due to flex. Use of this configuration was aborted.
- The second coring attempt was made with a 1-meter core barrel and 3 screen configuration. An inclination of 5.54° was expected, with a better than expected actual reading of 5.64° recorded.
- The first core of the fourth deviation was drilled on Friday, 1/18/13. A 0.7m core was drilled, with a 40mm wide ledge at the top followed by the broaching ramp, which faded out just before the end of the core. The bottom of the core was full

108mm diameter. Marks were evident on the broach ramp where the 2-meter drill had been pushed up against it. The 2-meter drill had been able to reach over 60mm, but since there was no ledge, it was pushed back into the parent hole by the ramp.

- Due to the high inclination of the parent bore at this depth, coring on the fourth deviation will continue with a 1-meter and 4 screen configuration, as the longer drill cannot make the turn into the high side of the parent bore.

## SAFETY

- Nothing to report

## COMMENTS

### (Problems, Concerns, Recommendations, Etc.)

- Masha Tsukernik presented a science lecture on Wednesday, 1/16/13, discussing cyclones in relationship to Antarctic weather.
- Mike Roberts, a mountaineer onsite for the POLENET group, presented an adventure lecture Friday, 1/18/13, discussing his “Guiding of the Seven Summits”, not the least of which includes Mt. Everest.
- With the 3-day drilling extension approved, drilling operations will now end on Thursday, 1/31/13. Pack up and close out will continue until Monday, 2/4/13, when the entire drill crew will return to McMurdo. All drillers are scheduled to fly back to Christchurch on Wednesday, 2/6/13.

## PROJECT SITUATION REPORT DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No. 11 for period:** 1-20-13 **through:** 1-26-13

**Prepared by:** Kristina Dahnert **Date:** 1-27-13

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Josh Goetz  
Mike Jayred  
Jay Johnson  
Nicolai Mortensen  
Elizabeth Morton  
Tanner Kuhl  
Linda Morris (IDPO – departed WSD)

### ACTIVITIES DURING PERIOD

- A combination borehole camera and dummy logging tool run was completed for deviation #4 on Sunday, 1/20/13. The tool passed the deviation area with ease and only a 16N change in WOB was observed.
- Nicolai completed repairs on the instrument section L base plate.
- Deviation #4 was completed on Tuesday, 1/22/13, at a drillers depth of 2000.203 meters. A total of 48.203 meters of core were collected from this deviation.
- Milling operations were immediately started on deviation #5. This is the same location in which deviation #2 was started, so we are able to forego broaching operations and utilize the notch already formed during deviation #2.
- Mill/broaching hybrid operations were performed from a depth of 2409 meters and down to 2412 meters. When poor cutting was encountered, the stroke length was then increased by one meter at a time, beginning at 2408 meters and then at 2407 meters. Prior to initiating milling with shoes, we were looking to see an inclination change of 0.7° over the 4 meter stroke length.
- All six actuator arms were thoroughly cleaned and the force settings calibrated for each arm.
- Mill/broaching operations continued, though only light cutting was observed. The final inclination change recorded at 2412 meters was 1.17°, which gives a notch depth of 102mm. As the LVDT's on two of the lower arms were reading 33 counts by the end of the run, the shear pins were replaced on these arms. They were found to be more than half sheared.
- Milling with shoes operations were initiated on Wednesday, 1/23/13.
- The first core of deviation #5 was collected on Thursday, 1/24/13, with a 2 screen and 1-meter core barrel configuration, however the crescent at the bottom of the

core was narrower than the crescent at the top. At this point, we returned to milling with shoes. Since the coring drill had not been able to tilt all the way over onto the previous ledge created by milling, a small ledge remained with which to continue milling with shoes. Milling was continued down to the depth from which the first core had just been recovered. This technique proved successful at moving the high side wall over.

- A second coring run was then completed with a 2 screen and 1-meter core barrel configuration. The core was found to be full diameter right from the start. The screens were, however, empty as chunks of ice in the hole may have interfered with the check valve flaps, allowing the flaps to remain open during ascent and thus causing the chips to be dumped back into the borehole.
- A third screen was subsequently added to the drill configuration to allow for collection of longer cores, up to one meter in length. Coring of deviation #5 continued using this configuration.
- Difficulty was again encountered with the crown sheave, reminiscent of the issues observed during the 2009-2010 season. The crown sheave began making a clicking noise during ascent operations and upon inspection, three of the six screws that mount the bearing hub to the sheave were found to have sheared off. The sheave was removed and six new screws were installed. The noise is no longer heard.
- Two drums of 141B were added to the bulk fluid tank. The Isopar-K tank is still ¼ full. If any additional fluid is needed for this season's operations, it will be brought into the Arch by individual drums.
- Linda Morris departed WSD on Friday, 1/25/13.

**\*\*\*The final core of deviation #5 and of the 2012-2013 season was collected on Saturday, 1/26/13. Final depth of the deviation was 2428.74 meters.\*\*\***

- Borehole cleaning operations were initiated. The first configuration consisted of the original DISC drill screen barrel with 10 screens and the DISC Drill conical tool. As this barrel has a more snug fit in the borehole than the smaller diameter Replicate Coring barrels, it was utilized to capture the most chips possible from the hole. The drill was lowered at 0.3 m/s in the narrow section of the borehole, which starts at 1530 meters when the DISC Drill was originally changed from a 170 mm diameter borehole to the smaller kerf 164 mm diameter borehole. The first cleaning run was completed at a depth of 3392 meters, when the drill would not penetrate any further. 8.5 screens of chips were recovered.
- Saturday was a day off for 2<sup>nd</sup> and 3<sup>rd</sup> shifts. 1<sup>st</sup> shift will have off on Sunday, 1/27/13.
- Borehole cleaning operations will continue into the beginning of next week and packing operations will begin. Drillers will begin leaving WAIS Divide early this week, with the majority of the crew returning to McMurdo around Friday, 2/1/13.

## SAFETY

- Nothing to report



## COMMENTS

### (Problems, Concerns, Recommendations, Etc.)

- WAIS Divide has turned windy and cold this week, reminding us it is time to start packing up. On Wednesday, 1/23/13, the winds picked up overnight and visibility dropped to less than ¼ mile. While the winds have fluctuated and the sun makes an appearance once in a while, there is fair amount of digging and cleanup being performed around the Arch whenever possible.
- A steak and lobster dinner was enjoyed by all of camp on Saturday night, 1/26/13, to celebrate the conclusion of replicate coring as well as a great season overall at WAIS Divide. Kaija Webster, our camp manager, put together a nice photo slideshow from pictures taken throughout the season. This was enjoyed by all after dinner.

## PROJECT SITUATION REPORT

### DISC Drill 2012-13 Season

**Project:** T-350-M

**Project Principal Investigator:** Dr. Charles Bentley

**Report No.** 12    **for period:** 1-27-13                      **through:** 2-3-13

**IDDO PERSONNEL ONSITE:** Patrick Cassidy  
Kristina Dahnert  
Dave Ferris  
Jason Goetz  
Josh Goetz  
Mike Jayred  
Jay Johnson  
Nicolai Mortensen  
Elizabeth Morton  
Tanner Kuhl

#### ACTIVITIES DURING PERIOD

- Borehole cleaning operations resumed on Sunday afternoon using a 6 screen, 2-meter core barrel and coring head configuration in order to try and core the chip pack at the bottom of the borehole. The drill touched off at 3392m, 13 meters from the bottom of the borehole, but after approximately 30cm of penetration, the WOB started to climb. Payout was stopped, causing the WOB to slowly decrease, but the cutter torque continued to climb steadily. This appeared to indicate that we were not having luck coring the chip pack and that the drill was binding in the borehole. As this was beginning to resemble a situation in which the drill could become stuck in the borehole, the motor hand-off was done while both the cutter and pump were still running. The two motors were then stopped and then the 'core break' was immediately performed. Cable tension at core break was recorded at 36,000 N, indicating the drill was indeed beginning to stick in the hole. Upon returning to the surface, patches of refrozen chips were observed on the outside of the coring head, in the wrench notches on the core and screen barrels, and the step in barrel diameters just above the head had ice built up on it. There was also a 10cm chunk of refrozen chips in the end of the core barrel. The core barrel was filled with mostly slush, however, there were also several chunks of refrozen chips.
- Additional cleaning runs were completed down to 2000 meters depth, as the majority of chips were thought to be congregating several hundred meters above that depth and around the deviation areas, as seen by previous borehole videos. A slow feed rate of 0.3 m/s was used and only a light coating of very fine chips were recovered in the screens.
- A cleaning run was completed with the 10 micron filter sock installed in the bottom three screens. Traveling at a feed rate of 0.1 m/s down to 400m and then

at 0.3 m/s down to 2000m, only a small amount of material was brought back in the filter sock.

- A borehole camera run was then completed. The camera was lowered at 0.05 m/s through deviation areas 2, 3, 4 and 5. The first deviation was not filmed as excellent footage had already been captured from that depth. The camera was then actuated into deviation #5 and lowered a few meters. The fluid clarity is generally very good, except when passing a deviation where it is cloudy and thus good footage on the final camera run was not obtained.
- One final attempt was made to clean the bottom of the borehole on Monday, 1/28/13. The original DISC Drill barrels were run in an 8 screen and 2-meter core barrel configuration. As the drill approached 2490m, it began to bind in the borehole due to borehole closure. Reaming of the hole was performed for several meters before Chief Scientist Don Voigt made the decision that these efforts would be in vain given the distance remaining to the bottom of the borehole and the days remaining for our fieldwork. With the added risk of sticking the drill using other configurations, we concurred with his decision to halt borehole operations at this time.
- Packing operations were initiated on Monday, 1/28/13, and the Chief Scientist was given the opportunity to cut the drill cable from the drill sonde.
- The first four carpenters arrived from McMurdo on Monday, 1/28/13 to begin taking down town buildings.
- Nicolai Mortensen departed WAIS Divide on Monday, 1/28/13.
- The drill sonde was removed from the drill tower, disassembled and the sections were taken to the MECC for drying.
- Packed the replicate coring barrels and heads
- Packed the computer rack and the Glassman high voltage rack
- Brought the borehole fluid level up to 146 ft (44.5m) meters on Monday, 1/28/13
- Emptied and cleaned the centrifuge collection tank and the fluid mixing tank
- Emptied both bulk fluid tanks
- Packed the air monitor
- Retrieved the fluid transfer pumps and other fluid handling equipment for return to Madison
- Removed the tower drip pans and rollers
- Packed the blue sonde crate
- Packed the winch motor crate with the FED vacuum, the Tiger vacuum, the core saw and other miscellaneous components
- Packed the winch cabinet crate
- Packed two smaller Hardigg cases with replicate drill parts and sonde component cases
- Disassembled and packed the barrel turning fixture
- Took a drill fluid inventory; remaining fluid includes 58 full drums of Isopar K as well as one partial drum and 11 full drums of 141b as well as one partial drum.
- Removed and packed all winch cables
- The Arch Jamesway was taken down on Tuesday, 1/29/13
- Organized the orange shipping container and installed the DISC Drill screen and core barrels along the container walls for transport back to Madison

- Disassembled the centrifuge frame
- Disassembled and packed the screen cleaning system
- The Science rack tent in town was taken down on Wednesday, 1/30/13
- Removed the crown sheave and the upper and lower tower sections
- The borehole fluid level was again checked on Wednesday, 1/30/13. It had dropped approximately five feet down to 151 ft (46m).
- Nicolai Mortensen departed MCM on Wednesday, 1/30/13
- Removed the tower actuator
- Packed the MECC machine shop
- Completed final organizing in the arch
- The borehole fluid level was again checked on Thursday, 1/31/13 and was found to be at 152 ft (46.3m)
- Two pallets of replicate ice core, containing all ice core drilled this season departed WAIS Divide on Thursday, 1/31/13, and arrived safely in McMurdo.
- The remaining nine drillers onsite (Cassidy, Dahnert, Ferris, Goetz, Goetz, Jayred, Johnson, Kuhl, Morton) departed WAIS Divide on Friday, 2/1/13, as originally scheduled, arriving in McMurdo at 3:00am on Saturday morning.
- All sleep kits were returned to the BFC on Saturday, 2/2/13
- Returned Comms equipment on Saturday, 2/2/13
- Attended the McMurdo All-Hands meeting in the Galley from 3:30-4:30pm on Saturday, 2/2/13

#### SAFETY

- NA

#### COMMENTS

##### (Problems, Concerns, Recommendations, Etc.)

- Thank you again to everyone who has made not only this season, but this entire project successful. Here's to a successful end to another great field year. Cheers!