

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

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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 O₂ 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!