

## **IODP Expedition 384: Engineering Testing**

### **Week 2 Report (26 July–1 August 2020)**

#### **Operations**

Week 2 of International Ocean Discovery Program (IODP) Expedition 384, Engineering Testing, began with the completion of the last 326 nmi of the 1100 nmi transit from Kristiansand to Site U1554 (proposed site REYK-06A). The transit ended at 0629 h on 27 July 2020 when we established dynamic positioning (DP). The average speed of the transit was 11.6 kt.

An advanced piston corer/extended core barrel (APC/XCB) bottom-hole assembly (BHA) was made up and the drill pipe was assembled and deployed at 1445 h. The pipe stands were measured and cleared of rust during deployment. Hole U1554A was started at 2300 h with a 5.7 m long mudline core. The calculated water depth was 1870 m. We completed APC coring in Hole U1554A at 0625 h on 28 July with Core 8H to 72.2 m driller's depth below seafloor (DSF), with a recovery of 74.7 m (103%). The ship was offset 20 m to the east and Hole U1554B was completed at 1515 h with Core 8H to 76.0 m DSF, with a recovery of 76.8 m (101%). The ship was offset 20 m to the south and we completed Hole U1554C at 2330 h with Core 8H to 75.0 m DSF, with a recovery of 77.0 m (103%). Core orientation was measured on all cores in each hole. On 29 July the ship was offset once more, this time 20 m west of Hole U1554C, and coring in Hole U1554D began at 0045 h. Here we drilled down to 14 m DSF and cored a single Core 2H from 14 to 23.5 m DSF, with a recovery of 9.72 m (102%). This core was taken for future training and testing purposes on the ship. The drill string was retrieved and cleared the rig floor at 0715 h, ending operations at Site U1554.

The rig was secured and the ship began the transit to Site U1555 (proposed Site REYK-13A) at 0900 h. During the transit the brake on the rotary table was repaired. We arrived at Site U1555 at 1518 h and switched to DP mode. The ship was positioned 50 m east of the coordinates for proposed Site REYK-13A, along the survey line toward proposed Site REYK-11A. Additional holes were planned at 20 m intervals along this same line. The goal at Hole U1555A as well as at subsequent holes was to penetrate the 210 m of sediment, as estimated from geophysical site survey data, and then deepen the hole ~100 m into the basaltic basement, or drill for ~40 h, whichever would come first. The water depth for Hole U1555A, calculated from precision depth recorder (PDR) readings, was 1517 m.

For this first drilling test, a Gemini 12¼ inch Tungsten Carbide Insert (TCI) roller-cone bit from Schlumberger/Smith Bits was made up with a Baker Hughes 8 inch Ultra XL/VS mud motor. The bit used for this test is similar to the TCI bits previously used on the *JOIDES Resolution* (JR), but is a much more robust version (IADC Grade 647Y). The motor used is the same high-torque model of motor used previously on the JR when running casing. The bit and motor assembly was flow tested before deployment.

Deployment of the drill string was completed at 0015 h on 30 July and we began drilling Hole U1555A. The seafloor was barely felt with the drill string at approximately the depth determined

by the PDR. Sediment penetration proceeded at a controlled advancement rate of ~40 m/h. At 0545 h, with the bit at ~185 m driller's depth below seafloor (DRF), the formation stiffened and the rate of advancement slowed by an order of magnitude, typically to <5 m/h. At 1930 h the bit got stuck at 224 m DRF and time was spent trying to free the drill string, including offsetting the ship to be able to set the slips and remove a joint of pipe, circulating mud sweeps, and working the pipe free. The bit was raised to 213 m DRF for further mud circulation and hole cleaning. On 31 July, the driller had to pull the bit back two more times by ~30 m for hole cleaning with additional mud sweeps at 242.6 m DSF (0415 h) and at 252.6 m DSF (0915 h). When the bit reached 262.6 m DSF (1045 h), the hole was reamed up to 242.6 m DSF before the final 20 m of advancement. We reached the target basement penetration of ~100 m (97.4 m exactly) at 2000 h on 31 July, at 282.0 m DSF. The drill string was retrieved, with the bit clearing the rig floor at 0245 h on 1 August, ending Hole U1555A.

The ship was offset ~20 m east of Hole U1555A in preparation for the second test. The second test bit, a 12¼ inch hybrid PDC/TCI "Kymera" bit from Baker Hughes was made up to the bottom of the mud motor and flow tested. The motor started rotating at 5 strokes/min, compared to 30 strokes/min before, indicating that the bearing assembly was now broken in, but the flow across the motor seals was still normal. The BHA was made up and the drill string was deployed. Due to heave in excess of 4 m and winds approaching 40 kt, the decision was made to suspend operations with the bit at 1435 m below the rig floor, or ~100 m above seafloor. The week ended at midnight on 1 August, with the ship waiting on weather.

## **Science Results**

### *Basalt Drilling Tests*

The first test using a more robust type of TCI bit than previously used on the JR met expectations in terms of average penetration rate. The target penetration of ~100 m (97.4 m exactly) was achieved in significantly less than the allotted 40 h. The roller cones showed little wear, whereas the gauge cutters on the outside of the bit showed more serious wear. This confirms previous experience that maintaining gauge is a more difficult challenge than crushing the hard formation with the roller cones.

### *Core Orientation Tests*

The core orientation tests required a set of cores that are characterized with the standard set of shipboard measurements and observations. To that end, all cores from Holes U1554A–U1554D were first measured for magnetic susceptibility (MS) and gamma ray attenuation (GRA) on the Special Task Multisensor Logger (STMSL), which was configured to perform these measurements as rapidly as possible to allow real-time stratigraphic correlation. This is necessary to provide real-time feedback to the driller and ensure that all coring gaps in a hole are covered by cores in at least one of the adjacent holes. Our coring gaps in Hole U1554A were perfectly covered in cores from both Holes U1554B and U1554C using that method, which

allowed construction of a composite depth scale to 83.29 m core composite depth below seafloor (CCSF) and a splice representative of the complete stratigraphic section. Higher resolution measurements of MS and GRA on the Whole-Round Multisensor Logger (WRMSL), which also includes *P*-wave velocity measurements, and on the Natural Gamma Radiation Logger (NGRL), were subsequently performed on all whole-round core sections.

We began to split the core sections and perform additional routine core characterization, including visual light and X-ray imaging, color reflectance and MS measurements on the Section Half Multisensor Logger (SHMSL), magnetic remanence logging with the superconducting rock magnetometer (SRM), moisture and density and magnetic property measurements on a small set of discrete samples, and rudimentary core description.

The success of the core orientation tests depends on first determining the mean paleomagnetic declination of each core from the SRM measurements. We have measured about half of the 25 cores collected and will evaluate the performance of the four orientation tools used during coring after we have completed the remaining measurements.

## **Technical Support and HSE Activities**

### *Laboratory Activities*

- Processed core sections from Site U1554 through the Core Laboratory for routine core characterization.
- Set up the Minolta spectrophotometer for demonstration and comparison with QEPro spectrophotometer data.
- Documented the drill bit tests with before and after images of the drill bits.
- Investigated a low flow error that keeps occurring on the Bruker X-ray Diffractometer. The water lines from the Haskris to the Bruker have been flushed many times to clear debris. The issue is not yet resolved and troubleshooting continues.
- Resolved communication issues on the X-Ray Imager reported last week by cycling power on the Teledyne communication cable box.
- Obtained seafloor depths for drilling operations on lower power settings because the Bathy2010 Echosounder is experiencing degradation of output and input signal at higher output power settings. Staff will contact SyQwest to help troubleshoot the issue.
- Technical staff worked on projects including:
  - GEODESC project programming and testing.
  - Catwalk Module testing.
  - Miscellaneous individual small projects.

### *IT Support Activities*

- Worked with Siem Offshore Electrical Supervisor to resolve Internet outages. The ship moved out of the coverage area of one satellite and transitioned to another space vehicle.

- MarLink resolved additional Internet outages that occurred due to misconfigurations in the system.
- Resolved an issue where RigWatch was not acquiring data. Restarting a network switch restored data acquisition.
- Assisted laboratory technicians with troubleshooting X-ray and Minolta Spectrophotometer instruments.

#### *Application Support Activities*

- Continued work on Catwalk Module.
- Corrected some Drill Report data errors, and investigated an error pop-up that has recently appeared. The issue is not consistently reproducible.
- Assisted developers with LORE report changes.
- Developed a proof-of-concept with the EPM for an alternative core summary image to be provided along with the Virtual Photo Table image, using much of the same or similar code. This proposed new type of lengthwise concatenated and reduced core image would primarily be used for stratigraphic correlation in the Correlator app, which will have this capability in the next version, and will also be useful for miscellaneous practical applications by scientists and staff.

#### *HSE Activities*

- Tested safety shower and eye wash stations.