IODP Expedition 390C: South Atlantic Transect Reentry Systems

Week 7 Report (15–21 November 2020)

Operations

During Week 7 of the International Ocean Discovery Program (IODP) Expedition 390C, South Atlantic Transect Reentry Systems, we attempted to install a reentry system at Site U1558. Unforeseen challenges with disengaging the Dril-Quip running tool from the reentry cone resulted in two failed attempts and the initiation of a third attempt.

Hole U1558A

Following the termination of coring in Hole U1558A, we tripped the drill string back to the surface. The bit cleared the rig floor at 0710 h on 15 November 2020, ending the hole.

Hole U1558B

The ship was offset 20 m east and preparations for casing began. The Dril-Quip running tool stand was made up and the upper guide horn was removed. A casing string of 13⅜ inch casing was made up, followed by a crossover and the 16 inch casing hanger needed to latch in to the reentry system. The first three joints were locked and welded. Sea conditions were unfavorable and one of the joints was cross-threaded during assembly and was removed from the string. A replacement casing joint was added, which shortened the casing string slightly to 159.3 m. The plan was for the casing to extend slightly into basement and allow for a second 10¾ inch casing string to be added in the future. We paused operations to wait on weather at 2300 h on 15 November. The reentry cone was lifted off the moonpool doors and the area secured for rough seas. Operations resumed at ~0630 h on 16 November. The casing string was lowered and landed in the reentry cone in the moonpool. The bit, mud motor, and underreamer were made up with the underreamer arms set to open to a diameter of 15½ inches. We conducted a test to determine the pump rate required to open the arms of the underreamer (40 strokes/min and 400 lb/inch^2). Then the rest of the stinger bottom-hole assembly (BHA) was made up with the Dril-Quip running tool on top. The running tool was latched into the reentry cone, and the driller lifted the complete assembly to measure the weight of the system and check the engagement of the running tool. Finally, the moonpool doors were opened, and the reentry system was lowered through the splash zone at 1220 h. Drill pipe was then tripped to the seafloor. Pipe was filled with water every 10 stands to ensure equalized pressure.

Hole U1558B was spudded at 0120 h on 17 November and the process of drilling in the reentry cone and 13⅜ inch casing began. The subsea camera system was deployed after the drill-in began to limit the amount of time that the camera was at depth and avoid a pressure-related failure as occurred at Site U1557. The camera system with the conductivity-temperature-depth (CTD) sensor strapped to the frame was deployed through the moonpool at 0700 h and was lowered rapidly toward the seafloor. At 0830 h and a depth of ~3700 m below sea level (mbsl), the video feed failed first on the entry camera and then on the survey camera. The camera

system was brought back up to a depth of 300 mbsl and kept there so that the drill-in of the casing could continue without interruption. At 155.9 m below seafloor (mbsf), the rate of penetration decreased substantially, indicating that we were now drilling into basement. Basement at Hole U1558B was encountered 3 m shallower than expected based on Hole U1558A (158.9 mbsf). The shallower basement required a longer drilling time than anticipated. We progressed at a rate of ~1 m/h until 1415 h and a depth 161.1 mbsf, where an increase in the measured weight on bit indicated that the reentry cone had landed on the seafloor.

We then spent several hours trying to disconnect the drill string from the reentry system, applying torque to the drill string and attempting to rotate the Dril-Quip running tool 3.5 turns. At 1600 h on 17 November, we were still unable to disengage the running tool and we decided to bring the camera system back on deck to conduct emergency repairs. While the camera system was being repaired, we continued to attempt to disconnect from the reentry cone without being able to observe it. The ship was moved in a 50 m grid pattern, and then a 100 m grid pattern, in an attempt to find a position and angle that might allow the tool to release from the reentry cone.

The issue with the subsea camera system was determined to be with the connector between the junction box and telemetry pod, as with the two previous failures. With no remaining spare connectors and clear evidence that the connectors cannot handle pressure, an alternative solution was found. New fiber and power connections were independently terminated at the junction box and telemetry pod. This solution reduced functionality, but did provide light and a single video feed. Subsea camera system repairs were completed just before midnight on 17 November. At ~0010 h on 18 November, the repaired camera system was deployed through the moonpool. It was lowered rapidly to the seafloor without incident and allowed us to view the reentry cone and drill string, although the Dril-Quip running tool itself was obscured by suspended sediment and cuttings. Even with the assistance of the camera, we were unable to disconnect the running tool. At 0230 h, after a total of 12 h trying to disengage from the reentry system, we made the decision to pull the entire drill string back to the surface, diagnose the issue, and attempt to drill in the casing again in Hole U1558C. The subsea camera system was recovered and secured at 0500 h. The next ~12 h were spent tripping pipe back to the surface.

The reentry system was pulled up through the splash zone at 1600 h on 18 November and set onto the moonpool doors. We observed that the Dril-Quip running tool was not easily able to move along the length of the slots in order to achieve the neutral position required to disengage it. Nonetheless, we were able to rotate and disengage the tool. The tool was lifted to the rig floor and examined. Once on the rig floor, it was able to move freely and there was nothing obviously wrong with it. The underreamer and bit were also examined and found to be in good condition. The bit cleared the rig floor at 2000 h on 18 November, ending Hole U1558B.

Hole U1558C

The Dril-Quip running tool was exchanged for a spare, newly inspected and overhauled one, and the process of redeploying the reentry system began. We again tested the mud motor and underreamer to confirm the pump rate required for rotation and to open the underreamer arms. The stinger was then reassembled, removing a 1 m drill collar pup joint from the assembly to decrease the distance between the bit and the casing. The ship was moved back toward Hole U1558A instead of following the standard offset pattern, with the expectation that we would encounter hard rock at ~158.9 mbsf instead of the shallower 155.9 mbsf basement depth found in Hole U1558B, and thus spend less time drilling in hard rock. The stinger with the mud motor, underreamer, and bit was lowered through the reentry cone and casing, and the running tool at the top of the stinger engaged with the reentry cone. Then we opened the moonpool doors and the reentry cone was lowered through the splash zone at 0245 h on 19 November. We tripped pipe down to the seafloor, filling the drill pipe with water every 10 stands. When the bit was near the seafloor, we paused operations to perform a routine slip and cut of the drilling line. We then picked up the top drive and spudded Hole U1558C at 1635 h.

Drilling in the casing continued smoothly through the sediment column. We contacted hard rock at 158.9 mbsf. The subsea camera system was deployed just before contact with basement at 0100 h, so that we could observe the release of the Dril-Quip running tool from the reentry system. Drilling continued until a decrease in hook load indicated that the reentry cone had landed on the seafloor. We slowly transferred the weight of the reentry system with casing to the seafloor while trying to maintain weight on the bit. We reached a final hole depth of 162.7 mbsf where we were confident that the weight of the reentry system was entirely supported by the seafloor. The next 12 h were spent attempting to disconnect the running tool from the reentry system. We were ultimately unable to do so, despite the installation modifications we had made after the first failed attempt.

At 1700 h on 20 November, in consultation with the Expedition 390 and 393 Co-Chief Scientists, we made the decision to abandon Hole U1558C and pull the reentry system back to the surface. The subsea camera system was recovered at 1800 h, and the process of tripping drill pipe back to the surface began. The bit cleared the seafloor at 1850 h. We decided to make one additional installation attempt of the reentry system at this site. This time, the plan was to remove one joint of casing so that the casing string would end in sediment instead of basement, because we believed that the casing string ending in hard rock inhibited our ability to disconnect from the reentry system.

The reentry system was raised to just below the ship at ~0600 h on 21 November. We opened the moonpool doors but had zero visibility in the dark, and we were unable to determine the orientation of the reentry cone base. We paused operations until daylight when we could safely recover the reentry system. At 0815 h we reopened the moonpool doors, oriented the base, and recovered the reentry system. We observed that three out of four load-bearing plates on the mud skirt had fallen off during the attempted redeployment. As with our first attempt at Hole

U1558B, the Dril-Quip running tool was easily disconnected from the reentry system once at the surface despite our inability to disconnect it while on the seafloor. The running tool, underreamer, and bit were raised to the rig floor and inspected. The underreamer was found to be in excellent condition. The bit cleared the rotary table at 1056 h on 21 November, ending Hole U1558C.

Hole U1558D

We then started preparations for a third attempt at installing the reentry system. The 16 inch casing hanger was released at 1320 h on 21 November by screwing releasing bolts into the snap ring that holds the hanger in place in the reentry cone, after some initial difficulty with compressing the snap ring caused by debris caught in the ring. The hanger was raised to the rig floor and swapped out for a spare. We shortened the casing string by removing a single joint and had reassembled it with a length of 146.1 m by 1745 h. The running tool was then latched into the casing hanger and the hanger installed in the reentry cone. We picked up the mud motor, underreamer, and bit and tested them to determine the pump rates required for rotation and for the underreamer arms to open up. Finally, the BHA and stinger were lowered to 150 m below rig floor, and new plates were welded onto the mud skirt to replace the ones that were lost. The next steps will be to lower the reentry system to the seafloor and attempt to drill it in at Hole U1558D.

Science Results

The newly acquired (CTD) sensor was deployed along with the subsea camera system at Hole U1558B. It successfully logged water column data.

Outreach

No Onboard Outreach Officer is sailing during Expedition 390C. Limited social media posts were made via the JR Facebook and Twitter accounts.

Platform	# of posts	Analytics	Notes
Facebook	11	1197 engagements (comments, shares, likes, or clicks on parts of the post)	
Twitter	14	1973 engagements (including 66 retweets, 7 comments, 372 likes), 3 new followers	Does not include retweets of other accounts.

Technical Support and HSE Activities

Laboratory Activities

- We finished processing cores from Hole U1558A. Some additional chemical analyses still need to be conducted, but they will be run as a larger batch once coring during Expedition 390C is complete.
- The CTD sensor was successfully deployed on the subsea camera system frame at Hole U1558B.
- We completed analysis of X-ray diffraction (XRD) samples sent from shore on the Aeris instrument.
- Calibration procedures for the Section Half Imaging Logger (SHIL) are nearly finalized.
- Crossover Zoom meetings with oncoming staff were scheduled for the next two weeks.
- The expedition T-shirt logo pressing party was held.
- Staff worked on technical reports for the expedition.
- Staff contributed to the GEODESC, Catwalk sampling module, and DEI projects.

Application Support Activities

- Tested LORE and DrillReport file retrieval after operating system upgrades were made.
- Deployed new versions of the Catwalk module and the GEODESC template manager.
- Made manual changes to carbon-hydrogen-nitrogen-sulfur analyzer (CHNS) data in the database.

IT Support Activities

- Made upgrades to several servers and monthly updates to Windows computers.
- Installed Zebra software to allow custom label printing on the Chemistry Laboratory and core entry computers.
- Applied an update to the XRD Malvern Highscore software.
- Continued testing for Mac computer OS and firewall issues.

HSE Activities

- The ship doctor conducted a weekly temperature check.
- We tested emergency shower and eye wash stations.
- We conducted a lifeboat muster drill.