IODP Expedition 395E: Complete South Atlantic Transect Reentry Systems

Site U1557 Summary

Background and Objectives

International Ocean Discovery Program (IODP) Site U1557 (proposed Site SATL-56A) was started during South Atlantic Transect (SAT) Expedition 390C in November 2020. Site U1557 was cored to basement in Hole U1557B and a reentry system consisting of a reentry cone and 60 m of 16 inch casing was installed in Hole U1557D (Estes et al., 2021). The objective for Expedition 395E was to complete the reentry system in Hole U1557D by installing a second, nested 10¾ inch casing string down to basement. This engineering work will expedite basement drilling during SAT Expeditions 390 and 393.

Site U1557 is located in the central South Atlantic Ocean at 31°S in 5010.7 m water depth, ~1250 km west of the Mid-Atlantic Ridge, on seismic line CREST1A/B at CDP 4470 near the CREST05 crossing line (Coggon et al., 2020). A reflector at ~7.2 s two-way traveltime (TWT) was interpreted as the top of basement and the sediment-basement transition was found at 564 m below seafloor (mbsf) in Hole U1557B. This site is located 6.7 km from Site U1556, and the ocean crust at both sites is estimated to have formed at ~61.2 Ma at a half spreading rate of ~13.5 mm/y. Ocean crust at these sites is the oldest that will be drilled along the South Atlantic Transect and will be compared to younger crustal material from the sites to the east, closer to the Mid-Atlantic Ridge. The sedimentary succession at Site U1557 is about twice as thick as at Site U1556. Contrasts between these closely spaced sites will allow exploration of the blanketing effect of sediment thickness on hydrothermal circulation and crustal evolution. The sediments at Site U1557 consist of calcareous ooze and hemipelagic clays, and will be used in paleoceanographic and microbiological studies. The thick succession at Site U1557 will allow development of paleoceanographic records covering the entire Cenozoic, including reconstruction of Atlantic Ocean circulation patterns during periods of elevated atmospheric carbon dioxide.

Operations

Hole U1557D

The ship transited 502 nmi from Site U1560 to Site U1557 (proposed Site SATL-56A) in 44 h at an average speed of 11.4 kt, arriving at Hole U1557D (30°56.4546′S, 26°37.7898′W) at 2130 h on 29 April 2021. The thrusters were lowered and the ship switched to dynamic positioning (DP) mode at 2215 h. The plan was first to deepen Hole U1557D from the depth of the existing 16 inch casing shoe (60 mbsf) down to 10 m into basement, in preparation for installing the 10¾ inch casing string using a Dril-Quip running tool in a separate run. We used this two-stage method because the water depth (5010.7 m below sea level [mbsl]) and casing depth (~573 mbsf)

at Site U1557 meant that a mud motor stinger and hydraulic release tool (HRT) assembly, used at Hole U1560B, would be too heavy to deploy safely.

The 14¾ inch drilling bottom-hole assembly (BHA) was assembled at 0230 h on 30 April, and we ran it down to 4980 mbsl by 1100 h. We then deployed the subsea camera and conductivity-temperature-depth (CTD) instrument. The camera worked well, confirming that the upgrade to the fiber-optic pigtail connection that had been made during the port call was successful (the connection had failed in these water depths during Expedition 390C). We picked up the top drive and reentered Hole U1557D at 1600 h, retrieved the subsea camera and CTD instrument, and brought them back on board at 1815 h. At 1830 h we started lowering the BHA into the cased part of the existing hole, taking weight at 60 mbsf at 1930 h. Over the next 37 h we drilled down and we reached the sediment/basement contact at 566.6 mbsf at 0830 h on 2 May. This compares to a basement depth of 564 mbsf in Hole U1557B. It took another 7.5 h to reach the target depth of 576.6 mbsf. We then swept the hole of cuttings by pumping 50 bbl of high viscosity mud. Next, we made a wiper trip to clear the hole of obstructions and infill. We racked back the top drive and raised the drill bit to the base of the 16 inch casing (60 mbsf), then lowered the drill bit back down to 524.1 mbsf. At that point, we reinstalled the top drive and rotated the drill bit down, encountered infill at 568.1 mbsf, and then washed it out down to the hole depth of 576.6 mbsf. We made another sweep of the hole with 50 bbl of high viscosity mud, and then filled the hole with 12 ppg heavy mud to help reduce any caving of the borehole walls. On 3 May, we pulled the drill bit out of the hole, clearing the seafloor at 0315 h and reaching the rig floor at 1430 h. We assembled the casing running tool and set it aside in the derrick, and then assembled the casing string, which took the remainder of the day. On 4 May, we lowered the casing string down to 4978 mbsl, and at 1000 h we started to lower the subsea camera. We reentered Hole U1557D at 1245 h and lowered the casing string to 554 mbsf. At that depth we engaged the top drive to allow rotation, if required, and continued lowering the casing to its full depth of 571.6 mbsf at 1535 h, landing the top of the casing in the existing reentry cone. There was no circulation in the hole while pumping, showing that the formation had sealed around the casing, and that the base of the casing would not need to be cemented. We released the casing from the Dril-Quip running tool and cleared the reentry cone at 1600 h.

Starting at 1645 h on 4 May, the *JOIDES Resolution* moved from Hole U1557D to Site U1556 in DP mode, travelling 3.6 nmi in 12.5 h at an average speed of 0.3 kt. During this slow transit, the subsea camera was brought back aboard at 1830 h. We raised the BHA and the Dril-Quip casing running tool and had disassembled it by 0630 h on 5 May, officially ending operations at Hole U1557D. We arrived at Site U1556 at 0715 h on 5 May.

Principal results

The sediment/basement contact in Hole U1557D is at 566.6 mbsf, based on the abrupt reduction in drilling rate at that depth. This is 2.6 m deeper that the basement depth of 564 mbsf in Hole

U1557B. The difference can be attributed to normal local variations in basement surface topography.

Expedition 395E did not core any material in Hole U1557D, but a basic description of the cores from Hole U1557B, cored during Expedition 390C, is available in the *Expedition 390C Preliminary Report* (Estes et al., 2021).

Additional analyses and data interpretations will occur during Expeditions 390 and 393, which are scheduled to take place in 2022.

References

Coggon, R.M., Christeson, G.L., Sylvan, J.B., Teagle, D.A.H., Estes, E., Williams, T., and Alvarez Zarikian, C.A., 2020. *Expedition 390/393 Scientific Prospectus: The South Atlantic Transect*. International Ocean Discovery Program. https://doi.org/10.14379/iodp.sp.390393.2020

Estes, E.R., Williams, T., Midgley, S., Coggon, R.M., Sylvan, J.B., Christeson, G.L., Teagle, D.A.H., and the Expedition 390C Scientists, 2021. *Expedition 390C Preliminary Report: South Atlantic Transect Reentry Systems*. International Ocean Discovery Program. https://doi.org/10.14379/iodp.pr.390C.2021