

IODP Expedition 390: South Atlantic Transect 1

Week 2 Report (17–23 April 2022)

During the second week of International Ocean Discovery Program (IODP) Expedition 390, South Atlantic Transect 1, we completed transit to Site U1556 (proposed Site SATL-53B) and commenced rotary core barrel (RCB) drilling of hard rock and basement in Hole U1556B. Site U1556 was first visited during Expeditions 390C, South Atlantic Transect Reentry Systems, and 395E, Complete South Atlantic Transect Reentry Systems, when a single advanced piston corer (APC) hole was cored to the sediment/basement interface and a reentry system and casing was installed in Hole U1556B. All times in this report are ship local time (UTC + 2 h).

Operations

Between 17 and 20 April 2022, the *JOIDES Resolution* completed the final 1046 nmi of the 2296 nmi voyage from Cape Town, South Africa, to Site U1556. Overall, the voyage averaged 11.1 kt and took 8.6 d. On 20 April at 2330 h the vessel arrived on site, lowered the thrusters, and transitioned from cruise mode into dynamic positioning mode. The bottom-hole assembly for RCB drilling in Hole U1556B was made up. Pipe was tripped to 5011 meters below rig floor (mbrf), stopping twice to fill stands with seawater and microbial contamination tracer. At 1930 h on 21 April, we deployed the subsea camera system to observe reentry into Hole U1556B. The reentry cone for Hole U1556B was spotted immediately, but the first reentry attempt stirred up sediment and obscured the cone's location. Repeated attempts were made, but the combination of stirred-up sediment and weather conditions near the operational limit made reentry challenging. The cone appears to be flush with the seafloor and was partially buried by resuspended sediment. Reentry was finally made at 0405 h on 22 April and the subsea camera system was recovered at 0640 h. Pipe was tripped down the cased hole to 267.0 meters below seafloor (mbsf), the top drive was picked up and drilling knobbies put in, and the hole was washed down to 291.0 mbsf where the bit contacted a hard layer. The drilled interval from seafloor to 291.0 mbsf was designated Core U1556B-1-1. A nonmagnetic core barrel and liner was pumped down, beginning RCB coring at 1052 h.

Core U1556B-2R advanced 9.3 m to 300.3 mbsf and recovered 1.64 m (18%). The decision was made to drill half-length cores to improve recovery and reduce time on bit per core. The ship was experiencing heave which made drilling difficult, and the rate of penetration was slow (<3 m/h for Cores 2R and 3R); both factors limited our ability to drill and achieve good recovery of full-length cores. Cores 3R to 10R advanced to 339.3 mbsf. In total, we advanced 48.3 m and recovered 25.05 m of core (52%) during Week 2 of Expedition 390.

From 17 to 19 April, all shipboard personnel took daily rapid antigen tests for COVID-19. 19 April marked seven days of daily testing, after which point the testing regimen switched to every other day. All personnel took tests on 21 and 23 April. All tests were negative.

Science Results

During transit, shipboard scientists worked to describe cores collected during engineering Expeditions 390C and 395E. Description results are summarized below.

On 18 April, a Site U1556 Presite Meeting was held for each of the four science party subgroups, formed to maximize social distancing. Operations plans, core flow, and plans for discrete shipboard samples and pooled geochemistry samples were discussed at the Presite Meeting. On 19 April, the Stratigraphic Correlators, Co-Chief Scientists, and Staff Scientist met with the Operations Superintendent and Siem Offshore Toolpushers to discuss options for the correlation of planned Hole U1556C to the previously cored Hole U1556A. Finally, in preparation for arrival at Site U1556, a prespud meeting was held between science and Siem Offshore personnel to go over operations details.

Site U1557

Holes U1557A and U1557B were cored during Expedition 390C. Hole U1557A consists of a single missed mudline core 9.63 m in length. Hole U1557B consists of Cores U1557B-1H to 66X, penetrating to 574.0 mbsf. The sediment/hard rock interface was encountered at 564.0 mbsf in Core 63X. Cores 63X to 66X had not previously been split during Expedition 390C. During Expedition 390, the sediment sections (63X-1 and 63X-2) were split, analyzed on the section half track systems (the Section Half Imaging Logger [SHIL], and the Section Half Multisensor Logger [SHMSL]), and described. Hard rock material in Cores 63X to 66X were binned, imaged using the DMT core scanner, and then split and described. Core pieces were large enough that almost all could be imaged via the DMT core scanner. Discrete samples for paleomagnetism, physical properties, and micropaleontology were taken from sediment overlying the sediment/hard rock interface. Additional discrete samples for X-ray diffraction (XRD), X-ray fluorescence, chemical analysis via inductively coupled plasma–atomic emission spectroscopy, paleomagnetism, and physical properties were taken from the hard rock material.

Sedimentology

The sedimentology team completed description of sediment in Holes U1557A and U1557B, consisting of Cores U1557A-1H and Cores U1557B-1H to 63X. The sediments recovered at Site U1557 are a mix of biogenic (mainly calcareous nannofossils and foraminifers) and siliciclastic (mainly clay minerals) sediments. The color of the sediment reflects its lithologic characteristics; sediments composed mainly of nannofossil and calcareous ooze are pinkish-white, whereas silty clays tend to vary from reddish-brown (relative high carbonate content as observed via smear slide) to brown/dark brown. Bioturbation is sparse and most commonly occurs at lithological contacts. Downcore, lithology transitions to primarily calcareous nannofossil chalk with foraminifera and then nannofossil-rich calcareous chalk. Occasional volcanoclastics and thin layers of silty clay occur.

Petrology

Hard rock material in Core U1557B-63X consists of intermixed sediment and basalts. In Cores 64X to 66X, hyaloclastite is the predominant lithology. The cores contain poorly sorted breccia with subangular pebble-sized clasts composed of palagonite or cryptocrystalline aphyric basalt. Some carbonate veins have a vuggy fill texture.

Biostratigraphy

Core catcher samples from Hole U1557B were collected during Expedition 390C and shipped to scientists on shore for biostratigraphic analysis. During Expedition 390, biostratigraphers worked to refine the age model by analyzing new calcareous nannofossil samples taken from the archive half sections as well as new planktic foraminifera and nannofossils samples from freshly split core at the sediment/basement interface of Hole U1557B. Site U1557 contains sediments spanning the Pleistocene to the middle Paleocene with a large unconformity spanning the middle Eocene through earliest Oligocene and encompassing the Eocene/Oligocene boundary. Calcareous nannofossil assemblages are generally abundant and vary in preservation from moderate to well-preserved throughout the record, with a few samples showing poor preservation. Planktic foraminifera vary significantly in abundance and preservation throughout the site, with preservation in the Paleocene/Eocene interval generally better than that of the Oligocene/Neogene. Planktic foraminifera and calcareous nannofossils show good agreement at the sediment/basement interface, and date the oldest sediments as middle Paleocene, ~60.7 Ma, in line with the projected basement age of 61 Ma.

Paleomagnetism

Five discrete samples were collected and analyzed from the previously unsplit Cores U1557B-63X to 66X. Two sediment samples and three hard rock samples were cut from the cores: a basalt, a weathered basalt with minor breccia, and a hyaloclastite. All five were subject to alternating field (AF) demagnetization in steps up to 100 mT. Additionally, isothermal remanent magnetization (IRM) techniques were applied to three of the samples for further magnetic mineral characterization. The samples indicated positive inclinations, suggesting the presence of a reverse chron at the sediment/basement interface of Hole U1557B compatible with Chron C26r and the estimated basement age of 61.1 Ma. However, the inclinations were shallower than expected for a geocentric axial dipole at this latitude. The median destructive fields for the four samples fell between 15–25 mT, suggesting the dominance of magnetite in the samples. IRM analysis confirms this interpretation. No drill string overprint was noted in the five discrete samples.

Physical Properties and Downhole Measurements

During Expedition 390C, core sections were analyzed on track scanning systems, including the Natural Gamma Radiation Logger and Whole-Round Multisensor Logger, and the SHIL and SHMSL, as well as for thermal conductivity. As part of Expedition 390, additional measurements were made on material from the previously unsplit Cores U1557B-63X to 66X.

New measurements include four discrete moisture and density (MAD) and triaxial *P*-wave measurements, four thermal-conductivity measurements, and 3-D digital imaging with the DMT core scanner of five whole-round core sections. Lithologies sampled include lithified sediment, altered basalt, and hyaloclastite. *P*-wave velocity, bulk and grain density, and porosity vary substantially with the lithology of the discrete samples. Thermal conductivity was higher in the one sample from a mixed lithified carbonate sediment and basalt than in other lithologies, which did not vary substantially in thermal conductivity.

Site U1556

During Week 2 of Expedition 390, we began RCB drilling in Hole U1556B. Cores U1556B-2R to 10R were cored, sampled for microbiology, and binned, and splitting lines were drawn by one of the shipboard petrologists. Whole rounds were analyzed on the whole-round track and larger pieces were imaged with the DMT core scanner. After imaging, cores were split into archive and working halves for description and discrete shipboard samples.

Petrology

Cores U1556B-2R to 7R have been described for igneous and alteration petrology. The cores alternate between two primary lithologies: hydroclastite and moderately olivine phyric basalt. Cores 2R and 3R contain a mix of moderately to sparsely olivine phyric basalt and sedimentary breccia. Core 4R represents a massive lava flow and contains sparsely olivine phyric basalt. Cores 5R to 7R contain breccia with a hyaloclastite matrix and calcite cement. Glass content is variable in Cores 2R–4R and consistently present in Cores 5R–7R, manifesting primarily as chilled margins, palagonite, and basalt fragments. Breccias, veins, and vesicles most commonly have polycrystalline fill, but botryoidal, massive, or vuggy fill types are also observed. Fill material is iron oxides, calcite, and saponite.

Biostratigraphy

A thin recovered interval of sediment directly overlying basement in Core U1556B-2R is roughly the same age of that observed in Hole U1557B, with the same marker taxa placing it in the mid-Paleocene. Nannofossils and foraminifera are abundant and moderately preserved, and marker taxa correlate to those identified at the base of Hole U1556A.

Paleomagnetism

Five discrete samples have been collected from Cores U1556B-2R to 10R and shared with the physical properties team. Two were designated for thermal demagnetization and are awaiting analysis. The three remaining samples were subjected to AF demagnetization, and two of three were analyzed via IRM for further magnetic mineral characterization. One of these three samples appears brecciated, while the other two would be considered “fresh.” The demagnetization curve for the breccia exhibited a “humpback” feature, increasing in intensity during the demagnetization process. This occurs between the natural remanent magnetization measurement and 10 mT. The directional data for this sample requires further analysis. The two “fresh”

samples exhibited smoother demagnetization curves, and their directional data indicate a reversed polarity during these depths. The IRM analysis for the two samples also indicates magnetite is the dominant carrier. Again, no drill string overprint is observed in the data.

Physical Properties and Downhole Measurements

Physical property measurements taken on the hard rock Hole U1556B cores collected during Expedition 390 include natural gamma radiation, gamma ray attenuation for bulk density, magnetic susceptibility, and 3-D digital imaging via the DMT core scanner of 50 whole-round core sections. We also collected color reflectance and point magnetic susceptibility (SHMSL) and 2-D images (SHIL) on 43 split half-core sections, collected five discrete MAD and triaxial *P*-wave measurements, and made 16 thermal conductivity measurements.

Microbiology

During transit, microbiologists prepared for sampling at Site U1556. Media was made for incubations and the Isotope Van was set up for experiments using both stable and radioisotopes to determine what substrates are being utilized by seafloor microorganisms and to quantify rates of sulfate reduction. The Microbiology Laboratory was also set up for sampling of cores using the KOACH system, which provides a clean air, overpressured area that mitigates contamination from the air, and a custom-made steel “rock box” for microbiology sampling of hard-rock material. A new imaging protocol for microbiology whole-round samples was tested using the Foldio lightbox/turntable system. Thus far at Site U1556B, the microbiology team collected samples from Cores U1556B-2R, 3R, 5R, 7R, and 9R. Subsamples from the microbiology whole rounds from these cores were preserved for cell counts and analysis of community DNA, RNA, and lipids during postexpedition research.

Education and Outreach

The following outreach activities took place during Week 2.

- Posted six new “Expedition Log” (blog) posts, including two videos, and one containing audio/video of unique *JOIDES Resolution* sounds. All blog posts contain an audio reading of each post’s text to increase accessibility. Blog posts are available on the [JOIDES Resolution expedition website](#).
- [Facebook](#): Reached 5,231 people and added 23 followers.
- [Twitter](#): 16 new tweets posted, 1,180 engagements, and 62 new followers.
- [Instagram](#): Five new posts reaching 1,567 accounts.
- Completed nine ship-to-shore broadcasts, reaching an audience of ~360 people in two countries (USA and Spain).
- Added updates to the Google Earth expedition-related files: [Scientists on Board](#), [Voicemails from the JR](#), [Where is the JR?](#)

Technical Support and HSE Activities

The following technical support activities took place during Week 2:

Laboratory Activities

- General
 - Ship-air inline filters for the N₂ generator were replaced. Greasy, rusty fluid was found coming out of two of the filters, which were last replaced in October 2021. No grease/rust entered the N₂ generator and N₂ generator filters were observed to be clean. We will continue to monitor the ship's air supply.
 - The IODP store credit card machine was set up and is operational.
- Core Laboratory and Splitting Room
 - A leak in the water line inside the super saw was temporarily fixed; the line will need to be replaced during a tie-up period.
 - A small bench was built to support the DMT laptop.
 - A set of black arches that fit over a core section were 3-D printed to assist the DMT core scanner camera in focusing on long core sections.
- X-ray Laboratory
 - The Bruker X-ray diffractometer experienced a problem where it would randomly shut down every 24–48 h. A voltage meter recording ship's power found the voltage variation was insignificant and the Haskris water chiller was determined to be working correctly. The instrument can be restarted without issue. The vendor recommended a service call.
 - The Aries XRD is not functioning.
 - The portable X-ray fluorescence spectrometer (pXRF) failed to recognize and scan discrete powder samples, although it successfully analyzed standard powders in identical sample cups. The instrument was used to measure section halves.
- Chemistry Laboratory:
 - New methods for neutralizing and disposing of hazardous waste were researched.
- Microbiology Laboratory
 - Remote control of the microbial contamination tracer pump via Rigwatch was restored.

Application Support Activities

- Made several changes to fix ongoing issues with the MADMax program.
- A mini-project to modularize the MUT uploader was deployed at the pXRF and PMAG workstations.
- Work was conducted on the Sample and Data Request Management and Auther projects.

IT Support Activities

- Rigwatch was rebooted and communication to the correct IP address was reassigned in order to restore remote control of the microbial contamination tracer pump.
- A credit card terminal for the IODP store was added to the ship network.
- Continued monitoring network traffic and studied firewall features with the goal of better managing the *JOIDES Resolution* network environment.
- Preparations were made for software updates, including a 7zip bundle for Zenworks tools, Firefox, Chrome, Edge, Notepad++, and CrowdStrike.
- The HP Universal Postscript Driver (v6.0.0.6) was observed to work on newer versions of the Monterey operating system and was distributed for wider use.
- Apple computers operating on the Mojave operating system experienced a number of issues relating to operating system end-of-life. Troubleshooting was conducted as possible.

HSE Activities

- Personnel took rapid COVID tests every other day.
- Personnel followed COPE protocols.
- Emergency shower and eye wash stations were tested.
- Personnel participated in a weekly fire and boat drill on 17 April.