

## **IODP Expedition 393: South Atlantic Transect 2**

### **Week 3 Report (19–25 June 2022)**

In Week 3 of International Ocean Discovery Program (IODP) Expedition 393, South Atlantic Transect 2, we cored basalt in Hole U1559B to a depth of 107.9 meters below seafloor (mbsf) using the rotary core barrel (RCB) system. Because of very slow drilling, we decided to end operations at Site U1559 (proposed Site SATL-13A) after the first bit wore out, and we moved on to Site U1558 (proposed Site SATL-43A).

COVID-19 safety protocols ended at 0700 h on 24 June 2022 following 14 days at sea. All times in this report are ship local time (UTC + 0 h).

### **Operations**

The ship completed the last 135 nmi of the 1713 nmi transit from Cape Town to Site U1559 and the ship's thrusters were lowered at 1220 h on 19 June, beginning operations at Hole U1559B.

An RCB bottom-hole assembly (BHA) was made up and run to 3031 meters below rig floor (mbrf). The top drive was picked up and a pipe “pig” was pumped through the drill string to clean rust from the inside diameter. The ship was maneuvered for reentry into Hole U1559B, which had been established and cased during Expedition 390C in November 2020. We reentered Hole U1559B at 0143 h on 20 June and washed to 58.9 mbsf, the bottom of the existing hole. Cores U1559B-2R to 13R penetrated from 58.9 to 107.9 mbsf and recovered 12.82 m (26.2%). Core 2R had no recovery and drilled very quickly, indicating softer sediment above basalt. Core 3R encountered basalt at a depth of approximately 65 mbsf. Coring proceeded through Core 11R with a rate of penetration of about 1 m/h. In Core 12R, penetration slowed to <0.5 m/h with recovery decreasing. After a very poor recovery on Core 13R, it was decided to terminate coring and retrieve the bit to surface. Significant damage to the bit cones was noticed upon recovery. The ship was secured for transit and switched from dynamic positioning (DP) to cruise mode at 1232 h on 23 June, ending Hole U1559B and Site U1559.

The ship completed the 508 nmi transit to Site U1558 in 46.5 h (1.9 days), arriving on site at 1125 h on 25 June. The ship was switched to DP mode, beginning operations at Site U1558. An advanced piston corer/extended core barrel (APC/XCB) BHA was assembled and deployed to 4321 mbrf. As Week 3 ended, a pipe “pig” was circulated down through the drill pipe to remove any rust from the new ~1300 m of pipe required to reach the seafloor at Site U1558, compared to the shallower Site U1559.

## Science Results

During Expedition 393 Week 3, the science party processed and described basalt cores from Hole U1559B. The micropaleontology team continued to work on the biostratigraphy of Hole U1558A. There were daily sample parties to collect shipboard samples from Hole U1559B, and after completion of Hole U1559B core description, a sample party was held for collection of pooled samples for postexpedition analysis.

### *Petrology*

The macroscopic description of Cores U1559B-2R to 13R was completed, and observation and preparation and description of thin sections is underway. Cores U1559B-2R to 13R consist of aphyric basalt, sparsely plagioclase phryic basalt, and sparsely plagioclase phryic basalt with rare olivine and clinopyroxene phenocrysts. The hole has been divided into five igneous units, and these units are interpreted to represent a comagmatic sequence of both sheet and pillow lava flows. The portable X-ray fluorescence spectrometer (pXRF) instrument was used to make ~100 measurements of elements in cut core surfaces and has become a key part of the core flow and dataset for lithostratigraphic interpretation. Preliminary pXRF interpretation is consistent with mid-ocean-ridge basalt (MORB). All of the core exhibits evidence of hydrothermal alteration, manifested as background alteration, alteration halos, and secondary minerals filling vesicles and veins. Some vugs are partially filled with calcite. The secondary mineralogy is dominated by clays, Fe-oxyhydroxides, and calcium carbonate. The Deutsche Montan Technologie (DMT) scanner was used to make 360° scans of some of the cores prior to splitting; however, poor recovery, consisting mainly of short noncylindrical pieces, prevented most of the recovered core from being scanned.

### *Lithostratigraphy*

The sedimentology team assisted the petrologists in the Core Description Laboratory with imaging and track measurements. They also worked on figures and text for the Site U1558 chapter, based on core description carried out previously during Week 2.

### *Geochemistry*

Preparations for interstitial water (IW) and Rhizon sampling were finalized in time for arrival at Site U1558, where the first pore water samples are to be taken. This included gathering and cleaning appropriate vials and planning for limited recovery IW scenarios, and squeeze cake subsampling, which will include X-ray diffraction (XRD) samples for shipboard analysis. Scientists were trained in running instruments for alkalinity and salinity measurements. We reviewed inductively coupled plasma–atomic emission spectroscopy (ICP-AES) data collected during Expedition 390 and began preparations for reanalyzing a number of Site U1556 and Site U1557 samples that had problematic initial ICP-AES results. Samples from Hole U1559B will be in the first set of analyses for ICP-AES. A performance test was run on the pXRF to assay the robustness of the calibration curves produced for data correction. Results from most of the

elements analyzed on the pXRF suggest that our working curves have been robust over the ~12 days since they were created and continue to produce reliable data. However, Si, Mg, Al, and V (all low-sensitivity species on this instrument) appear to suffer from intensity changes over time.

### *Microbiology*

The microbiology team collected and prepared hard rock samples from cores from Hole U1559B and stored them for postexpedition analyses. 360° images of the samples were taken before they were broken up. Protocols continued to be refined for the oxygen/temperature probe measurements and for using the plate reader for nutrient measurements (ammonium, phosphate, and sulfite).

### *Micropaleontology*

Because the cores from Hole U1559B were basalt, this week the main focus of the micropaleontology team was on resolving the biostratigraphy of Hole U1558A. Work was carried out both onboard and by shore-based scientists. The team finished analyses of all core catcher samples and additional nannofossil smear slides from selected horizons. In conjunction with paleomagnetic data, this biostratigraphy will serve as a foundation for building a reliable age-depth model for the site. Core U1558A-1H contains a hiatus or condensed interval, and Cores 2H to 18X are early Miocene to middle Eocene in age.

### *Paleomagnetism*

Magnetic measurements were made on cores and discrete cube samples from Hole U1559B. The remanence magnetization before and after alternating field (AF) demagnetization steps (5, 10, and 20 mT) were measured using the superconducting rock magnetometer (SRM) on pieces longer than 9 cm from all the cores recovered in Hole U1559B. A total of 11 discrete samples were prepared and measured, which is around one sample per core, covering both fresh and altered basalt lithologies. SRM data reveal positive inclination (reversed geomagnetic field polarity) throughout all the cores, with slightly lower inclination than predicted assuming a geocentric axial dipole (GAD). Measurements on the discrete samples confirm the results obtained from the SRM. Anisotropy of magnetic susceptibility (AMS) measurements were conducted on all discrete samples, and the results show consistency among specimens and a well-defined subhorizontal magnetic fabric. Isothermal remanent magnetization (IRM) acquisition curves and back-field IRM experiments show that low coercivity components dominate. In addition, a decrease in median destructive field (MDF) and coercivity of remanence ( $B_{cr}$ ) with depth likely indicates the presence of relatively coarse-grained magnetic minerals.

## *Physical Properties and Stratigraphic Correlation*

The physical properties specialists measured Cores U1559B-3R to 13R on the Natural Gamma Radiation Logger (NGRL), Whole-Round Multisensor Logger (WRMSL), and X-ray Imager tracks. Thermal conductivity was measured on 11 core pieces that captured the representative basalt lithology from the hole. The mean thermal conductivity was  $\sim 1.8 \text{ W}/(\text{m}\cdot\text{K})$  and this remained relatively constant with depth. Moisture and density (MAD) and *P*-wave velocity measurements were made on the same 11 cube samples that had been analyzed in the Paleomagnetism Laboratory. They have a mean *P*-wave velocity of 5634 m/s and mean porosity of 3.7%.

## **Education and Outreach**

This week the Onboard Outreach Officer made 33 posts on each of the social media sites, ran ten ship-to-shore video tours, and wrote a post for the JR Expedition Log.

- [Twitter](#) has an average 78 engagements (minimum is 12 and maximum is 170) per post, and an engagement rate of 3%, with 36 additional followers.
- [Facebook](#) posts reached 10,919 people, with 311 page views, and 24 new followers.
- [Instagram](#) posts reached 2,656 accounts, engaged 428 accounts, and has 18 new followers, 12 unfollows.
- Ten ship-to-shore video tours to a total of  $\sim 180$  people, the largest of which was to a middle school to the Basque-speaking area of France ( $\sim 60$  students).
- The [JOIDES Resolution website](#) has three new blog posts.

## **Technical Support and HSE Activities**

Technical staff supported the science laboratories at Hole U1559B and prepared for intensive microbiological sediment sampling during the transit to Site U1558.

### *Laboratory Activities:*

- Verified sample shipments and addresses with scientists.
- The core receiving platform flush/drain system was not working. After replacing a solenoid, replacing steel piping with PVC, and installing new brackets, it is fully operational.
- Repaired a rusted railing outside the Paleo Prep Laboratory.
- Wrote a Quick Guide for COY soft-shell anaerobic chamber.
- Several 3-D printed spacers were created for Section Half Imaging Logger (SHIL) imaging to indicate the locations of whole-round samples taken for IW and microbiology.
- Triggering tests were performed for familiarization with Niskin water sampler process.

- A non-metal Bendix PT06 connector was drafted and printed for the fluxgate probe cable.
- Found workarounds for switching between WRMSL and Special Task Multisensor Logger (STMSL) modes on the aft WRMSL.
- Prepared thin sections of Hole U1559B core samples.
- Finalized protocols for identifying pXRF measurement locations in the LIMS database.
- Wrote a Quick Start Guide for saving pXRF data.
- The pXRF could not connect to the shared folders by Wi-Fi; connecting by ethernet cable resolved the issue.
- The Aeris XRD instrument has been working well for Expedition 393 samples.

*IT Support Activities:*

- Continued to develop additional deployment images for the upcoming workstation upgrade.
- Patched Linux and Windows servers with monthly OS patches and other software.
- Tested and patched Windows PCs and laptops with OS patches, Office patches, and other software.
- Configured old vCenter server for inclusion to VMware as a virtual test environment host.
- Developing and testing deployment plans for Adobe Creative Cloud.
- Preparing for upcoming security assessment.

*HSE Activities:*

- Conducted showers and eye wash safety checks.
- A boat drill was held on 20 June. Scientists received an introduction to the lifeboats and went inside the lifeboats.
- The last set of COVID antigen tests was done on Thursday 23 June. All shipboard personnel tested negative. The COPE mitigation period ended at 0700 h on Friday June 24.