

## **IODP Expedition 390: South Atlantic Transect 1**

### **Week 4 Report (1–7 May 2022)**

In the fourth week of International Ocean Discovery Program (IODP) Expedition 390, South Atlantic Transect 1, we cored Hole U1556B to a depth of 633.2 meters below seafloor (mbsf) using the rotary core barrel (RCB) system and completed logging operations for the hole. All times in this report are ship local time (UTC + 2 h).

### **Operations**

Week 4 of the expedition was primarily occupied with RCB coring in Hole U1556B. Coring proceeded from Cores U1556B-42R through 59R, advancing 85.8 m and recovering 57.35 m (67%) to achieve a final hole depth of 633.2 mbsf. The total advance for Hole U1556B was 342.2 m with 191.87 m recovered (56%). Cores taken during this week were all half length, as half-length coring both improves recovery and prevents damage to the RCB drilling system. Mud sweeps were conducted after every half core. Microbial contamination tracers were pumped with drill fluids throughout coring of the entire hole. During initial drilling of Core 51R, we experienced high pump pressures (>2000 psi) and recovered the core barrel. Circulating pressure returned to normal after conducting additional mud sweeps and running the deplugger tool. Core 59R was the last core for the hole, arriving on deck at 1505 h on 4 May 2022. The RCB bit, having achieved 78 h drill time without failure, was dropped at the bottom of the hole using the mechanical bit release (MBR) system. We then began pulling out of the hole, setting pipe depth to 41 mbsf to prepare for logging operations.

To assist with logging, the hole was cleaned by pumping twice the hole's volume of seawater. The triple combo logging tool string, including tools for measuring formation density, resistivity, and magnetic susceptibility (MS), was lowered until it tagged hole bottom. The calipers were opened and the first upward pass started. Tool string telemetry failed after only a few meters of logging and the string was pulled back to the surface and recovered at 0815 h on 5 May. The Hostile Environment Natural Gamma Ray Sonde was identified as the issue and a spare tool was substituted into the string. The second attempt at logging was successful, with two passes of the triple combo string completed before pulling it back to surface at 1930 h. The second tool string run contained the Ultrasonic Borehole Imager (UBI) and Accelerator Porosity Sonde tool. The tool string was lowered to a depth of 622 mbsf, with the UBI sensor manually rotated to the "measurement" position—facing outward toward the formation—to avoid the possibility of fouling and jamming the sensor closed in the open hole. The upward pass generated high-quality data. The tool string was recovered at 0605 h on 6 May and the final logging tool string, the Formation MicroScanner (FMS)-sonic, was lowered until it tagged bottom. The string logged two upward passes and reached the surface for recovery at 1710 h. The rig floor was cleared of logging equipment and pipe tripped back toward the surface. We cleared the seafloor at 1830 h.

With the drill string at 2200 meters below rig floor (mbrf), the ship was repositioned 30 m south of Hole U1556B to prepare for drilling Hole U1556C.

Hole U1556B officially ended when the bottom-hole assembly (BHA) and MBR were recovered on the rig floor at 0405 h on 7 May. The crew performed a cut and slip of the drill line, then began tripping pipe toward the seafloor with the advanced piston corer/extended core barrel (APC/XCB) BHA for sediment coring in Hole U1556C. Tripping paused twice to fill the drill pipe with water. Core U1556C-1H, using a nonmagnetic APC core barrel, was shot from a depth of 5012.5 mbrf and recovered 7.61 m of sediment as well as the mudline. The core was received on deck on 2315 h. It was significantly disturbed, so seafloor depth was assumed to be 5005.7 meters below sea level (mbsl), offset from Hole U1556A instead of calculated from recovery.

## Science Results

During Expedition 390 Week 4, the science party completed processing and describing cores from Hole U1556B. Scientists conducted daily discrete shipboard sampling parties in addition to an occasional “pooled” sampling party, to select and generate samples that can form a shared geochemical dataset for representative basalts. In addition, scientists finished drafts of their reports covering Holes U1557A and U1557B and turned them into the science office for editing. On 7 May, the science party presented preliminary results from Hole U1556B, covering basement unit boundaries, alteration features, and highlights from the geochemistry, physical properties, and paleomagnetism datasets.

### *Site U1556*

Cores U1556B-42R to 59R were recovered, sampled for microbiology, and curated. Whole rounds were analyzed on whole-round track systems and larger pieces were imaged with the DMT core scanner. After imaging, cores were split into archive and working halves for description, section half track scanning, and collection of discrete shipboard samples.

### Petrology

Cores U1556B-35R to 59R were described for igneous and alteration petrology. Cores recovered from higher up in the hole predominantly contain moderately olivine phyric basalts emplaced as pillow lava flows. Cores in the lower portion of the hole transition toward aphyric basalts (Core 39R to Section U1556B-54R-3) emplaced as either pillow lava or massive flows. In Section 54R-3 through the bottom of the hole, cores transition further toward highly plagioclase olivine or olivine-augite phyric basalts emplaced as a massive lava flow. A dike is observed Core 38R. Groundmass for the moderately olivine phyric and aphyric basalts is typically cryptocrystalline; groundmass is microcrystalline in the plagioclase phyric basalts. Fill is predominantly veins with rare vesicles and breccia. Hyaloclastite intervals occur between pillows. Glass is present along

chilled margins and as discrete clasts in the hyaloclastite. Hyaloclastite in Cores 54 through 59R is cemented by micritic limestone.

### Paleomagnetism

We continued collection and analysis of samples from representative basalts in Cores U1556B-34R through 59R. Only those pieces with lengths of at least 9 cm were measured on the superconducting rock magnetometer. Standard cube samples for paleomagnetic analysis were collected from representative basalts recovered from Hole U1556B. Sampling targeted different grades of alteration. Both alternating field (AF) demagnetization of the natural remanent magnetization (NRM) and acquisition of isothermal remanent magnetization (IRM) indicate a variety of coercivities for the ferromagnetic phases present in samples, requiring fields up to 190 mT to fully demagnetize NRM. Nearly all samples carry a well-defined single component of remanence with normal inclinations (reverse polarity), compatible with the rock age. An additional small component of negative inclination is observed in brecciated rocks and some oxidized basalt samples that likely represents a component acquired upon alteration. This inclination is steeper in brecciated rocks and less altered basalts, while those with greater alteration display shallower overprinted inclinations. As analyzed samples are saturated or close to saturation at the maximum field applied during IRM acquisition (1.2 T), maghemitization of original magnetite-titanomagnetite minerals could cause this effect. A higher coercivity phase may be present in some samples. Finally, nine samples were subjected to thermal demagnetization up to 580°C (the temperature used to define magnetite by a loss in magnetization). This data confirms the results of both the AF demagnetization and IRM analyses.

### Micropaleontology

Thin section analysis of an interflow sediment deposit in the lowermost core reveals an assemblage of foraminifera indicative of Zone P4a, the same as the sediment/basement interface. No other paleontological analyses were performed this week.

### Physical Properties and Downhole Measurements

Physical properties measurements were made on 34 hard rock core sections collected during Expedition 390 from Hole U1556B, including natural gamma radiation (NGR), gamma ray attenuation bulk density, and MS. 3-D digital imaging with the DMT core scanner system was conducted on 39 whole-round sections. Color reflectance and point magnetic susceptibility measurements, as well as 2-D images (the Section Half Imaging Logger), were collected from 80 split half-core sections. Discrete measurements allowed us not only to characterize the properties of representative altered basalts within the basement interval at this hole, but also to capture targeted information about hyaloclastite- and breccia-dominated units. We collected moisture and density data on 42 discrete samples, made triaxial *P*-wave measurements on 44 discrete samples, and made 17 thermal-conductivity measurements. Physical properties of discrete samples vary with lithology. Hyaloclastite samples feature lower conductivities and higher

porosities than the basalts. We observe a distinct change in physical properties at ~610 mbsf—the MS values increase and the NGR values decreased substantially. For the discrete samples below ~610 mbsf, *P*-wave velocities increase and porosities decrease substantially. We find a strong anticorrelation between *P*-wave velocity and porosity that persists through all lithologies.

Downhole logging operations in Hole U1556B were conducted from 4–6 May, beginning with the triple combo tool string, which measured gamma ray, borehole diameter, density, electrical resistivity, and MS. The caliper log from the triple combo showed that the borehole size varied from ~10 to 12 inch in diameter, with few to no washed-out intervals. Gamma ray data were recorded through the cased interval, showing variations that likely correspond to lithologic changes in the sediments above basement. MS, gamma ray, electrical resistivity, porosity, and velocity data varied throughout the ~340 m interval of open basement hole, likely in response to changes in basement properties described in cores. UBI and FMS images will be generated in postacquisition processing, along with the rest of the logging data.

### Geochemistry

Rock samples were selected for loss on ignition inductively coupled plasma–atomic emission spectroscopy analyses from Cores U1556B-31R to 59R. At least one representative sample was selected for each lithological unit to obtain bulk major and minor elemental compositions, including basalt with different degrees of alteration. Samples through Core 35R have been analyzed. Additionally, squeezed interstitial water (IW) and Rhizon IW samples were collected for Core U1556C-1H for shipboard analyses and postexpedition research.

### Microbiology

During Week 4, the microbiology team collected approximately one sample per 10 m advance for preservation for shore-based analysis. Before processing the whole rounds, they were imaged using the Foldio lightbox/turntable system. All sampling was done within the KOACH system, a portable air filtration unit that creates a particle-free area for low-contamination sampling. Sample handling was conducted using an ethanol-washed steel rock box and chisels. 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. To test the contamination of drilling fluid, we collected the inner and outer rock chips containing perfluorocarbon tracer (perfluoromethyldecalin [PFMD]) from each whole round. Preliminary analysis of PFMD samples analyzed via gas chromatography/electron capture detection indicated no intrusion of drilling fluid in the majority of samples.

### Education and Outreach

The following outreach activities took place during Week 4.

- Posted four new “Expedition Log” (blog) posts, one video and three text. These include some data from our transit as well as weather data that can be used by classrooms following our journey. All blog posts contain an audio reading of each post’s text to increase accessibility. Blog posts available on the [JOIDES Resolution expedition website](#).
- [Facebook](#): Reached 5,416 people and added 10 new followers.
- [Twitter](#): 14 new tweets posted, 1,363 engagements and 36 new followers.
- [Instagram](#): 13 new posts, reaching 1,424 accounts; gained nine new followers.
- Completed eight ship-to-shore broadcasts, reaching an audience of ~350 people in three countries (USA, Japan, and UK). One tour was a seminar for the National Association of Geoscience Teachers (NAGT).

## Technical Support and HSE Activities

The following technical support activities took place during Week 4.

### *Laboratory Activities*

- Supported processing and sampling of hard rock cores from Hole U1556B, including shipboard discrete samples for standard analyses, the preliminary “pooled” geochemical samples, and microbiological samples.
- Core Laboratory
  - Built a shelf to house a carboy inside the Micropaleontology Laboratory fume hood.
  - Two of the thermal conductivity pucks were not working; examination under a microscope confirmed that both probes shorted out.
  - Tested MegaUploaderTron (MUT) 2 on laboratory instruments.
- Chemistry and Microbiology Laboratory
  - A whole-round extruder and multiple Delrin pucks were fashioned to assist microbiologists with whole round subsampling inside of the Coy anaerobic chamber.
  - The liquid scintillation counter was used to confirm the activity of the <sup>35</sup>S sulfur radioisotope tracer to be used in sulfate reduction rate experiments.

## Application Support Activities

- The MUT modularization project moved toward completion; extensive testing is still needed. The MUT module for the Paleomagnetism Laboratory KappaBridge instrument was changed so that it only uploads new data and not cumulative data, as the instrument software adds new data to the same file.
- Work was conducted on the Sample and Data Request Management (SDRM) and Auther projects.

- Investigated server disruptions that occurred on 8 May.
- Added support for an “acquired after” filter in all LORE reports.
- Investigated a problem with the Thin Section Report Writer, which is unable to write to its log file and instead presents old log files as new. The issue will be fixed on shore and deployed on the ship soon.
- Investigated an issue with the ValueListManager in DESClogik, where the program gives an error when uploading a list. The error may be related to server configuration.
- Reconfigured task bar shortcuts for IODP applications on instrument host computers, where the shortcut would not work if it had been created while the application was open.

### **IT Support Activities**

- Changed Windows Firewall settings to allow developers to access resources on shore-based servers.
- Addressed an issue where eDirectory was corrupted and rights were not applied properly to VOL4/scratch.
- Removed eDirectory accounts of former staff members.
- Resolved an issue with RigWatch/IRIS-DW-SLB, where core winch depth was passed to the overlay but not stored in RigWatch.

### **HSE Activities**

- Emergency shower and eye wash stations were tested.
- Siem Offshore personnel tested the vessel general alarm system.