

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

### **Week 7 Report (17–23 July 2022)**

In Week 7 of International Ocean Discovery Program (IODP) Expedition 393, South Atlantic Transect 2, we conducted logging operations in Hole U1583F (proposed Site SATL-33B) and then transited 182 nmi to Site U1560 (proposed Site SATL-25A), the last site of the expedition. Site U1560 is situated on ~15 Ma crust, the second youngest in the transect. We cored volcanic basement in Hole U1560B from 124 to 219.2 meters below seafloor (mbsf), recovering 38.4 m (40%), via the reentry system that had been installed on Expedition 395E in April 2021. On the last day of the week we changed the bit and reentered Hole U1560B to deepen it.

### **Hole U1583F Logging Operations**

On 17 July 2022 we started preparing the triple combo downhole logging tool string (consisting of natural gamma radiation, neutron porosity, density, and electrical resistivity tools) for logging Hole U1583F. There had been up to 3 m of fill after each core which was flushed out by mud sweeps; it was uncertain if the fill resulted from cuttings not being completely cleared from the hole or if new material was falling from the borehole wall. Because of these hole conditions and also because of ~3 m ship heave, which is high for logging, the density tool source and the magnetic susceptibility (MS) tool were not included in the tool string.

We lowered the triple combo tool string down Hole U1558F to 237 mbsf, within 3 m of the bottom, and made two logging passes in the open hole. While descending for the second pass, the tool string encountered an obstruction at 182 mbsf and could not pass below it. We raised the triple combo to the rig floor, disassembled it, and assembled the Formation MicroScanner (FMS)-sonic tool string. We lowered the FMS-sonic tool string down to 182 mbsf and made a logging pass up to the top of basement at 109.5 mbsf. At that point we found that the tool string could not go back down into basement, and overpull of approximately 8,000 lb was observed when trying to pull the tool string back into the drill pipe. After pumping to remove any potential obstruction, the tool string still could not enter the pipe. Finally, we rotated the pipe 180° and the tool string could be pulled in. When the tool string reached the rig floor, it was discovered that the FMS tool caliper arms had been damaged and one was missing. By midnight we had disassembled the FMS-sonic tool string, ending downhole logging operations at Hole U1583F. We raised the pipe from 102.8 mbsf, clearing the seafloor at 0035 h on 18 July. The bottom-hole assembly (BHA) reached the ship at 0645 h and was disassembled. The rig floor was secured for transit by 0840 h, and we raised the thrusters and began the transit to Site U1560.

## *Transit*

The ship completed the 187 nmi voyage to Site U1560 in 16 h at an average speed of 11.3 kt.

## *Hole U1560B*

In preparation for the current expedition, a reentry cone and 10<sup>3</sup>/<sub>4</sub> inch casing had been installed in Hole U1560B during Expedition 395E in April 2021. The base of casing was set at 122.0 mbsf and the hole itself extended to 124.0 mbsf where the bit met a hard surface, assumed to be basement. The casing was cemented with enough cement to fill the base of the hole and pipe to approximately 100 mbsf.

At 0130 h on 19 July we lowered the thrusters and started operations at Hole U1560B. We assembled the rotary core barrel (RCB) BHA and lowered it down to 3714 meters below sea level (mbsl). Guided by the subsea camera images, we reentered Hole U1560B at 0920 h on 19 July and lowered the bit down to 124 mbsf, the base of the existing hole. No cement was found by drilling.

We started coring Hole U1560B at 1215 h on 19 July. Cores U1560B-2R to 21R penetrated volcanic basement from 124.0 to 219.2 mbsf, recovering 38.4 m (40%). All cores were half-length (4.8–4.9 m). After cutting Core U1560B-21R, the bit had 52.3 h of drilling time. It was still cutting in-gauge, good-recovery cores, but would not last to the intended target depth, so at 2325 h on 22 July we started to raise the pipe to change to a new bit. There was 5,000–10,000 lb overpull at 128 mbsf, so the drillers rotated through this area to clear the tight spot. We deployed the subsea camera to observe the BHA coming out of the reentry cone, and the bit cleared the seafloor at 0250 h on 23 July. The BHA was racked in the derrick and the bit was replaced. At 1030 h we started lowering the new bit down to the seafloor. We redeployed the subsea camera and reentered Hole U1560B at 1955 h. By midnight on 23 July the bit had reached 203.4 mbsf and we dropped a core barrel to restart coring.

## **Science Results**

During Week 7, the science party processed and described basement Cores U1560B-2R to 21R, and finished analytical work on samples from previous Expedition 393 sites.

## *Petrology*

The petrologists made macroscopic descriptions, portable X-ray fluorescence spectrometer (pXRF) measurements, and took images with the Deutsche Montan Technologie (DMT) scanner of the exterior of cores from Hole U1560B. The volcanic basement cores are dominated by variably aphyric to moderately plagioclase-olivine phyric pillow basalts with occasional 1 m or thicker sheet flows. These basalt lavas were split into five stratigraphic units and intervals of

pervasive strong alteration were recorded. pXRF analysis revealed three major compositional units so far that all correspond with petrologically defined unit boundaries.

### *Lithostratigraphy*

No sedimentary cores were recovered or described this week, so the sedimentology team worked on site reports from the earlier expedition sites.

### *Geochemistry*

The geochemists completed the fifth and sixth inductively coupled plasma–atomic emission spectroscopy (ICP-AES) runs, completing analyses of all Site U1558 basalt samples and all but five of the Site U1583 basalt samples. pXRF analyses on Site U1583 were also completed, and the first pXRF analyses were collected on the Site U1560 basalt cores. The remaining Site U1583 samples and the first set of Site U1560 samples have been fused and beaded for dissolution and ICP-AES analysis in the next few days.

Basalts from Site U1583 differ from those at Sites U1558 and U1559 in having overall higher incompatible trace element contents, and somewhat lower MgO contents, suggesting somewhat greater degrees of crystallization before eruption. Alteration indicators such as K/Zr ratios are overall lower than those of the older basalts, but run to higher values than seen in younger Site U1559 basalts. The geochemistry team also worked on site reports from the earlier expedition sites.

### *Microbiology*

The microbiology team collected approximately one basement sample per 10 m advance in basement in Hole U1560B, where recovery was sufficient, for preservation for shore-based analysis. Before processing the basement 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 for postexpedition research.

### *Micropaleontology*

The main focus this week was to refine the biostratigraphy and age model for Site U1583 and produce the site report. Shore-based scientists worked on the biostratigraphy of Site U1560 using existing samples from Hole U1560A, and also worked on making mass accumulation rate estimates for earlier expedition sites.

## *Paleomagnetism*

This week, the paleomagnetism team finished measurements on basement cores of Hole U1583F and started measurements on basement cores of Hole U1560B. Continuous measurements were conducted using the superconducting rock magnetometer (SRM) to monitor remanence magnetization before and after 3 different alternating field (AF) demagnetization steps (5, 10, and 20 mT). A total of 13 basalt cubes were sampled and measured from Hole U1560B cores so far, which is about 1–2 samples per core. Most of the samples are from the least-altered basalt with a few samples from alteration halos in basalt. They have a mostly clear negative characteristic remanent magnetization (ChRM), which indicates normal polarity.

## *Physical Properties and Stratigraphic Correlation*

The physical properties specialists finished processing basement core material from Hole U1583F and started working on basement samples from Hole U1560B. This included running all whole-round sections through the Natural Gamma Radiation Logger (NGRL) and Whole-Round Multisensor Logger (WRMSL), as well as making discrete measurements of moisture and density (MAD), *P*-wave velocity, and thermal conductivity. In addition, all relatively cylindrical core pieces were scanned using the DMT core scanner prior to being split.

WRMSL measurements for Hole U1583F show two intervals with elevated MS, from 110 to 120 mbsf (in Unit I) and at ~160 mbsf (between Unit 3A and 3B). One notable feature is a peak in NGR at ~172 mbsf, which coincides with the lowest density and highest porosity measured in the core corresponding to the sedimentary breccia that makes up volcanoclastic Unit 4. Hole U1583F basalts have a mean thermal conductivity of  $1.63 \pm 0.13$  W/m·K ( $\pm 1$  standard deviation) and a mean bulk density of  $2.74 \pm 0.16$  g/cm<sup>3</sup>.

After completion of coring, wireline logging tool strings were run in Hole U1583F (see Operations, above). The data, in particular the resistivity log, are of good quality and will help constrain the major units identified in the volcanostratigraphy.

## **Education and Outreach**

This week the Onboard Outreach Officer made 32 new posts (crossposted on each of the social media sites), ran eight ship-to-shore video tours, and wrote a post for the JR Expedition Log.

### *Social Media*

- [Twitter](#) has an average of 57 engagements (minimum is 12 and maximum is 227) per post, and an engagement rate of 2.8%.
- [Facebook](#) posts reached 6,792 people, with 257 page views and 10 new followers.
- [Instagram](#) posts reached ~2,210 accounts, engaged 323 accounts, and has 11 new followers, 10 unfollows.

- We gave six ship-to-shore video tours to a total of ~172 people, including to groups at the Kochi Mirai Museum and Chiba University in Japan.
- The [JOIDES Resolution website](#) has one new blog post entitled “You have to go where for microbes?”

## Technical Support and HSE Activities

Technical staff supported downhole logging in Hole U1583F and core processing and science laboratories for cores at Site U1560.

- Deepwater samples and Conductivity-Temperature-Depth (CTD) profiles were collected on all subsea camera deployments. Extra water samples will be sent to microbiologists’ laboratories for their future experiments.
- Continuous GPS tide data collection is still running for the fourth week.
- Replaced the motor brushes on the small treadmill in the gym.
- Replaced the drain kit for the inlet airline filter on the nitrogen generator.
- Conducted troubleshooting on the TK04 thermal conductivity instrument after connectivity failed again after the instrument’s ribbon cable had been repaired in Week 5.
- For the third time this expedition, the AERIS X-ray diffraction (XRD) instrument gave the error message “Motion control error on the goniometer Omega axis” upon initializing a scan. Restarting the instrument cleared the message and allowed measurements.
- A science party geochemist advised that for the cleaning of the platinum crucibles, 2 h in the acid bath is enough, instead of 12 h. This will be added to the user guide, but we will consult with future shipboard scientists before using this revised protocol. This is only an issue when an expedition runs many ICP-AES analyses and needs a quicker turnaround time.
- Held daily sample parties for Hole U1560B shipboard and pooled samples.
- Reset legacy flag to false for samples from Expedition 390C.
- Helped a scientist troubleshoot uploading microscope images into LIMS. Only jpeg files were exported, but both jpeg and tiff files are required for uploading. The scientist retook these images.

### *HSE Activities*

- Conducted showers and eye wash safety checks.