IODP Expedition 390: South Atlantic Transect 1

Site U1556 Summary

Background and Objectives

Site U1556 is in the central South Atlantic Ocean, ~1250 km west of the Mid-Atlantic Ridge at a depth of ~5000 meters below sea level (mbsl). Site U1556 was previously occupied during engineering Expeditions 390C and 395E, during which the sediment succession and uppermost <6 m of basement were cored with the advanced piston corer/extended core barrel (APC/XCB) system (Hole U1556A). A reentry system with casing that extends almost to the sediment/basement interface was installed in Hole U1556B. The main objectives for visiting Site U1556 during Expedition 390 were: (1) to core a second hole with the APC/XCB system to recover the complete sediment succession (via stratigraphic correlation with Hole U1556A) and sample the sediment/basement interface, and (2) to core 350 m into basement with the rotary core barrel (RCB) system in Hole U1556B. Sediment and interface cores provide samples that address the microbiological, geochemical, and palaeoceanographic objectives of the South Atlantic Transect (SAT) expeditions, while basement cores provide material that addresses the petrological, geochemical, and microbiological objectives of the SAT.

Site U1556 is located 6.7 km west of Site U1557, and the basement at both sites is predicted to have formed at ~61.2 Ma at a half-spreading rate of ~13.5 m/My. Oceanic crust at these sites is the oldest out of all sites drilled during the SAT expeditions. The mineralogy and extent of alteration of the basement rocks at Site U1556 change in physical properties such as porosity. The composition of the microbial communities will be compared to the same characteristics at the other sites along the transect to investigate the development of hydrothermal circulation and crustal aging of the upper oceanic crust formed at slow to intermediate spreading rate mid-ocean ridges. The sedimentary succession at Site U1556 is about half as thick as at Site U1557, and contrasts between these closely spaced sites will allow exploration of the blanketing effect of sediment thickness on hydrothermal circulation.

Operations

Expeditions 390C and 395E

Site U1556 was first visited during Expedition 390C, an engineering leg with the goal of coring a single APC/XCB hole to basement for gas safety monitoring and to install a reentry system with casing through sediment to ~5 m into basement; however, failure of the subsea camera system prevented installation of the reentry system at Site U1556. Engineering Expedition 395E returned to Site U1556 and installed a hydraulic release tool reentry system with 284.2 m of 10¾ inch casing in Hole U1556B. Casing did not extend into the basement at Hole U1556B, due to thicker sediment resulting from either a shallower seafloor or deeper basement.

Hole U1556B

During Expedition 390, the *JOIDES Resolution* completed its 2296 nmi voyage from Cape Town, South Africa, to Site U1556 on 20 April 2022, arriving at 2330 h (UTC + 2 h). Overall, the vessel averaged 11.1 kt and took 8.6 d to complete the transit. Operations at Site U1556 started with reentry in Hole U1556B and basement coring with the RCB system. Reentry was made at 0405 h on 22 April and the hole was washed down to 291.0 meters below seafloor (mbsf) where the bit contacted a hard layer. This depth is deeper than the 286.2 mbsf hole bottom observed during Expedition 395E; whether this discrepancy is due to subsidence of the reentry system, tidal variation in water depth, or another factor remains undetermined. Poor recovery and low penetration rates led to the decision to primarily drill half-length cores in Hole U1556B.

Coring progressed smoothly from Cores U1556B-2R through 28R, at which time the bit had completed 61 h of drill time and we conducted a bit change. Core U1556B-35R experienced high pump pressures (>2400 psi) and the core barrel was retrieved so that we could attempt to restore circulation. The deplugger tool was deployed and several mud sweeps were run, which successfully returned circulating pressure to normal coring values. Core 59R was the last core for the hole. The RCB bit, having completed 78 h of drill time without failure, was dropped at the bottom of the hole using the mechanical bit release. We then pulled out of the hole, setting pipe depth to 41 mbsf to prepare for logging operations. RCB drilling in Hole U1556B overall advanced 342.2 m to 633.2 mbsf and recovered 191.87 m of basement material (56%). Microbial contamination tracer was pumped with the drill fluid throughout RCB coring in Hole U1556B.

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. Tool string telemetry failed after only a few meters of logging and the string was pulled back to the surface and recovered. 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. Two additional tool strings were then run: the Ultrasonic Borehole Imager and Accelerator Porosity Sonde tool, and the Formation MicroScanner, which logged two upward passes. Following completion of logging, the ship was repositioned 30 m south of Hole U1556B to prepare for drilling of Hole U1556C. Hole U1556B used 16.2 d of operational time in total.

APC/XCB Holes U1556C–U1556E

Three APC/XCB sediment holes were cored at Site U1556 during Expedition 390: Hole U1556C, which was cored to 280.3 mbsf; Hole U1556D, where the hole was terminated after a missed mudline core; and Hole U1556E, which resampled the top 43.1 m of sediment for microbiology and geochemistry objectives. In Hole U1556C, coring progressed through Core 30X, which recovered basalt fragments in the core catcher. Overall, Cores 1H–30X penetrated to 276.3 mbsf and recovered 281.74 m of sediment (102%). Cores 31X and 32X advanced another

4 m into basement to 280.3 mbsf, recovering 2.07 m (52%). APC cores in Hole U1556C (Cores 1H–16H) were collected using nonmagnetic core barrels and oriented for paleomagnetic research using the Icefield MI-5 magnetic orientation tools. Advanced piston corer temperature (APCT-3) tool temperature measurements were made on Cores 4H, 7H, 10H, and 13H. In Hole U1556E, 40 m south of Hole U1556C, coring progressed through Core U1556E-1H in a water depth of 5003.1 m, achieving a final hole depth of 43.1 mbsf and recovering 43.33 m (100.5%). Cores from Hole U1556E were not oriented, and no temperature measurements were made. APC/XCB coring in Holes U1556C–U1556E took 4.5 d of operation time overall.

Principal Results

Stratigraphic Unit Summary

Site U1556 comprises two sedimentary units as well as 13 basement units, identified on the basis of macro- and microscopic visual observations combined with mineralogical analyses (by X-ray diffraction [XRD], for sediment), spectral color analyses, and MS data. The sediment/basement interface was recovered at three different depths below seafloor in Holes U1556A, U1556B, and U1556C. Differences in basement depth are likely attributable to basement topography and subsequently different sediment thicknesses, but may also be due to differences in seafloor height. For stratigraphical correlation across holes and reporting, basement was defined at 290.29 mbsf based on the first occurrence of basalt in Hole U1556C, the hole with the reentry system and casing where we conducted basement drilling.

Sediment

Sedimentology

In the five holes cored at Site U1556, a mixture of biogenic and siliciclastic sediments was recovered. The former typically consists of pinkish-white or light gray calcareous nannofossil ooze, which lithifies to chalk downhole. Variable but minor amounts of foraminifera are present throughout. Siliciclastic sediment consists of silty clays, which range from brown/dark brown, where carbonate is absent, to reddish-brown, where the carbonate content is higher. Two main lithologic units (I and II) are defined based on a combination of visual observations of sedimentological characteristics, microscopic examination of smear slides, and bulk mineralogical analysis by XRD, integrated with MS and color spectral observations. Lithologic Unit I is composed of ~235 m of upper Oligocene to Pleistocene sediments, mainly silty clay and calcareous nannofossil ooze. Lithologic Unit II is composed of ~42 m of Paleocene or Eocene sediments, predominantly nannofossil-rich calcareous chalk or calcareous nannofossil chalk. Differences in mineral assemblages are relatively small with increasing burial depth within the respective silty clay and ooze/chalk phases. Below the sediment/basement interface is a transitional unit that comprises both pelagic sedimentary material and volcanic clasts, where the sediment matrix is composed of calcareous chalk with clay.

Biostratigraphy

Calcareous nannofossil and planktic foraminifer biostratigraphy was performed on core catcher samples recovered from Hole U1556A (collected during Expedition 390C and examined onshore) and at a higher resolution (utilizing both core catchers and two additional samples from the working half of each core) from Hole U1556C. Additional calcareous nannofossil and planktic foraminifera samples were taken from section halves to refine the biostratigraphic zonation. Calcareous nannoplankton are present in the oozes and chalks but are mostly absent from the clays; planktic and benthic foraminifera are also mostly absent from the clays and have variable abundance in the nannofossil oozes of Unit I, in which they commonly comprise depauperate assemblage of mostly very small specimens.

Sedimentation rates appear to be relatively continuous from the Recent through the early Oligocene. A ~44 m thick condensed interval or unconformity composed of dark brown pelagic clay spans the early Oligocene to early Eocene at Site U1556. Below this unconformity, the Eocene extends from ~216–266 m core depth below seafloor-B (CSF-B). Eocene assemblages contain significant reworking of Paleocene calcareous nannofossils and foraminiferal taxa, which appear to be principally or entirely sourced from the middle Paleocene planktic foraminifer Zone P4a and calcareous nannoplankton Zones NP5/CNP8-7, including a coherent slump deposit that contains an entirely Paleocene assemblage. Increasing reworking downhole makes precise age determinations difficult, but the middle Eocene (likely below planktic foraminifer Zone E5 and calcareous nannofossil Zones NP11/CNE3) unconformably overlies the middle Paleocene in the lowermost part of the sediment section, representing an interval of missing time spanning at least 5 My and up to 10 My. Samples directly above the in-place Paleocene sediments contain an increased proportion of benthic foraminifera and broken planktic foraminifera. Samples below the Paleocene/Eocene unconformity are middle Paleocene in age (planktic foraminifer Zone P4a and calcareous nannofossil Zones NP5/CNP8-7).

To constrain the age of basement at Site U1556, samples were taken as close to the sediment/basement interface as possible and comprise the same middle Paleocene assemblages of planktic foraminifera and calcareous nannofossils. A thin section from a sediment lens in the deepest core in Hole U1556B (~633 m CSF-B) recorded a planktonic foraminifer assemblage zoned to P4a. This suggests that the entire 341 m sequence of basalt cored at Site U1556 must have been erupted within 220 ky, or between 60.54 and 60.76 Ma (based on the global calibration for the duration of Zone P4a by Gradstein et al., 2020) because sediments at the sediment/basement interface and at the bottom of the basement were deposited within the same planktic foraminifer zone.

Benthic foraminifera indicate that Site U1556 was at lower bathyal depths in the Paleocene and early Eocene before subsiding to its present abyssal depth by the Pliocene. Subsidence likely occurred even earlier, but the lack of benthic foraminifera in the intervening samples makes a precise determination impossible.

Sieved residues at Site U1556 contain varying abundances of broken fish debris (most abundant in pelagic clays), siliceous microfossils (diatoms, radiolarians, and sponge spicules), and authigenic manganese (Mn) oxide. Siliceous material is most common in the Pliocene/Pleistocene and then again in the middle Oligocene. Mn oxides are primarily found in the Neogene.

Paleomagnetism

Paleomagnetic investigation of Site U1556 sediments comprised remanence analysis of cores split during engineering Expedition 390C, alongside Expedition 390 analyses of the archive halves of Sections U1556A-30X-1 to 4 (the portion of Core 30X above basement), Cores U1556C-1H to 30X, Core U1556D-1H, and Cores U1556E-1H–5H on the superconducting rock magnetometer (SRM), and 59 discrete sediment samples primarily from Hole U1556C. We use these data to establish a magnetostratigraphy for the sediment package at Site U1556, which will be refined with additional analysis postexpedition. All three Expedition 390 holes display clear polarity reversals, which can be tied to Hole U1556A for magnetostratigraphic correlation. Furthermore, Hole U1556C recovered material from depth intervals that were not recovered at Hole U1556A, including around the base of the sediment package, which will allow better constraint of the basal age.

Anisotropy of magnetic susceptibility (AMS) and bulk susceptibility were measured on all discrete cubes. AMS is routinely used as a petrofabric proxy to determine the preferred alignment of the magnetic mineral assemblage under an external field, while bulk susceptibility is used to determine the concentration of magnetic material present. Likewise, all cubes were alternating field (AF) demagnetized, up to 190 mT in some instances. Stepwise demagnetization characterizes, to a first order, the dominant magnetic mineral assemblage and allows determination of the characteristic remanent magnetization (ChRM) of the sample, which reflects the magnetic field direction at or soon after sediment deposition and aids in the magnetostratigraphic interpretation. Acquisition of isothermal remanent magnetization (IRM) and backfield IRM experiments were performed on a subset of discrete samples to characterize the magnetic mineral assemblage. Both the AF demagnetization and IRM experiments suggest the presence of titanomagnetites/titanomaghemites of various oxidation states and/or grain sizes. Of the 59 discrete sediment samples, 49 had orthogonal vector plots (OVP) “clean” enough to contribute to defining the ChRM, and only 28 gave maximum angular deviation angles of less than 15°.

Age Model and Mass Accumulation Rate

The age model for Site U1556 was constructed using calcareous nannoplankton and planktic foraminifer bioevents and paleomagnetic reversal datums from Hole U1556C, which is the best recovered hole at Site U1556 and the most densely sampled for biostratigraphy. Overall, the sediment section ranges in age from Recent to middle Paleocene, with a ~10 My unconformity/condensed interval spanning the middle Eocene to earliest Oligocene, and a ~5 My unconformity spanning the middle Paleocene to early Eocene. Overall sedimentation rates average 0.58 cm/ky from the Recent to early Oligocene (0–32.1 Ma) and 0.36 cm/ky in the early Eocene between the unconformities (46.7–53.6 Ma). Mass accumulation rates at Site U1556 are generally highest from the late Miocene to Recent (up to 1.01 $g/cm^2/kyr$) and in the early Oligocene (up to 1.3 $g/cm^2/ky$), and tend to covary with carbonate accumulation rate, indicating that sedimentation is primarily driven by pelagic carbonate production. Organic carbon accumulation rates are very low at Site U1556, with a maximum value of 0.003 $g/cm^2/ky$, in the early Eocene.

Physical Properties & Downhole Measurements

Physical properties characterization of the sediment section at Site U1556 was based on cores and in situ downhole measurements from Holes U1556A and U1556C and wireline logging data from Hole U1556B. Whole-round core-based measurements included natural gamma radiation (sensitive to the abundance of minerals containing radioisotopes of K, U, and Th; [NGR]), bulk density from gamma ray attenuation, MS (an indicator of the concentration of magnetic minerals), and *P*-wave velocity. Discrete measurements of moisture and density (to estimate grain density and porosity), thermal conductivity, triaxial *P*-wave velocity, and rheological properties (shear and compressional strength) were made on samples from working half sections. Trends in the physical properties and downhole logging data generally correlate well with lithologic units.

NGR values are generally low and vary from 6 to 20 counts/s in calcareous nannofossil ooze/chalk, and moderate with variability up to 65 counts/s in silty clay. Spectral gamma data from wireline logging show clearly defined intervals of lower and higher values, consistent with the presence of alternating ooze/chalk and silty clay, respectively. At Site U1556, spectral gamma ray logs show that the NGR signal comes largely from the radioactive isotopes of potassium and thorium, with additional contributions from uranium in the higher gamma ray, silty clay layers. Sediment lithologic unit boundaries coincide with sharp changes in NGR, as well as MS. MS values are low (0–60 instrument units [IU]) in carbonate-dominated lithologies and high (up to 250 IU) in silty clays. Bulk density and *P*-wave velocity generally increase with depth in the sedimentary section, which is consistent with a compaction trend. Both are generally locally anticorrelated with NGR and MS, indicating that oozes and chalks are denser with higher velocities than silty clay lithologies. Discrete porosity values in sediments decrease downhole, with some variation that is likely related to lithology but also to drilling disturbance in XCB cores. Mean thermal conductivity values in sediments range from 0.8 to 1.5 W/(m·K).

Eight successful downhole temperature measurements were made in sediments at Site U1556 with the APCT-3. Measurements were made along with Cores 4H, 7H, 10H, and 13H in both Holes U1556A and U1556C, extending temperature data to a depth of 123 mbsf. Linear temperature profiles varied between the two holes, with a geothermal gradient of 15°–36°C/km.

Data from cores recovered using the APC/XCB system in Holes U1556A, U1556C, U1556D, and U1556E were correlated to produce a near-continuous shipboard splice for the upper 195.6 m core composite depth below seafloor (CCSF). The correlation is primarily based on changes in MS, NGR, and density in cores from Holes U1556A and U1556C that correspond to lithological variations between silty clay and nannofossil ooze/chalk. Holes U1556D and U1556E record stratigraphy that can be correlated to fill gaps in the upper ~40 mbsf of the splice generated between Holes U1556A and U1556C. The composite depth scale will permit future sampling at higher resolution. Deeper than 195 m CCSF, physical property records from Holes U1556A and U1556C are consistent and can be tentatively correlated, but the construction of a detailed composite section is not possible.

Geochemistry

During the sediment drilling in Holes U1556A, U1556C, and U1556E, interstitial water (IW) was extracted via squeezing. For APC coring, IW whole-round samples were taken at a frequency of 2 per core. One IW per core was taken during the XCB drilling. Sampling frequency of the squeezed IW increased to 2 per core within 40 m above the basement. Rhizon IW samples were taken for Holes U1556C and U1556E for postexpedition research. Shipboard analyses on the squeezed IW from Holes U1556A and U1556C include pH, salinity, alkalinity, major cations and anions (sodium, calcium, magnesium, potassium, chloride, and sulfate) using ion chromatography, major and minor elements using inductively coupled plasma–atomic emission spectroscopy (ICP-AES), nutrients (phosphate and ammonium), and sulfide on the spectrophotometer. Additionally, dissolved inorganic carbon and dissolved organic carbon were measured for squeezed IW from Hole U1556E. Carbonate and total carbon measurements were then conducted on the squeeze cake and selected samples on the working half. The remaining IW and squeeze cake were distributed to scientists for postexpedition research. Dissolved oxygen in the pore water was also measured in Holes U1556C and U1556E using the optical oxygen sensors, with a resolution of ~1–5 m.

Data generated from Holes U1556A and U1556C IW samples are very similar. They both show a strong redox gradient in the top ~100 m, with decreasing sulfate and increasing dissolved manganese and ammonium concentrations consistent with organic carbon respiration. Below ~260 m in both holes, sulfate concentrations increase, and dissolved manganese concentrations are minimal. In Holes U1556C and U1556E, direct measurements of porewater oxygen likewise show a sharp decrease in concentration from Core U1556C-1H, with concentrations increasing again near the basement. Maxima in silica concentrations at ~5 and ~150 mbsf may reflect biogenic silica dissolution. Carbonate contents vary depending on lithology (up to ~93 wt% in the carbonate ooze/chalk, and often <1 wt% in the silty clay), whereas the organic carbon concentrations are all below 1 wt%.

Microbiology

The microbiology team collected sediment samples at Hole U1556C (Cores U1556C-1H through 31X) and Hole U1556E (Cores U1556E-1H through 5H). The team processed all samples destined for physiology experiments in the anaerobic chamber in the walk-in cold room, while samples destined for postexpedition cell counts and nucleic acid analysis were conducted at room temperature between two KOACH air-filtering units to mitigate contamination. This dual setup allowed faster sample processing. In addition, the dissolved oxygen concentrations of sediment cores were measured in both Holes U1556C and U1556E. To test for potential contamination, drilling fluid was collected during coring of Hole U1556C on 9 May and Hole U1556E on 10 May. During postexpedition research, DNA will be extracted from these samples to create a database of potential contaminants for comparison with cored samples.

Basement

Igneous Petrology

In Hole U1556B, 342.3 m of igneous rock, including breccias, was cored after the igneous basement was reached at 291.4 mbsf. The igneous rock succession consists predominantly of pillow lavas, with thin intervals of either more massive lava flows or larger pillows, all punctuated by periodic occurrences of breccias. The igneous sequence was divided into 13 lithologic units based on changes in petrographic type and phenocryst assemblage. The lithologic units were grouped into three overarching stratigraphic sequences (Stratigraphic Sequence A: U1556B-2R-2 through 38R-2, "orange spotty;" Stratigraphic Sequence B: U1556B-38R-3 through 54R-3, 130 cm, "old red;" and Stratigraphic Sequence C: U1556B-54R-3, 130 cm through 59R-4, "H-POPP"). The uppermost 5.1 and 4.7 m of the igneous sequence at Site U1556 were also recovered in Holes U1556A and U1556C, respectively.

The uppermost igneous basement and the top of Stratigraphic Sequence A comprises a 11.7 m thick sedimentary breccia (Lithologic Unit 1), which probably represents talus deposits of volcaniclastic debris transported downslope via a gravity flow. Beneath this is a series of sparsely to moderately olivine phyric basalt pillow lava flows interspersed with volcanic breccias in Lithologic Units 2 to 11. The breccias contain clasts of chilled pillow margins and glass (altered to palagonite), but the proportions of sedimentary matrix and carbonate cement vary significantly between breccia units. Lithologic Unit 12, which has six subunits, corresponds to Stratigraphic Sequence B. It consists of a series of aphyric to very sparsely olivine (micro)phyric basalts that are highly altered. Lithological Unit 11 is noteworthy in that it records intrusive relationships between the lavas of Stratigraphic Sequences A and B. Stratigraphic Sequence C corresponds to Lithologic Unit 13, which is a highly plagioclase-olivine-pyroxene phyric basalt that contains cognate inclusions interpreted as cumulates formed in a magma chamber.

Metamorphic and Alteration Petrology

All the rocks recovered from Site U1556 are altered to some degree. Alteration manifests as a wide range of styles and extents from slight to moderate background alteration all the way to almost complete oxidation and replacement of groundmass and phenocrysts. The pattern of this alteration is strongly spatially controlled at the scale of individual section and is primarily related to the locations of veins and the chilled margins of igneous flows/pillows, which have provided free surfaces for fluid–rock interactions. The overall degree of alteration broadly increases downhole and is closely related to the igneous stratigraphy and emplacement style of the basalts. Altogether, >5000 veins and vein networks, 600 intervals of breccia cement, and 320 occurrences of filled vesicles were recorded in Hole U1556B. The most abundant fill phases include smectite clays, carbonate, Fe oxyhydroxides, and zeolites. A range of different alteration styles characterize the cores and, together with crosscutting relationships, indicate a potentially prolonged sequence of alteration under a variety of conditions both oxidative and more reducing.

Paleomagnetism

Standard cube samples for paleomagnetic analysis were collected from representative basalts recovered from Hole U1556B, targeting both fresher basalts and those with varying extents and styles of alteration. Both AF demagnetization of the natural remanent magnetization (NRM) and acquisition of IRM indicate a variety of coercivities for the ferromagnetic phases present in samples, requiring fields up to 190 mT to fully demagnetize NRM. The identity of the contributing ferromagnetic minerals cannot be identified without additional shore-based work. Most samples carry a well-defined single component remanence with normal inclinations (reverse polarity) compatible with the rock age. An additional component of negative inclination was observed in brecciated orange-colored rocks and some oxidized basalt samples that likely represents a component acquired upon alteration. 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 is suspected. Suitable half-core pieces (greater than about 15–20 cm length) from the archive halves have also been measured on the SRM. Finally, a subset of samples was subjected to thermal demagnetization up to 580°C (the temperature used to define magnetite by a loss in magnetization). These data confirm the results of both the AF demagnetization and IRM analyses.

Physical Properties & Downhole Measurements

Basement physical properties were determined primarily from cores and downhole logging data from Hole U1556B, with additional information from the deepest cores from Holes U1556A and U1556C, which extended several meters into basement. Measurements on whole-round and split half sections were compared with each other and with downhole measurements from Hole U1556B for lithostratigraphic characterization and integration of core description and borehole data. In addition to the standard whole round and discrete measurements, high-resolution 3-D exterior images were also taken from ~170 m of hard rock whole round cores using the DMT core scanner.

In the basement interval of Site U1556, NGR data distinctly show variations that correspond well with the three main stratigraphic igneous units. NGR values range from 0 to 60 counts/s in the uppermost Stratigraphic Sequence A. Between 504 and 529 m CSF-B, mean NGR value increases, which corresponds to a transitional zone in the basement in which both shallower Stratigraphic Sequence A and deeper Stratigraphic Sequence B appear together. Below 529 m CSF-B in Stratigraphic Sequence B, NGR values decrease and vary between 7 and 25 counts/s. At 609 m CSF-B, NGR decreases abruptly and remains low to the base of the drilled interval, all within Stratigraphic Sequence C. Gamma ray from wireline logging shows similar trends, and sharp changes in these data are associated with igneous lithologic subunit contacts. MS values in the basement interval range from 0 to >800 IU, generally increasing with depth in basement. A sharp increase in MS coincides with the change from Stratigraphic Sequence B to C at 609 m CSF-B. Bulk density generally decreases downhole, and discrete sample data indicate that the majority of basalt samples have higher density, lower porosity, and higher *P*-wave velocity than hyaloclastite samples. Electrical resistivity and porosity data from wireline logging are both sensitive to formation porosity and show clear distinctions between the more massive basalt flows, which have higher density and resistivity and lower porosity, and the hyaloclastite intervals, which have lower density and resistivity and higher porosity. Thermal conductivity values in basement cores range from 1.0 to 1.7 W/(m·K), with lower values generally associated with hyaloclastite samples and higher values in basalt samples.

Geochemistry

For the Hole U1556B basement cores, representative samples were taken from the freshest portions of each lithological subunit to obtain a downhole record of the primary magmatic conditions. These samples were supplemented with additional basalt samples with different styles and extents of alteration that were considered homogenous at the scale of sampling, in order to make a preliminary investigation of the alteration effects on elemental compositions. Additionally, lithified sediments were sampled from the matrix of volcaniclastic breccia comprised of micritic limestone. Combined, a total of 45 samples were taken for loss on ignition (LOI) and bulk rock geochemical analysis via ICP-AES from the Hole U1556B. The 45 samples also included three paired basalt samples, with each pair sampling different portions of a single lava flow that displays different styles or extents of alteration to investigate the effects of alteration on the bulk rock composition. LOI varies between 0.2 – ~4 wt%, indicating that all selected samples are at least partially altered, with higher LOI suggesting more alteration. Most basalt samples are categorized as basalt and trachybasalt with a transition to lower concentrations for incompatible elements at the bottom of the hole. Comparison of the paired samples suggest addition of Al_2O_3, Na_2O, K_2O, Ba, and Zn with increased degree of alteration. High-field strength element ratios (e.g., Zr/TiO_2) show a transition from the normal mid-ocean ridge basalt at the bottom of the hole to the ocean island basalt at the top.

Microbiology

The microbiology team collected approximately one whole-round sample per 10 m advance in Hole U1556B 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.

Cell counts and analysis of community DNA, RNA, and lipids will be performed during postexpedition research on subsamples from these microbiology whole rounds. To test potential contamination of whole rounds by 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 (GC/ECD) indicated no intrusion of drilling fluid in the majority of samples.