IODP Expedition 395: Reykjanes Mantle Convection and Climate

Week 8 Report (30 July–5 August 2023)

Operations

Week 8 of International Ocean Discovery Program (IODP) Expedition 395 began while breaking down the reentry installation equipment. The rotary core barrel (RCB) bottom-hole assembly (BHA) was made up with a C-4 drill bit. The drill pipe was run to a depth of 1598.7 meters below sea level (mbsl). The subsea camera system, with the Conductivity-Temperature-Depth (CTD) recorder and Niskin bottles attached, was deployed through the moonpool at 0845 h on 30 July 2023 and the drill pipe was filled with water. The drill string continued to be lowered to several meters above the seafloor. The reentry cone for Hole U1564F was found and the bit reentered the hole at 1052 h. The subsea camera was recovered while the drill string was lowered to the base of the hole and the top drive picked up. The center bit was deployed, and the hole was conditioned with 20 barrels of high viscosity mud. The hole was advanced without recovery from 553.4 to 598.0 meters below seafloor (mbsf). The center bit was retrieved and an RCB core barrel deployed.

Cores U1564F-2R to 43R (598.0–995.8 mbsf) were recovered and Core 4R had no recovery.

The basaltic basement was reached at ~997.2 mbsf within Core 44R. This core recovered 7.03 m of material (74%), including 1.43 m of sediment and the remainder basalt. Coring continued with Cores U1564F-45R to 49R (1005.3–1039.2 mbsf). Beginning with Core 46R, all cores were half advances (4.7 or 5.0 m), except for Core 48R.

Following Core U1564F-49R, the drill bit had reached 59.7 rotating h and the drill string was pulled out of the hole to change the bit. At 1640 h on 4 August, the bit cleared the seafloor, and the vessel was offset 20 m east of Hole U1564F. At 2030 h, the bit cleared the rig floor. A C-7 RCB bit and mechanical bit release were made up. The drill pipe and BHA were run from the ship to near the seafloor for reentry into Hole U1564F. At 0315 h on 5 August, the subsea camera was deployed to guide the hole reentry. The bit was spaced out, and after nearly 2 h of searching for the reentry cone, the bit entered Hole U1564F at 0725 h. The drill pipe was run in the hole and the subsea camera retrieved. At 1115 h, coring resumed. Cores U1564F-50R to 52R (1039.2–1053.9 mbsf) were retrieved with 76% recovery. Core 52R was cut in 20 min over a 4.9 m interval and contained 3.83 m of sediment.

Science Results

Sedimentology

Sediment Cores U1564F-2R to 44R were described. The primary lithologies include greenish gray silty claystone, nannofossil chalk, and silty nannofossil chalk. Moderate to abundant bioturbation is observed throughout. Soft sediment deformation is present in some cores. Veins, fractures, and faults are common, many with calcite infilling and slickensides. These are mainly present toward the base of this interval. The base of the sedimentary section contains variable lithologies and colors, including several meters of glauconite-rich sediment. Isolated small (2 mm or less) glauconite clasts and clusters of glauconite clasts are present throughout. Some thin, mostly altered glass layers and sharp boundaries are observed. Dominantly reddish gray and reddish brown nannofossil chalk with thin brecciated intervals immediately overlay the basement. Coring disturbance ranges from slight to moderate, with some sediment developing long fractures parallel to the core liner.

Descriptions of thin sections from Site U1602 were completed and the sedimentologists began describing those collected at Hole U1564F.

Petrology

Thus far, 39 m of basalt were obtained from Hole U1564F with an average recovery of ~80%. Cores U1564F-44R to 49R were described and sampled for thin sections and shipboard inductively coupled plasma–atomic emission spectrometry (ICP-AES) at ~10 m resolution. Portable X-ray fluorescence (pXRF) analyses were conducted, with one spot analysis per section. The basalts consist of a series of highly altered sheet flows with numerous veins and sediment-filled fractures. Although chemical alteration is extensive, the cores contain patches of fresher basalts with clearly visible plagioclase phenocrysts. There are many excellent examples of drusy vein cavities filled with calcite, celadonite, and other minerals. The fracture-filling sediment is hard and recrystallized.

Micropaleontology

The micropaleontologists sampled, processed, and observed 43 core catcher and additional in-section samples spanning ~400 m of Oligocene to Miocene sediment recovered from Hole U1564F. Section half samples were taken to further refine calcareous nannofossil biohorizons, or when core catcher samples had very few nannofossils. Calcareous nannofossils are of moderate to high abundance and mostly demonstrate moderate to poor preservation within the nannofossil chalk lithology. The increasingly lithified sediment continued to be difficult to prepare for planktonic foraminifer analysis, with a combination of freeze-drying samples and preparing thin sections from the most lithified cores. Several late Miocene to early Oligocene marker species are identified, both from the calcareous nannofossils and foraminifers, providing relatively good biostratigraphic control and an indication of reduced sedimentation rates below ~800 mbsf. The

base of the sedimentary succession yields characteristic earliest Oligocene (>32 Ma) nannofossil assemblages.

Physical Properties

In the past week, the physical properties team processed the cores recovered in the sediment and basalt sections of Hole U1564F. The sedimentary cores were scanned on the whole-round track systems to obtain density, magnetic susceptibility (MS), and natural gamma radiation (NGR) measurements. The lower part of the Hole U1564F sedimentary section, where there is nannofossil chalk, shows remarkably low MS (<12 IU). With the recovery of the sediment/ basement interface in Core U1564F-44R, the workflow for the physical properties was adjusted for the basalt cores. The processing of discrete samples for moisture and density (MAD), *P*-wave velocity, and thermal conductivity measurements includes fully soaking the samples with seawater to obtain reliable and comparable measurements. Overall, the data show values typical for basalts with low NGR (average 5 gAPI), high density (>2.8 g/cm^3), and high MS (>3000 IU).

Paleomagnetism

We measured the natural remanent magnetization (NRM) of the sediment archive section halves from Hole U1564F, and used alternating field (AF) demagnetization with steps of 0, 10, 15, 20, 25, and 30 mT at a resolution of 2.5 cm. Cores U1564F-44R through 52R contain basalt, and these core sections were measured for NRM and demagnetized at AF steps of 0, 5, 10, 15, 20, 25, 30, 35, and 40 mT at a resolution of 1 cm. Pieces or fragments of basalt <8 cm in length were not measured in the superconducting rock magnetometer (SRM).

A set of discrete samples was collected from the sediments and basalts, ~2 to 3 cubes every 10 m. We first measured the anisotropy of magnetic susceptibility (AMS). The samples were then measured for NRM and subsequently AF demagnetized at 0, 5, 10, 15, 20, 25, 30, 40, 50, 60, 80, and 100 mT. A small subset of the discrete samples was set aside following NRM measurements to be thermally demagnetized later.

Geochemistry

Geochemical analyses continued at Hole U1564F. Sediment sampling was completed for headspace gas below 650 mbsf (Cores U1564F-7R to 43R, and 52R). Water column (n = 1) and interstitial water (IW) sampling was completed at a resolution of one sample per 10 m from whole-round core samples from Cores 6R to 22R, at which no more water could be collected from the sediment. A water column sample was collected with a Niskin bottle several meters above the sediment/water interface. Shipboard IW analyses include pH, alkalinity, ammonium and phosphate by spectrophotometry, and major/minor elemental composition by ion chromatography and ICP-AES. Sediment samples from squeeze cake residues and discrete intervals from the working half of split cores were measured for wt% total carbon, organic carbon, nitrogen, sulfur, and $CaCO_3$. Discrete samples for bulk elemental and mineralogical composition were also selected from the squeeze cakes for X-ray diffraction analyses.

Microbiology samples were subsampled from the IW samples from Cores 2R to 43R and 52R and from discrete whole-round hard rock samples from Cores 44R–50R, and processed shipboard for postexpedition analyses.

Outreach

The Outreach Officer (OO) participated in seven ship-to-shore events with more than five different countries, and continued to post to social media sites throughout the week. The OO created new YouTube content after researching and observing the process of deploying casing and a reentry funnel. She also provided photos for a story about one of the Expedition 395 scientists for IODP-Italy and wrote an article, "In the Repository," for the USSSP newsletter. The OO began working with a micropaleontologist on a lesson plan involving biostratigraphy, CO_2 levels, and climate change. One blog post was created after interviewing a member of the Entier Staff and speaking with the Siem Offshore crew.

Social Media

- Twitter: 50 posts with 106,000 impressions and 42 new followers.
- Facebook: 11 posts with 24,000 impressions and seven new followers.
- Instagram: 12 posts with 2,500 impressions and 10 new followers.
- YouTube: "Reentry Funnel Installation" was posted and has had 31 views.

Ship-to-Shore Broadcasts

31 July

- University of Melbourne (Australia)—30 people participated.
- Jaganath Vidyala MHSS (India)—100 students participated over two broadcasts.

2 August

- A training tour for the Expedition 400 OOs was given with a Q&A session afterward.

3 August

- IODP-China test broadcast.
- Coastal Ocean Environment Summer School (Ghana)—A virtual event for 45 students. The participants were from many different countries, including Nigeria and Ghana.

4 August

- IODP-China—An estimated 400,000 people participated in a tour of the ship and a Q&A that was livestreamed in Chinese.

Expedition Log (blog posts)

8 August: "JR in the Family" was posted. It is a blog about one family's link to the *JOIDES Resolution*.

Feedback

"Thank you! It was super interesting. Your tour is well done, it is absolutely fantastic to see what researchers are doing, live and hands-on, on a research vessel! Memorable for the students, and much appreciated." (University of Melbourne)

"Thank you so much for your time, with the tour around the ship, and explaining your process. It was really a new experience for us and for our students." (Jagannath Vidyala MHSS)

Technical Support and HSE Activities

Laboratory Activities

- The staff processed cores and samples from Hole U1564F.
- We completed the T-shirt logo printing and pressing.
- New staff were trained in hard rock curation.
- The guide for the Niskin bottle trigger string was cracked. We 3-D printed and installed a new one.
- The pXRF was set up in the Downhole Measurements Laboratory and the scientists were trained on the equipment and software.
- The Chemistry Laboratory helped with IW sample analyses.
- The Thin Section Laboratory processed sediment and basalt samples.

Developer/IT Activities

- We changed the weekly backup tapes.
- Windows updates were applied to all Windows machines.
- We assisted with the setup and configuration of the pXRF.
- GEODESC: Revisions were applied to the DataCapture application and web services to enable the hole summary template to work correctly.
- SEM Uploader: The application now works correctly after being tested by technical staff.

HSE Activities

- The eye wash stations and safety showers were tested.