

IODP Expedition 395C: Reykjanes Mantle Convection and Climate: Crustal Objectives

Week 4 Report (27 June–3 July 2021)

Operations

During Week 4 of the International Ocean Discovery Program (IODP) Expedition 395C, Reykjanes Mantle Convection and Climate: Crustal Objectives, we continued operations at Site U1554 (proposed Site REYK-6A).

Hole U1554E

Coring at Hole U1554E ($60^{\circ}7.5235'N$, $26^{\circ}42.1324'W$) using the extended core barrel (XCB) system advanced from Core U1554E-56X to 62X (586.9–647.7 m below seafloor [mbsf]), with 50.5 m of core recovered (83%). Basement was encountered at ~647 mbsf while drilling Core 62X; the core contained 1 m of basalt interlayered with carbonate sediment. After reaching the basement and a final hole depth of 647.7 mbsf, Hole U1554E was prepared for downhole wireline logging operations.

The hole was cleaned and displaced with heavy mud and the drill string pulled up to 72.8 mbsf. The triple combo tool string was made up and run in the hole at 2100 h on 27 June 2021. The triple combo measures spectral and natural gamma ray, porosity, density, resistivity, and magnetic susceptibility (MS). The tool string was able to descend to the base of the hole (~647 mbsf) and the triple combo made two passes of the borehole. The first attempt to pull the triple combo through the bit and into the drill pipe occurred at 0115 h on 28 June. The lockable float valve (LFV) at the bit had closed, preventing the tool string from reentering the pipe. After several hours of pumping seawater and rotating the drill string, the triple combo was pulled past the LFV and the tools reached the surface at 0845 h. The Formation MicroScanner (FMS)-sonic string was assembled and deployed at 1120 h. The FMS-sonic tools measure spectral and natural gamma ray, sonic velocity, and produce resistivity images of the borehole. A go-devil was attached to the top of the tool string to lock open the LFV. After two passes of the borehole, the FMS-sonic was unable to pass through the LFV and reenter the pipe. After additional pumping, the tools were successfully recovered and the FMS-sonic tool string reached the rig floor at 2055 h. Based on the caliper results from the triple combo, which showed that the borehole was washed out to greater than 14 inch diameter for the majority of the hole, the decision was made not to run the Versatile Seismic Imager (VSI). Following logging operations, the drill string was pulled out of the hole with the bit clearing the seafloor at 2210 h on 28 June. At 0245 h on 29 June the bit cleared the rotary table, ending the hole.

Hole U1554F

The ship was positioned over the Hole U1554F coordinates ($60^{\circ}7.5136'N$, $26^{\circ}42.1140'W$) and the rig floor crew began assembling the casing and reentry system. The mud skirt of the reentry system was moved over the moonpool and the hydraulic release tool (HRT) was made up and

racked in the derrick. A 602.3 m long casing string, composed of 52 joints of 10³/₄ inch casing, was assembled. The HRT running tool was attached to the casing and lowered to the mud skirt. The HRT running tool was then detached and put back into the derrick. The mud motor, underreamer, and bit were assembled and tested. The first mud motor rotated too freely and was replaced with a second mud motor. After a successful test, the crew made up the bottom-hole assembly (BHA) with the HRT running tool assembly and the reentry cone. At 0638 h on 30 June, the HRT reentry system was deployed through the moonpool. The casing and drill string were run to a depth of 1552 m below sea level (mbsl) and the subsea camera system was deployed to observe the casing operations. Hole U1554F was spudded at 1345 h at a water depth of 1870 mbsl, and the casing was drilled in to a depth of 602 mbsf. Once the casing and reentry system were in place, a go-devil was pumped down the pipe to activate the HRT running tool and release the drill string from the casing. The drill string, including the HRT running tool assembly, was pulled from the hole with the bit clearing the seafloor at 1610 h on 1 July. The rig floor crew broke down the HRT running tool assembly.

A rotary core barrel (RCB) BHA, with a C-4 RCB bit, and the drill pipe was made up and run to a depth of 1836.5 mbsl. The subsea camera, along with the Conductivity-Temperature-Depth (CTD) instrument, was run to the end of the drill string to observe the bit reenter Hole U1554F. The bit entered Hole U1554F at 1057 h on 2 July. The subsea camera was retrieved and the drill string advanced to the base of the casing string (602 mbsf). The center bit was dropped into the RCB bit and Hole U1554F was drilled without recovery to 620 mbsf. Two drilled intervals, U1554F-1-1 (0–606.3 mbsf) and 2-1 (606.3–620 mbsf), were recorded for the hole. The center bit was retrieved and an RCB was deployed. Cores U1554F-3R to 5R advanced from 620 to 649.1 mbsf with 19.86 m of core recovered (68%). Core 5R contains the sediment-basement interface. Cores 6R to 11R advanced from 649.1 to 678.2 mbsf with 16.76 m of basalt recovered (58%). The rate of penetration (ROP) was slow for these cores, ranging from 1.1 to 2.4 meters per hour (m/h).

Science Results

The JRSO technical staff processed the cores and samples in the ship laboratories, following the measurement and sampling plan constructed by the shore-based Expedition 395 Co-Chief Scientists and science party members. Core description, biostratigraphy, and analysis of shipboard data will take place postcruise.

Hole U1554E

The sedimentary cores from Hole U1554E were measured using the whole-round (WR) and section half tracks. The WR core measurements included MS, gamma ray attenuation (GRA) bulk density, *P*-wave velocity, and natural gamma radiation (NGR). The split cores were imaged and measured for thermal conductivity, color reflectance, point magnetic susceptibility (MSP), and magnetic properties. Headspace gas samples were collected across the entire cored interval

for safety monitoring and postcruise research. Samples for postcruise biostratigraphy were collected from each core catcher. Catwalk sampling for interstitial pore waters and microbiology began at Core U1554E-31X (~350 mbsf) and continued downhole. The overlying sedimentary section will be sampled for these analyses during Expedition 395 when the section is re-cored and a sailing science party is available to assist with these measurements. Carbonate and XRD samples were collected from the interstitial water (IW) squeeze cakes.

Cores 44X to 55X (470.5–586.9 mbsf) are composed of dark gray clay and silt with dropstones. Pyritized gastropods are present. Core 56X records a lithology change to lighter material with soft sediment deformation and erosional surfaces. Cores 57X to 60X contain sediments that alternate between light green to dark gray with varying amounts of calcium carbonate and clay content. Sharp erosional contacts and burrows are observed in these cores. Core 61X transitions from the dark gray material to a light green and white nanofossil ooze. The basement was recovered in Core 62X, and is composed of basalt alternating with carbonate. The XCB cores have prevalent biscuiting from the coring process.

The physical properties of the cores reflect the changes in lithology. MS and NGR show cyclic patterns from 0 to ~450 mbsf. At ~450 mbsf, the values of both properties decrease and remain reduced to the base of the hole. The average porosity of samples collected between Cores 31X and 61X (344.4 to 645.2 mbsf) is 62%.

There are very clear downhole changes in the magnetic inclination values measured with the superconducting rock magnetometer (SRM). These measurements will be used postcruise to construct a magnetostratigraphy for the site.

Pore water alkalinity decreases from 12.5 mM at ~350 mbsf to 2.3 mM at the base of the hole. Carbonate results from sediments in Hole U1554E show a significant increase in calcium carbonate at the base of the hole. Cores 31X to 51X have an average calcium carbonate concentration of 5.4 wt%. Below Core 51X (~550 mbsf), carbonate concentrations increase steadily to a maximum value of 85 wt% at the base of the sedimentary section (647 mbsf). Total organic carbon values average 0.47 wt%.

Hole U1554F

The cores from Hole U1554F contain sediments and basalt. The cores were run through the WR track systems and the split section half track systems. The WR core measurements included MS, GRA bulk density, and NGR. The split cores were imaged and measured for *P*-wave velocity, thermal conductivity, color reflectance, MSP, magnetic properties, and X-ray fluorescence (XRF) using a portable X-ray fluorescence spectrometer (pXRF). WR rock pieces were routinely collected for postcruise microbiology studies and select core pieces were scanned using the SRM.

Cores U1554F-3R to 5R (620–641.5 mbsf) are composed of carbonate-rich sediment. Sections 3R-1 to 4 contain fine-grained, light green sediment with darker green mottling that is heavily bioturbated with burrows present throughout. Section 3R-5 preserves the transition between the

light green, bioturbated sediment and a white nannofossil ooze. The nannofossil ooze is present through Section 5R-2, where the sediment-basement interface was captured at ~642 mbsf. Section 5R-3 through Core 10R consists of basalt that is interlayered with thin beds of carbonate. The basalt contains glass and varying degrees of alteration with several veins present. Some of the carbonate intervals contain brecciated basalt clasts.

Education and Outreach

This week the Education and Outreach effort spanned multiple media types.

Shore-based Outreach Officer Jose Cuevas held a shore-to-shore event with Research Experiences for Undergraduates (REU) students in the Texas A&M University College of Geosciences.

Social Media Posts

Social media is spread across three platforms: [Facebook](#), [Twitter](#), and [Instagram](#). The table below summarizes the metrics and impacts of original posts (retweets not included). This includes impressions, which are the number of times a post has been displayed, and engagements, which includes likes, shares, and comments.

Social media is a collaborative effort, with many of the Expedition 395 science party and Expedition 395C technical staff engaged in posting original content and sharing posts from the *JOIDES Resolution* accounts.

This month, the *JOIDES Resolution*'s Twitter account hit a major milestone: the most engagements and impressions in the account's history. June 2021 saw 144 tweets with over 500,000 impressions and 16,000 engagements.

Platform	Number of Posts	Impressions	Engagements
Facebook	34	62,492	3,946
Twitter	39	240,714	8,783
Instagram	14		940 likes

Technical Support and HSE Activities

The JRSO technical staff were engaged in laboratory and project activities.

Laboratory Activities

- The technical staff received and processed core from Holes U1554E and U1554F.
- All sampling and measurements were taken by the technical staff.
- The CTD sonde was deployed at Hole U1554F.
- The old magnetometer cable was removed from the winch drum and was replaced with a new full-length cable.
- Two new Coy Labs chambers for microbiology were assembled. The polymer anaerobic chamber was set up in the Microbiology Laboratory and the staff were trained to use the chamber. The vinyl chamber was inspected and prepared for long-term storage. The *JRSO Lab Notebook* was updated to include this new equipment.

IT Support Activities

- The logging winch telemetry to RigWatch failed. The host was removed for repair or replacement.
- The transfer of downhole logging data between the Lamont Doherty Earth Observatory (LDEO) borehole group and the ship was completed successfully.
- Data from Expedition 384 were made available in Laboratory Information Management System (LIMS).
- The Texas A&M University IT department applied software updates to the email system.
- Software and operating system updates were made on laptops.
- We continued researching and testing for a full visual display unit (VDU) video distribution replacement.

Developer Support Activities

- A bug was fixed in the LIMS Online Report (LORE) Carbonates report.
- The new release of LORE did not run properly on some computers but updating to the latest versions of Chrome and Firefox fixed this issue.
- The development of the QCViewer program is ongoing and has been deployed for viewing and testing.

Health and Safety Activities

- The safety shower and eye wash stations were tested.
- A life boat drill was held on Sunday 27 June.