IODP Expedition 390: South Atlantic Transect 1

Week 1 Report (7–16 April 2022)

The first full week of the International Ocean Discovery Program (IODP) Expedition 390, South Atlantic Transect 1, was comprised of port call activities in Cape Town, South Africa, and transit to Site U1556 (proposed Site SATL-53B). All times in this report are ship local time (UTC + 2 h).

Operations

IODP Expedition 390 began in Cape Town, South Africa, Repair Quay 3, at 1154 h on 7 April 2022. Due to the COVID quarantine period (seven days), oncoming *JOIDES Resolution* Science Operator (JRSO) technical staff, crew, and scientists did not board until 9 April. PCR COVID tests for oncoming personnel were conducted on days 4 and 6 of the hotel quarantine. All members of the science party and staff tested negative and were cleared to board the vessel, except for four staff members whose quarantine was either delayed or prolonged. On 9 April, the outgoing staff and crew disembarked, and the 40 oncoming scientists and staff joined the vessel. The remaining staff boarded on 10 April or 11 April.

Much of the oncoming freight was loaded by the previous crew, including the DMT core scanner, a third-party instrument that will be used to create 3-D images of hard rock material. During the Expedition 390 port call, staff and crew received catering provisions and additional chemicals and supplies. They also received several pallets of archive half cores from engineering Expeditions 390C, South Atlantic Transect Reentry Systems, and 395E, Complete South Atlantic Transect Reentry Systems, that will be described during Expeditions 390 and 393. Fuel bunkering was done via barge on 10 and 11 April, with the vessel taking on 1000 mt. All personnel took a final PCR test for COVID on 10 April as well as a rapid antigen test on 11 April. All tests were negative. Personnel followed a staggered meal schedule as part of the COVID mitigation protocol.

On the morning of 12 April, the pilot boarded at 0812 h, two harbor tugs arrived, and the mooring lines released, with the last line released at 0836 h. The pilot departed the vessel at 0857 h at the pilot station, while three contractors remained on board to conduct testing and maintenance. Two of the contractors observed the function of the ship's uninterruptible power supply (UPS) system while underway. The other contractor inspected and adjusted the ship's magnetic compass. The contractors completed work and disembarked at 1135 h. The vessel began sea passage at 1136 h. The week ended at midnight on 16 April, with the vessel having completed 1250 nmi of the 2296 nmi transit to Site U1556.

Science Objectives

The South Atlantic Transect Expeditions (engineering Expeditions 390C and 395E as well as Expeditions 390 and 393) will drill seven sites, recovering a complete sedimentary section as well as the upper ~250 m of the underlying oceanic crust at each site. This drilling forms a transect along a slow/intermediate spreading rate crustal flow line at 31°S. Crustal age at the drilled sites will range from 7 to 61 Ma, filling critical gaps in sampling of intact ocean crust with regard to age, spreading rate, and sediment thickness. A primary objective is to investigate the history and trajectory of low-temperature hydrothermal interactions between the aging ocean crust and the evolving South Atlantic Ocean, and to quantify past hydrothermal contributions to global geochemical cycles. Another primary objective is to investigate the microbial ecosystem's response to variable conditions in a low-energy gyre and in aging ocean crust. Analysis of sediment collected during the South Atlantic Transect expeditions will also generate records of carbonate chemistry and deepwater mass properties across the western South Atlantic through key Cenozoic intervals of elevated atmosphere CO_2 and rapid climate change.

Expedition 390 will visit the youngest site (Site U1559, 7 Ma crust) and the two oldest sites of the transect (Sites U1556 and U1557). Sites U1556 and U1557 are both located on 61 Ma ocean crust but have differing sediment thicknesses. Expedition 393 will visit the three intermediate sites, at 15, 31, and 49 Ma crustal ages respectively. Only engineering Expedition 395E conducted operations at Site U1561, located on 61 Ma crust near Sites U1556 and U1557.

Science Results

The Expedition 390 science party includes shipboard scientists from six IODP member countries, shore-based scientists from five member countries, and two shipboard Outreach Officers from the USA. During the seven-day hotel quarantine period (2–8 April), Expedition 390 scientists received a virtual orientation of the ship and IODP procedures, including an operations overview, publication obligations, curation, laboratory safety, shipboard outreach, onboard computing and shipboard software, and life at sea. Scientists gave presentations of their individual research objectives, began organizing research collaborations, and worked within their laboratory groups to develop shipboard sampling plans and begin writing drafts of their methods for the expedition.

At 1100 h on 9 April, the Expedition 390 scientists boarded the vessel and moved into their cabins. All scientists immediately went onto shift as part of the COVID mitigation protocols. Day-shift scientists received a presentation on ship safety and a ship safety tour, and then set up their computers to access the ship's network. On 10 April, night-shift scientists received the same safety training and began orienting to their laboratories. A PCR COVID test was conducted at midday on the pier. Between 10–12 April, scientists received training in shipboard software including SampleMaster and DESClogik as well as a core flow tour. Trainings were conducted in groups of 5 to 6 as part of the COVID mitigation protocols. Laboratory group-specific

trainings and safety overviews occurred between 12–16 April, including physical properties instrumentation, microscopes, and use of the portable X-ray fluorescence spectrometer (pXRF). The science party spent time writing drafts of their laboratory methods.

The towed magnetometer was deployed on 14 April after the vessel entered international waters. Shipboard COVID mitigation protocols continued to be followed, including daily rapid antigen testing of all personnel.

During transit, shipboard scientists worked to describe cores collected during engineering Expeditions 390C and 395E. Description results are summarized below.

Site U1559

Hole U1559A was cored during Expedition 390C. It consists of Cores U1559A-1H to 9X and was drilled to 66.2 meters below seafloor (mbsf). The sediment/basement interface is present in Core 8X. Cores 8X and 9X had not been split previously during Expedition 390C. During Expedition 390, the sediment sections were split, analyzed on the section half track systems (Section Half Imaging Logger [SHIL], and the Section Half Multisensor Logger [SHMSL]), and described. Hard rock material in Cores 8X and 9X was binned, imaged using either the DMT core scanner or, for smaller pieces, the Foldio lightbox turntable imaging system, and then split and described.

Sedimentology

The Sedimentology Team completed description of sediment in Hole U1559A, consisting of Cores U1559A-1H to 8X, with the basement contact located at 64.0 mbsf. Cores 1H to 4H are dominated by pale brown or white nannofossil-rich calcareous ooze with foraminifera. Cores 4H to 8X are dominated by very pale brown calcareous nannofossil ooze.

Igneous and Alteration Petrology

Hard rock material from Hole U1559A consists of ~10 cm of rubbly basalt in the core catcher from Core U1559A-8X and ~40 cm of basalt in Core 9X.

Paleomagnetism

Archive half core sections from Hole U1559A were previously stepwise demagnetized at 5, 10, 15, and 20 mT during Expedition 390C at 2 cm resolution. These sections were remeasured on the superconducting rock magnetometer (SRM) during Expedition 390 to monitor any remagnetization artifacts acquired during transport and storage. A single 20 mT step was applied to check reproducibility and SRM noise levels. Reproducibility was found to be good.

Site U1556

Hole U1556A was cored during Expedition 390C. It consists of Cores U1556A-1H to 33X and penetrated to 283.3 mbsf. The sediment/hard rock interface was encountered at 278.0 mbsf in Section 30X-5. Cores 30X to 33X had not previously been split during Expedition 390C. During

Expedition 390, the sediment sections (30X-1 to 4) were split, analyzed on the SHIL and SHMSL, and described. Hard rock material in Cores 30X to 33X was binned, imaged using the DMT core scanner, and then split and described. Core pieces were large enough that almost all could be imaged via the DMT core scanner, so the Foldio lightbox system was not used. Discrete samples for paleomagnetism, physical properties, and micropaleontology were taken from sediment overlying the sediment/hard rock interface. Additional discrete samples for X-ray diffraction (XRD), X-ray fluorescence, chemical analysis via inductively coupled plasma–atomic emission spectroscopy, paleomagnetism, and physical properties were taken from the hard rock material.

Sedimentology

The Sedimentology Team completed description of sediment in Hole U1556A, consisting of Cores U1556A-1H to 30X. Sediment consists of layers of primarily brown silty clay and pink or pinkish-gray calcareous nannofossil ooze, alternating on a 1–10 m scale. Cores 26X to 30X are almost entirely calcareous nannofossil ooze and date to the upper Paleocene. Sparse to high bioturbation, primarily mottling, is observed throughout the cored interval.

Igneous and Alteration Petrology

Hard rock material in Cores 30X to 33X, extending from 278 to 283.3 mbsf, consists of peperite. The matrix is preliminarily described as micritic limestone; igneous material is present as fragments of highly altered, moderately olivine phyric basalt with chilled contacts.

Paleomagnetism

Archive half core sections from Hole U1556A were likewise remeasured on the SRM using a single 20 mT step. The reproducibility of these measurements compared to those made during Expedition 390C was good.

Education and Outreach

The following outreach activities took place during Week 1:

- Four new "Expedition Log" (blog) posts were posted, including one with video. Blog posts contain an audio reading of each post's text to increase accessibility. Blog posts are available on the *JOIDES Resolution* expedition website.
- Facebook: Reached 10,623 people (+27%) and added 31 followers.
- Twitter: 14 new tweets and added 28 followers.
- Instagram: Five new posts reached 1,867 accounts.
- Completed five ship-to-shore broadcasts. The first four, to U.S. audiences, reached ~160 people. A broadcast to China reached an audience of 40,000.

- Leveraged Google Earth to create three expedition-related files that will be updated as the expedition progresses: Scientists on Board, Voicemails from the JR, Where is the JR?.
- Created a webpage to share existing videos and curricular exercises for teachers with additional information to help teachers utilize the Google Earth files with students.

Technical Support and HSE Activities

The following technical support activities took place during Week 1:

Laboratory Port Call and Transit Activities

- Underway Geophysics and Downhole Logging
    - The towed magnetometer was briefly deployed and then recovered due to a ship tachometer issue. It was redeployed on 14 April and has been providing bathymetric and magnetic data during transit.
    - Two advanced piston corer temperature tools were set up for use.
- Core Laboratory
    - The DMT core scanner third-party instrument was moved onto the vessel and assembled. Scientists conducted testing and are currently scanning core material from Sites U1556 and U1559.
    - Core description for sediment and basement cores from Expeditions 390C and 395E began.
    - The Core Description Technician worked with scientists to design DESClogik templates adequate for describing baked sediments and breccias with basalt intrusions, as the standard organization system did not permit co-occurring igneous and sediment lithological units.
- Paleomagnetism
    - Testing determined that oscillations in Mettler balance tare data were highly correlated with SRM background noise, demonstrating that some background noise derives from ship motion.
    - The Haskris cooling system was flushed and cleaned after it began producing a loud noise due to air bubbles in the line.
    - Two of the Icefield MI-5 core orientation tools were set up and the new Paleomagnetism Technician received training in the tool's operation and maintenance.
- Imaging
    - The SHIL temperature control box overheated and was smoking. Two extra mechanical relays were installed to prevent the issue in the future.
    - The new Zeiss Axio Imager scope experienced a power issue that was resolved by removing a small PC board and bypassing the light setting microswitch. A new power source was installed. The microscope is currently not operational as the small PC board was found to be faulty.

- Physical properties
    - The X-ray source on the X-ray Imager failed and was replaced. A safety survey was conducted prior to use.
    - The moisture and density (MAD) oven blew a fuse, which was replaced along with a damaged wire. Troubleshooting continued on an issue with the MAD oven setting off the UPS alarm at temperatures above 125°C; the instrument is operational at 105°C.
- XRD:
    - The Bruker XRD Vantec-1 controller detector module had a blown fuse. The vendor helped troubleshoot and the issue was resolved.
    - The Haskris chiller was flushed and cleaned.
    - The Aeris instrument is down after it displayed several error messages that could not be cleared by power cycling.
- Chemistry
    - Troubleshooting occurred on the source rock analyzer (SRA) to resolve an issue with a pinched wire that prevented the sample loader pedestal from returning to the "load" position, instead getting stuck in the "run" position. The sample loader elevator rod was cleaned to improve motion.
    - The detector unit of the Agilent ion chromatograph was replaced. A new calibration determined that this replacement resolved an issue with noisy anion baseline data.
    - The total organic carbon instrument was turned on and tested.
- Microbiology
    - The cold room undercounter freezer failed.
    - Both undercounter incubators in the Radiation Van were not functioning properly; one was dead, and the other was only able to freeze and the temperature could not be adjusted. A new freezer was installed and an additional incubator from the Microbiology Laboratory was moved into the Radiation Van.
    - A baseline wipe test was performed.
    - Both scientists who will be working in the Radiation Van conducted their protocols.
    - The microbial contamination tracer pump was flushed and primed. The pump is working but can only be operated manually. Rigwatch remote control of the system failed to control the high-pressure liquid chromatography pump.

Application Support Activities

- The LEGACY flag was removed from cores, sections, and section half data in the database for Expedition 390C so that the Catwalk program can update parent sections when new pieces are created and as Expedition 390C basement material is curated.
- A bug was fixed in LIVE that prevented images from legacy expeditions from displaying because the program was looking in the wrong ASMAN location.

- Changes to MUT for the new KappaBridge MFK-2 were installed and tested.
- Requested changes to the MADMax were completed and deployed. One additional change, having MADMax automatically pop up the MAD_Calc dialogue, is still under development.
- Work continued on the Auther rewrite.
- A new version of VirtualPhotoTable was deployed that allows the user to specify credentials when the application is first run on a new device. The new version can also generate COREPHOTO images for instances where legacy sections are rescanned.
- The ImageCapture issue where thin section image orientation (portrait vs. landscape) was affected by ship motion was resolved.
- A DESClogik bug related to cascading formulas was repaired.
- A bug in the Cahn Balance uploader for the Elemental Analyzer was fixed.
- New builds of Catwalk, Coulometer, and the Cahn Balance applications were deployed to resolve an issue that occurred during Expedition 392 due to a change in the LDAQ framework.

IT Support Activities

- Expedition 390C and 395E data were copied onto data1 and made visible to scientists in LIMS.
- The pXRF laptop operating system failed. The Windows package was reloaded and applications, including IODP software such as MUT, were reinstalled.
- Troubleshooting of Rigwatch remote control of the microbial contamination pump occurred; the issue is not yet resolved.
- Testing of the firewall system and monitoring of traffic continued.
- The scintillator host computer in the Radiation Van was brought back online.
- A new host computer was assigned and brought online for the Radiation Van Cahn Balance.
- An external hard drive was designated for use in transferring DMT core scanner data from the instrument computer to the server, as the DMT host computer will not be connected to the network.

HSE Activities

- Laboratory-specific safety awareness orientations were conducted for the science party. A training and safety overview for the pXRF occurred.
- The emergency showers and eye wash stations were tested.
- Personnel took daily rapid COVID tests.
- Personnel followed COPE protocols.