IODP Expedition 392: Agulhas Plateau Cretaceous Climate

Week 6 Report (13–19 March 2022)

The sixth week of the International Ocean Discovery Program (IODP) Expedition 392, Agulhas Plateau Cretaceous Climate, included half-length advanced piston corer (HLAPC), extended core barrel (XCB), and rotary core barrel (RCB) coring of Site U1581. A compassionate evacuation from the vessel was also conducted. All times in this report are in ship local time (UTC + 2 h).

Operations

Week 6 of the expedition began on 13 March 2022 with continued HLAPC coring in Hole U1581A. Piston coring continued to 1030 h with Core U1581A-38F. The recovered cores were showing a great deal of disturbance (suck-in) and the decision was made to switch to XCB coring. XCB Cores U1581A-39X to 41X advanced from 276.1 to 300.5 meters below seafloor (mbsf); however, strong swells and resultant low recovery and poor core quality led to the termination of coring in Hole U1581A at 1800 h.

The drill string was pulled out of the hole and pipe tripped back to the vessel, with the bit clearing the seafloor at 1945 h and the rig floor at 0825 h on 14 March. It was determined that a compassionate evacuation was needed for a crew member. An attempt was made to recover the acoustic positioning beacon. The beacon signaled a clean release from the seafloor; however, the positioning signal was lost temporarily as the beacon rose, and was picked up again in the center of the vessel. It appeared the beacon had surfaced inside the moonpool. The upper guide horn was pulled and the moonpool doors opened, but there was no visible sign of the beacon. The ship was repositioned against the current in case the beacon was lodged underneath the vessel; however, there was still no visual sign of the beacon and it was deemed lost.

The vessel was switched from dynamic positioning (DP) to cruise mode at 0945 h and the thrusters were up and secured at 1014 h, beginning the sea passage to Gqeberha (formerly known as Port Elizabeth). The vessel arrived at the edge of the Gqeberha harbor at approximately 0700 h on 15 March. Clearance for the departing crew member was received at 1300 h, and they disembarked the vessel via launch at 1402 h. We then began the transit to Site U1581, arriving just before noon on 16 March. The thrusters were lowered and the vessel was switched to DP mode at 1216 h. The acoustic positioning beacon was still providing a signal, revealing that it had not released as previously thought.

The bottom-hole assembly (BHA) with a C-4 bit was made-up and tripped to 4499.7 meters below rig floor (mbrf) before a slip and cut of the drilling line. We continued to trip pipe to the seafloor, and Hole U1581B was spudded at 0230 h on 17 March. An RCB barrel with a center bit was used to drill ahead to 289 mbsf, with several mud sweeps during the drill down. The drill down portion of the hole averaged 46.2 m/h. The center bit was recovered and coring

commenced with Core U1581B-2R at 1445 h. Coring continued through Core 26R, with a bottom depth of 531.5 mbsf on 19 March. RCB coring rates averaged 16 m/h, which were slower in the top section until the full weight of the BHA could be applied.

Science Results

Site U1581

Science activities during the week included the processing and measurement of core sections and shipboard samples for Site U1581. The science party continued to edit reports.

Lithostratigraphy

The lithostratigraphy team completed the report for Site U1580 and described Cores U1581A-28H through 41X (221.5–292.1 mbsf) and Cores U1581B-2R through 22R (289.0–491.6 mbsf). Cores from Hole U1581A consist dominantly of silt and medium- to fine-grained sand with some intermittent calcareous intervals. The siliciclastic intervals are normally graded and alternate with layers of calcareous sediment composed of sandy/silty/clayey nannofossil ooze. These are interlayered with rare thin-medium to coarse beds of sand. The sedimentary succession recovered at Hole U1581B predominantly consists of dark greenish-gray clayey silt with nannofossils and black clay with silt.

Micropaleontology

The micropaleontology team analyzed core catcher and split-core samples from Cores U1581A-29H to 41X (231.0–292.1 mbsf) for nannofossils and foraminifers, and performed routine checks for diatoms and palynomorphs on a selection of the core catcher samples. Nannofossils are generally common and moderately preserved, although a few samples are barren. Foraminifers vary in abundance through this interval and are poorly to moderately preserved. Siliceous microfossils are absent, whereas dinocysts are present in varying proportions. Nannofossils and dinocysts provided age constraints for this part of Hole U1581A, which is dated to the Oligocene (~23–30 Ma). The micropaleontology team finalized the Site U1580 site report during the transit to and from Gqeberha. The team then analyzed core catcher and split-core samples from Cores U1581B-2R to 23R (289.0–500.6 mbsf) for biostratigraphic age constraints. Nannofossil abundance varies significantly, with many samples barren, although in general nannofossils are common and moderately preserved down to ~400 mbsf. Below this, nannofossils are absent down to ~435 mbsf, but present in low numbers with good preservation through the rest of the cored section. Larger foraminifers are generally absent, although very small foraminifers (<45 µm) are often observed in smear slides. Pyritized diatoms are also present, especially below ~400 mbsf. Dinocysts are generally absent above ~370 mbsf and present below. Sparse microfossils made age control difficult; however, the cored interval in Cores U1581B-2R to 23R is dated to the Eocene through Maastrichtian.

Paleomagnetism

The paleomagnetism team completed shipboard measurements of Cores U1581A-17H through 41X and Cores U1581B-2R through 22R. Cores U1581A-17H to 29H were advanced piston corer (APC) cored and oriented with the FlexIT orienting tool. Cores U1581A-30F to 38F were HLAPC cores and were not oriented. Likewise, Cores U1581A-39X to 41X were XCB drilled and were not oriented. All cores at Hole U1581B were RCB drilled and unoriented. Archive section halves underwent low-field alternating field (AF) demagnetization up to a peak field of either 15 or 20 mT. Shipboard measurements also included full AF demagnetization of one to two representative discrete samples per core, up to peak fields of 70–120 mT. Cores U1581A-17H to 41X yielded noisy directional data and it was difficult to identify clear magnetic reversals. However, portions of sections with more stable magnetic directions were identified. Additionally, characteristic remanent directions were identified from discrete sample analysis for these cores. As such, correlation to the geomagnetic polarity timescale (GPTS) may be possible with more analysis. In Cores U1581B-2R to 22R, the magnetization is reasonably high (10^{-3} A/m), but magnetic directions from archive half measurements are noisy and discerning magnetic polarity is difficult. Despite this, some magnetic reversals were clearly identified. Characteristic remanent directions were able to be constrained from ~90% of the discrete samples, and with additional analysis, correlation to the GPTS may be possible. Additional experiments including measurements of bulk magnetic susceptibility (MS), anisotropy of magnetic susceptibility (AMS), isothermal remanent magnetization (IRM) acquisition, and S-ratio calculation were conducted on discrete specimens from both holes to determine rock magnetic properties.

Stratigraphic Correlation

The stratigraphic correlation report for Site U1579 was completed and the report for Site U1580 was prepared for final review. Physical property track data were collected for Holes U1581A and U1581B. Physical property track data (gamma ray attenuation [GRA] density, MS, natural gamma ray [NGR]) and data from core section halves (reflectance spectroscopy and colorimetry, point MS, red-green-blue (RGB) color space from core images) of Holes U1580A, U1580B, and U1581A were cleaned for plotting purposes, which involved removal of outliers and measurements on endcaps or gaps. For Hole U1580A, core data were successfully correlated to the downhole logging data using NGR data.

Geochemistry

Headspace samples were taken at the base of each core of Holes U1581A and U1581B for monitoring hydrocarbons. Methane concentrations remained below 5 ppmv in Hole U1581A and Cores U1581B-2R to 26R. Sediment samples are being prepared for analysis for carbonate content on the coulometer and total carbon on the elemental analyzer.

Sampling for interstitial waters (IW) occurred at Site U1581. One IW sample was taken per core below Core U1581A-4H and in all cores of Hole U1581B. Alkalinity values remain between 1.5 and 2.5 in Hole U1581B. Sediment and hard rock samples were analyzed by inductively coupled plasma–atomic emission spectroscopy (ICP-AES) for bulk elemental geochemistry.

Physical Properties

Standard measurements of physical properties were made on cores from Holes U1581A and U1581B using the Whole-Round Multisensor Logger (WRMSL), Section Half Multisensor Logger (SHMSL), and the Natural Gamma Ray Logger (NGRL). Discrete measurements were also made for moisture and density (MAD) analysis, thermal conductivity, and *P*-wave velocities. At the seafloor, sediments have high NGR values (30–40 counts/s) and moderately high WRMSL MS values (~20 IU), but both parameters sharply decrease within the shallowest 5 m. Average NGR levels are higher at Site U1581 compared to the two previous sites on the Agulhas Plateau, reflecting lower carbonate content and higher clay content in the Transkei Basin. Values for *P*-wave velocity, thermal conductivity, and bulk density all increase downcore through the upper ~190 mbsf at Site U1581. A sharp ~0.2–0.3 g/cm^3 increase in bulk density below ~190 mbsf occurred at a lithological contact where a hiatus is suspected based on biostratigraphy. To some degree, changes in MS appear to covary with core color reflectance values such as a* (red versus green). Finer scale changes in physical properties at Site U1581 are associated with decimeter scale nannofossil ooze/chalk beds, which appear turbiditic in origin. Decreased NGR and MS characterize these carbonate-rich beds.

No downhole measurements were made during Week 6. However, the processed downhole logging data for Site U1580 were returned from Lamont-Doherty Earth Observatory and the report for Site U1580 was written.

Education and Outreach

The following outreach activities took place during Week 6:

- Posted three blogs with photos on the Expedition 392 page on the *JOIDES Resolution* (JR) website (two written by the Outreach Officer, and one written by Co-Chief Scientist Gabriele Uenzelmann-Neben).
- Posts on Facebook: 7
- Posts on Twitter: 7, plus retweets of scientist posts.
- Stories posted on Instagram: 2
- Held a meeting with U.S. Science Support Program (USSSP) to discuss postexpedition work.
- Wrote haiku for *3-9-2 haiku* (a proposed postexpedition book) and collected haiku from the science party.
- Completed 4 ship-to-shore live tours; 9 events are scheduled for the coming weeks.

- Conducted interviews with various members of the science party and JRSO technicians.

Technical Support and HSE Activities

The following technical support activities took place during Week 6:

Laboratory Activities

- Physical Properties
    - All "Half Space" and "Mini" pucks (used to measure thermal conductivity) were examined and tested. Test results were sent to shore for evaluation. It appears that several have issues and will need to be replaced.
    - Another USB failure occurred on the WRMSL workstation. This was fixed by refreshing the Device Manager.
- Core Description
    - The smear slide zebra printer was moved to the aft wall, next to the Core Laboratory color printer as requested by the science party.
- Paleomagnetism
    - Troubleshooting continued on the superconducting rock magnetometer (SRM) in relation to data noise issues. A Zoom session was held with David Schuler of Applied Physics. The next steps are to work with Cryomech to determine the cooling efficiency of our system.
    - The cryogenic compressor will be swapped near the end of the current expedition to see if this improves the SRM signal degradation.
    - While cleaning the pressure case for Icefield Tool #2043, cracks were found in the brass orientation key. We are currently looking into the possibility of repairs onboard. A replacement may be necessary.
- X-ray
    - Setup and updated the license for ICDD Axiom2019 database (X-ray diffraction analysis software).
- Chemistry
    - Troubleshooting on the source rock analyzer (SRA) continued in an attempt to improve data quality.
    - The old Nanopure water unit that was reinstalled at the beginning of the expedition failed. Troubleshooting is ongoing. We have enough bottled Nanopure to complete all remaining analyses of the expedition.
    - During hydrogen fluoride (HF) neutralization, it was determined that waste which already includes "HF Eater" will foam significantly following the addition of acid neutralizing calcite sand. Excess foam was contained in the secondary container with only minor spillage within the hood. All waste was safely disposed and the interior of the hood and all equipment were fully cleaned with acid neutralizer, HF Eater (spray down) and deionized water (DI) rinse.

    - Based on this, we are no longer pre-adding the HF Eater to the waste container. Instead, only DI water and calcite sand are placed in the bottom. Once we have neutralized the acid, the HF Eater will then be stirred in slowly.
- Publications
    - Portcall transfer/travel and COVID testing needs were confirmed with the science party and JRSO staff.
    - T-shirt design contest is underway.
- IRIS
    - The Driller's interface is nearly completed and is currently undergoing testing against RigWATCH.

Application Support Activities

- A new version of the Catwalk module was deployed.

IT Support Activities

- Preparations began for the next expedition.
- Windows OS machines have been updated with the exception of a few machines. Another round of updates is planned toward the end of the expedition and during the upcoming portcall. Server and Workstation updates this week were successful and will continue next week.
- The initial phase of new "DriveMapper for macOS.app" development was completed and tested. This was necessary to address newer macOS compatibility concerns for the future. Application to be installed sometime over the next week on our macOS based machines on the vessel. The final version should be officially released for Expedition 390, pending any unexpected major setbacks.
- Adobe Update Server is in the final stages of preparation and setup. Testing is currently scheduled to begin towards the end of Week 7.

HSE Activities

- Conducted Sunday safety checks (showers and eye wash).
- Conducted lifeboat drill.