

IODP Expedition 392: Agulhas Plateau Cretaceous Climate

Week 7 Report (20–26 March 2022)

The seventh week of the International Ocean Discovery Program (IODP) Expedition 392, Agulhas Plateau Cretaceous Climate, included rotary core barrel (RCB) coring and attempts to downhole log Site U1581. All times in this report are in ship local time (UTC + 2 h).

Operations

Week 7 of the expedition began on 20 March 2022 with continued coring in Hole U1581B, from Core U1581B-27R at 531.5 meters below seafloor (mbsf) to the last core (Core 74R) at 997.1 mbsf, the final depth for Hole U1581B. Sepiolite mud sweeps were pumped on 17 cores between Cores 28R and 74R. Coring was completed at 1745 h on 24 March. The RCB coring rate was 17.3 m/h overall, although the final two cores were cut at 6.9 m/h.

In preparation for downhole logging, the hole was swept with sepiolite mud sweep to flush cuttings. The mechanical bit release (MBR) shifting tool was run down and the bit was released at 1835 h on 24 March. The hole was then displaced with barite mud and the drill string was pulled up to 188.9 mbsf. At 0100 h on 25 March the circulating head was rigged up and the hole was displaced with additional mud to account for the displacement of the drill pipe coming out of the hole. The circulating head was rigged down at 0130 h and the drill string was placed to 77.8 mbsf for downhole logging.

At 0230 h a safety meeting was conducted prior to rigging up for downhole logging, and the Schlumberger Versatile Seismic Imager (VSI) was made-up for the first run. The tool began its descent at 0415 h and exited the drill pipe into the hole just after 0800 h, but it encountered a solid ledge at 222.4 mbsf at 0830 h. The tool was worked up and down for almost an hour, but it was unsuccessful at passing the ledge. The decision was made to bring the tool back to surface and move the drill pipe down, to cover the ledge. The vertical seismic profile (VSP) cleared the rig floor at 1120 h and the drill pipe was run in to 408.5 mbsf. Due to the lack of daylight for another VSP run, a modified triple combo tool string was made up, with the Dipole Shear Sonic Imager (DSI) in place of the High-Resolution Laterolog Array (HRLA) unit. The tool string consisted of the Hostile Environment Natural Gamma Ray Sonde (HNGS), Hostile Environment Litho-Density Sonde (HLDS), DSI, and Magnetic Susceptibility Sonde (MSS).

Upon make-up, a problem was found with power to the lower portion of the tool string, and it was found that an alignment pin spring was bent. This was replaced and the tool string was deployed at 1630 h. At 2606.8 meters below rig floor (mbrf) depth (still within the water column), there was growing evidence of an electrical fault with the tool. It was decided to bring the tool back to the surface, clearing the rig floor at 1845 h. A new head was connected and the tool was redeployed at 2330 h. The triple combo tool had reached 1300.0 mbrf by early on 26

March, but was again showing an electrical fault, and the decision was made to terminate logging. The tool string was pulled out of the hole, clearing the rotary at 0250 h. The cause of the electrical fault is still to be determined.

The triple combo tools were disassembled and the drill string was tripped back to the vessel, clearing the seafloor at 0555 h and the rig floor at 1510 h on 26 March, ending Hole U1581B. The drill floor was secured, the vessel was switched to cruise mode, and the thrusters were up and secured by 1548 h. The sea passage to Site U1582 (proposed Site AP-07A) was then begun and the week ended with 152 nmi of the transit remaining.

Science Results

Site U1581

Science activities during Week 7 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 described Cores U1581B-23R through 74R. The sediments largely consist of black claystone and dark green clayey siltstone, with occasional intervals that are finely laminated. There are also brown intervals of siderite-rich (or calcium magnesium iron carbonate-rich) siltstone and claystone that become more frequent toward the bottom of the hole. Eleven X-ray diffraction (XRD) samples were taken and show an abundance of quartz in all samples, occasional gismondine and glauconite, and confirm the presence of calcium magnesium iron carbonate and/or siderite in several samples. All sediments described this week are assigned to Lithostratigraphic Subunit IIb. The core description team also worked on the report for the Site U1581.

Micropaleontology

The micropaleontology team analyzed core catcher and split-core samples from Cores U1581B-24R to 74R for calcareous nannofossils, foraminifers, diatoms, and palynomorphs. Generally well-preserved nannofossils are present in rare to few numbers down to Core 47R. Below this, abundance decreases and preservation deteriorates, although rare, moderately preserved nannofossils are present in some fine-grained lithologies. Foraminifers are completely absent from the >63 μm size fraction; however, very small foraminifers (<45 μm) were occasionally observed in smear slides throughout the cored interval. Despite their small size, foraminifers appear well preserved, and specimens from Cores 19R through 21R were imaged on the scanning electron microscope (SEM). Pyritized diatom fragments are also present throughout, with some samples containing whole valves with fine details preserved by the pyrite. Well-preserved palynomorphs including dinocysts, pollen, and miospores are common to abundant throughout the cores. Nannofossils and dinocysts provide age control for Hole U1581B, which is

dated to the early Maastrichtian to late Campanian. After coring was completed, the micropaleontology team worked on the report for Site U1581.

Paleomagnetism

The paleomagnetism team completed shipboard measurements of Cores U1581B-23R through 74R. All cores were RCB drilled and unoriented. Archive section halves underwent low-field alternating field (AF) demagnetization up to a peak field of 20 mT. Full AF demagnetization was additionally performed on one or two representative discrete samples per core, up to peak fields of 70–150 mT. The measured archive section halves have good magnetic signals and intervals of stable magnetic direction were identified. Additionally, characteristic remanent directions were constrained from ~90% of the discrete samples, and these results are consistent with those from the archive halves. From the magnetic data, numerous clear magnetic reversals were identified. In collaboration with the micropaleontology group, identified intervals of stable polarity were correlated to the geomagnetic polarity timescale (GPTS). It was determined that these cores covering Chrons C31r to C33n were deposited in the Late Cretaceous. Additional rock magnetic experiments including measurements of bulk magnetic susceptibility (MS), anisotropy of magnetic susceptibility (AMS), and isothermal remanent magnetization (IRM) acquisition were performed on discrete samples to better understand the magnetic mineralogy. After completing measurements, all magnetic data were analyzed and the paleomagnetism team worked on the report for Site U1581.

Geochemistry

Samples for interstitial water (IW) were taken in Hole U1581B to a depth of 978 mbsf. Generally, one sample was taken per core beginning with Core U1581B-2R. Alkalinity values remained low (~1.5 mM) throughout the hole, and sulfate values declined from ~17.5 mM at the top of Hole U1581B (~290 mbsf) to more variable concentrations (~3–7 mM) below 681 mbsf. The major elements—sodium, chloride, potassium, and magnesium—declined steadily throughout the hole, whereas the calcium decrease began at a depth of ~389 mbsf. The geochemistry team also worked on the report for Site U1581.

Physical Properties

The physical properties team measured cores from Hole U1581B using track instruments including the Whole-Round Multisensor Logger (WRMSL), Section Half Multisensor Logger (SHMSL), and the Natural Gamma Radiation Logger (NGRL). Discrete measurements were made for moisture and density (MAD) analysis, thermal conductivity, and *P*-wave velocities on the ultrasonic caliper system (PWC). In the Cretaceous claystone and sandstone lithologies, the *P*-wave velocity was measured along each of the three axes separately using the PWC on 10 samples. In Hole U1581B, a major increase in MS to ~400 instrument units (IU) occurs in the clayey silts and silty clays of Lithostratigraphic Subunit IIa and corresponds to the Cretaceous/Paleogene (K/Pg) boundary interval. Thin nannofossil ooze/chalk beds, turbiditic in

origin, result in finer-scale changes, e.g., of NGR and MS. Elemental abundances of potassium (K), uranium (U), and thorium (Th) were deconvolved from the NGRL spectral data and provided additional insights into trends of the full NGR profile, along with geochemical information.

The grain density of claystones in Lithostratigraphic Subunit IIb is high (~ 2.75 to ~ 2.85 g/cm³) and likely relates to the presence of authigenic minerals such as pyrite and siderite. The average *P*-wave velocity trend increases from ~ 1650 m/s at the seafloor to ~ 2200 m/s at the base of Lithostratigraphic Unit II. The PWC measurements on discrete samples indicate 10%–15% lower vertical (PWC-z) velocity values compared to horizontal (PWC-x) velocities. The degree of seismic anisotropy appears to decrease with depth. Porosity generally decreases with depth from values of $\sim 60\%$ – 70% immediately below the seafloor in the biogenic oozes of Lithostratigraphic Subunit Ia to values of less than 40% below ~ 900 mbsf in the deepest intervals of claystones and siltstones in Lithostratigraphic Subunit IIb. The stiff carbonates are characterized by low porosity (10%–15%) and high grain density 3.0–3.4 g/cm³. In some intervals, deformation structures such as shear bands and carbonate dissolution seams are associated with these carbonate layers.

Education and Outreach

The following outreach activities took place during Week 7:

- Posted two blogs with photos on the Expedition 392 page on the [JOIDES Resolution \(JR\) website](#) (one 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
- 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; 10 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 7.

Laboratory Activities

- Logistics
 - Prepared shipments and planned for the upcoming port call.

- Physical Properties
 - Intermittent USB failures continue to occur on the WRMSL workstation.
- Underway Geophysics
 - Assembled gun and rigging for the VSI. Logging tool was unable to enter the hole; disassembled gun and rigging.
- Microscopes
 - Repaired the height adjustment on one of the older Zeiss microscopes.
- Chemistry
 - Repaired an issue with a loose light fixture affecting results on the coulometer.
 - Previous issues with the Nanopure system have been resolved.
- Publications
 - T-shirt design contest and pressing completed.
- IRIS
 - The Driller's interface was introduced to Siem Offshore staff for review.
 - Verified that the pipe counter correctly adds pipe length from the pipe tally tables and updates the bit depth.
 - Work began on embedding Sample Master's "new core" function into the Driller's interface.

Application Support Activities

- Continued to work on GEODESC Template Manager application.

IT Support Activities

- The new DriveMapper for macOS application was deployed to UserRoom Macs and is in use with no issues so far. The application will be deployed ship wide during Week 8.
- The Adobe Update Server is currently being tested. Preliminary results are great for Adobe Named User License version. If Adobe Creative Cloud Desktop App recognizes the user is logged in, it will allow the user to install/update Apps from the server.
- CorelDRAW 2021 is having issues loading on the new Publications Specialist PC user profile. Further troubleshooting will continue.
- Linux server patching still underway.

HSE Activities

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