IODP Expedition 397: Iberian Margin Paleoclimate

Week 4 Report (6–12 November 2022)

Operations

The fourth week of Expedition 397 began on 6 November 2022 at Site U1587 while coring with the extended core barrel (XCB) in Hole U1587B from a depth of 133.4 m below seafloor (mbsf). Drilling operations continued to 303.3 mbsf when high heave caused coring to stop after retrieving Core U1587B-33X at 2330 h. The bit was pulled to a depth of 282.8 mbsf to wait for the sea to subside.

By 0215 h on 8 November, sea conditions had improved sufficiently for rig floor operations to resume. The hole was washed down from 282.2 to 303.3 mbsf and the XCB coring system was deployed. Coring continued through 0210 h on 9 November after retrieving Core U1587B-46X from 421.7 mbsf, when drilling operations were stopped again due to significant heave (over 6 m). The bit was pulled off the bottom while the rig crew waited for reduced heave. By 1315 h on 9 November, the heave had subsided to 3.6 m and continued to decrease. XCB coring resumed and continued to 547.8 mbsf, ending with Core U1587B-59X retrieved at 1320 h on 10 November. The bit was raised, clearing the seafloor at 1630 h, and ending Hole U1587B. The total core recovered in Hole U1587B was 534.27 m (98%).

After clearing the seafloor, the vessel was offset 20 m from Hole U1587B at 45° to start Hole U1587C. The rig crew slipped and cut 115 ft of drill line prior to spudding Hole U1587C. The bit was positioned at 3486 m below rig floor (mbrf), an advanced piston corer (APC) core barrel was lowered, and Hole U1587C was spudded at 2042 h on 10 November. Seafloor was calculated to be 3490.2 mbrf/3489.0 m below sea level (mbsl) based on recovery from Core U1587C-1H. Coring continued with the APC until a partial stroke on Core U1587C-12H, ending APC coring at a depth of 98.3 mbsf. The XCB was deployed, and coring continued with Cores U1587C-13X (98.3 mbsf) through 41X (379.6 mbsf) at midnight on 12 November.

Science Results

This week we acquired and analyzed data from Holes U1587A through U1587C, finalized Site U1586 reports, and began discussing postcruise research plans. A summary of this week's activities from each laboratory team follows.

Lithostratigraphy

Cores U1587B-9H to 59X and U1587C-1H to 36X were described. Sediments in Holes U1587B and U1587C are consistent with the previous findings from the same depth intervals in Hole U1587A. They consist predominantly of lithofacies 1, which is expressed as alternating intervals of

nannofossil ooze and nannofossil ooze with clay and varying amounts of foraminifera. Only minor parts of the core are composed of lithofacies 2 (clay). Color banding and small pyrite nodules are dominant features throughout. Trace fossils such as *Planolites, Chondrites, Thalassinoides,* and *Zoophycos* are commonly observed. Core disturbance is generally slight to moderate, and uparching in APC cores and biscuiting in XCB cores is common. Similar to observations in Hole U1587A, sediments downhole, starting from Core U1587B-43X, show more distinct contrast in color between light layers (nannofossil ooze) and dark layers (nannofossil ooze with clay), and magnetic susceptibility (MS) notably increases in dark layers.

Examination of smear slides from Cores U1587B-54X to 59X (from 489.6–546.01 mbsf) shows that the dominant (>50%) component of sediments are nannofossils. All smear slides from this interval are classified as lithofacies 1. Siliciclastic grains range from rare to abundant (>1%–50%). Detrital carbonate, foraminifera, and authigenic grains in smear slides are trace to rare (<1%–10%). Biosiliceous components, including diatoms (valves of vegetative and resting spores), radiolarians, sponge spicules, and dinoflagellate cysts, were found in smear slides from Section U1587C-7H-1A (46.3 to 47.7 mbsf).

Portable X-ray fluorescence spectrometer (pXRF) measurements were performed on Sections U1587B-22X-1 and 22X-5 to 22X-7. Darker intervals contain higher percentages of Al_2O_3, SiO_2, and Ti, among other elements, and lesser Ca, which increases in lighter intervals. Thus, the data support the findings from visual macroscopic and microscopic description that darker intervals consist of a greater concentration of siliciclastic material than lighter intervals.

Biostratigraphy

Samples U1587B-53X-CC (479.9 mbsf) to 59X-CC (547.8 mbsf) were examined for biostratigraphic markers and identified as early Pliocene to late Miocene (Tortonian). Eight additional samples from Hole U1587B (U1587B-17X-CC to 24X-CC, between 152.8 and 216.0 mbsf) were processed and examined to refine benthic foraminiferal and ostracodal paleoenvironmental results. Compared to planktonic foraminifera, benthic foraminifera increase in abundance in the late Miocene section. The biostratigraphers continue to examine additional samples to refine the age model and estimate sedimentation rates for the site. Fourteen planktonic foraminifera and 37 calcareous nannofossils bioevents have been recognized.

Scientists continued attempts to examine and document micropaleontological, sedimentological, and geochemical data with the scanning electron microscope (SEM) and electron dispersive spectroscopy system; however, the quality of the images produced is too poor for publication.

Paleomagnetism

Natural remanent magnetization (NRM) of archive half core sections from Holes U1587B (Core U1587B-9H to bottom) and U1587C (Cores U1587C-1H to 32X) were measured before and after 20 mT alternating field demagnetization. Additionally, we measured the NRM of a few core sections from Hole U1587B using more detailed (3 to 5) demagnetization steps. The results show that

<20 mT demagnetization is often not sufficient to remove the overprint. Therefore, we continued to measure the NRM of core sections before and after 20 mT demagnetization. The Icefield MI-5 core orientation tool was deployed to orient 12 APC cores in Hole U1587C. A total of 134 cube samples were taken from Hole U1587B, and seven cube samples were taken from Core U1587C-12H. We measured the NRM of 133 cube samples with stepwise demagnetization up to 50 mT. For most of these measurements, we increased the total demagnetization steps from 14 to 22 because measurements on the superconducting rock magnetometer (SRM) appear to be frequently influenced (2 to 6 out of 22 steps) by possible flux jumps along the *z*-axis. Four cube samples were subjected to low-temperature treatment using liquid nitrogen before NRM measurement.

Hole U1587B was cored down to 550 mbsf, 50 m deeper than Hole U1587A. The intensity of NRM after 20 mT (NRM_{20mT}) for cores from Hole U1587B is similar to that in Hole U1587A and generally follows the trend of changes in MS. NRM_{20mT} intensity of Hole U1587B cores is on the order of 10^{-2} A/m for the top ~40 mbsf and decreases downhole to the order of 10^{-4} to 10^{-3} A/m between ~40 and 100 mbsf. Between ~100 and 400 mbsf, NRM_{20mT} intensity is low and mostly on the order of 10^{-5} to 10^{-4} A/m, and it increases to ~10^{-4} to 10^{-3} A/m between ~400 and 450 mbsf. NRM_{20mT} intensity appears to vary around 10^{-2} A/m between ~450 and 540 mbsf, followed by a decrease to ~10^{-4} A/m in the bottom ~10 m of the hole. NRM_{20mT} intensity of cores from Hole U1587C is similar to those from Holes U1587A and U1587B from overlapping depth intervals. The Brunhes/Matuyama boundary is identified in APC cores from Holes U1587B and U1587C. This is supported by NRM data from cube samples. Magnetostratigraphic interpretation for the XCB cores in Holes U1587B and U1587C is difficult due to heavy drilling-induced overprint, especially for core sections from ~100 to 400 mbsf where NRM_{20mT} intensity is low (10^{-5} to 10^{-4} A/m). NRM data of archive half core sections and cube samples suggest that sediments between ~450 and 540 mbsf in Hole U1587B, where NRM_{20mT} intensity is stronger (~10^{-4} to 10^{-2} A/m), potentially could have recorded several reversals during late Miocene.

Geochemistry

The chemistry group continued to work on the interstitial water samples from Hole U1587A for major and minor elemental composition by ion chromatograph and inductively coupled plasma–atomic emission spectrometry (ICP-AES) and for ammonium and phosphate by spectrophotometry. Discrete samples from the working half of split cores (two per core) were selected for total sedimentary carbon, organic carbon, nitrogen, sulfur, and total inorganic carbon/$CaCO_3$ wt%. Discrete samples for bulk elemental and mineralogical composition were also selected from the working half of split cores (one per core) for paired ICP-AES and X-ray diffraction analyses. With approval to extend the penetration depth at the site by 50 m to 550 mbsf, concentrations of methane, ethane, and other gases were measured in the headspace sample of the bottommost section of each core from 500 to 549 mbsf at Hole U1587B. Bulk sediment analyses were also done on the cores within the bottommost 50 m interval.

Physical Properties and Downhole Measurements

We conducted a suite of petrophysical analyses of cores from Holes U1587B and U1587C. All whole-round cores were run through the Whole-Round Multisensor Logger (WRMSL) and natural gamma radiation (NGR) tracks with the help of the JRSO technicians. Whole-round core sections from Holes U1587B and U1587C were not equilibrated to room temperature prior to measurements through the WRMSL. Cyclic variations in MS, NGR, and sediment color reflectance are coherent with lithologic changes.

P-wave velocity and thermal conductivity were measured on the section halves of Cores U1587B-55X to 59X in the depth range from 500 to 550 mbsf that was not cored at Hole U1587A. Discrete samples for wet, dry, and grain densities and porosity measurements were also taken and analyzed from Cores U1587B-55X to 59X.

Stratigraphic Correlation

The stratigraphic correlators used multiple proxy signals, such as NGR, MS, and color (L* and RGB data) to finalize the composite section and splice of Site U1586. The splice appears continuous to ~325 m of core composite depth below seafloor (m CCSF-A) except for two tenuous ties with small overlap among holes. Holes U1587A through U1587C are being carefully monitored to ensure the gaps between cores are bridged in companion holes. The cyclicity of physical properties is remarkable at Site U1587 with a strong precession signal expressed throughout the late Miocene and Pliocene, which will be used to develop an astronomically tuned timescale.

Outreach

The Onboard Outreach Officer hosted seven live ship-to-shore broadcasts from the *JOIDES Resolution*, reaching approximately 150 people in Germany, Portugal, and USA. So far, a total of approximately 900 people have connected to the ship via virtual broadcast. Six posts were made to Twitter, earning 16,400 impressions, 284 engagements, 37 retweets, 163 likes, and five replies. The Twitter account gained 61 new followers. Five posts were made on Facebook, reaching 4,039 people and leading to 186 reactions, 15 comments, and seven shares. Two new people followed the Facebook account. Two posts were made to Instagram, reaching 1,637 people and earning 177 reactions, four comments, and three shares. The Instagram account gained six new followers. One blog post was published to the *JOIDES Resolution* website. Two new audiogram files were published on Twitter and Facebook, showcasing the work of inorganic chemist Sophie Hines and physical properties specialist Saray Sanchez.

Members of the science party continue to support outreach efforts by hosting or cohosting tours, and participating in Q&A sessions with audience members.

The Shore Outreach Officer continued to wrap up onshore education and outreach by assisting with coordination of ship-to-shore broadcasts with Portuguese schools, creating “swag bags” to mail to

students in Portugal, contributing to the *JOIDES Resolution* social media accounts, and compiling social media engagement data.

Technical Support and HSE Activities

Laboratory Activities

- Technical staff supported the science party in core processing at Holes U1587A, U1587B, and U1587C.
- The high-temperature alarm on the SRM compressor went off several times. The staff rapidly switched to the backup water chiller with no interruption in operations. A follow-up investigation revealed that the filter on the ship's incoming chill water gets clogged, and when this happens in conjunction with a slight rise in temperature of the chill water, the compressor inlet temperature will surpass the alarm set point. Staff cleaned the filter and back-flushed the Haskris water chiller. Regular cleaning of the filter and water chiller is now recommended.
- The abort sequence in the SRM software was triggered twice without user input and the degausser stuck in coil ramp-up. Both occurrences were noticed immediately and rectified. The cause is still unknown.
- An audible alarm system is being developed for when the SRM degausser is applying current to the coils past a defined length of time. The alarm will be installed when the SRM is free from scientific measurements.
- The Bruker pXRF was set up to measure a few core sections, and two members of the science party were trained to use the instrument.
- Water backed up out of the drains in the core splitting room floor. The Siem Offshore engineers cleared out the drains. The blockages are likely due to years of buildup. Sink drain strainers and a sediment trap have been ordered to reduce larger materials from going down the drains.

Application Support Activities

- Corrected deployment issues in the Sample and Data Request Management System (SDRM) related to the Angular library update and licensing issues with a third-party library.
- Completed the SDRM feature related to showing and hiding fields when toggling request type from Research to XRF. Added double click to open requests.
- Worked with physical properties scientists to update the MATLAB code used to deconvolve K, Th, and U results from the NGR aggregated test results.

IT Support Activities

- The JRSO Internet connection with shore was lost on 8 November at ~2200 h and the outage lasted over 24 h. Discussed with the Siem Offshore Electrical Supervisor about a possible

backup system for JRSO staff to be able to communicate with Marlink directly and troubleshoot any problems.

- Two TVs from the starboard quarantine cabins were moved to cabins that are occupied and had no TVs. Additional TVs will arrive for the next expedition and will be distributed to cabins without TVs.
- The PC workstation that arrived with the new SEM, but was subsequently replaced, was located but the hard drive had been removed. The hard drive was found in the IT office and installed in the computer case.

HSE Activities

- Weekly fire and boat drill was conducted on Sunday, 6 November.
- Eyewash and showers were tested.