

## **IODP Expedition 397: Iberian Margin Paleoclimate**

### **Week 2 Report (23–29 October 2022)**

#### **Operations**

During the second week of the International Ocean Discovery Program (IODP) Expedition 397, Iberian Margin Paleoclimate, we continued coring operations at Site U1586 (proposed site SHACK-11B).

We began the week using the extended core barrel (XCB) in Hole U1586B at a depth of 190.0 m below seafloor (mbsf). Cores U1586B-23X and 24X (190.0–209.4 mbsf) were retrieved before high seas forced us to pause coring at 0500 h on 23 October 2022. The drill bit was raised two stands off the bottom of the hole and set at 146.2 mbsf while waiting for the seas to subside. By 0645 h on 24 October, the seas had calmed and coring resumed. The drillers washed the hole down to 209.4 mbsf where ~2 m of sediment fill were encountered. At 0900 h, after the fill was cleared, an XCB barrel was deployed and coring continued.

Coring operations and laboratory activities were suspended at ~2130 h that day due to smoke and fumes from the overheating of the superconducting rock magnetometer's (SRM) degaussing coils. The system was isolated, and the situation was addressed by the JRSO technical staff and Siem Offshore personnel. Coring resumed and the scientists returned to work in the Core Laboratory. Cores U1586B-25X through 40X extended the hole to 350.0 mbsf. Then the bit was raised back to seafloor, ending Hole U1586B at 1320 h on 25 October. A total of 335.13 m of core (96%) was recovered from Hole U1586B.

The vessel was repositioned 150 m at 225° from Hole U1586B, over the location of Hole U1586C. During this movement, the drill crew conducted routine maintenance that consisted of slipping and cutting the drill line, and we ran the ship's precision depth recorder (PDR) to estimate the water depth. Based on this measurement, the bit was spaced to 1698 m below the rig floor (mbrf), and Hole U1586C was spudded at 1825 h on 25 October. A seafloor depth then was calculated as 4703.5 mbrf (4692.4 m below sea level [mbsl]) based on material recovered in Core U1586C-1H. Coring in Hole U1586C continued under calm seas through the early morning of 28 October to a final depth of 349.1 mbsf. The full-length advanced piston corer (APC) system was used over a 118.0 m interval with a recovery rate of 105% (Cores U1586C-1H to 13H). Nonmagnetic core barrels and the Icefield MI-5 core orientation tool were used for all APC cores. The XCB coring system was deployed over the next 231.1 m interval with a recovery rate of 92% (Cores U1586C-14X to 38X). A total of 334.37 m of core (96%) was recovered.

The vessel was offset 20 m at 225° from Hole U1586C, the bit was positioned at 4702 mbrf, and Hole U1586D was spudded at 1120 h on 28 October. Based on recovery from Core U1586D-1H, the seafloor depth was calculated to be 4704.7 mbrf (4693.6 mbsl). Hole U1586D was cored to 111.3 mbsf by midnight on 28 October using the full-length APC system under increasing heave,

which resulted in APC cores deploying early during core orientation (Cores U1586D-5H and 6H; the orientation tool was removed after 6H) and recording incomplete strokes. These drilling problems translated into the cores being heavily disturbed, and we decided to pause drilling at 0100 h on 29 October and wait until the ship's heave was reduced to try to improve the quality of the cores. With heave conditions around 2 m and decreasing, we changed to the XCB system and resumed coring at 0700 h on 29 October. By midnight, Cores U1586D-13X through 25X were retrieved from 111.3 to 234.8 mbsf and recovered 120.3 m (97%).

At 1258 h on 25 October, the seagoing tug *Spartacus* arrived alongside the ship and took two crewmembers (a scientist and a member of the catering team) to shore for compassionate evacuation.

COVID-19 mitigation protocols continued to be followed with mask wearing, social distancing, and daily antigen testing of all personnel until 29 October when mitigation measures were dropped as per the JRSO and Siem Offshore COPE protocol.

## Science Results

Scientists acquired and analyzed data from Holes U1586B, U1586C, and U1586D, and began summarizing their results in the shipboard reports while initiating preparations for analysis at the next site. A summary of this week's activities from each laboratory team follows.

### *Lithostratigraphy*

The sedimentology team described Cores U1586B-20X to 40X, U1586C-1H to 38X, and U1586D-1H to 19X. The sedimentary sequence at Site U1586 was divided into three lithostratigraphic units based on the frequency and occurrence of three lithofacies. Lithostratigraphic Unit I consists almost entirely of Lithofacies 1 (nannofossil ooze; >92%) and minor Lithofacies 2 (clay; up to 8%). The top of Unit II is marked by dark brown beds of Lithofacies 2. Throughout Unit II, clay varies from 20% to 35% of the stratigraphy, although it is still predominantly nannofossils ooze (65%–80%). In Unit III, Lithofacies 1 is still dominant, although it is reduced to ~55%–60% of the strata. Lithofacies 2 makes up ~30%–40% and Lithofacies 3 (sand) makes up the remaining 5%–10%. Overall, sediments are predominantly composed of Lithofacies 1, which consists of a pale beige to light brown nannofossil ooze, also occurring with varying amounts of clay and calcareous grains (detrital and biogenic). This lithofacies is distinctively color-banded throughout, which is expressed as thick continuous units many tens of meters in thickness, presenting sparse to heavy bioturbation. The second most common is Lithofacies 2, siliciclastic clay often with minor silt grains that can be homogenous, thinly to thickly laminated, or have overprinting of color banding, presenting moderate to heavy bioturbation. Colors vary between dark brown, green, blue/gray, or red. In the last three cores of each hole, very fine to coarse sand beds (Lithofacies 3) consisting predominantly of foraminifera with other calcareous grains are present. The sand beds are marked by sharp erosional bases with minor loading and scours. Some are normally graded or laminated

and show little to no evidence of bioturbation. Sand beds are interbedded by bioturbated red or green clay (Lithofacies 2).

We encountered several slumps at Site U1586 that disrupt the otherwise continuous stratigraphy. Deformational structures, such as slump folds, convoluted bedding, and contorted beds, are observed in five different intervals, with most of them being well-correlated among all holes.

Trace fossils were identified in cores from all holes, with the most common including *Chondrites*, *Planolites*, and *Zoophycos*. Different types and degrees of drilling disturbance were observed in the cores, with the most common type being uparching, flow-in, soupy and slurry in the APC cores, and biscuiting and fall-in for the XCB cores. Cores U1586D-5H, 6H, 9H, 11H, and 12H were severely disturbed because of significant ship heave during coring (see Operations above).

### *Biostratigraphy*

The biostratigraphers finished analysis of split core and core catcher samples and developed a refined biostratigraphic chart for Site U1586 that includes 51 nannofossil events and nine planktonic foraminifera events, ranging in age from middle Miocene to Holocene. Analysis of the top of the last core of Hole U1586A revealed a mixture of nannofossils of early Oligocene–late Eocene age. Approximately 35 samples were taken from Hole U1586C for refinement of nannofossil biostratigraphy, especially the Miocene/Pliocene boundary.

The micropaleontologists, the Co-Chief Scientists, and the Expedition Project Manager, with support from JRSO staff, continued testing the new scanning electron microscope (SEM) while attempting to document their findings and produce images for the site reports and presentations. However, they were unable to make any suitable images successfully, even when sea conditions were calm on site. Problems encountered with the SEM ranged from the inability to adequately focus on sedimentary grains or/and microfossils to constantly obtaining distorted or out-of-focus images.

### *Paleomagnetism*

Natural remanent magnetization (NRM) of archive-half core sections from Holes U1586B (Core 19X to base of the hole), U1586C (all cores), and U1586D (uppermost 18 cores) were measured to verify and improve the magnetostratigraphy of Site U1586. A possible software and hardware communication issue caused the SRM in-line degauss coils to overheat. It appears that the issue was triggered when attempting to cancel an ongoing demagnetization sequence using the software's "Abort" function. No samples were being measured when the incident happened. Follow-up tests after the degauss coils cooled down suggest that they are performing normally. Owing to the delay caused by the incident, we only measured NRM after 20 mT alternating field (AF) demagnetization for core sections below Core 29X-2A in Hole U1586B. NRM measurements of all other core sections completed during the week were collected before and after 20 mT demagnetization. The Icefield MI-5 core orientation tool was deployed to orient all 13 APC cores in Hole U1586C and Cores 1H through 6H in Hole U1586D (the tool was taken out beginning on

Core 7H to reduce coring-induced deformation). Cube samples from Holes U1586A (110 in total) and U1586B (seven in total) were measured before and after stepwise AF demagnetization with peak fields up to 80 mT using either the SRM or the JR-6A spinner magnetometer. The SRM appears to produce less noisy data than the JR-6A. Seven cube samples were collected from Section U1586C-18X-3W and measured on the SRM with stepwise demagnetization up to 50 mT (as a cautious measure to avoid potential damage to the in-line degauss coils).

Similar to results from Hole U1586A, intensities of NRM after 20 mT demagnetization ( $\text{NRM}_{20\text{mT}}$ ) of core sections from Holes U1586B, U1586C, and U1586D are on the order of  $10^{-2}$  A/m for the top ~40–45 m cored depth below seafloor, Method A (CSF-A), and decrease to  $10^{-3}$  A/m level between these depths and the depths where XCB coring started in these holes (~110–140 m CSF-A).  $\text{NRM}_{20\text{mT}}$  intensities of the XCB-cored sections are usually one order of magnitude higher than those from the overlapping APC cored sections in Hole U1586A, suggesting strong overprint of the XCB-cored sections that are not completely removed after 20 mT demagnetization. The Brunhes/Matuyama boundary, the Jaramillo subchron, and the Matuyama/Gauss boundary are identified in Holes U1586B and U1586C. Strong coring disturbance in many of the APC cores of Hole U1586D makes it difficult to provide magnetostratigraphic interpretations. Cube sample results are generally consistent with interpretations made based on the core section data from Hole U1586A and are helpful for constraining the Brunhes/Matuyama boundary in Hole U1586B.

### *Geochemistry*

The geochemists took pore water samples using Rhizons from the middle (at a ~75 cm offset) of Sections 1 and 3 of Cores U1586C-1H to 11H (until no water was yielded). The 2 ml Rhizon interstitial water (IW) samples were fixed with 10  $\mu\text{l}$  100%  $\text{HgCl}_2$  and then sealed in glass ampoules for shore-based carbon and sulfur isotope analysis. The X-ray diffraction (XRD) scan data were analyzed and the paired samples of bulk sediments were processed and digested for inductively coupled plasma–atomic emission spectroscopy (ICP-AES) analysis.

### *Physical Properties*

Gamma ray attenuation (GRA) bulk density and magnetic susceptibility (MS) were measured on whole-round cores from Holes U1586B, U1586C, and U1586D using the Whole-Round Multisensor Logger (WRMSL) with a measurement interval of 2.0 cm without room temperature equilibration to support rapid stratigraphic correlation. Natural gamma radiation (NGR) was measured on whole-round cores at an interval of 10 cm. Downhole sediment compaction is reflected in increasing GRA bulk density with depth. Cyclic variations of MS, NGR, and color reflectance are clear throughout the sequence in Holes U1586B, U1586C, and U1586D, which is consistent with the cyclic lithologic changes. In addition to the regular measurements of GRA, MS, and NGR, X-ray images were taken of selected split core section halves.

## *Stratigraphic Correlation*

The major activities of the stratigraphic correlators were assessing the overlap between offset holes and developing a preliminary stratigraphy based on tying proxy variations to orbital climatic cycles of Pleistocene/Miocene age. Overlap appears continuous except for a small interval around 120 mbsf where an overlap is not firmly documented. We also found significant core gaps in XCB coring, despite the high quality of the XCB cores. Gaps ranged from 50 cm to more than 4 m. The section below the Pleistocene/Pliocene boundary appears to be dominated by precessional cycles, with strong amplitude modulation present. The latest Miocene sequence has two adjacent slumps in all offset holes.

## **Outreach**

### *Onboard Education and Outreach*

In the second week of the expedition, the Onboard Outreach Officer hosted 13 live ship-to-shore broadcasts from the ship. So far, approximately 551 people in Germany, India, Japan, Portugal, the United Kingdom, and USA have had a tour of the ship (total for Weeks 1 and 2). Eight posts were made to [Twitter](#), earning 29,600 impressions, 758 engagements, 64 retweets, 334 likes, and four replies. The Twitter account gained 52 new followers. Ten posts were made on [Facebook](#), reaching 5,196 people and leading to 534 reactions, 13 comments, and 11 shares. Twelve new people followed the Facebook account. Thirteen posts were made to [Instagram](#), reaching 1,637 people and earning 552 reactions, four comments, and seven shares. The Instagram account gained 19 new followers. Two blog posts were published on the *JOIDES Resolution* [website](#).

Members of the science party have been very supportive of outreach by hosting or co-hosting tours, answering questions during them, and helping with content for blog posts and social media posts.

### *Shore Education and Outreach*

The Shore Outreach Officer visited three secondary schools and one primary school in Portugal, facilitating nine presentations that reached approximately 400 participants.

## **Technical Support and HSE Activities**

### *Laboratory Activities*

- Technical staff were fully engaged in core processing and science support at Holes U1586B, U1586C, and U1586D.
- The x-axis coil in the degaussing unit on the SRM overheated Monday evening, causing fumes and smoke to emanate from the shield housing and significant heating of the shielding. The overheating was caused when a demagnetization sequence was aborted but

the coil remained energized and went unnoticed. Once the coil cooled down, it was inspected and the whole degausser was tested and found to be in good operational condition. The SRM was put back in service for routine section measurements with low demagnetization steps. The manufacturer and JRSO management were consulted before proceeding with higher demagnetizations steps. Troubleshooting of the cause of the issue continues.

- The new mineral database was installed and activated for the Panalytical HighScore software used for XRD data analysis.
- It was found that the reference model in the expanded LORE report of the LIMS database of Downhole Temperature (APCT-3 tool) was recorded in the tool\_serial\_number column. The LORE report was modified to include a reference\_model column. The TpFitLoader data uploader was modified to upload and record the values correctly.
- The LIVE data display did not show description data for Hole U1586C after a new Lithology rank column was added in GEODESC. The new column was removed from the core description template, and a bug was found and corrected in the webservice used by LIVE.

#### *Application Support Activities*

- Changed the expanded version of the Orientation Report to sort by top hole instead of test number. This is the same change as in the standard version earlier this expedition.
- Continued development of the new sample request software.
- Investigated the “Abort” button’s behavior and the overheating issue on the SRM. This issue was widely reported and discussed.
- Fixed webservice call to fix LIVE’s call to GEODESC data.
- Fixed some critical bugs in SPLAT that were reported from shore.

#### *IT Support Activities*

- Deployed script shipwide to grant full-control permissions to all users’ C:\ProgramData\IODP to resolve permission issues with IODPLauncher and IODP Applications.
- Installed and registered updated PDF-4 Axiom 2023 software on virtual XRD workstation and XRD Instrument Host.
- Resolved an issue related to several SNAP TV units that were not connecting to the network.

#### *HSE Activities*

- The weekly fire and boat drill was conducted on Sunday, 23 October.
- COVID-19 mitigation protocol ended on 29 October. Wearing masks and daily testing are no longer mandatory.
- Eyewash and showers were tested.