

IODP Expedition 397: Iberian Margin Paleoclimate

Week 5 Report (13 November–19 November 2022)

Operations

The fifth week of Expedition 397 began on 13 November 2022 at Site U1587 (proposed Site SHACK-14A) while using the extended core barrel (XCB) in Hole U1587C from a depth of 379.6 m below seafloor (mbsf). XCB coring continued to a total depth of 567.9 mbsf with Core U1587C-61X recovered at 1900 h on 14 November. With the scientific objectives at Site U1587 achieved and high seas expected later in the week, the expedition management team decided not to drill another hole, and proceeded to log Hole U1587C with the triple combo tool string.

A total of 61 cores were taken in Hole U1587C over a 567.9 m interval. The advanced piston corer (APC) system was used for 12 cores over a 98.3 m interval with 105% recovery. The hole was extended to its total depth using the XCB system for the remaining 49 cores over a 469.6 m interval with 96% recovery.

A 30-barrel sweep of high-viscosity mud was pumped to clean the hole and the bit was pulled to a logging depth of 80.1 mbsf. The drill floor was prepared for logging, and the triple combo tool string was assembled and deployed into the hole to a depth of 558 mbsf, roughly 10 m above the total depth of the hole (567.9 mbsf). Next, we conducted an upward pass with the caliper open at a pace of 274 m/h over the entire hole to achieve the maximum possible data resolution from the natural gamma ray sonde of the triple combo. The caliper was closed before entering the pipe, and the main pass was completed above the seafloor. Owing primarily to several spots where the hole was significantly undergauge and to the inability to close the caliper fully, it was impossible to make any additional passes, so the tools were pulled to the surface and rigged down at 0810 h.

The drill string was raised, clearing the seafloor and ending Hole U1587C and Site U1587 at 0850 h on 15 November. The bit was raised to 2484 m below rig floor (mbrf), and at 1115 h, we started transit to Site U1385 (proposed Site SHACK-04C) under dynamic positioning (DP) navigation mode.

The vessel arrived at Site U1385 at 0220 h on 16 November. With the bit at 2557.5 mbrf at 0330 h, a deteriorating sea state cause the ship to wait on the weather until the seas subsided enough to begin coring operations at 0015 h on 18 November. However, because the heave was still above 3 m, it was decided to drill without recovery instead of coring the upper section. This strategy was feasible because Expedition 339 had already drilled four holes to ~145 mbsf at Site U1385, and the expected stratigraphy in Hole U1385F would be identical to the legacy holes, allowing us to drill safely and to correlate both records relatively easily.

Hole U1385F was spudded at 0220 h on 18 November and advanced without coring to 96.9 mbsf (Interval U1385F-1, 1). An XCB barrel was then dropped, and coring began with Core U1385G-2X from 96.9 to 106.6 mbsf.

After deploying the next core barrel and making a connection, the driller accidentally slacked off the top drive with the pipe still in the elevators on the rig floor. Approximately 55,000 lb were set down on the drill pipe and knobbies, causing a significant bend between the top drive and the elevators. The toolpusher stopped the driller and had him raise the top drive. The knobbies and one stand of 5½ inch drill pipe were substituted with new ones.

Coring continued with Core U1385F-3X to 33X from a depth of 106.6 to 400 mbsf. The bit was pulled out of the hole, clearing the seafloor at 2335 h on 19 November, ending Hole U1385F.

Thirty-two XCB cores were taken over a 303.1 m interval with 96% recovery. Core U1385F-27X had no recovery. It was determined that the core catcher was stuck open, allowing the core to fall out as the core barrel was retrieved. There was one drilled interval, from seafloor to 96.9 mbsf.

Science Results

This week, the science party acquired and analyzed data from Holes U1587C and U1385F. They presented and discussed the results from Site U1587 and started to write and submit the site reports. The scientists also developed a shipboard sampling strategy to conduct a collaborative, multidisciplinary study aimed at examining the causes of the strong (potentially precession-driven) cyclic changes observed in the sediment physical properties at Site U1587. The objective is to generate a shared geochemical, sedimentological, paleomagnetic, and micropaleontological dataset covering three selected intervals of Miocene, Pliocene, and Pleistocene cyclicity before the sampling party.

A summary of this week's activities from each laboratory team follows.

Lithostratigraphy

The sedimentology team described Cores U1587C-37X to 61X and U1385F-2X to 28X. Hole U1587C was the deepest (567.9 mbsf) drilled at Site U1587. The sediments retrieved from Hole U1587C are lithologically consistent with the two previous holes. Core U1587C-37X to Section 43X-3A primarily consists of gradational alternating lithologies within lithofacies 1 (nannofossil ooze to clayey nannofossil ooze) of Lithostratigraphic Unit I. This interval also contains color-banding, pods of foraminiferal sand, pyrite, and trace fossils. Sediments from Sections U1587C-43X-4A to 56X-5A are included in Lithostratigraphic Unit II, which differs from Unit I in showing marked color contrast between dark layers of nannofossil ooze with clay and light layers of nannofossil ooze. Color-banding, pyrite, and sparse to heavy bioturbation are present. Sections U1587C-56X-5A to 61X-CC are assigned to Lithostratigraphic Unit III, where lithofacies 1 predominates, but the alternating light and dark layers are significantly muted relative to Unit II. The amount of nannofossil ooze increases downhole over this interval. Color-banding and trace fossils are common.

At Site U1385, Cores U1385F-2X to U1385F-28X span 96.9 to 357.46 mbsf and consist largely of lithologies from lithofacies 1 (nannofossil ooze to clayey nannofossil ooze), with minor occurrences of lithofacies 2 (clay with calcareous nannofossils). Based on smear slide analyses, calcareous nannofossils are the dominant (>50%) component in lithofacies 1. Siliciclastic components range from trace ($\leq 1\%$) to abundant (>25%–50%), and detrital carbonate from trace ($\leq 1\%$) to common (>10%–25%). Foraminifera, authigenic minerals (pyrite, dolomite, glauconite, iron oxides), sponge spicules, radiolarians, and diatoms range from trace ($\leq 1\%$) to rare (>1%–10%). Authigenic minerals and foraminifera are present in most of the samples. For all components (biogenic and siliciclastic), 53%–87% of sediment grains are in the clay-size fraction, 10%–40% of grains are in the silt-size fraction, and 1%–10% of grains are in the sand-size fraction.

Contacts between lithologies are color boundaries or bioturbated, straight to irregular, and gradational to sharp. Color-banding is common throughout. Dark patches are present in Cores U1385F-2X to 9X, and pyrite nodules are present in Cores U1385F-2X to 28X. Bioturbation varies from slight to moderate, and trace fossils such as *Chondrites*, *Thalassinoides*, *Planolites*, *Zoophycos*, and *Ophiomorpha* are common. Complete shells and their fragments are observed in Cores U1385F-17X, 19X, 20X, and 22X to 24X. Cores U1385F-2X to 9X are slightly affected by gas expansion. Slight to moderate biscuiting is common from Core U1385F-10X to 28X. Drilling disturbance increases from Core U1385F-20X to 28X, with severe to moderate core extension, fragmentation, and fracturing becoming more common.

Biostratigraphy

In Hole U1587C, one sample per section in Cores U1587C-59X to 61X was analyzed for calcareous nannofossil biostratigraphy. This confirmed a Tortonian age for the bottom of the hole. In addition, 25 samples were studied from Core 47X to analyze the calcareous nannofossil and planktonic foraminifera assemblages and their variability in alternate dark and light sediment layers during the late Miocene (Messinian). Preliminary results correlate cold eutrophic assemblages in the surface water mass with light sediment layers. Warmer and oligotrophic conditions correspond to dark layers.

Thirty-two core catcher samples from Hole U1385F were processed for planktonic foraminifera and calcareous nannofossils. In addition, discrete samples from split core sections were analyzed for calcareous nannofossils. Based on the observed biostratigraphic markers, Cores U1385F-2X through 18X are assigned a Pleistocene age, and Cores 12X through 33X are assigned a Pliocene age. Overall, calcareous microfossils are abundant and show good preservation. In addition, siliceous microfossils such as diatoms and radiolarian are occasionally present. The micropaleontologists started to process the samples for the cyclostratigraphy project.

Paleomagnetism

Natural remanent magnetization (NRM) of archive half core sections from Holes U1587C (Cores 33X to 61X) and U1385F (Cores 2X through 26X) were measured before and after 20 mT alternating field (AF) demagnetization. Sixty-two cube samples ($\sim 7 \text{ cm}^3$ each) were taken from

Sections U1587A-31X-3W to 6W, U1587A-44X-1W to 5W, and U1587B-23X-2W to 7W for paleomagnetic analyses. In addition, ~1–2 cm³ bulk sediments were collected from each of the positions where the cubes were taken. Together with one previously collected cube from Section U1587B-23X-3W, these samples will be used for postcruise paleomagnetism and rock magnetism analyses, as part of a shipboard initiative of proof-of-concept study to investigate the cyclostratigraphy at Site U1587.

The intensity of NRM after 20 mT (NRM_{20mT}) for cores from Hole U1587C is similar to those from Holes U1587A and U1587B for overlapping depth intervals, and generally follows the trend of changes in magnetic susceptibility (MS). Below ~540 mbsf, NRM_{20mT} intensity stays low (~10⁻⁵ to 10⁻⁴ A/m) until the bottom of the hole (567.9 mbsf). We identified the Brunhes/Matuyama boundary (0.773 Ma), the Matuyama/Gauss boundary (2.595 Ma), and the C3An.1n (6.023–6.272 Ma) and C3An.2n (6.386–6.727 Ma) Subchrons in all three holes at Site U1587. The Jaramillo (0.99–1.07 Ma) and possibly the Cobb Mountain (1.18–1.215 Ma) Subchrons are recorded in Hole U1587A. The C3Bn Chron (7.104–7.214 Ma) and part of the C4n Chron (7.537–8.125 Ma) may be present in Holes U1587B and U1587C.

In Hole U1385F, core collection started from ~97 mbsf with XCB coring. NRM_{20mT} intensity of the measured cores (2X through 26X) is on the order of 10⁻⁵ to 10⁻⁴ A/m. NRM_{20mT} directions are noisy due to both XCB coring and weak magnetization of the sediments, making it difficult for magnetostratigraphic interpretations for the drilled sediments in Hole U1385F.

Geochemistry

The chemistry group conducted bulk sediment measurements of total organic carbon (TOC), CaCO₃, total nitrogen (TN), total sulfur (TS), and the paired analyses of mineralogical abundance (by X-ray diffraction) and elemental composition (by inductively coupled plasma–atomic emission spectrometry) for Site U1587. CaCO₃ varies between 2.9–78.1 wt% with an average of 37.4 wt%, and is positively correlated with the sediment color reflectance parameter L* and negatively correlated with natural gamma radiation (NGR). TOC, TN, and TS values at Site U1587 are generally low, ranging from 0–2.02 wt% (mean 0.48 wt%), 0–0.13 wt% (mean 0.05 wt%), and 0–0.37 wt% (mean 0.03 wt%), respectively. Organic C/N ratios (0–86.7 wt%; mean 20.0 wt%) suggest that organic matter has marine and terrestrial sources.

The geochemists also started preparations for interstitial water measurements and bulk sediment geochemical characterization for the reoccupation of Site U1385.

Physical Properties and Downhole Measurements

The physical properties and logging team conducted a suite of petrophysical analyses of core samples from Holes U1587C and U1385F. Whole-round cores >0.5 m were run through the Whole-Round Multisensor Logger (WRMSL) and NGR tracks with the help of the JRSO technicians. However, Holes U1587C and U1385F 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 U1587C-59X to 61X (bottom of Hole U1587C) in the depth range from 540 to 568 mbsf, where the records extended beyond the total depth of Holes U1587A and U1587B, and on Cores U1385F-2X to 24X. Discrete samples for wet, dry, and grain densities and porosity measurements were also taken from Cores U1587C-59X to 61X and U1385F-2X to X24.

Stratigraphic Correlation

Work focused on developing the preliminary composite section of Site U1587, correlating logging data with core measurements, and participating in shipboard sampling for a collaborative postcruise project aimed at examining patterns and processes of cyclicity.

Initial evaluation of the downhole log from Hole U1587C looks promising for correlating many features seen in physical property measurements. At Hole U1385F, Cores 2X to 7X correlate with the legacy cores from Holes U1385A, U1385B, U1385D, and U1385E. A hiatus or compromised section was again recognized in the mid-Pleistocene, approximately equivalent to MIS 51–76. Multiple proxies in Pliocene sections appear to strongly reflect precessional cycles as they did at Sites U1586 and U1587.

Outreach

Twelve live ship-to-shore broadcasts were hosted from the *JOIDES Resolution*, reaching approximately 800 people in Germany, India, Portugal, Spain, and USA. So far, approximately 1,500 people have connected to the ship via virtual tours. Six posts were made to [Twitter](#), earning 20,700 impressions, 425 engagements, 31 retweets, 138 likes, and four replies. The Twitter account gained 89 new followers. Six posts were made on [Facebook](#), reaching 5,816 people and leading to 377 reactions, 22 comments, and 20 shares. Nine new people followed the Facebook account. Four posts were made to [Instagram](#), reaching 1,129 people and earning 269 reactions. The Instagram account gained two new followers. Two blog posts were published to the *JOIDES Resolution* [website](#). Two new audiogram files were published on Twitter and Facebook. Members of the science party continue to support outreach efforts by hosting or cohosting tours and by participating in Q&A sessions with audience members.

Technical Support and HSE Activities

Laboratory Activities

- Technical staff were fully engaged in core and sample processing and science support at Holes U1587C and U1385F.
- The Hitachi scanning electron microscope (SEM) was set up at the request of the Co-Chief Scientists and science party on an open workbench in the Chemistry Laboratory.

- Installed and successfully tested an in-house designed alarm system to indicate when the degausser controller on the superconducting rock magnetometer (SRM) is powering the degaussing coils longer than the user-defined set point.
- Monitored the fluctuations in temperature of the ship's chill water used in the Haskris water chiller for the SRM compressor to understand what was causing the CryoWatch temperature alarm to go off frequently. The alarm set points in the CryoWatch software had reset to a default temperature of 70°F instead of the desired set point of 73°F; therefore, the alarm was triggered any time the ship's chill water temperature cycled up.
- Performed maintenance on and exercised the port magnetometer winch.

Application Support Activities

- MUT/Natural Gas Analyzer: Fixed an issue where edited analysis could not be uploaded.
- IMS/SRM: Fixed the "abort" button issue and the ability to close the dialog box so that IMS does not lock up.
- IMS/Section Half Imaging Logger: Working to revert the code to remove the crop that is being applied to the end of uncropped section half JPEG and TIFF image files.
- Sample and data request: Fixed a bug pushed out to shore during deployment last week and investigated duplicate email issue.
- GEODESC Data Capture: Researched and reported incidents regarding:
 1. Section length reported incorrectly in one template, and
 2. Multiple worksheets created for a single core.

IT Support Activities

- Set up the instrument host for the Hitachi SEM that is currently set up in the Chemistry Laboratory.
- The UPS is going to be serviced in Tarragona on 14 December. It is unknown if a data center shutdown will be required but concerned people have been informed.
- TAMU IT will be applying updates to shipboard TAMU Windows Servers.

HSE Activities

- Weekly fire and boat drill was conducted on Sunday, 13 November.
- Eyewash and showers were tested.