

IODP Expedition 397: Iberian Margin Paleoclimate

Week 3 Report (30 October–5 November 2022)

Operations

The third week of Expedition 397 began on 30 October 2022 at Site U1586 while coring with the extended core barrel (XCB) in Hole U1586D from a depth of 234.8 m below seafloor (mbsf). Coring continued to 350.0 mbsf, ending with Core U1586D-38X retrieved at 2315 h on the same day. The total core recovered in Hole U1586D was 337.78 m (97%) and the total core recovered at Site U1586 was 1346.84 m (97%).

After reaching the total depth of 350.0 mbsf, the driller pumped a 30-barrel sweep of high viscosity mud (sepiolite) to clean the hole and the bit was pulled to 84.6 mbsf for logging. After a safety meeting between the rig crew and the Schlumberger engineer, the drill floor was rigged up for logging and the triple combo tool string was assembled and deployed at 0445 h on 31 October. A short test of the new wireline heave compensator was performed while the tool string was still in the drill pipe. The test was successful, and the tools were lowered through the drill pipe and into the open hole, reaching 4690 m below the rig floor (mbrf)/255.3 mbsf, approximately 100 m above the total depth of the hole. Attempts to open the caliper were unsuccessful until the tool string reached 4945 mbrf (240.3 mbsf). From there, an upward pass successfully collected magnetic susceptibility (MS), resistivity, density (with caliper), neutron porosity, temperature, and natural gamma radiation (NGR) data to 4843 mbrf (125.3 mbsf). Attempts to close the caliper were unsuccessful and a second pass with the tool string could not be performed. The triple combo was pulled into the drill string but became stuck with the top of the tools, about 18 m above the bit. Attempts to free the tools were unsuccessful. The Kinley wireline crimper and cutter was deployed to cut the logging cable and keep the tools in the drill pipe.

After the severing operation, the wireline was recovered to the rig floor, followed by the drill pipe, with the bottom-hole assembly (BHA) clearing the seafloor at 1820 h on 31 October and reaching the rig floor at 0145 h on 1 November. Three stands of drill collars were racked back in the derrick so that the crew could work on freeing the stuck logging tools. The tools were freed and laid down at 0630 h. Then the rig floor was secured, and the vessel was readied for transit to Site U1587 (proposed Site SHACK-14A) at 0810 h on 1 November.

The vessel completed the 16.9 nmi transit to Site U1587 with the thrusters down and the vessel heading controlled by dynamic positioning at 1121 h on 1 November. The drill crew made up an advanced piston corer (APC)/XCB BHA using the same APC/XCB polycrystalline diamond compact bit used at Site U1586. The bit was deployed to 1881 mbrf when a noisy roller in the traveling block dolly caused a stop in operation. The roller was changed out and the bit was run to seafloor. The top drive was picked up, and based on the depth reading with the ship's precision depth recorder, the bit was spaced to 3481 mbrf to spud. The spud attempt produced an empty core barrel and the bit was lowered 4 m to 3485 mbrf for a second attempt. Hole U1587A was spudded

at 2243 h on 1 November. Seafloor was calculated to be 3491.7 mbrf/3480.5 mbsl based on recovery in Core U1587A-1H. Coring continued using the full-length APC to 135.8 mbsf, where a partial stroke was recorded on Core U1587A-15H and the APC system reached refusal. The XCB was used to extend the hole to its total depth of 500 mbsf, recovering Cores U1587A-16X to 53X. While XCB coring, a kink in the forward core winch line caused coring to pause while the rig crew fixed the problem. The instance occurred on 4 November and required that 1000 m of the forward core winch be cut and the wire reheaded. After reaching 500 mbsf, the bit was pulled out of the hole, clearing the seafloor at 0350 h on 5 November, ending Hole U1587A.

The vessel was offset 20 m at 45° from Hole U1587A and the bit was spaced to 3489 mbrf. While running in the sinker bars, a kink in the forward winch line was noticed again. Approximately 350 m of wireline was spooled out and respooled onto the drum. The core barrel was lowered to the landing seat and Hole U1587B was spudded at 0730 h on 5 November. Based on recovery from Core U1587B-1H, the seafloor was calculated at 3489.2 mbrf/3478.0 mbsl. Coring continued with the full-length APC system through Core U1587B-11H at 104.3 mbsf, where a partial stroke signaled APC refusal. The XCB was deployed, and by midnight, Cores U1587B-12X through 14X were recovered. By the end of the day on 5 November, a 104.3 m interval had been cored with the full-length APC system with 106% recovery. The XCB system had been used over a 39.1 m interval with 96% recovery.

Science Results

This week, the science party acquired and analyzed data from Holes U1586D, U1587A, and U1587B, presented their results from Site U1586, and summarized them in the site reports. The Co-Chief Scientists presented the scientific and operational objectives for Site U1587.

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

Lithostratigraphy

We described Cores U1586D-20X to 38X, Cores U1587A-1H to 53X, and Cores U1587B-1H to 8H. Cores U1586D-20X to 38X are coherent with the findings from the same depth intervals in Holes U1586A through U1586C. They consist of lithofacies 1 (nannofossil ooze), lithofacies 2 (clay), and lithofacies 3 (sand), and compose Lithostratigraphic Units I, II, and III.

The cores retrieved from Holes U1587A and U1587B consist predominantly of lithofacies 1, expressed as alternating intervals of nannofossil ooze and nannofossil ooze with clay. Only minor parts of the core comprise lithofacies 2 (clay). Color-banding is a dominant feature, as are pyrite nodules. Bioturbation ranges from slight to heavy. Trace fossils such as *Planolites*, *Chondrites*, *Thalassinoides*, and *Zoophycos* are commonly observed, with the latter starting to appear in cores deeper than Core U1587A-11H. Macrofossil shells are present in Sections U1587A-11H-2A, 14H-2A, and 19X-5A. One slumped interval is observed from Interval U1587A-3H-1A, 0 cm (12.3 mbsf), to 3H-2A, 70 cm (14.5 mbsf). Laminated intervals are present in Intervals U1587A-

21X-2A, 50 cm, to 21X-5A, 50 cm, and 21X-6A, 0–20 cm. Gas expansion was observed in Cores U1587A-7H to 12H and U1587B-7H to 8H. The first several XCB cores (Core U1587A-16X to Section U1587A-20X-3A) show no drilling disturbance and therefore are of exceptionally high quality for this drilling system.

Biostratigraphy

Fifty-three core catchers from Hole U1587A were sieved for planktonic foraminifera and processed into smear slides for calcareous nannofossils biostratigraphy. Biostratigraphic markers indicate the base of the Pleistocene at ~221 mbsf (base of Core U1587A-24X). Biostratigraphic markers indicate the Pliocene extends from Core U1587A-25X to 44X (~415 mbsf). Late Miocene nannofossils are identified in Cores U1587A-45X to 53X (~415 to 500 mbsf), with the middle Messinian found in Core U1587A-53X. At the base of Core U1587A-22X, the core catcher sample contains an extraordinary abundance of ichthyoliths, a high diversity of benthic foraminifer, and a monospecific ostracod assemblage. Overall, nannofossils are extraordinarily abundant and all calcareous microfossils are well-preserved.

Paleomagnetism

Natural remanent magnetization (NRM) was measured on archive half core sections from Holes U1586D (Cores 19X to 38X), U1587A, and U1587B (Cores 1H to 8H), before and after 20 mT alternating field (AF) demagnetization. All 13 APC cores from Hole U1587A and 11 APC cores from Hole U1587B were oriented using the Icefield MI-5 core orientation tool. Some sections from the weakly magnetized XCB cores in Hole U1587A appear to have acquired a remanence (10^{-4} A/m level) along the section after the 20 mT AF demagnetization, suggesting the occasional existence of field near the sample region during the demagnetization process. Repeated demagnetization of the sections appears to remove the acquired remanence. To determine the desired positions of discrete samples for magnetostratigraphic verification more accurately, sampling for paleomagnetic studies was postponed to Hole U1587B after gathering more precise age information from the biostratigraphers and the stratigraphic correlators.

NRM intensities after 20 mT demagnetization of Hole U1586D are similar to those from the other holes at Sites U1587 and U1586, and are on the order of 10^{-3} to 10^{-2} A/m for the top ~300 mbsf, dropping to $\sim 10^{-4}$ to 10^{-3} A/m below ~300 mbsf. Many APC cores from Hole U1586D were heavily disturbed during coring, making the magnetostratigraphy interpretation of the hole difficult. NRM intensities (after 20 mT) of cores from Holes U1587A and U1587B are on the order of 10^{-2} A/m above ~45 m mbsf and drop to $\sim 10^{-4}$ to 10^{-3} A/m level between ~45–100 mbsf. In Hole U1587A (with complete NRM after 20 mT data), intensities further drop to 10^{-5} to 10^{-4} A/m level between ~100–405 mbsf, then increase to 10^{-3} A/m level between ~405–450 mbsf, followed by an increase to around 10^{-2} A/m level in the bottom ~50 m of the hole. The Brunhes/Matuyama boundary and the Jaramillo Subchron are identified in the APC cores of Hole U1587A. Magnetostratigraphic interpretation for the XCB cores in Hole U1587A is difficult due to heavy drilling-induced overprint in the core sections.

Geochemistry

We processed 65 whole-round samples (5–10 cm) from Hole U1587A in the Geochemistry Laboratory. Interstitial water (IW) was squeezed and aliquoted for shipboard and shore-based analyses. Residual squeeze cakes were also split for shipboard and shore-based analyses. The IW samples were taken at the base of every section for the upper 34 mbsf, at the base of Sections 2 and 6 from 34 to 47 mbsf, and then at the base of Section 6 (i.e., the second-to-last section recovered from every core) until Core U1587A-49X, after which water could no longer be squeezed due to compaction of the sediments. Immediately upon squeezing, IW samples were measured for salinity, chlorinity, alkalinity, and pH. Samples were also prepared for analyses, including major and minor elemental composition by ion chromatograph and inductively coupled plasma–atomic emission spectrometry (ICP-AES), and for ammonium and phosphate by spectrophotometry. Total sedimentary carbon, organic carbon, nitrogen, sulfur, and total inorganic carbon/CaCO₃ wt% were measured on discrete samples selected from the working half of split cores (two per core). 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. Concentrations of methane, ethane, and other gases were measured in the headspace of the bottommost section of each core. We also took Rhizon IW samples from the middle (at ~75 cm) of Sections 1 and 3 from Cores U1587B-1H to 11H until they yielded no water. The 2 ml of Rhizon-extracted IW samples were fixed with 10 µl 100% HgCl₂ and then sealed in glass ampoules for shore-based carbon and sulfur isotope analysis. Samples are currently being processed for bulk sediment geochemistry.

Physical Properties and Downhole Measurements

The physical properties team conducted a suite of petrophysical analyses of core samples from Holes U1586D, U1587A, and U1587B. All whole-round cores of sufficient length were run through the Whole-Round Multisensor Logger (WRMSL) and NGR tracks with the help of the JRSO technicians. Holes U1586D and U1587B whole-round core sections were not equilibrated to room temperature prior to measurements through the WRMSL; however, whole-round core sections from Hole U1587A were equilibrated to room temperature for at least 3 h. Cyclic variations in MS, NGR, and sediment color reflectance are coherent with lithologic changes.

We conducted downhole logging in Hole U1586D with the triple combo tool string. The raw logging data were sent to the Lamont-Doherty Earth Observatory for processing and quality control. The petrophysics and downhole measurements team is reviewing the processed data and comparing them with the core physical properties data.

We took four downhole formation temperature measurements with the advanced piston corer temperature tool (APCT-3) in Hole U1587A. The temperature ranged from 3.93°C at 31.3 mbsf to 7.78°C at 116.8 mbsf.

Stratigraphic Correlation

The principal activities of the stratigraphic correlation team were developing the composite section and splice of Site U1586 and ensuring that core breaks of Hole U1587A are covered in Hole U1587B. In the splice of Site U1586, the overlap appears continuous except for two intervals around ~140 and ~325 mbsf, where overlaps are not firmly documented. At Hole U1587A, multiple proxy signals, such as NGR and L* color reflectance, appear strongly modulated by orbital forcing.

Outreach

We hosted seven live ship-to-shore broadcasts from the *JOIDES Resolution*, reaching approximately 150 people in Portugal, the United Kingdom, and USA. So far, almost 700 people have had a virtual tour of the ship. Nine posts were made to [Twitter](#), earning 26,000 impressions, 617 engagements, 49 retweets, 214 likes, and three replies. The Twitter account gained 63 new followers. Seven posts were made on [Facebook](#), reaching 6,006 people and leading to 223 reactions, eight comments, and eight shares. Four new people followed the Facebook account. Three posts were made to [Instagram](#), reaching 1,402 people and earning 108 reactions, one comment, and four shares. The Instagram account gained 14 new followers. One blog was published on the *JOIDES Resolution* [website](#). Members of the science party continue to support outreach efforts by hosting or co-hosting tours and participating in Q&A sessions with audience members.

Technical Support and HSE Activities

Laboratory Activities

- Technical staff supported the science party with core processing at Holes U1586D, U1587A, and U1587B.
- Set up and successfully analyzed shipboard samples with the new energy dispersive X-ray spectrometer on the scanning electron microscope.
- Resolved the IMS code issue related to the “ABORT” window for the superconducting rock magnetometer (SRM). Tests conducted confirm that the “ABORT” button now works properly.

Application Support Activities

- Worked with the Marine Instrumentation Specialists on the SRM degaussing notification project. Reviewed code and made suggestions.
- Fixed bugs in SADR.

- Made a minor change in the LORE style sheet so that the left-hand menu always appears to the left, no matter if the web browser's text size has been changed from 100%.

IT Support Activities

- Set up Tracer 5 on the portable X-ray fluorescence spectrometer laptop.
- Observed an extended and large upload of data over the Internet. Updated firewall to block OneDrive.

HSE Activities

- Weekly fire and boat drill was conducted on Sunday, 30 October.
- Eyewash and showers were tested.