

IODP Expedition 397: Iberian Margin Paleoclimate

Week 7 Report (27 November–3 December 2022)

Operations

The seventh week of Expedition 397 began on 27 November 2022 at Site U1385 (proposed Site SHACK-04C) while cutting Cores U1385I-15X and 16X from 133.1 to 152.5 m below seafloor (mbsf). The bit was then raised above the seafloor at 0315 h, ending the hole. The vessel was offset 20 m south, the bit was spaced to 2598.0 m below rig floor (mbrf), and Hole U1385J was spudded at 0455 h. Based on material recovered in Core U1385J-1H, the seafloor was calculated to be 2593.1 m below sea level (mbsl). Coring continued until 1400 h with the advanced piston corer (APC) to 98 mbsf when Core U1385J-11H registered a partial stroke, indicating APC refusal. The extended core barrel (XCB) coring system was then deployed. Thirty-two cores were recovered over a 302.0 m interval (98% recovery) to a final depth of 400 mbsf at 0415 h on 29 November. Core U1385J-14X did not recover any material. The total core recovery for Hole U1385J was 397.77 m (99%).

After coring was completed in Hole U1385J, the drillers cleaned the hole by pumping 30 barrels of high-viscosity mud in preparation for downhole logging. The end of the pipe was set at 78.3 mbsf and the triple combo tool string was rigged up and deployed. The source was loaded, but as the string reached the bit, a decrease in tension at the logging head and the surface was observed, indicating that the total weight of the string was supported by something other than the wireline. The string was picked up a few meters and another attempt was made to pass the bit, and the tools moved partially out of the drill pipe. The tools were raised again for another attempt, but would not pull back into the pipe this time. Several attempts over three hours were made to pull the tools back into the pipe without success, each attempt causing a sharp increase in tension, indicating that the tools were hanging up on something inside the drill pipe.

With all options exhausted, the Kinley wireline cutter and crimper was deployed to crimp, then sever the wireline at the toolhead. This was successful, and the wireline was retrieved. The pipe and tools were then tripped to the surface. Once on the drill floor, it was noted that most of the tool string was below the bit. The connection closest to the bit was broken, the radioactive source was removed, and the tools were laid out. The Kinley equipment was accessible when the drill collar connection was broken, and the tow hammers and the cutter were removed. The cable stub was pulled, and it was found that it was free, allowing the removal of the crimping tool. However, this also meant that the weight of the tools had not been supported by the crimper as designed, and the tools were stuck somewhere below. Further investigation revealed that a portion of a bowspring centralizer had broken and wedged in the lockable float valve (LFV), trapping the tool string. The tools were removed from the LFV, and the rig floor was secured for transit by 0245 h on 30 November, ending Hole U1385J and Site U1385.

Site U1588

The thrusters were raised, and the transit to Site U1588 (proposed Site SHACK-10B) began at 0245 h on 30 November and ended with the thrusters lowered and the heading controlled by dynamic positioning navigation mode at 0700 h on 31 November, beginning operations at Site U1588. In 3.6 h and with an average speed of 10.4 kt, we completed the 37.4 nmi transit.

An APC/XCB bottom-hole assembly was assembled, and the APC core barrels were spaced out. The bit was then run to 1308 mbrf. The top drive was picked up and the bit was spaced to a depth of 1343.4 mbrf. Hole U1588A was spudded at 1330 h on 30 November. Based on recovery in Core U1588A-1H, the seafloor was calculated to be 1339.3 mbsl. Coring continued with the APC system through Core U1588A-17H when a partial stroke signaled APC refusal at a depth of 154.2 mbsf. The XCB was deployed for the remainder of the hole, beginning with Core U1588A-18X. Significant core expansion caused by high gas content in the sediments prompted a change in coring strategy. Beginning with Core U1588A-25X, half advances were used to allow the cores to expand inside the core liners. Core expansion over the cored interval was 30% to 40% for the rest of the hole. Coring was terminated at the Co-Chief Scientists' request after Core U1588A-49X at 353.0 mbsf at 0045 h on 2 December to maximize the complete recovery of the section in the limited operation time remaining for the expedition. The bit was pulled to the surface, clearing the seafloor at 0245 h on 2 December, ending Hole U1588A. Forty-nine cores were taken over a 353.0 m interval, with a core recovery of 159.14 m (103%) for the APC system and 219.23 m (110%) for the XCB system. Formation temperature measurements were done with the advanced piston corer temperature (APCT-3) tool on Cores U1588A-4H, 7H, 10H, and 13H. All APC core barrels were nonmagnetic and oriented using the Icefield MI-5 orientation tool.

The vessel was offset 20 m to the north and the bit was spaced to 1347.0 mbrf. Hole U1588B was spudded at 0445 h on 2 December. Based on recovery in Core U1588B-1H, the seafloor was calculated to be 1350.7 mbsf/1339.3 mbsl. Coring continued with the APC through Core U1588B-9H at a depth of 81.8 mbsf, the depth at which we needed to move to XCB to mitigate the effects of expansion in the cores.

The XCB system was used for the remainder of the hole, beginning with Core U1588B-10X from a depth of 81.8 mbsf and continuing through Core U1588B-64X at a depth of 350.0 mbsf. Half advances were used again on all XCB cores, and core expansion of 30% to 40% over the cored interval was observed for all XCB cores. Finally, the bit was pulled out of the hole, clearing the seafloor at 2243 h on 3 December, ending Hole U1588B. A total of 456.08 m (130%) of core was retrieved from this hole.

By 2400 h on 03 December, the vessel had been offset 20 m to the east and was over the coordinates for Hole U1588C.

Science Results

This week, the scientific party finished the data collection and analyses of the last holes at Site U1385 and began acquiring and analyzing data from Site U1588 (Holes U1588A and U1588B). They summarized and presented the Site U1385 results and documented them in the site reports. A more detailed summary of this week's activities from each laboratory team follows.

Lithostratigraphy

The sedimentology team described Cores U1385I-8H through 16X and U1385J-1H through 43X from Site U1385, and Cores U1588A-1H through 49X and U1588B-1H through 35X from Site U1588.

At Site U1385, the sedimentary sequence recovered from 0 to 400 mbsf consists of one lithostratigraphic unit, in which the principal lithology is nannofossil ooze (>99% of sediment by thickness). Sediments from ~50 to ~300 mbsf (Cores U1385J-14X to 33X) consist mostly of dark layers of nannofossil ooze with clay (and/or carbonate), clayey nannofossil ooze, or clay with nannofossils intercalated with light-colored beds of nannofossil ooze. Sediments across this interval are gray to greenish-gray. From ~300 to 400 mbsf (Cores U1385J-34X to 43X), the sediment consists mostly of nannofossil ooze with clay and nannofossil ooze, and the clay component decreases downhole. Sediments across this interval are gray to greenish-gray.

Foraminifera, diagenetic features (dark patches, pyrite), and color-banding are observed throughout all cores. Bioturbation varies from absent to heavy and generally increases downhole. Trace fossils such as *Zoophycos*, *Chondrites*, *Planolites*, and *Thalassinoides/Ophiomorpha* are common.

As observed in previous holes, drilling disturbance is present throughout most cores in Hole U1385J, varying from slight to severe, and influenced by the drilling type, operational conditions (ship heave), and gas (methane) content in the sediments.

At Site U1588, because of significant core expansion owing to high gas (methane) content in the sediment, all depths are reported in meters of core below seafloor, Method B (m CSF-B). This depth scale corrects for core expansion by uniformly compressing the recovery to the coring advancement. Three major lithofacies are recognized in Holes U1588A and U1588B, from the top to the bottom of the holes: clayey nannofossil ooze with carbonate, nannofossil ooze with carbonate, and nannofossil ooze with carbonate and clay. A few other lithologies (e.g., clayey carbonate with nannofossils and carbonate nannofossil ooze with clay) are minor. These lithofacies are interpreted within one lithostratigraphic unit from the seafloor to 350 m CSF-B at Site U1588.

Foraminifera and diagenetic features (dark patches, pyrite) are observed throughout all cores. Bioturbation varies from absent to moderate. Trace fossils such as *Zoophycos*, *Chondrites*, *Planolites*, and *Thalassinoides* are common, and *Ophiomorpha* are minor. Mollusk shells and shell fragments are found in several cores in both holes, and a deep-sea coral was found in Hole U1588B. The visual description did not identify slumps, contorted beds, or indications of depositional hiatuses. Major drilling disturbance observed includes slight-to-strong gas expansion throughout the

hole, biscuiting (deep in each hole), and slurry/soupy sediment in the top tens of cm (~15–60 cm) of Section 1 in many cores.

Biostratigraphy

Forty-nine core catcher samples from Hole U1588A were processed for planktonic foraminifera and calcareous nannofossils. For biostratigraphy, calcareous nannofossils were examined in all the samples, and planktonic foraminifera in 22 samples. In addition, the presence of benthic foraminifers, ostracods, mollusks, and diatoms was also investigated in the same 22 samples. Biostratigraphic markers show that the succession recovered from Site U1588 lies within the Pleistocene and the base of Core U1588A-48X is younger than 1.9 Ma.

All calcareous microfossils, including nannofossils, planktonic and benthic foraminifers, ostracods, and pteropods, are abundant and well-preserved in most samples. Some reworking is also common.

Paleomagnetism

Natural remanent magnetization (NRM) of archive half core sections from Holes U1385I (Core 8H to bottom), U1385J (all cores), U1588A (all cores), and U1588B (Cores 1H to 34X) was measured before and after 20 mT alternating field (AF) demagnetization. To keep up with the increased pace of the core flow, NRM of Section U1588B-11X-3A and all subsequent sections were measured after 20 mT AF demagnetization. All measurements were made at every 4 cm intervals. The Icefield MI-5 core orientation tool was deployed to orient 11 APC cores in Hole U1385J, 17 APC cores in Hole U1588A, and nine APC cores in Hole U1588B. Seven cube samples were collected from Hole U1385I and 35 from Hole U1588A. NRM of cube samples from Hole U1385I was measured after 22-step demagnetization with a peak field up to 50 mT using the superconducting rock magnetometer.

Holes U1385I and U1385J were cored from the seafloor to ~150 and ~400 mbsf, respectively. The intensity of NRM after 20 mT (NRM_{20mT}) of cores from Holes U1385I and U1385J is similar for overlapping depth intervals and generally follows the trend of change in magnetic susceptibility (MS). We identified the Brunhes/Matuyama boundary (0.773 Ma), possibly the Jaramillo Subchron (0.99–1.07 Ma), the Olduvai Subchron (1.775–1.934 Ma), and the Matuyama/Gauss boundary (2.595 Ma) at Site U1385.

NRM_{20mT} intensity in Hole U1588A is on the order of 10^{-2} A/m between ~0–50 m CSF-B and varies on the order of 10^{-4} to 10^{-2} A/m between ~50–150 m CSF-B. Below ~150 m CSF-B, NRM_{20mT} intensity is mostly on the order of 10^{-5} to 10^{-3} A/m. The Brunhes/Matuyama boundary (0.773 Ma), the Jaramillo Subchron (0.99–1.07 Ma), and the top of the Olduvai Subchron (1.775 Ma) are possibly recorded in Hole U1588A. However, the base of the Olduvai Subchron is not recorded, suggesting that the bottom age of Hole U1588A is likely younger than 1.934 Ma.

Geochemistry

The chemistry group took 54 interstitial water (IW) samples from Hole U1588A for routine shipboard analysis—salinity, chlorinity, alkalinity, and pH; major and minor elemental composition by ion chromatography and inductively coupled plasma–atomic emission spectrometry (ICP-AES); and ammonium and phosphate by spectrophotometry. Splits of IW samples were saved for other shore-based analysis. We began measurements for Hole U1588A on bulk sediments, total organic carbon (TOC), CaCO₃, total nitrogen (TN), total sulfur (TS), and the paired analyses of mineralogical abundance (by X-ray diffraction [XRD]) and elemental composition (by ICP-AES).

Carbonate ranges from 15 to 53 wt%, with an average of 30 wt%, while the TOC ranges from 0.33 to 1.89 wt%, with an average of 0.33 wt%. Alkalinity in Hole U1588A has a shallow peak reaching 12.5 mM at 11 m CSF-B, likely associated with sulfate reduction, then shows a gradual increase downhole to ~30 mM at the bottom of the hole.

Physical Properties

The physical properties team conducted a suite of petrophysical analyses of core samples from Holes U1385I, U1385J, U1588A, and U1588B. All whole-round cores of sufficient length were run through the Whole-Round Multisensor Logger, X-Ray Imager, and natural gamma radiation (NGR) tracks. The NGR measurement resolution was reduced from 10 to 20 cm starting at the first XCB core in Hole U1588B to improve core flow speed and to ensure that all necessary measurements would be taken before the end of the expedition. Core sections were not equilibrated to room temperature prior to measurements. Wet, dry, and grain densities and porosity measurements (moisture and density), *P*-wave caliper, and thermal conductivity measurements were done on discrete samples taken at Hole U1588A, with a sampling resolution of one for every full-length core (9.5–9.7 m advances) and one every other core for the half-length cores (4.8–4.9 m advances).

Variations in MS, NGR, and sediment color reflectance are coherent with lithologic changes. Measured downhole bulk density, thermal conductivity, *P*-wave velocity, and porosity are attributed to the compaction of sediments with depth. X-ray images of whole-round core sections from Hole U1588A reveal severe gas expansion below 40 m CSF-B.

Four downhole formation temperature measurements were taken at Hole U1588A between 30.7 m CSF-B (Core 4H, 12.12°C) and 116.2 m CSF-B (Core 13H, 14.88°C).

Stratigraphic Correlation

Work focused on developing the initial splice of Site U1385 and assessing the completeness of core recovery at Site U1588. The core recovery at Site U1385 was excellent, and we can likely achieve a complete splice with no gaps. At Holes U1588A and U1588B, core expansion resulting from methane production was severe, posing challenges for correlation. To prevent cores from extruding from their core liners, Cores U1588A-25X to 49X and U1588B-10X to 64X were half-advanced XCB cores. Instead of the CSF-A depth scale, we used the CSF-B depth scale, which compresses the expanded core depths back to the drillers depth for correlation. These drilling and correlation

strategies were helpful for correlating the severely expanded cores. However, many core gaps in Holes U1588A and U1588B will require additional holes to be bridged.

Outreach

Sixteen live ship-to-shore outreach events were hosted from the *JOIDES Resolution*, reaching a record-breaking 3.5 million people in Canada, China, France, India, Japan, Portugal, Spain, and USA. So far, approximately 3,503,000 people have connected to the ship via 77 virtual tours. The enormous spike in audience reflects a Chinese tour with six schools that was also live streamed via the Xinhua News Agency. Twelve posts were made to [Twitter](#), earning 27,800 impressions, 808 engagements, 119 retweets, 330 likes, and eight replies. The Twitter account gained 80 new followers. Seven posts were made on [Facebook](#), reaching 5,049 people and leading to 393 reactions, 10 comments, and 11 shares. Four new people followed the Facebook account. Three posts were made to [Instagram](#), reaching 1,286 people and earning 250 reactions, two comments, and two shares. The Instagram account gained 13 new followers.

One blog post was published to the *JOIDES Resolution* [website](#). Two new audiogram files were published on Twitter and Facebook, each presented in English and German. Members of the science party continue to support outreach efforts by recruiting new tour sites, hosting or co-hosting tours, and participating in Q&A sessions with audience members.

Technical Support and HSE Activities

Laboratory Activities

- Technical staff was fully engaged in core and sample processing and in science support at Holes U1385I, U1385J, U1588A, and U1588B.
- Published the end-of-expedition calendar of deadlines and events.
- Electronics technicians surveyed spare audiovisual equipment for function and need of use.
- Broken or unneeded equipment will be sent to IODP JRSO on shore for surplus.
- Checked and refilled oil in the Carver presses.

Application Support Activities

- Sample and Data Request Management System (SDRM): Continued development for this web application where users can request samples from curation. Testing is currently ongoing and our work primarily consists of fixing bugs. A new version was deployed to shore.
- Sample party planning application (SPLAT): This companion application for SDRM is changing so that it shares data with SDRM. This conversion is about 85% complete and is expected to be deployed within the next week for testing.

- GEODESC Data Capture: Several bug fixes were deployed this week in an effort to prevent duplicate worksheets from being created under certain circumstances. Changes were made to the web services that are used to create and retrieve records from the database. Minor user interface changes were made to retain selected values to make the user flow more streamlined.
- Portable X-ray fluorescence spectrometer (pXRF) analysis: A new analysis upload module has been started to facilitate uploading data from the new pXRF. It is about 50% complete.
- Correlator downloader: Looking into making minor feature enhancements in response to scientists' requests.

IT Support Activities

- Distribution lists for Expedition 398 were created.
- Set up pXRF on XRD instrument host.

HSE Activities

- Weekly fire and boat drill was conducted on Sunday 27 November.
- Eyewash and showers were tested.