IODP Expedition 397: Iberian Margin Paleoclimate

Week 6 Report (20–26 November 2022)

Operations

The sixth week of Expedition 397 began on 20 November 2022 at Site U1385 (proposed Site SHACK-04C), preparing to spud Hole U1385G. The vessel was offset 20 m to the north of Hole U1385F, the top drive was picked up, and the bit was spaced out to a depth of 2596.0 m below rig floor (mbrf). Hole U1385G was spudded at 0200 h on 20 November. Based on material recovered in Core U1385G-1H, the seafloor was calculated to be 2603.7 mbrf/2592.4 m below sea level (mbsl). Coring continued with the advanced piston corer (APC) to a depth of 106.3 m below seafloor (mbsf) with Core U1385G-12H. The extended core barrel (XCB) system was deployed to a final depth of 397.3 mbsf. The bit was pulled out of the hole, clearing the seafloor at 0300 h on 22 November and ending Hole U1385G. A total of 42 cores were taken over the 397.3 m interval with 104% recovery for the APC system and 98% recovery for the XCB system (overall 100%).

The vessel was offset another 20 m to the north and Hole U1385H was spudded at 0345 h on 22 November with a 114.6 m drilled interval. The hole was then cored to a total depth of 399.2 mbsf using the XCB coring system (Cores U1385H-2X through 32X). The bit was pulled out of the hole, clearing the seafloor at 0015 h on 24 November and ending Hole U1385H. Thirty-one XCB cores were taken over a 284.6 m interval with 100% recovery.

Seas increased significantly with heave reaching above 5 m, causing operations to wait on weather. During the next 56.75 h, heave increased to over 9 m, then finally decreased enough to start operations again at 0900 h on 26 November.

The vessel was offset 20 m to the east of Hole U1385H, and Hole U1385I was spudded at 1103 h on 26 November. Seafloor was calculated at 2604.5 mbrf/2589.1 mbsl based on recovery in Core U1385I-1H. The hole was cored to a depth of 104.0 mbsf using the APC system before a partial stroke on Core U1385I-11H signaled APC refusal. The XCB system was deployed, reaching 133.1 mbsf by 2400 h on 26 November with Cores U1385I-12X to 14X, but Core 14X was retrieved empty.

In summary, Holes U1385F, U1385G, and U1385H were drilled this week. They were cored from 96.9 to 399.6 mbsf, from 0 to 396.2 mbsf, and from 114.6 to 399.2 mbsf, respectively. In total, 972.3 m of sediment were recovered across the first three holes at Site U1385.

Science Results

This week, the science party acquired and analyzed data from Holes U1385F, U1385G, U1385H, and U1385I. They submitted the reports from Site U1587 and described their results in the reports for Site U1385. A summary of this week's activities from each laboratory team follows.

Lithostratigraphy

The sedimentology team described Cores U1385F-29X to 33X, U1385G-1H to 42X, U1385H-2X to 32X, and U1385I-1H to 7H. The sedimentary sequence recovered from Site U1385 (0–400 mbsf) consists of one lithostratigraphic unit in which the principal lithology is nannofossil ooze (>99% of sediment by thickness). Sediments from Cores U1385G-1H to 4H (0–30.5 mbsf) and U1385I-1H to 4H (0–37.9 mbsf) are mostly nannofossil ooze with clay and do not display a clear cyclicity in color or lithology. Sediments from 30 mbsf to approximately 290 mbsf in all holes (Cores U1385F-2X to 21X, U1385G-5H to 31X, U1385H-2X to 20X, and U1385I-5H to 7H) are characterized by alternating layers of nannofossil ooze and nannofossil ooze that contain common (>10%–25%) to abundant (>25%–50%) clay. Downhole of 290 mbsf in all holes (Cores U1385F-22X to 33X, U1385G-32X to 42X, and U1385H-21X to 32X), the clay component in sediments decreases to <10% and sediments are predominantly described as nannofossil ooze. The decrease in the clay component in sediments downhole of 290 mbsf is consistent with the increase in Red-green-blue color space values downhole of this depth horizon. Lithologic descriptions of 0 to 150 mbsf (Cores U1385G-1H to 17X and U1385I-1H to 7H) are consistent with those of Expedition 339, which drilled Holes U1385A, U1385B, U1385D, and U1385E to approximately 150 mbsf.

Foraminifera, diagenetic features (dark patches, pyrite), and color-banding are disseminated 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. Shells and shell fragments were found in several cores across Holes U1385F, U1385G, U1385H, and U1385I. Deformational sedimentary structures are rare, and when present, occur at a centimeter to decimeter scale. No slumps, contorted beds, or indications of depositional hiatuses were observed in the visual description across these three holes. Drilling disturbance was present through many cores in all holes, was slight to severe, and varied with drilling type and sea conditions. Biscuiting occurred in almost all XCB cores and was generally slight to moderate in Holes U1385F and U1385G. However, high heave conditions resulted in strong to severe biscuiting in several cores of Hole U1385H.

Biostratigraphy

The biostratigraphy team completed a refined age model and sedimentation rate analysis for Site U1385 using core catcher and split-core samples. Calcareous nannofossil and planktonic foraminifera biostratigraphy assigns Cores U1385F-5X to U1385F-16X to the Pleistocene and assigns Cores U1385F-16X to U1385F-32X to the Pliocene. In addition, the biostratigraphers used nannofossil biostratigraphy to calibrate Cores U1385G-6H and 7H to the Expedition 339 Site U1385 biostratigraphy, as published in Balestra et al. (2015). All markers within these cores were found to

be at comparable depths to the Expedition 339 biostratigraphy. In addition, all calcareous microfossils are well-preserved throughout the cored interval, and the scientists are documenting and imaging their taxa using the scanning electron microscope.

Paleomagnetism

Natural remanent magnetization (NRM) of archive half core sections from Holes U1385F (Core 27X to bottom), U1385G (all cores), U1385H (all cores), and U1385I (Cores 1H–7H) were measured before and after 20 mT alternating field (AF) demagnetization. Measurements were made at 2 cm intervals for core sections from Holes U1385F and U1385G and at 4 cm intervals for sections from Holes U1385H and U1385I to keep up with the core flow pace. The Icefield MI-5 core orientation tool was deployed to orient 12 APC cores in Hole U1385G and 11 APC cores in Hole U1385I. We collected 44 cube samples (~7 cm^3 each) from Hole U1385G (approximately one sample per core). NRM of cube samples was measured after 22-step demagnetization with peak field up to 50 mT using the superconducting rock magnetometer (SRM), or after 11-step demagnetization with peak field up to 80 mT using the spinner magnetometer and a D-Tech Model D-2000 AF demagnetizer.

The intensity of NRM after 20 mT (NRM_{20mT}) of cores from Holes U1385F through U1385I is similar for overlapping depth intervals and generally follows the trend of changes in magnetic susceptibility (MS). NRM_{20mT} intensity is on the order of 10^{-2} A/m between ~0–45 mbsf and decreases downhole to the order of 10^{-4} to 10^{-3} A/m between ~45–100 mbsf. Below ~100 mbsf, NRM_{20mT} intensity is mostly on the order of 10^{-5} to 10^{-4} A/m in all holes. We identified the Brunhes/Matuyama boundary (0.773 Ma), possibly the Olduvai Subchron (1.775–1.934 Ma), and the Matuyama/Gauss boundary (2.595 Ma) at Site U1385, based on available data from the holes.

Geochemistry

The chemistry group took 59 interstitial water (IW) samples from Hole U1385G for routine shipboard analysis—salinity, chlorinity, alkalinity, and pH; major and minor elemental composition by ion chromatograph 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 U1385G on bulk sediments, total organic carbon (TOC), $CaCO_3$, total nitrogen (TN), total sulfur (TS), and the paired analyses of mineralogical abundance (by X-ray diffraction) and elemental composition (by ICP-AES). In addition, Rhizon sampling was carried out for the upper cores from Hole U1385I.

Alkalinity, pH, phosphate, and ammonium increase in the upper part of the hole, reaching a peak (except ammonium) at around 50 mbsf, then decreasing deeper in the hole. Correspondingly, sulfate decreases in the upper part of the hole, reaching a minimum close to zero, around 50 mbsf, while Ba increases. In contrast to Sites U1586 and U1587, but comparable to the legacy holes from Expedition 339 Site U1385, sulfate decreases in two steps between the seafloor and 50 mbsf, punctuated by a 20 m interval with a constant concentration of ~17 mM. In the upper 50 m at Site U1385, there is also a sharp decrease in Mn and Fe. Preliminary TOC and TN results (wt%) show a gradual decrease with depth.

Physical Properties and Downhole Measurements

The physical properties team conducted a suite of petrophysical analyses of core samples from Holes U1385G, U1385H, and U1385I. All whole-round cores of sufficient length were run through the Whole-Round Multisensor Logger and the Natural Gamma Radiation Logger. Core sections were not equilibrated to room temperature prior to measurements. Discrete samples for wet, dry, grain density and porosity measurements (moisture and density), *P*-wave caliper measurements, and X-ray images were collected at one per core from Cores U1385G-1H to 12H.

Cyclic 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.

Stratigraphic Correlation

Stratigraphic correlation focused on assessing the completeness of core recovery at Site U1385. The material recovered to date during this expedition appears highly correlative to the legacy Holes U1385A, U1385B, U1385D, and U1385E. In addition, MIS 11 and Termination V, not recovered during Expedition 339, were recovered in the newly drilled holes. Although the comparison between Holes U1385F and U1385G revealed substantial core gaps ranging from 3 to 4 m between 126 and 195 mbsf, ideal offsets with other holes allowed correlation and produced a nearly complete record. However, Core U1385F-27X had no sediment recovery and poses a challenge for correlation between 338 to 348 mbsf where the core gap between Cores U1385G-36X and U1385G-37X was potentially covered by less than 2.36 m of Core U1385H-26X. This interval will be recovered again in a subsequent hole.

Outreach

Fifteen live ship-to-shore outreach events were hosted from the *JOIDES Resolution*, reaching approximately 500 people in Belgium, Japan, Portugal, Spain, and USA. So far, approximately 2,000 people have connected to the ship via 61 virtual tours. Six posts were made to Twitter, earning 12,900 impressions, 270 engagements, 26 retweets, 134 likes, and six replies. The Twitter account gained 66 new followers. Six posts were made on Facebook, reaching 5,778 people and leading to 308 reactions, nine comments, and 14 shares. Six new people followed the Facebook account. Four posts were made to Instagram, reaching 1,119 people and earning 224 reactions, one comment, and one share. 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, including one in Chinese. 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. Packages of *JOIDES Resolution* themed posters, stickers, magnets, and pencils were compiled to be mailed to teachers in Portugal who participated in in-person outreach events.

Technical Support and HSE Activities

Laboratory Activities

- Technical staff was fully engaged in core and sample processing and in science support at Holes U1385F, U1385G, U1385H, and U1385I.
- Technical staff grounded and shielded the communications cable to the MS loop sensor on the forward multisensor logger currently used as the Special Task Multisensor Logger after noticing noise in the data. Troubleshooting isolated the cable as the source of the noise but the cause behind it has not been determined.
- Minor floor repair in the Core Laboratory.
- Scientist group photos were taken.

Application Support Activities

- Worked on SPLAT, the shore-based application that helps facilitate preparation for shore sample parties. Integrated SPLAT to use the Sample and Data Request Management System user tables and web services.
- Assorted tasks in support of the laboratories, technical staff, and scientists.

IT Support Activities

- Created shipboard accounts for Expedition 398 scientists and Outreach Officer and for new staff members.
- RigWatch froze several times when there was no rig activity. This does not happen when there is rig or coring activity. We will continue to observe and report on this.
- Weekly backup tapes were completed.

HSE Activities

- Eyewash and showers were tested. Replaced an eyewash assembly in the Paleontology Preparation Laboratory after a hose was found to be damaged.