

IODP Expedition 403: Eastern Fram Strait Paleo-Archive

Week 7 Report (14–20 July 2024)

Operations

On 14 July 2024, extended core barrel (XCB) coring at Hole U1623A continued from 226.0 meters below seafloor (mbsf) to the final depth of 369.3 mbsf with Core U1623A-51X at 2200 h (UTC + 2 h). The top drive was set back and the bit was pulled out of the hole, clearing the seafloor at 0011 h on 15 July and ending Hole U1623A. A total of 51 cores were taken over a 369.3 m interval, recovering 330.72 m of sediment (90%). The advanced piston corer (APC) was deployed for 9 cores over a 67.4 m interval with 67.65 m of recovery (100%). The half-length APC (HLAPC) was deployed for 16 cores over a 75.2 m interval with 78.71 m of recovery (105%). The XCB was deployed for 26 cores over a 226.7 m interval, recovering 184.36 m of sediment (81%). Nonmagnetic core barrels were used on all APC and HLAPC cores. The total time spent on Hole U1623A was 54.25 h (2.3 d).

The vessel was offset 20 m at a bearing of 22°, and the drill string was flooded with perfluorocarbon tracer (PFT) for microbiology (MBIO) sampling. Hole U1623B was spudded at 0238 h on 15 July with Core U1623B-1H recovering 0.05 m of rock and gravel. Hole U1623B was terminated at 0300 h in favor of achieving a better mudline.

The vessel was offset another 20 m at a bearing of 22° and the drill string was flooded with PFT for MBIO sampling. Hole U1623C was spudded at 0320 h on 15 July. The seafloor was calculated at 1706.4 meters below sea level (mbsl) based on recovery from Core U1623C-1H. Coring continued with the APC to a depth of 79.9 m, to Core U1623C-9H. Partial strokes on Cores 8H and 9H signaled APC refusal. The HLAPC was then deployed for Cores 10F–28F to extend the hole to a depth of 163.4 m. The XCB was deployed for Core 18X to core a 7.0 m interval to offset coring gaps for stratigraphic correlation. Partial strokes on Cores 27F and 28F signaled HLAPC refusal. The XCB was deployed to extend the hole to its final depth of 369.0 mbsf (Cores 29X–55X) at 0545 h on 17 July. To prepare the hole for logging, a sweep of sepiolite mud was pumped, and the bit was pulled up to a depth of 65.5 mbsf. The logging instruments were rigged up and the triple combo tool string was assembled and deployed. The tool string met an obstruction in the drill pipe approximately 80 m prior to exiting the bit. Efforts to pass the obstruction were unsuccessful and the tool string was pulled to the surface. The driller lifted the top drive and thus the pipe by about 2 m and pressured up the drill string to approximately 1800 psi to clear the obstruction. Once the pressure returned to normal, a deplugger tool was deployed to verify that the drill string was clear. The bit was again placed at 65.5 mbsf and the triple combo tool string was again deployed. The tool string encountered an obstruction as it was exiting the bit, and it was unable to pass. Logging was terminated and the logging tools were recovered and rigged down. The bit was recovered, clearing the seafloor at

1830 h and the rig floor at 2050 h on 17 July. The rig floor was secured for transit and the vessel switched from dynamic positioning (DP) to cruise mode at 2319 h on 17 July, ending Hole U1623C. A total of 55 cores were taken over a 369.0 m interval, recovering 322.38 m of sediment (87%). The APC was deployed for 9 cores over a 79.9 m interval with 67.65 m of recovery (85%). The HLAPC was deployed for 18 cores over a 76.5 m interval with 75.90 m of recovery (99%). The XCB was deployed for 28 cores over a 212.6 m interval, recovering 322.28 m of sediment (87%). Nonmagnetic core barrels were used on all APC and HLAPC cores. Total time on Hole U1623C was 65.5 h (2.9 d).

The vessel made the 71.6 nmi transit to Site U1624 (proposed Site ISD-01) in 6.06 h, at an average speed of 11.8 kt. The thrusters were down and secured at 0557 h and the vessel switched to DP mode at 0600 h on 18 July, starting operations at Site U1624. An APC/XCB bottom-hole assembly was assembled and deployed. A precision depth recorder reading was taken on site arrival and the bit was lowered to 1312.2 mbsl. Hole U1624A was spudded at 1100 h on 18 July. The core barrel was recovered; however, water pressure in the liner pushed the sediment out and onto the rig floor before the liner was moved to the catwalk. It was decided to terminate coring in Hole U1624A to achieve a better mudline core. One core was taken in Hole U1624A over a 1.3 m interval with 1.33 m of recovery (102%).

The vessel was offset 5 m east and the bit was lowered to 1315.0 mbsl. Hole U1624B was spudded at 1140 h on 18 July. The seafloor was calculated to be 1319.8 mbsl based on recovery from Core U1624B-1H. Coring continued with the APC through Core 10H to a depth of 86.9 mbsf. There was a partial stroke on Core 10H and it was decided to deploy the HLAPC. Core 11F resulted in a full stroke and an additional APC was attempted. This resulted in another partial stroke with only 1.9 m of recovery. The HLAPC was deployed to advance the hole to a depth of 145.3 mbsf with Cores 13F–24F. Core 24F resulted in a partial stroke with 0.12 m of recovery and it was decided to advance the hole using the XCB system from 145.3 mbsf to the target depth of 258.0 mbsf. Starting around 0700 h on 19 July, several of the ship's laboratory computers were affected by the global CrowdStrike update issue and they went into a permanent boot loop (blue screen). At 0815 h, the computer analyzing the gas safety headspace samples was also affected; thus, coring was halted until 1015 h, at which time the Marine Computer Specialists (MCS) were able to break the boot loop and get the headspace computer up and running again. Normal operations resumed, thanks to their great work. Throughout the day the MCSes and JRSO staff recovered all computers and servers. The bit was pulled out of the hole, clearing the seafloor at 0022 h on 20 July. A total of 45 cores were taken over a 258.0 m interval, recovering 223.09 m of sediment (87%). The APC was deployed for 11 cores over an 88.8 m interval with 81.23 m of recovery (82%). The HLAPC was deployed for 13 cores over a 56.5 m interval with 60.57 m of recovery (107%). The XCB was deployed for 21 cores over a 112.7 m interval, recovering 81.29 m of sediment (87%). Formation temperature measurements using the advanced piston corer temperature (APCT-3) tool were taken on Cores 4H, 7H, 10H, and 14F.

Nonmagnetic core barrels were used on all APC and HLAPC cores. Total time on Hole U1624B was 36.75 h (1.5 d).

The vessel was offset 20 m at a bearing of 225° and Hole U1624C was spudded at 0241 h on 20 July. The seafloor was estimated to be 1319.6 mbsl based on recovery from Core U1624C-1H. Core 10H was a partial stroke and coring switched to the HLAPC to a depth of 137.6 mbsf (Cores 11F–21F). Core 21F was a partial stroke and coring switched to the XCB. At 0000 h on 21 July, the hole had been advanced to a depth of 217.1 mbsf at Core 36X. A total of 36 cores were taken over a 217.1 m interval, recovering 210.29 m of sediment (97%). The APC was deployed for 10 cores over an 87.7 m interval with 76.05 m of recovery (87%). The HLAPC was deployed for 11 cores over a 49.9 m interval with 53.06 m of recovery (106%). The XCB was deployed for 15 cores over a 79.5 m interval, recovering 81.18 m of sediment (102%). Nonmagnetic core barrels were used on all APC and HLAPC cores.

Science Results

Lithostratigraphy

The sedimentology team described all cores from Site U1623A and Holes U1624A and U1624B. The primary lithologies encountered at Site U1623 are silty clays and clayey silts with a few layers of sandy mud and sand lenses. Clasts are present in most cores and are observed along with isolated sandy and muddy diamictos. Hole U1624A recovered only the core catcher, which contained sandy mud that is rich in calcareous microfossils. The dominant lithologies at Hole U1624B include silty clay with sandy mud and clay intervals. Dispersed to common clasts are present in many of the cores with varying grain sizes.

Biostratigraphy

This week the biostratigraphy team finalized analysis of calcareous nannofossils, diatoms, and planktic foraminifers from Site U1622 and provided an initial biostratigraphy for Site U1623. The uppermost 6 m of Hole U1622A appear to be in situ, and calcareous nannofossils show that the sediments are younger than marine isotope stage (MIS) 5. Both calcareous nannofossils and planktic foraminifers indicate an Arctic-polar environment with seasonal sea ice. The planktic foraminifers are reworked below 6 mbsf, and all sediments are barren of diatoms. Site U1623 was analyzed for calcareous nannofossils, dinocysts, diatoms, and planktic foraminifers. All microfossil groups indicate a Pleistocene age, and together they indicate that the upper ~270 m are younger than 1 Ma. Using magnetic susceptibility (MS) and calcareous nannofossil data, interglacial intervals were identified and sampled further for dinocysts and planktic foraminifers. The paleoenvironment varies between colder and warmer intervals with influence of Atlantic water. The microfossils also indicate that seasonal sea ice has been present throughout the record.

Paleomagnetism

Paleomagnetic and rock magnetic investigations of archive half and discrete cube samples were completed for Site U1623 and are underway for Site U1624. At Site U1623, discrete cube samples were helpful for resolving ambiguous archive half data from XCB cores, and they clearly define the Brunhes/Matuyama boundary at 773 ka and Jaramillo Subchron between 990 and 1070 ka. Data are more difficult to interpret from ~300 mbsf to the base of the site. Like Site U1621, initial rock magnetic data from Site U1623 are consistent with a magnetic mineral assemblage dominated by (titano)magnetite in the upper 90 m and become more variable below this depth. Initial archive half measurements at Site U1624 indicate that sediments at the site were deposited during the Brunhes Chron (<773 ka) through the base of APC/HLAPC coring. Data from XCB cores recovered below this depth are difficult to interpret and future investigation of discrete cube samples will help evaluate the potential for defining polarity zones below 145 mbsf. Initial correlation of physical properties between Bellsund Drift Sites U1621 and U1623 and Isfjorden Drift Site U1624 in the upper 50 m show that there are reproducible paleomagnetic features between the three sites, indicating potential for higher resolution reconstructions of past geomagnetic change.

Geochemistry

This week the geochemistry group finished analyses, which included bulk sediment analyses of total organic carbon (TOC), CaCO₃, total nitrogen (TN), and total sulfur (TS), as well as interstitial water (IW) analyses of major and trace elements. CaCO₃ varies between 1.7–22.3 wt% (Hole U1621A), 1.9–3.8 wt% (Hole U1622A), and 0.25–15.3 wt% (Hole U1623A). TOC ranges between 0.3–1.3 wt% (Hole U1621A), 0.5–1.6 wt% (Hole U1622A), and 0.6–1.5 wt% (Hole U1623A). TN contents ranged between 0.04–0.15 wt% for all three holes, and TS was low. The IW analyses of Holes U1621A and U1623A showed similar geochemistry trends observed at previous sites, whereas Hole U1622A showed unique geochemistry trends not previously observed, resulting in the group thinking about how this can be related to expedition objectives. Geochemical analysis of Site U1624 is underway. Headspace, IW, and carbonate samples were collected from Hole U1624B. IW and headspace analyses are complete and carbonate results should be available in the coming days. Site U1624 gas geochemistry is normal, which ensured drilling could proceed safely.

Physical Properties

The physical properties team finished all measurements for Site U1623 and began measurements for Site U1624. The gamma ray attenuation (GRA) source was turned off for Cores U1623C-11F through 14F, which were sampled for sedimentary ancient DNA analyses. GRA measurements resumed in subsequent cores. The group also acquired thermal conductivity and moisture and density data at ~5 m intervals for Holes U1623A and U1624A. At Sites U1623 and U1624, MS values covary with other physical properties and have only a few large peaks, suggesting less

postdepositional alteration compared to previous sites. Anelastic strain recovery instruments continued to collect logarithmical recovery of anelastic strain for whole-round samples collected at Site U1623 and at previous sites.

The downhole temperature measurements at all sites indicate typical geothermal gradients. Holes U1621A and U1623A showed almost the same linear trends downhole, while Hole U1622A indicated a slightly lower temperature, suggesting lower thermal conductivity due to less-consolidated sediments than Sites U1621 and U1623. In Site U1623, the planned downhole loggings with triple combo and Formation MicroScanner-sonic strings were canceled due to an obstruction at the bit that the tools could not pass.

Stratigraphic Correlation

Stratigraphic correlation at Sites U1623 and U1624 was undertaken by matching distinct features in the MS and GRA density curves. At Site U1623, the correlation and stratigraphic splice based on Holes U1623A and U1623C are preliminary since the vessel will return to Site U1623. At Site U1624, Holes U1624B and U1624C are used for correlation; however, this work is ongoing while operations are underway at Hole U1624C. The preliminary correlation suggests that we have a good splice from 0–150 mbsf and relatively good coverage between ~150–200 mbsf. Below that and to the end of the holes at ~250 mbsf, there are large gaps due to poor recovery caused by large drop stones in the sediments.

Microbiology

This week the microbiology scientists sampled MIS 11 in Hole U1623C. The group sampled across an interval from ~84–101 mbsf and took 31 samples. Preliminary tracer data suggests little contamination in the sample set.

Education and Outreach

As we approach the end of coring operations, most of the Outreach Officers' (OO) focus has been on capturing the necessary interviews to communicate the scientific work as it is done in real time. Getting the necessary coverage, as well as the small and subtle transitions between working groups, is an important feature of the film. In terms of outreach, the OOs released three more *Meet the Scientists* profiles, another episode of *The Adventures of the JOIDES Resolution*, and a feature on the outstanding MCS response to the CrowdStrike update outage, and they worked with both Chinese scientists to host a ship-to-shore call with the China-Northwestern Museum, which had a large audience of 1,500,000 attendees in China. Other ship-to-shore calls hosted the University of Trieste, Italy; the GLASS Summer School in College Station, Texas; and the INSPIRE-Geoscience Program in New York City. Across all social media platforms, we had 20,400 impressions.

Technical Support and HSE Activities

Laboratory Activities

- Staff continued to handle cores with high gas content that resulted in expansion and shattered liners.
- The global CrowdStrike outage caused more than 80% of PCs in the offices and laboratories to reboot in the middle of coring operation. Several instrument hosts went into recovery mode and were not operational.
- Due to the shutdown of PCs during the outage, several of the computers lost their profiles and could not find the instrument settings. Programmers and MCSes helped to rebuild login profiles, reinstall Mutt Uploader software, and fix the instrument settings. Coring operations were paused for 2 h while waiting to get the gas chromatography computer back in operation.
- Reviewed the End-of-Expedition schedule.

Application Support Activities

- Developers helped to restart the Correlator Station computer and ensured that all applications were running correctly following the CrowdStrike outage.
- The developers made sure all applications are running correctly, especially the Mutt Uploader, after being affected by the CrowdStrike outage.
- Staff continued to work on the Hyperscan project.

IT Support Activities

- The CrowdStrike update caused a worldwide outage on Windows workstations and servers. On the ship we had many systems that blue screened and rebooted. Some came back up without issues; however, several were stuck in a bluescreen boot loop. About 1.5 h into the outage, the MCSes were able to get the computers back up. The MCSes worked with Texas A&M University campus staff on shore to help bring the servers back online, and they worked to bring all the workstations back online. A couple of systems had corrupt profiles caused by the bluescreen. Most systems were back online by 1500 h that day.
- VSAT outages from 5–20 min in duration began on 19 July.

HSE Activities

- Emergency shower and eye wash stations were tested.
- A lifeboat drill was held on 15 July.