IODP Expedition 400: NW Greenland Glaciated Margin

Week 2 Report (20–26 August 2023)

Operations

This week we (1) completed the transit to our first site, (2) cored two holes with the advanced piston corer (APC) and half-length advanced piston corer (HLAPC), and (3) made preparations for a third hole at the site using the rotary core barrel (RCB) system.

Transit to Site U1603

Week 2 of the expedition began on 20 August 2023 with the vessel 1106 nmi from Reykjavík, Iceland, with ~741 nmi remaining on the transit to proposed Site MB-23A (Site U1603). Two time changes were made during the week. The vessel's clock was set back 1 h (to UTC – 2 h) at 1400 h on 20 August, and the second change was to UTC – 3 h at 0200 h on 22 August.

The vessel arrived on Site U1603 (proposed Site MB-23A) at 1355 h on 23 August. The thrusters were lowered and secured at 1412 h and the vessel was fully in dynamic positioning (DP) mode at 1420 h, ending the initial transit. The journey covered 1721 nmi at an average speed of 11.3 kt (including pilotage).

Hole U1603A

The rig crew was given the all clear and began picking up drill collars. Two stands of collars were made-up and racked back for later use. An APC/extended core barrel (XCB) bottom-hole assembly (BHA) with a slightly used C-4 bit, lockable float valve (LFV), and nonmagnetic collar was made-up and run in on 5 inch drill pipe. The drill pipe was measured and drifted as it was picked up.

The pipe trip carried over into 24 August to 1768.5 meters below rig floor (mbrf). The top drive was picked up, the drill string was spaced-out, and the cleanout pig was pumped. The sinker bars were stabbed in through the block and the APC core barrel lowered. The first attempt to spud was an APC shot from 1802.0 mbrf, resulting in a water core. The pipe was lowered 5 m and shot from 1807 mbrf. Hole U1603A was spudded at 0425 h on 24 August with 4.65 m recovered. The seafloor was calculated at 1800.8 meters below sea level (mbsl) (1811.9 mbrf). Meters below rig floor (mbrf) is 11.1 m greater than meters below sea level (mbsl).

APC coring continued to Core U1603A-13H at 118.6 meters below seafloor (mbsf). The advanced piston corer temperature (APCT-3) tool was run on Cores 4H, 7H, 10H, and 13H. The core liner shattered on Core 13H and had to be pumped out of the liner.

At 1515 h on 24 August the bridge notified the drill floor that an iceberg had entered the Red Zone (i.e., will be within 3 nmi of the vessel in less than twice the time it will take to trip up to

50 mbsf). The drill string was tripped up with the top drive from 109.1 mbsf to 43.21 mbsf at 1600 h. From 1600 h to 1715 h, the vessel tracked two icebergs. At 1715 h, with one of the icebergs entering the Termination Zone (within 1 nmi of the vessel) the order was given to pull the pipe clear of the seafloor. The drill string was again pulled up with the top drive, this time to 1778.3 mbrf, clearing the seafloor at 1742 h and ending Hole U1603A.

The vessel was moved 500 m south in DP mode. The closest iceberg passed within ~0.6 nmi of the vessel. Once it was safe to do so, the vessel was moved back over location and offset 10 m northwest from Hole U1603A, coming into position at 2000 h on 24 August.

Hole U1603B

The drill string was run in to 1807 mbrf and a wash barrel was dropped. The seafloor tag was observed on the weight indicator at 1811.9 mbrf (1800.8 mbsl). Hole U1603B was spudded at 2035 h on 24 August.

Hole U1603B was washed down to 109.1 mbsf by 0100 h on 25 August. The sinker bars were installed and the wash barrel was retrieved. The APC core barrel was run in and APC coring commenced with Core U1603B-2H from 109.1 mbsf to 5H at 147.1 mbsf. After an overpull and drillover of Core 5H, we switched to the HLAPC system.

Coring with the HLAPC started with Core U1603B-6F and continued to Core 27F, shot from 243.9 mbsf at 0230 h on 26 August. The barrel pulled free from the formation with no overpull; however, the coring line could not pull the barrel up. The drill string was tripped back up to the vessel, with the bit clearing the rig floor at 1157 h, ending Hole U1603B.

Once the BHA was aboard the core barrel was recovered with 0.08 m of material, likely from the push down trying to free the barrel. The final depth for Hole U1603B was 244.0 mbsf. After the previous BHA was disassembled, the drill crew began making up an RCB BHA with a C-4 bit. Next, the rig was serviced. The drill string was run in on 5 inch drill pipe to 1776.6 mbrf. Following this, the drilling line was cut (115 ft), slipped over the blocks, and rewound on the drum, the first “slip and cut” of the expedition. The top drive was picked up. The week ended with the drill string being spaced out to spud Hole U1603C.

Science Results

Site U1603

Science activities during the week included laboratory orientations, working on the Methods sections for the expedition *Proceedings* volume that will be published postcruise, and processing and measurement of core sections and shipboard samples.

Lithostratigraphy

All cores from Holes U1603A and U1603B were split and described. The lithology is dominated by gray to greenish gray mud with dispersed clasts and fine to very fine sand, with sand often occurring as laminae. Individual mm- to cm-scale sand laminae are often sharp-based and sometimes show evidence of fining-upward. Outsized clasts of plutonic, metamorphic, and metasedimentary petrology occur sporadically, reaching up to 6 cm in diameter. Centimeter-scale blebs of unconsolidated sand also occur in intervals with outsized clasts. Black laminae, patches, and infilled voids, likely formed by iron sulfide, are observed as well. Multiple prominent 1–5 cm calcareous intervals are present. Smear slide examinations show the carbonate to be abiotic (rhombs and fine mud-sized material), perhaps detrital. Cemented intervals or concretions were found in Core U1603A-10H and below. Minor drilling disturbance is common throughout much of the site. This disturbance becomes more variable through the HLAPC cores. Core U1603B-26F, near the base of Hole U1603B, contains reddish brown calcareous mud with dispersed clasts and clast-poor muddy diamicton.

Biostratigraphy

All core catchers from APC cores in Holes U1603A and U1603B were examined for microfossils, including diatoms, foraminifera, and dinocysts. In Hole U1603B every other core catcher was examined for the sequence of HLAPC cores. The abundance of microfossils was low in all fossil groups and did not allow for any detailed zonation but were consistent with a middle to late Pleistocene age. Palynological processing of the core catchers is still underway. Diatoms are barren in most samples except in Section U1603A-1H-1 where trace diatom valves with moderate preservation were identified. Palynological processing indicated the presence of reworked pollen and spores in nearly all samples, as well as varying amounts of the dinocyst *Brigantidinium*. In addition to samples from the core catchers, targeted intervals of interest (based on natural gamma radiation (NGR), X-ray images, and changes in lithologies) in Sections U1603A-8H-5, 11H-3, and 11H-5 were sampled. In Section U1603A-11H-3, *Neogloboquadrina pachyderma* was present and the palynomorph assemblage is distinct from the general assemblage recorded in most core catcher samples.

Paleomagnetism

Paleomagnetic studies for Holes U1603A and U1603B focused on measurement of natural remanent magnetization (NRM) of archive half sections, collection of discrete samples from working halves, and measurement of NRM and alternating field (AF) demagnetization of a set of discrete samples. 152 discrete samples were collected from Holes U1603A (73) and U1603B (79). Archive half sections were demagnetized at a peak field of 20 mT, while discrete samples were demagnetized at a peak field of 80 mT. Inclination data from the first 111 archive half sections measured (~170 mbsf) suggest that all of Hole U1603A and Hole U1603B down to Core 11F were deposited in the Brunhes chron.

Geochemistry

In Holes U1603A and U1603B whole-round core samples were processed for interstitial water (IW) and headspace void gas samples for gas analysis. IW and headspace gas samples were collected at a resolution of one per core, with headspace gas sampling increasing to a resolution of two per core below a depth of 200 mbsf. IW salinity, pH, and alkalinity, as well as headspace gas methane and ethane concentrations, were measured in near-real time, and the remaining pore water was subsampled and preserved for additional shipboard and shore-based analyses. For headspace samples taken below 200 mbsf, we encountered methane concentrations of up to 40,000 ppm and ethane concentrations of up to 4 ppm. Methane/ethane ratios (C1/C2) were consistently around 10,000, indicating hydrocarbon gas production from biogenic sources. Analyses of solid phases for carbonate content, total carbon, nitrogen, and sulfur are ongoing.

Physical Properties, Downhole Measurements, and Stratigraphic Correlation

Whole-round sections of Holes U1603A and U1603B were logged on the Natural Gamma Radiation Logger (NGRL) as soon as they arrived in the laboratory, following by logging on the Whole-Round Multisensor Logger (WRMSL) once equilibrated to room temperature (~18°C). *P*-wave velocity (PWL), magnetic susceptibility (MS), and gamma ray attenuation (GRA) bulk density were logged at 2 cm resolution. Thermal conductivity was measured on one section per core. When possible, the data were obtained on the whole-round section; however, some lithology warranted thermal conductivity measurements on half-sections for a number of cores. X-ray images were collected for all archive section halves on the XSCAN imager. Discrete *P*-wave velocity measurements were done using the *P*-wave caliper (PWC). In addition, moisture and density (MAD) samples were taken to determine wet and dry bulk density, grain density, water content, and porosity. Temperature measurements were made on Cores U1603A-4H, 7H, 10H, and 13H with the APCT-3 tool. Holes U1603A and U1603B are correlated based on the overlap between Cores U1603A-13H and U1603B-2H. In general, NGR values increase downhole in Hole U1603A; however, values are slightly lower further downhole in Hole U1603B. Average MS increases downhole in Site U1603, as well as the measured bulk density values from GRA and MAD, which correlate fairly well. *P*-wave velocities increase deeper in the site.

Outreach

The following outreach activities took place during Week 2.

A blog post about the first week onboard and about operations in regions with ice was published on the joidesresolution.org homepage. A post for “Reach The World” about transportation was also published. We scheduled 20 ship-to-shore tours, 9 of which will be with an International School in Denmark. An Open House ship-to-shore event was scheduled for 30 August at 2100 h ship’s time. Outreach Officers practiced tour routes and did Zoom application tests. Discussions

were held with most of the science party regarding their individual outreach plans. Routines and schedules for outreach tasks including blogs, reports, and social media and coordination between Outreach Officers continued. Several social media posts this week included questions to increase engagement.

Social Media

Group	**No. of posts**	**Analytics**	**Notes**
Facebook	7	15 new followers Post reach: 16,000 Post reactions & likes: 355 Avg Post engagement: 7.46% Post shares: 61	Top post: passing southern tip of Greenland. 100 reactions
Instagram	8	19 new followers Post Reach: 7,600 Post Impressions: 6,200 Post reactions & likes: 800 Avg Post engagement: 11.43%	Top post: Magical skies. 169 likes
Twitter	13	36 new followers Post impressions: 30,000 Post reactions & likes: 405 Avg Post engagement: 4.36% Re-tweets: 99	Dear Colleague letter (post by USSSP), 6.77% engagement

Ship-to-Shore Broadcasts

Group	**No. of people**	**Notes**
Live event with major exhibition at University of Geneva, Switzerland (scientist home institution)	~40	

Technical Support and HSE Activities

The following technical support activities took place during Week 2.

Laboratory Port Call and Transit Activities

- Technical staff continued preparation of laboratories and training of the scientific party participants for expedition activities.
- The tracer pump was tested and is functioning with Rigwatch.
- Technical staff were fully engaged in core processing and science support at Holes U1603A and U1603B.
- Replaced the prefilters on the nitrogen generator after a drop in purity was observed. Some oil was present in the filters. Despite the slight drop in purity, the purity is adequate for routine activities.
- The *P*-wave transducers on the WRMSL were leaking oil after too much oil was present in the lines. The WRMSL was cleaned up and adjustments to the oil reservoir were made.
- Repaired the top of section sensor on the Section Half Multisensor Logger (SHMSL).
- Experienced intermittent signal loss from the gamma ray attenuation (GRA) sensor on the WRMSL resulting in the need to remeasure sections. Communication is restored by disconnecting and reconnecting the USB cable and restarting the IMS software. The USB hub was changed with no improvement in behavior. The Ortec digiBase with cable was changed and calibrated during the break in coring activity. The behavior will be monitored.

Application Support Activities

- Performed fixes and enhancements to GEODESC and added a link to GEODESC in LORE.
- Researched how the Section Half Imaging Logger (SHIL) camera plug-in works as part of the hyperspectral logger project.
- Investigated a problem uploading JR-6A spinner magnetometer data. Assisted the technician and scientists but no code changes were made.
- Applied fixes in LIVE related to showing GEODESC and XSCAN data. Assisted the technician with LIVE panel data color assignments.
- Applied further changes to MUT's scanning electron microscope (SEM) uploader for compatibility with the Hitachi SEM.
- Investigated an issue with XSCAN jpeg images not showing properly in Mac preview application. The issue is unresolved, but it appears to be a macOS issue.
- Investigated and assisted technicians with correcting hardware problems on the Special Task Multisensor Logger (STMSL) and WRMSL.
- Assisted technicians and scientists with various data corrections, account access, and other minor issues.

IT Support Activities

- Completed the initial setup and implementation of the WifiGem Captive Portal to utilize the Starlink network.
  - Rolled out to staff users initially to test the Captive Portal and the Starlink satellite internet system.
  - The product is expected to go live to all IODP expedition participants by 1 September.
- Performed routine updates to our appliances, servers, workstations and daily-use software.
  - Replaced the Video Display Unit (VDU) in the Upper 'Tween Deck ataging area due to a hardware failure of the previous unit.
  - We are working to address the issue with our VDU streams becoming unresponsive on the Bridge Deck.

HSE Activities

- Emergency shower and eyewash stations were tested.
- Daily COVID-19 tests were conducted.