IODP Expedition 400: NW Greenland Glaciated Margin

Week 7 Report (24–30 September 2023)

Operations

This week we (1) cored three holes with the rotary core barrel (RCB) system and (2) completed downhole logging in two holes.

Hole U1607A

Week 7 of the expedition began with the continued coring of Hole U1607A. Cores U1607A-92R to 103R advanced from 867.0 to 978.0 meters below seafloor (mbsf) and recovered 30.97 m (28%). Sepiolite (drilling mud) was swept through the hole and the bit was released in the hole at 1940 h on 24 September 2023 to prepare for logging Hole U1607A. The hole was displaced with heavy mud (barite) and the pipe was tripped up with the end of the pipe at 42.1 mbsf, and the quad combo tool string was deployed to the base of Hole U1607A. At 938 mbsf (40 m from the bottom of the hole) a hard contact was encountered. Following a complete pass of the hole the quad combo was pulled up to the rig floor and broken down. The Versatile Seismic Imager (VSI) was rigged up and the protected species watch began at 0930 h on 25 September. The VSI was deployed to 930 mbsf and stations were measured every 30 m uphole until 1715 h, at which time the protected species watch also concluded. The VSI was brought back onboard, and with logging completed we tripped the pipe out of Hole U1607A, clearing the rig floor at 2111 h. The drill floor was secured for transit and the thrusters were raised and secured for transit at 2124 h, ending Hole U1607A and Site U1607.

Hole U1608A

The vessel completed the 23 nmi transit to Site U1608 (proposed Site MB-06D) on 26 September. The thrusters were lowered and secured and the ship was fully in dynamic positioning (DP) mode at 0051 h on 27 September. The rig crew made up a RCB bottom-hole assembly (BHA) and the drill string was tripped to near the seafloor. Hole U1608A was spudded at 0435 h, tagging the seafloor at 606.9 meters below sea level (mbsl). Cores U1608A-1R to 60R advanced from 0 to 561.0 mbsf and recovered 267.35 m (48%).

Sepiolite was swept in the hole and the bit was released in the hole at 1555 h on 29 September to prepare for logging Hole U1608A. The hole was displaced with heavy mud (barite) and the pipe was tripped up, with the end of the pipe placed at 103.9 mbsf due to concerns about the condition and stability of the hole. The quad combo tool string was deployed to the base of Hole U1608A and tagged the bottom at 558.6 mbsf. Following a complete pass of Hole U1608A, the quad combo was pulled to the rig floor and broken down. The Formation MicroScanner (FMS; without the sonic tool) tool string was then assembled and deployed at 0235 h on 30 September. After two successful logs the FMS tool was brought back onboard and broken down. The VSI

was rigged up and deployed and the protected species watch began at 0730 h. Stations were measured uphole every 20 m and the VSI was back onboard by 1300 h. With logging completed we tripped the pipe out of Hole U1608A, clearing the rig floor at 1555 h on 30 September. The drill floor was secured for transit and the thrusters were raised and secured for transit at 1630 h, ending Hole U1608A and Site U1608.

Hole U1606B

The vessel began the 6.6 nmi transit back to Site U1606 and arrived at 1715 h on 30 September. The thrusters were lowered and secured and the ship was fully in DP mode at 1738 h. The rig crew made up a RCB BHA and the drill string was tripped to near the seafloor. Hole U1606B was spudded at 2125 h, tagging the seafloor at 656.4 mbsl. Core U1606B-1R advanced 4.6 m and recovered 2.64 m (57%).

Science Results

Sites U1607 and U1608

Science activities during the week included the processing and measurement of core sections and shipboard samples for Sites U1607 and U1608. The science party also worked on reports and gave site summary presentations for Site U1607.

Lithostratigraphy

Cores U1607A-87R to 103R were split and described. The cored sediments consist primarily of grayish brown bioturbated sandy mud, glauconite-rich intraclast conglomerate, and dark grayish brown mud with color banding. Cores U1608A-1R to 60R were also split and described. At this site, the recovered intervals consist primarily of dark greenish gray bioturbated mud, muddy sand, and stratified or massive sand with dispersed clasts. Centimeter- to decimeter-scale yellowish grey calcareous mud intervals are present. Rare bioclasts, including wood and shell fragments, are also observed.

Biostratigraphy

The Biostratigraphy team processed and analyzed core catcher and section half samples from Holes U1607A and U1608A for foraminifera, diatoms, and dinoflagellates. Planktonic foraminifera were detected near the bottom of Hole U1607A that suggest Oligocene age sediments. Dinocyst abundances in the deepest samples from Hole U1607A also indicate a late Oligocene age. Diatoms are generally barren in the deepest samples from Hole U1607A but are observed in the majority of samples from Hole U1608A with high genus and species-level diversity. The diatom assemblages from Hole U1608A suggest a Pliocene age. The palynological assemblages for Hole U1608A were highly variable in the quantity of dinocysts, plant material, pollen, and spores. Samples from the mudline to Section U1608A-24R-CC were analyzed, and

the deepest samples indicate a Pliocene age. Four samples in Hole U1608A and a mudline sample from Hole U1606B were collected for sedimentary ancient DNA (sedaDNA) analysis.

Paleomagnetism

Archive section halves of cores from Holes U1607A and U1608A were measured on the superconducting rock magnetometer (SRM). Discrete cube samples were collected from Holes U1607A and U1608A working section halves. Discrete samples were measured on the SRM; we measured the natural remanent magnetization (NRM), as well as magnetization after stepwise alternating field (AF) demagnetization up to peak fields of 50 mT. Inclination values in Hole U1607A are generally bimodal at the estimates from geocentric axial dipole (GAD) inclinations for normal and reverse polarities at this latitude, suggesting that intervals of both normal and reverse polarity were recovered at Site U1607. Poor magnetizations below 400 m core depth below seafloor, Method A (CSF-A) in Hole U1607A result in inclinations that are not possible to interpret as polarity zones.

Geochemistry

Whole-round core samples for interstitial water (IW) were processed and headspace sampling (HS) void gas samples were measured for Sites U1607 and U1608. One IW and two HS samples were collected per core. Hydrocarbon gas concentrations in the deepest cores of Hole U1607A (~850–970 mbsf) are elevated (methane, 9,960–103,000 ppm; ethane,119–672 ppm; propane and *n*-butane present at ~50 ppm). In Hole U1608A methane concentrations range from 3 to 88,400 ppm throughout the hole, while ethane concentrations range between 0 and 40 ppm. Propane, iso-butane, and *n*-butane were detected, with concentrations up to 15, 17, and 17 ppm, respectively. Methane/ethane ratios (C1/C2) varied between 713 and 44,705. Measurements were made for pH, alkalinity, and salinity from IW samples at Site U1608. Alkalinity ranges from 4.59 mM to 23.85 mM, salinity between 32 and 21, and pH between 7.56 and 8.01. Additional analyses of IW samples for Site U1608 are in progress. Analyses of major elements, major ions, and nutrients for IW samples from Site U1607 were also completed.

Physical Properties

Whole-round sections from the remaining cores of Hole U1607A and all cores of Hole U1608A were logged on the Natural Gamma Radiation Logger (NGRL) as soon as they arrived at the laboratory, followed by logging on the Whole-Round Multisensor Logger (WRMSL) after 4 or 5 h for thermal equilibration (~20°C). *P*-wave velocity, magnetic susceptibility (MS), and gamma ray attenuation (GRA) were logged at 2 cm resolution. Thermal conductivity was measured on the working-half section with a contact puck. Upon core splitting, X-ray images were obtained on the XSCAN imager for all archive-half sections of Holes U1607A and U1608A. Discrete *P*-wave velocity measurements were made using the *P*-wave caliper on the working-half sections (2–3 per core). Moisture and density (MAD) samples (2 per core) were taken on working-half sections. Wet and dry bulk density, grain density, water content, and porosity were determined

upon analyses of the samples. Hole U1608A natural gamma radiation (NGR) values decrease slightly downhole, while MS values are highly variable. *P*-wave velocities are relatively constant downhole in Hole U1608A.

Downhole Measurements

Hole U1607A was logged on 25 September during a ~23 h period of continuous operation. The first logging run consisted of the quad combo tool string measuring formation NGR, acoustic velocity, resistivity, MS, and density. The protected species watch began during the rig down of the quad combo. The VSI was lowered to the bottom of the hole and successful check shots were obtained at 33 stations. Downhole logging operations at Hole U1608A were conducted on 30 September over ~14 h. In addition to the quad combo and VSI tools, time allowed a third run in Hole U1608A using the FMS tool, which recorded the microresistivity of the formation. All downhole data from Sites U1607 and U1608 are of high quality, and the logs are currently being processed at Lamont-Doherty Earth Observatory (LDEO).

Outreach

The following outreach activities took place during Week 7:

Sixteen live ship-to-shore events were held this week. Scientists Yancheng Zhang, Jian Ren, Vikash Kumar, Fawz Naim, Georgia Grant, and Lisa Tauxe co-led ship-to-shore events for their institutions. Co-Chief Scientist Anne Jennings conducted an interview with University of Colorado at Boulder. A virtual Open House was held on September 30 and included scientists and technicians. A blog about the Beaufort Scale, a long-established visual estimate of wind speed, was posted on www.joidesresolution.org. A promotional video was recorded and posted for the upcoming Reach the World (RTW) event next week.

Social Media

Group	No. of posts	Analytics	Notes
Facebook	8	2 new followers Post reactions & likes: 238 Post Impressions: 11,000 Avg Post engagement: 5.67% Post shares: 25	Top post: #EXP400's most productive site (84 reactions and comments)
Instagram	18	11 new followers Post reactions & likes: 458 Post Impressions: 7,700 Avg Post engagement: 8.12%	Top post: Styrofoam cups (101 likes)

X (formerly known as Twitter)	14	8 new followers Post reactions & likes: 405 Post impressions: 26,000 Avg Post engagement: 3.34% Re-tweets: 78	Top post: Search lights (6.85%)

Ship-to-Shore Broadcasts

Group	No. of people	Notes
Victoria University of Wellington, New Zealand	Unknown	Co-led by Georgia Grant; introductory geology course
IODP China	~1.2 million	Co-led by Yancheng Zhang and Jian Ren; middle school students
Copenhagen International School	~41	Climate change and ocean acidification; middle school students
Copenhagen International School	~24	Climate change and ocean acidification; middle school students
University of Otago, New Zealand	45	Co-led by Georgia Grant; modern and ancient sediments course
IODP China	~1.15 million	Co-led by Yancheng Zhang and Jian Ren; middle school students
The Chinese University of Hong Kong	~100	Hosted by Professor Zuo Xuran
Central Oregon Geoscience Society	50–70	Co-led by Lisa Tauxe; professional geologists
National Centre for Polar and Ocean Research, Goa, India	~100 students	Co-led by Vikash Kumar and Fawz Naim; students from Vidya Vikas Academy
Copenhagen International School	~44	Evidence of climate change, Grade 7

Copenhagen International School	~42	Evidence of climate change and ocean acidification; Grade 8
Halesowen College, England	Unknown	Requested a presentation on how mid-ocean ridges are formed; pre-university geology students
Copenhagen International School	~24	Evidence of climate change, Grade 7
Copenhagen International School	~26	Evidence of climate change and ocean acidification; Grade 7
Oasis Academy Southampton, England	~140	The rock cycle; students
Open House	~65	Included viewers from Greenland Summit Station and Iceland

Technical Support and HSE Activities

The following technical support activities took place during Week 7:

Laboratory Activities

- Technical staff were fully engaged in core processing, sampling, laboratory maintenance, and science support for Holes U1607A, U1608A, and U1606B.
- Replaced the pump unit for one of the Carver Autopaks, connected to the porewater squeezing presses in the Chemistry Laboratory.
- Repaired a Cahn microbalance in the Chemistry Laboratory.
- Logged Holes U1607A and U1608A and performed protected species observations in conjunction with the vertical seismic profile (VSP) operations.

Application Support Activities

- Worked on GEODESC improvements.
- Assisted technicians and scientists with minor issues in LIMS and GEODESC.
- Worked on improvements to iRIS, the new rig instrumentation software.
- Worked on improvements to IMS and integrated new code for X-ray image processing into IMS.

IT Support Activities

- Prepared for Adobe licensing model change and Adobe Creative Cloud applications upgrades for upcoming dry dock.
- Continued to configure new switches for upcoming dry dock network maintenance.
- Reconfigured current network management system to accommodate new switches and allow for smoother installation.
- Updated macOS computers and browsers for all shipboard workstations to address zero-day vulnerabilities.
- Explored macOS configuration profiles to help standardize system preferences and security settings.
- Upgraded firewall signatures to fix App Control due to firmware issues.
- Applied patches for VMware ESXi hosts and software tools to mitigate security risks.

HSE Activities

- Emergency shower and eyewash stations were tested.
- An abandon ship drill was held on 24 September at 1300 h.