

## **IODP Expedition 379: Amundsen Sea West Antarctic Ice Sheet History**

### **Week 6 Report (17–23 February 2019)**

Nearly the entire week was spent rotary core barrel (RCB) coring in Hole U1532G. Multiple interruptions to coring operations caused by drifting ice totaled 3.32 d this week and ultimately led to our abandoning of Hole U1532G after coring to 794.0 m. We departed Hole U1532G at 1615 h on 23 February and, after a 31 nmi transit, we arrived at Site U1533 (proposed Site ASRE-09A) at 2109 h on 23 February. This week, Cores U1532G-15R to 47R penetrated from 497.1 to 794.0 m and recovered 251.52 m (85%). Unless otherwise noted, all depths are calculated as core depths below seafloor (CSF-A) and are reported as “m.” All times in this report are in ship local time (UTC – 3 h).

### **Operations**

Last week ended with having to pause operations at 1315 h on 16 February due to approaching ice. After waiting for ice to clear the area until 1845 h on 17 February, we lowered the bit from 65.0 m to 467.5 m and resumed RCB coring at 2130 h on 17 February. We then had nearly 40 h of uninterrupted coring. Cores U1532G-15R to 34R penetrated from 497.1 to 688.6 m and recovered 170.51 m (89%).

After Core 34R arrived at 1445 h on 19 February, we had to stop coring due to approaching ice. At 1915 h on 19 February, we were able to resume coring and Cores 35R–37R penetrated another 28.7 m (688.6–717.3 m; 24.73 m recovered; 86%). As soon as we finished cutting Core 37R at 0045 h on 20 February, we had to raise the bit up to 54.5 m below seafloor due to approaching ice. We were finally able to retrieve Core 37R at 0420 h on 20 February.

At ~0655 h on 20 February, we were cleared to resume coring and started lowering the bit back down the hole. We installed the top drive when the bit encountered some resistance at 567.5 m, and we rotated and circulated back to 709.2 m. At that depth, we had to drop a center bit to redrill the final ~8 m to the bottom of the hole (709.2–717.3 m). After we circulated 25 barrels of mud to clean the cuttings out of the hole, at 1315 h on 20 February approaching ice forced us to raise the bit back up to 64.5 m below the seafloor. We continued waiting on ice to clear the area until 0230 h on 21 February, when approaching ice forced us to pull the bit out of Hole U1532G so we could offset the ship. At 0630 h on 21 February, we deployed the camera system in anticipation of being able to reenter Hole U1532G. After adjusting the bit depth for reentry at 0845 h, we surveyed the seafloor around Hole U1532G and then began attempts to reenter the hole. The free-fall funnel (FFF) of the reentry system (with ~14 m of casing below) was not visible; it had settled substantially into the seafloor. After numerous attempts, we were finally able to reenter at 1225 h on 21 February. After the camera system was recovered, we started

lowering the bit back down to the bottom of the hole. At 1615 h, the bit encountered some resistance at 620.5 m, so we installed the top drive (so we could circulate and rotate), dropped a core barrel, and reamed back down to the bottom of the hole (717.3 m). We recovered the core barrel (Core U1532G-38G; 0.47 m recovered) at 2125 h on 21 February and resumed RCB coring. Cores 39R to 45R then penetrated from 717.3 to 779.9 m. Approaching ice forced us to stop cutting Core 45R after penetrating only 5.1 m. At 1315 h on 22 February, we raised the bit up to 754.5 m and recovered Core 45R. We resumed operations at 1615 h, lowered the bit back to the bottom of the hole, and started coring at 1700 h. After Cores 46R–47R were recovered (779.9–794.0 m), we had to pause operations again at 2245 h on 22 February due to approaching ice, and we raised the bit up to 64.5 m below the seafloor. We continued waiting on ice to clear the area until 0545 h on 23 February, when the approaching ice forced us to pull the bit out of the hole. At 0630 h, we decided to stop further operations in Hole U1532G and started to recover the drill string. The bit arrived back on the rig floor at 1335 h and the rig floor was secured for transit at 1455 h on 23 February. In total, Hole U1532G was drilled without coring from the seafloor to 372.3 m and then RCB cored from 372.3 to 794.0 m, recovering 366.41 m (87%).

Before we could get underway, we had to maneuver the ship away from the ice to raise the thrusters. We started our transit to Site U1533 (proposed Site ASRE-09A) at 1618 h. After a ~31 nmi transit (4.4 h; 7.1 nmi/h), we arrived at Site U1533 and switched to dynamic positioning at 2109 h on 23 February. We spent the rest of the day on (a) conducting routine servicing of the drill line (slip and cut), (b) preparing the rig floor and moonpool for assembling a free-fall reentry system (FFF, mud skirt, and two joints of 10.75 inch casing), and (c) initial assembly of the reentry system.

## **Science Results**

### *Lithostratigraphy*

Cores U1532G-8R to 45R were X-rayed and described. The core recovery was 85% with only slight to moderate core disturbance. The sediments consist of dark gray to dark greenish gray thinly laminated silty clay with interbeds of varying thickness, consisting of greenish gray silty clay with dispersed sand and granules. In addition, we observed many new sedimentary structures within the cores, including the presence of soft sediment clasts, carbonate cemented silt- or sandstone (with varying thicknesses), silt lenses, and normally graded, fanning and deformed laminae.

We began preparing samples for petrological and mineralogical characterization of the silt- to fine sand fractions using residues that remained after dissolution of carbonate-cemented layers for biostratigraphic analysis. In addition, material from a core barrel recovered when reaming back to the bottom of the hole (Core U1532G-38G) was prepared for petrological

characterization and counts of abundant small pebbles that existed within a mixed, probably washed out mass of material recovered from the bottom of the core barrel.

Clay mineralogy data show changes in clay mineral assemblages between the dark gray and the greenish gray units. Four thin sections were prepared and analysed, targeting intervals with soft sediment clasts draped by a variety of laminations (thin, graded, faulted thin, and bioturbated black). Collection of handheld X-ray fluorescence (pXRF) data, which includes the relative abundance of major and trace elements, began this week and point measurements of key intervals were made. The qualitative XRF analysis included carbonate cement, soft sediment clasts, greenish massive units, and thinly laminated intervals.

### *Biostratigraphy*

Micropaleontology samples were analyzed from core catcher and selected split core samples from Cores U1532G-6R to 47R (410 to ~790 m). Samples were generally barren of diatoms and other siliceous fossils, calcareous nannofossils, and foraminifers, especially in laminated sediments. Exceptions include samples from bioturbated horizons in Cores 5R, 11R, 13R, and 16R, which contain trace-to-rare occurrences of diatoms, and Core 11R, which contains rare radiolarians. A biosiliceous clast in Section U1532G-9R-4 (445 m) contains abundant and well-preserved diatoms.

Few age-diagnostic microfossils were identified in the lower section of Hole U1532G. However, diatoms present in Sections U1532G-5R-4 (~406 m), 9R-5 (~446 m), 11R-4 (~463 m), 13R-4 (~483 m), and 16R-3 (~509 m) indicate an early Pliocene age. Diatom age assignment of a clast sampled in Section 9R-4 (445 m) also indicates an early Pliocene age (possibly 5.1–5.3 Ma). Radiolarians recovered from Section 11R-4 (~463 m) yielded mostly broken fragments. The species we were able to identify are consistent with a Late Miocene to Pliocene age. The second green facies in Section 13R-4 (~483 m) yielded only trace amounts of radiolarian fragments. None of the lower green facies contains radiolarians, based on smear slides observations and sieved material prepared from one such facies in Sample 30R-CC (~649 m). Sparse marine non-age diagnostic palynomorphs and common reworked Cretaceous and Paleogene pollen were observed.

### *Paleomagnetism*

We measured and subsequently demagnetized the natural remanent magnetization (NRM) of all archive-half sections from Hole U1532G. In addition, 82 oriented discrete samples were measured to support the archive-half measurements as well as for bulk and anisotropy of magnetic susceptibility (AMS). The AMS data demonstrate a prominent anisotropy with the maximum susceptibility within the bedding plane. Intensity of NRM ranges from  $\sim 10^{-3}$  to  $\sim 10^{-2}$  A/m. Demagnetization of NRM at the 20 mT level reveals five polarity transitions in depths between ~406 and ~581 m. The oldest magnetic polarity reversal (Core 23R) is

preliminarily attributed to the beginning of Subchron C3n.4n (5.2 Ma). Reversed magnetic polarity continues down to the bottom of Hole U1532G.

### *Petrophysics*

Density and magnetic susceptibility (MS) were measured using the Whole Round Multisensor Logger with a measurement interval of 2.0 cm. Natural gamma radiation (NGR) was also measured on whole-round (WR) cores at an interval of 10 cm. Additionally, three thermal conductivity measurements were conducted on split core sections. Moisture and density (MAD) measurements were made on 104 discrete samples, and 222 *P*-wave caliper velocity measurements were made on split core sections. Continuous and distinctive variations in MS provided clear correlation tie points between Holes U1532G, U1532C, and U1532D. Repeating patterns in NGR data were noticed in several core sections and testing of the NGR data quality is ongoing.

### *Geochemistry*

Fourteen interstitial water samples were collected from Hole U1532G from WR samples that ranged in length up to 30 cm. The extracted water volume ranged from 6 to 21 mL and analyses of salinity, alkalinity, pH, and chlorinity were conducted. pH, alkalinity, and chlorinity changed dramatically with depth (i.e., 450–600 m), which is consistent with the observed occurrence of carbonate nodules. Alkalinity decreased from ~6.7 mM at 450 m to 0.7 mM at 620 m. The SO<sub>4</sub> concentration drastically decreased from 9.9 mM at ~400 m to 2.32 mM at 662 m, which is the minimum value at this site.

Headspace gas analysis documented only low methane (CH<sub>4</sub>) concentration throughout most of Hole U1532G. Methane concentrations started to increase at 670 m and averaged 5,000 ppmv below 720 m. Between 720 and 785 m, ethane was detected but in persistently low concentration (<2 ppmv). The depth of the lowest SO<sub>4</sub> concentration coincides with the distinct rise in methane concentration. Low total carbon, total organic carbon, total nitrogen, and total sulphur values continued to the base of Hole U1532G, except for a distinct maxima below ~500 m that is related to the presence of carbonate nodules and carbonate-cemented silts and sands. Sampling for microbiological analysis and tracer experiments were carried out continuously in Hole U1532G.

### **Outreach**

The Outreach Officers continue to document the expedition with photos, videos, writing, and comics. Ten language translations of the introductory #EXP379 comic have been completed and are available for education or public outreach. A second giant comic has been created and is focused on one of the Co-Chief Scientist's seismic work. Two additional giant comics are underway. Social media (Facebook [<https://www.facebook.com/joidesresolution>], Twitter [<https://twitter.com/TheJR>], and Instagram [[http://instagram.com/joides\\_resolution](http://instagram.com/joides_resolution)]) continue to

be active and dynamic with photos and comics. The British Antarctic Survey (BAS) published the first in a series of blogs about the expedition and promoted it through their social media channels. The footage of one Co-Chief Scientist appeared on a German television science news program (nano at 3sat) promoting the expedition and Antarctic research. Media interviews are being scheduled for the final week of the trip. Interviews for postcruise videos and articles are being conducted with shipboard scientists. Styrofoam items transported to the seafloor with the reentry camera system will be used to share understanding of pressure at depth.

## **Technical Support and HSE Activities**

Staff continued supporting science activities at Site U1532 and prepared for work at Site U1533.

### *Laboratory Activities*

- Chemistry:
  - Caver Hydraulic Jacks: Repairs and rebuilds were completed. We replaced all of the Chemistry Laboratory jacks with newly rebuilt systems. We now have four working spares; another one was not repairable.
- Physical Properties:
  - NGR:
    - Staff worked on recovering data processed with a corrupted configuration file.
    - We are looking closely at issues with detector number 7. During a recent energy calibration, it was noted that the trim pot was very sensitive (as compared to the other detectors), making the bias adjustment nearly impossible. We also noted that between repeated calibrations the channel assignments were jumping. We are currently preparing a new pre-amp to replace #7 on the transit back to port.
    - We are currently working on resolving the kev threshold pick issue.
- Underway Geophysics:
  - Electronics technicians have started work installing the new housing for the level winch controller.
  - We assembled the vertical seismic profile (VSP) seismic source in preparation for potential Vertical Seismic Imager (VSI) logging. We used the opportunity to train new staff.
  - We updated the protected species watch guide and distributed it to staff.
- X-Ray Imaging:
  - We implemented an automated image reprocessing in the IMS software. This is experimental, for evaluation purposes only. The science party is still processing images offline.

- We updated the X-ray Safety Survey form with recent changes to the warning light system.

### *Application Support Activities*

- Composite Image: After cancelling and regenerating the composite image, there have been two instances when the core catcher image was missing. No pattern was observed other than a long delay between capture of the original core catcher image and the capture of the last section.
- NGR Lore Report: The NGR Expanded Report is not showing the configuration\_asman\_id and configuration\_filename columns. The issue has been handed to shore staff for follow-up.
- Sample Master: An issue regarding a wash core required manual editing of the initially created record so that the top depth of the wash core was higher than the bottom depth of the previous core.
- Java-11:
  - CorrelationDownloader: We are currently applying extensive changes and testing.
- PWAVE-C: We corrected offset values due to failure of the instrument's laser to correctly determine the sample offset correctly.
- Coulometer: The application is not showing history for Expedition 379. We moved Expedition 368X data and this allowed the application to see Expedition 379 data as normal.

### *IT Support Activities*

- VSAT: Worked with Rignet to change frequency and modulation, improving our internet connectivity. Still encountering short term outages due to our location.
- Internet: On 21 February, we lost internet for ~24 h due a fiber optic cable issue in Houston.
- JR Website: Retrieved updates from shore and updated the shipboard website with the new JRSO Code of Conduct as requested by the Expedition Project Manager.

### *HSE Activities*

- Weekly fire and boat drill was held as scheduled.