

IODP Expedition 383: Dynamics of Pacific Antarctic Circumpolar Current (DYNAPACC)

Week 2 Report (26 May–2 June 2019)

During the second week of the International Ocean Discovery Program (IODP) Expedition 383, Dynamics of the Pacific Antarctic Circumpolar Current (DYNAPACC), we completed the 1634 nmi transit from Punta Arenas, Chile, to Site U1539 (proposed Site CSP-2B) in the central South Pacific sector of the Southern Ocean. All times in this report are in ship local time (UTC – 3 h).

Operations

The vessel departed the Cabo Negro Fuel Terminal in Punta Arenas after the last line was brought aboard and anchors secured at 0100 h on 25 May 2019. The vessel took the western route through the Strait of Magellan to the central South Pacific and completed the sea voyage in 6.4 d, at 1142 h on 31 May.

Upon arrival at Site U1539, all thrusters were lowered and the vessel was placed in dynamic positioning (DP) mode at 1211 h. No positioning beacon was deployed. An advanced piston corer/extended core barrel (APC/XCB) bottom-hole assembly (BHA) was made up with a 11-7/16 inch C-3 drill bit and deployed to 4050 meters below rig floor (mbrf). The top drive was picked up and the bit spaced out to 4077 mbrf for spudding. Hole U1539A (56°9.06'S, 115°8.0461'W) was spudded at 0445 h on 1 June, and Core U1539A-1H recovered 4.56 m of sediment, establishing a seafloor depth of 4081.9 mbrf (or 4071.1 m below sea level). APC coring continued to a depth of 90.1 mbsf with advanced piston corer temperature tool (APCT-3) measurements taken on Cores U1539-4H (33.1 mbsf), 7H (61.6 mbsf), and 10H (90.1 mbsf). Coring was stopped at that point to allow the rig crew time to repair a leak in the aft core winch line load cell. This repair took approximately 3.75 h, and coring resumed with Cores 11H and 12H (90.1 to 107.6 mbsf). Coring was terminated after Core 12H due to rough weather and sea conditions. The bit was pulled back to a depth of 3885.6 mbrf, clearing the seafloor at 0225 h on 2 June, and ending Hole U1539A at a total depth of 108.6 mbsf. Shattered liners were recorded on Cores 5H and 11H. Shear pins were sheared prematurely on Cores 1H, 11H, and 12H.

Science Results

All scientific teams completed the initial drafts of the Methods chapters and converged on a shipboard sampling plan for shipboard analyses. They received training on their laboratory instruments and continued to become familiar with laboratory procedures, to be ready for the first cores. The scientific party met daily during the transit to discuss the planned work, and

during the last two days of transit before arriving at Site U1539, we had science presentations by four individual scientists. The Co-Chief Scientists gave presentations on the expedition scientific objectives to the IODP JRSO technical staff and the Siem Offshore crew.

Lithostratigraphy

The Sedimentologists agreed on the lithologic classification to be used on the expedition and updated the DESClogik templates to accommodate anticipated lithologies that were identified in the site survey cores. They also performed core description exercises and received training on the core X-ray imaging instrument, which we plan to use to identify clasts and bioturbation intensity in the cores.

The first three cores from Hole U1539A (1H through 3H) were described. They consist of alternations between light greenish gray and light gray nannofossil-rich diatom ooze and diatom-rich nannofossil ooze. Bioturbation varies from moderate to high.

Biostratigraphy

The Paleontology team reviewed reference micropaleontological material, and agreed on the timescale and main biostratigraphic events that will be used during the expedition. They produced a chart that integrates all the bioevents and biozones from all the microfossil groups. They also collected water samples in international waters along the way to Site U1539 to study the winter distribution of modern diatoms, radiolarians, and calcareous nannoplankton in this mostly unexplored region of the South Pacific Ocean.

Once the first cores from Hole U1539A were recovered, they estimated the age of each core based on siliceous and calcareous biostratigraphic markers, and determined an age of >0.44 Ma for the base of Core U1539A-10H.

Paleomagnetism

Paleomagnetic measurements were made to investigate the natural remanent magnetization (NRM) of core sections from Hole U1539A. The NRM of the first two sections of Core U1539A-1H were strong (10^{-3} A/m) for pelagic mud, but intensities reduced sharply in the sections below. After removal of a small drill string overprint, typically by 5 mT alternating field (AF) demagnetization, NRM directions moved toward those expected for the site location, although intensities remained weak ($<10^{-5}$). After 10 mT and then 15 mT AF demagnetization, reliable polarity information with inclinations predominately around expected geocentric axial dipole values for the site's location are observed. The uppermost four cores (U1539A-1H to 4H) appear to be in the Brunhes Chron, consistent with preliminary biostratigraphic age determinations and correlation with changes in physical properties data (e.g., density), which follow glacial/interglacial cycles. Sediment deformation is the major noise contributor, including core twisting, which occurred in Cores U1539A-3H and 5H. A few anomalous intensity spikes are observed that could reflect non-steady state diagenetic (authigenic formation of magnetic

minerals) or depositional (ice rafted debris, dust) processes, or something else (tephra, etc.), and will be monitored as measurements progress. These intensity spikes are usually associated with shallower than expected inclinations that are unlikely to be geomagnetic in origin and will be considered in our interpretations.

Geochemistry

The Geochemistry team started to analyze the interstitial water chemistry from 30 whole-round samples collected from Hole U1539A cores. They are first being measured for alkalinity, pH, and chlorinity. Sediment samples are also being collected for solid phase analyses. Headspace samples were taken from every core to monitor hydrocarbon gases. Methane concentrations are less than 17 ppmv.

Physical Properties

The Petrophysics team measured Cores U1539A-1H through 11H in the Whole-Round Multisensor Logger (WRMSL) for gamma ray attenuation (GRA) density and magnetic susceptibility (MS), and in the Natural Gamma Radiation Logger (NGRL). The NGR data will be used to deconvolve the NGR spectrum into K, U, and Th signals. They also measured thermal conductivity at a resolution of one measurement per core on Cores 2H through 6H. Moisture and density (MAD) sampling was carried out for Cores 1H through 6H, taking one sample from each undisturbed section. GRA density measurements usually were not reliable on the first section of each core due to the presence of water inside the liner in the uppermost ~1 m. Measurements on Core 5H also were compromised because the core liner shattered upon retrieval, and the core and the liner had to be restored in the core receiving platform. For thermal conductivity measurements, we tried different power settings (from 0.7 to 3 W/m), but we did not succeed in getting reliable thermal conductivity measurements from Cores 2H to 6H, probably because of high water concentration in the cores. NGR measurements indicate alternating total NGR counts, that reflect warm/cold climatic stages.

Stratigraphic Correlation

The Stratigraphic Correlators trained on Correlator v3.0 using legacy data and contributed to discussions regarding how to optimize core flow. After coring started in Hole U1539A, they used whole-round petrophysical data to learn more about how to use Correlator v3.0 in anticipation of drilling Hole U1539B.

Air Sampling

Six air samples were collected at the bow and bridge wing of the *JOIDES Resolution* while transiting in international waters between the Chilean margin and Site U1539. The radiocarbon content of the air will be measured by researchers at GNS Science (New Zealand) to better understand how carbon cycle dynamics operate in the Southern Ocean.

Technical Support and HSE Activities

Laboratory Activities

- The towed magnetometer was deployed once we entered international waters, and was pulled back aboard 2 h prior to arrival at Site U1539.
- Surface seawater samples were taken every 6 h for paleontologists.
- Survival suit training sessions were conducted by Siem Offshore crew.
- Hydrofluoric acid (HF) solid waste from Expedition 382 was sorted.
- Conducted routine instrument testing and calibrating throughout the laboratories.
- Trained scientists in their assigned laboratories.
- Worked on changing the Section Half Imaging Logger (SHIL) settings so that we can get higher resolution RGB data.
- Updated MATLAB and TP-Fit software to latest versions.
- All whole-round tracks experienced issues with parsing core label IDs into the proper fields. Troubleshooting is in progress.

Application Support Activities

- Ongoing development of SampleMaster Catwalk module replacement.
- Deployed new SampleMaster version with bug fix.
- Resolved problem with LIVE that was showing all measurements at the tops of sections.
- Fixed LORE batch download issue on several reports.
- Deployed revised DESClogik with new “most recently used” sorting option for value lists.
- Investigated CSF-B issue (unresolved, but a workaround exists).
- Assisted scientists and technical staff with various minor instrument issues.

I.T. Support Activities

- Assisted scientists and technical staff with login problems and slow responding laptops.
- New software was installed on X-ray diffractometer (XRD) instrument host and three workstations in the Core Laboratory.
- Set up a laptop with MATLAB and located it near the NGR station per a scientist’s request, to be used for extracting U, K, and Th data from NGR data.
- Installed latest version of Igor Pro on Stratigraphic Correlator workstation.
- Reduced print speed of Core Entry Zebra printer to try to resolve a label parsing issue with the instrument scanners. Troubleshooting is still in progress.

HSE Activities

- Conducted weekly test of safety showers and eyewash stations.

- The abandon ship and fire drill planned for Sunday 2 June was postponed until Monday, 3 June 2019, because of high seas.