

IODP Expedition 375: Hikurangi Subduction Margin

Week 2 Report (11–17 March 2018)

Operations

This week we (a) completed the transit to our first site, (b) cored three holes with the advanced piston corer/extended core barrel (APC/XCB) system, and (c) started coring a fourth hole with the rotary core barrel (RCB) system.

Transit to Site U1518

The *JOIDES Resolution* departed from Timaru, New Zealand, at 0728 h on 11 March and began the 495 nmi journey to Site U1518 (proposed Site HSM-15A). The vessel travelled at a reduced speed to allow Cyclone Hola to dissipate and clear the area of operations. The vessel arrived at Site U1518 at 1900 h on 13 March. Upon arriving on location, the thrusters were lowered, the dynamic positioning system was engaged, and an acoustic positioning beacon was deployed.

Holes U1518C and U1518D

The crew made up an APC/XCB bottom-hole assembly (BHA) and lowered it to the seafloor. The top drive was picked up and a “pig” (a high-density foam plug with metal bristles) was pumped through the pipe to clean it of rust. The bit was set at 2642 m below rig floor (mbrf) and Hole U1518C was started at 0905 h on 14 March (Expedition 372 collected logging-while-drilling [LWD] data at Holes U1518A and U1518B). A full core barrel was retrieved and the hole was abandoned to attempt another mudline core. The bit was raised 3 m and Hole U1518D was started at 1020 h. Another full core barrel was retrieved and this hole was also abandoned.

Hole U1518E

The vessel was offset 5 m to the north, the bit was raised another 3 m, and Hole U1518E was started at 1125 h on 14 March. A good mudline core was recovered that established a seafloor depth of 2636.8 mbrf (2626.1 m below sea level). Cores 1H–10H penetrated to 63.3 m with 98% recovery. Half-length APC (HLAPC) Cores 11F–25F penetrated from 63.3 to 123.5 m with 90% recovery. XCB Cores 26X–32X penetrated from 123.5 to 175.6 mbsf with 87% recovery. Formation temperature measurements were taken with the APC temperature tool (APCT-3) while taking Cores 4H, 6H, 8H, 10H, and 14F. Nonmagnetic core barrels we used for all APC/HLAPC cores and all of the APC cores were oriented with the IceField tool. The decision was made to switch to RCB coring after discovering that the cutting shoe used with Core 31X had been completely destroyed and after it took 80 min to advance 3.6 m while cutting Core 32X.

Hole U1518F

The vessel was offset 5 m to the south and a RCB BHA was made up and lowered to the seafloor. Hole U1518F was started at 0135 h on 17 March 2018 and was advanced without coring to 197.7 mbsf. By the end of the week, Cores 2R–7R had reached 255.2 m with 35% recovery.

Science Results

Site U1518

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

Lithostratigraphy

At Site U1518, lithologic Unit I is composed of alternating layers of dark gray silty sand, very fine sand, and greenish gray silty clay. The base of Unit I is not yet defined. The coarser layers are generally <10 cm in thickness with sharp bases and normal size grading, whereas the finer grained background sediment contains more nannofossils. Light gray ash pods and thin ash beds are common. An ~1 m thick tephra layer occurs in the upper part of Core U1518E-5H. Drilling disturbance increases downhole.

Biostratigraphy

Calcareous nannofossil and foraminifer biostratigraphy places Cores U1518E-1H through 32X and U1518F-2R through 9R in the Pleistocene, with an age <2.17 Ma. Calcareous nannofossils are common throughout the sampled interval, and preservation is moderate to good. Reworked calcareous nannofossils of Pliocene to Eocene age occur in most of the examined samples. Foraminifers are common to abundant and preservation is good, but faunal yields are often low. Reworked late Pliocene and early late Miocene foraminifers occur in some samples.

Paleomagnetism

Paleomagnetic studies focused on identifying magnetic polarity changes based on inclination values, in order to provide a chronostratigraphic framework for Hole U1518E. Continuous measurements of the natural remanent magnetization were conducted on archive-half core sections prior to and following alternating field demagnetization up to peak fields of 30 mT.

Inclinations are negative in the upper part of the hole as expected for this latitude. A transition from negative to largely positive and shallow inclinations occurred at 125 m. Verification of this reversed polarity horizon is hampered by the cyclic presence of turbidites and the presence of a

high-coercivity secondary mineral phase. To verify the results of the long-core measurements, a few discrete samples were collected and demagnetized up to a peak-field of 110 mT.

Structural Geology

The sediments cored in Hole U1518E include intervals of gently to moderately dipping beds (0°–30°). Where beds can be measured, their orientations tend to be systematic within a given core. Small normal faults are found locally, typically showing offsets of <5 cm. The cores have suffered significant drilling disturbance, precluding detailed structural measurements. The most common drilling disturbance features are upward warped beds associated with piston coring, which do not yield reliable orientations. More severe drilling disturbance results in large domains with mingled lithologies sheared parallel to the core liner. We have not been able to recognize any key structural intervals in this hole.

Geochemistry

The Geochemistry Laboratory focused on processing whole-round (WR) samples for interstitial water (IW) analysis and headspace and void gas samples for gas analysis. IW samples were collected at a resolution of six per core down to 20 m, three per core from 20 to 40 m, and ~1–2 per core below 40 m. IW salinity, pH, alkalinity, and Cl concentrations, as well as headspace/void gas methane, ethane, and propane concentrations were measured in near-real time, and the remaining pore water was subsampled and preserved for additional shipboard and shore-based analyses. Between Cores U1518E-1H and U1518F-5R (~227 m), Cl concentration ranges from 552 to 580 mM, salinity concentration ranges from 32 to 36 PSU, and alkalinity concentration ranges from 2.4 to 26.5 mM with a maximum in Section U1518E-2H-1. Methane is present in all cores but no heavier hydrocarbons were detected. The geochemistry group is currently processing WR samples from Hole U1518F, measuring major and minor element concentrations on the ion chromatograph and phosphate and ammonium concentrations on the spectrophotometer, and also preparing samples for TOC and TIC analyses.

Physical Properties and Downhole Measurements

We measured WR cores from Holes U1518C, U1518D, U1518E, and U1518F, and split-core sections and discrete samples from Hole U1518E. A drastic change in physical properties is observed at 10 m in Hole U1518E, with porosity decreasing from 70% to 45% and compressional wave velocity increasing from 1500 to 1600 m/s. Downhole temperature (APCT-3) measurements and thermal conductivity values yield a preliminary heat flow value of 74 mW/m². This value is high given the regional environment but consistent with shallow probe measurements of heat flow previously collected near Site U1518.

Core-Log-Seismic Integration

The week started with learning how to use Techlog and producing Techlog projects with the necessary logging-while-drilling (LWD) data that we will need for Expedition 375. Some effort

was required to confirm that we are working with the latest versions of resistivity-at-the-bit (RAB) images processed by Schlumberger for Expedition 372. RAB bedding, fracture, and breakout data picked by Expedition 372 scientists were circulated to scientists on board. Subsets of core description and physical properties data were uploaded to Techlog, and preliminary synthetic seismic traces were produced. High-resolution plots of LWD data, seismic data, and maps for Site U1518 were provided to the rest of the science party. Based on the LWD data, we reevaluated the target depths for the various modules of the Site U1518 observatory.

Observatory

IODP JRSO engineers added pressure lines and valves to the CORK wellhead. The osmosampler housing was filled with water to prevent the fluid lines from filling with air. All temperature sensors were programmed and attached to the instrument string's rope sections. The pressure loggers were tested and confirmed to be operational and logging data correctly. Calculations are in progress for the lengths of the various rope segments needed to connect the osmosampler assembly, temperature loggers, weak links, and sinker bars.

Education and Outreach

Live Broadcasts

This week the Education/Outreach team conducted four live broadcasts with schools in the UK, Germany, Australia, and the USA. These reached 865 students, aged between 10 and 17 years old. The German broadcast was streamed live on a German teenager's TV channel. These included participation of both shipboard scientists as well as technical staff.

"Ship's log" Blog

We posted four blogs on <http://joidesresolution.org>, covering "Follow our Journey," "Meet the 375 team," "The hanging wall of Hikurangi," and a "First core on deck" video. Future blogs in development include a blog about shipboard signs, a video about how we store cores, Mt. Hikurangi, the Gisborne student's video, CORK observatories, a video interview with the Co-Chief Scientists, and other topics.

Social Media

We posted photos on Facebook (<https://www.facebook.com/joidesresolution>), Twitter (<https://twitter.com/TheJR>), and Instagram (http://instagram.com/joides_resolution) daily. The Facebook statistics are good, showing a total of 11,994 people reached (up 134% on the previous week), and 58 new followers (up 234%). There are three videos: a quick tour, a time-lapse, and a longer "First core on deck" clip. On Twitter, we have had 739 new followers and good engagement. On Instagram, we posted five times and attracted about 160 new followers. There

have been three videos published to the *JOIDES Resolution* YouTube channel (<https://www.youtube.com/user/theJOIDESResolution/>)

Technical Support and HSE Activities

The following technical support activities took place during Week 2.

Underway Activities

- Magnetic and bathymetric data were collected on the transit from Timaru to Site U1518.

Laboratory Activities

- Laboratory orientations and training were given to the science party.
- After extensive troubleshooting of the Bruker D4 XRD between IODP staff and a Bruker engineer, it has been determined that a board in the detector that facilitates communication between the detector and measurement software has failed and no measurements can be made. Contingency planning is in progress.
- Two of the Carver 25-ton jacks on one of the pore water squeezing units were serviced and put back into service after performing poorly.

Application Support Activities

- Continued work on Cahn Balance program.
- Helped resolve minor issues with the superconducting rock magnetometer and the *P*-wave discrete and whole-round systems.
- Trained core-log-seismic integration scientists how to use the stratigraphic correlation software.

IT Support Activities

- Redeployed the Windows 7 MAD instrument host.
- Updated Cumulus database.
- Updated ship website content.
- Resolved problem with bow VSAT antenna not locking onto satellite.
- Assisted with troubleshooting of the Bruker D4 Diffractometer and its host computer.

HSE Activities

- Held the weekly fire and boat drill as scheduled.
- Tested safety showers and eye wash stations.