

IODP Expedition 375: Hikurangi Subduction Margin

Week 6 Report (8–14 April 2018)

Operations

This week we finished coring at Site U1520, spent nearly three days not being able to conduct drilling operations due to poor weather, and started observatory operations at Site U1519.

Site U1520

Coring in Hole U1520C ended with Core 44R at 0515 h on 8 April. We terminated coring at that point so we could conduct wireline logging before the weather deteriorated. To prepare the hole for logging, we circulated the cuttings out of the hole with a 50-barrel mud sweep, filled it with heavy mud, and recovered the rotary core barrel (RCB) bottom-hole assembly (BHA). The subsea camera was deployed to check the reentry cone, which seemed to have sediment inside, and the cone was flushed with seawater. Once the drill string was recovered, we made up a logging BHA and lowered it to the seafloor. Hole U1520C was reentered at 0250 h on 9 April and the drill pipe was set at 599 m for logging, 42 m above the casing shoe. We deployed a modified triple combo tool string with the following tools from the bottom up: Dipole Sonic Imager (DSI; sonic velocity), High-Resolution Laterolog Array (HRLA; resistivity), Hostile Environment Litho-Density Sonde (HLDS; caliper only, without the density source), and Enhanced Digital Telemetry Cartridge (EDTC; gamma ray and telemetry). We made two logging passes from 642 to 947 m, where we encountered an obstruction at 107 m from the bottom of the hole. The tools were back on the rig floor at 1505 h on 9 April, and the drill string was recovered at 0010 h on 10 April, ending operations at Hole U1520C.

Waiting on Weather

Based on weather forecasts predicting 7–10 m swells at the vicinity of our drill sites, we headed north to the Bay of Plenty to seek shelter. We started the 204 nmi transit at 0118 h on 10 April and completed it at 1054 h on 11 April at an average speed of 6.1 kt due to the strong winds and high sea state. We waited on weather for 36.75 h. We started the 172 nmi transit to Site U1519 at 0018 h on 13 April and arrived on site at 1810 h.

Site U1519

Operations at Site U1519 include installing an observatory to ~280 m that will collect temperature and pressure data, and coring a portion of the sedimentary section. Hole U1519A was drilled during Expedition 372 for logging-while-drilling (LWD) measurements. Upon arrival at 1810 h on 13 April, we moved the base of the reentry cone needed for the observatory installation to the moonpool. Next, we assembled a BHA with a 14¾ inch drill bit. Hole U1519B was started at 0105 h on 14 April and reached a total depth of 285.1 m at 1630 h. A 30-barrel

mud sweep was circulated to clean the hole of cuttings and the bit was raised to 71 m below the seafloor. At 1845 h, the reentry cone and its base were released from the moonpool and allowed to fall to the seafloor. The subsea camera was deployed to check that the reentry cone had landed properly and to observe the reentry cone while pulling the BHA out of the hole. The subsea camera was recovered at 2015 h and the drill string was recovered at 2225 h on 14 April. Finally, the hydraulic release tool (HRT) that will be used to deploy the first stage of the observatory was assembled and stored in the derrick.

Science Results

Science activities during the week included collecting the last analyses from Hole U1520C and taking personal samples for postcruise research.

Lithostratigraphy

We described the last cores from Hole U1520C. Cores 42R through 44R are somewhat enigmatic. They contain a blend of several lithologies without a recognizable stratigraphic organization. The lithologies include altered volcanoclastic conglomerate, black pyrite-rich siltstone, dark gray mudstone with planar laminae and elevated concentrations of organic carbon, reddish-brown mudstone, light gray limestone, and vesicular basalt with preserved interstitial and/or trachytic texture.

Biostratigraphy

We analyzed a few more foraminifer and nannofossil samples to refine the ages of the Miocene–Cretaceous sediments and worked on the Hole U1520C report.

Paleomagnetism

We completed thermal demagnetization of the last few discrete samples, which confirmed the results obtained from the archive-half sections, and we worked on the Hole U1520C report.

Structural Geology

In the bottom of Hole U1520C (Cores 42R through 44R), we observed distinct flow banding. This interval contained dispersed veins and cemented zones, as well as a number of faults with low to moderate dips, which were generally absent in the volcanoclastic material above. Further analysis of thin sections was carried out to constrain the textures and compositions of the structures observed as well as their structural reorientations. The rest of the week was spent working on the Hole U1520C report.

Geochemistry

We finished the pore water and bulk sediment analyses for Hole U1520C. In total, 30 whole-round samples were analyzed for pore water composition and 86 bulk sediment samples were analyzed for CaCO₃, inorganic carbon, organic carbon, and nitrogen concentrations. The rest of the week was spent working on the Hole U1520C report.

Physical Properties

At Site U1520, porosity values in the pelagic section from 646 to 849 mbsf generally range from 33%–48%, with a few distinct shifts and changes in the porosity-depth trend that coincide with minor lithologic variations. Below 849 mbsf, in the volcanoclastic unit, porosity values range from 40% to 60%. From 826 mbsf to the bottom of the hole, several instances of low porosity consistently appear that are roughly 20%–25% lower than the general trend.

Thermal conductivity values increase from ~1.21 W/(m·K) at 646 mbsf to 1.82 W/(m·K) at 700 mbsf, stay constant to 850 mbsf, and decrease to 1.22 W/(m·K) between 850 and 1038 mbsf. *P*-wave velocity values increase with depth from 2000 m/s at 646 mbsf to ~2400 m/s at 690 mbsf, below which they stay constant to 849 mbsf. Between 849 and 1016 mbsf, *P*-wave velocity values range between 1.8 and 4.9 km/s, with considerable variation that appears to correlate with degree of cementation. Between 1016 and 1045 mbsf, values decrease with depth from 3.5 to 1.5 km/s.

Core-Log-Seismic Integration

We analyzed the wireline logging data collected in Hole U1520C. The new data reveal the presence of a low velocity zone at 850 mbsf, which corresponds with the boundary between the two primary lithostratigraphic units. The wireline logs were merged with the LWD sonic data collected during Expedition 372 to produce a complete *P*-wave velocity log from 0 to 940 mbsf. This log was used together with a composite LWD density and laboratory density record to compute a synthetic seismic trace for Site U1520 from 0 to 940 mbsf. This allowed us to develop a more detailed interpretation of the seismic reflection stratigraphy around the deeper part of Hole U1520C, and to consider a range of possible correlation scenarios to the deformation front. Finally, an analysis of precruise seismic sections and Hole U1519A LWD data collected during Expedition 372 was used to assist with observatory planning at Site U1519.

Observatory

We undertook preparations for the Site U1519 Observatory installation, including testing of the pressure data loggers, and began assembling the temperature sensors and ropes. We continued working on the Site U1518 report.

Education and Outreach

Live Broadcasts

This week we conducted five live broadcasts with schools and universities in New Zealand and the United States. These reached 240 people, from middle school to university students.

Social Media

We posted photos and videos (see below) on Facebook (<https://www.facebook.com/joidesresolution>), Twitter (<https://twitter.com/TheJR>), and Instagram (http://instagram.com/joides_resolution). Facebook had 9,728 followers, Twitter had 3,998 followers, and Instagram had 1,074 followers. We also hosted a Reddit “Ask Me Anything” live event on 8 April.

Videos

We posted an animation of the Site U1518 observatory installation on YouTube, Facebook, Twitter, and Instagram, and started working on a video explaining core-log-seismic integration.

Blogs

We published four blogs at <http://joidesresolution.org> on the geology and scientific objectives of Site U1520, a profile of an early career scientist, and an animation of the Site U1518 observatory installation.

Technical Support and HSE Activities

The following technical support activities took place during Week 6.

Laboratory Activities

- Finished processing cores from Hole U1520C including taking additional personal samples.
- Dismantled and removed core racks and deck grating from the Core Receiving Platform (Catwalk) in preparation for the crew to perform repairs.
- Performed an inventory of the library books.
- Continued cross training on the NGR and MAD measurements, including a presentation on the Python programming language.
- Refurbished the small sample saw.
- A list of requested updates to the ship and shore websites’ laboratory layout pages was submitted to the IODP webmaster. Still images of the current laboratory equipment will be taken when the laboratories are clean at the end of the expedition.

Application Support Activities

- Continued work on the Cahn Balance program.
- Fixed a minor issue with the LORE Drilling Summary reports.
- Updated the “About” section of the Thermal Conductivity report to reflect recent changes.

IT Support Activities

- Implemented firewall configuration changes for new Oracle server.
- Created email and server accounts for Expedition 376 participants.
- Satellite outages continued through Tuesday due to the autumnal equinox.
- Assisted multiple users with subscriptions that had expired since leaving port a month ago and required internet access to renew.

HSE Activities

- The IODP technical staff Marine Emergency Training Squad (METS) participated in a simulated fire drill and casualty evacuation.
- We held the weekly fire and boat drill as scheduled.
- Conducted emergency drill for IODP and Siem Offshore 1800–0600 h night shift personnel.
- We tested safety showers and eye wash stations.