IODP Expedition 375: Hikurangi Subduction Margin

Week 7 Report (15–21 April 2018)

Operations

This week we finished the observatory installation at Hole U1519B and cored Holes U1519C, U1519D, and U1519E.

Hole U1519B

The next step in the observatory installation was to assemble the 279 m long ACORK casing string, consisting of 22 joints of 10¾ inch casing, two casing joints with 2 m tall screens for pressure monitoring, and an umbilical secured on the outside of the casing to connect the two casing screens to pressure loggers on the wellhead. As the casing string was assembled from the bottom up, the umbilical was connected to the bottom and top screen, intended to be deployed at 264 and 124 m below seafloor, respectively. The casing string was completed at 1245 h on 15 April and landed in the moonpool.

Next, we assembled the drilling assembly needed to help get the casing into the predrilled hole. The drilling assembly was composed of a 9⅞ inch drill bit, an underreamer with its arms set to 14 inch to clear any obstacles in the predrilled hole, and a mud motor to rotate the bit and underreamer in isolation from the ACORK casing. The underreamer arms were tested and the drilling assembly was completed and landed inside the casing by 1645 h on 15 April.

The pressure umbilical terminations were made on the ACORK wellhead at 1930 h, and the wellhead was submerged for 10 min with the valves in the open position to purge the lines of air. The wellhead was then brought back to the surface to set the valves to their deployment (closed) position, and the wellhead was submerged for the last time. The entire assembly with the hydraulic release tool (HRT), the ACORK wellhead, casing and umbilicals, and the drilling assembly was lowered to the seafloor between 2000 and 2130 h on 15 April.

The subsea camera was then deployed to assist with the reentry. Hole U1519B was reentered at 2310 h, and the ACORK wellhead landed in the reentry cone on the seafloor at 0635 h on 16 April. Once the ACORK had been released (0715 h), we recovered the subsea camera and deployed a free-fall funnel (FFF) at 0845 h. The subsea camera was redeployed to verify that the FFF had landed correctly on top of the ACORK wellhead. The drill string with the mudmotor, underreamer, and drill bit was recovered at 1605 h, and the bottom-hole assembly (BHA) was cleaned with water.

In preparation for deploying a bridge plug at the bottom of the ACORK casing, the drill string was deployed with a 9⅞ inch drill bit BHA. Hole U1519B was reentered at 2100 h on 16 April with the aid of the subsea camera, the hole was cleaned of cuttings, and the drill string was

recovered at 0315 h. Next, we assembled a BHA with a bridge plug to seal the bottom of the ACORK casing. The drill string was lowered to the seafloor and the subsea camera was deployed to aid with the reentry. Hole U1519B was reentered at 0755 h on 17 April. The end of the drill string was positioned at 277 m inside the ACORK casing, the bridge plug was activated until the packer was set at 1135 h, and the bridge plug BHA was recovered at 1455 h.

Next, we started assembling the 269 m long CORK-II casing string, which consists of 20 full joints and four pup joints of 4½ inch casing, four 6¾ inch drill collars, and a bull nose. The CORK-II body and casing string were deployed with a J running tool and the entire assembly was lowered to the seafloor. The subsea camera was deployed and the CORK-II entered the ACORK funnel at 0120 h on 18 April. The CORK-II wellhead was lowered to ~20 m above the ACORK and was kept there while we deployed the instrument string.

At 0230 h on 18 April, we started assembling the 268 m long instrument string, which consists of a single segment of Spectra rope with 15 miniature temperature loggers, one weak link and a sinker bar at the bottom, and a top plug. The top plug was connected to the Schlumberger wireline with the Electrical Release System (ERS), and the instrument string was lowered to the seafloor inside the drill pipe connected to the running tool. Once the top plug latched inside the CORK-II wellhead at 0530 h, the ERS mechanism was activated, releasing the instrument string. The CORK-II then landed inside the ACORK funnel at 0700 h, and was released from the running tool at 0735 h on 18 April, completing the observatory installation. Following a brief visual survey of the wellhead, the camera and running tool BHA were recovered at 1100 h. In the inspection video we noted minor damage of the CORK-II wellhead caused during the running tool release, and a thick cuttings cover over the hydraulic connections in the ACORK funnel, which should not pose a problem for future data recovery.

Hole U1519C

The primary coring objective at Site U1519 was to sample sediments in the intervals surrounding the ACORK pressure screens (around 124 and 264 m) and in the sedimentary section from ~520–640 mbsf. In preparation for coring, we assembled a rotary core barrel (RCB) BHA. The drill string was lowered to the seafloor and the vessel was offset 20 m from Hole U1519B at a heading of 122°. Hole U1519C was started at 1640 h on 18 April and drilling without core recovery continued to 108 m until 0600 h on 19 April. The center bit was removed and Cores 2R to 7R advanced from 108.0 to 163.6 m and recovered 11.67 m (21%). This interval brackets the top pressure screen of the ACORK observatory. The center bit was redeployed and we drilled without core recovery from 163.6 to 250.0 m. The center bit was removed and Cores 9R to 12R advanced from 250.0 to 288.4 m and recovered 23.84 m (62%). This interval brackets the bottom pressure screen of the ACORK observatory. Recovery over this entire interval was 35.51 m (38%). The center bit was redeployed and drilling without core recovery continued to 518.4 m until 0915 h on 20 April. The center bit was removed and Cores 14R to 26R advanced from

518.4 to 640.0 m and recovered 83.66 m (69%). Recovery over the entire interval was 119.17 m (55%). The drill string was recovered at 0815 h on 21 April, and the RCB BHA was put away.

Hole U1519D

The final objective at Site U1519 was to core the shallow sedimentary section and collect in situ temperature measurements with the advanced piston corer temperature tool (APCT-3). An advanced piston corer/extended core barrel (APC/XCB) BHA was assembled and the drill string was lowered to the seafloor. The vessel was offset 10 m at a heading of 122°, and Hole U1519D was started at 1505 h on 21 April. Cores 1H to 3H advanced from 0 to 23.2 m and recovered 23.64 m (101%).

Hole U1519E

Because coarse unconsolidated material made it difficult to collect in situ temperature measurements and resulted in a partial stroke with Core U1519D-3H, we decided to start a new hole. The vessel was offset 20 m at a heading of 122°, and Hole U1519E was started at 1845 h on 21 April. Cores 1H to 5H advanced from 0 to 40.1 m and recovered 40.47 m (101%). At the end of the week we were cutting Core 6H, with APC coring planned to ~80 m before moving to proposed Site HSM-08A.

Science Results

Science activities during the week included science presentations on Hole U1520C findings, a presentation on postexpedition obligations and moratorium guidelines, and processing cores from Holes U1519C, U1519D, and U1519E.

Lithostratigraphy

Description of cores from Hole U1519C continued this week. Cores 2R to 5R are composed of mudstone with variable amounts of silt-sized sediment, and are severely disturbed by drilling. Cores 6R and 7R had very little recovery. Cores 9R to 12R contain mudstone with a few sand pods, and are also heavily disturbed by drilling.

In Core 12R, the mudstone becomes slightly coarser and lighter in color. Cores 14R to 19R contain dark greenish-gray mudstone and scattered interbeds of fine sandstone. The interbeds are several centimeters thick, normally graded, and contorted by drilling disturbance.

Core 19R contains an interval with soft-sediment deformation, interpreted as a mass transport deposit. Below that interval, the abundance, thickness, and grain size of sandy beds increase considerably. The sand beds in Cores 22R and 23R are weakly indurated and contain mostly

sedimentary-rock fragments and shell fragments. These lithologies remain common to the bottom of Core 26R.

Biostratigraphy

Planktonic foraminifer biostratigraphy suggests that in Hole U1519C we recovered late middle Pleistocene sediments (<0.54 Ma) in intervals 2R-CC, 15–20 cm, through 6R-CC, 0–12 cm (111.69–144.42 mbsf) and 9R-CC, 9–19 cm, through 12R-CC, 6–16 cm (256.76–284.80 mbsf), and middle early to middle Pleistocene sediments (0.54–2.17 Ma) in interval 14R-CC, 0–15 cm, through 26R-CC, 0–5 cm (522.39–635.65 mbsf). The presence of the calcareous nannofossil *Gephyrocapsa* spp. (medium) in Sample 22R-CC, 13–23 cm (602.98–603.08 mbsf) indicates a Pleistocene age (<1.73 Ma).

Paleomagnetism

Paleomagnetic analyses at Hole U1519C included the measurement of the natural remanent magnetization (NRM) of archive-half core sections prior to and following stepwise alternating field demagnetization in increments of 10 mT to a peak field of 40 mT. Severe drilling disturbance between 100 and 150 mbsf (Cores 2R to 5R) and 250 and 300 mbsf (Cores 9R to 12R) resulted in destruction of the primary depositional remanence. All core sections between 525 and 635 mbsf were measured.

The data interpretation is made difficult by the overall tectonic deformation of the sedimentary succession, disturbance of the magnetic remanence by mass transport deposits, and most likely the diagenetic acquisition of a secondary chemical remanence. Vector component diagrams often display complex demagnetization trajectories that do not extend through the origin. Inclinations are predominantly negative to 591 mbsf, and predominantly shallow and positive below 591 mbsf.

Structural Geology

The shallow intervals recovered in Hole U1519C yielded intensely biscuited sediments that precluded any meaningful structural observations. Structural features were preserved in Cores 14R and below (>518.4 mbsf), and include bedding planes with dips up to 60° (including several intervals of overturned bedding) and abundant filled and open fractures with dips between 0° and 90°. Fractures were observed both parallel to and inclined relative to bedding. Some fractures were probably drilling induced but the abundant filled fractures, often in complex intersecting arrays, illustrate in situ deformation features. Few faults were interpreted, due to a lack of clear offset horizons and other slip indicators.

Geochemistry

Seventy-four whole-round (WR) samples were collected for pore water chemical analyses at Site U1519. Chloride concentrations in Hole U1519C range from 460 to 557 mM. Alkalinity ranges

from 15 to 38 mM. Headspace gas samples were collected at a resolution of two per core in Hole U1519C. The gas composition is dominated by methane, but trace amounts of ethane and propane were present below 520 mbsf. Samples from Holes U1519D and U1519E are still being processed.

Physical Properties

Preliminary moisture and density (MAD) measurements from Hole U1519C cores yield a general decrease in porosity with depth, ranging from ~45% at 110 mbsf to 34% at 566 mbsf. Thermal conductivity ranges from 1.1–1.3 W/(m·K) at 109–135 mbsf to 1.3–1.5 W/(m·K) at 250–285 mbsf. *P*-wave velocity ranges from 1480 to 1640 m/s at 0–10 mbsf, and gradually increases with depth to ~2000 m/s at ~600 mbsf.

Core-Log-Seismic Integration

The week was largely spent working on the integration of Site U1519 coring, logging, and seismic data. Synthetic seismic traces were developed from Site U1519 logging-while-drilling data and the velocities were compared with preexpedition velocity models. We also assisted the management team with final selection of the seamount site (HSM-08A or alternate Sites HSM-11A/12A).

Observatory

The ACORK was assembled and installed with the pressure umbilical on the outside, and the pressure monitoring equipment was mounted on the ACORK head. We tested and programmed the correct sampling rates on the pressure monitoring equipment prior to mounting on the ACORK head. The CORK-II was then assembled and inserted within the ACORK. Temperature sensors were attached to the CORK-II instrument string, the rope was cut to length, and end splices were completed based on a final length determination. The instrument string was lowered into the drill pipe and then lowered down into the CORK-II casing with the Schlumberger wireline. The weight of the instrument string was monitored, and the top plug appears to have seated appropriately.

Education and Outreach

Live Broadcasts

This week we conducted six live broadcasts with schools and universities in France, China, and the United States. These reached 213 people, from high 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 8,212 followers, Twitter had 4,011 followers, and Instagram had 1,084 followers.

Videos

We posted three videos on YouTube, Facebook, Twitter on (1) "Old meets new" about the techniques involved in splicing the rope used for the observatory instrument string, (2) micropaleontology (on Facebook this reached 3,200 people), and (3) a squid vs squid attack captured by our subsea camera during observatory operations.

Blogs

We published six blogs at http://joidesresolution.org, including a blog on the geology and scientific objectives of Site U1519 and the observatory, two profiles of early career scientists, and three video blogs (see above).

Technical Support and HSE Activities

The following technical support activities took place during Week 7.

Laboratory Activities

- We assisted with the assembly of the Hole U1519B ACORK.
- We reassembled the Core Receiving Platform (Catwalk) after extensive maintenance by the Siem Offshore crew.
- We processed cores from Holes U1519C, U1519D, and U1519E.
- The Chemistry Laboratory technician provided training on the gas safety protocol and use of the gas chromatographs.

Application Support Activities

- We deployed the Cahn Balance program and we are ready for testing.
- We made a modification to the new Thermal Conductivity Uploader.
- We corrected all Drilling Summary Reports to display bottom drilling depth.
- We discussed with the Laboratory Officer and Expedition Project Manager about the comments displayed in LORE reports.
- Cahn Balance: made user interface changes, did the module testing, continued testing communication with device, deployed, and ready for testing.

IT Support Activities

- An instructional document has been produced to assist any scientist wanting to use the Mozilla Thunderbird email program to take their ship email home.
- Linux software licensing reporting issues were resolved.
- Instrument host backup reporting issues were resolved.
- Shipping documentation for Expedition 375 has been completed.
- Windows security updates for April were applied to computers in the Core Deck laboratories before coring resumed late in the week.

HSE Activities

- IODP JRSO technical staff participated in chemical spill training and a simulated spill of hydrogen peroxide in the Paleontology Prep Laboratory.
- Staff received training in dry ice shipping procedures.
- We tested safety showers and eye wash stations.