IODP Expedition 371: Tasman Frontier Subduction Initiation and Paleogene Climate

Week 8 Report (10–16 September 2017)

Operations

Week 8 began while waiting on weather in dynamic positioning (DP) mode at a position 380 nmi north of Site U1510 (proposed Site LHRS-3A). At 0736 h on 10 September, the thrusters were raised and the vessel began the transit to Site U1510. The voyage was made in heavy winds and seas and the vessel arrived at 0918 h on 12 September. The thrusters were lowered, DP was established, and the drill floor was cleared for operations at 0936 h. No seafloor positioning beacon was deployed at this site.

An advanced piston corer (APC)/extended core barrel (XCB) bottom-hole assembly (BHA) was assembled and deployed. After the first seven stands of drill pipe were added, the iron roughneck clamping valve refused to unclamp from the drill pipe. While the repair was taking place, drill pipe assembly continued using the rig tongs instead of the iron roughneck for the next 23 stands. When the iron roughneck repair was complete, the remaining eight stands of drill pipe were run. The top drive was picked up, the nonmagnetic core barrels were dressed with core liners, and the orientation tool was installed. Coring in Hole U1510A started at 1915 h on 12 September.

APC coring continued through Core 17H, which stroked out only ~3 m because the cutting shoe impacted a chert layer. At 0645 h on 13 September we decided to switch to XCB coring. We stopped deploying the orientation tool after Core U1510A-15H. Temperature measurements were taken on Cores 4H, 7H, 10H, 13H, and 17H. The APC-cored interval penetrated from 0 to 150.5 m DSF and recovered 147.9 m (98%).

XCB coring continued until 1930 h on 14 September. Cores 18X through 52X penetrated from 150.5 to 483.4 m DSF and recovered 108.1 m (32%). Recovery was seriously compromised because of frequent chert layers.

Coring in Hole U1510A concluded with a total penetration of 483.4 m DSF and total recovery of 260.0 m (53%). The drill pipe was retrieved from Hole U1510A, clearing the seafloor at 2135 h on 14 September and ending Hole U1510A. The time spent on Hole U1510A was 60 h or 2.5 d.

The ship was offset 20 m to the east and APC coring in Hole U1510B began at 2300 h on 14 September with Core 1H and ended at 0215 h on 15 September with Core 7H. Nonmagnetic core barrels were used for Cores 1H through 7H and a single APCT3 temperature measurement was taken on Core 7H. Cores U1510-1H through 7H penetrated from 0 to 66.3 m DSF and recovered 64.7 m (98%). The drill string was recovered and the rig floor was secured for transit at 0815 h, ending Hole U1510B and operations at Site U1510. The time spent on Hole U1510B was 10.75 h or 0.4 d.

The thrusters were raised and at 0842 h the ship began the transit to Site U1511 (proposed Site TASS-2A). The ship completed the 216 nmi transit at an average speed of 7.7 kt and arrived at Site U1511 at 1248 h on 16 September. The thrusters were lowered and DP was established. Operations at Hole U1511A began at 1334 h with the assembly of a rotary core barrel (RCB) BHA. By the end of the week, deployment of the drill string had reached 4097 m below the rig floor, 761 m above the seafloor.

Science Results

During week 8, scientists collected data and observations for Holes U1510A and U1510B. All depth references in meters refer to the depth scale type CSF-A, unless noted otherwise.

Lithostratigraphic Unit I (0–138.0 m) is composed of calcareous ooze with subtle color banding in the uppermost 33.4 m. The boundary between Unit I and Unit II is defined by the first occurrence of chert at 138 m.

Lithostratigraphic Unit II (138.0–418.1 m) consists of ~340 m of calcareous ooze and chalk interbedded with cherty limestone and chert. Unit II is divided into three subunits. Subunit IIA is a ~9.5 m thick white homogenous nannofossil ooze with bioclasts. The upper ~30 cm of Subunit IIA consists of centimeter-sized extraclasts composed of chert, cherty limestone, and lithic clasts. Although this interval could be affected by drilling disturbance (i.e., "fall-in" at top of core), it also contains the first occurrence of chert, and similar material had not been found in the cores above. Subunit IIB (147.5–349.4 m) is a 201.9 m thick interval of light gray, moderately bioturbated clayey calcareous chalk interbedded with cherty limestone. Subunit IIC (349.4–478.1 m) is a 128.7 m thick homogenous white nannofossil chalk interbedded with chert and sparse siliciclastic intervals in the lower portion of the subunit.

Core recovery in Unit I was near 100%, with coring disturbance limited to uparching and soupy sediments. Recovery dropped to ~20% in Subunits IIA and IIB due to the presence of chert and cherty limestone and the use of the XCB coring system, with drilling disturbance including severe fracturing of chert and cherty limestone intervals and moderate to severe biscuiting of the calcareous chalk intervals.

Nannofossils are generally abundant with moderate preservation. Planktic foraminifera abundance and preservation decrease downhole (from 215 m and 187 m, respectively) with a few barren samples. Radiolaria are rare throughout except for a short middle Miocene interval (109.6–119.7 m) where the preservation is good. Benthic foraminifera were recovered with generally low abundance from all cores, with very good preservation for the Neogene and generally poor preservation for the Paleogene. Paleodepth was lower bathyal from the Pleistocene through the Eocene. During the late and middle Eocene a significant component of the benthic fauna appears to be derived from shallower (shelf, upper bathyal, middle bathyal)

sources. Ostracods are very abundant in most samples with good preservation from 0 to ~150 m, and with poor preservation below. Due to weather constraints on processing, no samples from Site U1510 were analyzed for palynology.

Based on nannofossil and foraminifera biostratigraphy, the following ages were determined for the sequence in Hole U1510: Pleistocene (5.0–33.5 m), Pliocene (43.1–70.3 m), Miocene (72.3–135.4 m) and late, middle, and early Eocene (138.8–147.7 m, 150.5–438.9 m, and 448.9–478.2 m, respectively).

Low intensity of natural remanent magnetization of most cores, low core recovery, and significant core disturbance from XCB coring make it difficult to establish shipboard magnetostratigraphy at Site U1510.

Physical property measurements show a gradual increase in bulk density and *P*-wave velocity with depth in the nannofossil and foraminiferal ooze of Unit I. In Subunits IIA and IIB, from 140 to ~350 m, physical property measurements are less reliable and sparse due to drilling disturbance and low recovery, respectively. Bulk density (~1.75 g/cm^3) and *P*-wave velocity (~1750 m/s) increase downhole to 300 m and then decrease again to the base of Subunit IIB, where fewer chert layers are observed. Magnetic susceptibility and natural gamma radiation (NGR) both increase downhole in these two subunits, then decrease towards the base of Subunit IIB. *P*-wave velocity peaks and spikes in NGR in Subunit IIC correlate with sandstone and claystone. Near the base of the hole (~470 m), where sediments become more lithified, density and velocity increase and porosity decreases.

Headspace samples from Site U1510 yielded hydrocarbon gas concentrations below detection limit. A total of 118 interstitial water (IW) samples were taken from Site U1510 by squeezing whole-round sediment and by Rhizons. Concentrations of Ca increase, and Mg and K concentrations decrease downhole, similar to Sites U1506 and U1507. These profiles may result from the reaction of pore water with volcanic material in the sediment. Sulfate and ammonium concentration profiles mirror each other, suggesting sulfate reduction of organic matter. Dissolved Sr, Si, Li, and B concentrations increase downhole, likely reflecting dissolution of biogenic carbonate and silica. Dissolved Mn and Fe concentrations decrease within the uppermost meter, suggesting the true mudline is missing. Dissolved Fe concentrations in Rhizon IWs decrease downcore, consistent with the smell of H_2S at ~10 m.

Carbonate content is >90% in Unit I as well as in Subunits IIA and IIC, corresponding to calcareous ooze and chalk lithologies. In Subunit IIB, carbonate content decreases downhole towards the middle of the subunit, along with decreasing L* and increasing NGR. Interbedded cherty and tuffaceous layers are distinguished by carbonate contents of <50% and <20%, respectively. Total organic carbon content is mostly below detection limit, but represented by somewhat higher values (0.35%) below 400 m.

Coring of U1510B was monitored in near real time through out-of-sequence measurement of whole-round sections. Using primarily NGR data, cores from Holes U1510A and U1510B were depth-shifted to construct a composite depth scale. A spliced record was generated using the composite scale, which provides a continuous record of the top ~44 m of sediment at Site U1510.

Education and Outreach

Ship-to-Shore video outreach events were held with the participation of several science party members and technical personnel:

- Pullenvale State School, Brisbane (Australia)
- University of Otago (New Zealand)
- Cleveland District High School, Brisbane (Australia)
- Middletown High School, Connecticut (USA)
- Robinson's Secondary High School, Fairfax, Virginia (USA)
- Corinda State High School, Brisbane (Australia)
- Clairvaux Mackillop College, Brisbane (Australia)
- Licei Galilei-Oberdan-Petrarca (Italy)
- Pukerua Bay primary school (New Zealand)
- Lycee Branly Boulogne sur Mer (France)

Preparations are being carried out for 13 upcoming events in New Zealand, Switzerland, USA, Australia, Spain, and Germany. An ABC documentary on the education and outreach program run by IODP from the *JOIDES Resolution,* featuring Pascack Hills High School (Montville, New Jersey, USA), is being planned.

Technical Support and HSE Activities

Underway Activities

- Magnetometer and bathymetric data were collected on the first half of the transit to Site U1510, then were suspended due to heavy sea conditions.

Logistics Activities

- Preparing information for offgoing shipment.

Laboratory Activities

- No issues were reported this week.

Application Support Activities

- Issues with the web service for the X-ray fluorescence (XRF) summary report were fixed.
- A new feature was added to the LDAQ ResourceManager that will be routinely looking for updated resources.
- Work began on the development of a new version of the Change Password application.
- Work began on changes to the MUT uploader program to support a new file format for the JR6 spinner analysis.

IT Support Activities

- Internet outage of ~20 min recurs daily due to signal interference from the sun during autumnal equinox. On September 15, we experienced a 3 h outage period when the antennas failed to reacquire the satellite. RigNet analysts assisted the MCS to restore the VSAT connection.
- Server backup jobs were reviewed and trimmed to reduce the size of backups.

HSE Activities

- The weekly fire and lifeboat safety drill was postponed due to inclement weather.
- Staff completed routine checks of laboratory safety systems.