IODP Expedition 368X: Return to Hole U1503A (South China Sea)

Week 3 Report (25 November–1 December 2018)

The third week of International Ocean Discovery Program (IODP) Expedition 368X: Return to Hole U1503A (South China Sea) comprised coring in Hole U1503A (proposed Site SCSII-9B) from 1470.5 to 1633.0 m. All times in this report are in ship local time (UTC + 8 h).

Operations

Week 3 of Expedition 368X began while coring in Hole U1503A with the rotary core barrel (RCB) system from a depth of 1470.5 m below seafloor (mbsf) (Core 52R). Coring continued until 0400 h on 26 November 2018 and reached a total depth of 1528.0 mbsf with Core 57R. With 50.8 h on the bit, the hole was circulated clean with a 30-barrel sweep of high viscosity mud. The bit was raised to 1383 m within the open hole (casing extends to 995.1 m) and 200 barrels of 10.5 ppg heavy mud were displaced into the borehole. The heavy mud was used with the intent of increasing the hydrostatic pressure on a very unstable section of hole. The top drive was set back and the drill pipe was pulled back to just above the casing shoe to 953.0 mbsf. The upper guide horn was pulled up and the subsea camera system was deployed.

While running the subsea camera system to just above the seafloor, a slip and cut of the drilling line was performed. The bit was pulled out of the hole at 1247 h and cleared the secondary funnel without issue. The measurement to the top of the cone was confirmed as 3879.7 m below rig floor (mbrf). The subsea camera system was pulled back to the surface and secured onboard. The remainder of the drill string was recovered and the bit cleared the rig floor at 2045 h on 26 November. The outer core barrel was disassembled and inspected and a new C-4 bit was picked up and installed with a mechanical bit release (MBR).

The drill pipe was lowered to 3855 m below the rig floor and at 0545 h the subsea camera was deployed. Hole U1503A was reentered at 0830 h on 27 November 2018 after 30 min of maneuvering. The subsea camera system was pulled back to the surface and the trip back to bottom continued until the driller encountered a bridge at 1345.0 mbsf. The top drive was picked up and the driller washed and reamed from 1345.0 mbsf back to bottom at 1528.0 mbsf. After reaching total depth, the hole was circulated clean with high viscosity mud. A nonmagnetic core barrel was dropped and coring resumed at 2100 h on 27 November.

Coring with bit #2 began with Core 58R and continued through Core 75R (1528.0–1633.0 m). Basement was reached at 1597.84 mbsf. After reaching basement, half cores were used to improve recovery. Basement recovery from 1605.0 to 1633.0 mbsf was 33%. With 42.2 h on the bit, the hole was circulated clean with three 50-barrel sweeps of high viscosity mud. The bit was raised to 1355.7 m within the open hole and 200 barrels of 10.5 ppg heavy mud were displaced into the borehole with the intent of increasing the hydrostatic pressure on the unstable section of the hole. The top drive was set back and the drill pipe was recovered, clearing the seafloor at 1050 h on 1 December. After recovering the remaining drill pipe, the bit cleared the rig floor at 1725 h on 1 December. The outer core barrel was disassembled, cleaned, and inspected, and a new C-7 bit was picked up and installed with an MBR. At the end of Week 3 we had lowered the 5 inch drill pipe to a depth of 2902 mbrf.

Science Results

During Week 3 of Expedition 368X the science party began to acquire and analyze data from Hole U1503A RCB cores. We held daily meetings with the entire science party to discuss operational and laboratory updates. The science party also received a presentation from the Publications Specialist and participated in a videoconference with the Expedition 367/368 Expedition Project Manager and Co-Chief Scientists to discuss the remaining operations at Hole U1503A.

Lithostratigraphy

The structural geologists and petrologist described cores from Hole U1503A by a combination of visual core description (VCD), thin section, smear slide, core imaging, and core scanning for color spectra and magnetic susceptibility (MS). Cores 49R to 75R (1441.7–1633.0 mbsf) were described based primarily on macroscopic description; these combined with Cores 2R to 48R comprise four lithostratigraphic units.

Unit I (995.1–1484.7 mbsf) is composed of well consolidated to lithified claystone, interbedded with greenish gray and dark greenish gray sandstone and siltstone intervals. The transition from Unit I to Unit II is gradual with alternating bands of reddish and greenish gray color. Subunit IIA (1484.7–1533.6 mbsf) consists mainly of well consolidated to lithified dark reddish brown claystone; bioturbation is heavier in the greenish intervals. Subunit IIB (1533.6–1542.8 mbsf) is composed of lithified reddish brown, clay-rich, nannofossil-bearing chalk. Unit III (1542.8–1597.8 mbsf) is composed of greenish gray highly bioturbated nannofossil-rich claystone and dark gray claystone. Recovery of Unit III was poor (<5%) and the recovered material was highly disturbed by drilling. The contact between Unit III and the first igneous material (Unit IV) was recovered at 1597.84 mbsf. Unit IV (1597.8–1633.0 mbsf) is primarily composed of sparsely plagioclase to plagioclase phyric basalt. The texture is ophitic to aphanitic. Glass residues are observed and five chilled margins have been described. Some basalts have a higher density of vesicles. A baked sediment interval was recovered in Core 72R. Randomly oriented veins are filled mainly by calcite and iron oxides, and alteration of the basalt is slight. The textural and structural features of the basalt suggest that it was emplaced as pillows or lobate lava flows.

Archive halves from Cores 49R to 75R (1441.7–1633.0 mbsf) were measured on the Section Half Multisensor Logger (SHMSL). The reddish brown claystone of Subunit IIA has high MS, which decreases in Subunit IIB with increasing carbonate content. The MS of basalts in Unit IV is 1–2 orders of magnitude higher than the sediments.

pXRF (portable X-ray fluorescence) data were collected at 20 cm intervals from Core 51R to 70R (1460.9–1610.5 mbsf), with additional measurements collected at intervals where lithology changes. Unit I is highly variable with respect to Ca, Fe, Rb, and Sr content, whereas Subunit IIA is more uniform. Subunit IIB and Unit III are high in carbonate content, consistent with the abundant observed nannofossils. Discrete samples (16) were collected from Cores 40R to 57R (1355.3–1528.0 mbsf) for X-ray diffraction (XRD) analyses. Sediments are primarily composed of quartz, muscovite, plagioclase, and clay minerals. More than half of the samples also contain calcite.

Paleomagnetism

Hole U1503A archive halves from Cores 49R to 75R (1441.7–1633.0 mbsf) were measured on the superconducting rock magnetometer (SRM) at a 2.5 cm measurement spacing. Cores with <2% recovery were not measured. After measuring the natural remanent magnetization (NRM), Cores 49R to 63R (1441.7–1557.3 mbsf) were subjected to stepwise in-line alternating field (AF) demagnetization at 5, 10, 15, 20, and 25 mT. For Cores 67R to 75R (1576.5–1633.0 mbsf), we adopted a set of narrower AF steps at an incremental rate of 2 mT from NRM up to 10 mT, and at a rate of 5 mT from 10 to 25 mT.

Discrete samples (10) were collected from sediments to perform AF demagnetization. The samples were first measured to determine the anisotropy of magnetic susceptibility (AMS) with an AGICO Kappabridge KLY4. Then, the NRM was measured with a JR-6A spinner magnetometer at room temperature and after demagnetization using the DTECH AF demagnetizer. Archive halves and discrete samples show normal and reverse polarities. The AMS shows an oblate shape with a fabric typical of sedimentation in calm pelagic environment, with the exception of a sample from 1596.4 mbsf that shows a ~30° inclination, which is consistent with structural geology observations.

Geochemistry

Headspace gas samples were collected for the routine safety program in Cores 48R to 70R (1432.1–1610.5 mbsf). Methane averages 1103 ppmv in Cores 48R to 68R before reaching a maximum downhole content of 5066 ppmv in Core 69R (1596.78 mbsf). Core 70R (1606.25 mbsf) contains 529 ppmv methane. Discrete sediment samples for carbonate, total carbon, nitrogen, and sulfur were collected in Cores 48R to 57R (1432.1–1528.0 mbsf). Total carbon decreases over this interval from 1.1 to 0.1 wt%, with organic carbon values below detection limit in Cores 53R to 57R. Nitrogen and sulfur content does not vary greatly, averaging 0.06 and 0.6 wt% respectively.

Discrete samples were collected for shipboard XRD analysis and colocated samples were retained for shore-based analysis for concentrations of major elements and several trace elements via inductively coupled plasma–atomic emission spectroscopy (ICP-AES).

Petrophysics

This week we performed whole-round measurements of MS and gamma ray attenuation (GRA) density on Cores 49R to 60R and 62R to 75R. Natural gamma radiation (NGR) was only measured on Cores 49R to 57R and 69R to 75R because Cores 58R to 68R were too short for meaningful NGR measurements. *P*-wave velocity was measured using the caliper (PWC) at discrete positions on working-half core sections for Cores 49R to 75R. Moisture and density (MAD) was measured on discrete samples for Cores 49R to 69R (sediments) but not on Cores 70R to 75R (basalts). Thermal conductivity (TCON) was measured on discrete samples from Cores 49R to 75R.

The MAD bulk density of discrete samples averaged 2.26 g/cm^3 for claystone and siltstone and 2.56 g/cm^3 for sandstone. The calculated porosity averaged 28.7% for claystone and siltstone and 10.2% for sandstone. Thermal conductivity averaged 2.02 W/(m·K) for claystone and siltstone, 3.75 W/(m·K) for sandstone, and 1.93 W/(m·K) for basalt. *P*-wave velocities of claystone and siltstone increase by ~0.8 m/s per 1 m depth between 995.1 and 1597.8 mbsf, and average 2569.6 m/s. *P*-wave velocities for sandstone (3026–4480 m/s) and basalt (3674–4792 m/s) are much higher. At the transition from sediment to basalt at the basement interface, we observed a major increase in MS and *P*-wave velocity coupled with a decrease in NGR.

Technical Support and HSE Activities

The following technical support activities took place during Week 3.

Laboratory Activities

- Processed Cores 52R through 75R from Hole U1503A.
- IODP JRSO technical staff participated in cross-training activities.
- Replaced the adsorber on the current spare Cryomech compressors for the SRM.
- Electronics technicians gave Core Laboratory technicians training in the use of the large pneumatic staplers.

Application Support Activities

- Worked on modules of the new sampling/curation program (SPLAT).
- Working on converting Lims2Excel to Java 9, then to Java 11.
- Worked on SampleBrowser for the Sample Master replacement software.
- Fixed bugs in the MadMax MAD software.

IT Support Activities

- Discovered a compatibility issue with our iPrint version and macOS High Sierra, and discussed it with the oncoming MCSs, who will bring patches to address the issue.
- Bow VSAT dome still not able to track satellite. Service call by vendor for Hong Kong port call in progress.
- Successfully configured server for Confluence Wiki database.
- Verified and created multiple ship distribution lists.
- Continued finalizing ICE Observer laptops in preparation for Expedition 379.

HSE Activities

- Radiation Producing Device training material created for the Olympus XRF.
- Abandon ship and fire drill held.
- Safety showers and eyewash stations tested.