

IODP Expeditions 367 and 368: South China Sea Rifted Margin

Expedition 368 Week 8 Report (28 May–3 June 2017)

This week consisted of (a) advanced piston corer (APC) and extended core barrel (XCB) coring in four holes at Site U1505 (to a maximum depth of 480.2 m in Hole U1505C), and (b) downhole logging with a modified triple combo tool string in Hole U1505C. All times in this report are in ship local time (the same as in Hong Kong, UTC + 8 h).

Operations

The week started while retrieving the drill string after completing RCB coring in Hole U1504A, ending operations at Site U1504. The bit was recovered aboard at 1740 h on 28 May and the rig floor was secured for transit. We began the transit to Site U1505 (alternate Site SCSII-03D) at 1854 h on 28 May and arrived on site at 2112 h the same day. The thrusters were lowered and the heading was controlled by dynamic positioning at 2148 h. An APC/XCB bottom-hole assembly (BHA) was assembled and lowered to the seafloor, followed by the subsea camera system to observe the end of the pipe tag the seafloor (2916.6 mbsl). Before retrieving the underwater camera we conducted required routine rig servicing, which consisted of slipping and cutting 115 ft of drilling line. The top drive was picked up while recovering the subsea camera, and the bit was placed at 2911.2 mbsl to spud Hole U1505A (18°55.0560'N, 115°51.5369'E). There was an apparent misfire (failed shear pins) of the APC and the core barrel was recovered to surface. The barrel had recovered 0.38 m of core, far less than anticipated, and the hole was terminated at 1200 h so that we could acquire a better mud line core.

The bit was placed at 2912.1 mbsl and coring in Hole U1505B (18°55.0562'N, 115°51.5370'E) started at 1235 h on 29 May. The core recovered 3.23 m of sediment. Having obtained a good mudline core, Hole U1505B was terminated at 1300 h. The vessel was offset 20 m east of Hole U1505B and the bit was spaced out to 2916.1 mbsl. The decision was made to APC/XCB core to refusal or to the maximum drill string weight that could be lifted using the drawworks high clutch (due to a leak in the newly replaced low clutch diaphragm). Hole U1505C (18°55.0570'N, 115°51.5370'E) was started at 1340 h on 29 May. The seafloor was calculated at 2917.4 mbsl based on recovery from Core U1505C-1H. The full length APC system was used to core to refusal at 207.1 mbsf with advanced piston corer temperature tool (APCT-3) measurements taken on Cores U1505C-4H, 7H, 10H, and 13H. All four deployments produced good temperature data. APC refusal was determined after partial strokes on five consecutive cores, beginning with Core U1505C-19H and continuing through Core U1505C-23H. The half length APC (HLAPC) was then deployed and used to recover 24 cores, U1505C-24F through 47F. All HLAPC cores were considered partial strokes, with the standpipe retaining pressure after each

core. HLAPC refusal was determined with recovery of 3.14 m and 2.60 m on Cores U1505C-46F and 47F, respectively.

XCB coring then penetrated to 480.2 m before the overall drill string weight dictated the end of coring operations. The hole was displaced using heavy mud and the bit was raised up to 80.1 m below the seafloor for logging.

A modified triple combo tool string was rigged up and lowered into the hole. The tool string was exceptionally long, consisting of all tools typically run as part of the “triple combo,” with the addition of the Dipole Sonic Imager (DSI) tool for acoustic velocity. It was added to the first run in anticipation of potential hole problems that might prevent subsequent runs, based on experience at nearby sites with similar lithology. The triple combo began collecting data a few meters above the seafloor and recorded continuously to the deepest point the tools could reach, an obstruction at 341.2 m. The tool string was unable to pass below that depth. Two logging passes were conducted from that depth—the main one extended up into the end of the pipe and within the pipe to just above the seafloor. The tools were pulled to surface after logging was completed and rigged down.

The vessel was offset 20 m south of Hole U1505C and the bit was placed at 2911.6 mbsl. Hole U1505D (18°55.0485'N, 115°51.5501'E) was started at 2200 h on 2 June. The seafloor was calculated as 2917.5 mbsl based on recovery from Core U1505D-1H. The hole was then cored to a total depth of 184.5 m using the full length APC system. The drill string was recovered, the thrusters were raised, and the rig floor was secured for transit. The vessel started the transit back to Site U1504 at 0048 h on 3 June.

Science Results

This week we acquired and analyzed data from Site U1505. This site (proposed Site SCSII-3D) is located in a water depth of 2917 m on a broad regional basement high named the Outer Margin High (OMH). It was an alternate for Site U1501, should time be left for drilling following completion of the high-priority sites included in the *Scientific Prospectus*. Both Sites U1505 and U1501 are located on the same structural high with similar water depths and only ~10.5 km apart. The main target for Site U1505 was the sedimentary sequence within the small Cenozoic half-graben basins present on the OMH. According to the comparison of seismic profiles, the sediment sequences at Sites U1501 and U1505 should be similar to each other, but 1) the sedimentation rate at Site U1505 is expected to be higher and more suitable for high-resolution paleoceanographic and paleoclimatological studies, and 2) the seismic reflectors at Site U1505 are more distinctive and in general show more horizontal orientation and concordant relationship of the strata, indicating the sediment sequence here would be more complete. Therefore, Expedition 368 decided to occupy this site following the failure to drill down below the cased

hole at Site U1503, as well as due to the depth limit of 3400 m (water depth plus penetration) imposed by the constraints of the drilling equipment (no use of drawworks low clutch).

This week we also finalized the Site U1502 and U1503 reports and began summarizing the results from Sites U1504 and U1505 for presentations and reports. On 2 June we held a meeting for our Expedition 368 laboratory groups to present a summary of the Hole U1504A data. At this meeting, we hosted 17 scientists from the previous South China Sea Expedition 367.

Lithostratigraphy, Petrology, and Structural Geology

The team of sedimentologists, petrologists, and structural geologists described the cores from Holes U1504A and U1505C.

From Hole U1504A, Cores 3R to 21R were described and subdivided into three Lithological Units based on their main lithological characteristics. Unit I consists of nannofossil and foraminifer ooze with minor nannofossil-rich clay intervals with biogenic silica at the top of the unit. Unit I was subdivided into four subunits, based on changes in the biogenic components. Unit I of Hole U1504A correlates well with Unit I of Hole U1501C, although there are small differences between the exact subunits that can be recognized, and there is a possible hiatus in Hole U1504A. Unit II consists of pink bioclast-rich limestone with clasts of sedimentary and metamorphic origin and of light brownish gray clast supported limestone with abundant large benthic foraminifera and common epidote grains. Unit III is a metamorphic unit made up of greenish gray epidote-chlorite schist with a mylonitic fabric and veined clasts of epidote-chlorite fels. Representative samples of this unit were measured by pXRF, indicating a mafic igneous composition.

In Hole U1505C, Cores 1H to 64X were described and subdivided into two lithological units. Unit I consists of gray, greenish gray, and brownish nannofossil ooze with varying amounts of foraminifera and clay and, in the upper interval, biogenic silica. The transition to Unit II in Core U1505C-57X is marked by a change to dark greenish silty clay and clayey silt with nannofossils. Both Units in Hole U1505C are consistent with Units I–II at Site U1501, but with less distinctive subunits in Unit I.

Biostratigraphy

The micropaleontology team processed and examined all core catcher samples from Holes U1505A, U1505B, and U1505C for planktonic foraminifers, calcareous nannofossils, and diatoms. Our results show a continuous biostratigraphic sequence extending back to the late Eocene in Hole U1505C. A significant change in microfossil preservation and assemblage composition occurred between Cores U1505C-56X and 57X (~27 Ma) (~400 m), which corresponds to the unconformity T60 in the seismic data.

Detailed examination of the limestone interval found in Hole U1504 revealed that it is abundant in the large benthic foraminifera *Nummulites* and *Assilina*, which provides a tentative Eocene age (or slightly younger) to this interval.

Paleomagnetism

Archive-half sections of Cores U1504A-3R to U1504-21R and Cores U1505C-1H to U1505C-63H were measured on the superconducting rock magnetometer (SRM). A comparison of magnetization intensities between discrete samples and sections suggest there may be issues with the SRM geometric calibration for core sections, and we decided not to demagnetize the Hole U1505C cores, but instead to measure NRM only (starting from Section U1505C-3H-2). We plan to take U-channel samples onshore to analyze and demagnetize this core for postcruise analyses.

Seventy discrete samples were collected from the working halves (15 from Hole U1504A and 55 from Hole U1505C cores), measured, and demagnetized up to 120 mT on the JR-6A spinner magnetometer. The anisotropy of magnetic susceptibility (AMS) of all cubes was measured on the Kappabridge KLY-4S and plotted in stereonets.

The current magnetic inclination at Site U1504 was computed to be $\sim 26^\circ$, while the geomagnetic predicted inclination based on latitude should be $\sim 34^\circ$.

Geochemistry

The geochemistry group measured headspace and squeezing interstitial waters (IW) samples from Hole U1504A and Holes U1505B and U1505C. Headspace gas samples were collected and measured from each core, finding methane levels below the detection limit. Samples for IW analysis were also collected and trimmed thoroughly to try to eliminate any RCB-coring induced contamination (Hole U1504A). Preparation of samples for total nitrogen, total organic and inorganic carbon, and total sulfur measurements was initiated.

Physical Properties

We completed whole-round core measurements of the bulk density, *P*-wave velocity (PWC), magnetic susceptibility (MS), and natural gamma radiation (NGR), as well as moisture and density (MAD) discrete measurements of Hole U1505C cores. Thermal conductivity and PWC velocity measurements were also performed on the half sections. These measurements are currently being performed on Hole U1505D cores.

In Hole U1505C, bulk densities increase gradually with depth from 1.4 g/cm³ at the seafloor to ~ 2.2 g/cm³ at ~ 400 m. *P*-wave velocities display a similar trend and range from <1500 m/s at the seafloor to >2100 m/s at ~ 400 m. In contrast, porosities decrease with depth from 80% to 45%. A noticeable drop in *P*-wave velocity and density as well as reflectance L^* is observed at 400 m, coinciding with the T60 unconformity in the seismic data. NGR fluctuates between 10 to 50 cps

throughout the hole followed by a sharp increase to 90 cps at about ~400 m. MS increases with depth from the seafloor through the upper ~60 m, followed by a decreasing trend to the bottom of the hole. Thermal conductivity varies between ~0.6 and ~1.7 W/(m·K).

Downhole measurements on Hole U1505C were conducted on 2 June using a modified triple combo tool string. These data showed that the hole diameter was mostly >14 inch (limit of the width of the Formation MicroScanner [FMS] arms), so we decided not to run the FMS-sonic tool string. The processed log data were returned to the ship and are being analyzed. In general the data are of good quality. The Hole U1505B APCT-3 formation temperature measurements show a relatively high temperature gradient and heat flow, consistent with the results of other ODP/IODP drill hole measurements of this region.

Education and Outreach

The Education/Outreach team continued to interview the scientists to create stories for blog posts and other media outlets. New footage and a song were acquired for a potential new montage video. This week the Education/Outreach team conducted nine broadcasts and reached ~340 students. As of now the team has coordinated outreach events that connected to ~2450 students at schools and universities across the world during this expedition.

The U.S. Education/Outreach Officer scheduled educational and outreach broadcasts, and communicated them to the crew and scientists through the weekly calendar. She produced blog stories daily and semidaily depending on the broadcast schedule at <http://joidesresolution.org>. She promoted Expedition 368 on social media (Facebook (<https://www.facebook.com/joidesresolution>), Instagram (http://instagram.com/joides_resolution), and Twitter (<https://twitter.com/TheJR>), #exp368). She produced three media interviews about science and technology.

1. Mike Meiring, Electronics Specialist on the *JOIDES Resolution*:
https://youtu.be/_gPoN_PJWoQ
2. Sara Satolli, Paleomagnetist, Expedition 368
<https://youtu.be/RYE2mtBULRk>
3. Jian Lin, Petrophysicist and Downhole Measurements Specialist, Expedition 368 (collaborative project with Shuhao Xie, Chinese Observer):
<https://youtu.be/8xPI7kbe-xs>

The Chinese journalists produced several news media pieces including news articles, broadcasts and live education/outreach broadcasts, and daily blogs. They hosted a special activity with Expedition 368 Scientists and Technicians for Children's Day. They also posted blogs and news on Weibo, and produced and broadcast several videos, including short TV news reports for SMG News in China, and several articles for Science and Technology Daily.

1. Education and Outreach Activities for Children, Part 1 (30 May):
<http://mp.weixin.qq.com/s/LIHUqq6YK1UDmGPzsmJSLg>
2. Learning from Education and Outreach Activities onboard the *JOIDES Resolution* (front page of Science and Technology Daily, 1 June):
http://digitalpaper.stdaily.com/http_www.kjrb.com/kjrb/html/2017-06/01/content_370385.htm?div=-1
3. Children's Day event (front page of Science and Technology Daily, 1 June):
http://digitalpaper.stdaily.com/http_www.kjrb.com/kjrb/html/2017-06/01/content_370387.htm?div=-1
4. TV News Report:
www.kankanews.com/a/2017-05-31/0018011167.shtml

Technical Support and HSE Activities

Laboratory Activities

- Brunker D4 XRD: A positioning error developed when the sample lift moved to its upper position reference. The problem was resolved by using their procedures to align and set the lift's position. We now have an unknown issue that is preventing the X-ray from coming on. We suspect that the new configuration data for the lift is in conflict with some other configuration data. All of the information has been sent to Brunker and we expect a response on Tuesday.
- Chemistry Laboratory Water: The pre-filter has been installed.
- Chemistry Laboratory Caver Press: Had issues with the middle press and swapped out the jack with new hardware so that it could be rebuilt. Then the new jack was changed out because of an issue in the manual check-valve that was previously repaired. After several jack changes the system is operational.

Other Activities

- Staff are updating user manuals and other documentation.
- Staff are documenting instrument host setups and archiving data/documents in preparation for the host change.
- Working with shore IT staff to define requirements for LabView instrument host image.

Application Activities

- Crossover with shore developers for Coulometer project.
- Continued work on DisplayMeasure Actor—implemented events handler.

- Section Half Imaging Logger (SHIL) discussion about how to handle situation with creating web, dry, and other nonstandard images, and how to display them in LORE and LIVE with minimum impacting our current workflow.
- Windows 10 upgrade preparation, installed LabView 2014 from media.
- Research and experiment with methods to load LabVIEW DLL into C+ applications.
- Reported wrong filename with incorrect sample offset in ImageCapture; found the issue and fixed it.
- Coded DataManagerActor functions with Java.
- Worked on HistoryActor and LDAQ test.

IT Support Activities

- Early in the week, the VSAT system experienced periodic slowdowns and outages due to rain fade. Internet data throughput during these times was poor to unusable. The affected periods lasted two to three hours.
- Work on automating the cleanup of older log files on the servers was completed. Scheduled log cleanup jobs were set up and tested for effectiveness.
- The copier required preventative maintenance, and the device was offline for several hours. Maintenance codes on the copier were cleared, which allowed for continuing usage until a service technician can perform the proper maintenance during the upcoming tie-up period.

HSE Activities

- Held the weekly fire and boat drill as scheduled.
- All safety equipment has been checked.