IODP Expeditions 367 and 368: South China Sea Rifted Margin

Expedition 367 Week 2 Report (12–18 February 2017)

The second week of the IODP South China Sea Expedition (367) consisted of the last two days of port call activities in Hong Kong, the transit to Site U1499 (proposed Site SCS-14A), and our initial APC/XCB coring to 540 m in Hole U1499A. All times in this report are in ship local time (UTC + 8 h) throughout the expedition.

Operations

The second week of Expedition 367 started with continued port call activities in Hong Kong. On 12 February, we completed loading remaining operations hardware including 288 joints of drill pipe, spooling of new coring line onto the forward coring winch, offloading of trash prior to sailing, continued securing all equipment for heading out to sea, and made necessary arrangements with port authorities for departing the next day.

At 1000 h 13 February, immigration authorities boarded the ship and the vessel was cleared for departure. The harbor pilot arrived on board just before noon, and the vessel was underway with the last line released at 1215 h on 13 February. We proceeded to the pilot station, and after a 7 nmi transit the pilot disembarked the ship at 1248 h. Our 277 nmi transit to Site U1499 (proposed Site SCS-14A) took 28.0 h with an average speed of 9.8 kt. After arriving at Site U1499 at 1615 h on 14 February, we lowered the thrusters, deployed a seafloor beacon, assembled two extra stands for rotary core barrel (RCB) coring later in the expedition, put together the advanced piston corer (APC)/extended core barrel (XCB) bottom-hole assembly, and lowered to 3749.4 mbrf in preparation for coring. The calculated precision depth recorder (PDR) depth for the seafloor at Hole U1499A was 3774.4 mbrf and we chose to place the bit at 3769 mbrf to take the first core. An APC core barrel was lowered to the bit and coring in Hole U1499A started at 0930 h on 15 February. Based on a mudline core recovery of 7.5 m, we calculated the seafloor to be 3771.0 mbrf (3760.2 mbsl). APC Cores 1H–18H penetrated to 162.4 m and recovered 167.51 m (103%). All APC cores used nonmagnetic core barrels and were orientated. Formation temperature measurements (APCT-3) were made while taking Cores 4H, 6H, 8H, 10H, 12H, and 14H.

APC Cores 12H–18H (102.5 to 162.4 m) encountered increasingly firm formation and the core barrel did not fully penetrate the formation for many of them. Due to our primary expedition objectives, we switched to XCB coring instead of first using the half-length APC system which would take twice as long to penetrate the formation.

XCB Cores 19X–57X penetrated from 162.4 to 540.7 m and recovered 227.37 m (60%). XCB core recovery was highly bimodal. We had quite high core recovery in the fine-grained intervals

(Cores 19X–36X, 162.4–337.0 m, 158.99 m recovered, 91%; Cores 44X–50X, 404.9–472.8 m, 65.19 m recovered; 96%). We had very fast penetration rates and extremely low recovery in unconsolidated sands (Cores 37X–43X, 337.0–404.9 m, 1.37 m recovered, 2%; Cores 51X–57X, 472.8–540.7 m, 1.82 m recovered, 3%). One exception was Core 25X which came back with only 2 cm of core, but the core liner appeared to have had sediment in it, so we inferred it was fine-grained but fell out of the barrel while retrieving the core barrel.

Once we encountered the unconsolidated sands, we started circulating mud sweeps (30 barrels at 337.0, 346.7, 375.8, 404.9, 443.7, 472.8, 492.2, 511.6, and 531.0 m). While making a connection at 492.2 m, the drill string became stuck and could not be rotated. We circulated an additional 50 barrels of mud and we were able to regain rotation. At the end of the week, we were continuing XCB coring in Hole U1499A, in part to search for an adequate formation to set the base of the casing for our second hole at this site to core and log deeply into basement.

Science Results

While we were still in port, and during the first afternoon at sea, we had several meetings of the entire science party. The meetings included a tour of the shipboard facilities and laboratories, a general safety overview, a presentation by the Co-Chief Scientists on the main objectives and global context of the expedition, presentations by the two Education and Outreach Officers, an overview of curation of samples, and an overview of drilling and logging. The Co-Chief Scientists updated the group on the choice of drill site locations.

We also held a group science meeting in which each participant gave a brief summary of their background and interests in the science objectives of the two expeditions. Smaller research group meetings and training sessions for specific disciplines were ongoing, and these are discussed under the individual group sections that follow.

Lithostratigraphy

The sedimentologists spent the first half-week familiarizing themselves with the instrumentation and methods to be used during core description. We attended a number of training sessions given by the JRSO technical staff, including an overview of the use of Sample Master and DESClogik. Technical staff explained the operation of the Section Half Imaging Logger (SHIL) and Section Half Multisensor Logger (SHMSL). We prepared and submitted the first draft of our Methods section for our IODP *Proceedings* volume. This involved discussions with the group on how we would undertake the core description.

Later in this week, the sedimentologists started to describe cores from Hole U1499A using a combination of visual core description (VCD), microscope inspection of smear slides, and core imaging as well as core scanning for color spectra and magnetic susceptibility. The upper 31 cores from Hole U1499A were described. The sedimentary sequences were temporarily divided

into three units. Unit I (Cores 1H–6H) is composed of dark greenish gray clay with silt and clayey silt and sand interbeds. The clayey silt and sand layers are fining upward with an erosive basal contact. These interbeds of sand and silt have been interpreted as small turbidite sequences. The turbidites in this unit become thicker and coarser downward, from 1–2 cm clayey silt in upper Cores 1H–3H to ~70 cm silty sand in Core 6H. However, on average, these sequences range from 5–15 cm. Four centimeter-scale, light brownish gray ash layers occur in this unit. Unit II (Cores 6H–11H) contains interbedded greenish gray clay-rich calcareous ooze and dark greenish gray nannofossil ooze-rich clay. Most of the sequences have undergone extensive soft-sediment deformation with small-scale folds and contorted beds. Unit III (Cores 11H–31X) consists dominantly of very thick and massive greenish to dark greenish gray clay with very thin (mostly <1 cm thick) silt interbeds. The sediments in this unit are heavily bioturbated and rich in trace fossils (e.g., *Zoophycos*, *Neteites*, *Planolites*). XCB drilling disturbance (biscuiting, fracturing) was pervasive in nearly all XCB cores (Core 21X and downward).

Biostratigraphy

During the first three days of this week, the paleontology team became familiar with the ship laboratories' workflow, underwent DESClogik training, and reviewed the Methods section of the expedition reports. Micropaleontological analyses have been performed on all core catcher samples down to 424 m. Planktonic foraminifera and calcareous nannofossils have been studied to obtain a biostratigraphical age model. Foraminifer and nannofossil preservation is moderate to good, with some samples containing reworked species. The total abundance of foraminfera is very low in most of the samples. The biostratigraphic results suggest that the sequence recovered in this top part of Hole U1499A spans from the late Miocene to the late Pleistocene.

Paleomagnetism

All the archive core halves from 1 to 21 have been measured on the new Superconducting Rock Magnetometer (SRM) that was installed at the start of the previous expedition. As we analyzed the sediments and fine-tuned our procedures, we adjusted the demagnetization steps and sample interval several times. We also took one discrete sample in every section of core to assess magnetic fabrics and confirm the SRM measurements with thermal and higher AF demagnetization levels. We are also fine-tuning the demagnetization steps for the discrete samples, which are being measured on the JR6 spinner magnetometer.

Geochemistry

Headspace gas samples collected for the routine safety program only contain methane with a maximum of ~6000 pmmv at 161 mbsf; none is present below 267 mbsf.

Fifty interstitial water (IW) samples were collected, and their salinity and alkalinity have been determined. The alkalinity gradually increases with depth, reaching a maximum value of

13.0 mM at ~39 mbsf, and then gradually decreases with depth. The alkalinity most likely is controlled by the mineralization of sedimentary organic matter and the carbonate diagenesis.

Sediments for carbonate, TOC and TN content, and major and minor element analysis were collected, and analysis is ongoing.

Petrophysics

During the port call and the transit to the Site U1499, we reviewed the techniques and practiced measuring physical properties using the Whole-Round Multisensor Logger (WRMSL), the Natural Gamma Radiation Logger (NGRL), the Thermal Conductivity Meter (TK04), the Section Half Measurement Gantry (SHMG) system, and the dual balance and Pycnometer system to estimate sample weight and volume for Moisture and Density (MAD) calculations. We also familiarized ourselves with the APCT-3 measurements processing. One of the eight NGRL detectors was not working, but measurements were successfully made using the other seven detectors. Six formation temperature measurements (APCT-3) were made in the uppermost part of the sediments, which can be used together with the thermal conductivity measurements to calculate the thermal gradients and to estimate heat flow values. We stopped collecting *P*-wave velocity on whole-round cores after coring switched to XCB because the slightly narrower core does not permit adequate contact of the sensors. The section-half velocity measurements using the Y and Z Gantry bayonets on the section halves were stopped when the cored sediments became too hard at Core 10H. Our results show:

- a smooth increase of *P*-wave velocity with depth (from 1450 m/s at the surface to 1600 m/s at 200 m depth),
- a smooth increase of bulk density with depth (from 1330 g/cm^3 at the surface to 1950 g/cm^3 at 350 m depth),
- lower natural gamma radiation (NGR) for the sandy layers compared to the clay-rich layers,
- a low magnetic susceptibility (MS) in Core 7H, and
- a high thermal gradient (91°/km) and a heat flow value of ~100 mW/m^2.

Education and Outreach

This week the Education and Outreach Officer continued to communicate with schools to plan video connections, conducted connection tests before broadcasts, and sent educational materials about the IODP program and the *JOIDES Resolution* to teachers. Other activities included continuing to post to social media and the *JOIDES Resolution* website (http://joidesresolution.org), setting up a couple of scientists to provide blogs, setting up the 360° camera for future use, and continued collection of photos and videos.

Technical Support and HSE Activities

Laboratory Activities

- Processing Hole U1499A cores.
- See Application Developer section for additional instrument updates.

Miscellaneous Activities

- Held prespud and at sea preseismic operations planning meetings.

IT Activities

- Restored Uservol and scratch due to a Cryptolocker ransomware attack from a scientist laptop.
- Deleted and reinstalled operating system on scientist laptop to clear any possible traces.

Application Developer Activities

- Shipboard staff joined ongoing GeoDESC project discussion.
- Discussions continued toward Gulf Coast Repository X-ray fluorescence (XRF) data storage and user interface requirements.
- Joined planning for Oracle 12c database upgrade targeted for tie-up.

Maintenance Activities

- Revised uploader and distributed for change in XRD data storage model.
- Resolved Section Half Multisensor Logger (SHMSL) calibration issues, which were related to the light remaining on for dark calibration. Returned the shutter to computer control.
- Mettler Toledo balance continued to fail intermittently so it was replaced with the spare.

Work in Progress

- Begin NGR run with channel #7 disabled. Further troubleshooting is planned at the end of first hole to avoid any risk to the NGR that might be caused by troubleshooting.
- Continued vetting of new *P*-wave logger (PWL) hardware and worked out effective calibration procedure.

HSE Activities

- A fire and boat drill was held on 19 February.