

IODP Expeditions 367 and 368: South China Sea Rifted Margin

Expedition 368 Week 7 Report (21–27 May 2017)

Week 7 of Expedition 368 was burdened by mechanical problems with the drawworks that accounted for a total of 125.5 h (5.2 d) of time. There were two failures of the drawworks' low clutch diaphragm and one failure of the drawworks aft shaft bearing on one of the Elmagco brakes. Although we utilized some of this downtime to assemble casing and the drilling string to install it, ~48 h were spent waiting for a supply boat with spare low clutch diaphragms. In addition, because of the mechanical problems, Site U1503 was abandoned without achieving any scientific objectives as there was not sufficient time left in the expedition to reach basement. However, we did install a reentry system and 991.5 m of casing (10.75 inch) in Hole U1503A which remains as a legacy hole for future occupation. During the later part of the week, we transited to Site U1504 (alternate site SCSII-27A) where we RCB cored to 165.5 m in Hole U1504A. All times in this report are in ship local time (the same as in Hong Kong, UTC + 8 h).

Operations

The week started after three spare low clutch diaphragms were delivered to the *JOIDES Resolution* by the seagoing tug *M/V Taikoo* just before midnight on 20 May. The crew then began replacing the low clutch diaphragm, and repairs were completed by 0415 h on 21 May. The driller continued lowering the casing string from 2379 mbsl to the seafloor, filling the pipe with seawater every 25 stands. The subsea camera was deployed and Hole U1503A was reentered at 1005 h on 21 May with the 10.75 inch casing string. The casing began taking weight at 342 mbsf, thus it was pulled back, the top drive was installed, and the mud motor, bit and underreamer were used to drill the casing to the bottom of the predrilled hole at 908.2 mbsf. We continued drilling in the last 86.9 m of casing, reaching 991.5 mbsf. The casing was released at 0915 h on 22 May, and the camera and the drilling assembly were recovered. The mud motor and underreamer were flushed with fresh water and laid out. The casing running tool was detorqued and laid out.

The upper guide horn was installed and the drill crew began making up and deploying a rotary core barrel (RCB) bottom-hole assembly (BHA). The bit was lowered to 1232 mbsl when the drill crew noticed a loud noise coming from the forward Elmagco brake. The aft bearing on the forward Elmagco brake had failed. The crew began working to replace the brake with a reconditioned unit that was loaded aboard in Hong Kong. This job was scheduled for the maintenance period following Expedition 368. We were in luck that the seas were calm, as this typically cannot be done at sea.

Repairs began at ~0530 h on 23 May. Because of the calm seas, the crew was able to make the heavy crane lifts required. The forward brake was disconnected and moved to the rig floor where the hub could be removed for use on the replacement. The 28,000 lb (12.7 MT) nonfunctioning brake was then transferred to the main deck and the replacement moved to the rig floor to have the hub fitted and be installed on the forward end of the drawworks. The brake was moved into place, the electrical and water connections were made, and the shaft was aligned by 0600 h on 25 May.

Operations resumed with the bit being lowered to a depth of 3819 mbsl at 1100 h on 25 May, when it was noticed that the low clutch diaphragm was leaking again. The diaphragm was replaced for the fourth time on this expedition (completed at 2100 h on 25 May). Due to the deep water depth along with the planned deep penetration at Site U1503, we would need to use the low clutch extensively. Considering this fact, combined with the number of diaphragms failures so far, and with only one more spare left aboard, it was determined that the safest action would be to terminate operations at Hole U1503A without reentering the cased hole. An optimistic delivery date for additional clutch diaphragm spares, if available, was estimated for 2 June. If we were to reenter Hole U1503A, and had an additional clutch failure coring below the casing, the remaining spare would be enough only to get the drill string out of the hole, and any failed operations in the open hole could have prevented a future reentry operation. This was a very difficult decision to make, but with two more weeks left in the expedition, the decision was made to switch to operations at sites with shallower water depths and penetration that did not require the use of the low clutch while drilling or coring. Therefore we decided to transit to Site U1504 (alternate site SCSII-27A) and continue operations there.

Before departing from Site U1503, the subsea camera was deployed to the seafloor to inspect the Hole U1503A reentry cone. The cone appeared to be 1–2 m below the seafloor, but it is clearly visible and expected to be available for reentry at a later date. Consequently, the site can be considered a legacy site for future expeditions. The camera was retrieved, the bit was recovered, and the rig was secured for transit. The thrusters were up at 0930 h on 26 May, and the vessel began the 42.5 nmi transit to Site U1504.

At 1400 h the same day, the *JOIDES Resolution* arrived at Site U1504 (18°50.9199'N, 116°14.5397'E). The thrusters were lowered and we switched to dynamic positioning at 1432 h. An RCB BHA was made up and deployed to 1720 mbsl before a failure of the pipe spinner on the iron roughneck. The spinner was replaced and the crew continued to lower the pipe to 2776 mbsl. The underwater camera was deployed and the bit was placed at 2813 mbsl for a short seafloor survey to verify that no seafloor cables were in the area. The seafloor was tagged after the survey, determining a water depth of 2816.6 m. The camera was retrieved and the top drive was picked up for starting Hole U1504A. Coring in Hole U1504A started at 0215 h and the bit reached the sediment-basement contact at 136.4 m (at 1455 h on 27 May). Coring continued to 165.5 m, where erratic torque and overpull caused us to terminate coring operations at 1100 h on 28 May.

Science Results

This week we acquired and analyzed data from Site U1504. This site is located in 2816 m of water on a structural high that can be interpreted as an easterly extension of the Outer Margin High (OMH). The OMH was drilled at Site U1501 and the acoustic basement in that location proved to consist of highly lithified sandstones and conglomerate, most likely of pre-Cenozoic age. The main target for Site U1501 was the Cenozoic sedimentary sequence within the small half-graben basins present on the OMH, and not the nature of the basement. Site U1504, on the contrary, was designed to sample the nature of basement below a very thin (~120 m) succession of young sediment covering this distinct basement high. The site was proposed during Expedition 367, and approved during Expedition 368 as an alternate site, should time be left for drilling following completion of the high-priority sites described in the proposal and the *Scientific Prospectus*. The specific goal of the site was to determine the nature of the basement, in particular if deep tectonic exhumation had led to exposure of the deep or middle crust, or even the mantle lithosphere, during breakup. Expedition 368 decided to occupy this relatively shallow site following the inability to core below the cased hole at Site U1503, and the depth limit of 3400 m (water depth plus penetration) imposed by the weight limitations resulting from being unable to use the drawworks low clutch.

In addition to characterizing the cores and samples from Hole U1504A, we also edited and resubmitted revised drafts of the Site U1502 reports for final review, and started to write the background, objectives, and operations reports for Site U1503. We presented ongoing results in daily crossover meetings, and initiated postcruise research discussions and related presentations. Communications with Expedition 367 Scientists have already been initiated and will be expanded next week.

Lithostratigraphy, Petrology, and Structural Geology

The core description team completed the final changes to the Site U1502 report. After an all hands scientific discussion about the alternation of the brownish and greenish-gray layers observed in Hole U1502B, it was decided to measure the elemental composition of the colored layers in selected cores with the handheld X-ray fluorescence (XRF) scanner. The measurements show that there are slight chemical differences, both between layers with different colors and between different lithologies. A presentation about these results was given at the end of the week.

At Site U1504, Cores U1504A-1R to 12R were described this week using a combination of visual core description (VCD), microscope inspection of smear slides, core imaging, and core scanning for color spectra and magnetic susceptibility. The sedimentary sequence consists of greenish gray to light brownish gray clay-rich nannofossil ooze and nannofossil ooze with foraminifera. Bioturbation ranges from moderate to heavy.

Biostratigraphy

The paleontology group examined core catcher samples from Cores U1504A-1R to 16R for planktonic foraminifera, calcareous nannofossils, and diatom biostratigraphic markers. Calcareous microfossils were abundant in Cores 2R to 12R, but absent in Core 13R and below. Diatoms were only observed in the core catcher samples from Cores U1504A-2R, 3R, and 4R. The planktonic foraminifer and calcareous nannofossil data provide an estimated age of Early Miocene to the base of this sequence. Detailed examination of the planktonic and benthic microfossil fauna is in progress.

Paleomagnetism

The AMS data collected with the AMSSpin software was not initially readable and it had to be sent to the company Agico for conversion to a legible format. After this conversion, the total number of basalt measurements included in the Site U1502 report increased from 14 to 43. With better statistics on magnetic anisotropy measurements, the average dip angle of the magma flow plane (approximate depositional dip) is estimated to be 8°.

Detailed analysis of the SRM data from the basalt from Hole U1502R revealed a possible reversal in Cores U1502B-9R and 10R.

Geochemistry

The geochemistry group returned to measuring headspace gases and squeezing interstitial waters (IW) from sediment samples at Site U1504. Headspace gas samples were collected and measured from each core, finding methane levels below the detection limit. Samples for interstitial water analysis were also collected and trimmed thoroughly to try to eliminate any RCB-induced contamination. We also started to prepare samples for total nitrogen, total organic and inorganic carbon, and total sulfur measurements.

Physical Properties

The petrophysics group measured bulk density, *P*-wave velocity, magnetic susceptibility (MS) and natural gamma radiation (NGR), and thermal conductivity on the cores recovered from Hole U1504A. No formation temperature measurements were made in this hole. Our results show:

- A gradual linear increase in thermal conductivity with depth, from the seafloor to ~145 m.
- Strong peaks in magnetic susceptibility at 46.5 and 56.8 m.
- Overall, higher NGR for the upper carbonate ooze interval compared to the underlying hard rock cores (unsplit).
- A slight increase in *P*-wave velocity with depth.

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 video. Nine broadcasts with a reach of ~315 students were conducted with schools in China, Europe, and the United States. As of this week, the Education/Outreach team has coordinated education and outreach activities to approximately 1450 students at schools and universities across the world.

The U.S. Education/Outreach Officer scheduled educational and outreach broadcasts, and communicated them to the crew and scientists through the weekly calendar; produced blog stories daily and semidaily depending on the broadcast schedule at <http://joidesresolution.org>; 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); worked on the production of three media interviews about science and technology on the ship; facilitated a Science Reddit “Ask-Me-Anything” with scientists; and simultaneously posted a completed project with the Chinese journalist: <https://youtu.be/cVaIkKKwdXk>.

The Chinese journalists produced several news media pieces including news articles, broadcasts and live education/outreach broadcasts, and daily diary columns. 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. Examples of these posts include:

1. A video and TV news report about Co-Chief Scientist Hans-Christian Larsen:
www.kankanews.com/a/2017-05-20/0037997779.shtml
www.kankanews.com/a/2017-05-21/0017999009.shtml
2. Article and video about the expedition:
http://digitalpaper.stdaily.com/http_www.kjrb.com/kjrb/html/2017-05/22/content_369826.htm?div=-1
video link: <https://v.qq.com/x/page/v0505oh9w50.html>

Technical Support and HSE Activities

Laboratory Activities

- SHIL 360: Staff tested changes to the 360 imaging code on the Section Half Imaging Logger (SHIL), uploading and downstream reports.

Other Activities

- Staff updated user manuals and other documentation.

Application Activities

- Coulometer Project:
 - Conducted daily meetings to monitor progress and address issues.
 - Worked on device actor, implemented complete set of functions and tested in test harness.
 - Completed work on data manager actor, tested all functions in test harness.
 - Worked on history-display actor.
 - Worked on measure-display actor.
- LORE Reports: Modified report definition for expanded WRLS to include new components for cropped images.
- LIVE: Modified to show cropped WRLS images.
- Met with Laboratory Officer and technicians to plan replacing instrument hosts with Windows 10-based computers during tie-up and transit to Townsville.

IT Support Activities

- A virtual server was built that will serve as a replacement for the physical server currently hosting the inventory system and document management system.
- The Macintosh workstation build document was reviewed and updated in preparation for deploying replacement Macs on the ship.
- Work was done to confirm that the wired Internet connectivity from a local vendor in Subic Bay meets our specifications.

HSE Activities

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