IODP Expeditions 367 and 368: South China Sea Rifted Margin

Expedition 367 Week 5 Report (5–11 March 2017)

This week we (1) finished penetrating with rotary core barrel (RCB) coring in Hole U1499B at 1081.8 m due to unstable borehole conditions, (2) successfully acquired downhole log data with two tool strings in Hole U1499B from 651 m to a maximum of 1020 m (~65 m above the base of the hole), (3) transited to Site U1500 (proposed Site SCSII-8B) in dynamic positioning (DP) mode, and (4) initiated operations in Hole U1500A. All times in this report are in ship local time (UTC + 8 h).

Operations

Site U1499

After changing the RCB bit, we reentered Hole U1499B, lowered the bit through the 651 m of casing and back to the bottom of the hole (1013.9 m), and resumed RCB coring at 0115 h on 5 March. Cores 39R–43R penetrated from 1013.9 to 1062.4 m and recovered 4.1 m (4%). We pumped 30 barrels of mud after each of these cores.

At 0100 h on 6 March, Core U1499B-44R arrived on the rig floor (1062.4–1072.1 m, 0.45 m recovered). While cutting Core 45R, there were periods of erratic torque, high pump pressures, and some short times when the drill string could not be rotated. The driller raised and lowered the drill string and was able to keep coring. Just after we put the core line into the drill string to retrieve Core 45R, the pipe became stuck. For ~45 min, we worked the drill string until it was freed; then we removed the core line from the drill string. We raised the bit back up to 994 m and worked to clean out the hole. Eventually at 1045 h, conditions had improved enough that we retrieved Core 45R at 1150 h (1072.1–1081.8 m, 0.09 m recovered; 0.9%). We spent the next 10 h attempting to wash, ream, drill, and circulate our way back to bottom. However, we never were able to get below ~1053 m (~30 m above the bottom of the hole) without the drill string getting stuck. We decided that additional attempts to get back to the bottom of the hole and RCB core deeper were not reasonable, so we started to prepare the hole for wireline logging. We circulated 50 barrels of mud to clean cuttings out of the hole, retrieved the core (wash) barrel that was in place during the hole remediation efforts, and lowered the rotary shifting tool (RST) on the coring line to release the bit in the hole.

After the bit was released, we raised the end of the pipe from 1052.7 up to 877.3 m and shifted the mechanical bit release sleeve back into the circulating position. We then raised the end of the pipe up to 780 m and pumped 235 barrels of heavy mud into the hole to help maintain good hole conditions during logging. At 1030 h on 7 March, we had raised the end of pipe back up inside the casing to 85.1 m and started to prepare the rig floor for logging. Our first logging tool string

consisted of the resistivity, velocity, density, and natural gamma tools. We started lowering it at 1345 h on 7 March. The tool string was able to reach 1020 m, and we successfully logged up to the base of the casing at 651 m. Log data were also collected up the casing and drill pipe to the seafloor. This tool string arrived back at the rig floor at 2215 h on 7 March. Based on the first logging run results, we decided to conduct a second logging run with the Formation MicroScanner (FMS) and natural gamma ray tools.

We assembled the FMS and natural gamma ray tools and started lowering them at 0130 h on 8 March. The tool string was able to reach 1010 m, and we were able to make two passes of the open hole up to the base of the casing at 651 m. Initial results show that we collected some excellent data in intervals with good borehole diameter. The tool string arrived back on the rig floor at 0925 h, and all of the logging equipment was off the rig floor at 1030 h on 8 March. We pulled the end of the drill string out of Hole U1499B at 1120 h, recovered the seafloor beacon, and started the transit to Site U1500 (proposed Site SCSII-08B) in DP mode. While in transit, we continued to recover the drill string (it arrived back on the rig floor at 1830 h on 8 March), as well as assemble a new RCB bit and begin lowering it to the seafloor. We spent a total of 22.1 d at Site U1499.

Site U1500

We arrived at Site U1500 (proposed Site SCSII-8B) at 0415 h on 9 March, and we lowered the subsea camera system to observe the bit tag the seafloor to establish the water depth (3801.7 m). After recovering the camera system, we started drilling without coring in Hole U1500A at 0935 h on 9 March. Unfortunately, at 1930 h with the bit at 340.5 m, the drawworks clutch diaphragm that had been replaced earlier in the expedition failed. The clutch diaphragm was repaired with one of the new diaphragms that had been delivered to the ship by boat on 27 February. As soon as it was replaced (0930 h on 10 March), we resumed drilling without coring from 340.5 to 378.2 m. We recovered the center bit and started RCB coring at 1245 h on 10 March. Cores U1500A-2R to 6R penetrated to 426.7 m and recovered 22.4 m (46%).

On 11 March, we RCB cored from 426.7 to 494.6 m (7R to 13R), drilled without coring from 494.6 to 641.2 m, and then resumed coring from 641.2 to 660.6 m (15R to 16R). All of these cores penetrated the formation very quickly, with all but two taking only 5 min. Recovery was extremely poor (0 to 14 cm), except for Cores 9R (2.86 m) and 13R (1.06 m). In addition, these RCB cores penetrated 87.3 m yet only recovered 4.2 m (5%). We pumped frequent mud sweeps (30 barrels at 436, 446, 455, 475, 494, 505, 564.3, 583.7, 612.8, 632.2, and 650.9 m). The week ended with continued RCB coring in Hole U1500A. Our primary objective in this hole is to determine the formation properties that will allow us to decide how much casing we will drill in at the next Hole U1500B.

Science Results

This week scientists continued to analyze and summarize Site U1499 data. We presented our summaries in three 1 h meetings on Thursday, Friday, and Saturday. These meetings were attended by scientists from Expedition 368 who participated using the shipboard videoconferencing system. At the end of the week, we started working on new cores from Hole U1500A.

Lithostratigraphy

The core description team described Cores U1499B-39R to 45R and finalized the Site U1499 stratigraphic column. Section 30R-2 to Core 45R composes Unit IX, which was divided into two subunits. Subunit IXA (Sections 30R-2 to 30R-6) contains matrix-supported breccia with angular clasts of varying sizes and compositions. The supporting matrix consists of brownish to greenish clay. Subunit IXB (Section 30R-6 to Core 45R) contains gray to dark gray gravel with silty sand intervals. The boundary between Subunit IXA and IXB is marked by an erosive contact at the bottom of Section 30R-6. The cores in Subunit IXB are fragmented and were recovered as pebble- to cobble-sized clasts with some intervals of moderately consolidated silty sand that might represent matrix that was not well recovered. The clasts are composed of breccia and clastic sedimentary rocks. The clastic sedimentary rocks vary in grain size from siltstone to gravelly sandstone. Thin sections of these rocks show they are composed of varying constituents, including abundant mono- and polycrystalline quartz, feldspar, muscovite, detrital zircon, as well as lithic grains of igneous, metamorphic, and sedimentary origin. Small inclusions of apatite and zircon were also identified within some of the quartz crystals.

We also described Cores 2R–11R from Hole U1500A. These cores contain heavily bioturbated dark greenish gray clay with a few thin silt interbeds. The clay changes from greenish gray to grayish brown in Core U1500A-5R. Core 11R (1%) contains one small piece of greenish foraminifer-rich sandstone.

Biostratigraphy

This week our group finished all observation of Hole U1499B samples, including analyzing additional samples from Core U1499B-30R. We observed some early Miocene bioevents in Section U1499B-30R-2, which is composed of pelagic claystone with manganese nodules. Below this depth, Oligocene assemblages of foraminifers and nannofossils are present in Sections U1499B-30R-3 to 6. However, poor preservation and deformation of planktonic foraminifers, as well as the presence of shallow water benthic foraminifers, suggest that these may be reworked.

We combined all bioevents from both Holes U1499A and U1499B and Hole U1499A paleomagnetic data to construct an age-depth plot for Site U1499. Four sedimentation rate

intervals are observed with rates that vary between 1 and 13 cm/ky; the lowest rates occur in the early Miocene through the earliest late Miocene.

At the end of the week, we started to work on initial cores from Hole U1500A. Coring in Hole U1500B started at 378.2 m, so our first cores (U1500B-2R to 11R) are late Miocene.

Paleomagnetism

This week we completed stepwise thermal demagnetization of the discrete samples from Hole U1499B. For most samples, the demagnetization behavior shows a clear trend and can confidently be assigned to normal or reverse polarity. However, because of significant core recovery gaps, we cannot correlate these reversals to the standard geomagnetic timescale. This contrasts with our Hole U1499A data that correlates well to the timescale. In our current age model, we did not recover the corresponding polarity patterns in the uppermost Late Pliocene, perhaps due to a change of sedimentation rate (although poor recovery in Core 25X complicates our ability to constrain this). We also measured cores below U1499B-30R that are mostly gravels using the superconducting rock magnetometer (SRM) at AF steps of 5, 15, and 25 mT. The characteristic remanence vectors for the individual clasts are highly dispersed in declination and inclination, indicating that the Unit IXB clasts have been transported since they were formed and have not been remagnetized. On Friday, we started collecting data on the new Hole U1500A cores.

Geochemistry

Other than summarizing our Site U1499 results, (1) a couple more samples from Hole U1499B were analyzed for the sedimentologists and show relatively low carbonate and higher organic carbon content, (2) twenty-six interstitial water samples from Hole U1499A were reanalyzed by IC, and (3) headspace gas analysis of the initial Hole U1500 cores were all below detection limits.

Petrophysics

This week, we measured physical properties on Cores U1499B-39R to 45R for whole-round measurements of magnetic susceptibility (MS), gamma ray attenuation (GRA) density, natural gamma radiation (NGR), and for split-core measurements of thermal conductivity (TCON), *P*-wave measurements using caliper (PWC), as well as moisture and density (MAD) measurements on a discrete sample from Core U1499B-30R.

These data were plotted and correlated with the observed lithostratigraphy. Due to the low recovery in Subunit IXB, the MS, GRA, NGR, and TCON measurements provide sparse, poor quality data. The gravels clasts measured individually yielded relatively high velocities (up to 5499 m/s), whereas the silty sand interbeds documented lower values (down to 3057 m/s). The only discrete MAD sample taken from this unit was from the core catcher of Core U1499B-30R;

it has a bulk density of 2.4 g/cm^3 (higher than the average ~2.3 g/cm^3 of the Subunit VIIIB above) and a porosity of 15% (lower than the average ~22% of the unit above).

Downhole logging was conducted with two tool strings (modified triple combo and Formation MicroScanner [FMS]) between the bottom of the casing at 651 m and ~1020 m. The triple combo tool string consisted of sensors to measure borehole sonic velocity (Dipole Sonic Imager [DSI]), litho-density (Hostile Environment Litho-Density Sonde [HLDS]), diameter (caliper on the HLDS), electrical resistivity (High-Resolution Laterolog Array [HRLA]), and natural gamma radiation (Hostile Environment Natural Gamma Ray Sonde [HNGS]). The FMS tool string also acquired borehole resistivity images (FMS) and NGR data over nearly the same interval. The raw logging data were sent to the Lamont-Doherty Earth Observatory for processing and quality control and the processed data were sent back to the ship two days later.

Education and Outreach

This week the Education and Outreach Officer continued scheduling and planning live video-outreach events, including connection tests before the broadcasts, sending the teachers educational materials about the IODP program and the *JOIDES Resolution,* and conducting post-event surveys. The E/O Officer continued the contest for students to guess the depth at which we will reach the basement at Site U1500. Routine posting to social media and to the *JOIDES Resolution* blog (http://joidesresolution.org) continued as well as interviewing scientists to generate blog content.

Technical Support and HSE Activities

Laboratory Activities

- Laid out leads in preparation for seismic source use for VSI.

Application Developer Activities

- Internet and phones went down for about 3 h. We determined the issue was with an ISP used to connect TAMU's network to RigNet in Houston. The vendor was able to correct the issue and get us back online.
- Continued input on the following ongoing/proposed projects: LIVE (LIMSpeak replacement), GeoDESC, Coulometer, and XRF data uploader.

HSE Activities

- Eye wash and safety showers were tested.
- A fire and boat drill was held on 7 March.