

IODP Expeditions 367 and 368: South China Sea Rifted Margin

Expedition 367 Week 7 Report (19–25 March 2017)

After last week's installation of casing to 842 m in Hole U1500B, we conducted continuous rotary core barrel (RCB) coring below the casing. Cores U1550B-2R to 56R penetrated the sedimentary section from 846.0 to ~1379 m and recovered 164.4 m (31%). Cores 57R to 60R penetrated from ~1379 to 1415.9 m in basement and recovered 28.3 m (76%). At the end of the week, we were retrieving the drill string to change the bit so we can core and log deeper in Hole U1500B. All times in this report are in ship local time (UTC + 8 h).

Operations

We spent the entire week RCB coring in Hole U1500B. The week started with us lowering the RCB bit through casing (842 m), into the open hole, to the bottom of Hole U1500B at 846.0 m. We found only 1 m of fill, circulated 25 barrels of mud displacing the heavy mud out of the hole, and started RCB coring at 0115 h on 19 March. The uppermost 5.3 m of the first core taken after installing the casing (Core 2R) was composed primarily of heavy mud mixed with some cuttings.

Overall core recovery in Hole U1500B was very poor over a significant interval of the sedimentary section, particularly from 893.8 to 1233.3 m (Lithostratigraphic Unit IV). Cores from this interval (U1500B-7R to 41R) penetrated 339.5 m and recovered only 51.3 m (15%). Cores in this interval that cut quickly (15 min or less) had core recovery of only 7%; we inferred the formation is likely dominated by unconsolidated sand/silt. In contrast, recovery in cores that took longer to penetrate (20–55 min) was higher (41%) and recovered sandstone with claystone and siltstone interbeds.

While cutting Core 42R, we encountered a substantial formation change at 1235 m, and core recovery increased to 66% for Cores 42R to 45R. The time to cut Cores 43R to 45R also increased to 40–80 min. The formation change is also reflected in the recovered cores, dusky red claystones with greenish alteration zones as well as a few interbedded sandstone layers. Cores 46R to 50R penetrated from 1272.1 to 1320.6 m and recovered 30.2 m (62%). Although it took quite a long time to cut each of these cores (1.8–3.8 h), the penetration rate was very smooth and hole conditions were quite good. Cores 51R to 57R then penetrated from 1320.6 m to 1388.5 m and recovered 32.4 m (48%). After Core 51R took 100 min to cut, the next five cores (52R–56R) penetrated quickly (all but one took only 5–25 min) and had relatively lower recovery (31%). Core 57R cut slowly (3.6 h) but smoothly and consistently and recovered 8.34 m, almost entirely basalt. Cores 58R to 60R continued in basalt, penetrating from 1388.5 to 1415.9 m and recovering 19.9 m (73%). These cores also cut slowly (4.3–5.4 h) but mostly smoothly and consistently. Since we had 52 rotating hours on the bit and we wanted to core and log deeper in

Hole U1500B, we decided to retrieve the drill string to change the RCB bit. We circulated cuttings out of the hole, raised the bit up to 1242 m, and pumped 235 barrels of weighted (11.0 ppg) mud into the hole to stabilize it while we changed the bit. We then pulled the drill string out of the hole, removing the top drive at 1066.0 m, and the bit cleared the seafloor at 2340 h.

Science Results

This week scientists worked on sediment and basement cores from Hole U1500B.

Lithostratigraphy

This week we described Cores U1500B-2R to 60R. We merged our observations from Hole U1500B with those from Hole U1500A and updated the lithostratigraphic summary for Site U1500. Eight lithostratigraphic units are now defined for Site U1500. The dark greenish gray claystone and dark gray sandstone intervals (Unit III) observed in the bottom of Hole U1500A continued through the first five cores (2R–6R) of Hole U1500B. Recovery was low (~15%) from Cores U1500B-7R to U1500B-41R, which could reflect a change in lithology. Although it remains unclear if the low recovery zone corresponds with a separate lithostratigraphic unit, we assigned this low recovery zone to Unit IV in an effort to maintain consistency with unit boundaries drawn at Site U1499. Starting with Core U1500B-42R, recovery improved (~68%) and the principal lithology changed to dark reddish brown claystone with thin sandstone and siltstone intervals, marking the top of Unit V. The lithology transitioned into a continuous interval of reddish brown to reddish gray chalk from Core U1500B-47R to 49R. The chalk is predominantly composed of nanofossils and foraminifera tests. We divided Unit V into two subunits. The reddish brown claystone intervals were assigned to Subunit VA and the chalk intervals were assigned to Subunit VB, with the subunit boundary placed at the top of Section U1500B-47R-6. Cores U1500B-50R to 56R comprise Unit VI, which includes two principal lithologies: a dark greenish gray nanofossil-rich silty claystone, and a medium-grained carbonate-cemented sandstone. In Section U1500B-57R-1 we recovered 32 cm of dark reddish brown claystone (Unit VII) with an abrupt planar contact on top of a sparsely plagioclase phyric to aphyric basalt (Unit VIII). The basalt is moderately altered to fresh and contains haloed and uniform veins, which are made up of carbonate, iron oxide, and other infilling materials. The upper contact of this massive basalt is characterized by a chilled margin showing highly altered plagioclase phenocrysts. No bottom contact has been found in this core. Fractures have been observed. Cores U1500B-58R and -59R continue with massive basalt, showing similar alteration intensity and texture as Core U1500B-57R. Possible chilled margins occur in Section U1500B-59R-7. Core U1500B-60R contains several glassy chilled margins and intercalated baked claystone. The basalt ranges from aphyric to moderately plagioclase phyric textures and is marked by haloed carbonate-iron oxide veins. This core is more fragmented than the previous basalt cores.

Biostratigraphy

This week the biostratigraphy group observed all core catcher samples from Cores U1500B-2R to 56R, and some additional samples from split cores. The preservation of microfossils is poor to moderate throughout Hole U1500B.

Microfossils are barren in most cores recovered, except for Cores U1500B-4R to 9R, which indicate a normal pelagic environment. Shallow water benthic foraminifers in some cores (e.g., Cores U1500B-3R, 11R, 24R, 34R, and 35R) suggest that these sediments may be reworked. Where microfossils are present and not reworked, several bioevents allow Cores U1500B-2R to 45R to be assigned to the late Miocene, and Cores U1500B-46R to 49R to the middle to early Miocene. Microfossil assemblages suggest that Cores U1500B-50R to 56R are late Oligocene.

Paleomagnetism

This week, we continued collecting paleomagnetic data from both the archive-half and discrete samples of the working half at Hole U1500B. Natural remanent magnetization (NRM) of all archive-half core sections (up to Core U1500B-56R) have been measured at 5, 15, and 25 mT steps, which are not sufficient to fully demagnetize the secondary magnetization and reveal the characteristic remanent magnetization (ChRM). For Core 50R and below, the moment of the NRM drops suddenly from $\sim 10^{-6}$ Am² in the reddish brown claystone to $\sim 10^{-8}$ Am² in the greenish silty claystone, which is close to the background value of the magnetometer.

We also collected 1–3 discrete samples per core to make measurements on the spinner magnetometer using a combination of alternate field and thermal demagnetization steps. The demagnetization behaviors of the first batch of 12 samples are quite straightforward to interpret and possibly indicate the existence of both magnetite and hematite.

We have also performed numerous calibration runs on the superconducting rock magnetometer (SRM) when it was not being used to measure archive-half cores.

Geochemistry

This week we measured 50 headspace gas samples for routine safety monitoring. Methane is below the detection value from 850 to 1253 m and remains <15 ppmv in the section down to the basement.

A total of 40 samples were analyzed for total inorganic carbon, total carbon and total nitrogen. Carbonate contents vary from <1 wt% to 40 wt%, but are quite low over the entire section. The higher values were in intervals selected for core description purposes. No downcore trend is observed for total organic carbon or total nitrogen, which were lower than 0.4 wt% and 0.05 wt%, respectively.

Petrophysics

This week, we measured physical properties on Cores U1500B-2R to 52R 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 discrete samples.

PWC values increase from 1.9 to 2.7 km/s in the depth interval between 850 m and 1300 m. In the deeper section (1040–1210 m), peaks up to 4.7 km/s were measured on lithified sandstone. NGR values are relatively constant, ranging between 50 and 82 cps, only decreasing slightly to 32 cps in the lowermost part (1230–1300 m). MS values show a strong peak at 437×10^{-5} SI around 850 m as well as around 1270 m with values up to 97×10^{-5} SI. Between the peaks, a general decrease in MS values from 62 to 12×10^{-5} SI is observed. GRA bulk density values are relatively constant, reaching up to 2.44 g/cm^3 . Grain density based on MAD measurements ranges between 2.7 and 2.84 g/cm^3 . Porosity decreases slightly from $\sim 42\%$ to $\sim 30\%$. Due to fractures in the samples, thermal conductivity measurements became more unreliable in the deeper sections (deeper than ~ 1300 m). However, thermal conductivity values from cores above 1300 m range between 2.0 and $3.6 \text{ W/(m}\cdot\text{k)}$. Both MS and NGR values decrease strongly from Core U1500B-46R to Core U1500B-52R (from 60 to 10×10^{-5} SI and from 80 to 40 cps, respectively).

Education and Outreach

This week the Education and Outreach Officer continued scheduling and planning live video-outreach events, including testing connection 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 with the contest for the schools about the depth at which we will reach the basement in Hole U1500B (particularly exciting now that we reached basement). Routine posting to social media and to the *JOIDES Resolution* blog (<http://joidesresolution.org>) continued, including interviews with scientists and IODP personnel and crew staff to create blog entries. On 24 March, we hosted a Reddit “Ask Me Anything” event where the shipboard scientists answered questions in real time!

Technical Support and HSE Activities

Technical Support Activities

- The technical staff continued processing core and performing routine operational laboratory, IT, and data management issues.

- The application developers continued working on ongoing projects including LIVE, and JANUS to LIMS (Curation).

HSE Activities

- Eye wash and safety showers were tested.
- A fire and boat drill and an anti-piracy drill were held.