

IODP Expedition 349: South China Sea Tectonics

Week 7 Report (8–14 March 2014)

Operations

Week 7 of Expedition 349 (South China Sea Tectonics) began with the vessel underway to Site U1433 (SCS-4B). After a 334 nmi transit, lasting 29.9 h, the vessel arrived at Site U1433 (SCS-4B) and switched into dynamic positioning (DP) mode at 0230 h on 8 March. At 0255 h an acoustic positioning beacon was deployed. An APC/XCB bottom-hole assembly (BHA) was run in the hole (RIH) to 800.4 mbrf. At 0520 h, a tool joint parted on the 24th stand of drill pipe, just after picking up the drill string and just prior to unlatching the lower set of elevators. The load cell weight at the time of the incident was recorded at ~200 klbs. The entire weight of the drill string dropped approximately 18 inches and landed in the lower set of elevators, which were resting on top of the dual elevator stool. The pin on the top single of drill pipe had parted leaving one single hanging from the upper set of elevators and two singles stuck up from on top of the lower set of elevators. The stand was then laid out to the V-door. The broken pipe was visually inspected and photographed. As a precaution the 23rd stand was also disassembled and laid out. The bottom set of elevators was removed from use and replaced with a reconditioned set of elevators. After clearing the rig floor, the trip in the hole resumed. When the bit was at 1147.8 mbrf (35th stand), another tool joint failed when the driller was picking up the 36th stand from the pipe racker. This time, one single fell back into the trough of the pipe racker still attached to the skate and a double remained connected to the elevators on the bales connected to the main block. After the second tool joint failure, we decided to discontinue using any of the 5 inch drill pipe that had been used in the stuck pipe incident at the previous site. Investigations continue into the root cause of the pipe failure. Documentation of the stuck pipe event is being collected for analysis. The failed tool joints have been prepared for shipment to a laboratory for detailed metallurgical analysis and will be shipped from the next port of call. The drill string was recovered and all suspect drill pipe above the BHA was removed from use and stored in the port pipe racker. We then picked up 201 joints of new 5 inch drill pipe (201 joints) from the riser hold. The new drill pipe was strapped and drifted as it was assembled and run into the hole. After completing the assembly of the new pipe, the remaining 37 stands from the starboard 5 inch pipe racker were picked up and RIH. The total number of 5 inch pipe stands available is now 104 stands. The 101 stands of suspect drill pipe in the port pipe racker need to be inspected before they can be put back in service.

After RIH with 104 stands of 5 inch drill pipe, the 5.5 inch drill pipe was picked up until the bit reached 4372.9 mbrf. The trip in the hole was stopped at 3587.0 mbrf to perform a slip and cut of the drilling line. The precision depth recorder (PDR) recorded an estimated depth of 4394.4 mbrf for the seafloor. The top drive was picked up and spaced out to 4390 mbrf. The non-magnetic core barrels were dressed with liners, the FlexIt core orientation tool was inserted, and a core

barrel run down and landed. Hole U1433A was spudded at 1000 h on 9 March. The core recovered 8.9 m of sediment and the seafloor was calculated to be 4390.6 mbrf (4379.4 mbsl). Coring continued without issue through Core U1433A-16H. While RIH with a core barrel the bridge informed the driller that a fishing boat was drifting toward the vessel's location. At 0540 h on 10 March, the Captain ordered the driller to suspend operations. The core barrel was retrieved and the driller began tripping out of the hole with the top drive. At 99.1 mbsf, the driller was instructed to standby. After the threat disappeared, the drill string was tripped back to bottom and coring continued to Core U1433A-20H. After four consecutive partial strokes of the APC core barrel, APC refusal was called at 188.3 mbsf. Orientation was measured on all APC cores. Temperature measurements (APCT-3) were taken on Cores U1433A-4H, -7H, -10H, and -13H. Perfluorocarbon tracer (PFT) fluid was used on Cores U1433A-18H through -20H. The bit was tripped to the surface and cleared the rig floor at 0325 h on 11 March, ending Hole U1433A. Twenty APC cores were taken over a 188.3 m interval in Hole U1433A and recovered 168.79 m of core (90% recovery). The total time spent on Hole U1433A was 73.0 h.

After offsetting the vessel 20 m to the east of Hole U1433A, a Rotary Core Barrel (RCB) bottom hole assembly was assembled with a new RCB C-4 bit. Three additional drill collars had to be picked up from the drill collar racks to replace the ones lost on Hole U1432B. The core barrels were then spaced out at the surface and the 172.07 m BHA was assembled and RIH. When the bit was at 4350.3 mbrf, the top drive was picked up and spaced out to spud Hole U1433B. A center bit was then dropped and pumped to land out in the bit. Hole U1433B was spudded at 1515 h on 11 March. The seafloor depth of 4390.6 mbrf (4379.4 mbsl) was determined by using an offset depth from Hole U1433A. We drilled ahead without coring from the seafloor to 186.1 mbsf. The center bit was recovered, an RCB core barrel dropped, and we started continuous RCB coring. So far, we have recovered Cores U1433B-2R through -56R to a depth of 5108.5 mbrf (717.9 mbsf). The PFT tracer pumps were turned on during the drill down period and PFT tracers were pumped through Core U1433B-26R. At the end of Week 7, we are continuing RCB coring with a depth objective of ~965 mbsf.

Science Results

Cores from Holes U1433A and U1433B were described using a combination of visual core description (VCD), microscope inspection of smear slides, core imaging, and scanning for color spectra and magnetic susceptibility. All cores from Hole U1433A were split and described, as were Cores U1433B-2R through -29R. To date we have defined two lithostratigraphic units based on the sharp increase in carbonate content in the cores going down section and have started to draft synthesis figures showing the overall character of the recovered section.

Lithostratigraphic Unit I spans Hole U1433A through Core U1433B-7R and consists mainly of dark greenish gray clay with occasional dark reddish gray clay interbeds. Lithostratigraphic Unit II spans Core U1433B-8R through the last core described (U1433B-29R) and is composed of

dark greenish gray clay with significant interbeds of light greenish gray nannofossil ooze. Bioturbation is heavy throughout much of the cored intervals.

The biostratigraphers analyzed core catcher samples and additional samples from split cores from Holes U1433A and U1433B. The sediment succession recovered in Hole U1433A is <0.91 Ma based on calcareous nannofossils and planktonic foraminifers. For Hole U1433B, the age for the sediment sequence between Cores U1433B-2R and -54R is ~0.9 Ma to ~8 Ma (Pleistocene to late Miocene) based on nannofossil and planktonic foraminiferal biostratigraphy. The Miocene/Pliocene boundary is placed in Core U1433B-34R (~499 mbsf) and the Pliocene/Pleistocene boundary in Core U1433B-17R (~338 mbsf). Calcareous nannofossils are generally common to abundant with good preservation in samples from the Pleistocene–Pliocene section, but become rare and heavily overgrown to even absent in some Pliocene and upper Miocene samples. Planktonic foraminifers are rare to common with moderate preservation in most Pleistocene–Pliocene samples but barren in some Pliocene–late Miocene samples. Planktonic foraminifers are abundant and well preserved in silty layers with numerous small (<150 μ m) specimens transported by turbidites, but those from upper Miocene lithified intervals are difficult to identify. Radiolarians are abundant and well preserved in the upper Pleistocene section in Hole U1433A, becoming rare or absent in older sediment sections downhole.

In Hole U1433A, sulfate concentration decrease with depth and sulfate is almost completely consumed (<1 mM) from ~30 mbsf to bottom of the hole (187 mbsf). Alkalinity increases with depth, reaching a maximum of 25.8 mM at ~30 mbsf, before gradually decreasing with depth. The horizon of depleted sulfate and alkalinity peak corresponds to an increase in methane from <5 ppmv to ~1000 ppmv. Methane concentrations continued to increase, varying from 22,000 to more than 85,000 ppmv throughout the remainder of Hole U1433A. Trace amounts of higher hydrocarbons (ethene, ethane, and propene) also occur below 60 mbsf. These results indicate that anaerobic oxidation of methane coupled with sulfate reduction is ongoing in the sediments. Geochemistry measurements are ongoing for Hole U1433B.

We acquired 44 whole-round microbiology samples from Holes U1433A (from 0.1 to 187 mbsf) and U1433B (from 187 to 692 mbsf). These samples will be processed for microbial community analysis (lipids, DNA, and RNA measurement) and selected samples will be used to inoculate microbiological growth enrichments. In addition, 86 samples were acquired from split core sections; 36 of these samples will be used to determine the microbial communities associated with interfaces and the remainder will be analyzed for lipids and DNA to determine the impact of drilling disturbance on microbial communities.

PFTs for contamination testing were deployed during Cores U1433A-18H to -20H, as well as during RCB coring in Hole U1433B from Core U1433B-2R to -25R. We also collected 21 sets of fluid community tracers (FCT) during coring of these holes, both by collecting drilling fluids from the rig floor, but also by collecting water that drained from the core liners on the catwalk. These water samples were filtered onto a 0.2 μ m filter and frozen at –80°C for subsequent

analysis of microbial communities. The microbial communities present in these samples will be compared to those present in the cores to ascertain whether the communities are notably different and also to determine whether there are unique species that qualify as indicator organisms.

APC Cores U1433A-1H through -20H used non-magnetic core barrels and the FlexIT orientation tool. Therefore, both paleomagnetic inclinations and corrected declinations are available for constructing magnetostratigraphy. Constrained by biostratigraphy, the basal age for Core U1433A-20H (at ~188 mbsf) is <0.91 Ma, which indicates a higher sedimentation rate than at Sites U1431 and U1432. A major shift in both declination and inclination at ~180 mbsf is assigned to the Matuyama–Brunhes reversal boundary (~0.78 Ma).

Within the Brunhes chron, eight polarity shifts were observed. These short-lived events most likely represent geomagnetic excursions as evidenced by both declination and inclination changes. The polarity shifts at ~12, 18, 28, 48, 53, 132, and 152 mbsf match well with known excursion events: Mono Lake (33 ka), Laschamp (41 ka), Blake (120 ka), Iceland Basin (180 ka), Pringle Falls (211 ka), Big Lost (560–580 ka), and Stage 17 (670 ka), respectively. For the other two directional anomalies at depths of ~78 and 88 mbsf, there are no counterparts from previous studies; therefore, further studies are needed to confirm the origin these two anomalies.

Physical properties measurements were made on all whole-round core sections, with additional measurements on split core sections and discrete samples ongoing. The first four cores in Hole U1433A (U1433A-1H to -4H) show a nearly constant *P*-wave velocity that is close to the velocity in water. Below this, a more normal trend of increase with depth resumes down to 150 mbsf, although some measurements (particularly *P*-wave velocity on the whole-round multisensor logger) were significantly affected by the high methane concentrations.

Education and Outreach

We held 13 live ship-to-shore video events this week with schools and universities in China, Australia, the United States, Brazil, Colombia, and Spain. We spoke with a group of kindergartners in Beijing, China, as well as a class of primary school students in Nanjing, China, and two high schools, one in Shanghai and the other in Kaili, China. We held events with three high schools in Sydney, Wainassa, and Glen Innes, Australia. In the United States we spoke with two classrooms from a high school in Virginia, as well as a high school associated with Louisiana State University. We also interacted with a high school in Valladolid, Spain. Finally, we held events with universities in São Paulo, Brazil and Manizales, Colombia.

Technical Support and HSE Activities

The following technical support activities took place:

Laboratory:

- Labs are busy processing cores from Site U1433.

Miscellaneous:

- A group photo was taken on 11 March.

The following HSE activities took place:

- A boat and fire drill was held on 11 March.