

IODP Expedition 344: Costa Rica Seismogenesis Project (CRISP-A2)

Week 5 Report (18–24 November 2012)

Operations

Week 5 of Expedition 344 (Costa Rica Seismogenesis Project, Program A Stage 2) began with XCB coring in Hole U1412B at a depth of 175.2 m below seafloor (mbsf) and continued through Core U1412B-20X to a depth of 304.3 mbsf. Coring over the last 75 m was punctuated by erratic and high torque. The drill string became stuck first at 233.4 mbsf. After working the pipe free with 140 klbs of overpull and 700 amps of torque, the hole was cleaned and coring resumed. Coring continued until 2245 h (UTC – 6) on 19 November 2012 and was terminated after the drill string became firmly stuck for the second time. This time the string was freed from the formation with 90 klbs of overpull and 800 amps of torque. We were unable to wash back down to 304.3 mbsf. With the bit at 289.35 mbsf, a 50-barrel high viscosity mud sweep was pumped to clean the hole. The drill string was then pulled to 231.3 mbsf. Four mud sweeps (total of 160 barrels) were pumped to try to keep the hole open. The wiper trip continued to 85.6 mbsf. Over the next 5.75 h we attempted to trip and wash back to bottom, eventually reaching a total depth of 289.4 mbsf. Another 50-barrel high viscosity mud sweep was pumped, a go-devil was dropped to open the lockable float valve, and the hole was displaced with 130 barrels of heavy logging mud. We then raised the drill pipe to 91.04 mbsf, and the logging tools were rigged up. The first logging run with the triple combo string started at 1040 h on 20 November. However, the tools were unable to exit the bottom-hole assembly (BHA) and the drill string became stuck. The tools were pulled from the hole and were laid out at 1600 h. The drill string was so firmly stuck that we were unable to lower the elevators the 1 m required to land them on the elevator stool, so the vessel had to be offset by 50 m to lower the elevators. Once the elevators had landed on the elevator stool, the top drive was picked up. With the top drive installed, the mud pumps were turned on and circulation was established. The drill pipe was slowly pulled from the hole and the vessel was moved back over the hole. Rotation was re-established and the bit finally cleared the seafloor at 1815 h on 20 November. The remainder of the drill string was pulled to surface and the bit cleared the rotary table at 2245 h on 20 November, ending Hole U1412B.

At Hole U1412B, one APC core was taken over a 6.7 m interval with 6.74 m recovered (101%). Eighteen XCB cores were taken over a 148.5 m interval with 21.52 m recovered (15%). The total recovery for Hole U1412B was 28.26 m (18%). The total time spent on Hole U1412B was 104.5 h.

After the drill string cleared the rig floor, the vessel was offset 20 m to the north-northeast. The RCB coring BHA was picked up and run to just above the seafloor. Seafloor depth for Hole U1412C was set at 1965.0 m below sea level from an offset depth on the previous hole. Hole U1412C was spudded at 0730 h on 2 November, and was drilled with a center bit to 300 mbsf in 20 h. The hole was then cleaned with a 40-barrel high viscosity mud sweep. Coring continued with Cores U1412C-2R to 10R to a final depth of 387.0 mbsf. Excessive torque (>800 amps) was present while cutting the final core, and in order to pull the final core, the bit had to be pulled back to 326 mbsf. However, high torque was still present at 326 mbsf and the drill string had to be pulled back all the way to 239 mbsf. We then attempted to wash back to bottom to resume coring. After several hours of working to clean the hole, we reached 307 mbsf. High and

erratic torque was still present. Due to the lack of progress and difficult drilling conditions, the decision was made to abandon Hole U1412C. The drill string was tripped to the surface and the bit cleared the rotary table at 2115 h. The rig floor was secured for transit at 2200 h on 23 November, ending Hole U1412C.

At Hole U1412C, nine rotary cores were taken over an 87.0 m interval with 36.6 m recovered (42%). The total time spent on Hole U1412C was 71.25 h.

The vessel arrived at Site U1413 (proposed site CRIS-13B) at 2330 h on 23 November after a 15-nmi transit from Site U1412 (CRIS-9A), and a positioning beacon was deployed at 2345 h. As soon as the vessel was stabilized over the site coordinates, the APC/XCB BHA was assembled and lowered close to the seafloor, at an estimated water depth of 541.2 m. Hole U1413A was spudded at 0635 h on 24 November. Seafloor depth was calculated at 539.9 m below sea level from the measurement of the mudline core. APC coring continued with non-magnetic core barrels and orientation through Core U1413A-9H. APCT-3 formation temperature measurements were taken with Cores 3H, 5H, 6H, 7H, and 8H. While pulling Core 7H, the aft coring line parted and the core barrel fell back to the landing seat in the BHA. The wireline spear was rigged up and run into the hole to extract the core barrel. In the process of fishing for the core barrel, the forward top drive tilt cylinder began leaking, which required 3 h to repair. After the cylinder was replaced and the coring line was re-terminated we resumed coring at 2000 h. The week ended with coring Core 10H at 79.5 mbsf.

Science Results

Hole U1412B

Hole U1412B lithology is dominated by dark greenish to greenish gray clay with some smaller variations in grain size to silty clay as in the lower portion of Hole U1412A. The sediments show strong textural destruction due to gas hydrate disassociation. From Core U1412B-8X on there is a sharp change in lithology and color to a whitish diatom ooze with nannofossils in the first 50 cm and afterwards, down to Core 20X, into a brownish nannofossil ooze with diatoms, sponge spicules, radiolarians, and foraminifers as well as rare feldspar crystals. Description of cores at the bottom of the hole was limited to a few lithified clasts in the core catchers as a result of the poor recovery.

Nannofossils indicate that the top of Hole U1412B is Pleistocene, with Samples 344-U1412B-3X-CC to 5X-CC assigned to Zone NN19. Samples 6X-CC and 7X-CC are indicative of Zone NN21, which may indicate a fault between Samples 5X-CC and 6X-CC or contamination caused by difficult drilling conditions. A major change from Pleistocene to Miocene is recorded in Sample 8X-CC, consistent with the depth of the Unit II/III lithostratigraphic boundary.

Benthic foraminifers in Hole U1412B are similar to those in Hole U1412A. In the upper part (Samples 344-U1412B-3X-CC to 5X-CC), foraminifers are present to rare and are moderately well preserved. A substantial change in foraminiferal assemblage occurs in Sample 7X-CC, with the appearance of *Globocassidulina subglobosa*, *Cibicidoides pachyderma* var. *bathyalis*, *Hansenisca altiformis* and *Planulina renzi*. The latter species last appeared in the middle Miocene, which agrees with the nannofossil and radiolarian biostratigraphy.

Physical properties values in Hole U1412B seem to continue the trend in Hole U1412A but the poor recovery makes it difficult to make any conclusive determinations.

Downhole logging was attempted in Hole U1412B, but we were unable to lower the tool string into the open hole below the base of the drill pipe. While trying to lower the drill pipe, the drillers noticed overpull and resistance when descending. This indicated that the hole was closing around and below the BHA and that further attempts to log would be fruitless.

Hole U1412C

Hole U1412C was washed down to 300 mbsf and the recovered brownish siltstone with a carbonate matrix is a continuation of the Hole U1412B lithology. Section 344-U1412C-6R-1 displays a sudden change back to terrigenous, slightly calcareous, greenish gray silty claystone that continues to the bottom of the hole at 387 mbsf.

Nannofossils in Samples 344-U1412C-2R-CC to 5R-CC are indicative of a Middle Miocene age. A major age inversion is recorded between Samples 5R-CC and 6R-CC, with the reappearance of Pleistocene assemblages.

Foraminifers from the upper sections of Hole U1412C (Samples 344-U1412C-2R-CC to 5R-CC) contain the same Miocene species as in Hole U1412B. Preservation and abundance decrease substantially, however, in comparison with Hole U1412B. In the lower sections (Samples 6R-CC to 9R-CC), benthic foraminifer abundance is low and species composition resembles that of the uppermost part of Hole U1412B.

Hole U1412C had steeply dipping bedding, normal and reverse faults, and intervals of brecciated sediments, in some cases with fragments where striated and polished surfaces are developed.

We completed the chemical analyses for six interstitial water samples collected from Hole U1412C. These few samples extend the trend observed in Holes U1412A and U1412B, with decreasing concentrations in alkalinity, boron, and magnesium, whereas calcium, barium, strontium, and lithium concentrations increase with depth. There is not enough resolution in the sampled intervals to delineate any fluid flow pathways. There is no significant change in the chloride values below the gas hydrate stability zone.

Physical properties values are more scattered in Hole U1412C than in Holes U1412A and U1412B.

Remanent magnetization measurements and detailed alternating field demagnetizations were performed on Site U1412 discrete samples. We subsequently analyzed the data to establish the magnetostratigraphy at the site and to observe the magnetic properties of each lithology in the units recovered. Overall, the paleomagnetic data are reasonably robust, allowing us to correlate certain magnetic polarity intervals recorded in the sediments with the geomagnetic polarity timescale and provide age information about the recovered sediments, which range from Pliocene to Pleistocene.

Hole U1413A

We described Cores 344-U1413A-1H to 5H (~50 mbsf). The lithology is dominated by a massive greenish gray silty clay that contains abundant centimeter-thick sequences of millimeter-thick, turbiditic, fine-sand laminae characterized by sharp basal contacts and gradational upper boundaries. Sediment composition is dominated by terrigenous components (volcanic glass, rock fragments, feldspar, amphibole, pyroxene, quartz, chlorite, biotite), glauconite, and abundant foraminifers, especially in the sandstones. Additionally, some ash layers and pods record the eruptive activity of the nearby Costa Rican volcanic arc.

Nannofossils and radiolarians from Samples 344-U1413A-1H-CC to 5H-CC indicate an Upper Pleistocene age.

We collected 12 pore fluids samples from Cores 344-U1413A-1H to 6H. The upper sections of the sediment reflect changes associated with organic matter diagenesis, mostly evidenced by an increase in alkalinity to a maximum of 37 mM in Core 5H. The sulphate-methane transition occurs at ~20 mbsf. Below this depth, methane increases and the C_1/C_2 ratio of $\sim 10^5$ is consistent with a biogenic methane source, as expected.

Five APCT-3 formation temperature measurements were taken with Cores U1413A-3H, 5H, 6H, 7H, and 8H. Physical properties and remanent magnetization measurements are too preliminary to report.

Education and Outreach

Blogs and photos were added to joidesresolution.org, Facebook, and Twitter. Video conferences were held with 20 high school students in New Egypt, New Jersey and ~85 middle school students in Columbia, South Carolina, and Washington, D.C. Work continued on video and animation production.

Technical Support and HSE Activities

The following technical support activities took place:

- Labs processing core

The following HSE activities took place:

- Vessel boat and security drill held on Monday, 19 November
- Eyewash stations tested
- Safety showers tested