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

**Week 2 Report (28 October–3 November 2012)**

## Operations

Week 2 of Expedition 344 (Costa Rica Seismogenesis Project, Program A Stage 2) began while spacing out to perform the jet-in test at Site U1380. The top drive was picked up and Hole U1380B was spudded at 0118 h on 28 October 2012. After 11.25 h, the 14¾ inch bit had been jetted into the formation 50 m. The BHA was then pulled out of the hole with the top drive in place and the bit cleared the seafloor at 1310 h on 28 October.

The re-entry cone was moved to the center of the moon pool and a 48-m long string of 16 inch casing was assembled. The casing string was then picked up with the Dril-Quip running tool and lowered and latched into the re-entry cone centered in the moon pool. There were some problems encountered with the initial shoe joint of the casing. An out of round deformed coupling was found and the shoe joint had to be replaced.

Once the re-entry system and casing had been assembled, the stinger assembly that is run below the casing running tool was assembled and run inside the casing. The Dril-Quip running tool was made up and inserted into the casing hanger and the assembly was lowered to the seafloor. The top drive was picked up and the 16 inch casing string was jetted into the formation. Hole U1380C was spudded at 1145 h on 29 October 2012. After 9.5 h of jetting operations, the re-entry cone was landed on the seafloor. The subsea camera system was run to bottom and the running tool was released and lifted clear of the re-entry cone. The bit was pulled out of the hole with the top drive and cleared the rig floor at 0155 h on 30 October. Our next step was to drill a hole for 10¾ inch casing. So, a 14¾ inch drilling assembly was made up and run into the hole. The subsea camera system was deployed, the top drive was picked up, and after 20 min of positioning the vessel Hole U1380C was re-entered at 0550 h on 30 October.

Drilling began at 48 mbsf and continued over the next 22.75 h to a total depth of 438 mbsf. Two high-viscosity gel sweeps were pumped and the hole was checked for fill. After finding 3 m of fill the hole was washed back to bottom and another high viscosity gel sweep was pumped. After cleaning the hole as much as practical a wiper trip was performed. The bit was pulled back with the top drive to 260 mbsf. Excessive overpull and high torque were experienced while the bit was between 338 and 396 mbsf. The top drive was then set back and the bit was pulled back to just above the casing shoe. The bit was then lowered back into the open hole section and a hard tag (weight loss) was experienced at 289 mbsf. The drill string was pulled back 20 m and the top drive was picked up. The hole was then washed and reamed back to bottom, where 3 m of fill was encountered. After reaching total depth, two 50-barrel mud sweeps were pumped. Given the hole problems experienced on the first wiper trip, we conducted another wiper trip. The top drive was left in place and the bit was pulled back to 289 mbsf. Overpull of 10–15 klbs was experienced in the same interval as before. After reaching 289 mbsf, the top drive was set back and the bit was pulled back to just above the casing shoe. While running back to bottom, the first hard tag was experienced at 337 mbsf. The drill string was pulled back and the top drive was picked up. The hole was then reamed back to bottom (438 mbsf), where 25 m of hard fill was encountered. The fill could not be washed through and had to be drilled and circulated out.

Another two high-viscosity gel sweeps were pumped and another wiper trip was performed. The same tight hole conditions were experienced between ~395 and 340 mbsf. The top drive was set back and the pipe was tripped back to just above the 16 inch casing shoe. Running back into the hole with the bit, a hard tag was experienced again at 347 mbsf. The top drive was again picked up and an attempt was made to jet into the hole without rotation. At 366 mbsf, 40 klbs of overpull and 500 amps of torque were experienced. We continued to run back in the hole with and without rotation to 425 mbsf. At that point we decided to attempt to stabilize the formation with cement from 396 mbsf to ~50 m higher. Sixty-five barrels of cement were mixed, pumped and displaced at 2045 h on 1 November 2012. After pumping the cement, the drill string was pulled up above the theoretical top of the cement and 2.5 times the volume of the drill sting was pumped with seawater to flush any remaining cement from the drill string. The pipe was then pulled all the way back to just above the casing shoe and circulated again, this time with 3 times the volume of the drill string at 100 spm. After waiting on the cement to cure for 9.75 h, we attempted to run back into the hole with the bit. Tight hole was noted at 153–163 mbsf and at 175 mbsf. At 175 mbsf, the top drive was picked up and we washed and reamed back to 347 mbsf, where we encountered the top of the cement plug. The cement plug was drilled out from 347 to 395 mbsf and the rest of the hole was reamed back to 438 mbsf. Two high-viscosity gel sweeps were pumped at the bottom of the hole and the drill string was then pulled back to 328 mbsf with no pump and no rotation. We then washed down with no rotation from 328 to 406 mbsf. The maximum weight on bit experienced was 10–15 klbs. At 406 mbsf, we began washing and rotating back to bottom. Two 50-barrel high-viscosity gel sweeps were pumped to clean up the hole, and the hole was displaced with 225 barrels of heavy (10.5 ppg) mud. We then pulled out of the hole with the top drive, the top drive was set back, and the drill string was pulled clear to surface to run casing. The 14¾ inch bit was laid out and the Dril-Quip casing running tool was made up to the casing hanger and a stand and set back in the derrick. The drill floor was then rigged up for running casing and a short safety meeting with the crew took place. The 10¾ inch casing length that was selected was 406 m. This was made up of 29 joints of 10¾ inch casing, one shoe joint, and one pup joint on the 10¾ inch casing hanger. The week ended with us just about to land the 10¾ inch casing string on the doors to the moon pool.

**Science Results**

As no new core was recovered this week, the science party continued processing samples from Hole U1381C and writing reports. In addition, scientists took ship tours to become familiar with all aspects of ship operations, from the Bridge and dynamic positioning controls to the engine room, waste treatment, and water generation.

During the second week core description of Hole U1381C sediments and the basal contact was finished and the definition of boundaries for Units I to V was finalized. The Unit I/II boundary is present in Core U1381C-7H and is characterized by a change between greenish grayish silty clay with some nannofossils and terrigenous minerals to a brownish grayish nannofossil-dominated ooze with abundant to common foraminifers and sections with predominant sponge spicules. This boundary is also seen in smear slide and XRD data. The top of Unit II is also characterized by a high abundance of up to 42-cm thick tephra layers. Judging from core description and smear slide data, a lithologic change in Core U1381C-11H to a finer grained nannofossil-rich clay with only some glass and feldspar components marks the Unit II/III boundary. The Unit III/IV boundary in Core U1381C-12H again shows a drastic change in lithology to a pure clay/claystone. XRD data indicate a mixing of smectite, probably saponite, pyrite, and to a less extent plagioclase. Sphalerite, calcite, and anhydrite are present as minor phases. Unit V starts in Core U1381C-13X and consists of a breccious oceanic basaltic basement. Overall alteration of the basaltic groundmass is slight to moderate with smectite replacing interstitial glass and partially corroding plagioclase and clinopyroxene phenocrysts.

The biostratigraphic characterization of Hole U1381C was constrained from calcareous nannofossils and radiolarians identified in core catcher samples,. Biostratigraphic zones indicate that Unit I is of Late Pliocene to Pleistocene age (~2 Ma). Unit II represents the middle Miocene (~11 to 14 Ma). Thus, the hiatus between Units I and II is ~9–12 my.

We determined the systematics of the benthic foraminiferal assemblages of 11 core catcher samples from Hole U1381C. Benthic foraminiferal assemblages from Unit I are substantially different from the ones of Unit II, indicating large paleoenvironmental changes related to organic carbon flux and bottom water ventilation. Of particular interest is the substantial presence of representatives of the *Stilostomella* extinction group in Section 344-U1381C-6H-CC. This provides an alternative biostratigraphic datum to the calcareous nannofossils.

Thirty-five measurements of bedding were taken principally from tephra layers in Hole U1381C. Bedding is generally sub-horizontal to gently dipping. In Unit III, toward the bottom of the sedimentary succession, we observed a few deformation bands and mineral-filled extensional and shear fractures, which have a normal displacement component.

We completed the pore water and gas analyses for Hole U1381C. Similar to the data from Expedition 334 Hole U1381B, there is little variation in salinity, chloride, sodium, and potassium downhole. Organic matter diagenesis in the upper sediments is indicated by increases in alkalinity, ammonium, and phosphate and consumption of sulfate, which reaches a minimum value of 11 mM at ~40 mbsf. A concomitant calcium decrease is indicative of carbonate precipitation driven by the alkalinity increase. The sulfate profile shows a reversal below ~40 mbsf, with a steady increase in concentration with depth, indicative of diffusive communication with a seawater-like fluid in the upper basement. This observation is similar to that previously reported for Hole U1381B and for the incoming sediment section off the Nicoya Peninsula.

Inorganic carbon distribution increases with depth in Hole U1381C, consistent with a change in lithology from the silty clay sediments of Unit I to the foraminiferal carbonate ooze of Unit II. We are waiting on results of total carbon and total nitrogen analyses.

Physical properties measurements on Hole 1381C samples were completed. Results show high porosities and low bulk densities in lithologic Units I and II, with little evidence for compaction. Electrical conductivity values appear generally consistent with porosity trends. *P*-wave velocity measurements indicate slightly higher values in Unit II than in Unit I, despite elevated porosities in Unit II. Vane shear and penetrometer measurements show values generally increasing downhole throughout Units I and II. Downhole temperature measurements are consistent with those from Expedition 334 and suggest a thermal gradient (230°C/km) that is higher than predicted for conductive cooling.

Downhole variations in the natural remanent magnetization (NRM) intensity for archive-half cores correlate well with lithology in Hole U1381C. Paleomagnetic measurements indicate that the silty clay of Unit I (0–55.93 mbsf) has a mean NRM intensity on the order of $10^{-2}$ A/m, whereas the foraminifer-rich ooze in Unit II has a lower NRM intensity of $10^{-2}$–$10^{-3}$ A/m. A number of higher NRM peaks appear in both Units I and II, and can be tied directly to the presence of tephra layers. The measured NRM declinations of different cores are scattered but upon correction with the FlexIt orientation data, declinations become close to magnetic north, indicating the remanence is of geomagnetic origin. The magnetic properties obtained from the archive section halves were confirmed by discrete sample measurements.

We used characteristic remanent (ChRM) declinations and inclinations from discrete measurements to define magnetic polarity sequences for the oriented core section in Hole U1381C. At a low latitude area such as Site U1381, a near 180° shift in declination in the cores is a more reliable sign of a polarity transition. For the upper part of Unit I, both pass-through and discrete sample measurements show signs of dominantly normal polarity of ChRM. An additional constraint is provided by an ash layer at ~25 mbsf which is inferred to be the Ar-Ar dated (320 ka) Tiribi Tuff ash layer. Thus, we interpret that the sediments from 0 to 52 mbsf were deposited within the Brunhes Chron (<0.78 Ma). From Section 344-U1381C-6H-5 through Section 6H-7 we see a dominantly reversed polarity in the section-half measurements. Discrete samples from this interval also show negative inclinations and corrected declinations show a ~180° shift, consistent with the magnetization acquired in a reversed field. Thus, we tentatively conclude that the Brunhes/Matuyama boundary is at a depth of ~52 mbsf.

## Education and Outreach

Blogs and photos were added to joidesresolution.org, Facebook, Twitter, and Tumblr. Interviews continued with the science party for video production. Two short animations showing the ship's thrusters and the core splitting process were completed. Footage was taken around the ship and during several science meetings. Work started on children's videos and on capturing ideas for creating a plate boundary animation.

## Technical Support and HSE Activities

The following technical support activities took place:

- CHNS repaired in the Chemistry Lab
- Middle core description table rigged up with sliding ruler and monitor as requested by science party
- Sampling of core from Hole U1381C finished
- SHIL problem fixed, it was cutting off scans short
- VSP guns rigged up and tested (firing circuit and air lines)
- Aft satellite dome railing installed

The following HSE activities took place:

- Vessel fire and boat drill was held on Friday, November 2
- Eyewash stations tested
- Hazardous storage locker shower tested