

## **IODP Expedition 336: Mid-Atlantic Ridge Microbiology**

### **Week 8 Report (6-12 November 2011)**

#### **Science Results**

This week we (1) finished installation of a 247.6 m long, multi-level, CORK observatory and (2) APC/XCB cored at four holes to sample the sediment overlying basement as well as the sediment/basement contact.

CORK Observatory: We successfully completed installation of a 247.6 m long CORK observatory. This includes three packer assemblies to isolate three separate depth intervals in oceanic crust. Five external umbilicals allow access to these three zones for microbiological, geochemical, pressure sampling. The CORK tubing (coated steel and fiberglass) extends to 247.6 mbsf and includes perforated and slotted intervals (67.4 to 129.4, 154.8 to 181.1 mbsf, and 203.7 to 246.6 mbsf) that provide access to the three isolated intervals. An internal OsmoSampler string extends the full length of the CORK includes seals isolating the three zones for microbiological, geochemical, and temperature experiments.

APC/XCB Coring: APC coring of sediments and XCB coring of the sediment-basement transition at three Sites U1383 (NP-2), U1382 (near 395A), and U1384 (NP-1) concluded the drilling activities of Expedition 336. In Hole U1383D, 44.3 m of sediment were cored, of which the lowermost 1 m was XCB-cored basalt and limestone-cemented breccia (0.76 m of basement were recovered). Nearby Hole U1383E cored 44.2 m of sediment and 1 m of basaltic basement, of which 0.3 m were recovered. Hole U1382B was drilled midway between Holes 395A and U1382A; here, 90.0 m of sediments were APC-cored and 8.8 m were advanced with the XCB, recovering a sedimentary breccia from between 90 and 91 mbsf and basaltic basement from the bottom of the hole. In Hole U1384A, 94.7 m of sediments are underlain by basalt and limestone-cemented breccia, of which 1 m was drilled and 58 cm recovered.

The sediments are nanofossil ooze with layers of foraminiferal sand. The lowermost several meters of the sedimentary pile are composed of brown clay. Sediments from Hole U1382B show moderately rounded rock fragments concentrated in layers or dispersed in the ooze. These fragments range from coarse sand to pebble in grain size and consist of serpentinitized mantle peridotite, gabbro, troctolite, and basalt. Both XCB cores from Hole U1382B also contain coarse sediment with predominantly serpentinite clasts, including soapstone and talc-tremolite schist. The occurrence of these rock fragments is consistent with the polymict sedimentary breccia recovered during basement drilling at Sites 395 and U1382. The deformed and metasomatized lithologies encountered in Hole U1382B corroborate the hypothesis that this material has transported to the Site U1382 area in North Pond by mass wasting events and that its source is a oceanic core complex, probably in the southern rift mountains.

Each of the four holes cored were intensively sampled for microbiology and interstitial water analyses. The sampling program was similar for each of the holes. In total, we collected 167 whole-round samples for interstitial waters and 691 whole-rounds samples for microbiologic analyses. Sampling density was increased in the bottom section. Pore waters in these basal sediments are dominated by diffusion of

components from the basement fluids into the sedimentary pile. They allow estimation of basement fluid compositions by extrapolation. Whole round cores were preserved for shore-based molecular analysis to provide a detailed description of the microbial community. Ship-based enrichment cultures were established to enrich for multiple metabolic functional groups. These cultures will be analyzed onshore for both metabolic activity and community composition. Sediment samples were also analyzed for oxygen using optodes. Hard rock samples were sectioned and allocated following previous strategies established during the hard rock drilling phase of the expedition. Multiple basalt samples were provided for RNA/DNA, geochemistry and culture analysis. All requests were filled to the best ability of the group given time and materials available.

## **Operations**

Week 8 of Expedition 336 started with the final assembly of the 254.3 meter-long CORK for Hole U1383C. Five external umbilicals allow access to three zones for microbiological, geochemical, pressure sampling. The CORK tubing (coated steel and fiberglass) extends to 247.6 mbsf and includes perforated and slotted intervals (67.4 to 129.4, 154.8 to 181.1 mbsf, and 203.7 to 246.6 mbsf) that provide access to the three isolated intervals, yet leaves the bottom portion of the hole open for future logging and access (247.6 to 331.5 mbsf). An internal OsmoSampler string extends the full length of the CORK and includes seals isolating the three zones and microbiological, geochemical, and temperature experiments. At 1700 hours on 5 November, we finished assembling the 247.6 m-long CORK observatory and picked up the CORK head and attached it onto the casing string. The last umbilical connections were made to the bottom of the CORK head. The CORK was then lowered to the moonpool and landed on the moon pool doors. The CORK running tool was then removed and the OsmoSampler instrument string was assembled and lowered inside the CORK and casing. The CORK running tool was then re-installed and the packer inflation line was connected. The CORK was then lowered below the keel to flood umbilicals to remove air from the pressure lines. The CORK was then raised to the moon pool and the seafloor fast-flow OsmoSampler was installed. All valves except the geochemistry bay upper zone 2 valve (which was connected to the seafloor fast flow OsmoSampler) were closed and secured. The CORK was lowered about 100 m below the sea surface and the camera frame was test fit over the CORK head. At 0000 on 6 November 2011, after approximately 21 hours of assembly, we started lowering the CORK assembly to the seafloor. During the trip in the hole, the drill pipe was filled with seawater every 6 stands. This lengthened the trip to a total of 8.25 hours. At 0915 hours the vessel began maneuvering to re-enter Hole U1383C. The hole was re-entered at 0941 hours. After re-entry, the CORK was slowly lowered into the hole, while carefully monitoring drill string weight and observing the procedure with the camera. Approximately 35 meters above the landing point, the top drive was picked up and the CORK was fully landed at 1127 hours on 6 November. After landing the CORK, the mud pumps were brought online to pump up the packers. After 30 minutes of applying pressure to the packers, we were unable to get the pressure to hold a sustained pressure. It was evident that there was a small leak somewhere in the system between the standpipe on the rig floor and the bottom packer. We were unable to detect where the leak might be and there are many possibilities or combinations depending on where the leak is located, from all packers pressurized and sealing to only the top swellable packer sealing. After recovering the camera, the ROV platform was assembled and hung from the camera frame and run to

bottom. It was released at 1630 hours without incident. The camera was then pulled back to the surface, the slings and releasing tool were removed, and the camera lowered back to bottom to monitor the release of the running tool from the CORK head. The running tool was released at 2015 hours on 6 November ending the Hole U1383C CORK deployment. When releasing the CORK running tool it appeared that the CORK wellhead also rotated during this procedure. Several possibilities could account for this action and likely results from additional tightening of the upper casing in excess of the manual tightening on the rig floor. Other antidotal information about a similar occurrence with the Juan de Fuca CORKs was made. The camera and drill string were retrieved with the CORK running tool arriving back on the rig floor at 0315 hours on 7 November ending Hole U1383C. This was the final CORK observatory operation of the expedition.

Hole U1383D (NP-2) – Sediment and Basement Contact Coring: The final operations of the expedition were focused on APC/XCB coring of the sediment above basement and the sediment/basement contact. The APC/XCB bottom-hole assembly was made up with a new APC/XCB bit and lowered to 4 m above seafloor. The vessel was positioned halfway between Holes U1383B and U1383C, offset 5 m to the northwest and Hole U1383D spudded at 1426 hours on 7 November. Six APC cores were taken from 0 to 43.3 mbsf (Cores U1383D-1H to 6H) and recovered 47.89 m of sediment. Core 6H only penetrated 0.2 m before hitting basement, so the majority of the recovery was sucked in when pulling the barrel out of the formation. After hitting basement with the last APC core, we penetrated 1 m with Core 7X and recovered 0.76 m. Hole U1383D ended at 2350 hours on 7 November 2011 when the bit cleared the seafloor.

Hole U1383E (NP-2) – Sediment and Basement Contact Coring: The vessel was then offset 10 meters to the southwest and Hole U1383E was spudded at 0038 hours on 8 November. APC Cores 1H to 6H extended to 43.2 mbsf and recovered 50.38 m of sediment. Core 6H only penetrated 2.3 m before encountering basement, so the remaining 6.22 m of sediment recovered was likely sucked in when pulling the barrel out of the formation. After hitting basement with the last piston core, the XCB core barrel was dropped and the sediment/basement interface was cored for approximately 1 hour to a depth of 44.2 mbsf. Core U1383E-7X recovered 0.3 m. Hole U1383E ended at 1000 hours on 8 November 2011 when the bit cleared the seafloor.

Hole U1382B – Sediment and Basement Contact Coring: After pulling out of Hole U1383E and raising the bit well above seafloor (4300 mbrf), we moved in dynamic positioning mode to Site U1382. After the 3.28 nmi transit was completed at 1445 hours, the bit was lowered to just above the seafloor and the top drive picked up and spaced out for spudding. Hole U1382B was spudded at 1700 hours on 8 November. APC Cores U1382B-1H to 10H extended to 90.0 mbsf and recovered 83.70 m of sediment. Core 10H, the last APC core, encountered basement after penetrating ~8.5 m so the lowermost portion of sediment recovered in this core is likely flow-in. Temperature measurements (APCT3) were attempted on Cores U1382B-3H to 5H. The measurements were not good due to tool movement. They were discontinued because they were thought to be disturbing the sediment cores. Subsequent splitting of the cores seemed to indicate that the disturbed cores could have been caused by the lithology of the cores – coarse sediments up to pebble-size were found inside the cores. After hitting basement with the last piston core, the XCB core barrel was

dropped and the sediment/basement interface was cored. After a few minutes of XCB coring, the formation changed and the XCB quickly advanced to the remainder of the kelly length (4.7 m). After pulling Core U1382B-11X another core barrel was dropped and XCB coring continued until encountering hard formation around 98.8 mbsf. After 30 minutes of coring with no advance, Core U1382B-12X was pulled. The XCB cutting shoe had lost all the carbide teeth and the recovery was only 18 cm of core. Cores U1382B-11X and 12X recovered a total of 0.58 meters over an 8.8 m interval. Hole U1382B ended at 1315 hours on 9 November when the bit cleared the seafloor.

Hole U1384A – Sediment and Basement Contact Coring: After raising the bit above the seafloor (4400 mbrf), we moved in dynamic positioning mode to Site U1384 (NP1). The 3.38 nmi transit was completed at 1815 hours. We lowered the bit to just above the seafloor, picked up the top drive, and spaced out for spudding. Hole U1384A was spudded at 2130 hours on 9 November. APC Cores U1384A-1H to 11H extended to 94.7 mbsf and recovered 93.51 m of sediment. Core 11H was only a partial stroke likely due to encountering basement. XCB Core U1384A-12X advanced 1.5 m in about 40 minutes where penetration stopped. When Core 12X was retrieved it had recovered 0.58 m of core and the XCB cutting shoe had lost all the carbide teeth. Hole U1384A ended at 0042 hours on 11 November.

After the drill string was back on board, the bottom-hole assembly was disassembled and the drill floor was secured for transit. The transit to Ponta Delgada began at 0042 hours on 11 November. Planned arrival in Ponta Delgada is 0730 hours 17 November 2011.

### **Education and Outreach**

Outreach efforts for this expedition have continued through a variety of programs.

Blogs: Current bloggers this week include our onboard education officer Jennifer Magnusson (personal blog and educator ideas). Katrina Edwards continues her blog on the *Scientific American* Expeditions page and the C-DEBI site. Beth Orcutt continues to blog about microbiology on the Adopt-a-Microbe website and Amanda Haddad continues to provide science content and connect with a special needs audience on the Classroom Connections website. Heath Mills continues writing about Mid-Atlantic Ridge microbiology on Texas A&M's georesearch page.

Videoconferences: Seven live ship-to-shore interactive programs were conducted with the following audiences: 3<sup>rd</sup> graders in California, high school special education students in Arizona, 6<sup>th</sup> graders in Florida, 6<sup>th</sup> – 8<sup>th</sup> graders in Illinois, 9<sup>th</sup> graders in Virginia, and university students in England. One final interaction is scheduled for next week.

Social Media: The education officer continues to post daily updates on the JR Facebook page and Twitter account. Updates include links to the blog or other pages on the JR website, photos, videos, operational updates, and classroom activities. Daily math questions continued to be posted.

Adopt-A-Microbe: Week 8 activities (classes completed experiments to examine how microbes process chemicals in the environment) were submitted. Week 9 activities were delayed due to sediment core recovery and processing.

Classroom Connection: This week was a review of the expedition, and students participated in a variety of activities, including a game of JR Jeopardy and an interview with the onboard education officer, Jennifer Magnusson. In addition, students used online resources to explore hydrothermal vents.

Documentary: The videographers have continued full-time filming and interviewing for their documentary.

### **Technical support and HSE activities**

Science Mission Support: This week technical staff was fully engaged providing support for coring operations in Holes U1382B, U1383D, U1383E and U1384A. In particular, laboratory specialists are providing substantially increased support in the physical properties laboratory due to limited science staffing. In addition, staff continued work on a variety of maintenance issues and began logistical preparations for shipping and port call activities in the Azores.

Other Technical Activities:

- Continued to assist scientists with DESCLogik;
- Developers continued to work with staff to correct and test upgrades to Sample Master

The weekly fire and abandon ship drill was held as scheduled.