

IODP Expedition 336: Mid-Atlantic Ridge Microbiology

Week 3 Report (2–8 October 2011)

Science Results

The primary activity this week was to install a CORK observatory to perform long-term coupled microbiological, biogeochemical, and hydrological experiments in uppermost basaltic crust. We installed a re-entry cone with 53 m of 16 inch casing, installed 102 m of 10.75 inch casing and cemented it a few meters into the basaltic basement, and then cored 100 m of basalt. As the week ended, we prepared the hole for downhole logging, formation hydrologic (packer) experiments, and CORK installation.

Hole 1382A was drilled 50 m west of DSDP Hole 395A. After the re-entry cone with 53 m of 16 inch casing was jettied in, the hole was deepened to 110 m with a 14.75 inch tri-cone bit. Hard lithology was encountered at 90 mbsf and three meters of it were penetrated in 30 minutes. The interval from 93-99 mbsf consists of soft sediments, but the underlying formation drilled slowly (2-3 m per hour) and without significant torque to 110 mbsf. Next, 10.75 inch casing was installed and successfully cemented to 102 mbsf. After the cement was drilled out, RCB coring proceeded from 110 to 210 mbsf (Cores U1382A-2R to -12R). We obtained 33.3 m of core with recovery rates ranging from 15 to 63%. The uppermost lithologic unit extends to 123 mbsf and is aphyric, fine- to medium-grained, sparsely to moderately altered massive basalt with scarce clay and carbonate veins. Coring from 123 to 161 mbsf recovered 9.85 m of aphyric, glassy to variolitic to cryptocrystalline, sparsely vesicular pillow basalt with overall minor alteration. Penetration rates were very high between 157 and 165 mbsf, before we recovered a sedimentary unit comprising peridotite, gabbroic rocks, various types of basalt, carbonate-cemented polymictic breccia, and nanofossil ooze. From 172 to ~205 mbsf, we recovered weakly altered, prophyritic massive basalt, before aphyric cryptocrystalline pillow basalt were encountered above the bottom of the hole. This succession resembles the lithostratigraphy encountered in DSDP Holes 395 and 395A and provided superior sampling material for various microbiological studies. The CORK completion is being designed to monitor and sample the sedimentary unit around 75 m sub-basement.

A primary objective of the basement coring was to obtain samples for microbiological analysis. We collected 46 hard rock and 2 sediment whole-round samples for these studies. Samples were selected in the core splitting room as quickly as possible after core recovery, following initial discussion with petrologists on sample representation and photographing of the sample before removal from the core liner. When sample volume permitted, samples were preserved for shore-based DNA and RNA analysis, shore-based fluorescence in situ hybridization and cell counting analysis, ship-based culturing and enrichment, shore-based isotopic analysis, and ship-based fluorescent microsphere analysis. Generally, one microbiological hard rock sample has been collected from every core section. Hard rock samples span a range of lithological units, alteration states, presence of chilled margins, and some contain at least one vein/fracture. Additionally, a few recovered plastic bags that held the fluorescent microsphere solutions in the core

catcher have been collected as a contamination check in DNA analysis. Examination of the microsphere abundance in/on the recovered samples and culturing and enrichment studies are ongoing.

Operations

Week 3 of Expedition 336, Mid-Atlantic Ridge Microbiology (North Pond) began with running to bottom with the re-entry system and 52.98 m of 16 inch casing. The trip was temporarily suspended to install the camera system. The camera system was run to bottom as the pipe trip continued to just above the seafloor. When the casing shoe was just above the seafloor, the top drive was picked up and the drill string was spaced out to spud Hole U1382A. Hole U1382A was spudded at 0745 hours on 2 October. After jetting in the casing for 2.75 hours, the re-entry cone mud skirt was landed on the seafloor. This was verified with the camera system and the running tool was rotated approximately 3.5 turns clockwise to release the casing running tool. The running tool released at 1035 hours on 2 October. The camera system was then pulled to the surface as the drill string and running tool were pulled back to the rig floor. The bottom hole assembly (BHA) was set back and the running tool was de-torqued at the rig floor. The BHA for drilling the 14.75-inch hole was assembled and the drill string was tripped to just above the re-entry system. During the pipe trip the camera system was installed and run as the drill string was tripped to bottom. After the drill string was spaced out for re-entry, the vessel positioned for re-entry, which occurred at 0348 hours on 3 October 2011. The top drive was then picked up and the drill string was run to the casing shoe and spaced out for drilling. The sediment section was drilled without coring from 4547 to 4584 mbsf (53-90 mbsf) where basement was contacted at 90 mbsf. Drilling parameters indicated a fairly hard formation from 90-93 mbsf, but then went fairly quickly from 93-99 mbsf. From 99 to 110 mbsf, drilling parameters returned to slow and consistent indicating a hard formation. We decided to terminate the hole at 110 mbsf to allow 8 m of rat hole below the 102 m of 10.75 inch casing. After conditioning the hole, the bit was then tripped above the casing shoe, the top drive was removed and the drill string was then tripped back to the rig floor. The seafloor was cleared at 1605 hours on 3 October and the bit cleared the rotary table at 2300 hours. Before we could begin rigging up for running casing, we had to slip and cut 115 feet of drill line. We then assembled 101.86 m of casing and attached to a 10.75-inch casing hanger and casing running tool. The casing string was then lowered to the just above the seafloor with a break only to install the camera system. The drill string was then spaced out for re-entry, the vessel positioned for re-entry, and Hole U1382A was reentered at 1355 hours on 4 October 2011. The casing was lowered smoothly into the hole until the last couple of meters when we had to circulate to help clear the way to get it to fully land. The casing string was fully landed and latched in at 1515 hours and the casing was cemented with 20 barrels of cement blended with loss circulation material (Cello-Flake). The displacement calculation was made to leave approximately 15 m of cement inside the casing above the casing shoe. The casing running tool was released from the casing hanger at 1712 hours on 4 October 2011 and the vessel was then repositioned 50 m east to perform a survey of Hole 395A re-entry system. After approximately an hour seafloor survey of Hole 395A, the camera system was retrieved as the drill string was tripped to surface. The casing running tool was back on board at 0200 hours on 5 October 2011. The tool was then de-torqued and

laid out. The RCB BHA was then made up and the coring assembly was spaced out in the seal bore drill collar. A new C-7 RCB bit was made up, the center bit installed, 3 stand BHA was assembled, and the drill string was tripped towards the seafloor. A break in tripping pipe occurred around 1030 hours to install the camera system, but it was quickly retrieved when the subsea camera did not work. The pipe trip continued for another hour and was halted again to install the repaired camera system. At 1330 hours, the drill string was spaced out for re-entry, the vessel positioned for reentry, and Hole U1382A was quickly reentered at 1337 hours. The bit was carefully run into the hole and cement was encountered 14 m above the casing shoe. The top drive was then picked up and the cement was drilled from 88 mbsf to just below the casing shoe that had been positioned at 102 mbsf. We circulated mud to clean the hole, recovered the center bit by wireline, dropped an RCB core barrel, and RCB coring began at 2115 hours. The first core on deck, Core U1382A-2R, arrived at 2300 hours on 5 October 2011. Coring continued through Core U1382A-12R and was completed at 2130 hours on 7 October 2011. We cored a total of 100 m from 110 mbsf to 210 mbsf and recovered 33.3 m (33%). After coring was completed, five wiper trips were made from total depth to the casing shoe and back to total depth. The first 3 trips found tight spots and circulation problems. The fourth and fifth trips were made with no evidence of drag or circulation problems and no fill was found at the bottom of the hole. After hole cleaning and conditioning were completed, the drill string was tripped from the hole, clearing the seafloor at 0729 hours on 8 October 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 and kids blogs) and staff scientist Adam Klaus (operations). 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.

Videoconferences: Seven live ship-to-shore interactive programs were conducted with 8th graders from Pennsylvania, 11th/12th graders from Missouri, 9th – 12th graders from California, 11th/12th graders from Florida, and 6th graders from California. Preliminary feedback from teachers indicates that the conferences have been successful in engaging students in science content. Nine conferences are 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. A short video was produced describing some of the highs and lows of the past few weeks.

Adopt-A-Microbe: Week 3 activities (classes completed microbe-related math problems) were submitted and Week 4 activities (microbe haiku) were assigned.

Classroom Connection: This week's theme was "Drilling," and students participated in a variety of related activities. These included creating a scale model of the drill string using

straws, watching videos about drilling on the JR website, and an interview with the head driller, Charlie Watts.

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

Technical support and HSE activities

Science Mission Support: Technical staff engaged in providing full support for coring operations on Hole 1382A.

Other Technical Activities:

- Assisted scientists with the use of DESCLogik for describing Hole U1382A basalt cores;
- Investigated issues with inconsistent velocity calibration on the whole core track;
- Continued work on the rock saw splash hoods;
- Continued work on the 3D camera project;
- Laser engraver is now operational and was used for most of the Hole U1382A cores.
- Completed testing of the “large bore” integration sphere for color spectral measurements, which is currently being used by science party. The new sphere improves integration times and significant lowers the dark calibration values.
- Installed repaired movie room projector. Moved 60” LCD TV to the lounge.

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