

IODP Expedition 336: Mid-Atlantic Ridge Microbiology

Week 2 Report (25 September – 1 October 2011)

Science Results

The second week of IODP Mid-Atlantic Microbiology Expedition (336) began with successful logging of 600 m of Hole 395A with a new in situ tool for detecting microbial life in ocean floor boreholes - the Deep Exploration Biosphere Investigative tool (DEBI-t). The rest of the week was spent assembling a 530-m long, multi-level CORK observatory to perform long-term coupled microbiological, biogeochemical, and hydrological experiments.

Hole 395A is located in the southeastern part of North Pond in an area of exceptionally low conductive heat flow. The low conductive heat flow is due to cooling of uppermost basement by cold seawater that recharges into basement and flows underneath the sediment cover in a northerly direction. Investigating the coupled geochemical and microbial processes in active aquifers within the upper oceanic crust is a main science objective of Expedition 336.

Assembling the observatory entailed preparing OSMO-pump-driven fluid samplers, microbial incubation experiments, seven temperature, and two oxygen sensors. Packers at 111, 149, and 463 m seafloor depth were installed to separate the borehole into three compartments that are characterized by different thermal and fluid flow regimes. Fluid sampling lines were designed to reach depths of 122, 220, 430, and 506 m below seafloor. OSMO samplers for fluid geochemistry and microbiology were placed at the 118-140, 240-261, 415-438, and 499-527 m depth intervals. The CORK wellhead was instrumented with sensors for monitoring pressures in the four zones isolated by packers and with OSMO pumps for retrieving fluid samples from the lowermost zone.

The assembly and installation proceeded well until the CORK head broke off during the final step. The CORK head experienced forces that bent the wellhead and severed it above the cup packers, about 4 m below the reentry cone. This also parted the spectra line and the umbilicals, leaving the downhole tool string in place. On the basis of recovered pieces of the wellhead, the upper end of the remaining CORK 4.5 inch casing near the seafloor is not completely rounded, but not closed enough to restrict the recovery of the downhole samplers, sensors, and experiments. Several stainless steel tubes likely extend above the cup packers and the top of the 4.5 inch casing. These tubes may impede recovery of the downhole instrument string. A plan is being formulated to recover the downhole instrument string in four years with a remotely operated vehicle (ROV). The CORK pressure logging system was recovered along with the broken-off wellhead. The recorded data do not definitively resolve whether or not the downhole CORK packers actually inflated. The seafloor gauge and three formation gauges show very similar slight increases in pressures after the time of attempted inflation, but the similarity to the seafloor gauge could be consistent with a tidal influence without inflation of the downhole packers.

Operations

Week 2 began with the continuation of downhole logging in Hole 395A. A ledge or bridge in the hole had prevented the microbiology logging string from passing below ~4670 mbrf during the first attempt at logging. After lowering the logging bit ~21 m below the ledge, the microbiology logging string was able to make two runs all the way to the depth objective of 600 mbsf. After logging was concluded, the drill string was lowered to 600 mbsf to check for obstructions and make sure the hole was ready for the new CORK to be installed. When no obstructions were encountered, the string was pulled back to surface and the bit was back on board at 1230 hours on 25 September 2011. After slipping and cutting the drill line, the assembly of the new Hole 395A L-CORK commenced. Around midnight on September 26th, all casing, packers, umbilicals and the L-CORK were assembled and ready to run. The CORK was lowered about 100 mbrf and the camera system was lowered over the CORK head to ensure it would pass. Then the OsmoSampler instrument string was assembled and lowered inside the CORK. An attempt to land and latch the top plug was made, but the top plug could not be latched. The CORK was pulled back and landed in the moon pool and an attempt was made to latch the top plug at the rig floor level. After numerous attempts, it was finally decided to run the top plug without the latch being engaged. When the CORK was pulled to the surface it was apparent that something had broken off the lateral valve on the CORK body. The lateral valve was replaced with a 4" cap to seal the lateral. It is unclear how the breakage occurred. At 1100 hours on 27 September the CORK started to be lowered to the seafloor. During deployment the camera system was installed and followed the CORK to bottom. When the casing string stinger was just above the seabed, the drill string was spaced out for re-entry and Hole 395A was re-entered at 2003 hours. The casing was carefully lowered into Hole 395A while observing the weight and carefully watching the string at known critical depths in the borehole (based on previous logging data). At 2315 hours, the top drive was picked up and the drill string was spaced out to land the CORK. The CORK was apparently landed at 2400 hours on 26 September and over the next two hours the packers were inflated to 1400 psi according to the inflation procedure and appeared to be holding pressure. Simultaneously the camera system was pulled to the surface and work began to put together the ROV platform. At 0800 hours the ROV platform had reached the CORK head and it released. The release was not smooth with one side of the platform releasing before the other side. Eventually the platform completely released and appeared to settle into position. An initial attempt was made to release the running tool from the CORK. After about 45 minutes of attempting to release the running tool, the camera was retrieved to remove the ROV platform release mechanism and slings to allow the camera to get a closer view of the CORK running tool. While the camera was being pulled to surface, the driller lost the 10,000 lb overpull that was being maintained on the CORK. At the time it was assumed that the running tool had released. When the camera system had been lowered back down to the seafloor to make a visual check of the CORK installation, at 1145 hours on 27 September we could immediately observe that the CORK head was no longer inside the re-entry cone but was still attached to the running tool, offset from the reentry cone, and had broken off from the CORK casing below. We retrieved the camera system and drill string and at 1845 hours on 28 September the CORK head was back at the moon pool and we began to survey the damage. The CORK head was then raised up to the rig floor, the running tool removed, and the CORK head was laid down.

Our next objective was to install a CORK in Hole U1382A (50 m west of Hole 395A) to monitor the uppermost basaltic crust. However, this plan had to be put on hold because we had to leave the area because of Tropical Storm Philippe. After the ship was secured for transit at 0215 hours (29 September), we headed to the northeast to avoid the approaching storm. After Tropical Storm Philippe crossed over North Pond drilling area, we arrived at Hole U1382A at 1224 hours on 30 September. We began to assemble the new reentry cone, 53 m of 16 inch casing, and the bottom-hole assembly for jetting-in the seafloor structure.

Education and Outreach

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

Blogs: Posts on the *JOIDES Resolution* blog (<http://joidesresolution.org/blog>) include our current operations, expedition-related classroom activities, and personal accounts of life at sea and scientific research aboard the JR. Current bloggers this week include our onboard education officer (personal, educator ideas, and kids blogs), Everett Salas (blog about DEBI-t microbiology tool), Tania Lado Insua (blog in Spanish), and Paul Le Campion (blog in French). Katrina Edwards continues her blog on the *Scientific American* Expeditions page (<http://blogs.scientificamerican.com/expeditions/>), which is also published on the C-DEBI site (<http://www.darkenergybiosphere.org/return-to-northpond/>). Beth Orcutt continues to blog about microbiology on the Adopt-a-Microbe website (<http://www.darkenergybiosphere.org/adoptamicrobe/category/letters-from-the-giant-microbes/>) and Amanda Haddad continues to provide science content and connect with a special needs audience on the Classroom Connections website (<http://www.darkenergybiosphere.org/classroomconnection/category/blog/>).

Videoconferences: Three live ship-to-shore interactive programs we conducted with 11th-12th graders from Missouri, 5th graders from Pennsylvania, and 11th-12th graders from California. Six 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.

Adopt-A-Microbe: Week 2 activities (classes built a Winogradsky Column) were submitted and Week 3 activities (Microbe Math) were assigned.

Classroom Connection: This week's theme was "Logistics," and students participated in a variety of related activities. These included shipboard signs and hand signals, tracking the JR in transit, and an interview with the second mate, Jake Robinson.

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

Technical support and HSE activities

Science Mission Support: Technical staff assisted scientists, engineers and drill crew with the Hole 395A CORK assembly. After the loss of the CORK, technical staff helped with

the recovery of the instruments. Currently, the staff are preparing the laboratories for upcoming coring operations that will recover basalt.

Other Technical Activities:

- Assisted scientists with the setup of DESCLogik templates;
- Investigating issues with inconsistent velocity calibration on the whole core track;
- Software updates installed for the following applications:
 - o Velocity Gantry track
 - o Image Logger track
 - o DESCLogik
 - o Web services
- Rebuilt the counter space for osmotic samplers to increase storage space;
- Work continued on the rock saw splash hoods;
- Work continued on 3D camera project;
- Modified exhaust ducting in the Core Entry to vent the laser engraver;
- Installed “large bore” integration sphere for color/spectral measurements. Testing started to determine if data quality is affected.

The weekly fire and abandon ship drill was held.