

IODP Expedition 336: Mid-Atlantic Ridge Microbiology

Week 1 Report (15-24 September 2011)

The first week of IODP Mid-Atlantic Microbiology Expedition (336) consisted of a very short port call in Barbados, the transit to the North Pond area on the flank of the Mid-Atlantic Ridge, and the retrieval of the existing CORK observatory from Hole 395A.

Science Results

The primary science objective of IODP Expedition 336 is to investigate the nature of the subseafloor deep biosphere in oceanic crust and overlying sediments. The upper ~500 m of igneous ocean crust is fractured and permeable, harboring the largest hydrologically active aquifer on Earth. We know that microbes inhabit this aquifer, and we also know that microbes are abundant and play active roles in rock alteration of exposed outcrops at the seafloor. However, we do not know the extent of microbial colonization in the subseafloor, the diversity and activity of this crustal biome, or its role in modulating geochemical exchange between crust and ocean.

Expedition 336 will initiate these investigations by installing multilevel subseafloor borehole observatories (CORKs) at three sites in a thinly-sedimented basin on the flank of the Mid-Atlantic Ridge called North Pond. These North Pond CORK observatories will contain long-term coupled microbiological, biogeochemical, and hydrological experiments. The basaltic crust will also be characterized by coring parts of the crust, by collecting downhole *in situ* petrophysical data by wireline logging, and by conducting hydrologic (packer) experiments. Coring at four sites will characterize the overlying sediment section.

The North Pond Expedition will lay the foundation for long-term monitoring, experimentation, and observations by subsequent remotely operated vehicle (ROV) or submersible dive expeditions. The installed CORKs will be used in perturbation and monitoring points for single- and cross-hole experiments.

Prior to Expedition 336, the *JOIDES Resolution* was berthed in Curaçao. Although the Expedition 336 officially did not begin until 15 September in Barbados, all of the CORK observatory hardware and experiments were sent to Curaçao in advance of the expedition. In addition, a few scientists and engineers boarded the ship in Curaçao and used the 2-day transit to Barbados to start preparing the CORK observatories and a new *in situ* tool for detecting microbial life in ocean floor boreholes - the Deep Exploration Biosphere Investigative tool (DEBI-t).

The remaining scientists, engineers, and technical staff boarded the ship in Barbados on 16 September and we left for the North Pond area on 17 September. During our first week on board the ship, we have been conducting all the usual safety, science, and technical orientation activities. However, our main focus has been to continue preparing the scientific experiments to be deployed in the Hole 395A CORK observatory. This includes all of the geochemical and microbiological experimental packages and the

pressure and temperature sensors and data loggers. The CORK engineers prepared all the hardware and set up for deployment. CORK scientists and engineers met to finalize the plan for our first observatory installation and to pressure test the CORK plumbing.

After arriving on site and successfully repairing the camera system winch, we were able to locate Hole 395A, lower the CORK pulling tool over the existing CORK, and we successfully pulled the CORK out of the hole. This CORK had been installed 14 years ago on ODP Leg 174B. Once the CORK was secured on board, we pulled out the internal string composed of a data logger, pressure sensors, and the 600 m long thermistor string that was in open hole in the oceanic crust. The pressure and temperature data were downloaded, the thermistors cut out of the string, and sections of the string were sampled for microbiologic analyses. The last operation at the end of this week consisted of preparing to trip back to the seafloor to log the hole with a new in situ tool for detecting microbial life in ocean floor boreholes - the Deep Exploration Biosphere Investigative tool (DEBI-t).

Operations

Week 1 of Expedition 336, Mid-Atlantic Ridge Microbiology (North Pond), began with the first line ashore in Bridgetown, Barbados at 0948 hours on 15 September 2011. Minor port call activities began immediately after the early arrival. Airfreight shipments were quickly loaded, completing all cargo operations immediately after arrival. On day 2 of the port call, the science party and remaining technical staff joined the vessel. Siem Offshore completed their scheduled crew change. The vessel was then secured for sea and departed Bridgetown, Barbados at 0742 hours on 17 September 2011. The pilot departed the vessel at 0812 hours and the vessel completed the 986 nm transit at 2330 hours on 20 September 2011, averaging 11.4 knots. At 0012 hours on 21 September 2011 the vessel was placed into dynamic positioning mode and drill floor operations began. Prior to the start of CORK pulling operations a planning meeting was held with Siem Offshore, IODP staff, the Chief Scientists, and other critical science staff.

Operations began at DSDP Hole 395A by first picking up the CORK pulling tool for the Hole 395A CORK and making it up to a pony drill collar. The rest of the bottom hole assembly (BHA) was attached and the drill string was tripped to just above the seabed. At 2166 mbrf, tripping operations were temporarily halted to install the VIT frame to begin running the subsea camera. It quickly became apparent that there was a problem with the sonar system and the VIT camera frame was pulled to repair the sonar. Tripping continued to 2824 mbrf where operations were again suspended to install the VIT camera frame. Tripping operations resumed as the VIT was carefully lowered towards the seafloor. Periodically the VIT winch was stopped and the hoisting function was checked. At approximately 3700 mbrf, it became clear that the winch did not have sufficient power to retrieve the VIT camera frame. Drill pipe tripping operations continued while mechanics and engineers attempted to diagnose the VIT winch problem. At 1630 hours tripping operations were complete and the top drive was installed. From 1630 hours on 21 September 2011 until 1630 hours on 22 September diagnostics and repair were performed on the VIT subsea TV camera winch. After changing both the hydraulic motor and the hydraulic pump the TV camera was restored to a working condition. The

VIT camera frame was installed and lowered carefully to the survey position. The Hole 395A re-entry cone and CORK were located and the pulling tool was lowered over the CORK at 2040 hours on 22 September 2011. The CORK was then picked up approximately 7 m and the core line was deployed to retrieve the data logger through the drill pipe. After running an overshot 3 times and attempting to jar onto the top of the data logger, attempts to pull the thermistor string were halted and the CORK was pulled to the surface. After landing and securing the CORK in the moon pool, the recess where the top of the data logger was located was cleaned and the overshot was installed. The data logger was then jarred loose and all 600 m, including 10 thermistors and sinker bar were removed at the rig floor. A lifting sub was installed on top of the CORK and it was pulled through the rig floor and then moved to the starboard aft main deck for sampling. Next the stinger, made up of 3 joints of 5.5" drill pipe, was broken down and laid out. After clearing the rig floor of CORK pulling tools, the logging bit and BHA were made up and the drill string was tripped back to seafloor. There was a break in tripping operations after running stand 70 to deploy the VIT camera, which was lowered to the bottom, following the bit down. Hole 395A was re-entered at 0134 hours on 24 September 2011 after a 19 minutes of maneuvering. After rigging up to log with the DEBI-t microbiology string, it was run into the hole to log Hole 395A. After a 45-minute interval to repair the logging winch, the tools were run down into the hole. The logging tool was unable to pass a section of the hole at 4670 mbrf (~186 mbsf) and after repeated attempts the logging string was pulled back to surface and was rigged down at 1430 hours. We plan to lower the logging bit through this obstruction and then re-deploy the DEBI-t logging string.

Education and Outreach

We have an active and wide-ranging education and outreach program for our expedition. In addition to sailing with an Education Officer, two videographers on board are filming an expedition documentary. Several shipboard scientists are also leading interactive activities as well. These efforts are focused through the *JOIDES Resolution* education web portal (www.joidesresolution.org) and the Center for Dark Energy Biosphere (<http://www.darkenergybiosphere.org/>). Blogs are being posted there and in *Scientific American* (<http://blogs.scientificamerican.com/expeditions/2011/08/30/introducing-expedition-336-at-north-pond/>). Interactive programs being conducted from the ship include live ship-to-shore interactions (40 currently scheduled), the “Adopt-A-Microbe” program (<http://www.darkenergybiosphere.org/adoptamicrobe/>), and “Classroom Connection” which is intended to spark interest and enthusiasm for learning in the special education classrooms (<http://www.darkenergybiosphere.org/classroomconnection/>). On 19 September, scientists received an orientation to education/outreach activities and opportunities to get involved. The videographers have been busy throughout filming and interviewing for their documentary. Our first live ship-to-shore interaction took place on 23 September with high school juniors and seniors from Australia.

Technical support and HSE activities

Science Mission Support: Prior to the start of the expedition supplies and equipment were loaded in Curaçao. After a two-day transit, the ship arrived in Bridgetown, Barbados where the oncoming technical staff completed crossover activities and the science party boarded the ship. Starting in the port call and continuing on the transit to our first site,

oncoming scientists and engineers were introduced to their workspaces, met technical staff, and trained on data systems and instrument hosts software. Seafloor magnetic and bathymetric data were collected during our transit from port call to our first site. On site, technical staff assisted microbiologists with sampling and engineers with the retrieval of the thermistor string.

Other Technical Activities:

- Scientists involved in core description were introduced DESCLogik;
- NGR on site calibration was completed; work on the laser positioning upgrade was started;
- Technical staff assisted logging and CORK scientist position equipment and supplies in the lab;
- Additional counter space for the assembly of the osmotic samplers was installed;
- Work began on the rock saw splash hoods;
- The forward GPS antenna was installed;
- The Winfrog navigation system was reconfigured and following features implemented:
 - The forward GPS was added as a secondary positioning input;
 - Ship's heading can now use either the ship's gyro or use the base line calculations between the two GPS antennas;
- Work began on 3D camera testing;
- Issues with RF noise disrupting the PWL velocity signal were resolved by shielding the track's servo motor and adjusting equipment grounding;
- X-Bob wireline depth display problems continues to be diagnosed;

The science party and new technical staff completed Siem Offshore's safety induction and the IODP's Laboratory Safety Tour. The weekly fire and abandon ship drill was held as scheduled. In addition, safety training was given to scientists needing to work periodically on the rig floor.