IODP Expedition 336: Mid-Atlantic Ridge Microbiology

Week 4 Report (9–15 October 2011)

Science Results

After finishing drilling operations in the 210-m deep Hole 1382A with repeated wiper trips, an 18-hour logging program was conducted. The first tool string comprised the DEBI-t laser-induced fluorescence probe, density/caliper, total gamma ray, temperature, and resistivity tools. Upon completion of the first pass, a power outage occurred and the tool was brought up. Next, a second tool string with the spectral natural gamma ray sonde and the formation microscanner (FMS) was lowered and run down and up the hole twice. The FMS data show variable borehole caliper between 145 and 168 m depth below seafloor. The full logging data are currently being processed.

A packer hydrologic test was carried out next, but the packer did not seal for more than 10 minutes (due to ship heave up to 3 m) and the test was abandoned after four attempts. Following these operations a visual inspection of the Hole 395A re-entry cone and ROV landing platform was performed in order to assess the position and integrity of the landing platform in anticipation of future operations.

We also successfully installed a CORK observatory in Hole 1382A. This 210-m deep hole is equipped with an instrument string comprising six osmotic pump-driven samplers for basement fluids and microorganisms as well as enrichment experiments, an oxygen probe with data recorder, and temperature sensors. The samplers and probe are installed in an interval from 152 to 174 mbsf. A pressure gauge and fast-pumping osmosamplers are situated in the wellhead and monitor/sample fluids at 161 m depth below seafloor.

Sampling of core material for shipboard studies included cutting of thin section billets, quarter-round core for bulk rock chemistry and XRD work, cubes for physical property measurements, and microbiology. Microbiological sampling took place first in the core splitting room prior to other sampling. Two to six samples were selected based on lithology and alteration and were processed in the microbiology/chemistry lab for DNA/RNA, cultivations, microscopy, spectroscopy and biogeochemical assays. The shipboard petrologists then divided the recovered core into 8 major lithologic units, comprising up to 17 subunits. Major unit boundaries are defined by contacts between massive and pillowed flow and interlayered sedimentary units. Each major lava flow units consists of several cooling units, which are recognized by glassy or variolitic margins and/or marked changes in grain size. Initial results from thin section studies reveal a large range of grain size ranging from glassy to medium-grained and textures (aphanitic to subophitic or intersertal). Basalts are either aphyric or plagioclase-olivine phyric and have <3% vesicles. Phenocryst contents range up to 25%, with plagioclase being more abundant than olivine. The extent of alteration ranges up to 20%, with clay (smectite, nontronite, celadonite) being the most abundant secondary phase, followed by Fe-oxyhydroxides and zeolites. The sedimentary unit in Cores 8R and 9R feature a variety of clasts, including plutonic and mantle rocks. The peridotites are weakly serpentinitzed harzburgites and lherzolites with a protogranular texture. Intensity of deformation of the gabbroic lithologies ranges from undeformed to mylonitic. Minor cataclastic deformation of the

peridotites has led to the development of carbonate-filled vein networks, along which the rocks have been subjected to oxidative alteration, resulting in the breakdown of olivine to clay, oxide, and carbonate. Sampling for physical properties has been conducted to cover the range of lithologies as well as potassium and uranium concentrations identified during natural gamma-ray core scanning.

Operations

Week 4 began while tripping out of the Hole U1382A after reaching 210.0 mbsf. After the bit was back on the rig floor and before starting logging, we assembled a stand of 6.75 inch perforated and coated drill collars for the lowermost portion of the CORK installation. We wanted to do this sufficiently prior to assembling the CORK as we painted it with an epoxy paint that needed to dry prior it being deployed. Next, we assembled a logging BHA with a logging bit and the drill string packer, lowered it 50 m into Hole U1382A, and began deploying the logging tools. Logging proceeded with a modified triple combo string with the DEBI-t tool on the bottom of the string. Log data were collected while lowering it to the bottom of the hole. However, while logging upward, the power failed approximately 20 m below the casing. The tool string was pulled to surface and the problem was found to be in the cable head. The cable head was re-terminated and we decided to run the FMS-Sonic tool string next. After 2 successful passes, the lower portion of the FMS (calipers) would not enter the logging bit. After two hours of working the string up and down, opening and closing the calipers, and pumping seawater, the entire tool string finally was able to pass through the logging bit. We then spaced out the drill string for the hydrologic (packer) flow test and we started attempts to inflate the packer. We made four attempts to set the packer inside the 10.75-inch casing, however, each time high vessel heave (3 m) caused the packer to deflate – so the experiment was cancelled. Before pulling out of the hole, we lowered the logging bit to the bottom of the hole to check that the hole was still open to full depth prior to installing the CORK. We did not encounter any problem intervals and only ~1.5 m of fill. The drill string was recovered and the bit back onboard at 1328 hours on 10 October. Before we could begin our next operation we had to slip and cut 115’ of drill line. We started assembling the CORK at 1500 hours on 10 October.

The pre-assembled 6.75 inch perforated drill collar stand was picked up and run through the rotary table. A crossover to the 5.5 inch perforated casing was installed, followed by 15.35 m of 5.5 inch perforated casing. Miniscreens were attached to the outside of the lowermost perforated 5.5 inch casing joint. Crossovers to the 4.5 inch fiberglass casing were installed and then 44.25 m of 4.5 inch fiberglass casing were made up. Umbilicals from the mini-screens and centralizer/protectors were installed on the outside of the casing as it was run. Next to be installed was a crossover to the landing seat for the instrument string, followed by a crossover to the mandrel containing the swellable and inflatable packers. Umbilicals were terminated and connected to the bottom of the combination packer tool and terminated and connected to the top of the combination packer tool. From there ~91.01 m of 4.5 inch steel casing were run, followed by the CORK head. All pressure and sampling lines from were connected to the bottom of the CORK. It took us 10 hr to assemble the complete CORK assembly and the bottom of the CORK string extends to 188.7 mbsf.

Our next step was to assemble and install the OsmoSampler string into the CORK at the rig floor. Modification had to be made to the top plug so it would latch into the

CORK head – however these likely did not work. This operation was completed in 3.5 hr. The camera system was then test fit over the CORK and at 0630 hours on 11 October, we began lowering the CORK package to the seafloor. The camera system was installed and Hole U1382A was re-entered for the last time at 1630 hours on 11 October.

After carefully lowering the CORK into the hole, we landed the CORK at 1820 on 11 October. The packer was then inflated to 1200 psi and the camera was pulled to surface. Next the ROV platform was assembled and rigged up with the ROV deployment tool attached below the camera system and it was lowered back to the CORK on the seafloor. The platform was released over the CORK at 0055 hours on 12 October. The camera system was retrieved and after removing the ROV deployment system, it was lowered back to bottom to observe the final step of installing the Hole U1382A CORK observatory – the release of the CORK running tool from the CORK. This was successfully released at 0425 hours on 12 October. The drill string with the CORK running tool was recovered back onboard at 1145 ending Hole U1382A.

Our next objective was to install a multi-level CORK observatory to perform long-term coupled microbiological, biogeochemical, and hydrological experiments in deeper portions of the oceanic crust at Site U1383 (NP-2). Our first step was to use an 18.5 inch tri-cone drill bit to perform a jet-in test to determine the length of 20 inch casing to install with the reentry cone. While we assembled this bottom-hole assembly and lowered to the seafloor, we retrieved the seafloor beacon used for Hole 395A and transited (~5.8 km) to Site U1383 in dynamic positioning mode. After arriving at Site U1383, we dropped a positioning beacon at 1812 on 12 October. The jet-in test began at 2240 on 12 October and reached 36 mbsf at 0200 hours on 13 October. The penetration rate during the last two meters was very slow. The 18.5 inch bit was back on board at 0930 hours ending Hole U1383A.

Based on the jet-in test, we decided to run 34.84 m of 20 inch casing for Hole U1383B. The casing and re-entry cone were run to bottom but our initial attempt managed to jet the casing in only to 29 mbsf. After trying to advance the casing for over 3 hours with no progress, we pulled the string out of the seafloor and moved 50 m to the northeast. We started our second attempt to start Hole U1383B at 0810 hours on 14 October. This time, we were able to fully land the re-entry system and casing at 1015 hours. We released the running tool at 1035 hours and retrieved the drill string with the bit arriving on the rig floor at 1915 hours.

Our next job was to drill an 18.5 inch hole into uppermost basement for the 16 inch casing. After laying out both drill collar pup joints and the casing running tool, the 18.5 inch bit was removed, the nozzles changed and the BHA was made up and run back to bottom. During the trip into the hole, we had to pause to slip and cut 115' of drill line and to start lowering the camera system for reentry. We reentered Hole U1383B at 0518 hours on 15 October, began drilling at 0704, and encountered basement at 0723 at a depth of 53 mbsf. Drilling continued at a penetration rate of ~2 m/hr to 68 mbsf. We chose this depth to allow ~9 m of rat hole for the 16 inch casing. After reaching 68 mbsf, the hole was reamed and conditioned.

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). We also had guest posts from Wolfgang Bach (hydrogeology) and Alyssa Stephens (publications/graphics). 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 the following audiences: naval engineering students from Spain, 5th graders from South Carolina, 6th graders from California, university students from France, 11th/12th graders from Missouri, and university students from the Virgin Islands. Participation from scientists has been excellent, and they have indicated that they are enjoying the interactions with students. Eight 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 daily math problem contest was posted and will continue throughout the expedition.

Adopt-A-Microbe: Week 4 activities (classes wrote microbe haiku) were submitted and Week 5 activities (exploring microbial habitats) were assigned.

Classroom Connection: Students were on fall break this week, so there were no activities planned.

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

Technical support and HSE activities
Science Mission Support: Technical staff provided analytical support for materials recovered from Hole U1382A and assisted with CORK deployment operations.

Other Technical Activities:

- Continue to assist scientists with DESCLogik
- Resolved noise issue on PWL velocity signal but issues with consistent velocity calibrations are still unresolved
- Numerous issues were encountered with various database applications during the processing of Site 1382 cores. Several upgrades appear to have resolved some of the issues
- Work continued on 3D camera project
- Upgraded Winfrog workstation #1 to Windows 7
- Completed installation of a sound control cabinet around the cryo-refrigeration system

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