IODP Operations Review Task Force Meeting

Expedition 336
Mid-Atlantic Ridge Microbiology

September 12th – 13th, 2012
TAMU, College Station
TX, USA

EXPEDITION 336 OPERATIONS REVIEW TASK FORCE (ORTF)

PARTICIPANTS

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MEETING FORMAT

The IODP-MI Operations Review Task Force (ORTF) met on September 12th - 13th at the Texas A&M University (TAMU), College Station (USA) to review operational aspects of Integrated Ocean Drilling Program (IODP) Expedition 336 Mid-Atlantic Ridge Microbiology. The review concentrated on "lessons learned" from the expedition with an emphasis on "what should be done differently in the future". The ORTF review was based upon confidential reports submitted by the U.S. Implementing Organization (USIO) and the Expedition 336 Co-Chief Scientists, as well as the expedition daily and weekly reports available on-line.

The meeting began with oral presentations by the Co-Chief Scientists (Katrina J. Edwards, Wolfgang Bach) and the Manager of Science Operations (Adam Klaus) that summarized the Co-Chief Scientists' and USIO reports, respectively. The Co-Chief Scientists also presented Co-chiefs' joint recommendations. Following the presentations, the external reviewers and IODP-MI personnel had an Executive Session to identify important issues related to this expedition and to formulate draft recommendations. On the second day of the meeting, the ORTF reviewed the draft recommendations from the Executive Session and finalized them. These recommendations are presented in this report.

EXPEDITION SUMMARY

Expedition 336: September 1st 2011 – November 17th 2011
Co-Chief Scientists: Katrina J. Edwards, Wolfgang Bach
Expedition Project Managers: Adam Klaus
USIO Operations Superintendent (OSI): Stephen Midgley

Integrated Ocean Drilling Program (IODP) Expedition 336 was implemented to achieve scientific objectives proposed in IODP Proposal 677. The main goal of Expedition 336 was to address fundamental microbiological questions concerning the nature of the subseafloor deep biosphere in oceanic hydrological, geological, and biogeochemical context. Determining the nature of subseafloor microbiological communities in young igneous ocean crust and their role in ocean crust alteration was a primary objective. The primary operational goal for Expedition 336 was the installation of subseafloor borehole observatories (CORKs) for long-term coupled microbiological, geochemical, and hydrological experiments.

Expedition 336 drilled nine holes at three sites, cored 645.5 m, recovered 359.4 m of core (56% recovery), and installed subseafloor borehole observatory at a young mid-ocean ridge flank setting. All sites are located in the North Pond at 22°45'N, 46°05'W in 4414 to 4483 m water depth. This area was known from previous ocean drilling and site survey investigations as a site of particularly vigorous circulation of seawater in permeable 8 Ma basaltic basement underlying a <300 m thick sedimentary pile. Understanding how this seawater circulation affects microbial and geochemical processes within the uppermost basement was a primary science objective of Expedition 336.

Basement was cored and wire-line-logged in Holes U1382A and U1383C. Upper oceanic

crust in Hole 1382A, which is only 50 m west of Hole 395A, was cored between 110 and 210 m below seafloor (mbsf). Of the penetrated basement 31% was recovered and allowed identification of different volcanic flow units with distinct geochemical and petrographic characteristics. Hole 1383C recovered 50.3 m of core from an interval between 69.5 and 331.5 mbsf. In addition to traditional downhole logs, Expedition 336 used a new logging tool for detecting in situ microbial life in ocean floor boreholes - the Deep Exploration Biosphere Investigative tool (DEBI-t).

Major strides in ridge flank studies have been made with CORK observatories, as they facilitate combined hydrological, geochemical, and microbiological studies and controlled experimentation within the subseafloor. Expedition 336 installed fully functional observatories in two newly drilled holes (U1382A and U1383C) and placed an instrument and sampling string in an existing hole (395A). While the CORK wellhead at Hole 395A broke off and another Hole (U1383B) was abandoned after a bit failure, these holes and installations in them will be useful for future observatory science targets. The CORK observatory in Hole U1382A has a packer seal in the bottom of the casing and monitors/samples a single zone in uppermost oceanic crust extending from 90 to 210 mbsf. Hole U1383C was equipped with a three-level CORK observatory which separates a zone of thin basalt flows with intercalated limestone (~70-146 mbsf) from one within glassy, thin basaltic flows and hyaloclastites (146-200 mbsf) and a lowermost zone (~200-331.5 mbsf) of more massive pillow flows with occasional hyaloclastite in the upper part.

See http://iodp.tamu.edu/scienceops/expeditions/midatlantic_ridge_microbio.html for more details regarding the background and objectives, the preliminary scientific results, and conclusions of the Expedition 336.

RECOMMENDATIONS OF THE EXPEDITION 336 ORTF

Overall, the Expedition 336 Operations Review Task Force concluded that the Mid-Atlantic Ridge Microbiology Expedition was successful and reached most of their science objectives. The scientists were able to obtain critical samples and installed CORK observatory at two new sites required to address expedition science targets. This success resulted from a combination of factors including close collaboration and communication between science party and operators, and professionalism, willingness and the concerted effort shown by all parties to work through issues as they arose at sea and onshore. All parties involved in this expedition are to be congratulated on their successful microbiological CORK observatory deployments and with taking novel approaches on funding and planning. The ORTF believes this success will produce a wealth of scientific knowledge in the years to come. ORTF made the following Acknowledgement 336-01 for this successful expedition.

Acknowledgement 336-01:
The ORTF recognizes operational, engineering, and scientific achievements of IODP Expedition 336, particularly in light of the challenging tasks of new tool development (DEBI-t) and novel approaches to microbiological CORK observatory installations. Success was depended heavily on excellent coordination among and planning by the scientific, engineering, and operational groups.

The ORTF also identified several areas for future *JOIDES Resolution* operational improvements, particularly pre-expedition planning/preparation and during-expedition operations. The issues discussed during this review were related to observatory installation planning and its operations by *JOIDES Resolution*. The Expedition 336 ORTF has formulated six recommendations so that future expeditions can benefit from these recommendations.
Although the primary focus of this review was on the USIO operations during Expedition 336, many recommendations in this report are equally valuable for other IODP operators, Science Advisory Structure (SAS), IODP scientists, and some of our recommendations are also directed to those groups.

Recommendation 336-01: Science Party Staffing
The ORTF recommends that in areas of critical data collection, greater attention needs to be paid to proper disciplinary staffing. Quality control procedures including calibration, documentation and oversight can be improved. This includes pre-expedition review of instrument status and performance. This responsibility should be shared between science party and IO staff.

Routing: IOs, Co-Chiefs, Expedition Project Manager (Staff Scientists)

Background: During Expedition 336, geochemists identified that sample analyses using ion chromatography (sulfate in pore water), gas chromatography (hydrocarbons in head space), and CHNS analyses of rocks results were not useable. These measurements are normally routine but the problems encountered underscore the need for expert oversight. Because a dedicated and experienced organic geochemist did not sail the issue with the poor CHNS data was not resolved until after the cruise and usable data were delayed until onshore measurements could be made. Shipboard scientists were not offered a satisfying explanation from USIO staff about the poor performance of CHNS instrument.

Recommendation 336-02: Engineering Staffing
The ORTF recommends that complex CORKing legs or other complex engineering legs include engineering support whose primary responsibility lies in the mechanical success needed to achieve scientific objectives. Continuity in engineering oversight should be provided between planning, procurement, and operation phases.

Routing: IOs, Lead Agencies

Background: Overall engineering at Expedition 336 went very smoothly, particularly with regard to CORK installations with the exception of the decapitation of the CORK replacement at Hole 395A. One key factor to the success of the installations was the availability of additional engineering expertise on the rig floor. Katrina Edwards (Co-Chief) provided substantial support for an external CORK engineer Tom Pettigrew (Stress Eng./Pettigrew Eng.) from the University of Southern California, paid by a grant from the Gordon and Betty Moore Foundation.

The USIO also committed a significant portion of its engineering resources to ensuring Expedition 336 to be success. The USIO Supervisor of Engineering led the project with a Senior Staff Engineer along with partial support from another Staff Engineer. The Operations Superintendents, Senior Design Technician, and Materials Specialist also provided significant additional support beyond normally provided to each expedition. The USIO also coordinated the inclusion of external CORK engineer's work into the overall observatory engineering implementation.
The ORTF believes that all these efforts and unique methods taken by the Co-Chiefs and USIO were critical to the success of Expedition 336.

Recommendation 336-03: Engineering Design
The ORTF recommends that CORK well-head design and fabrication should be reassessed with strength, stability, and (most importantly) sealing integrity in mind. In particular, consideration should be given to a design that is insensitive to specific dimensions of casing hangers.

Routing: IOs

Background: The Expedition 336 began by retrieving the existing Hole 395A CORK and thermistor string that had been installed during ODP Leg 174B in 1997. After the CORK was retrieved, a new Lateral CORK (L-CORK) wellhead, with a cup packer extension for the DSDP reentry hardware, was assembled and run into Hole 395A. Although the assembly was complex, as this was the first installation for several types of components, it was executed following the planned procedure. Unfortunately, during the last stage of installation, the CORK wellhead broke off at the throat of the reentry cone and the installation failed.
A detailed report by USIO on this incident concluded that a restricted diameter in the throat of the reentry cone caused the CORK to land on the reentry cone throat, bend, and fail at a

weld in the top portion of the cup packer (See Recommendation 336-04 background for more detail).

Recommendation 336-04: Operational Procedures
The ORTF recommends that existing holes targeted for CORK installation should be assessed for compatibility. This should include development of field assessment procedures. In addition, the ORTF recommends that alternate umbilical design and installation be considered for safety and efficiency.

Routing: IOs

Background: The CORK replacing operation at Hole 395 on Expedition 336 was problematic and ultimately failed because of reentry hardware incompatibility. The new Hole 395A L-CORK, a design modified to fit DSDP reentry hardware by USIO, failed during the final stages of installation in the borehole. The USIO's preliminary analysis suggests that the bottom of the L-CORK head landed on the lower portion of the reentry cone instead of the casing hunger inside of the reentry cone. This was indicated by damage to the leading edge of the lowermost stabilizer fins. Therefore the L-CORK wellhead did not have lateral support from the DSDP reentry cone (only supported by packer). Finally the L-CORK bent at the throat of the reentry corn by stress and broke into two parts.
The USIO has very little information as to why the L-CORK landed high on reentry cone. A prevailing theory is that the internal diameter of the reentry cone's 24 inch transition pipe, through which the stabilizer fins must pass, was narrower than USIO indicated on DSDP engineering diagrams.

Recommendation 336-05: Drilling Support Equipment
The ORTF is gratified that acquisition of a new VIT system using a fiber optic cable and the ability to add tools is being considered. The ORTF recommends that winch replacement should be considered. Furthermore, we recommend that a capability for remote observations and operations by ROV be considered i.e., for checking well-head instruments, state of drill pipe, etc.

Routing: USIO

Background: During the Expedition 336, there was avoidable downtime due to an old winch system repair of vibration isolated television (VIT) camera. Also the quality of the video taken by VIT was poor and made observation and diagnosis of the status of the seafloor completions problematic. The Co-Chiefs suggested that it is critical to have a camera system that can zoom and pan & tilt, so that latching/unlatching operations can be visualized during operations. The USIO reported that they are currently in the process of completely replacing the camera system.

Recommendation 336-06: Engineering and Scientific Post-expedition assessments
The ORTF recommends that field performance of items such as special casing, coatings, packers, and DEBI-t, should be assessed when relevant data become available, documented, and made available for future planning efforts. Scientists need to keep the engineers informed of the performance of past efforts and vice-versa. In some cases the journal Scientific Drilling may be an appropriate venue to highlight both successes and failures.

Routing: IOs, Scientific Party

Background: To prevent contamination of microbiological samples, Expedition 336 introduced the following three major new technologies that were used for the first time in IODP and produced excellent results;
1) USIO deployed 4½ inch Series 1750 fiberglass casing. This fiberglass casing is strongly preferred for the microbiology science experiments as opposed to steel or coated steel and was significantly cheaper than coated steel casing. The fiberglass was assembled and run in the hole with no apparent issues and deemed a success.
2) USIO deployed a combination packer on CORKs for the first time. This packer combines an inflatable section with a swellable section, all on the same mandrel. These were used for the uppermost borehole seal instead of separate inflatable and swellable packers (as on Juan de Fuca Expedition 327). While not significantly cheaper, these combo packers were quicker to install.
3) Based on Co-Chiefs request, USIO deployed the unique, third-party, Deep Exploration Microbiology Investigative tool (DEBI-t) for the first time. The DEBI-t successfully provided some core-log integration.

Comments 336-01: Hydrologic state
The ORTF recognizes that the target for Expedition 336 was based on excellent site characterization and previous drilling observations. As such North Pond provided an unparalleled site for achieving the scientific goals. However, the sub-hydrostatic state of North Pond creates challenges for sampling pristine fluids. For future expeditions where pristine formation fluid sampling and in-situ experiments are planned, consideration should be given to the local formation pressure state. Targeting super-hydrostatic basement conditions has clear advantages by minimizing contamination from flow into the formation and facilitating fluid sampling at the seafloor via umbilicals.

Routing: SAS, Future proponents

Background: The Expedition 336 study site North Pond is a sediment pond on the western flank of the Mid-Atlantic Ridge, which is underlain by hydrologically active upper oceanic crust. The observatories were designed to allow monitoring conditions and study processes in-situ after the drilling-induced disturbance and contamination of the borehole environment have dissipated.
Previous observations and hydrologic models of North Pond indicate that basement aquifer pressures are sub-hydrostatic and that recharge and discharge is taking place through

basement outcrops surrounding the basin. Additionally, previous North Pond DSDP/ODP temperature and flow logs indicated rapid fluid flow (~1000 L/h) into the unsealed Hole 395A and low formation pressures. These appear to have persisted for many years after drilling. Despite more than two decades of recharge into and through Hole 395A, scientists found the hydrology of the North Pond system has not been significantly affected.
However, the task force wishes to point out that this basement pressure state increases the risk of continuing contamination by inflowing fluid if there are leaks in any of the CORK observatory seals. This was impossible to avoid in this case, but this hydrologic issue should be considered in the planning of any future long-term fluid sampling project.