Expedition 336 Mid-Atlantic Ridge Microbiology Engineering Report
November 17, 2011

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Summary

Expedition 336 initiated in Barbados on Sep 17, 2011, with several personnel boarding a few days earlier in Curacao to begin preparations for the engineering-intensive mission. The engineering highlights (i.e., what was done, what worked well, what needs to be improved or corrected) are the focus of this report. Follows are brief summaries of the major engineering operations. Please refer to the Expedition 336 Operations Report and Site Summaries for 395, 1382, and 1383 for operational or scientific details.

Pulling 395A CORK and Thermistor String (Sep 22-Sep 24):

The expedition began by pulling the 395A CORK and thermistor string, installed during Leg 174B. The operation was initially delayed waiting on repairs to the VIT camera winch. The CORK Pulling Tool OJ6690, without the shear screws in the funnel guide, was latched onto the OJ6400 CORK wellhead. Four attempts were made to retrieve the thermistor string via wireline using the RS tool, outfitted with a long, windowed latch sleeve. Finally, the CORK was retrieved instead with the thermistor sting. The CORK was set on c-plates on the moon pool doors, the pulling tool removed, the top of the CORK water-blasted, and the thermistor retrieved successfully. The CORK running tool was used to lay down the CORK. A detailed recovery procedure is in the expedition file.

Installing 395A CORK (new) (Sep 26-Sep 28):

The new L-CORK wellhead, with a cup packer extension for the DSDP reentry hardware, was assembled and run in hole at 395A. The assembly was intense, as this was the first installation for several types of components, but was executed fairly well per procedure. The running procedure and the CORK plan (what was assembled) can be found in the expedition folder.

The CORK broke off at the throat of the reentry cone and returned on the end of the running tool. A separate preliminary report has been written on this incident. In

summary, it is believed there is a restricted diameter in the throat of the reentry cone. This caused the CORK to hang-up high, bend, and fail at a weld in the top portion of the cup packer.

Installed 1382A L-CORK (Oct 10-Oct 12):

A new L-CORK was assembled and installed in Hole 1382A. This was the shortest of the three CORKS and the installation was uneventful. Again, the running procedure and plan are in the expedition files.

Installed 1383C L-CORK (Nov 5-Nov 6):

The final L-CORK assembly, a 248m one, was the quickest of the three (approximately 24 hours, including the time spent pre-building the plumb bob). The assembly procedure had been tweaked and the crew was able to anticipate the next operation. The only drawbacks were a slight pressure loss during packer inflation and the CORK turned about 1 revolution on release. There is a chance the packers are not inflated, but we will not be sure until an ROV visit early in 2012. There is a swellable packer in the throat of the 10-3/4 casing, so we should have isolation from the open ocean.

Packer Flow Testing (Oct 9-Oct 10 and Nov 3-Nov 4):

Flow testing of the formation was conducted at Holes 1382A and 1383C prior to deploying the CORKs. In both instances the heave was too high (almost 4m and 3m range, resp.) for the packer to adequately seat. In the last test the packer element was torn away from the upper end ring, likely during an up heave while [in]deflating.

Deploying platform on 1383B (Nov 3):

Science wished to have a platform over the Hole 1383B, abandoned when the 14-3/4" bit lost two of its three cones. The thought was this would help with future ROV operations and deployment of a "mini-CORK" in the throat of the reentry cone. A modification to the platform to allow it to drop cleanly was designed and installed. The platform was successfully free-fall deployed on 1383B.

What Worked

Follows is a synopsis of "what worked" during the mission, or items that went well and would strongly recommend be done in the future. They are categorized, but are not necessarily in order of priority.

Planning:
Two enhancements to this expedition were biweekly conference calls between IODP and the CORK science proponents and a detailed master equipment list. The biweekly calls allowed everyone to give their input, understand choices and priorities, and in general allowed us to avoid "surprises". The detailed master equipment list, while used in a more general form for prior legs, was down to the O-ring level for 336. It helped keep track of the 400+ items, their status (i.e., ordered, shipped), cost, and location. Both the phone calls and master equipment list are highly recommended for future CORK work.

Drill Collars:
This expedition was the first to use 6-3/4" perforated drill collars as the "plumb bob", or the weight to keep the CORK string in tension. These collars were leftover from ADCB (i.e., cheap) and seemed to provide a good balance between weight and clearance in the hole (versus the 8-1/4" collars used in the past).

Coatings:
The use of NOV TK-34XT, Amerlock, and Alocit (underwater cure) epoxies and the Xylan coatings are still being evaluated by science. However, using the hand-applied versions of the Amerlock and Alocit products to cover up tong/slip marks and v-door damage seemed a success. It was also an improvement to make the "plumb bob" up before-hand, then have the roughnecks re-coat and stand it back to dry. Also, having Xylan-coated 4-1/2" and 5-1/2" couplings for the perforated casing and packer mandrels proved useful (and cheaper). Coating these collars with TK-34XT at the pipe yard was problematic. As a final note, using rags to apply the repair coating in the moon pool was much easier than brushes (the epoxy cures very fast – the brushes start to stick).

Fiberglass:
This is a first deployment for the 4-1/2" Series 1750 fiberglass casing. This casing is significantly cheaper than coated steel casing. The fiberglass was assembled and run in the hole with no apparent issues and could be deemed a success. Please note, however, that we had optimal weather conditions for all three CORKs.

Centralizers:
There were several different centralizers/protectolizers used on these CORKs:

- Kwik-zip Centralizers (plastic, bladed, 8.25" OD) were used on the fiberglass pipe and were a crew favorite. They are quick to install (less than 20 sec) and seem to stay in place well. They're believed to provide more than adequate protection for the umbilicals on the fiberglass pipe. So successful were these centralizers, they were even used on the steel portion for the final CORK.
- 5-1/2" and 4-1/2" coated, bladed protectolizers (both 8" OD) were used on the 5-1/2" perforated casing and on the packer mandrels. These use (4) setscrews to bite into the pipe body, holding the protector in place. They provide excellent protection for the mini-screens and packer elements. Science seemed satisfied using these with the Xylan coating.

Note these centralizers/protectolizers were all less than the full hole diameter (9-7/8") to reduce wall drag. They are for protection, not centralization.

SmartTies:
We used non-metallic (Nylon 11) control line ties, called SmartTies from HCL Clamping Solutions, for the first time. These ties were a hit, much quicker and easier to install than the metallic banding used on the 327 and 328 CORKs. These are highly recommended for any future CORKs. As a bonus, they are slightly cheaper than the stainless steel banding.

Packers:
We deployed a combination packer for the first time. This packer combines an inflatable section with a swellable section, all on the same mandrel. These were used instead of separate inflate and swellable packers (as on 327). While not significantly cheaper, these combo packers were quicker to install. They also have the same number of connections while avoiding using the split-section swellable design from 327 and 328. The split-design proved very difficult and time consuming to install, and the element tended to bow under its own weight, producing an oversized packer.

Marking the packer boxes with an ID and which end is "TOP" was very helpful. Also recording tally lengths before shipping saved time and trouble.

Umbilicals:

The Tefzel hoses (for microbiology) were outfitted with titanium junctions ahead of time, so there was no need to stop to change the fittings. This was a great time saver and one less spot to make a mistake.

The new split bearing design on the large, flatpack umbilical stands worked very well. It saved a great deal of time and effort when switching reels.

The Maxis jack stands for the Tefzel (microbio) umbilicals worked very well. These were welded down in place using 4x4 tubing as "lifts". The reels were put in place and "jacked" up for unreeling just prior to assembly of the CORK.

Making a spreader bar to hold (3) banana sheaves worked well. Note: maximum umbilicals in the moon pool is likely (6).

Although not used, having a backup hose saw (for cutting microbio umbilical) and crimper (attaching unions) is advised.

Mini-screens:
The stainless mini-screens for the pressure and geochemistry sampling were all ordered with 1/4" fittings, and used as is on the 1/4" lines and with a crossover fitting to the 1/8" lines. This avoided different size screens and worked well. Also, the mini-screens were plumbed with only 1 to 2 in. of tubing inside the mini-screen (versus running the tubing to near bottom), which should accommodate more contamination before clogging. The screens were made-up prior to running the CORK, again a huge time savings and highly recommended.

Pups:
We used a) 2, 6, and 10 foot fiberglass pups, b) 3m, 4m, and 6m 4-1/2" steel pups, and c) 3m and 6m 5-1/2" perforated casing. We used over half of the pups. They proved very handy in the CORK space-outs (in placing packers at the best depth). The pups are highly recommended.

Handling:
We used new 14 ft. bails (links) on the heave compensator for the first time. These helped tremendously in handling the smaller elevators used on the smaller CORK casings. These links are critical for CORK operations and are being left onboard. The shorter links (yellow) are being returned for surplus.

Miscellaneous/Execution:
Several improvements for 336 proved to work:

- Having an excel-spreadsheet of the installation (the CORK plan) to distribute was very helpful.
- Providing schematics of the umbilical plumbing to/from the packers and the CORK is highly advised (a picture – a thousand words).
- A pre-made pressure gauge and needle valve assembly, connected by hose/crow's foot to the rig water, was used extensively to pressure-test the CORK plumbing prior to deployment.
- Although minor, aluminum workboxes, collapsible plastic tote boxes, and small plastic tote trays proved invaluable.
- The aluminum CORK Gauge, to check VIT clearance, was handy.
- Painting the edge of moon pool CORK grating yellow and covering the mouse-hole were excellent safety improvements.
- Using liquid Teflon on steel casing joints worked fine, and the microbiologists were pleased we were not using the lead-based pipe dope.

Lessons Learned

Although Expedition 336 was fairly successful, from an execution standpoint, there were still many aspects that could be improved or corrected. Again these are categorized, but not necessarily in order of importance. As well, future effort may prove some of these observations or suggestions to be incorrect, unworkable, or cost prohibitive.

395A CORK:
A separate report has been delivered on the failure of the 395A CORK wellhead. One action item from the incident is to make a ring gauge to fit both the old 395A CORK and the 336 one. This diameter can be used as a "no go" dimension for any future work on 395A. Remains of both CORKs are being returned to TAMU.

Given the failure seen on 336, increase the strength of the cup packer section of any future 395A CORK deployment.

CORKs:

Completing the plumbing and pressure testing before shipping is still the preferred method.

Make the CORK pallet with a "v-block" structure (out of wood) at the upper and lower 10-3/4" section of wellhead. This would allow easier and safer turning to access the three bays.

The plastic valve blocks built by science for the geochemistry and microbiology bays are difficult to plumb (e.g., one problem is cannot get a wrench on end tubing connection.) Suggestions were made on how to fix these issues, but were either received too late or ignored. These changes need to be incorporated in the next cycle.

Increase the bending strength in the CORK wellhead by making the following changes to the vertical panels; 1) increase the width from 3/8" to 1/2", 2) remove the cutouts for sample hang-offs (use weld-on hooks instead), and 3) reduce the size of the cutouts for running and strapping lines.

The CORK and packer layouts for the pass-through lines were opposite orientation. This was due to a misinterpreted cross-sectional view on the vendor packer drawings. This was easy to correct by crossing the lines at the top when connecting to the CORK wellhead, but in the future we should reverse the packer pass-through orientation to match the CORK.

Connecting the CORK Running Tool to the top of the CORK is a labor-intensive effort and may be sea state dependent (good weather for 336 didn't affect our operation). We should investigate alternate ways to either connect the tool or ways to deploy the CORKs. However, please note the current running tool has been effective at deploying the CORK, so any changes must be weighed against this success.

Elevators need to be test-fitted with the intended pipe. The elevators brought for the fiberglass casing needed grinding, even though they had been tested with a fiberglass pup. Turns out the fiberglass joints/pups vary greatly in size. Also, the "new" (reconditioned) 4-1/2" elevators needed minor grinding as well.

We need to use a color-coded (yellow is suggested) set of slips, dog collar, and elevator for the fiberglass pipe to avoid confusing the roughnecks.

The top plug's (OJ4500) latching mechanism needs to be redesigned. It was not latching into place without major modification (i.e., adding springs and grinding off a portion). The top section of the 395A CORK is being returned as a test fixture. We also have the top plug from that run.

Dropping the platform from the deployment tool, dubbed the LuLa, while working, proved to be less than smooth. On two of the three deployments the platform hung-up. Working the VIT and the LuLa up and down for a minute or two allowed the platform to slip free. Opening up the holes where the LuLa engages the platform have helped. The leading culprit is thought to be the LuLa/platform rocking on the way down. If the LuLa strikes the top of the CORK running tool at a small angle then one or two (of the three) legs may pre-release, leaving the platform hung on the third leg. Providing a smoother profile on top of the CORK Running may help. On 327 the LuLa struck a protective bolt (which has since been shortened) on the running tool, damaging the leg and causing the platform to hang-up. However, on 336 no damage to the LuLa was seen even though the platform hung temporarily on the first two installations. The third installation was textbook.

Add the plastic dust cover for the L-CORK flow meter interface to the IODP drawing archive. We were not aware we were responsible for this item. It was made onboard.

Using JB Weld on plastic CORK signage was okay, but sand the glossy finish on the back of the signs first, as well as the intended spot on the CORK.

Packers:
Given the potential problem with the packer inflation on 1383C, we should consider modifying our approach. One, perhaps with some modification the packers can be plumbed in parallel, versus in series. This may reduce the number of single points of failure. Two, abandon inflatable packers and go solely to swellables to save time and money, at the sacrifice of initial pressure data and perhaps increasing the span of microbiological contamination. Third, reduce the overall cost (see below) of the packers to allow using inflatable/swellable combo packers across the board.

The same vendor has provided all the packers for 327, 328, and 336. In addition to the single vendor risk, these packers are very expensive and perhaps a bit overkill for our purpose (5000 psi differential ratings, where we need at most 200 psi across the elements). Also, standardizing our packer designs will help reduce the cost. We have tended toward custom-designed packers for each expedition. A priority for the program should be specifying packers, locating other suitable vendors, educating them on our needs, and obtaining preliminary quotations.

Another minor task would be to epoxy-coat the packer mandrels prior to shipment. These mandrels cannot be coated and oven-cured (the element is baked on the mandrel – the two processes interfere with each other). However, hand-applying a coat of epoxy earlier would help retard/stop rust.

Ensure any swellable packers are tightly wrapped. Water got to a portion of the last swellable packer picked-up. We trimmed a small portion of the elastomer off the bottom end before running in hole.

Coatings:
The NOV TK-34XT coating pre-selected by science for use on microbiological-focused CORKs has proven to be very costly. A major issue for NOV is applying the coating to the OD of the casing, and the price reflects this. For example, the quoted price to coat the 6-3/4 perforated collars for 336 with TK-34XT was almost $100k. The price to coat with Xylan, which is used on the instrument string, was $33K (and the direction we went). Amerlock, Alocit, and Xylan samples have been/are being provided to do dispersion/contamination tests. The program needs to pursue commonly available coatings and vendors willing to do the work at a more reasonable cost. NOV and their proprietary TK-34XT coating is state-of-the-art, but perhaps a more cost effective coating can be used.

Umbilicals:
We need a quicker and/or safer way to strip the insulation from the flatpack umbilicals than the drawknife method. Options may include changing to a softer insulation (with some risk) to identifying or making custom-stripping equipment. At a minimum heavier gloves, shirts, and a chainmail/butcher's apron is needed.

Use more straps on the umbilicals. On the last CORK (1383C) we could see gaps between the casing and the umbilicals. We were using straps every 3-4 meters. Recommend straps be used every 1.5-2 meters.

Test fit any umbilical reel bushings with the intended reel. The reel ID's vary greatly.

Packer Flow Tests:
The packer flow tests are very susceptible to heave conditions. There may be a better way to assure these tests can be performed. However, most simple fixes, such as running one or more bumper subs, will not allow us to log through the same BHA. Combining the logging run with the packer test saved a great deal of time on 327 and 336. We will need to weigh the need for a successful flow test against the extra time involved. There may be a way to still do both, but it would likely be more expensive.

Leave the tool joints off of the straddle packer (for testing prior to deployment).

We ran two MicroSmart transducers at the same time for both deployments. If we do this again in the future we need to bring more batteries.

We only need (1) collar below the straddle packer upper section (versus a stand). You need some weight to overcome seal friction and open the packer, but not so much as to make the packer harder to seat.

Order more ports/plugs for packer control sleeve. We are running low.

Rigwatch:
Rigwatch worked well with the exception of the coreline/VIT encoding subsystem. Several major changes/discoveries were made during 336;

1) The Xbob application was re-written with a log capability and renamed "Veeder Depth" (aka DeadBob, to distinguish the server-run application from the Xbob hardware).
2) It was discovered that running Hyperterminal to check veeder responses can interfere with the numbers coming into the DeadBob application. In general, do not run HyperTerminal unless actively trouble-shooting communication issues.
3) The Startech device in the SubSea shop occasionally needs to be rebooted (unplug/replug power cable).
4) The Krakatoa server will on occasion freeze or COM3 will lockup. Restart Krakatoa. Then start the VirtualSerialPort Console software (requires Administrator privileges), the Serial Port Splitter software, the Veeder Depth/DeadBob application, and finally RigWatch. A new set of startup instructions have been left on the Krakatoa desktop and will be incorporated into the manual.

The coreline/VIT depth was working fairly well the last two weeks of the expedition, after being intermittent during the early part.

In calibrating the drawworks encoder following a slip-and-cut, it was decided to experiment with the calibration. Given the depth of this mission, 4500m, versus our more normal operations, it was felt the calibration would be more accurate if performed at depth. The reason being the drill line will see a great deal more tension, which will increase the stretch in the line. We calibrated the drawworks at approximately 4550m, before picking up the top drive, and arrived at a different set of pulse counts (see below). This seemed to work, as the driller had to perform fewer

depth corrections during coring. This technique needs to be vetted before adopting fully.

Bail Position (m)	Pulse Count
0.83	-64485
4.92	-62591
13.98	-58396

Miscellaneous:
The 10-3/4" x 16" bow-spring centralizers were again not run (327, 238, and 336) due to fear they will hang-up in the casing on the way in. Don't bring out anymore and surplus the remaining centralizers.

Stress relief/drop mats would help with fatigue and prevent items from dropping in the moon pool during the CORK assembly.

We need to manufacture saver subs with 6-5/8 FH Modified pins for the CORK Running Tools. The saver subs will allow us to recut a bad connection on the expensive running tools. The saver subs need the modified (longer) pin to hold the stinger in place.

The cementing Shoes, plugs, and darts were not run on 327 or 336. Would recommend not sending out unless in the plan.

The hydraulic jars were not run (hesitant to use since not routine, especially at that water depth), although if the 395A CORK had been stuck they might have been picked up.

Not specific to 336:
Improving the XCB core barrel against corrosion (i.e., different materials, sealing) may reduce the tendency to "biscuit" the core.

We need to investigate a junk seal on the mechanical bit release to stop the wear on the upper body (the part we reuse).

Check the ID on the 10-3/4 casing hanger pups joints. One pup required grinding on this leg. Also, check lubrication on the threads. We had one dry, rusty pin thread.

While not an issue on the mission, we should investigate "dampening" the APC landing to prevent shearing the pins.