IODP Expedition 336: Mid-Atlantic Ridge Microbiology
Site 395 Summary

Investigating coupled geochemical and microbial processes in active aquifers within the upper oceanic crust is the main science goal of Expedition 336. The primary objective of the expedition is initiating multilevel subseafloor borehole observatories (CORKs). One observatory was planned to be installed in the 664-m deep Hole 395A in the southeastern part of North Pond. Hole 395A was drilled during DSDP Leg 45 in 1975-1976, was logged repeatedly, and equipped with a first-generation CORK in 1997 during Leg 174B (Becker et al., 1998). Hole 395A is located in an area of exceptionally low conductive heat flow (Langseth et al., 1992). The low conductive heat flow is due to cooling of uppermost basement by cold seawater that recharges basement and is inferred to flow underneath the sediment cover in a northerly direction.

At the beginning of our operations at Site 395, the old Leg 174B CORK, including the entire 603-m internal string with thermistors, a data logger and pressure sensors, was successfully pulled out of Hole 395A and secured on board. The pressure and temperature data were downloaded, the thermistors cut out of the string, and sections of the string were sampled for microbiologic analyses. Further microbiological samples were obtained from the CORK ROV platform and CORK wellhead elements. The hole was then logged with a new *in situ* deep UV fluorescence tool for detecting microbial life in ocean floor boreholes - the Deep Exploration Biosphere Investigative tool (DEBI-t). Other logging data obtained include spectral gamma ray, and temperature. A rock ledge in the borehole at around 180 m below seafloor (mbsf) had to be bridged by lowering the logging bit to ~198 mbsf, but then an open hole section of 405.7 m was logged (total depth reached was 603.5 m). The lowermost ~50 m of the hole was not logged as Leg 174B found it filled with rubble. The logging results are consistent with the data obtained by Bartetzko et al. (2001) and allow distinguishing the distribution of massive basalt, pillow basalts, altered lava flows, and rubble zones (sedimentary breccia and hyaloclastite).

A 530-m long, multi-level CORK observatory was assembled to perform long-term coupled microbiological, biogeochemical, and hydrological experiments. Assembling the observatory entailed preparing osmotically-driven fluid samplers, microbial incubation experiments, seven temperature, and two oxygen sensors. Packers at 111, 149, and 463 mbsf were installed

to isolate the borehole into three intervals that are characterized by different thermal and fluid flow regimes. Umbilicals containing fluid sampling lines attached to the outside of the CORK casing were designed to reach depths of 122, 220, 430, and 506 mbsf. OsmoSamplers for fluid geochemistry and microbiology were lowered on spectra rope inside the slotted or perforated CORK casing to sample four intervals: 118-140, 240-261, 415-438, and 499-527 mbsf. The CORK wellhead was instrumented with sensors for monitoring pressures in the four zones isolated by packers and with OsmoSamplers for retrieving fluid samples from the lowermost zone.

The assembly and installation proceeded well until the CORK head broke off during the final step of releasing the CORK running tool. The CORK head experienced forces that bent the wellhead and severed its 5 inch pipe about 4 m below the top of the reentry cone. This also parted the spectra line and the umbilicals, leaving the downhole tool string in place. Based on the portion of the CORK wellhead recovered, the upper end of the remaining 5 inch diameter cup packer subassembly near the seafloor (5 inch pipe mandrel) is not completely rounded, but may be open enough to allow recovery of the internal downhole samplers, sensors, and experiments in the future. Several stainless steel tubes likely extend above the cup packers and the top of the 5 inch casing. Damage on stabilizing fins above the cup packers suggests that they may have been too large in diameter to enter the throat of the reentry cone (DSDP documentation indicated a 24 inch diameter; but now thought to be less). This may have been the root cause of the installation failure – similar damage was observed on the Leg 174B CORK that was recovered (it too did not fully land). 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, however, no data are otherwise available to suggest that the packers did not inflate as intended either. A plan is being formulated to recover the downhole instrument string in four years with a remotely operated vehicle (ROV).

References

Bartetzko, A., Pezard, P., Goldberg, D., Sun, Y.-F., Becker, K., 2001. Volcanic stratigraphy of DSDP/ODP Hole 395A: An interpretation using well-logging data. Mar. Geophys. Res. 22, 111-127.

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