

IODP Expedition 328: Cascadia Subduction Zone ACORK Observatory

Site U1364 Summary

The operational objective of Expedition 328 was the installation of a new permanent hydrologic borehole observatory near Ocean Drilling Program Site 889. The format of the new installation followed the Advanced CORK (ACORK) design, which will facilitate pressure monitoring at multiple formation levels on the outside of a 10³/₄ inch casing string. The casing is sealed at the bottom, leaving the inside available for future installation of additional monitoring instruments. The successful installation of the observatory will allow documentation of the average state of pressure in the frontal part of the Cascadia accretionary prism, the pressure gradients driving flow from the consolidating sediments, the mode of formation of gas hydrates, the influence of gas hydrates and free gas on the mechanical properties of their host lithology, the response of the material to seismic ground motion, and the magnitude of strain at the site caused by episodic seismic and aseismic slip in this subduction setting. At a later date, the observatory will be connected to the NEPTUNE fiber-optic cable for power and real-time communications from land.

Expedition 328 began at 0836 hr on 5 September 2010 when the first line was passed ashore at Ogden Point Pier A in Victoria, B.C. After completing port call public relations, logistical, and maintenance activities, we departed Victoria for Site U1364 (CAS-01CORK) when the last line was released at 1606 hr on 9 September. After maneuvering away from the pier, the vessel began the 145 nmi transit to the site at 1700 hr. The ship arrived on location at 0600 hr on 10 September concluding a transit that averaged 11.2 knots.

Our first objective was to perform a jet-in test to verify the water depth and establish the conductor casing length to be deployed with the re-entry cone, followed by jetting in the casing and re-entry cone. The Vibration Isolated Television (VIT) was deployed to observe the bit contacting the seafloor at 1329.0 m below rig floor (mbrf), and the jet-in test was conducted reaching 55 m below seafloor (mbsf). Based on this result, the conductor casing was assembled consisting of 3 joints of 16 inch casing and a casing shoe joint for a total length of 53 m, which was latched into a standard re-entry cone. Once the drilling bottom hole assembly (BHA) equipped with a 11⁷/₁₆ inch APC/XCB bit was latched into the casing hanger, the reentry cone was deployed and the jetting of the reentry cone and casing was initiated at 0600 hr on 12 September while being monitored via the VIT. The 53 m assembly was jetted in and landed by 1435 hr and the drill string was tripped back to the rig floor.

After jetting in the 16 inch casing and re-entry cone, our next objective was to drill a 14³/₄ inch hole to accommodate the 10³/₄ inch casing string. A drilling BHA with a 14³/₄ drilling bit was made up and deployed, reentering Hole U1364A at 0905 hr on 13 September. The VIT was recovered and then drilling advancing without incident to a final depth of 336.0 mbsf. High viscosity mud sweeps (20 barrels (bbl) each) were circulated at 164, 193, 222,

278, 307, and at 336.0 mbsf. A large high viscosity 50 bbl flush was pumped at the conclusion of drilling. The hole was then displaced with 250 bbl of 10.5 pounds/gallon (ppg) mud. The drill string was recovered with the bit clearing the rotary table at 1435 hr on 14 September.

The next operational step was to make up the ACORK assembly. The construction of the ACORK, which include making connections to the hardware, strapping and taping the umbilical to the casing, and making the plumbing connections to the screens and ACORK, began at 1430 hr on 14 September and continued to 1000 hr on 15 September. The ACORK assembly included a custom ACORK head, a 10³/₄ inch casing hanger, 20 joints of 10³/₄ inch casing, 2 pup joints of 10³/₄ inch casing, a TAM Freecap 10 inch x 14 inch dual-element swellable packer, and 4 screen joints of 10³/₄ inch casing and one shoe joint. The length of the entire assembly was 329.1 m. Because 6.0 m of ACORK head extended above the hang-off point in the reentry cone, the effective depth of the assembly into the hole was 323.1 m. With a 12.9 m rat hole, the bottom of the hole was 336.0 mbsf. The next phase was making up a reaming BHA, which included a 9⁷/₈ inch tricone bit, a 9.5 inch HOC DTU950 under-reamer, a 9.5 inch Ultra XL mud motor, and the CADA casing running tool. The total length of this BHA was 418.9 m. As the BHA was being assembled, it was lowered incrementally into the ACORK suspended in the moon pool until the running tool landed into the ACORK at 1345 hr on 15 September. The ACORK and reaming assembly were then lowered into the water with the ACORK head ~10 m beneath the surface for 5 minutes to purge any entrapped air. Once the ACORK head was back in the moon pool, the four purge valves were manually turned to the closed position. The ACORK and reaming BHA were deployed and Hole U1364A was entered for the 2nd time at 1930 hr. The ACORK was gradually lowered into the open hole until it was successfully landed in the reentry cone at 0025 hr on 16 September. No under-reaming was required, because the hole appeared to have remained open, possibly due to the presence of the 10.5 ppg mud that was pumped into the hole at the conclusion of the drilling process.

The ROV platform was tethered to the VIT and deployed at 0400 hr on 16 September. The platform was successfully deployed when the mechanical release activated upon contacting the CADA top hat at 0515 hr. The VIT was then recovered.

A Hammer Drill System (HDS) cone, adapted to fit over the 16 inch casing hanger at the top of the ACORK to facilitate re-entry, was made up and free fall deployed at 0820 hr on 16 September. However, the cone was dislodged while retrieving the drill string and fell to the seafloor. The drilling string was tripped back to the rig floor.

The final operation was deployment of a hydraulic packer to seal the bottom of the 10³/₄ inch casing. The packer assembly was deployed and Hole U1364A was reentered for the third time at 2320 hr on 16 September. Although the 16 inch casing hanger presented a smaller target than the HDS cone, the reentry was made in less than an hour. The packer was positioned at 319 mbsf or 4 m above the casing shoe with a circulating head in place. Prior to activating the packer, the inside of the casing was displaced with one volume of seawater while maintaining pressure below 200 psi to insure that the packer would not

inflate prematurely. At 0230 hr the activating steel ball was dropped into the pipe and seated inside the bridge plug. The pressure was gradually increased until the packer set at ~1300-1400 psi. The packer was released at 0335 hr when ~2700 psi was applied. The driller pulled back in the hole, circulated seawater while waiting for the cement to be mixed, and then pumped ~4 bbl of 16 ppg cement covering the packer with ~14 m of cement. The inside of the casing was then flushed with 3 volumes of seawater. At 0600 hr, the driller began to recover the drill string, which was back onboard at 1400 hr, ending operations at Site U1364.

The ship was secured for transit, the thrusters raised and the ship departed for port. The JR arrived at Esquimalt Graving Dock in Victoria B.C. at 0800 hr on 18 September 2010, concluding Expedition 328.