CORK Borehole Observatory

OCEAN DRILLING PROGRAM
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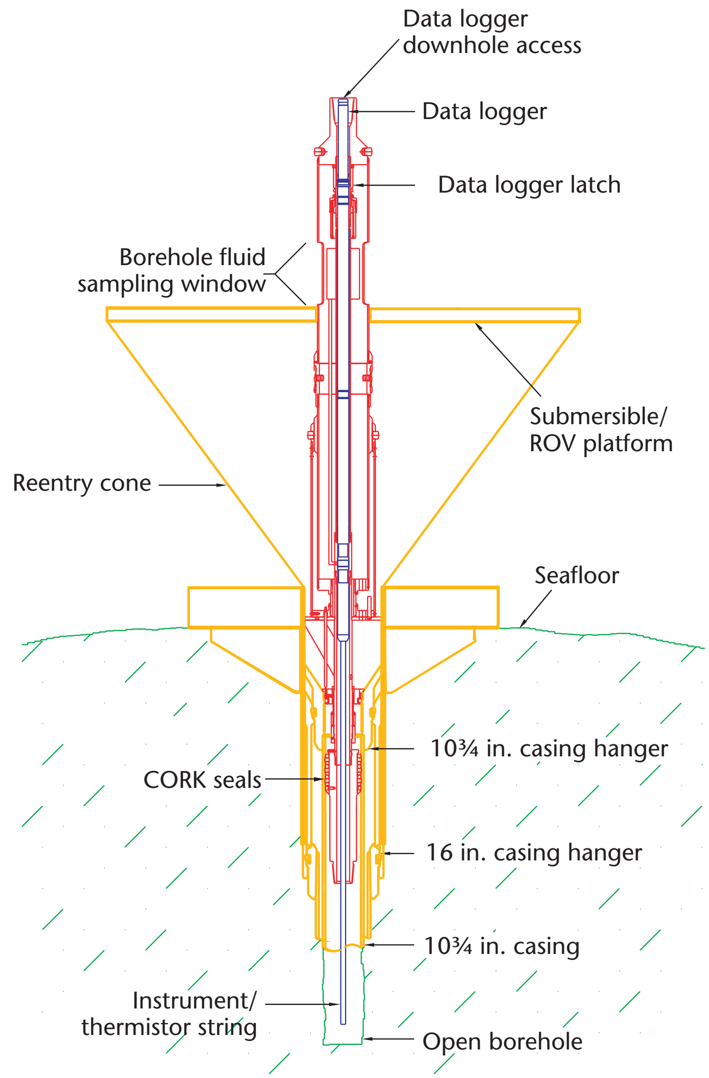
Scientific Application

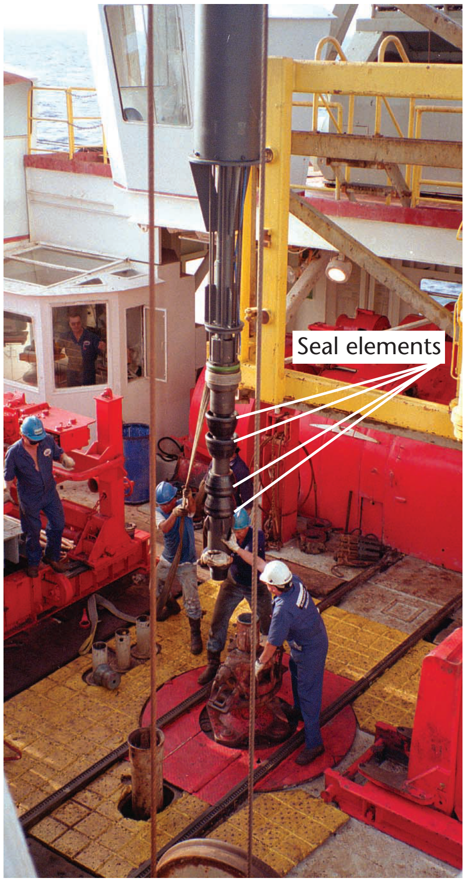
The CORK (Circulation Obviation Retrofit Kit) was designed for thermal and pressure characterization of subseafloor hydrology over an open formation interval in a variety of hydrologic settings. The CORK seals the top of the casing in an Ocean Drilling Program (ODP) reentry cone installation to prevent circulation between the open hole and ocean bottom water. CORKs are designed for long-term in situ monitoring of temperature and pressure as well as collecting borehole fluid samples through added tubing and valves. The CORK also provides a means to hang a third-party sensor or an osmotic sampler (to collect geochemical samples) in the casing and open hole. Remotely operated vehicles (ROVs) or submersibles are routinely used to retrieve the data from the top of a CORK for shore-based study. If the CORK can be attached to an existing subsea cable, data can be downloaded in real time.

Tool Operations

A reentry cone with a 16 in. and 10¾ in. casing is initially installed. The CORK is run on the end of the drill string and reenters the cased hole, but does not land in the cone. The instrument string is lowered on a wireline cable through the drill string into the casing and open hole until the electronic data logger lands in the CORK. With the instrument string suspended from the CORK, the data logger package is hydraulically latched into the CORK. The CORK then lands in the reentry cone, seals in the casing hanger, and is hydraulically latched in place, leaving the top of the CORK exposed in the reentry cone above the seafloor. An ROV platform is free-fall deployed to complete the installation (for more information on CORKs see Becker and Davis, 1998).



Schematic of a CORK installed in a reentry cone, which has 16 in. and 10¾ in. casing set. The CORK data logger and fluid sampling ports extend above the top of the reentry funnel, and a platform is free-fall deployed to the top of the funnel to provide access for submersibles/ROVs. The CORK seals the 10¾ in. casing. An optional third-party instrument string can be installed.



Lower portion of CORK with seal elements being prepared for installation in the reentry cone. Photograph by Karen Graber.

Design Features

1) Casing Design

Casing is set and cemented through the sediments. If the formations are stable, a 9⅞ in. hole is cored out below the 10¾ in. casing to access the zone of interest. If the hole is unstable, it is fully cased, and the zone of interest is accessed via a screened or perforated casing.

Benefit: Isolates the hydrogeologically active formations from the ocean bottom water. Screened casing prevents hole collapse, which could seal off the bottom of the CORK casing.

2) Casing Seal

An elastomer seal package is expanded in the top of the casing.

Benefit: Prevents flow into or out of the top of the casing effectively sealing the borehole.

3) Sensor String (third-party tool supplied by scientist)

Instruments can be deployed and retrieved from the CORK using the *JOIDES Resolution*, work boats, submersibles, or ROVs. The basic sensor string incorporates a pressure gauge and thermistor at the seafloor as well as pressure gauges and multiple thermistors that are spaced along a cable through the borehole.

Benefit: Determines in situ formation temperatures and monitors temperatures and pressures for indications of hydrologic events at the seafloor and within the borehole.

4) Data Logger with Memory (third-party tool supplied by scientist)

Temperature and pressure data can be recorded and stored in the data logger unit.

Benefit: Long-term borehole data can be downloaded periodically via a submersible or ROV.

ROV platform being assembled in the moonpool for free-fall deployment to finish the CORK installation in the reentry cone.

5) Borehole Fluid Sampling (third-party tool supplied by scientist)

Hydraulic tubing or pipe run from the CORK into the borehole can provide in situ water samples, which are collected via a valve in the CORK at the seafloor.

Benefit: The tubing can allow borehole fluid samples to be recovered at the seafloor, and tests can be performed while monitoring pressure (e.g., injecting fluid into the borehole). Two adjacent CORKs would allow hole-to-hole hydrologic tests (pulse, injection, and fluid production).

6) Osmotic Sampler (third-party tool supplied by scientist)

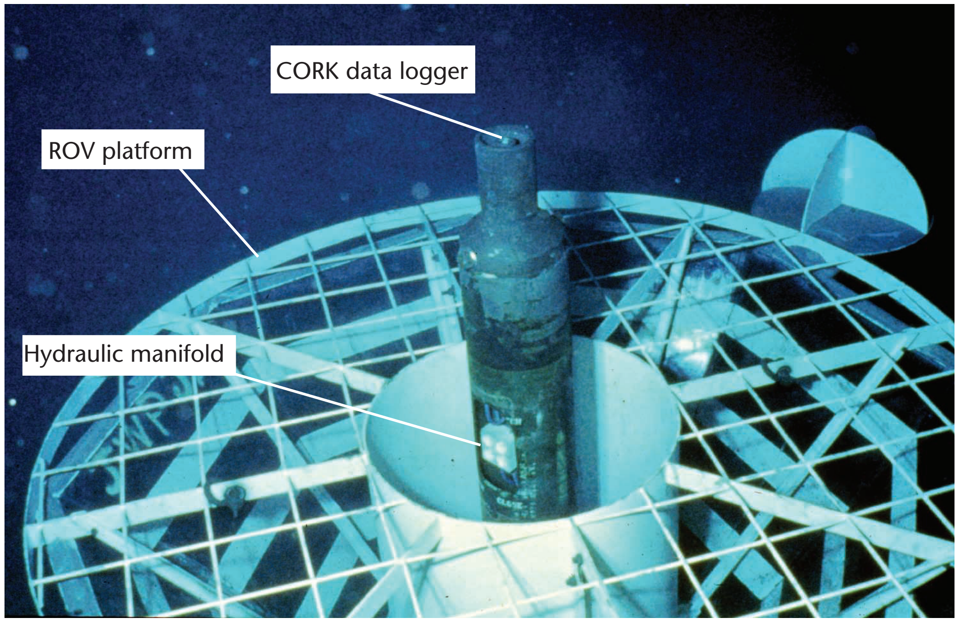
Modular downhole osmotic fluid samplers can sample and store in situ fluids over long periods of time.

Benefit: Formation fluids can be accessed for long-term geochemical evaluation.

7) Submersible/ROV Operations

The CORK extends above the reentry cone, and a landing platform is provided for access by submersibles or ROVs. Borehole fluid sampling and injection is accomplished via a hydraulic line and control valve, which are accessed via a window in the side of the CORK.

Benefit: Data and fluid samples can be retrieved by submersible/ROV operations without the *JOIDES Resolution*.



Subsea photograph of one of the first CORKs installed during Leg 139 in 1991. Water depth is 2400 m.

CORK Specifications

Hydraulic Connector Type

Aeroquip FD72 "push-on/pull-off" male hydraulic connector

Electrical Connector

Wet-mateable RS-232 connectors to data logger for ROV intervention

Minimum Inner Diameter through CORK (without data logger in place)

3.5 in. (89 mm)

Limitations

CORK technology only allows monitoring of the average conditions represented by either the full interval of the open hole below casing or a screened or perforated interval in a fully cased hole.

The sensor string and data logger are limited to diameters of less than 3.75 in. because they are deployed through the drill string.

Borehole fluid sampling and the use of an osmotic sampler are limited by the long time period required to displace the seawater from the sampling tube with formation fluids.

Borehole fluid samplers are currently not proven operational instruments.

A reentry cone installation with casing cemented in place is required to install a CORK. Once a CORK is installed, the CORK blocks all borehole reentry operations until it is removed.

Removal of the CORK requires the use of the *JOIDES Resolution* or a similar vessel.

The downhole osmotic sampler is a self-contained, modular fluid sampler driven by an osmotic pump. It can only be recovered when the sensor string and data logger are recovered, which exposes the sampling interval to ocean bottom water.

Reference

Becker, K., and Davis, E.E., 1998. Advanced CORKs for the 21st Century. *JOI/USSSP-sponsored workshop report* [Online]. Available from World Wide Web: <http://www.joiscience.org/USSSP/Workshops/AdvancedCORKs/Advanced_CORK_report.html> [Cited 2001-05-02]