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 International Ocean Discovery Program (IODP) 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.

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).

Features

1) Casing Design

Casing is set and cemented through the sediments. If the formations are stable, a 9/8 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, which 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 to prevent 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. These sensor strings determine in situ formation temperatures and monitor 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. Long-term borehole data can be downloaded periodically via a submersible or ROV.
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. 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. 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 are accomplished via a hydraulic line and control valve, which are accessed via a window in the side of the CORK. Data and fluid samples can be retrieved by submersible/ROV operations without the JOIDES Resolution.

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 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.