IODP Mariana Convergent Margin Expedition 366

The IODP Mariana Convergent Margin Expedition 366 will investigate geochemical, tectonic, and biological processes at intermediate depths of an active subduction zone.

This expedition is based on IODP proposals 505-Full5 and 693-APL (see below).

The detailed scientific drilling, coring, and logging operations will be finalized at a meeting about 1 year before the expedition sails.

This expedition plans to (a) core at 8 sites, (b) deploy a reentry cone and casing system at three of these sites to provide the necessary infrastructure for post-cruise installation of long-term monitoring, and (3) remove the existing borehole observatory (CORK) in Hole 1200C.

In contrast to the proposals, (1) Sites MAF-2B and -3B on Pacman Seamount will not be occupied and (2) no observatories will be installed during the expedition.
**Title:** Ancillary Project Letters: South Chamorro Seamount (ODP Site 1200): Modernization of a CORK in an Active Serpentine Mud Volcano

**Proponent(s):** Geoffrey Wheat (Univ. Alaska Fairbanks), Patty Fryer (Univ. Hawaii), Earl Davis (Pacific Geoscience Center), Hans Jannasch (MBARI), Craig Moyer (Western Washington Univ.), Doug Wiens (Washington Univ. at St. Louis)

**Keywords:** Chamorro, Sperpentine, Mud Volcano, CORK, Subduction

**Area:** Mariana forearc

**Contact Information:**

<table>
<thead>
<tr>
<th>Contact Person</th>
<th>Geoffrey Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
<td>GURU</td>
</tr>
<tr>
<td>Organization</td>
<td>University of Alaska Fairbanks</td>
</tr>
<tr>
<td>Address</td>
<td>PO Box 475 Moss Landing, CA, 95039, USA</td>
</tr>
<tr>
<td>Tel.</td>
<td>831-633-7033</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:wheat@mbari.org">wheat@mbari.org</a></td>
</tr>
</tbody>
</table>

Permission to post abstract on IODP-MI Web site: Yes

**Abstract:** (400 words or less)

We request three days on site to recover the “original-design” sealed borehole observatory (CORK) at South Chamorro Seamount, one of 14 large (up to 50 km in diameter and 2 km high) active serpentine and blueschist mud volcanoes on the Mariana Forearc, and replace it with a modified CORK II. Deployment of a CORK was envisioned to assess the temporal component of forearc-related processes by establishing a long-term observatory. However, the short lead time restricted CORK design and possible applications. We wish to upgrade the observatory to a modified CORK II system to provide enhanced scientific return, including flexibility for future deployments. These upgrades are critical for understanding biogeochemical processes in this hydrologic and seismically active environment by allowing us to sample formation fluids, conduct microbial and manipulative experiments, monitor pressures at significantly higher frequencies than is possible today, and add new instruments (e.g., tilt, accelerometer, seismometer). Initial data are tantalizing, showing the response to two seismic events and underscoring the value of monitoring this seismically active and distinctive biogeochemical environment.

Operations at sea will be similar to those successfully conducted at ODP Site 1026 on IODP Expedition 301. The drill ship is required to unlatch and remove the old CORK body and submersible platform and disassemble the various components (16 hours), assemble the CORK and lower it to the seafloor (13 hours), enter the hole and lower and set the packer (4 hours), deploy an instrument string inside the 4" casing and the ROV/submersible platform (15 hours), conduct a visual inspection and release the CORK running tool (2 hours), and recover the pipe (8 hours). Even accounting for additional time instrumenting the CORK before deployment, we anticipate completing the operations in 3 days. Such an operation could easily be conducted during a transit from Nankai to the eastern or southern Pacific Ocean and from the Pacific Ocean to the Indian Ocean.
Scientific Objectives: (250 words or less)

We propose to replace the CORK body at ODP Site 1200C (South Chamorro Seamount) and deploy a modified CORK II that allows one to collect fluids at the seafloor through a manifold specifically designed to minimize fluid contamination. Modified CORK IIs use reinforced plastic, stainless steel and titanium tubing to transport fluid from depth to the seafloor where a host of instruments and samplers can be deployed and recovered using a submersible or ROV. This configuration can accommodate a range of geophysical, geochemical, and microbial instruments, including new state-of-the-art pressure sensors and loggers that allow for a higher frequency of sample collection. With this newly configured CORK II we hope to (1) document the true formation pressure, which has yet to be reached, (2) observe events without the complexity caused by the “drilling perturbation”, (3) determine the interplay between events and the physical (pressure, tilt, accelerometer or seismometer) and chemical characteristics of the formation fluid, (4) discriminate between seismic shaking and static strain, and (5) conduct manipulative experiments to elucidate microbial (Archaea) processes. The number of large earthquakes in this region make such a study feasible.

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

Install a modified CORK II (similar operations as conducted at ODP Hole 1026B).

Proposed Sites:

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Position</th>
<th>Water Depth (m)</th>
<th>Penetration (m)</th>
<th>Brief Site-specific Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODP Leg195 Hole 1200C Chamorro Seamount</td>
<td>13°47’N, 146°00’E</td>
<td>2932.3</td>
<td>140</td>
<td>Recover old CORK and replace it with an instrumented modified CORK II</td>
</tr>
</tbody>
</table>
Introduction

Hydrogeologic processes at convergent plate margins play a critical role in geochemical cycling, seismicity, deformation, and the subsurface biosphere. The importance of these processes, and understanding how they are controlled and change with time, constitute a major focus for IODP and the MARGINS program at NSF. Most of the fluid transport studies at convergent plate boundaries have focused on accretionary convergent margins [1-3] where large wedges of accreted sediment bury the underlying crystalline basement. Fluids that are expelled at depth must penetrate this material during transit to the seafloor and thus are subjected to chemical exchange with sediment and alteration by microbial processes. These interactions obfuscate the original composition, which is critical for constraining pressure and temperature conditions at depth. In contrast, non-accretionary systems lack this overlying sediment burden and, in the case of the Mariana Forearc, provide direct access to deep crustal fluids via active serpentine mud volcanoes. This mud volcanism provides a window to the décollement and access to processes there through the use of readily-available technologies.

In March 2001 the Joides Resolution drilled South Chamorro Seamount, one of 14 large (up to 50 km in diameter and 2 km high) active serpentine and blueschist mud volcanoes on the Mariana Forearc [4-6]. Goals for drilling South Chamorro Seamount fall within IODP Proposal 505Full, which includes drilling three active mud volcanoes to the north. This research project is designed to elucidate mass transport and geochemical cycling in non-accretionary convergent margins, define spatial constraints on compositional variability of slab-related fluids within the forearc environment as a means for tracing water-rock reactions in subduction and supra-subduction zone environments, trace the metamorphic and tectonic history of nonaccretionary forearc regions, determine the role of biological activity associated with subduction-zone material including its relationship to macrofaunal assemblages, and assess the temporal component of these processes by establishing a long-term borehole observatory (CORK). Because the decision to drill this site was made ~6 months before the start of the expedition, it was possible only to deploy a standard CORK design with spare equipment from ODP Leg 168 [7]. Although this configuration is not ideal, it did provide flexibility for future deployments and upgrades. We request three days on site to recover the “original-design” CORK and replace it with a modified CORK II. Such an upgrade, similar to that completed successfully at ODP
Site 1026, is critical for understanding biogeochemical processes in this hydrologic and seismically active environment.

**Geologic Relevance and CORK instrumentation**

South Chamorro Seamount is ~85 km from the trench and about 26.5 km above the downgoing slab [8], and is primarily composed of unconsolidated flows of serpentine mud with clasts consisting dominantly of serpentinized mantle peridotite, but also containing blueschist fragments [9-11]. The summit shows active seepage of slab-derived fluids supporting macrofaunal assemblages that include mussels, gastropods, tube worms, and galatheid crabs [12]. Subsurface fauna include Archaea [13] and Bacteria [14]. Even with evidence for fluid flow from a deep source, temperatures measured in the upper meter at ODP Site 1200 are only 2–3°C, just above the bottom water temperature of 1.7°C. Measured heat flow near active sites of seepage averages 15 mW/m², whereas in the zone of maximum seepage the heat flow is 101 mW/m² [9].

Figure 1. South Chamorro Seamount is located at 13°47′N, 146°00′E, about 125 km east of Guam with a water depth of ~2950 m. Six boreholes were drilled but only one was cased for instrument deployment (ODP Hole 1200C).

The chemical composition of deep fluids from South Chamorro and Conical Seamounts [13, 15-16] are similar. These fluids, however, are distinctly different from pore waters collected using gravity cores on six other serpentine seamounts in the Mariana Forearc [8, 16]. Compositions range from calcium-rich, low alkalinity, and low magnesium in mud volcanoes located near the trench to calcium- and magnesium-depleted, high alkalinity (60 mmol/kg), high pH (~12.5) and sulfide-rich (several mmol/kg) fluid in mud volcanoes further from the trench (e.g., South Chamorro and Conical Seamounts). This difference is attributed to depth-dependent decarbonation of the down-going plate, setting constraints for pressure and temperature conditions along the décollement [8, 16].

---

5
Two pilot holes were drilled before ODP Hole 1200C was drilled to a depth of 266 mbsf. The drillstring was retrieved, but it was difficult getting the casing to depth. The final configuration set the casing shoe at 202.8 mbsf and the screened section from 148.8 mbsf to 202.3 mbsf. This screened section allows interaction between pore fluids in the formation and instruments within the borehole. Initial borehole instrumentation included a data logger, pressure sensors, nine thermistors, and two OsmoSamplers. The data logger was programmed to record date, time, borehole pressure, seafloor pressure, internal temperature, resistance of nine thermistors and two fixed, low temperature-coefficient resistors once per hour [e.g., 7]. OsmoSamplers are continuous fluid samplers driven by the osmotic flow generated across a membrane that separates solutions of different salt content [17, 18]. Each of these instruments was retrieved in 2003 after which we sealed the borehole.

**Initial CORK Results**

Because of the limitation in the initial CORK design, OsmoSamplers were placed within the cased borehole open to the formation at the bottom. Here high concentrations of dissolved carbon dioxide, methane, and sulfide diffused into the small bore Teflon sample tubing. These dissolved gases become supersaturated upon recovery resulting from a decrease in pressure (~290 to 1 atm) and an increase in temperature (~3 to 25°C). As a result, excess pressure in the sample coil was relieved by expelling the entire 2-year record of sample collection. Fluids actually shot out of the intake (1 mm I.D.), landing several meters away. In contrast, modified CORK IIs can accommodate fluids with a high gas content, because fluid sampling devices will be placed at the seafloor, where gas can diffuse through the Teflon tubing to seawater (e.g., major ions) and valves can be turned before recovery of gas-tight sample coils made of copper (e.g. dissolved gases).

Fortunately, the borehole is over-pressured and tapped a highly permeable zone that allowed fluids to vent from the borehole when the data logger and instruments were removed. Two fluid samples were collected from the open borehole, collecting a mixture of seawater and borehole fluids. Extrapolating these fluid compositions to the borehole fluid composition reveals several interesting results. First, pristine fluids from depth enter the borehole, representing the deepest fluids retrieved from this site. Second, the fluids match those recovered by coring, indicating that there are no discernable sampling artifacts from drilling. Third and most striking, the screened section intercepted the “bug zone” where Archaea reduce sulfate in the presence of methane at an in situ pH of 12.5 [13]. Interestingly, the depth of this Archaea “bug zone” is deeper at locations with more rapid upflow. Fourth, as this fluid flowed upward it reacted with seawater that was introduced though latch holes,
which are sealed when instruments are deployed within the borehole (Fig. 2). Brucite immediately precipitates as do Ca- and Sr-rich carbonates, leaving white crystalline precipitates on the rim and exterior of the pipe. Fifth, given the observed fluid venting velocity and the overpressure (~150 KPa), we calculate a permeability of $10^{-12}$ m$^2$ [e.g., 19], which is substantially greater than the range of $10^{-15}$ m$^2$ to $10^{-17}$ m$^2$ measured in three samples of blue serpentine muds from a mud volcano to the north. Thus, the borehole taps a highly permeable zone, allowing for a rapid fluid ascent and minimizing alteration of the fluid in transit.

In addition, we recovered pressure and thermal data, providing a unique 2-year record that includes 2 major events [20]. The record shows a long-term recovery from hydrostatic conditions at the time of drilling towards natural-state overpressure. The formation also responds to dynamic loading imposed at the seafloor by the ocean and atmosphere, and to seismic waves and tectonic loads imposed at the time of two regional earthquakes. In both cases, hourly-recorded data provided fortuitous, but highly aliased observations of the seismic surface waves: negative and positive in the first and second cases, respectively. The pressure offsets following these single-point anomalies are probably associated with elastic dislocation strain, although their magnitudes (which, given the formation properties constrained by the tidal loading efficiency, suggest strain of the order of $10^{-7}$) are much larger than predicted by a homogenous half-space dislocation model (on the order of $10^{-9}$). This
may be the result of strain focusing in the fluidized material beneath the volcano. The time constant for the hydrologic "drainage" is identical for both events, and the same as that which characterizes the drilling recovery.

**Work Plan for Joides Resolution**

The original CORK instruments installed in ODP Hole 1200C were recovered and replaced with a plug in April 2003 without instruments or samplers. Because of the high concentrations of dissolved gases in the pore fluids, this CORK can only provide data in the future for geophysical study. We propose to replace the CORK body and deploy a modified CORK II that allows collection of fluids at the seafloor through a manifold specifically designed to minimize fluid contamination [21]. The modified CORK II will have a packer within the borehole just above the screened section. Reinforced plastic, stainless steel and titanium tubes pass through this packer, providing multiple conduits to the seafloor. Numerous instruments and samplers can be deployed and recovered at the wellhead using a submersible or ROV, accommodating a range of geophysical, geochemical, and microbial instruments, including new state-of-the-art pressure sensors and loggers that allow for a higher frequency of sample collection [21]. Because the hole is overpressured and producing fluids, formation fluids can be sampled at the seafloor. Although a brucite and carbonate chimney should form at the seafloor when fluids egress and mix with seawater, these minerals cannot form at depth in the borehole because of the lack of Mg and Ca (from seawater), thus no mineralization will prevent emplacement of the packer.

Proposed operations to replace the CORK requires a drill ship to un latch and remove the old CORK body and submersible platform, disassemble the various components (16 hours), assemble the new CORK and lower it to the seafloor (13 hours), enter the hole and lower and set the packer (4 hours), deploy an instrument string inside the 4" casing and a ROV/submersible platform (15 hours), conduct a visual inspection and release the CORK running tool (2 hours), and recover the pipe (8 hours). Even accounting for additional time instrumenting the CORK before deployment, we anticipate completing the operations in 3 days, resulting in a fully functioning CORK that can accommodate a variety of research interests with samplers and sensors within the formation and at the seafloor. Such an operation could easily be conducted during a transit from Nankai to the eastern or southern Pacific Ocean and to the Indian Ocean.
References


IODP Site Summary Forms:
Form 1 - General Site Information

Please fill out information in all gray boxes
Revised 7 March 2002

Section A: Proposal Information

Title of Proposal:
APL: South Chamorro Seamount (ODP Site 1200), Modernization of a CORK in an Active Serpentine Mud Volcano

Date Form Submitted:
3/31/2006

Site Specific Objectives with Priority
(Must include general objectives in proposal)
We request three days on site to recover the “original-design” sealed borehole observatory (CORK) at South Chamorro Seamount, one of 14 large (up to 50 km in diameter and 2 km high) active serpentine and blueschist mud volcanoes on the Mariana Forearc, and replace it with a modified CORK II. Operations at sea will be similar to those successfully conducted at ODP Site 1026 on IODP Expedition 301. We anticipate completing the operations in 3 days. Such an operation could easily be conducted during a transit from Nankai to the eastern or southern Pacific Ocean and from the Pacific Ocean to the Indian Ocean.

List Previous Drilling in Area:
ODP Leg 195 Site 1200 Hole 1200C

Section B: General Site Information

Site Name:
ODP Hole 1200C

If site is a reoccupation of an old DSDP/ODP Site, please include former Site #

Latitude:
Deg: 13 N Min: 47

Longitude:
Deg: 146 E Min: 00

Coordinates System:
WGS 84, Other ( )

Priority of Site:
Primary: YES Alt: None

Area or Location:
Mariana Forearc

Jurisdiction:
USA

Distance to Land:
125 Kilometers East of Guam

Water Depth:
2932.3 m
## Section C: Operational Information

### Proposed Penetration:

<table>
<thead>
<tr>
<th>Sediments</th>
<th>Basement</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

What is the total sed. thickness? [ ] m

Total Penetration: [ ] m

### General Lithologies:

Cased Borehole

Replace CORK with a modified CORK II

- 1-2-3-APC [ ]
- VPC* [ ]
- XCB [ ]
- MDCB [ ]
- PCS [ ]
- RCB [ ]
- Re-entry [ ]

### Coring Plan:

(Specify or check)

- 1 - 2 - 3 - A P C [ ]
- V P C * [ ]
- X C B [ ]
- M D C B * [ ]
- P C S [ ]
- R e - e n t r y [ ]

* Systems Currently Under Development

### Wireline Logging Plan:

- To Determine Fill Depth

<table>
<thead>
<tr>
<th>Standard Tools</th>
<th>Special Tools</th>
<th>LWD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutron-Porosity [ ]</td>
<td>Borehole Televiewer [ ]</td>
<td>Formation Fluid Sampling [ ]</td>
</tr>
<tr>
<td>Litho-Density [ ]</td>
<td>Nuclear Magnetic Resonance [ ]</td>
<td>Borehole Temperature X</td>
</tr>
<tr>
<td>Gamma Ray [ ]</td>
<td>Geochemical [ ]</td>
<td>Borehole Seismic [ ]</td>
</tr>
<tr>
<td>Resistivity [ ]</td>
<td>Side-Wall Core Sampling [ ]</td>
<td>Acoustic [ ]</td>
</tr>
<tr>
<td>Acoustic [ ]</td>
<td>Others ( )</td>
<td>Others ( )</td>
</tr>
</tbody>
</table>

**Expected value (For Riser Drilling)**: 10°C

**Max. Borehole Temp.**

Expected value (For Riser Drilling): 10°C

**Mud Logging**

(Riser Holes Only)

Basic Sampling Intervals: 5m

### Estimated days:

<table>
<thead>
<tr>
<th>Drilling/Coring</th>
<th>Logging</th>
<th>Total On-Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

### Future Plan:

Longterm Borehole Observation Plan/Re-entry Plan – YES similar to the one conducted on IODP expedition 301 in which we removed the original CORK from ODP Hole 1026B and replaced it with a modified CORK II

### Hazards/Weather:

Please check following List of Potential Hazards

- Shallow Gas [ ]
- Complicated Seabed Condition [ ]
- Hydrothermal Activity [ ]
- Hydrocarbon [ ]
- Soft Seabed [ ]
- Landslide and Turbidity Current [ ]
- Shallow Water Flow [ ]
- Currents [ ]
- Methane Hydrate [ ]
- Abnormal Pressure [ ]
- Fractured Zone [ ]
- Diapir and Mud Volcano X
- Man-made Objects [ ]
- Fault [ ]
- High Temperature [ ]
- H2S [ ]
- High Dip Angle [ ]
- Ice Conditions [ ]
- CO2 [ ]

What is your Weather window? (Preferable period with the reasons)

I think March to June is the best To avoid tropical storms
# IODP Site Summary Forms:

Form 2 - Site Survey Detail

Please fill out information in all gray boxes

Proposal #: 693-APL  Site #: ODP Hole 1200C  Date Form Submitted: 3/31/2006

<table>
<thead>
<tr>
<th>Data Type</th>
<th>SSP Requirements</th>
<th>Exists In DB</th>
<th>Details of available data and data that are still to be collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 High resolution seismic reflection</td>
<td></td>
<td></td>
<td>Primary Line(s): See original for ODP Site 1200 Location</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Crossing Lines(s): See original for ODP Site 1200</td>
</tr>
<tr>
<td>2 Deep Penetration seismic reflection</td>
<td></td>
<td></td>
<td>Primary Line(s): See original for ODP Site 1200 Location</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Crossing Lines(s): See original for ODP Site 1200</td>
</tr>
<tr>
<td>3 Seismic Velocity †</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>4 Seismic Grid</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>5a Refraction (surface)</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>5b Refraction (near bottom)</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>6 3.5 kHz</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>7 Swath bathymetry</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>8a Side-looking sonar (surface)</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>8b Side-looking sonar (bottom)</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>9 Photography or Video</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>10 Heat Flow</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>11a Magnetics</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>11b Gravity</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>12 Sediment cores</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>13 Rock sampling</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>14a Water current data</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>14b Ice Conditions</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>15 OBS microseismicity</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>16 Navigation</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
<tr>
<td>17 Other</td>
<td></td>
<td></td>
<td>See original for ODP Site 1200</td>
</tr>
</tbody>
</table>

SSP Classification of Site:  SSP Watchdog:  Date of Last Review:

SSP Comments:

X = required; X*= may be required for specific sites; Y = recommended; Y** = may be recommended for specific sites; 
R = required for re-entry sites; T = required for high temperature environments; † Accurate velocity information is required 
for holes deeper than 400m.
Do you need to use the conical side-entry sub (CSES) at this site? No
Are high temperatures expected at this site? No
Are there any other special requirements for logging at this site? No

What do you estimate the total logging time for this site to be: 0 minutes

<table>
<thead>
<tr>
<th>Measurement Type</th>
<th>Scientific Objective</th>
<th>Relevance (1=high, 3=Low)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutron-Porosity</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>Litho-Density</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>Natural Gamma Ray</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>Resistivity-Induction</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>Acoustic</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>FMS</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>BHTV</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>Resistivity-Laterolog</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>Magnetic/Susceptibility</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>Density-Neutron (LWD)</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>Resistivity-Gamma Ray (LWD)</td>
<td>No Logging because it is a completely cased borehole</td>
<td>3</td>
</tr>
<tr>
<td>Other: Special tools (CORK, PACKER, VSP, PCS, FWS, WSP)</td>
<td>Replace the existing CORK with a modified CORK II (e.g. ODP Hole 1026B on IODP Expedition 301)</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: Sites with greater than 400 m of penetration or significant basement penetration require deployment of standard toolstrings.
# IODP Site Summary Forms:

Please fill out information in all gray boxes

<table>
<thead>
<tr>
<th>Proposal #: 693 -APL</th>
<th>Site #: ODP Hole 1200C</th>
<th>Date Form Submitted: 3/31/2006</th>
</tr>
</thead>
</table>

1. **Summary of Operations at site:**
   (Example: Triple-APC to refusal, XCB 10 m into basement, log as shown on page 3.)
   Replace the existing CORK with a modified CORK II (e.g. ODP Hole 1026B on IODP Expedition 301)

2. **Based on Previous DSDP/ODP drilling, list all hydrocarbon occurrences of greater than background levels. Give nature of show, age and depth of rock:**
   Methane – typically <4 uM with one sample as high as 18 uM
   Ethane – typically <20 uM with one sample as high as 65 uM
   Based on Mottl et al., 2003, Geochemistry Geophysics Geosystems

3. **From Available information, list all commercial drilling in this area that produced or yielded significant hydrocarbon shows. Give depths and ages of hydrocarbon-bearing deposits:**
   NONE

4. **Are there any indications of gas hydrates at this location?**
   Not in the borehole at ODP Hole 1200C

5. **Are there reasons to expect hydrocarbon accumulations at this site? Please give details.**
   No

6. **What “special” precautions will be taken during drilling?**
   No

7. **What abandonment procedures do you plan to follow:**
   None

8. **Please list other natural or manmade hazards which may effect ship’s operations: (e.g. ice, currents, cables)**
   None

9. **Summary: What do you consider the major risks in drilling at this site?**
   Similar operations were completed on IODP Expedition 301 during which we replaced the original CORK at ODP Hole 1026B with a modified CORK II. The biggest risk is deploying the CORK and making sure that the packer inflates.
IODP Site Summary Forms:

| Proposal #: 693-APL | Site #: ODP Hole 1200C | Date Form Submitted: 3/31/2006 |

<table>
<thead>
<tr>
<th>Sub-bottom depth (m)</th>
<th>Key reflectors, Unconformities, faults, etc</th>
<th>Age</th>
<th>Assumed velocity (km/sec)</th>
<th>Lithology</th>
<th>Paleo-environment</th>
<th>Avg. rate of sed. accum. (m/My)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cased borehole</td>
<td>Bottom of casing at 202.8 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cased borehole with screen