Workshop Report
USSSP-Supported CORK "Mini-Workshop"
May 26, 2004, at Joint Oceanographic Institutions, Inc.

I. Introduction

Following the May 24-25 USSSP-sponsored workshop on Downhole Tools for IODP, a subset of about 35 attendees stayed on for an extra session hosted by JOI May 26 to discuss CORK hydrogeological observatories in IODP. Appendix I lists the agenda and attendees for this CORK mini-workshop. The expected presence of a large majority of CORK-knowledgeable scientists, engineers, and program managers at the Downhole Tools workshop made for an excellent opportunity for CORK discussions at the beginning of IODP, at small added costs. The costs for attendance of most US participants at this added day were covered by USSSP under their guidelines for "mini-workshops." This summary is submitted as the mini-workshop report, with grateful acknowledgement of the added USSSP support and the gracious hosting efforts by JOI.

II. Objectives

In summary, objectives of the CORK mini-workshop were to bring all involved participants (scientists, engineers, program managers) up to speed on various aspects of CORK installations as IODP begins. The discussions were intended to be less formal than those at the Downhole Tools workshop, in the sense that the overall objective was the discussions themselves, rather than production of a formal workshop report with specific recommendations. CORK hydrogeological observatories were an important scientific and engineering contribution of ODP, and a number of new design variations were developed during the final few years of ODP. A primary objective of the mini-workshop was to update all of the attendees on the various design possibilities and experiences in ODP, and then to brainstorm about possible applications in IODP. In addition, as the transition to IODP is being completed, different funding and support models are evolving for support of CORK science and operations, and an important second objective was to at least begin discussions on such issues.

Thus, the focus on the mini-workshop was on informational discussions of technical and programmatic aspects of CORK operations, as opposed to any sort of review of CORK science. The breadth and scope of the latter would be extensive, as is evidenced by the ever-growing bibliography of CORK-related publications compiled as Appendix II to this report.

As summarized in the opening remarks, the specific objectives of the mini-workshop included:

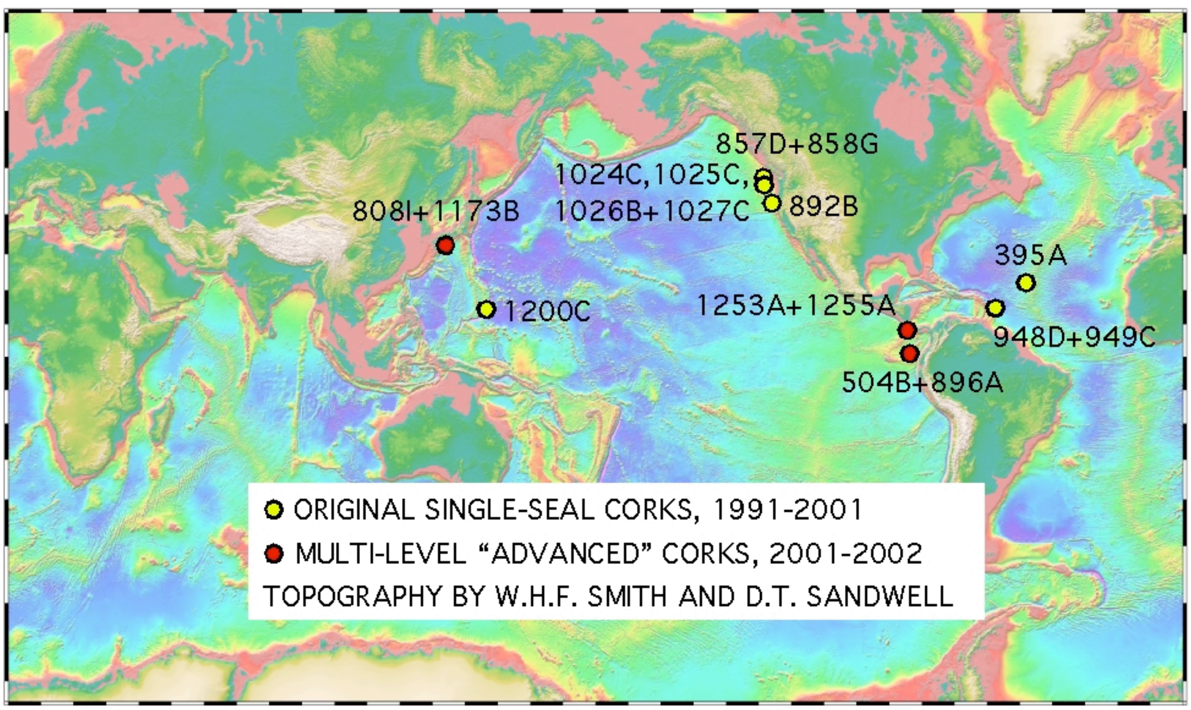
a. neither a review of CORK science and results, nor a complete primer on CORKs
b. compilation of existing CORK designs and bibliography
c. overview of lessons/pitfalls from past experience
d. preliminary suggestions for new IODP CORK models
e. preliminary discussion of possible support models in IODP.

III. Technical Review of ODP CORKs

The morning session was devoted to a review of CORK experience in ODP. This began with a technical overview of the four types of CORKs developed and installed during ODP. These included, in historical order:

1) the original single-seal CORK, comprising a CORK body sealing the top of a standard reentry hole and downhole instrument string hung from CORK body (14 deployed, 1991-2001);
2) the multi-seal Advanced CORK or ACORK, with packers and pressure monitoring lines incorporated on the outside of the casing system (2 deployed in Nankai Trough, 2001);
3) the wireline-deployed instrumented multi-packer system or wireline CORK (2 deployed on the Costa Rica Rift flank from R/V Revelle using the MPL Control Vehicle, 2001);
4) the CORK-II borehole instrument hanger (2 deployed at Costa Rica Trench, 2002, and 4 modified versions planned for Juan de Fuca Ridge flank, 2004).

These represent different design approaches with very different operational scenarios for installation. Technical details are provided in the references listed in section I of the CORK bibliography (Appendix II). Locations of the ODP-era installations are shown in the map below.



Of the installations deployed during the ODP period, the following remain active:

- Middle Valley: 857D CORK monitoring pressures
- Juan de Fuca Ridge flank: 1024C, 1025C, 1027C monitoring pressures, 1026B+1027C to be replaced with modified CORK-II's during IODP Expedition 301

- Mid-Atlantic Ridge flank: 395A monitoring pressures and temperatures
- Mariana Forearc: 1200C CORK instruments pulled in 2003, ready for reinstrumentation
- Nankai Trough: 808I+1173B ACORKs monitoring pressures
- Costa Rica Margin: 1253A+1255A monitoring pressures, osmosamplers to be serviced on the transit after IODP Expedition 301.

The overall success of the CORK efforts in ODP would not have been possible without close coordination and cooperation between scientists/proponents and program engineers and managers. It has also entailed coordinating and to significant extent distinguishing responsibilities (financial and otherwise) for the scientific and operational components of the CORKs. A general principle evolved that the program would support the engineering and procurement costs for the seafloor and subseafloor "infrastructure" whereas scientists would need to obtain support from national ODP funding agencies for the associated scientific instrumentation and post-deployment submersible operations. For the original CORK design, the lines of distinction between ODP program-supported costs and "third-party" science instrumentation costs were straightforward to define: the program provided the reentry hole, including cone and casing, as well as the CORK body, and national ODP funding agencies supported scientists/PI's to (a) provide the scientific instrument strings hung in the CORK body and (b) conduct any required post-deployment submersible operations. In the more recent CORK models, the lines of distinction were more complicated to define, and thus even more careful coordination between program engineers and scientists was required.

This support model continues into the initial phase of IODP. From the perspective of the scientists/proponents, scheduling installation of a CORK in ODP also entailed a dual proposal process, involving both a drilling proposal submitted to JOIDES and an instrumentation plus submersible proposal submitted to funding agencies. Normally the drilling proposal was submitted first to allow time for initial stages of the JOIDES evaluation process; then if that proposal were recommended by JOIDES for scheduling, or appeared close to being scheduled, a proposal to the funding agencies was required for the scientific instrumentation. This aspect also continues into the initial phase of IODP.

As noted above, CORK experiments have involved extensive post-deployment servicing with submersibles, for recovery of long-term data, reprogramming, and instrument servicing. Such submersible operations have been funded not by the program, but by national ODP funding agencies. The magnitude of this investment is indicated by the following tally of 1991-2004 CORK-related submersible operations supported by NSF, IFREMER, and/or JAMSTEC:

- Alvin: 1991, 1993, 1994, 1995, 1997-2002, 2004
- ROPOS: 1992, 2004
- Nautile: 1995, 1998
- Jason/Jason II: 1998, 2003
- MPL Control Vehicle: 1999, 2001
- Kaiko: 2002, 2003
- Shinkai 6500: 2004

After the technical overview, E. Davis led a discussion of some of the lessons learned and pitfalls encountered during the 12-year history of CORKs in ODP. T. Pettigrew commented extensively from the perspective of ODP engineering, and F. Spiess described lessons learned in the development of the wireline CORK.

IV. Programmatic aspects: engineering support, submersible support, funding models

Part of the afternoon session was devoted to a discussion of various issues involved in support of CORK efforts. In IODP, with three implementing organizations (IO's) overseen by IODP Management International (IODP-MI), the IO's may actually have less in-house engineering expertise available to support scientist-driven initiatives like CORKs than was available from the single operator in ODP. IODP-MI is envisioned to include an engineering development function, but IODP-MI is not fully staffed yet and the scope of that function remains to be clarified. C. Ruppel started the discussion by presenting the NSF agency perspective, emphasizing: (a) constraints on the submission and evaluation process for NSF proposals for CORK scientific instrumentation, (b) the need for including in these NSF proposals the appropriate engineering support for instrument construction, operation, and data retrieval, as opposed to relying completely on IO support, and (c) the need for close, early coordination with submersible operators like NDSF in the US.

In subsequent discussion, the value of and need for involvement IO engineers in support of post-installation submersible operations was emphasized. Involvement of IO engineers in these operations is important for feedback and improvement of CORK designs, may be essential in case of unanticipated problems, and may become even more important in future as designs become more complex. Discussion of models for engineering support turned to the possibility of establishing some sort of facility or contractual arrangement for engineering support of CORK design and submersible operations as needed. This discussion was not conclusive, but there was considerable support for the concept and a consensus to continue the discussion as the full management structure for IODP is put into place.

V. New CORK Designs for IODP

Potential new designs or applications of CORKs in IODP were also discussed during the afternoon session. Three such applications had been identified beforehand, and "brainstorming" discussion was led on these as follows:

- Simpler shallow installations in sediments — Harris/Moran
- Hydrates and microbiology installations — Schultz/Paull
- Seismogenic zone configurations — Tobin/Tomomoto

While the first and third would probably be quite different from any existing CORK designs, the consensus was that all three were feasible and should be pursued. This discussion led to the first three of the consensus recommendations described in the following section.

VI. Recommendations

- Quicker, simpler installations in sediments are quite feasible from either the non-riser ship or mission-specific platforms, and this development should be pursued.

- For gas hydrates and microbiology, a modified existing design might be appropriate. Scientific objectives need to be better defined, and a full workshop is recommended to do so plus flesh out design concepts.

- For seismogenic zone monitoring, a completely new design is needed, and this must be integrated with the riser wellhead. Riser wellheads likely to be used on D/V Chikyu make provision for multiple downhole sensor strings and/or pressure-monitoring of multiple zones, so this should be a feasible development.

- Discussion of models for engineering support for CORK design, installation from IODP platforms, and post-installation submersible operations should be continued. These should include (a) ensuring the continued involvement of IO engineers in all aspects, and (b) exploring the possibility of a facility or contractual arrangement for routine engineering support of CORK design and instrumentation across platforms, as well as post-deployment submersible operations.

Appendix I. Summary agenda, presenters or discussion leaders, and attendee list

0815 – call to order, introductions, marching orders	Becker
0830 – brief history	Becker
0845-1030 – technical review	Becker
(CORK, ACORK, CORK-II, wireline CORK plus discussion)	
1100-1215 – lessons learned/pitfalls	Davis/Pettigrew
1215-1315 – lunch	
1315-1415 – programmatic support aspects in IODP	Ruppel
ODP funding model – still current as IODP begins	
engineering support	
submersible support	
data and sample access and issues	
future funding models	
1415-1545 – ideas for new CORKs	
simple installations in sediments	Harris/Moran
hydrates and microbiology installations	Schultz/Paull
seismogenic zone ambitions	Tobin/Tomomoto
1545-1600 – final discussions	
1600 adjourn in time to make evening flights	

Attendees

Jamie Allan	National Science Foundation
Rodey Batiza	National Science Foundation
Keir Becker	University of Miami – RSMAS
Bob Burger	JOI
Earl Davis	Pacific Geoscience Centre, Geological Survey of Canada
Richard Dixon	Integrated Ocean Drilling Program, TAMU
Michelle Edwards	University of Miami - RSMAS
Andy Fisher	University of California, Santa Cruz
Peter Flemings	Penn State University
Dudley Foster	NDSF, Woods Hole Oceanographic Institution
Bill Gwilliam	Dept of Energy
Rob Harris	University of Utah
Martin Heesemann	University of Bremen
Dave Huey	Stress Engineering
Miriam Kastner	Scripps Institution of Oceanography
Masataka Kinoshita	Deep Sea Research Dept., JAMSTEC
Kazushi Kuroki	CDEX, JAMSTEC
Chris Marone	Penn State University
Kate Moran	University of Rhode Island
Rick Murray	Boston University
Charlie Paull	MBARI
Tom Pettigrew	Mohr Engineering
Frank Rack	JOI
Carolyn Ruppel	National Science Foundation
Demian Saffer	University of Wyoming
Derryl Schroeder	Integrated Ocean Drilling Program, TAMU
Adam Schultz	Oregon State University
Liz Screaton	University of Florida
Fred Spiess	Scripps Institution of Oceanography
Ralph Stephen	Woods Hole Oceanographic Institution
Harold Tobin	New Mexico Tech.
Jun Tomomoto	CDEX, JAMSTEC
Bill Ussler	MBARI
Heiner Villinger	University of Bremen
Geoff Wheat	University of Alaska
Bob Woolsey	University of Mississippi

CORK publications – v. 4, August, 2004

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