MEETING OF JOIDES DOWNHOLE MEASUREMENTS PANEL

Atlantic Geoscience Centre
Bedford Institute of Oceanography
Halifax, Nova Scotia
Canada

15-17 October 1991

EXECUTIVE SUMMARY

1. A key feature of this meeting was the joint session with the JOIDES Shipboard Measurements Panel directed at reviewing the current status of the shipboard integration of core and log data. Other important aims were to review the report of the JOIDES Working Group on In-situ Pore Fluid Sampling and to examine special logging needs for upcoming legs.

2. The Panel set a new DMP record on 16 October 1991, sitting from 0830 to 1945 hours, a session which broke the previous record (Townsville, Queensland, 13 October 1990) by 21 minutes.

3. The excellent performance of new tools on Leg 139 was seen as constituting a phenomenal success for the ODP downhole-measurements programme.

4. DMP strongly recommends that the Phase I Strategy for advancing the Geoprops Probe to the status of an ODP Development Tool prior to Leg 146, as outlined by ODP-TAMU, should be progressed as a matter of urgency.

   [DMP Recommendation 91/16 : to ODP-TAMU, Leg 146 Co-chiefs]

5. Panel endorses the Report of the JOIDES Working Group on In-situ Pore Fluid Sampling as modified.

6. A steering group should be formed to direct the implementation of the Working Group Report on In-situ Pore Fluid Sampling. The steering group should comprise representatives of LDGO, TAMU, DMP and SGPP, with a PCOM Liaison. The group should properly represent the areas of geochemistry, downhole measurements, and drilling and tool engineering. The steering group should meet as soon as (OPCOM) funds become available in order to progress the initiative and to contribute to the design of a request for proposals for a feasibility study. It should meet again to evaluate and decide upon the resulting bids. The group should meet a third time to review the output of the feasibility study. The composition of the steering group should be as follows:

ODP-TAMU Representative(s)	(Engineering)
LDGO Representative(s)	(Tool Engineering, Downhole Measurements)
SGPP Representative	(SGPP, Geochemistry)
R. Desbrandes	(DMP, Downhole Measurements)
J. Gieskes	(DMP, Geochemistry)
P.F. Worthington	(DMP, Downhole Measurements)
K. Becker	(PCOM, Downhole Measurements)

Day-to-day supervision of appointed consultants and contractors should be the responsibility of ODP-TAMU.

[DMP Recommendation 91/17 : to PCOM]

7. If gas hydrates are encountered, and it is intended to characterise them, logs should be run as soon as possible after an adequate "rat hole" has been drilled beyond the zone of interest, in order to minimize alteration. The logging suite should include the following tools: temperature, pressure, density, neutron, full waveform sonic, gamma ray, dual laterolog, geochemical (capture and inelastic modes), spherically focused, caliper and FMS. The density-neutron tool combination should be run separately from the sonic to enhance data quality.

[DMP Recommendation 91/18 : to LDGO, Legs 141/146 Co-chiefs]

8. The Japanese Downhole Magnetometer that is scheduled for use on Legs 143 and 144 should be deployed through a separate logging run to ensure safe and secure operations.

9. Panel reiterates its earlier Recommendation 91/7 to the effect that the previously aborted programme of logging at Hole 801C should be carried out around Legs 143 and 144. Panel notes that this is the oldest oceanic crust encountered in the Pacific, that there are indications that the older crust may be geochemically different from younger crust, and that the basement penetration of less than 150 m is not an impediment to the acquisition of useful physicochemical data. Panel also recognizes that failure to log the hole would constitute a lost scientific opportunity.

10. The supplemental science proposal to log Hole 801C should be upgraded from the status of an alternative site to a scheduled site either as part of Leg 143 or 144 or as a stand-alone subprogramme as proposed.

[DMP Recommendation 91/19 : to PCOM]

11. The feasibility study for alternative platforms should consider logging requirements at the outset. In particular, hole diameter should be maintained.

12. A public information brochure on ODP downhole measurements should be produced with the primary goal of educating the technical community. This brochure should draw upon modern graphic-art skills to illustrate vividly the successes of the downhole-measurements programme. There is also a need to inform the lay community. This might be achieved by a separate brochure or preferably by incorporating a downhole-measurements exposition into general ODP public information literature. The latter approach would emphasize logging as an integral part of ODP. The higher priority is the need for technical education.

[DMP Recommendation 91/20 : to LDGO, ODP-TAMU]

13. DMP and SMP agreed that the routine shipboard integration of core and log data is a very high priority and that implementation should proceed as a matter of urgency.

14. In logged holes where the APC has been deployed, the natural gamma log should be run through casing to the surface, to enhance core-log integration.

[DMP Recommendation 91/21 : to PCOM, LDGO]

15. At multi-hole (paleoceanographic) sites logging should be carried out in holes other than the last to be drilled, where there are clear scientific benefits to be gained from so doing. The flexibility to effect these decisions should be an integral part of the shipboard culture.

[DMP Recommendation 91/22 : to PCOM, LDGO, ODP-TAMU]

16. DMP and SMP identified four important areas of activity which have to be optimised if the shipboard integration of core and log data is to be progressed. These are Integration Philosophy and Personnel, Equipment, Reference Depth, and Data Handling. Specific goals and tasks were identified in all four areas.

17. The following critical tasks must be addressed for successful core-log integration in interactive mode on board the JOIDES Resolution.

    (1) Quantify contemporary methods of depth measurement for drillpipe and wireline.

    (2) Refer all depths to the (pipe-tied) gamma log.

    (3) Develop interactive graphics for depth matching.

    (4) Establish a relational database with an adequate structure and administrative mechanism.

    (5) Create the position of Data Correlation Specialist as a member of the scientific party.

    (6) Disseminate information throughout the scientific party in a readily transportable mode.

    (7) Support the related development work currently taking place at TAMU.

[DMP Recommendation 91/23 : to PCOM, LDGO, ODP-TAMU]

18. To facilitate the above recommendation, the following additional recommendation was formulated:

An independent assessment of drillpipe extension and cable stretch should be undertaken conjunctively by LDGO and ODP-TAMU.

[DMP Recommendation 91/24 : to LDGO, ODP-TAMU]

19. Where buoyant spheres have been wired to a re-entry cone, this installation should be recorded and notified to organisations who have indicated that a submersible is to visit that hole.

[DMP Recommendation 91/25 : to ODP-TAMU]

20. Dan Karig is rotating off DMP: a replacement nomination has been forwarded to PCOM.

21. The next DMP meeting is scheduled to take place in Kailua-Kona, Hawaii, during the period 28-30 January 1992.

PAUL F WORTHINGTON
28 October 1991

MEETING OF JOIDES DOWNHOLE MEASUREMENTS PANEL

Atlantic Geoscience Centre
Bedford Institute of Oceanography
Halifax, Nova Scotia
Canada

15-17 October 1991

MINUTES

Present

Chairman:	P.F. Worthington (UK)
Members:	R. Desbrandes (USA) J. Gieskes (USA) M. Hutchinson (USA) P. Lysne (USA) R. Morin (USA) C. Sondergeld (USA) M. Williams (USA) H. Crocker (Canada/Australia) H. Draxler (FRG) J.-P. Foucher (France) O. Kuznetzov (Soviet Union) M. Yamano (Japan)
Liaisons:	K. Becker (PCOM) X. Golovchenko (LDGO) T. Janecek (ODP-TAMU) J. McClain (LITHP)
Guests:	R. Anderson (LDGO) K. Moran (SMP)* J. Pocachard (CEA, France)**
Apologies:	D. Karig (USA) R. Wilkens (USA) N. Balling (ESF) J. Mienert (SGPP) B. Carson (Lehigh Univ)

* Present for agenda items 6(ii) and 17 only.
** Present for agenda item 6(iv) only.

N.B. Agenda item 17 was conducted in joint session with the JOIDES Shipboard Measurements Panel. The minutes pertaining to this item have been agreed jointly.

1. Welcome and Introductory Remarks

The meeting was called to order at 0840 hours on Tuesday 15 October 1991. The Chairman welcomed attendees to the third and final DMP meeting of 1991. A special welcome was extended to the two new panel members who were attending for the first time: Robert Desbrandes, who was replacing Bobb Carson, and Oleg Kuznetzov as the representative of ODP's newest international member, the Soviet Union. Ove Stephansson has resigned from DMP due to work commitments in his new position: he will be replaced by Nils Balling who was unable to attend this meeting.

The Chairman explained that this DMP meeting was being held one month later than usual in order to allow a joint session with the JOIDES Shipboard Measurements Panel whose chairperson, Kate Moran, had not been available in September. This joint session was a key feature of the meeting: it was planned to review the current status of the shipboard integration of core and log data and to identify the best way of progressing the initiative. Other key aims of the meeting were to review the report of the JOIDES Working Group on In-situ Pore Fluid Sampling, to examine special logging needs for upcoming legs, and to review the status of high-temperature downhole-measurement technology.

Review of Agenda and Revisions

The Chairman noted that Dr Jacques Pocachard of the French CEA will be reporting instead of Foucher on the French Sediment Magnetometer (Item 6(iv)). This presentation would take place at 1630 hours on 15 October.

McClain would provide a LITHP liaison report under new agenda item 5(iii): this report would also encompass messages from TECP with whom LITHP had met jointly.

With these modifications the precirculated agenda was adopted as a working document for the meeting.

2. Minutes of Previous DMP Meeting, LDGO, New York, 4-6 June 1991

The following modifications were proposed:

(i) Page 7, Section 5(v), Paragraph 2, Line 2.

Replace "subduction zone off Tasmania" with "Southern Ocean"

(ii) Page 26, Paragraph 4, Line 2.

Replace "leased" with "loaned".

(iii) Page 26, Paragraph 4, Line 4.

Replace "a Sandia tool" with "one of the Sandia tools".

With these modifications the minutes were adopted as a fair record.

Matters Arising

The Chairman reported that he had visited the JOIDES Resolution during the San Diego port call in July. One of the Co-chiefs, Earl Davis, had pronounced himself well satisfied with the status of downhole-measurement hardware that was available for the upcoming Leg 139. The Chairman had also been present in Victoria BC during the port call immediately after Leg 139. It was evident that Leg 139 had been a great success, both generally and from a downhole measurements standpoint.

3. OPCOM Report

The Chairman reported on the meeting of the JOIDES Opportunity Committee (OPCOM), which met in Washington DC on 7 June 1991. The meeting had been convened to examine how an additional $ 2.1 million, recently made available to ODP for FY 92, might be most effectively used to progress technological developments that are needed to pursue the scientific goals of the ODP Long Range Plan (LRP). This additional sum was seen as a "step" rather than a "spike" in funding and, as such, OPCOM extended their deliberations to include FY 93.

OPCOM recognised that the development of the Diamond Coring System (DCS) was critical for the attainment of LRP goals and that this should receive priority. Other important targets required the development of key downhole tools, in particular a slimhole high-temperature resistivity tool and an in-situ pore fluid sampler, and the incorporation into ODP of alternative platform(s).

OPCOM recommended the following apportionment of expenditure in decreasing order of priority.

		$ million FY 92	$ million FY 93
1.	Diamond Coring System	1.675	as needed
2.	High-temperature Resistivity Tool	0.150	0
	In-situ Pore Fluid Sampler	0.175	0.175
3.	Feasibility of Alternative Platforms	0.100	?

The Chairman noted that the Minutes of the August 1991 PCOM meeting were contradictory. On the one hand, they agreed with the DMP Chairman's recollection of the above priorities. However, the Minutes also stated that the OPCOM recommendations (other than DCS) were not in priority order. The distinction is important because PCOM modified the lower OPCOM "priorities", which are not listed here, to include a recommendation for $ 0.1 million to be spent on a deep drilling feasibility study in each of FY 92 and FY 93. Clearly, if admitted, such an expenditure would impact on the apportionment of funds for the higher priorities listed.

4. PCOM Report

Becker reported that he had not been present at the August 1991 meeting of PCOM, having sailed on Leg 139, and therefore he could only convey what was contained in the PCOM draft minutes. Four DMP Recommendations had been put forward for discussion by PCOM.

Rec. No.	Description	PCOM Response
91/10	Testing of Geoprops Probe during Leg 141	Geoprops is not ready but the Motor-driven Core Barrel (MDCB), essential for Geoprops deployment, is ready and will be tested on Leg 141.
91/12	Proper casing of re-entry holes to facilitate logging	Discussed in the context of the need for an increased number of re-entry holes. Proposals are needed for specific sites. Logging-friendly completions need to be specified prior to drilling.
91/13	Casing of deteriorated re-entry holes in North Atlantic	
91/15	Logging during Leg 140 if Hess Deep	Convey to Co-chiefs

Other DMP recommendations had been made implicitly through PCOM to other parts of the ODP network.

91/11 (LDGO)	Minimum tool masses	Included within 3rd party tool guidelines
91/14 (LDGO)	High-T memory temperature tool for Leg 139	Loaned by Sandia

Becker reported two other major items.

The Geoprops Probe is scheduled for Leg 146 but it is not ready for testing on Leg 141. A development plan is emerging which might allow testing on Leg 143 (see Item 6(i)).

Three supplemental science proposals were received, only one of which (logging at 801C in old Pacific crust) satisfied the time specifications. This proposal was not accepted but relegated to the status of an alternative site for Legs 143 and 144. The practice of supplemental science is to be discontinued but proposals for short studies will still be welcomed.

The Chairman thanked Becker for his report which had been based solely on the PCOM minutes. The PCOM discussion of DMP Recommendations 91/12 and 91/13 had not focused on the specific issues but had digressed to a more general, and not altogether relevant, discourse. Although this perception had been exacerbated by the temporary liaison problems, there is a need for some sharpening of the rapport between PCOM and DMP. The Chairman will talk to other service panel chairs to see if the problem is generic.

[ACTION: WORTHINGTON]

5. **Liaison Reports**

(i) TEDCOM

The Chairman reported on the meeting of TEDCOM held in Victoria BC during the period 11-12 September 1991. This report is attached as Annexure I.

(ii) KTB

Draxler reported that the main hole had reached a depth of 4512 m. Current diameter is 14.75 inches. Bottom-hole-temperature is 116°C, which is less than that at 4000 m in the nearby pilot hole. This disparity is attributed to hole cooling while drilling. A Schlumberger gyro log has confirmed that the hole is very close to vertical (maximum inclination 1.6°). The Eastman-Christensen vertical drilling system should be deployable until about 6000 m if temperature and hole-cooling estimates are reliable.

Since the main hole is now deeper than the pilot hole, coring has recommenced. Five cores have been recovered within the depth range 4149-4457 m. Average core length was 8.6 m: average recovery was 3.7 m (43%).

Logging is currently being undertaken. The suite includes the (ODP) standard logs plus fluid sampling, induced polarization and self potential tools, among others. The formation micro-imager is being run instead of the FMS. The DMT BHTV tool has been withdrawn because it does not produce useful results under the prevailing conditions. The signal would be reduced by a factor of 6-7 in a 14.75 inch hole with Dehydril/Hostadrill mud. There is no viable alternative that satisfies technical and fiscal needs.

The hydrofrac experiment was unsuccessful and has been terminated. A new experiment is being proposed. A three-month production test is being run in the pilot hole to sample fluids: production rate is 5-7 litres/minute.

ODP and KTB held a joint meeting in Hannover on 24-25 July 1991 to discuss possible collaboration in the area of high-temperature logging. Another joint meeting is scheduled for June 1992, immediately following the proposed DMP meeting in Windischeschenbach.

(iii) LITHP

McClain reported on the joint meeting of the JOIDES Lithosphere and Tectonics Panels held in Cyprus during the period 9-11 October 1991. LITHP ranking of the North Atlantic Prospectus was:

(1) Trans-Atlantic Geotraverse (TAG)
(2) North Atlantic Rifted Margins - second leg of volcanic programme
(3) Offset Crustal Drilling
(4) North Atlantic Rifted Margins - first leg of non-volcanic programme
(5) Vicap - Gran Canaria

LITHP endorsed the OPCOM priorities including the PCOM addendum, the deep drilling feasibility study. However, LITHP recognized that this study would merely indicate time-scale and costs, rather than provide solutions and exact cost estimates.

LITHP considered that logging at 801C in the old Pacific crust merited sacrificing 3 days worth of LITHP goals during the Atolls and Guyots legs.

There was concern that the Geoprops Probe might not be ready for Leg 146 (Cascadia). In addition to a general fluid sampling capability, LITHP wanted to see a capability for pore pressure, temperature and permeability. It was recognized that this capability already exists in various forms. However, there needs to be tight control where third party tools are involved.

McClain concluded by stating that a liaison from TECP to DMP was evidently needed. The Chairman responded by reminding the Panel that DMP had previously recommended such a liaison (DMP Recommendation 90/14) but that this recommendation had not been accepted by PCOM on the grounds that a liaison was not in the mandate of TECP (DMP Minutes, October 1990, Page 3). Any new initiative ought to come from TECP. McClain undertook to contact TECP Chairman with a view to progressing the liaison issue.

[ACTION: McCLAIN]

6. Tool Monitor Reports

(i) Geoprops Probe

The Geoprops Probe is scheduled for deployment on Leg 146. The discussion was disadvantaged by the unavoidable absence of Bobb Carson (Leg 146 Co-chief) and Dan Karig (Geoprops Proponent). The Chairman summarized recent events based on material received from PCOM, ODP-TAMU, Carson and Karig. A detailed report by ODP-TAMU on the feasibility of continued development of the Geoprops Probe is appended as Annexure II.

The chronological summary is as follows.

(1) In designing the Geoprops Probe, Karig has created an ingenious device which can be made to work. In order to bring the tool to fruition, there is a need for engineering input at the consultancy level.

(2) Bench tests carried out at TAM, Inc., on 26 June 1991 revealed three residual problems, two of which have already been rectified.

(3) TAM, Inc., consider that they have now discharged all their contractual obligations.

(4) ODP-TAMU engineers consider that several further tests are needed before the Geoprops Probe can be accepted as an ODP Development Tool, in accordance with DMP's guidelines for third-party tool development, for deployment on Leg 146.

(5) PCOM have reaffirmed (August 1991) the critical importance of the Geoprops Probe, or a comparable tool, as an integral part of scientific planning. PCOM have recommended that OPCOM funds be made available as soon as practicable to further this aim.

(6) OPCOM funds are unlikely to become available before January 1992.

(7) Geoprops has to operate in conjunction with the MDCB. This aspect of the operation can only be tested at sea. These sea trials should take place at least two legs prior to Cascadia (DMP Recommendation 91/2).

(8) ODP-TAMU have proposed a two-stage development plan for Geoprops, one phase to bring it to the status of "ODP Development Tool" and the second to progress it further to the status of "ODP Mature Tool", as per DMP guidelines. It is necessary to complete Phase I prior to Cascadia.

(9) Phase I would consist of testing, modifications, and preparation of support equipment, spares and documentation. This work would be the responsibility of ODP-TAMU but, in order to minimize its impact on in-house engineering manpower, it would be undertaken largely by an external consultant. Modifications to the two existing tools would be minimized. The objective would be to have sea trials on Leg 143 (4 MDCB/Geoprops runs would require two days of ship time, but might contribute to the scientific objectives of that leg) and operational deployment on Leg 146. The cost of this phase, excluding ODP-TAMU staff time, is estimated at $ 33 000.

(10) In order to complete Phase I in time for Cascadia, ODP-TAMU must have funding approval no later than 1 November 1991. Bobb Carson is looking at ways of securing the funding within this time-frame.

On the basis of this exposition, Panel made the following recommendation.

DMP Recommendation 91/16

"DMP strongly recommends that the Phase I Strategy for advancing the Geoprops Probe to the status of an ODP Development Tool prior to Leg 146, as outlined by ODP-TAMU, should be progressed as a matter of urgency."

The Chairman re-emphasized that Geoprops needs a functioning MDCB before it can be deployed. Until the MDCB is declared fully functional, Geoprops cannot be construed to have delayed the programme. However, once MDCB is declared functional, an uncompleted Geoprops would delay the programme from that point onwards.

(ii) <u>LAST</u>

Moran reported on the Phase-1 tool, which measures pore pressure and provides an estimate of lateral stress. The tool is deployed as a shoe on the APC and XCB: it can only be used during APC and XCB operations. The tool is awaiting replacement parts. It will be ready for Cascadia.

The Phase-2 LAST tool is similar to a pressure meter. It measures pore pressure and true lateral stress. It allows shear-strength and shear-modulus parameters to be determined in situ. The tool is pushed ahead of the bit and it might be possible to deploy it beyond the APC/XCB range. One component has failed during laboratory storage. The tool has only been subjected to land tests. It is hoped to test it at sea during the Chile Triple Junction leg (141) prior to its proposed deployment at Cascadia.

Moran noted that the Adara temperature tool, which performed so well during Leg 139, was developed by modifying the basic design of LAST. This is a clear benefit to industry.

(iii) BGR Borehole Magnetometer

Draxler reported that work on the tool has recommenced. Tool diameter is 3.625 inches. A redesigned sensor, which allows a faster logging speed, is internally rated to 125°C. The tool is dewared to withstand an environmental temperature of 260°C for 10 hours without the internal temperature exceeding 120°C. Final tests will take place in about 5 weeks' time. The tool should be ready for ODP deployment in 3-4 months. Draxler enquired about the opportunities for incorporating the tool into an upcoming ODP leg. Golovchenko will investigate.

[ACTION: GOLOVCHENKO]

(iv) French Sediment Magnetometer

Jacques Pocachard of the French CEA, one of the organisations involved in the development of a high-resolution sediment magnetometer, reported on progress to date. The tool has two components, each of which can be run separately. One tool (SUMT) uses an electromagnetic sensor to measure susceptibility. The other (NRMT) is a scalar magnetometer which measures total induction (remanent and susceptibility effects). Both tools are 9.3 cm in diameter, are rated to 125°C, and are run with a logging speed of 0.15 - 0.30 m/second. Data processing draws upon information about the prevailing earth's field from a nearby reference station, which is best sited on land. The output is natural remanent magnetisation which can be used to study reversals.

Pocachard presented examples of the tool's deployment in different geological provinces. Panel encouraged these developments and the Chairman thanked Pocachard for taking the time out to address DMP.

(v) Japanese Downhole Magnetometer

Yamano reported that tool development had been contracted and it was believed that the tool would be ready for Legs 143/144. The tool is housed in three pressure cases for battery, electronics and sensor. It is 3.5 m long, 67 mm in diameter and has a mass of 65 kg. The tool is a memory device and is intended to be run at the bottom of a Schlumberger tool string.

Golovchenko reported a concern that the tool is not sufficiently strong to support the weight of a (long and heavy) standard Schlumberger tool string. The wall of the pressure casing is not very thick and, if the tool should hit the bottom of the hole or it should be necessary to punch through bridges, there is a risk of the magnetometer bending and the entire Schlumberger string being lost.

Yamano said that according to the manufacturers, the tool can withstand 4 tonnes load. It was pointed out that an earlier version of this tool had been attached to a BHTV. Would that obviate the problem?

Golovchenko responded that we now lease BHTV tools and it is imperative that these are not put at risk. She suggested that the magnetometer be run separately.

Panel considered that the issue reduced to one of safety and that risk should be contained as far as possible.

DMP Consensus

The Japanese Downhole Magnetometer that is scheduled for use on Legs 143 and 144 should be deployed through a separate logging run to ensure safe and secure operations.

(vi) Flowmeter

Morin reported that the problem with packer deflation experienced on Leg 137 has been solved. The tool worked well on Leg 139. It is out on the ship now for deployment in Hole 504B. It is proposed to deploy the tool again at Cascadia (Leg 146).

In closing the discussion on tool developments, the Chairman noted varying degrees of compliance with the ODP Guidelines for Third Party Tools. It was proposed to re-examine this question in detail at the next DMP meeting. In the meantime Panel were reminded that if they become aware of any new third-party tool concept that might advance the cause of ODP downhole-measurement science, they should present this to the Panel for discussion and evaluation at an early date, in order to allow maximum time for development and thence compliance with the guidelines.

7. Operations Report : Legs 138 - 140

Golovchenko, Janecek (who had been on Leg 138) and Becker (Leg 139) reported on operational aspects of these three legs.

Leg 138 was the first leg in a tectonically active area with sufficient boreholes to evaluate directional stress differences between three plates. The elliptical form of the holes due to differential stress allowed principal stress directions to be delineated.

Leg 138 was also a milestone for core-log integration, driven by Tom Janecek. The leg set a record for core recovery. It was noted that the density log recorded a lower density than GRAPE. Since this is the opposite effect to swelling, and one would expect GRAPE to err on the low side due to core stretching, a GRAPE calibration error is suspected. It was noted that the difference between the log and GRAPE densities increases as calcium content decreases. Data calibration of logs and MST is a prerequisite for effective core-log integration.

Leg 139 had been in the minds of DMP since the Panel met jointly with LITHP in 1989. At that meeting, temperature measurement in high-temperature environments was identified as a prerequisite for the success of legs with hydrothermal objectives. At the June 1991 meeting of DMP, just one month before Leg 139, it was not clear that we would have an adequate temperature tool. In fact, following a flurry of activity, the ship sailed with five tools. All of these performed well and thanks were due to all contributors, Peter Lysne at Sandia, JAPEX, etc. The Panel's role in aggressively focusing on these tool requirements had also had a key impact.

More specifically, the temperature tools that sailed on Leg 139 were (with their ratings): JAPEX PTF Sonde (375°C), Sandia GRC Temperature Sonde (400°C), BRGM Tool (500°C), Comprobe PFC Tool (125°C) and a Kuster Mechanical Temperature Tool (375°C).

The performances of new tools deployed on Leg 139 were as follows.

Tool	Memory (M) or Wireline (W)	Success Ratio
Sandia GRC Temp	M	11/11
JAPEX PTF	W	8/8
Adara APC Temp	M	22/24
Strengthened WSTP	M	~15/20
Comprobe Flowmeter	W	2/2
GRC Pressure (Packer)	M	5/5
LANL Fluid Sampler	M	1/1
Instrumented Seals	M	2/2

Becker stated that this performance constituted a phenomenal success for downhole measurements and that it should be promoted as such.

No excessively high temperatures were recorded during Leg 139, primarily because of hole cooling. The maximum temperature encountered was 260°C. There were no H_2S problems. The packer/flowmeter system worked well. GLT and FMS data were recorded in a giant sulphide body discovered during Leg 139: this discovery had aroused great interest among Canadian geoscientists as evidenced at the Victoria port call. In other respects there were some problems with Schlumberger logging because of the absence of a wireline heave compensator. The FMS stuck twice: one of these incidents necessitated cutting the vector cable.

At Hole 858F one of the successful deployments of the Sandia GRC tool saw the tool break off, feared lost. The tool was recovered 20 hours later. This outcome proved highly opportune because the tool has 20 hours of preprogramming and was able to record temperature build-up over this period. Environmental temperature rose from 60°C to 180°C: the temperature of the electronics rose from 15°C to 80°C.

The Comprobe Flowmeter Tool measured a downflow of 10 000 litres/minute in Hole 857D. A log of flowmeter count with depth in hole showed that all this water is entering one 5 m interval of high permeability.

At Hole 858G a temperature log run prior to sealing measured 200°C at a depth of 20 m below sea floor. This feature was ascribed to hot water flowing laterally, most likely to nearby vents. At greater depths there was hole cooling because of water being sucked down to a permeable basement.

Borehole seals were emplaced on Holes 857D and 858G. Both were visited 20 days later by ALVIN to recover data in the form of a depth log of temperature. It was found that 857D was still recovering from the hydrothermal disturbance caused by drilling. Little temperature change with time was seen at Hole 858G because a nearby pilot hole in hydraulic contact with 858G was sucking fluids from the ocean. Becker showed Panel a video of this visit.

A message from Leg 139 is that memory tools were preferred to wireline tools for temperature measurement because they avoid the time to rig up for logging. This is relevant to planning for the East Pacific Rise (EPR).

Interesting temperature data have been recovered from Hole 504B as part of the current Leg 140. A comparison with temperature data obtained on Legs 111 and 137 show that the hole has changed from sucking fluids to not sucking. This provides some insight into the nature of variations in hydrothermal activity.

As regards the speciality tools on Leg 140, there are two BHTVs (one of conventional diameter, the other slimhole) and the temperature tools include the BRGM tool rated to 500°C. Both FMS tools have been damaged, one on Leg 139, the other during Leg 140. The latter incident was related to the high temperature at 504B. The Chairman has written to Schlumberger asking that the repairs to the FMS be given the highest priority.

8. Logging Contractor's Report

Golovchenko reported that advertisements had been placed for a Chief Project Scientist to replace Rich Jarrard. The FY92 budget makes provision for three new positions (reflecting the much greater use of log data by the community), computer hardware and software, developing the high-temperature (350°C) resistivity tool, and a Schlumberger workstation upgrade. MAXIS will not be acquired until FY 93. High-temperature (350°C) logging cable and the BRGM high-T (500°C) temperature tool have been acquired. LDGO has run up a $ 150 000 deficit over the past two years. Part of the problem has been that most of the annual increase in budget is absorbed by Schlumberger price increases leaving the LDGO BRG portion effectively flat. The new budget (FY 92) is better. A Performance Evaluation of the logging contractor has recently been made: this was the third since ODP began.

An ODP "retreat" involving NSF, JOI, JOIDES, TAMU and LDGO is to be held in two weeks' time with the object of establishing a four-year programme of technical development. Golovchenko asked what DMP would require.

The Chairman had not been approached for input to the retreat. DMP's needs had been stated frequently and they relate to the downhole-measurements technology required to achieve the goals of the LRP. They are high-temperature logging, slimhole logging and pore fluid sampling. The fusion of two of these into high-temperature slimhole logging is very much tied to the success of the DCS. The introduction of the MAXIS data acquisition, storage and processing facility might necessitate some changes to the tool strings. Cooperative efforts with industry and with other programmes should be sought.

Anderson gave his views of how the world had changed since ODP was initiated. It was necessary for ODP and its constituent groups to respond positively to these changes because they provide opportunities for us to do things better. Anderson provided a forward view of the ODP downhole measurements programme and how it might be carried out. This view generated much Panel discussion.

To take matters further, the Chairman proposed the following course of action.

On or before 16 November 1991 Panel Members should send to Anderson their views on and input to his forward vision.

[ACTION: PANEL]

Anderson will then use this material in drafting a white paper that encompasses his forward vision.

[ACTION: ANDERSON]

DMP Chairman will liaise with Anderson from 16 December 1991 onwards to progress the draft white paper to an agreed stage.

[ACTION: WORTHINGTON]

The revised draft will be circulated to DMP members prior to the January Panel meeting. Members will then be asked to provide their comments on the text.

[ACTION: PANEL]

The Chairman thanked Anderson for accepting the invitation to set out these views and for doing so in a way that had stimulated so much Panel interest. He looked forward to working with Anderson on the white paper.

9. JOIDES Working Group on In-situ Pore Fluid Sampling

Panel reviewed the Report of the JOIDES Working Group on In-situ Pore Fluid Sampling, which met in Houston, Texas, on 23 August 1991. A number of modifications were proposed. The revised document, as endorsed by the Panel, is attached as Annexure III.

DMP Consensus

Panel endorses the Report of the JOIDES Working Group on In-situ Pore Fluid Sampling as modified.

Panel discussed the implementation of the Report. A particular concern was that the views of the scientific community should be input continuously as the project evolved. To this end, Panel recommended the following course of action.

DMP Recommendation 91/17

"A steering group should be formed to direct the implementation of the Working Group Report on In-situ Pore Fluid Sampling. The steering group should comprise representatives of LDGO, TAMU, DMP and SGPP, with a PCOM Liaison. The group should properly represent the areas of geochemistry, downhole measurements, and drilling and tool engineering. The steering group should meet as soon as (OPCOM) funds become available in order to progress the initiative and to contribute to the design of a request for proposals for a feasibility study. It should meet again to evaluate and decide upon the resulting bids. The group should meet a third time to review the output of the feasibility study. The composition of the steering group should be as follows:

ODP-TAMU Representative(s)	**(Engineering)**
LDGO Representative(s)	**(Tool Engineering, Downhole Measurements)**
SGPP Representative	**(SGPP, Geochemistry)**
R. Desbrandes	**(DMP, Downhole Measurements)**
J. Gieskes	**(DMP, Geochemistry)**
P.F. Worthington	**(DMP, Downhole Measurements)**
K. Becker	**(PCOM, Downhole Measurements)**

Day-to-day supervision of appointed consultants and contractors should be the responsibility of ODP-TAMU."

Panel acknowledged the contribution of Dave Huey of ODP-TAMU who had co-convened the working group meeting with DMP Chairman.

10. Log Data Acquisition, Processing and Distribution

This agenda item is a subset of the discussions under Item 8. It was decided to defer this item to the next DMP meeting when the white paper defining the "big picture" should be available.

11. Legs 141 - 147

Janecek introduced the upcoming Pacific programme in terms of the downhole-measurement schedule.

(i) Leg 141 - Chile Triple Junction

The logging programme essentially comprises the standard strings (including FMS). A downhole temperature of 200°C has been predicted on the Northern Transect. The BRGM high-T temperature tool will be run here to determine bottom-hole temperatures before running the Schlumberger string. BHTV is scheduled for the alternative site SC-6. The Motor-driven Core Barrel (MDCB) and Sonic Core Monitor Phase 2 (SCM) will be tested during this leg. The SCM was land-tested last week and worked well. The Pressure Core Barrel (PCB) will be used to sample gas hydrates.

(ii) Gas Hydrates

Gas hydrates are anticipated on Legs 141 and 146. DMP recommended the following logging strategy for characterising gas hydrates. This strategy is based on standard logs.

DMP Recommendation 91/18

"If gas hydrates are encountered, and it is intended to characterise them, logs should be run as soon as possible after an adequate "rat hole" has been drilled beyond the zone of interest, in order to minimize alteration. The logging suite should include the following tools: temperature, pressure, density, neutron, full waveform sonic, gamma ray, dual laterolog, geochemical (capture and inelastic modes), spherically focused, caliper and FMS. The density-neutron tool combination should be run separately from the sonic to enhance data quality."

(iii) Leg 142 - Engineering/East Pacific Rise

The aim is to test the Phase 2 version of the DCS.

(iv) Legs 143 & 144 - Atolls and Guyots

The pre-cruise meeting is scheduled for the week of 28 October 1991. In basement holes the digital BHTV and the Japanese Downhole Magnetometer are scheduled in addition to the standard string. Where there is no basement penetration, only the standard string will be run.

The Chairman referred to DMP Recommendation 91/5 which had proposed one check-shot VSP per leg, to enhance the tie to seismic, and selective deployment of an enhanced geochemical tool for sediment characterisation. It was understood that an enhanced geochemical tool will not be available, but what about the VSP? Golovchenko undertook to raise this matter at the pre-cruise meeting.

[ACTION: GOLOVCHENKO]

(v) Hole 801C - Old Pacific Crust

Although it was recognized that DMP is an advisory and not a thematic panel, Panel members wished to reinforce their earlier position vis-a-vis logging at 801C.

DMP Consensus

Panel reiterates its earlier Recommendation 91/7 to the effect that the previously aborted programme of logging at Hole 801C should be carried out around Legs 143 and 144. Panel notes that this is the oldest oceanic crust encountered in the Pacific, that there are indications that the older crust may be geochemically different from younger crust, and that the basement penetration of less than 150 m is not an impediment to the acquisition of useful physicochemical data. Panel also recognizes that failure to log the hole would constitute a lost scientific opportunity.

DMP Recommendation 91/19

"The supplemental science proposal to log Hole 801C should be upgraded from the status of an alternative site to a scheduled site either as part of Leg 143 or 144 or as a stand-alone subprogramme as proposed."

(vi) Leg 145 - North Pacific Transect

The logging programme comprises the standard suite for all except the shallow holes. BHTV is scheduled for basement sites. The French high-magnetic-resolution sediment magnetometer is scheduled for this leg.

(vii) Leg 146 - Cascadia

This discussion was disadvantaged by the fact that Bobb Carson, one of the Co-chiefs, had had flight problems on his way to the meeting and was unable to attend. Standard logging is scheduled for all holes as is WSTP (6 runs per hole). Three holes (VI-5, OM-3, OM-3A) are targeted for BHTV, VSP, Geoprops (as alternative to the non-functional wireline packer), drillstring packer, and cone plug. VSP is also programmed for Hole VI-2d. Contingency time exists for other downhole measurements, e.g. LAST. The flowmeter tool will be run as part of the packer deployment. It was pointed out that the rotatable packer is no longer on the ship. The straddle packer is intended for cased holes only: a question was raised as to whether this will be improved/modified for uncased holes. Panel had no information on the status of Greg Moore's proposal for funding an extra ship for offset VSP. The Chairman undertook to contact Bobb Carson to clarify.

[ACTION: WORTHINGTON]

(viii) Leg 147 - East Pacific Rise or Hess Deep

The logging plan for Hess Deep should be the same as that already adopted for 504B. In addition to standard logs, BHTV, packer/flowmeter, high-T temperature, dual laterolog and magnetometer/susceptibility should be included in the programme for all sites.

(ix) Fluid Sampling

The Chairman raised the question of a short-term fluid-sampling strategy to be adopted until the Working Group report can be implemented. The favoured strategy was as follows.

(1) Soft rocks: squeeze cores and verify by WSTP and/or Geoprops if available.

(2) Hard rocks: top-hat deployment of Schlumberger or alternative formation testing tool with packer (as opposed to doughnut) sampling module.

12. North Atlantic Prospectus

Golovchenko reported that 11 proposals had been sent out to thematic panels for review. An additional proposal that is not in the prospectus relates to the Cretaceous-Tertiary boundary in the Carribean. The November meeting of PCOM will develop a leg structure for FY 93. It is important to identify logging input before detailed schedules are specified. An initial logging prospectus for the North Atlantic is attached as Annexure IV. The following specific points were noted by the Panel.

(i) Alboran Basin and Atlantic-Mediterranean Gateway

Proposed as a two-leg expedition. Good log-log and core-log correlation needed (via natural gamma and susceptibility).

(ii) Mediterranean Ridge

Detailed programme of downhole measurements, similar to Leg 146 (Cascadia). There is likely to be a high salt concentration in the accretionary prism. Kuznetzov suggested using a Russian 16-transmitter/receiver sonic array stress tool to investigate stress-strain relationships. This tool is being used in deep continental drilling in the Soviet Union. Kuznetzov will send the Chairman a description of the tool for circulation to Panel members so that the proposal can be discussed at the January meeting of DMP.

[ACTION: KUZNETZOV]

(iii) Eastern Equatorial Atlantic Transect

Logging times have been calculated assuming deployment of the side-entry-sub (SES). The LAST tool would contribute to the scientific aims of this leg.

(iv) New Jersey Sea Level

Proposal is concerned with eustatic changes in sea level. Crocker noted that Leg 133 might provide messages concerning the most effective downhole-measurements contribution to the scientific goals, despite the differences between carbonates and clastics. He undertook to evaluate and report back.

[ACTION: CROCKER]

New Jersey Sea Level would require an alternative platform. A feasibility study is to be commissioned by ODP. Panel expressed concern that the feasibility study would not take account of the systemic culture that is being fostered in ODP, namely that drilling, coring and logging are parts of a coupled investigative system and that they contribute interactively to the scientific goals.

DMP Consensus

The feasibility study for alternative platforms should consider logging requirements at the outset. In particular, hole diameter should be maintained.

(v) TAG Hydrothermal Field

Logging programme would be comprehensive. Standard logs would be run assuming that borehole temperatures are less than 150°C. The DCS would be deployed. Panel needs to monitor closely the development of a reaming capability. The high-temperature resistivity tool should be deployed. Some re-entry holes will be drilled and possibly fitted with instrumented seals.

(vi) VICAP Gran Canaria

FMS is essential to the success of the proposal. High-resolution magnetometer/susceptibility logs would be useful.

(vii) Ceara Rise

High-resolution susceptibility tool should be run.

(viii) Mediterranean Sapropel Drilling

No specific drill sites identified as yet.

(ix) North Atlantic-Arctic Gateways

At least a two-leg proposal. Logging-time estimates assume that the SES will be deployed.

(x) North Atlantic Rifted Margins

At least four legs would be needed. The well seismic tool (WST) and LAST should be run. Panel noted that MAXIS will not support the WST.

(xi) Offset Drilling

BHTV is recommended at all four sites: VSP at MK1 and MK2.

The Chairman advised Panel members that the North Atlantic drilling programme would also feature on the agendae of subsequent DMP meetings so that the logging programme might be tuned to the evolving drilling schedule.

13. High Temperature Technology

(i) Temperature/Pressure

The BRGM high-T temperature tool is at LDGO and will be out on Leg 141 (Chile Triple Junction). LDGO now has a 1 km length of high-T cable rated to 350°C and designed to be used with the BRGM tool. This cable will be joined by torpedo to the standard wireline cable. The 350°C cable temperature rating is the upper limit for tool deployment even though the tool itself is rated to 500°C. The tool and cable together with a ceramic cablehead connection will be land-tested in a California geothermal field prior to shipboard deployment.

(ii) Resistivity

LDGO have JOI approval to go ahead with a development contract with the Camborne School of Mines, UK. The tool is scheduled for completion in September/October 1992.

(iii) Borehole Fluid Sampler

Lysne reported on a proposal he had submitted to the US DoE in August for a slimhole (non-leaky) memory tool rated to 400°C. The DoE response was expected shortly.

(iv) Test Facilities

Morin reported that the USGS geothermal operations on the big island of Hawaii had been discontinued due to a blow-out. These wells therefore no longer constituted an option for testing high-temperature tools and cable.

14. Technology Review - Measurement-while-Drilling

Hutchinson reviewed the current status of measurement-while-drilling (MWD) technology for formation evaluation, variously described as formation-evaluation-while-drilling (FEWD) or logging-while-drilling (LWD). MWD was one of the technologies identified in the COSOD II white paper as having a potential future input to ODP.

A downhole MWD system essentially has four components: transmitter, power, memory and sensors. The sensors can include: pressure, temperature, gamma ray, resistivity, neutron porosity, density, photoelectric factor and (acoustic) caliper. There are also directional sensors and sensors near the drill-bit for weight-on-bit and bit torque. Temperature ratings are typically 175°C.

MWD logging systems are essentially memory tools. Therefore MWD records on an equal time basis, not equal depth. The data can be converted to equal depth subsequently.

Comparisons of data from different MWD and wireline companies with core data have furnished generally fair agreement although there are various disparities. MWD precision is lower than wireline precision (e.g. MWD density ± 0.035 g cm^{-3}: wireline density ± 0.02 g cm^{-3}) but when other factors are considered (e.g. invasion conditions, borehole effects) the difference may not be so important.

Future developments include:

(1) pore pressure measurement;
(2) acoustic travel-time sensors;
(3) seismic measurements (VSP/geosteering)
(4) smaller tools (4.75 inches diameter compared to the present 6.75-7 inch collars);
(5) fast two-way transmission

A feature of this scenario might be joint funding to look at generic problems, e.g. caliper measurement and vibration control.

MWD tools could be repackaged into slimhole memory units. However, MWD is unlikely to make an impact on ODP until data can be provided in real time to indicate when drilling targets have been reached. In the meantime ODP will continue to monitor developments through the LDGO membership of the Conoco-led industry MWD consortium.

15. Publicity Brochure

The Chairman reported on discussions he had had with the Public Information Coordinator of ODP-TAMU, Karen Riedel. An ODP initiative, currently in abeyance, has the objective of producing a P.R. brochure on ODP downhole measurements that can be distributed beyond the ODP community, e.g. to industry. The initiative has had the support of the Borehole Research Group of LDGO. There was a feeling in TAMU and LDGO that this might be an appropriate time to pursue the initiative actively so that a brochure could be produced to support the renewal process. However, in order to guide the initiative, certain key questions have to be answered first. These questions are

(i) Why is the publication necessary?

(ii) What would be its goal?

(iii) Who would be the audience?

(iv) What would be its size, scope and demographics?

Panel was invited to evaluate the proposal in these terms.

Panel considered that the most pressing need was to inform and educate the technical community both within and outside ODP. Although considerable effort had been expended by the logging contractor in the form of logging schools, and several key publications had been generated through the Panel's efforts, there was still much progress to be made. This is an important need because the ODP downhole measurements effort is highly professional and there should be general awareness of the ODP's technical capability in this area and of the resulting successes. A clear goal is to promote logging as an integral part of the culture of pure and applied earth science.

Panel identified several technical groups who would benefit from an increased awareness of ODP downhole-measurements capability.

(a) ODP (non-logging) shipboard scientists, who generally do not have succinct information on the rationale behind the downhole-measurements programme.

(b) ODP thematic panel members. Most proposals do not tie the logging capability to the science, merely citing the need for "standard logging". Members of the thematic panels should be in a position to relate logging opportunities to each proposal, e.g. those concerned with offset drilling.

(c) Government scientists. Big government earth science programmes usually have a particular mission. Can we indicate the potential benefits that logging would bring in pursuing their missions?

(d) Scientists in other programmes. We are seeking collaborative ventures with other programmes (e.g. KTB). By demonstrating our skills we might sow the seeds of opportunity.

(e) Scientists and technologists in industry. In some respects ODP logging is leading industry, particularly in the routine deployment of some advanced logging tools. Industry ought to be made aware of this experience and of the opportunities it brings. A particular case is the geothermal industry which only makes limited use of logs.

The size of the brochure should be determined by its scope and structure. Logging should be presented within the context of traditional geological subdisciplines, e.g. geochemistry, sedimentology, etc., as making an important contribution towards solving the contemporary problems of those subdisciplines. There should be one page per subdiscipline, each containing a brief description of the key potential input available from downhole measurements and one graphic illustration of a successful case history. The brochure should begin with a general introduction to the nature and scope of downhole measurements. It should end by relating downhole measurements to other technical areas, e.g. laboratory measurements through the integration of core and log data.

A second need is highlighted by the many requests for information received by BRG of LDGO, e.g. from non-JOIDES institutions, high school teachers, etc. This need requires a brochure couched in lay terminology. Such a brochure would also constitute a useful hand-out to lay visitors during port calls.

It was the overall (but not unanimous) view that one brochure could not satisfy both requirements. Two brochures are needed although there might be some overlap. Draxler reported on the KTB experience. There had already been 170,000 visitors to the KTB site. An outside organisation had produced a public information brochure which they offered for sale to members of the public. KTB recognises the need for a different brochure with a greater scientific emphasis. The KTB experience is that one brochure cannot serve both the lay and scientific communities.

DMP Recommendation 91/20

"A public information brochure on ODP downhole measurements should be produced with the primary goal of educating the technical community. This brochure should draw upon modern graphic-art skills to illustrate vividly the successes of the downhole-measurements programme. There is also a need to inform the lay community. This might be achieved by a separate brochure or preferably by incorporating a downhole-measurements exposition into general ODP public information literature. The latter approach would emphasize logging as an integral part of ODP. The higher priority is the need for technical education."

Panel acknowledged the contribution of Karen Riedel of ODP-TAMU for providing focused briefing notes to facilitate the discussion.

16. Lithosphere Characterisation

The Chairman reported that he had received a letter from Jill Karsten of the University of Hawaii expressing interest in the concept of closely spaced sub-ocean boreholes. It was proposed to defer discussion of the matter to the next DMP meeting. Jill Karsten would be invited as a guest.

17. Shipboard Integration of Core and Log Data

This agenda item was conducted in joint session with the JOIDES Shipboard Measurements Panel (SMP). DMP/SMP met jointly to review progress and prepare an implementation plan for the shipboard integration of core and log data. Both panels agreed that routine shipboard integration of core and log data is a very high priority and that implementation should proceed as a matter of urgency. Based on the trial efforts on Legs 134 and 138, it is clear that the technology exists to achieve shipboard integration of core and log data. In addition, on Leg 138 the scientific party agreed to support one individual among them to work as the core-log data integration specialist. Therefore it is clear that the scientific community is supportive and ready for the proposed integration plan. Both DMP and SMP unanimously support this effort. Moran reviewed the DMP/SMP recommendations from the joint meeting in Townsville in October 1990. A key recommendation was to adopt the merged wireline depth as the reference depth. Thus core data should be matched to log data. This will involve several steps. The Sonic Core Monitor (SCM) will be used to correct core sample depths within the barrel. Points on the core then need to be tied to points on the log, a procedure which is in need of refinement. Also the log depths should be tied to the bottom of the drill pipe.

Previous recommendations have also included the acquisition of a core natural gamma sensing facility and the running of a magnetic susceptibility tool as part of the standard logging suite. The core gamma facility is in hand. The magnetic susceptibility tool has not been acquired, primarily because of financial constraints. Tool resolution should ideally be within the range 3-10 cm, according to the needs of each particular leg. The French high (magnetic) resolution susceptibility tool has a spatial resolution of about 1 m; a new tool with a vertical resolution of a few tens of centimetres should be developed within a few months. Future plans provide for a target resolution of a few millimetres.

The primary goals of this joint session were to refine the basic requirements for effective core-log integration on board ship and to identify steps towards their implementation. Legs 134 and 138 saw the first real attempts to integrate core data in near real time.

Janecek reported on Leg 138. Efforts had been directed at the integration of different core data. There had been no time to consider core-log integration. However, Leg 138 was exceptional in that it was a paleoceanographic leg which set a new record for core recovery (> 99%). A more typical leg would not suffer the same time constraints. The strategy for integrating core data involved two stages, data synthesis and the creation of composite sections. Data synthesis drew upon specific laboratory data (e.g. GRAPE, susceptibility): future data will include natural gamma sensing, colour reflectance and SCM. These data were combined in summary tables as in ASCII format files available to shipboard scientists on the Fileserver.

Composite sections were built on the most complete data section at each site. The first step was the correlation of whole and split core data, involving the depth adjustment of whole cores and of pieces within a core. The creation of composite sections involved merging data from other holes at the site with the most complete section already identified. With this procedure it is necessary to present for each core ODP depths, composite depths, and an explanation/algorithm/shift linking one to the other.

Multisensor track (MST) data were the basis for core depths. They were merged by linear shifting: no data stretch (core expansion) was assumed, even though it was known to exist, because the major problem was to fill the data gaps, not to refine the data at a fine scale. GRAPE, susceptibility and reflectance data were used for developing composite sections. It was assumed that there were no lateral changes between the holes at a site, typically 20 m apart. No generic reference depth was identified. This can be expected to vary from leg to leg, and we need to know how to specify it for different situations.

The next task is to integrate the Sonic Core Monitor (SCM). Thereafter we would be well positioned to move to the next stage of core-log integration.

Janecek was congratulated on a very good effort which had advanced greatly the data-integration cause. Several further points emerged during discussion.

(i) Which hole is to be adopted as the core reference at a multi-hole site? It will be the hole that is logged. This will not necessarily be the hole with the most complete core data at each site, unless there is a change of logging policy.

(ii) How do we handle "excess" core recovery due to expansion? The answer might be to correlate major features with those in the depth-corrected logs and to collapse the core accordingly. We should develop the tools to do this but these tools may not be applicable on all legs.

(iii) We must have a data correlation specialist as a designated member of the shipboard party. This person and their role need to be clearly defined. On paleoceanographic legs, one data correlation specialist may not be sufficient. For example, on Leg 145 (North Pacific Transect) it is proposed to sail one full-time and one half-time data correlation specialist.

(iv) The forthcoming installation of a laboratory natural gamma sensor is primarily targeted at APC whole core, usually obtained over the uppermost 200 m or so of the sedimentary column. Laboratory gamma ray data are intended to facilitate core-log integration. Yet, logs are not usually run through the cased-out uppermost soft sediments (0-75 m) and therefore the degree of potential overlap between core and log gamma data is greatly reduced. Since we are interested in shape matching rather than absolute values of the gamma count, in-casing gamma logs would be useful.

DMP Recommendation 91/21

"In logged holes where the APC has been deployed, the natural gamma log should be run through casing to the surface, to enhance core-log integration."

(v) At multi-hole sites, logging is carried out at the last hole for drilling logistics reasons. In fact, where appropriate, logs should be run in an intermediate hole, to allow additional time for processing. Such a strategy would improve the prospects for core-log integration in real time. Further, the core reference hole, i.e. the hole with the best APC recovery which should ideally be the logged hole, may not be the last one to be drilled. All this points to the need for on-site flexibility concerning which hole is to be logged at multi-hole sites during paleoceanographic legs.

DMP Recommendation 91/22

"At multi-hole (paleoceanographic) sites logging should be carried out in holes other than the last to be drilled, where there are clear scientific benefits to be gained from so doing. The flexibility to effect these decisions should be an integral part of the shipboard culture."

(vi) A core-log integration workstation is already in the ODP budget.

(vii) Data handling on board ship needs to be enhanced generally, not just in the context of core-log integration. An increase in computing power is needed. There is a bigger problem which needs to be recognized.

The Chairman explained that there was now a need to progress the core-log integration initiative further. It is a very important issue indeed; one which could put ODP at the leading edge of technical achievement. The meeting agreed that four key issues needed to be addressed in order to advance the initiative. These were:

Integration Philosophy and Personnel
Equipment
Reference Depth
Data Handling

Syndicate and reporting sessions, directed at examining these key issues, led to the formulation of the following consensus.

DMP Consensus

SHIPBOARD INTEGRATION OF CORE AND LOG DATA

There are four important areas of activity which have to be optimised if the shipboard integration of core and log data is to be progressed. These are Integration Philosophy and Personnel, Equipment, Reference Depth, and Data Handling.

(i) <u>Integration Philosophy and Personnel</u>

Key factors affecting Integration Philosophy and Personnel are Motivation, Correlation Specialist, Approach to Integration, Reporting of Data, and Leg Scenarios

(1) Motivation

The motivation for using the core-log system lies in the recognition of the opportunity provided by the benefits of shared information. Potential impediments are time limitations on board ship and competition among the shipboard party either with each other generally or with the data correlation specialist in particular. Solutions are to make the data available to the shipboard party as soon as possible in formats that are compatible with standard shipboard and homebased hardware (MAC, PC or workstation), and to provide a dataset as a manipulatable product that is transportable. Further, the Co-chiefs will need to be educated so that they can sell the advantages to the scientific party. In particular, the correlation specialist should be promoted as a facilitator.

(2) Correlation Specialist

The correlation specialist serves the scientific party and, as such, should be a member of that party. The position of data correlation specialist should be identified in the shipboard manual and should be filled by the Co-chiefs in the usual way. ODP should offer a training course/workshop in the philosophy and methodology of core-log integration, and potential correlation specialists should attend that course wherever possible. Individual training as appropriate should be provided to nominees by the Science Operator and/or the Logging Contractor.

(3) Approach to Integration

The integration process should be built around key intervals of good data integrity (high core recovery, definitive logs). The rules for sorting these data and making correlation(s) should be codified. Artificial Intelligence methodology should be introduced with time. Data smoothing (software) should be applied where appropriate, especially to core data in order to harmonize the different vertical resolutions of core and log measurements.

(4) Reporting of Data

Data should be reported in consistent (SI) units. The reporting process should take account of the bias associated with different measurements. There should be an agreed set of standard definitions and an agreed nomenclature to promote compatibility. Documentation of the above should be produced, especially a glossary of terms and a summary of procedures.

(5) Leg Scenarios

The culture for core-log integration must take account of all the different leg scenarios that might be brought into play. These include paleoceanographic legs, tectonics legs, basement legs (conventional coring) and basement legs (DCS).

To recap, we require a system that will alleviate the shipboard problems of time and competition rather than aggravate them. It must be simple and flexible, easy to use, and capable of demonstrating its value at an early stage of an interactive interpretation exercise.

(ii) Equipment

The following additional equipment was considered necessary to implement the approach outlined above.

(1) Natural gamma ray sensor for core measurement (in place for Leg 145)

(2) Magnetic susceptibility downhole logging tool (required as soon as possible: acquisition date unknown)

(3) Sonic core monitor (Leg 141)

(4) Automation of the physical properties laboratory (March 1993)

(5) Core-log integration workstation (February 1992)

(6) Resistivity imaging equipment (acquisition date unknown)

(iii) Reference Depth

Key factors in developing a reference depth are the need for a Reference Datum, knowledge of the Length of Pipe, defining a Log-to-Pipe Tie-In, establishing a Core-Log Correlation, and the flexibility to handle Other Scenarios.

(1) Reference Datum

A working datum is the rig floor. A more permanent datum is sea level. Therefore we need to measure the height of the rig floor above sea level. This means that we have to measure a reference height which can change during the course of a leg.

(2) Length of Pipe

Errors are possible in counting the lengths of pipe that have been added to the drill string. Modern sensing facilities can do this automatically, e.g. an automated pipe counter. It is known that drillpipe stretches but it should be possible to compensate for this effect by making measurements of the pipe length under tension and using these to calculate total pipe length for any hung vertical deployment.

(3) Log-to-Pipe Tie-In

To do this, we need some signal in the pipe that can be sensed by the gamma ray log, e.g. a weak gamma ray source near the base of the pipe. Thus the pipe and log depths could be correlated when the tool is pulled up into the pipe. It is proposed to introduce the magnetic susceptibility log as a second core-log correlation facility: this tool should respond to drillpipe naturally.

(4) Core - Log Correlation

The approach should be to define a single (composite) trace for each site using the MST data, specifically GRAPE and magnetic susceptibility. Each trace should be smoothed to provide an equivalent resolution to that of the log with which it is to be correlated. Note that different logs have different vertical resolutions. The logs will already have been depth-merged with each other and tied to pipe. The smoothed core data can then be stretched or compressed to match the logs.

(5) Other Scenarios

If logs have not been run, core has to be tied to pipe only. In cases where the pipe is not vertical in the water, pipe depth will depart from true depth. Although pipe verticality can be measured using an inclinometer, it varies with time and it is unlikely that sufficient measurements can be made to characterize verticality meaningfully. Another possibility might be to calculate pipe length through water using one tie-in inclinometer measurement together with data from the dynamic positioning system of the JOIDES Resolution.

(iv) <u>Data Handling</u>

There are three key areas: Data Structure, Software Requirements, and Hardware.

(1) Data Structure

Data need to be input to a data structure. The data structure should accept data in a wide variety of formats including both core and log formats. The database framework is currently being planned at ODP-TAMU. This framework is seen as a longer term goal but we must develop and/or acquire software packages on the assumption that a global framework will exist.

(2) Software Requirements

Software needs can be described in terms of a set of modules each of which has its own specific function. Software modules are required for:

- vertically adjusting two or more data sets so that they match;
- stretching and squeezing to bring two or more data sets to match;
- interpolation of data from sparse data sets to output a regular data set;
- averaging, smoothing and regression to facilitate correlation;
- providing scientists with output data from the data structure in several different formats (scientists leave the ship "with Gigabytes in their pockets");
- generating graphics of various types;
- interrogating the database, e.g. for a particular horizon or technical subject;
- calling in all data that pertain to a particular reference depth.

Although these modules will be discrete, because that makes it easier to organise requirements and to write related software, the scientist will see them as a composite package. Therefore they should be seamless.

(3) Hardware

We must define the hardware that we need to provide the software listed above. The first requirement is for a networked group of workstations on board ship. To choose the hardware we should first clarify what we want to do, see what software is available already, and then select the best hardware option to match the software. In this way we avoid re-inventing the wheel.

The immediate goal is a set of data with a common depth reference. The long-term goal is a complete relational database that would allow, for example, interrogation of eustatic levels and then cross-referencing between wells.

By way of emphasizing the key points from the above consensus, the following recommendation was formulated.

DMP Recommendation 91/23

"The following critical tasks must be addressed for successful core-log integration in interactive mode on board the JOIDES Resolution.

(1) Quantify contemporary methods of depth measurement for drillpipe and wireline.

(2) Refer all depths to the (pipe-tied) gamma log.

(3) Develop interactive graphics for depth matching.

(4) Establish a relational database with an adequate structure and administrative mechanism.

(5) Create the position of Data Correlation Specialist as a member of the scientific party.

(6) Disseminate information throughout the scientific party in a readily transportable mode.

(7) Support the related development work currently taking place at TAMU."

As a lead-in to the above recommendation, the following additional recommendation was formulated.

DMP Recommendation 91/24

"An independent assessment of drillpipe extension and cable stretch should be undertaken conjunctively by LDGO and ODP-TAMU."

18. Panel Membership

The Chairman noted that two US panel members are due to rotate off DMP. They are Karig and Wilkens. Karig will rotate off after this meeting, Wilkens after the January 1992 meeting. In calling for nominations for these two slots, the Chairman noted that the concomitant departure of Stephansson and Karig would leave the Panel weak in the area of in-situ stress, especially as DMP had been denied a TECP Liaison. Wilkens should be replaced by someone with sea-going experience as a logging scientist on the JOIDES Resolution. Several names were proposed, including a stress specialist who had been previously identified by the Panel. In accordance with PCOM policy, the names of the individuals concerned are not minuted. The Chairman undertook to request of PCOM that the stress specialist be appointed to DMP with effect from the January 1992 meeting, as a replacement for Karig. The search to replace Wilkens will continue.

[ACTION: WORTHINGTON]

19. Next DMP Meetings

The next meeting of the JOIDES Downhole Measurements Panel is scheduled for the King Kamehameha Hotel, Kailua-Kona, Hawaii, during the period 28-30 January 1992. Roy Wilkens will host: this will be Wilkens' last panel meeting.

The January meeting will put the Panel back on its schedule of January, May/June and September for its three meetings per year.

The subsequent DMP meeting will be held at the KTB site in Windischeschenbach, FRG, during the period 2-4 June 1992. Hans Draxler will host. The third day of this meeting will comprise a joint session with KTB to further the collaborative efforts between ODP and KTB.

The following DMP meeting will be held in Santa Fe, New Mexico, in late September 1992.

20. Other Business

(i) Downhole Magnetic Susceptibility Tool

Sondergeld noted that a magnetic susceptibility tool would be required extensively in the North Atlantic. Panel needs to progress the initiative soon: it is, after all, a high development priority. The Chairman stated that this would be a major item on the DMP agenda for January 1992. Several options were emerging. LDGO Liaison is asked to report on these at the next DMP meeting. Panel members with potentially useful input are also asked to contribute to that discussion.

[ACTION: GOLOVCHENKO, PANEL]

(ii) Fluid Sampling

Draxler reported on information received from the Bergakademie Freiberg, FRG, concerning an in-situ pore-fluid sampler for use in marine sediments. The tool is similar in some respects to the LAST tool. It has been deployed successfully in the Black Sea. Draxler will obtain a descriptive translation and forward this to the Chairman to facilitate further discussion.

[ACTION: DRAXLER]

(iii) Sonic Waveform Tools

The ODP uses the Schlumberger Long Spacing Sonic (LSS) tool for waveform measurements rather than the Sonic Digital Tool (SDT) which had proved unreliable. Updated versions of the SDT are now available and it may be appropriate to consider switching back to the SDT, which is a technically superior tool. LDGO Liaison will raise this matter at the next meeting with Schlumberger.

[ACTION: GOLOVCHENKO]

(iv) Borehole Gravimetry

Draxler commented on the possible expansion of the logging programme for gas hydrates. The Borehole Gravimeter is a deep sensing tool which might be less affected by any hydrate decomposition around the wellbore due to the drilling process. A commercial gravimeter is available from EDCON who have links with Schlumberger. Should we consider expanding the log measurement suite for gas hydrates?

The Chairman responded that this question was not confined to gas hydrates. Borehole gravimetry had been identified as a possible key technology for the future in the COSOD II white paper on downhole measurements. It would therefore be appropriate for the Panel to hear an expose on this subject, just as they had heard about the state-of-the-art of MWD at this meeting. Sondergeld suggested a possible speaker and offered to make contact: he will advise the Chairman of this speaker's availability for the next DMP meeting as soon as possible.

[ACTION: SONDERGELD]

(v) ONDO Experiment

Yamano reported that a dive to Site 808 undertaken in July could only reach Hole 808D where the casing was seen to have failed. ONDO is in Hole 808E. Attempts to communicate with ONDO across the sea floor were unsuccessful. Therefore no data were recovered.

Yamano reported a safety issue in connection with re-entry Hole 808D. The pilot of the submersible had expressed concern about three buoyant spheres connected by wire to the re-entry cone of 808D. These were seen as potentially dangerous to the submersible. Golovchenko explained that the spheres are intended to facilitate the location of the re-entry cone by camera during a re-visit by a ship. In sediment, there is a possibility that some of the cone might become partly concealed.

Panel noted the distinction between shipborne re-entry and access by submersible. In the latter case a protruding vertical wire could constitute a safety threat.

DMP Recommendation 91/25

"Where buoyant spheres have been wired to a re-entry cone, this installation should be recorded and notified to organisations who have indicated that a submersible is to visit that hole."

(vi) Soviet Expertise

Kuznetzov conveyed greetings to the Panel from the geophysical community in the Soviet Union. He emphasized technical skills, especially in the nuclear and acoustics areas, that had been deployed at Kola. Kuznetzov suggested that he make a presentation on downhole measurements activity in the Soviet Union because this might afford opportunities for ODP.

The Chairman agreed that such a presentation should be made at the next DMP meeting. The agenda for the January meeting would include reports by National Representatives.

21. Close of Meeting

The Chairman thanked Panel Members, Liaisons and Guests for their contribution to the meeting, the Director of the Atlantic Geoscience Centre of the Geological Survey of Canada for the kind hospitality and the provision of meeting facilities, and Kate Moran for her gracious hosting. The meeting closed at 1610 hours on Thursday 17 October 1991.

PAUL F WORTHINGTON
21 October 1991

REPORT ON MEETING OF JOIDES TECHNOLOGY AND

ENGINEERING DEVELOPMENT COMMITTEE

Victoria BC
Canada

11 - 12 September 1991

1. **Preamble**

This meeting of JOIDES TEDCOM was attended in two capacities, as liaison from JOIDES DMP and as stand-in UK representative. A key feature of the meeting was to review progress with the Diamond Coring System (DCS).

2. **Operations Summary, Legs 134 - 139**

Storms (ODP/TAMU) reported, inter alia, the following highlights.

Leg 134: low core recovery in Hole 831B (12-70%); scientific objectives were met through the logging programme.

Leg 135: the Motor-Driven Core Barrel (MDCB) was re-tested in Holes 834A and 839B and cored sediment and basalt. A major design change re bit loading was suggested. This has been done and the MDCB will be subjected to sea trials on Leg 141.

Leg 136: a re-entry cone seal (CORK) was successfully deployed as an engineering test of the concept. Two corks were subsequently installed during Leg 139.

Leg 137: Hole 504B was cleared of junk and deepened to 1571 mbsf. RCB coring was resumed and a conventional oilfield core barrel was used to deepen the hole further (1611 mbsf). The uppermost stabilizer failed and left 18m of core barrel in the hole. This is to be fished during the next leg (140) after which further hole deepening will be attempted.

Leg 138: record number of holes cored (42) with 5536.8m recovered (99.9% recovery), also an ODP record. Holes were mostly shallow for palaeoceanographic purposes and were cored using APC with some XCB deployment.

Leg 139: 22 holes drilled at 4 sites. Pressure coring system was used for the first time in operational mode. Two sites were set with re-entry cones and sealed (corked). Overall core recovery was quite low. H_2S was not a problem. Hole cooling was very effective: 300°C bottom hole temperature was cooled to 43°C in one case.

3. **DCS Phase II Status**

Leon Holloway (ODP/TAMU) reported two significant milestones concerning tests of the upgraded shock-absorbing safety system. Two series of qualification tests have been completed, "drop" tests and "slingshot" tests. Data reduction and analysis are still in process, but the indications are that the tests will satisfy SEDCO concerns.

The secondary heave compensator should be assembled before the end of September; this will be tested during October. At the end of October the rig will be dismantled prior to shipment to Valparaiso for testing during Leg 142.

DCS seafloor hardware was reviewed. In general the modified system should be easier to deploy than that used during Leg 132.

4. **Engineering Leg 142 Status**

Leg 142 encompasses the third shipboard test of the DCS. The primary engineering goal is to maximise the amount of coring time available. A minimum penetration of 100m bsf with 50% minimum recovery is sought. To accomplish this task, a new 3-leg/hexagonal hard-rock guidebase will have to be set. Plans are to test the deployment of slimhole temperature/gamma ray/caliper tools from the platform into the 3.96" DCS hole. Then reaming out to a 7.25" hole through the "rubble" zone will be tried. If stable, and time permits, standard temperature/gamma ray/caliper tools will be run for comparison with the slimhole logs. If unstable, the upper "rubbly" section could be isolated behind the second stage drill-in BHA. DCS coring could then be resumed.

There was some discussion of this programme. One view was to continue coring in the primary hole and regard all other experiments as secondary to the goal of gaining drilling experience with the DCS. The secondary objectives should only be attempted if coring has to stop, eg through high temperatures. Alternatively, a second guidebase could be set to drill another hole. The degree of success on Leg 142 will influence whether the ship returns to EPR. The programme of tests must be designed to maximise the chances of success.

5. **DCS Phase 3 Status**

Current platform design is intermediate to allow the DCS concept to be proven, especially as regards secondary heave compensation. It has been recognised that in the long term a more efficient and safer system would have to be designed. The Phase 3 system is aimed at bringing operators back down to the rig floor. Two designs have been proposed, a bottom-mounted slip joint and a riser-tensioner system. Both of these have the potential to eliminate the raised platform. Feasibility studies have been commissioned on both. Final reports are awaited.

6. **Deep Drilling Studies by TAMU**

Gene Pollard described plans for drilling to 2km at Hole 504B. Deep drilling normally requires contingency casing strings which greatly increase the drilling time. It could take 100 days to drill to 2km; this would require two legs. Deeper holes to 3km would be more achievable with 200-300m of sediments, a water depth less than 3500m, a low temperature gradient, featureless topography, and low currents (< 2 knots). Recovery in pillow basalts is typically 10-15%: there is nothing available in industry that would improve this figure with a rotary coring system. At greater depths, in gabbros, where fractures are less of a problem, higher rates should be achievable. Slimhole systems would provide higher recovery rates throughout, but the DCS is not being considered as a solution to the deep drilling problem at this stage.

7. **Offset Drilling WG**

Eldridge Moores reported on the WG's primary goal, to examine the nature of the major ocean basins. There were many possible "type" sites of oceanic crust. Fast spreading sites include Hess Deep and Discovery Deep. Slow spreading centres include the Atlantis II Fracture Zone in the Western Indian Ocean. Major objectives are the Layer 2/3 boundary, long sections of Layer 3 and the Layer 3/4 boundary (the Moho).

8. **North Atlantic Rifted Margins DPG**

The North Atlantic is a type locality for studying the rift and drift history of conjugate margins. Sites were identified in volcanic-prone and non-volcanic-prone margins. The former typically has < 3km water, < 1km sediment, 1-2km basement. An example of the latter is site NB-3 with c.4km water, 2.5km sediment and limited basement penetration (100-200m). This will push the capability of the JOIDES Resolution.

9. **Deep Drilling - Thematic Needs**

It had been previously decided that TEDCOM could not ask TAMU to progress the issue of deep drilling without some indication of the characteristics of typical sites that ODP would expect to encounter. Three thematic panels were asked to provide this input: TECP, LITHP, SGPP.

TECP proposed two sites at rifted margins and two at convergent plate margins. For example, site NB-3 (Newfoundland Basin, North Atlantic) is a rifted-margin site with projected 3800m water depth, 2060m of clay, 200m of sandstone and 200m basement penetration, giving a total predicted depth of over 6200m. The other (Atlantic) rifted margin site is G-14. Convergent margin site proposals are DAP-1, in the Pacific, and DAP-2 at Barbados. The stress regimes in convergent margins could create drilling problems. Borehole televiewer (BHTV) logs would be required for stress determinations. NB-3 would be the highest priority.

LITHP described a generic ocean crust site with 6km of water and 4km of penetration, giving a total drillpipe length of 10km. This would exceed the operating limits of the Resolution. There would be 0-300m of sediments. The basement succession would comprise 1km pillow basalts, 1km sheeted dykes, 3km gabbros, 1km dunite/peridotite. Temperature would depend on age. Potential drilling problems include brittle crust in the upper sections and lost circulation in highly fractured zones.

SGPP nominated a site in the Western Somali Basin that is the subject of a current drilling proposal. Water depth is about 4900m with 1500m of sediment. Total depth would be 6.5-7.0km. This would extend the Resolution to its operating limit.

The next stage is to commission a detailed feasibility study that draws on outside expertise and is managed by ODP/TAMU. There is a need to pull in the expertise of the oil industry (Petrobras, Shell, Exxon). The task is a big one and should not be underestimated. External consultant(s) should be selected with the involvement of TEDCOM. A request for proposals, based on the thematic panel expositions, should be prepared by ODP/TAMU, approved by a TEDCOM subcommittee, and distributed to the community. Proponents should present their proposals to TEDCOM before one or more is selected for the feasibility study.

10. **Next Meeting**

TEDCOM is to increase the frequency of its meetings in order to become more effective. The next meeting is scheduled for April 1992.

Paul F Worthington
16 September 1991

FEASIBILITY OF CONTINUED DEVELOPMENT OF THE GEOPROPS PROBE

Scott McGrath
Ocean Drilling Program
Texas A&M University

16 September 1991

CONTENTS

1. TOOL DESCRIPTION/OVERVIEW

The Geoprops Probe is a 3 1/2" O.D. 24' long straddle packer device developed by TAM International under the direction of Dr. Dan Karig of Cornell University. The tool is intended to be deployed into a pilot hole made by the Motor Driven Pilot Barrel (MDCB). Once in place, the tool is actuated by pump pressure at the surface. Embedded in the packer elements are temperature and pressure measuring devices and fluid sampling ports. Upon inflation of the packer elements the temperature and pressure measuring devices as well as the fluid sampling port are placed in direct contact with the borehole wall. The formation temperature and pressure are measured every 15 seconds and the data is stored in an integral memory unit. The formation fluid flows through three segregated sample bottles to aid in determining the contamination of the fluid.

The Geoprops probe can also pulse the formation between the packer elements and record the pressure decay versus time to determine a formation permeability. Once back on deck, the integral memory unit can be downloaded into a PC via an RS-232 cable for evaluation of the 5 pressure and 2 temperature sensor measurements. The fluid samples can also be removed under pressure.

The landing mechanism for the Geoprops Probe was developed by ODP/TAMU's Engineering group. The landing mechanism serves three functions. First it provides the choke point creating a pressure seal to operate the tool. Second, it provides a landing shoulder which prevents the tool from completely existing the BHA and provides a control point from which the probe is spaced out. Finally, the landing mechanism provides a means of attaching the wireline for retrieval. Standard ODP/TAMU wireline tools are used to retrieve the tool.

2. BACKGROUND

The Geoprops Probe production plan was originally scheduled to allow for deployment of the tool on ODP Leg 131 (March 1990) but this plan was thwarted by production delays. Two tools were completed, however, by August of 1990. Two different "land" tests were then conducted on the tool.

The first land test occurred on December 11, 1990 at the Ocean Drilling Program test facility at Texas A&M University, Riverside Campus, College Station, Texas. The test was intended to check the sequence of mechanical functions of the probe under simulated operating conditions. The specific details of this test can be found in reports by Tom Pettigrew of ODP/TAMU and Dan Karig of Cornell University. Briefly, the recommendations that followed included:

1) Further "bench test" the tool to closely examine the operation of the slug valve and to "calibrate" the packer pressure response to the slug pressure pulse. (The packers are compressible and will expand into the interval area during a slug test. This volume change affects the recorded interval pressure and must be accounted for to correct the downhole data for equipment effects.)

2) The shear pins used in the tool must be calibrated in the valves because of the effect of the seats on the shear strength of the pins.

The second test was a "bench test" of the tool on June 26, 1991 at TAM International in Houston, Texas. The objectives of this test were to test the reliability of the slug valve regulator and determine the volume change in the interval due to reduction of interval pressure during the slug test. These were the main recommendations which followed the first test as mentioned above. The results of the bench test are detailed in reports by Dan Karig of Cornell University and Dave Huey of ODP/TAMU. Briefly, the recommendations that followed were:

1) Re-design the slug valve to prevent overtravel of the shuttle which is causing an o-ring failure.

2) Mill o-ring grooves in upper end of sample bottles so that pressure can be applied to empty the contents of sample bottles under pressure.

3) Refine practical method for setting/adjusting the shear pin and spring settings.

Upon completion of items 1 & 2 listed above, TAM International felt that they had fulfilled their contractual obligations and requested that ODP/TAMU, Dan Karig or some other principal party takeover tool development. **It should be noted that in addition to the three recommendations listed above, ODP/TAMU engineers in attendance at the bench test felt that the following additional steps were essential for ODP/TAMU acceptance of the tool:**

1) Bench test BOTH tools.

2) Include ALL functions in bench tests (slug tests, fluid samples, filter blockage tests, temperature measurements)

3) Test packer volume change into slug interval for BOTH packers.

4) Determine reliability of packer inflate check valve.

5) Investigate and confirm shock tolerance.

6) Compile a complete set of accurate final drawings.

7) Complete a bill of materials.

8) Complete a list of spare/consumable parts

9) Consider design upgrades such as enclosing the exposed wiring junctions and sample bottle sections in a pressure case.

The Geoprops Probe at this point had shown significant promise and most parties involved with the tool thought that it could ultimately be made to work. The judgement of the engineering staff at ODP/TAMU was that the tool needed to go through the steps outlined in the recommendations that followed the bench test of June 26th. According to ODP/TAMU's guidelines for Third Party Tool Development (JOIDES Journal, XVII,1,56-57 - See Attachment A.) the tool was not ready for acceptance by the DMP. At this point, the principal investigator, Dan Karig, felt that he had fulfilled his obligation to the project and that the scientific objectives of the tool had been met. The Geoprops Probe is at a point where it needs a principal investigator to see it through to completion along with the funds that this final stage would require.

Presently, there exists strong scientific interest in having the tool fully operational for Leg 146 (Cascadia). There has been significant discussion as to how the tool might be brought to a successful conclusion, resulting in a "Mature ODP Tool" that will be acceptable by both the DMP and ODP/TAMU. One option discussed was for the engineering staff at ODP-TAMU to take over development of the tool. At it's April 1991 meeting, PCOM prioritized the projects on which the engineering development effort should be spent. The bottom priority was development of the "MDCB, in preparation for the use of Geoprops in the Cascadia drilling." For the Geoprops Probe to be deployed on Leg 146, it would almost certainly need to go through trial runs on Leg 143 or 144.

3. <u>PURPOSE</u>

With this lengthy background in mind, this report will analyze the feasibility of ODP/TAMU's engineering staff assuming "continuation of development" of the Geoprops Probe to a mature state. If it is feasible then the question of external funding for the project still exists. ODP/TAMU may or may not add the Geoprops to it's current list of projects even if sufficient funds for the project are identified and allocated. ODP/TAMU also feels that a scientist should be involved with the final development of the tool to assure that the data gathered meets the scientific criteria. The decision to takeover the tool will be made by PCOM and DMP on the basis of this report, scientific interest, scheduling, and funding.

4. TOOL OPERATION AND DATA ACQUISITION

In order to understand the specific parts or sections of the tool which need to be modified for ODP/TAMU acceptance a description of how the tool operates is presented here. The material in this section is referenced from the small Geoprops Probe manual written by TAM.

The Geoprops probe is designed to be run in the pilot hole left after the MDCB coring bit is retrieved. The tool is dropped into the drill pipe at the surface, falls and lands at the core barrel latch with the majority of the probe protruding out the end of the drill pipe into the pilot hole.

The probe functions are controlled by drilling fluid pressure. Shear pin valves and spring loaded regulators control the packers and the slug tests pressures. Pressures presented to the probe are the result of differential pressure across jets in the top of the tool and pump flow rates controlled from the surface.

4.1 Valve control

After the probe is seated, surface pressure is applied to the probe to shear the pin that controls the packer inflate valve. When the packers have reached a specific pressure, the sample control valve pin will shear and the sample bottles will be opened to the sample ports in the packer walls. The bottles are plumbed sequentially such that after each bottle is filled, the sample fluid is directed to the next bottle.

After the packers are set, the pressure applied to the probe is raised sufficiently to shear the slug start valve pin, permitting fluid to flow to the slug regulator valve. Any pressure applied to the probe is then applied to the interval between the packers. The slug regulator valve will close off the interval when the applied pressure exceeds the annulus pressure by a preset amount. The valve will remain closed as long as the applied pressure exceeds the preselected pressure setting of the valve.

Packer deflation can be controlled by two possible methods. The normal deflations is by a shear pin controlled valve. When the pressure applied to the probe exceeds the pressure required to shear the deflate valve shear pin, the valve closes off any flow to the packers and vents the packers to the annulus. The second action occurs if the probe is pulled away from the packers. A port in the quick disconnect is opened to the annulus, relieving packer pressure. A weak link is built into the top of the packers which can be pulled in two if the packers will not follow probe motion.

4.2 Data Acquisition

The packers contain ports and transducers to gather data and fluid samples from the pilot hole wall (Fig.1). Filtered ports are connected to the sample bottle system and to pressure transducers. Once packer pressure opens the sample valve, fluid can flow to the sample bottles at 87% of the annular pressure. If the packer pressure decreases sufficiently to permit the packers to separate from the pilot hole wall, the sample valve will close and stop the sampling process.

Each bottle has a mechanically actuated valve that opens when the bottle is full and the piston in that bottle bottoms out. When the valve actuates, the sample fluid is directed to the next bottle, thus sequentially filling each sample bottle (Fig. 2).

Each packer has a pressure port that is sealed against the pilot hole wall when the packer is inflated. An Interval Pressure port is also mounted in the interval between the packers. Packer Pressure is measured at the packer dump valve and Annular Pressure is sampled at the bottom of the electronics section. The corresponding pressures are transmitted to pressure transducers mounted in the electronics section.

Each packer has a temperature transducer that is pressed against the pilot hole wall when the packer inflates. The transducer is a thermistor potted in a copper cup with epoxy. The thermistor is in thermal contact with the copper face which is in contact with the pilot hole wall.

4.3 Electronics

The electronics section amplifies the signals from the transducers, digitize's them, and then stores the results in solid state, non-volatile memory (Fig. 3). The electronics is battery powered and supplies the excitation to the pressure transducers (Fig. 4). After tool retrieval, the stored data is transmitted to the interface via an interconnecting cable.

4.4 Interface

The interface is a buffer between the probe and any computer that can communicate on an RS-232 serial port. The computer must be able to issue and receive ASCII characters. The computer is used to clear the probe RAM memory before the run and receive the data after the run. The interface powers the probe during these exercises (Fig. 5).

5. COST ANALYSIS

In order to make the Geoprops Probe fully operational some basic costs will be incurred. The costs include such items as spare parts, shipping containers, fluid sample transfer unit, etc., along with all of the recommendations made after the last bench test. The Geoprops Probe can be made operational with some minor design changes and further testing. However, some basic design flaws exist in the tool that may cause problems over time. Several examples are, the sample bottle chamber which is open to the annulus and not pressure sealed, the rubber wrapping around the external tubing, and the pin connectors that do not seat within the bulkhead. The cost analysis is based on a concept of Phase 1 and Phase 2 deployment scheme. Phase 1 will take the existing tool and just make it functional. Phase 2 will include the additional costs of engineering design changes necessary to make the Probe a standard ODP deployable tool. The goals For Phase 2 will be to make the tool less maintenance intensive, non-corrosive, serviceable, and reliable. ODP/TAMU will not be able to accept long term responsibility for Geoprops as a "Mature ODP Tool" until completion of Phase 2.

5.1 PHASE 1

The following items are necessary for initial acceptance of the Geoprops Probe:

1. **ADDITIONAL BENCH TESTS**
2. **PACKER VOLUME CHANGE**
3. **PORE FLUID SAMPLE TRANSFER UNIT**
4. **COMPLETE SET OF FINAL DRAWINGS**
5. **CALIBRATION SYSTEM**
6. **ELECTRONICS SECTION/SHOCK TOLERANCE**
7. **SPARE/EXPENDABLE PARTS**
8. **PROTECTIVE RUBBER BOOTS**
9. **OPERATING/MAINTENANCE MANUAL**
10. **SHIPPING/STORAGE CONTAINERS**
11. **CONSULTANT ENGINEER (NON-ODP/TAMU)**

1. ADDITIONAL BENCH TESTS

A bench test that includes ALL functions of the tool must be done. Some parties formerly involved with the Geoprops Probe felt that some tool functions could only be tested by deploying the tool at sea. The only limiting factor at any bench test is cost. Every function of the tool needs to be tested if the cost to setup such a test is reasonable.

2. PACKER VOLUME CHANGE

To obtain accurate interval pressure data during a slug test the packer volume change effects must be determined. Dr. Dan Karig, Professor of Geology at Cornell University did some work in that area during the bench test at TAM. The results of the tests can be found in a report by Dr. Karig dated 6/26/91. Basically a pressure differential at which leakage occurs between the packers and the interval was established. However, the packer volume change in the interval was not recorded using calibrated gauges and the gauges also lacked the proper resolution for such a test. The test should be repeated with better gauges while varying the packer pressure and holding the interval pressure constant and again with the packer pressure held constant and varying the interval pressure. BOTH sets of packers need to be tested and a relationship established.

3. PORE FLUID SAMPLE TRANSFER UNIT

The three sample bottles each have a check valve on one end. To empty the bottles a valve control tool is attached to the check valve and an external pressure is applied to the outlet of the valve control tool equal to the pressure of the bottle. The handle of the valve control is then turned in to open the check valve. Each sample bottle has 4 external vent holes, 3 of which can be plugged off and pressure applied to the fourth to expel the fluid sample. A comparable fluid transfer unit has been built for the Wireline Packer and this method can be copied. Parts needed include: high pressure valve control, high pressure hose, plugs, pump, and transfer bottles. A system to remove and transfer a fluid sample is much easier and cheaper than a system to remove a sample under pressure. If a sample under pressure is desired then the cost of the pressurized sample transfer bottle must be taken into account.

4. COMPLETE SET OF FINAL DRAWINGS

The Geoprops Probe is a third party tool developed by TAM International. TAM is claiming proprietary status on the detailed part drawings of the tool. TAM has released some basic layouts and schematics but they aren't sufficient for routine operations and maintenance. The alternatives are to be tied to TAM for ANY detail work that needs to be done on/for the tool, generate our own drawings, or get cooperation from TAM to provide at least enough detail for ODP to operate the tool from the ship.

5. CALIBRATION SYSTEM

A calibration system for the shear pins and spring valves must be developed. A small volume, high pressure pump attached to the top of the tool through an adapter would provide the necessary pressure. The packer sleeve used during the bench test has ports to monitor the pressure along the axis of the tool and could be used for calibration purposes. Additional parts required would be pressure gauges and hoses.

6. ELECTRONICS SECTION/SHOCK TOLERANCE

The Geoprops Probe needs to withstand a 40 g shock if it is to be deployed by free-falling through the drill pipe. The main part of the tool that appears to be susceptible to a great shock is the electronic section. No apparent shock absorption system of any kind is built into this area (Fig. 6). A padding, spring system or combination would certainly help cushion the electronics. A shock tolerance of the entire tool must be done before the assembly is declared acceptable.

7. SPARE/EXPENDABLE PARTS

Spare parts include Thermistors, Pressure Transducers, O-Rings, shear pins, fluid sampling port screens, backup packer assemblies, entire lower packer assembly (if pulled off) and a flushing agent to clean the tool. TAM recommends using antifreeze to flush the tool. The two straddle packers are made from a wire mesh covered by a rubber element. The rubber is subject to wear and will crack, tear and deteriorate with repeated usage. One packer element on one of the existing tools has developed a crack just above the fluid sampling ports due to age (2 yrs) and simple bench testing (Fig 7.) (Although TAM International claims that the crack is only in the outer shell and does not affect packer integrity). The separate elements can be replaced as necessary. If the packer assembly becomes stuck in the hole even after deflating, then a safety joint at the top of the packers can be pulled in two, leaving the packers in the hole. Therefore, a backup packer section would be necessary.

8. **PROTECTIVE RUBBER BOOTS**

The wires that run to the temperature thermistors on the packer assembly are routed through 1/8" tubing conduits on the outside of the tool. These tubing conduits are currently held in place by wrapping rubber bandaging around the tubing (Fig. 8). This occurs in between the packer elements and above the top element. Although this is a CHEAP means of clamping the tubing to the tool to prevent inadvertent hang-ups it by no means is acceptable by ODP/TAMU standards. The bandaging needs to be removed and replaced with a sturdy rubber boot to cover the exposed areas.

9. **OPERATING/MAINTENANCE MANUAL**

TAM International has furnished a brief instruction manual for the tool. The manual will have to be expanded to include: a routine calibration of the shear pin and spring valve settings, tool preparation, tool running procedure, data gathering techniques (fluid, pressure & temp data), tool maintenance, ODP/TAMU associated equipment, circuit diagrams, hydraulic diagrams, tool diagrams, and scientific operations such as software modifications to vary parameters according to various operating conditions.

10. **SHIPPING/STORAGE CONTAINERS**

Two complete sets of shipping containers will be needed to house the tools and the auxiliary equipment. The containers can be wooden boxes with a foam padding and a fiberglass liner on the outside.

11. **CONSULTANT ENGINEER**

ODP/TAMU has worked with consultant engineers in the past on engineering intensive tools (i.e. Pressure Core Sampler). If it is decided to continue development on the Geoprops Probe and if the time frame for deployment of the tool is quite short then a consultant engineer may be considered. The cost would be quite high but would be justified by satisfying all the requirements to make the Geoprops Probe a "Mature ODP Tool".

5.2 PHASE 2

Phase 2 will consider the additional engineering changes envisioned at this point in time to make the tool more robust and reliable as per standard ODP/TAMU downhole tools. This involves ensuring non-corrosive materials are used where necessary, shock tolerances are passed, tool is maintainable, repeatability is good, and the tool is basically reliable. The list will undoubtedly grow larger as the tool is developed and tested further.

The following list provides some of the engineering changes envisioned at this point in time to improve the tool:

1. **NON-CORROSIVE MATERIALS**
2. **SUPPORT SYSTEM**
3. **BULKHEAD CONNECTORS FOR PINS**
4. **PRESSURE CASES**
5. **HIGH COST REPLACEMENT PARTS**

1. NON-CORROSIVE MATERIALS

The sample bottle section of the tool is open to the annulus and allowed to flood with borehole fluids. This is necessary for the valves to equalize with hydrostatic pressure. The valves then operate by applying additional pressure (differential) from the surface. If the tool is designed to be open to borehole fluids then it should also be designed with non-corrosive parts in the same area. This may not be a problem if extreme diligence is applied to the cleaning and flushing of the tool after each run. Stainless steel is relatively inexpensive and can be used throughout this area.

2. SUPPORT SYSTEM

It is essential that the shear pins and spring valves be tested and set prior to each run in the hole. To access the valves in the sample bottle section, the internal section which rides on a "support bar" must be pulled from the external housing. When the sample bottle section is removed from the housing it becomes readily apparent that the support bar is giving minimal support. In addition the check valve which prevents over inflation of the packers is "force-fitted" into the bottom of the section (Fig.9). A better support system should be developed to allow easy removal of the sample section while lending support at the same time.

3. BULKHEAD CONNECTORS FOR PINS

The bulkhead connection between the packer section and the sample bottle section has four pin connections with rubber boots and insulators. There is some inherent slack in the wires for ease of assembly (Fig. 10). While that may ease assembly, the reliability of a connection that is allowed to move is questionable. A permanent, self-aligning bulkhead pin connection would ensure positive makeup of the pins while lending support at the same time. This is typical of the design on the Geoprops Probe where a function or connection can be made to work ONE time, but with no reliability during repeated use.

4. PRESSURE CASES

An alternative to converting all materials to stainless would be to enclose the tool in pressure cases. This is not uncommon, and in fact all downhole tools manufactured by wireline logging companies employ this technique to protect the tool. The tool is designed to allow the hydrostatic pressure to enter the valves and this would have to be changed. The electronics section of the Geoprops Probe is enclosed in a pressure case however. The addition of pressure cases to protect the tool from the environment would require a total redesign of the tool's structural framework.

5. HIGH COST REPLACEMENTS

The packer elements will need replacing due to wear and degradation over time. the cost to replace one inflation element on the straddle packer is formidable but needs to be taken into consideration ($6488.00). The cost to replace the lower straddle packer section of the tool, should the packer section get left in the hole, will be **$20,644.00**. With the redundancy of two tools on the ship, neither one of the parts will have to be maintained in inventory. Eventually, if the tool is developed these costs will come into consideration.

A detailed cost analysis of Phase 1 and Phase 2 is attached.

Third Party Tool Development

Introduction

Because of the complexity of downhole measurements required by scientific ocean drilling, ODP has historically relied in part on outside (i.e., "third party") development of various borehole devices. Some examples are the drillstring saddle packer, the Lateral Stress Tool (LAST), GEOPROPS (for measuring *in situ* physical properties), and the borehole seal. Support for such development comes from a variety of sources. In the U.S., third party tool development has generally been supported by the National Science Foundation, using funds earmarked for ODP and allocated to highly ranked, unsolicited proposals.

Because these tools must eventually make the transition from a developmental stage to actual deployment downhole, which puts them under the management and operation auspices either of the Borehole Research Group at LDGO (for wireline devices) or of ODP-TAMU (for all others), PCOM authorized DMP in 1988 to develop a set of guidelines for the overall process of monitoring third party tool development. The goal is to improve communications between cognizant management entities within ODP and outside investigators/agencies with interests in downhole measurements.

DMP completed its guidelines in January 1989, and PCOM approved those guidelines in May 1989. At DMP's request, and with the approval of the PCOM chair, those guidelines are reproduced here so that both their existence and general applicability will be clear to all concerned parties.

Guidelines for the Monitoring of Third Party Tools

There are two types of third party tools: Development Tools (instruments under development) and Mature Tools (established tools).

A.) For a tool to be considered an ODP Development Tool, and thereby scheduled for deployment, several criteria should be satisfied.

(a) There must be an identified principal investigator.

(b) LDGO (for wireline tools) or TAMU (for all others) should formulate a development plan in conjunction with the principal investigator, and then inform DMP of this plan.

(c) The development plan should:

- indicate the acceptance, desirability, financial and technical feasibility, and the usefulness of the measurements;
- identify development milestones;
- make provision for initial testing on land;
- satisfy safety considerations;
- specify shipboard requirements such as the data processing necessary to make the information accessible on board ship, any special facilities (emphasising areas where the tool is not compatible with existing hardware/software), and appropriate technical support;
- contain a statement of intent that the tool would be available for post-development deployment in ODP.

If DMP endorse the development plan, and subject to PCOM approval, the Panel will appoint a coordinator to monitor on behalf of the Panel the tool's progress through the development plan. The Panel monitor will receive reports from the Principal Investigator on request and will present these to DMP. DMP will review progress at regular intervals and will evaluate tool performance after each deployment. Day-to-day monitoring will be the responsibility of TAMU and LDGO. A tool cannot be regarded as an ODP Development Tool, and therefore cannot be scheduled for future legs, if it has not undergone the above procedure. All tools that are currently scheduled must have a development plan formulated as soon as possible. Once a tool has been accepted by DMP as a Development Tool, the Principal Investigator will be required to co-sign the development plan with TAMU or LDGO as appropriate as a visible accedence to the provisions of the plan. A Development Tool cannot be deployed on an ODP leg unless TAMU/LDGO and DMP are fully satisfied that the terms of the development plan have been fully met.

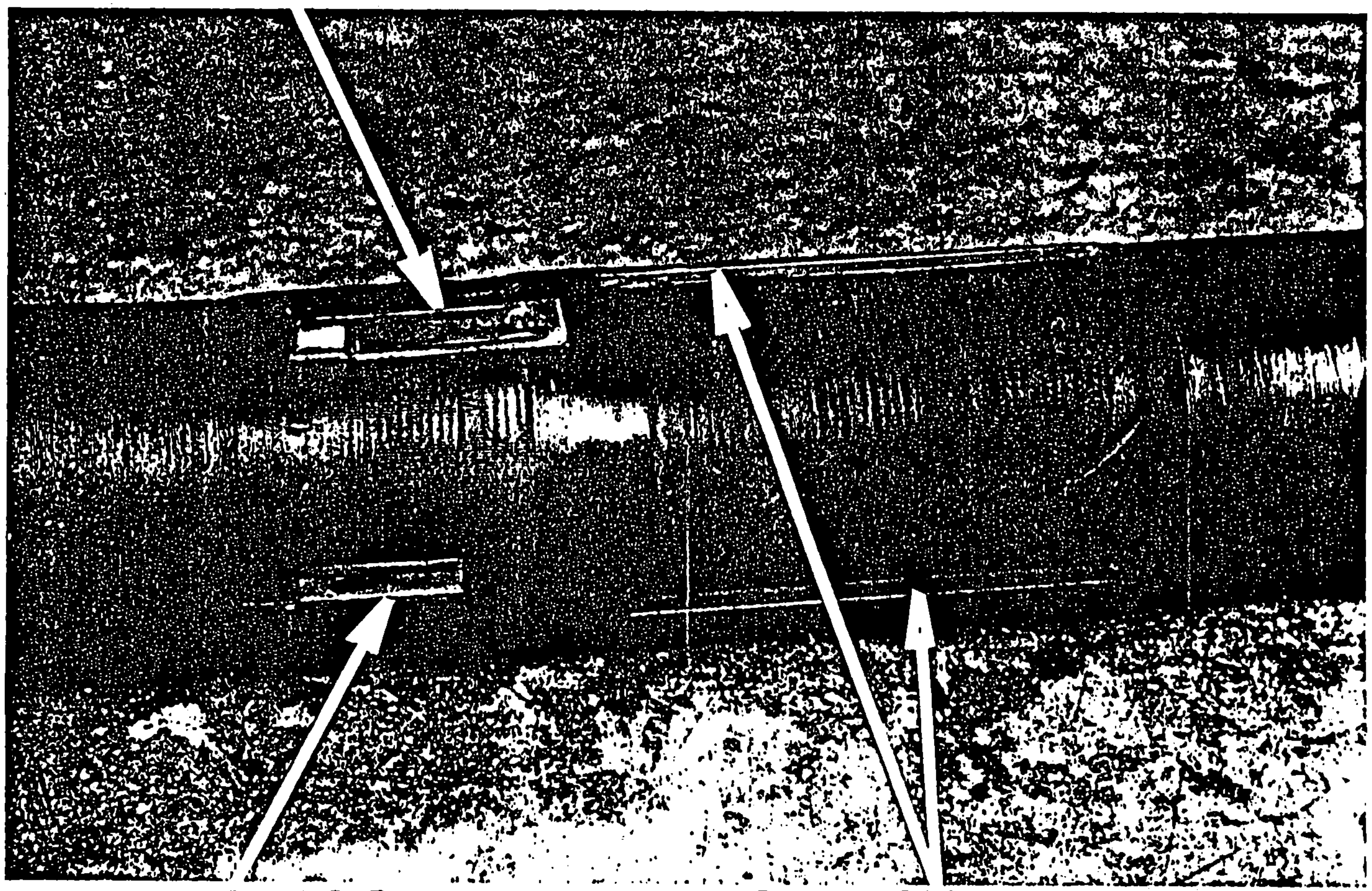
B.) For an ODP Development Tool to undergo the transition to an ODP Mature Tool, i.e. an established tool operated by TAMU or LDGO, there must be DMP endorsement. This endorsement will be given after Panel review of a proposal prepared by TAMU and/or LDGO and submitted to DMP. This proposal must satisfy DMP on the following counts:

- cost of routine operations including shipboard data processing;
- requirements for routine operations/processing;
- availability of spare components;
- facilities for maintenance;
- existence of an operating/maintenance manual;
- safety considerations;
- long-term usefulness of data;
- established track record both in land tests and shipboard deployment.

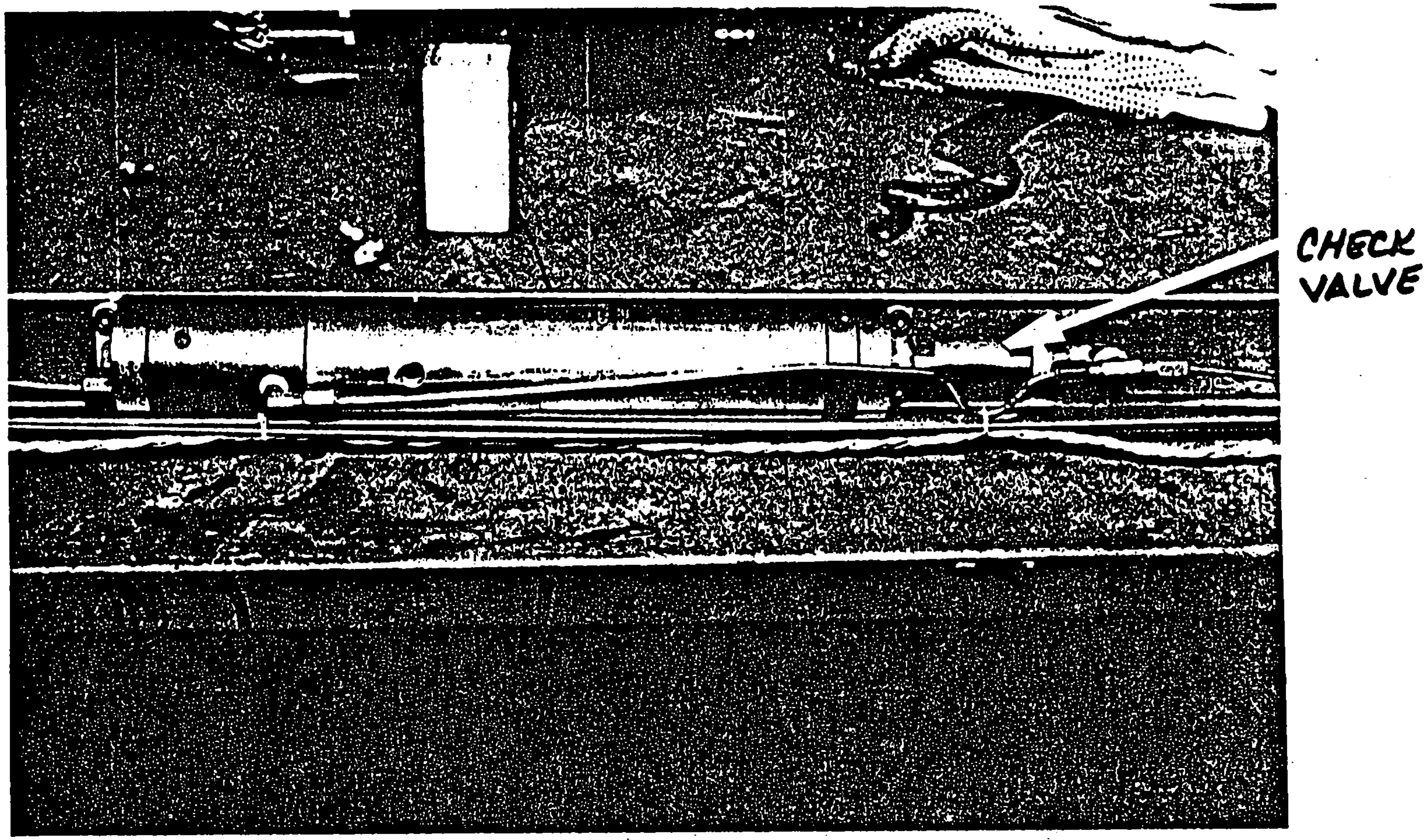
Where several Development Tools are competing for the same Mature Tool slot, DMP will require tha appropriate contractor to evaluate all tools and submit their multiple-tool evaluations to DMP for Panel consideration.

C.) Where an established third party tool is loaned for use in ODP, this tool will have to satisfy the criteria in paragraph B in order to be accepted as the technical equivalent of an ODP Mature Tool. Tools which do not satisfy these criteria cannot be programmed for future ODP legs.

D.) Last-minute requests to include an unproven third party tool within an ODP leg will not be accepted.

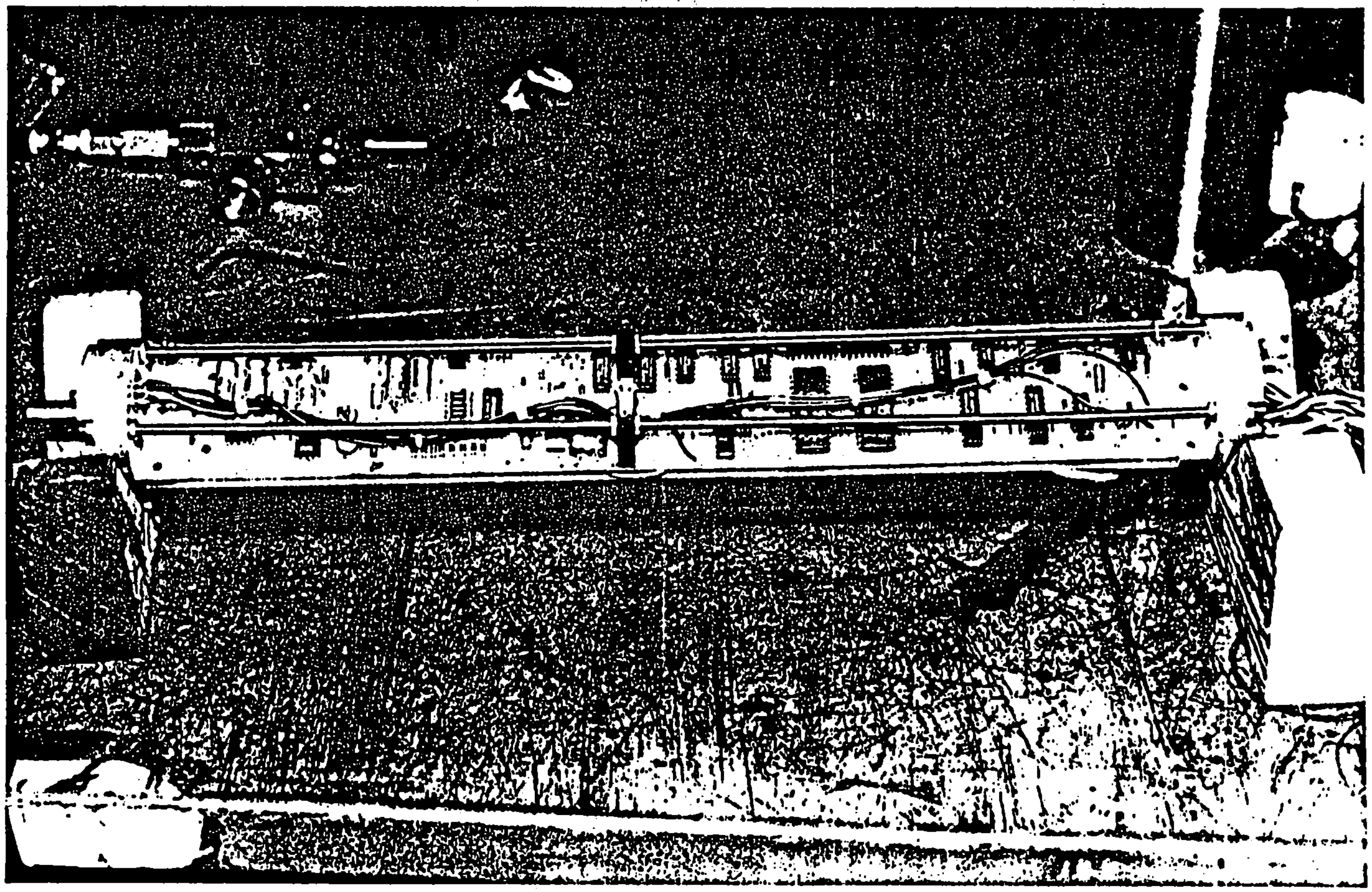


UPPER PACKER ELEMENT
FIG. 1



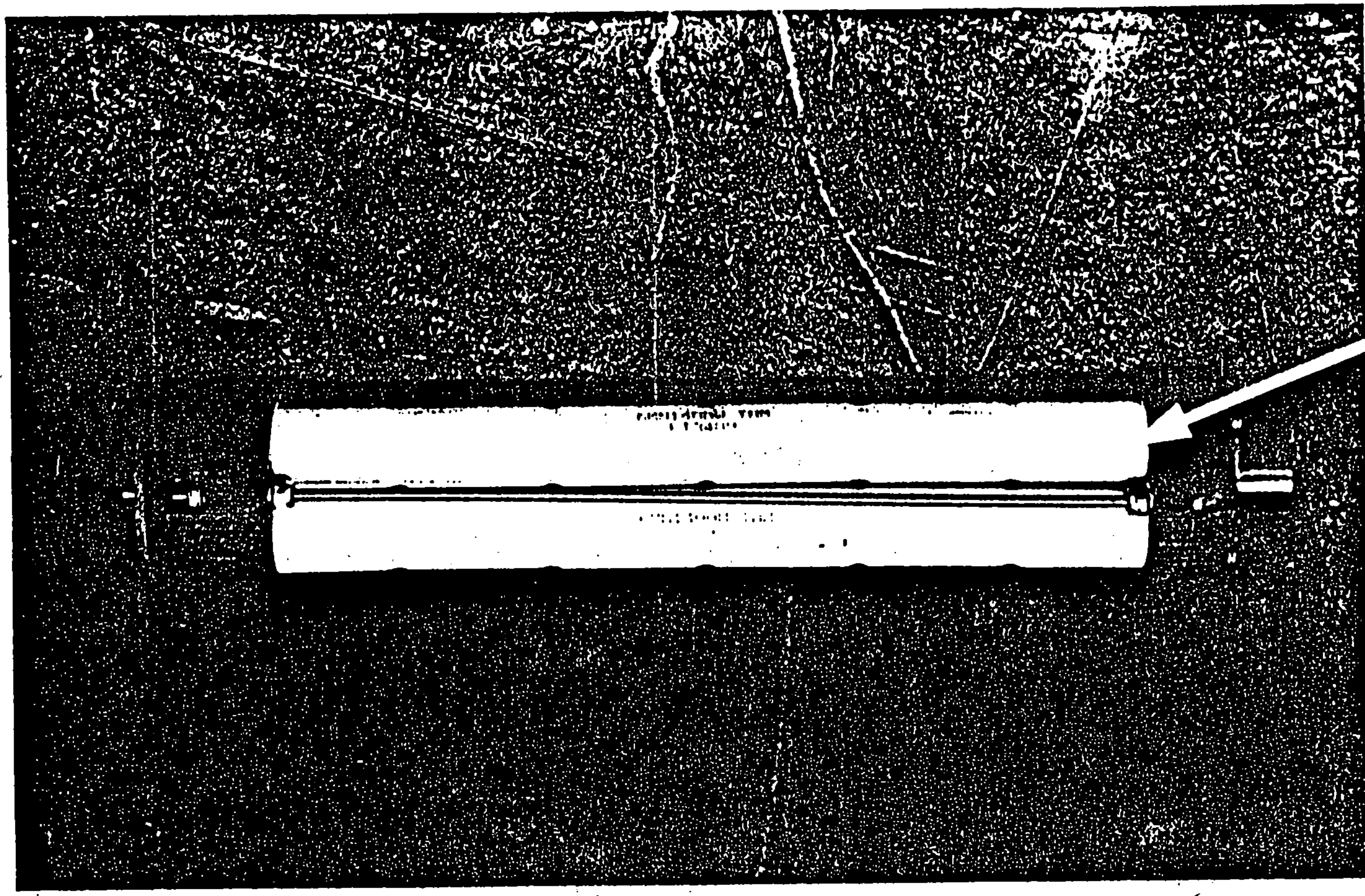
20cc SAMPLE BOTTLE (1 of 3)

FIG. 2



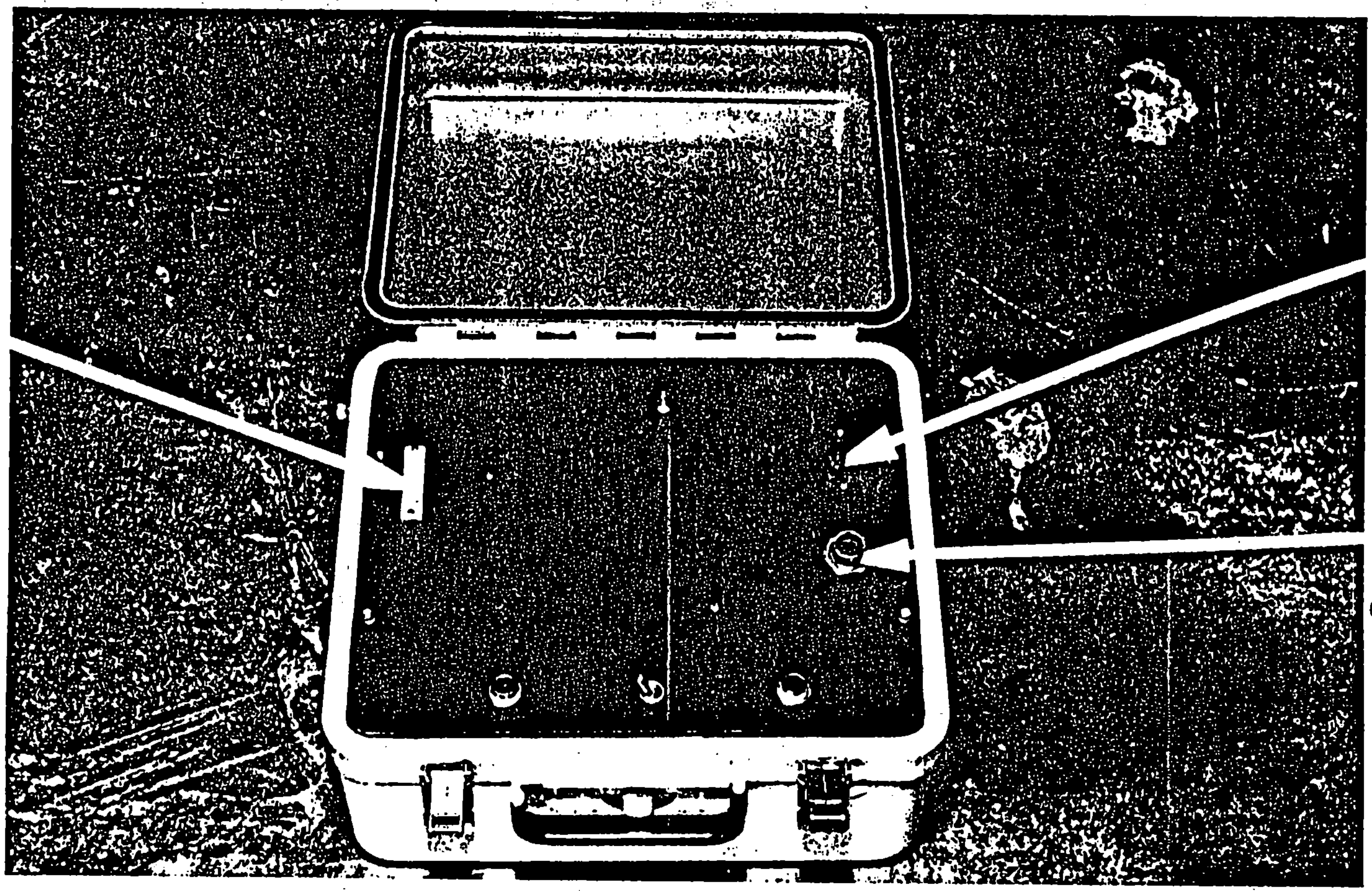
ELECTRONICS SECTION

FIG. 3

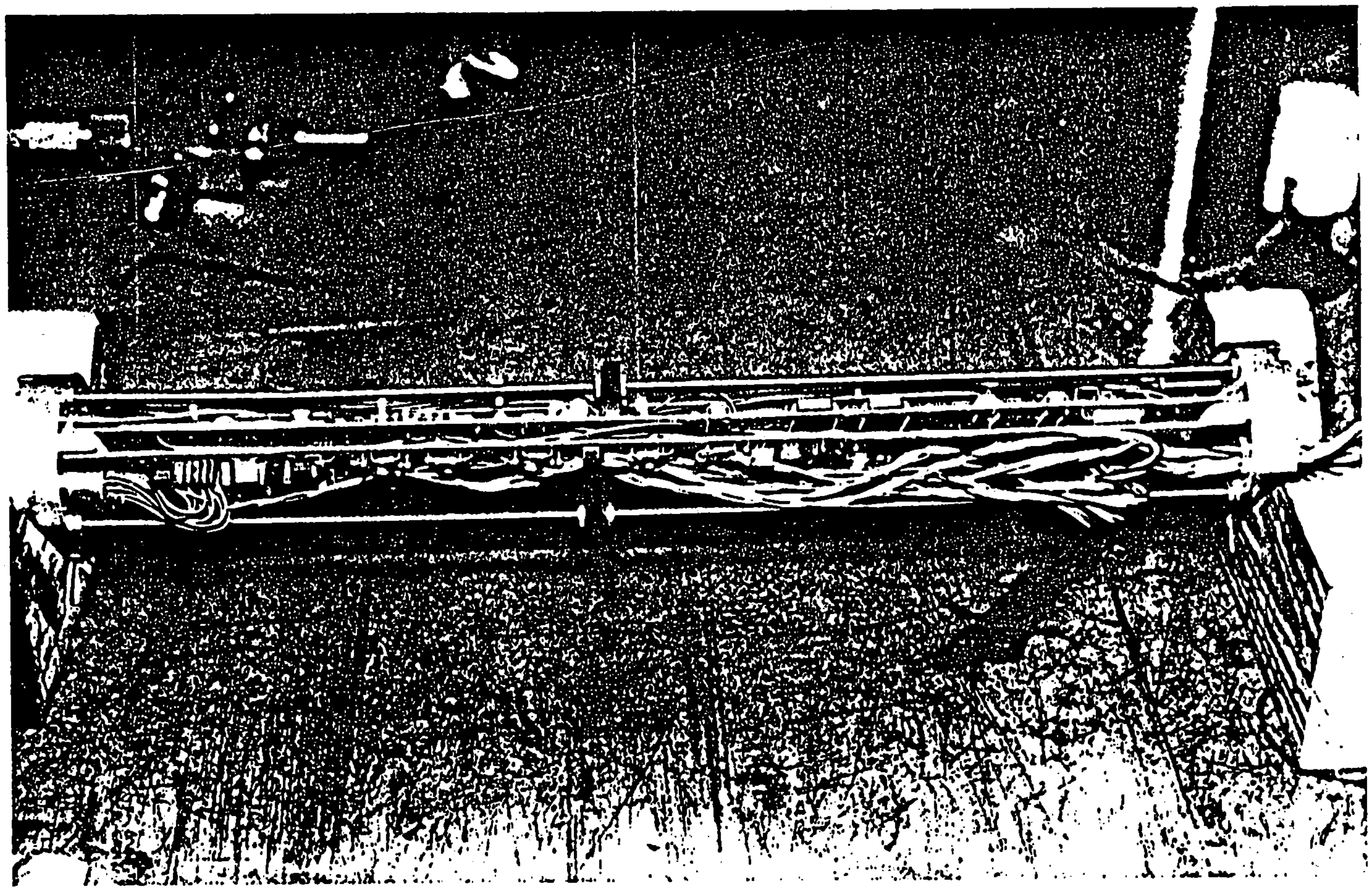


BATTERY PACK

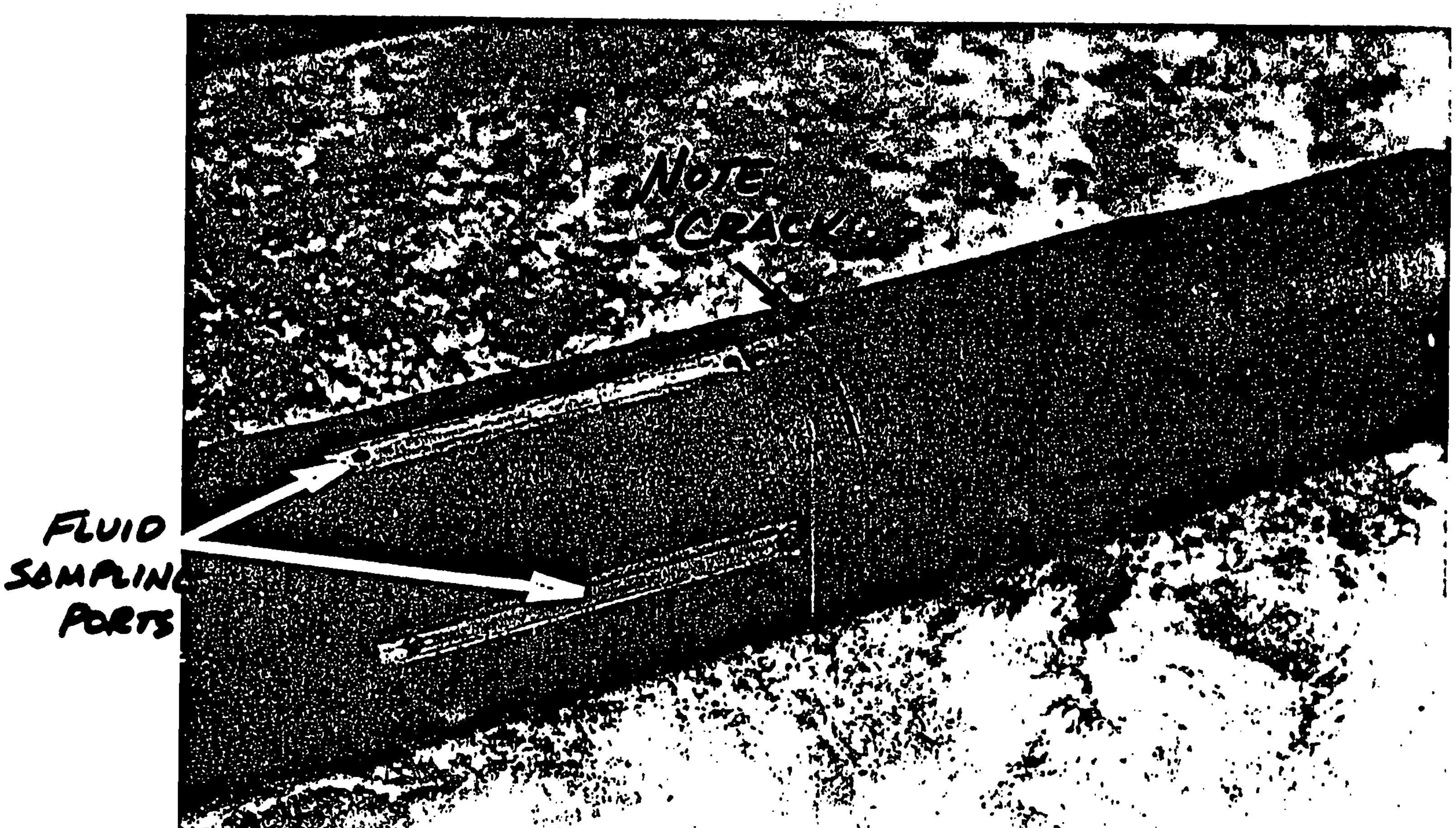
FIG. 4



COMPUTER INTERFACE
FIG. 5

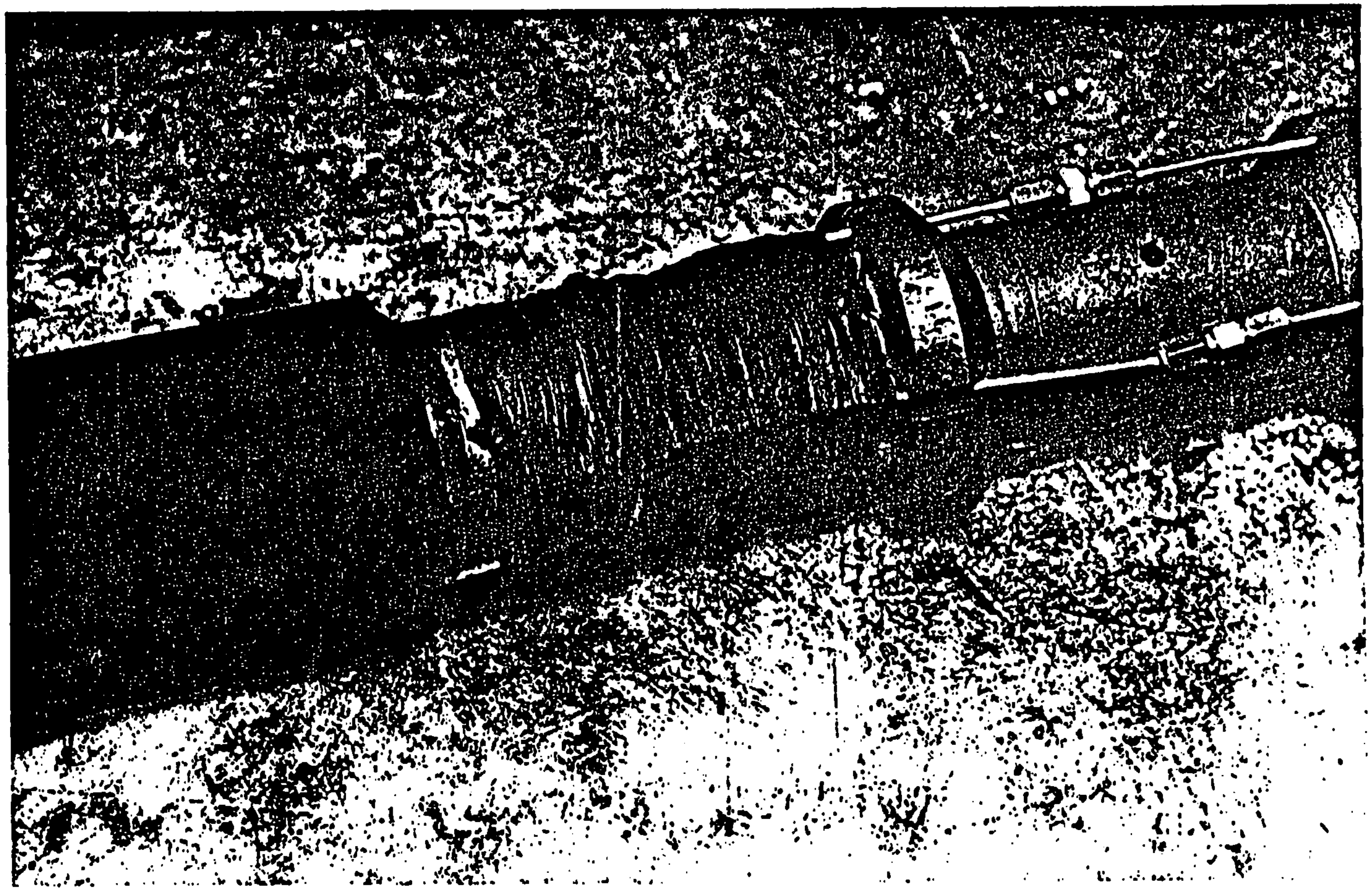


ELECTRONICS SECTION
FIG. 6

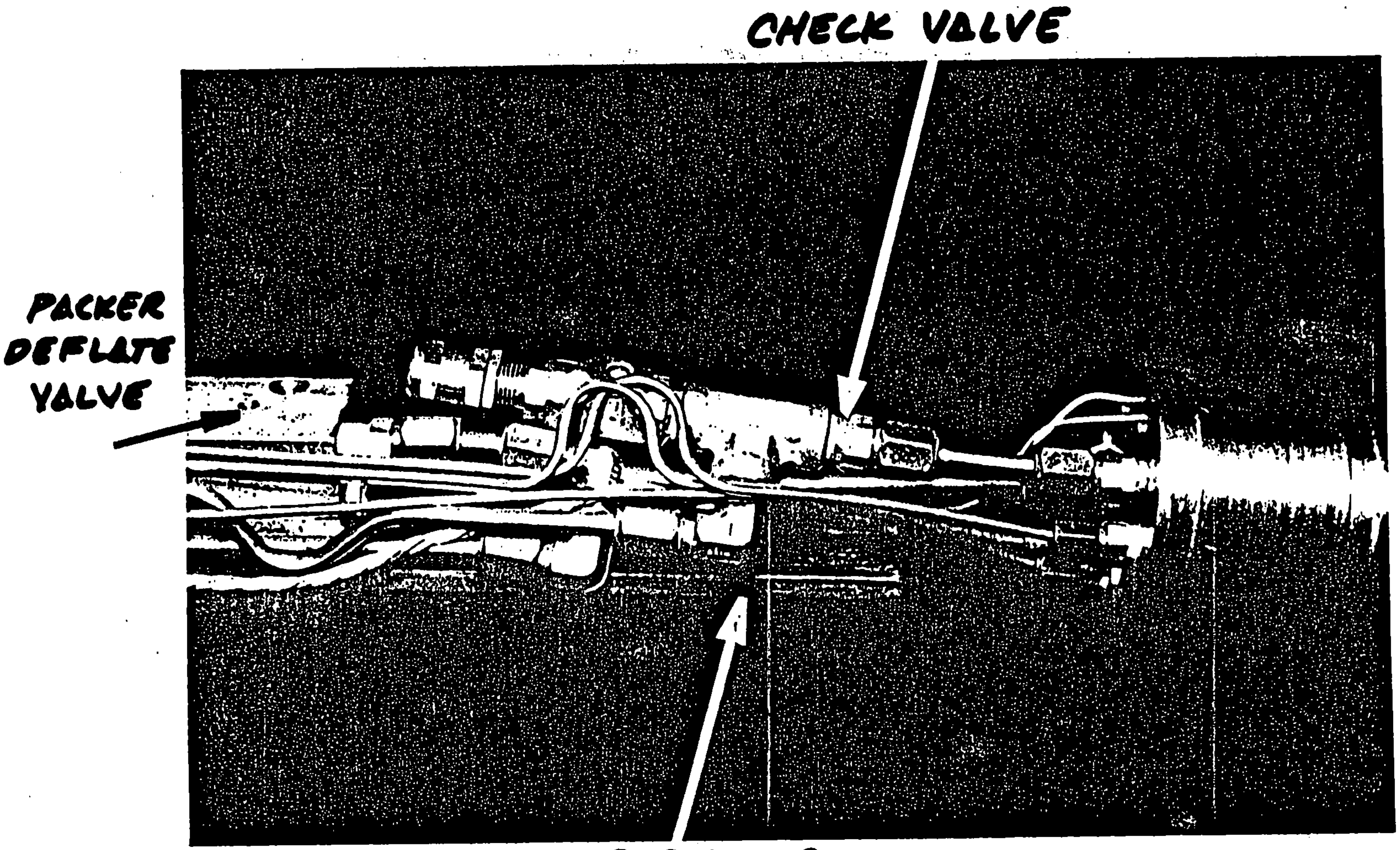


UPPER PACKER ELEMENT

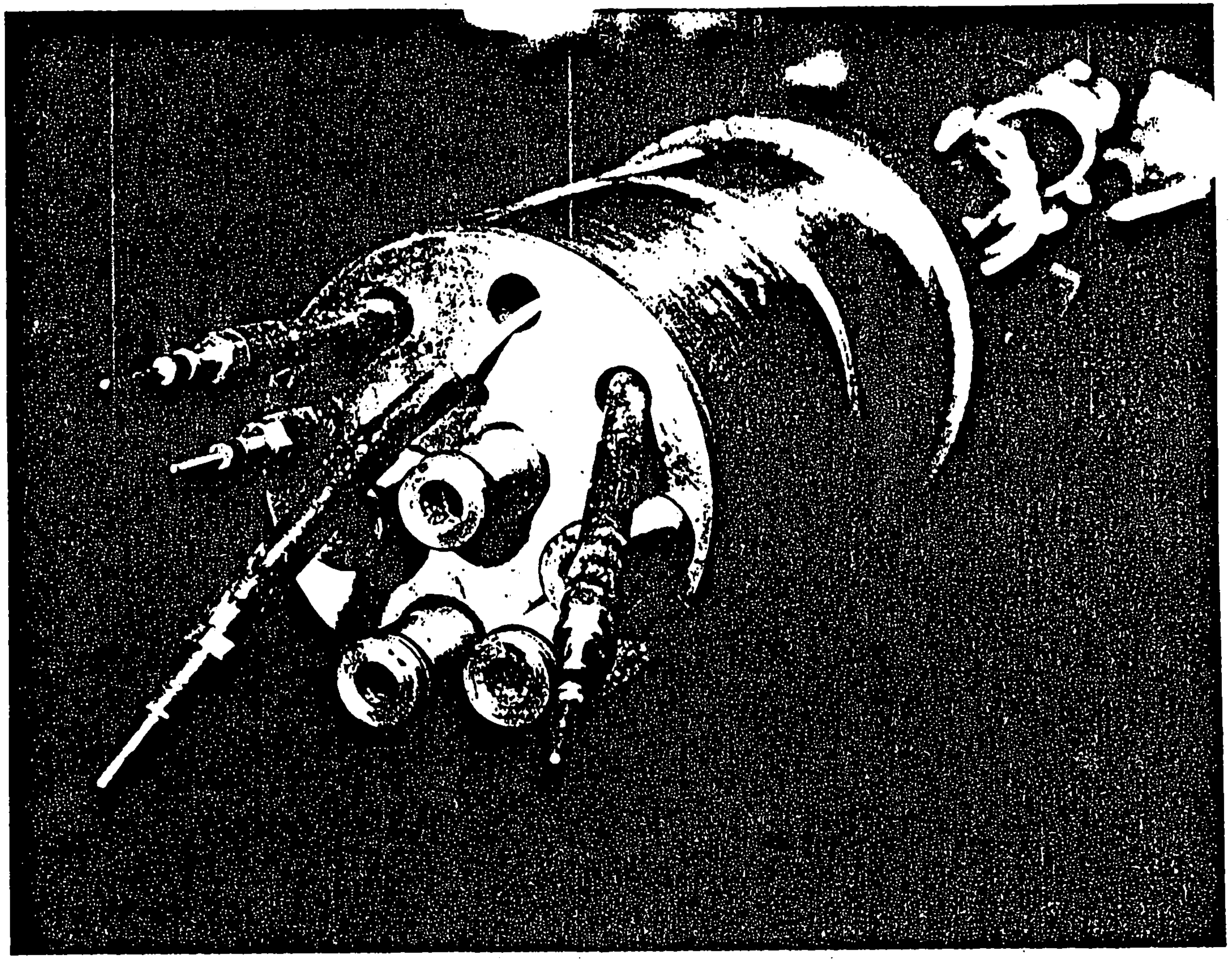
FIG. 7



RUBBER BANDAGING
FIG. 8



SUPPORT BAR / CHECK VALVE
FIG. 9



BULKHEAD CONNECTOR FOR PINS
FIG. 10

PHASE 1 COSTS FOR GEOPROPS PROBE DEVELOPMENT

PHASE 1			COST	SUBTOTAL
1) ADDITIONAL BENCH TESTS				
	Test Facility Setup		$3,000.00	
				$3,000.00
2) PORE FLUID SAMPLE TRANSFER UNIT				
	High Pressure pump		$500.00	
	High Pressure valves		$300.00	
	High Pressure hoses & fittings		$300.00	
	Transfer bottles		$1,500.00	
				$2,600.00
3) CALIBRATION SYSTEM				
	Gauges,test pipe,materials		$1,800.00	
				$1,800.00
4) SHOCK TESTING OF TOOL				
	Third Party test setup		$3,000.00	
	Repair of damaged parts		$1,000.00	
				$4,000.00
5) SPARE/EXPENDABLE PARTS				
	Thermistors (lot)		$88.00	
	Pressure Transducers (lot)		$4,250.00	
	O-Rings (lot)		$205.00	
	Shear Pins (lot)		$50.00	
	Fluid sampling port screens (lot)		$100.00	
				$5,693.00
6) PROTECTIVE RUBBER BOOTS				
	4 @ 250		$1,000.00	
				$1,000.00
7) SHIPPING & STORAGE CONTAINERS				
	6', 8', 10' boxes (2 EA)			
			Already	Budgeted
8) CONSULTANT ENGINEER				
	30 DAYS @ 500/DAY		$15,000.00	
				$15,000.00
TOTAL PHASE 1				$33,093.00

PHASE 2 COSTS FOR GEOPROPS PROBE DEVELOPMENT

PHASE 2			COST	SUBTOTAL
NON CORROSIVE MATERIAL CONVERSION				
	Materials		$5,200.00	
	Labor		$2,550.00	
				$7,750.00
SUPPORT SYSTEM			$4,000.00	
				$4,000.00
BULKHEAD CONNECTORS FOR PINS			$3,000.00	
				$3,000.00
PRESSURE CASES				
	Redesign of system		$10,000.00	
	Parts, seals, etc.		$5,000.00	
				$15,000.00
HIGH DOLLAR SPARE PARTS				
	Replacement inflation element		$6,488.00	
	Complete replacement straddle packer		$20,644.00	
				$27,132.00
TOTAL PHASE 2				$56,882.00
TOTAL PHASE 1 AND PHASE 2				$89,975.00

ANNEXURE III

OCEAN DRILLING PROGRAM

REPORT OF JOIDES WORKING GROUP

ON

IN-SITU PORE FLUID SAMPLING

Conveners: P.F. Worthington (DMP/BP Research)

D.P. Huey (ODP/TAMU)

Held: 23 August 1991

John Willand Marriott

Houston

Texas

Endorsed by Joides Downhole Measurements Panel

16 October 1991

CONTENTS

EXECUTIVE SUMMARY

From the standpoint of in-situ pore-fluid sampling, there are three types of borehole: those that draw in fluids from the ocean, those that produce fluids from the pore system, and those that are static. It is unlikely, but not impossible, that an uncontaminated pore-fluid sample will be recoverable from downhole tool deployment in a fluid-intake borehole. In a producing borehole, where the production rate is sufficient to allow pore fluids to occupy the entire well bore without residual contamination, it might be possible to sample pore fluids by sampling within the borehole itself: otherwise a shallow probe sampler might suffice. For static boreholes, which are seen as the more general case, five possible approaches to the problem of in-situ pore fluid sampling have been identified. They are listed below in increasing order of their operational impact:

(i) an upgraded version of the wireline packer, possibly used as an internal element with the straddle packer;

(ii) a self-boring pore-fluid sampler used in conjunction with the rotary coring system;

(iii) a full-bore straddle packer, possibly using multiple packers set in redrilled cement plug;

(iv) "top hat" re-entry deployment of modified commercial formation testers;

(v) conventional or modified drill-stem testing techniques.

It is proposed that these options be subjected to an engineering feasibility study as the logical next stage.

Different approaches will be necessary in the various types of rock formation that can be encountered. These range from fractured or fragmented formations to highly permeable unconsolidated sediments, to lower permeability indurated sediments and to very low permeability basement rocks. Given the range of conditions of wellbore hydrodynamics and rock coherence that can be encountered, it is likely that more than one tool-deployment option will be needed.

1. BACKGROUND

The need to obtain high-quality samples of formation fluids has stimulated an ODP technological objective that is supported by several of the Program's advisory panels. In order that this objective might be most effectively pursued, the JOIDES Downhole Measurements Panel (DMP) recommended to the JOIDES Planning Committee (PCOM) that a specialist working group be convened to advise on the most appropriate technical directions. This recommendation was accepted by PCOM.

The JOIDES Working Group on In-situ Pore Fluid Sampling, as approved by JOIDES PCOM, had been authorised to meet once only, that meeting to be held in the Houston area. The rationale behind this stipulation was governed by the need to draw upon targeted expertise in the oil industry, much of which was centred around Houston. The meeting was co-convened by Paul F Worthington, Chairman of the JOIDES DMP, and David P Huey, Supervisor of Engineering with ODP at Texas A & M University, the Program's Science Operator. The working group meeting took place on 23 August 1991 at the John Willand Marriott hotel, Houston, Texas. There were 25 attendees including representatives from ODP, industry, government laboratories and universities. In addition, six interested persons who were unable to attend the meeting contributed written suggestions or views.

2. PURPOSE

The working group meeting had two objectives:

(i) to formulate recommendations for developing the technology of in-situ pore fluid sampling to be used in ODP deep ocean boreholes;

(ii) to identify the most promising options as a lead-in to an engineering feasibility study to be conducted in the near future.

It should be noted that this initiative is concerned with sampling pore fluids and not borehole fluids. In flowing wells, these might be the same: if so, the problem can be reduced to one of effective sampling within the borehole column. In general, however, this is not the case, and therefore the exclusion of, or correction for, borehole fluids constitutes an essential technical requirement of the exercise. Further, there is the option to propose intermediate solutions pending further evaluation of the problem. This is an especially important point in view of the long-term interest in sampling fluids at high temperatures (350°C). The strategy is to solve the problem at conventional subsea temperatures before tackling the high-temperature problem.

A further complicating factor which argues in favour of a strategy of incremental development is the general lack of quantitative characterization in ODP boreholes of important formation properties that relate to fluid flow, especially permeability, nature of fractures (if any), and latent borehole stability. Furthermore, formation fluids are sought from two generically different regimes: hard rock and soft sediments. A reasonable first-approach strategy is to solve the hard rock problem initially with the expectation that such a tool would come close to satisfying requirements for fluid sampling in soft sediments. (It also must be noted that ODP currently employs an in-situ pore fluid sampler probe which is commonly deployed in soft sediments with some success.)

The output of the meeting would be a report submitted to JOIDES PCOM, with the endorsement of the JOIDES DMP. IF PCOM accept the recommendations of the working group, the matter would be placed in the hands of a technical steering group for implementation.

3. FLUID SAMPLING NEEDS OF THE GEOCHEMIST

The primary user of pore fluid samples and the data they provide is the geochemist. Russ McDuff (University of Washington) outlined the needs of the geochemist in terms of two key questions. Why do we need pore fluids? What demands do these interests place on sampling devices?

Pore fluid samples are needed to study chemical exchange between the oceans and oceanic crust. Pore fluids in subsea rocks were once seawater themselves, but they have subsequently been modified within the different temperature, pressure and chemical regimes that prevail in the rock systems. The degree of modification provides information on rock-water interchange. Thus, sea water is used as a hydrological tracer. The keys to this investigative process are the active fluid circulation zones within the subsurface. To investigate these most effectively, we need to delineate the spatial distribution of ionic constituents so that significant variations can be mapped over distances of tens to hundreds of metres. To do this, we need lots of samples of pore fluids.

Hitherto, pore fluid samples have been obtained through extraction techniques using sediments obtained from APC cores. A major problem has been the verification of shipboard observations through in-situ retrieval of pore fluid samples. Furthermore, in-situ sampling will be especially important for retrieving fluids from aquifers in hard sediments and/or hard rocks of Layer 2.

Sampling devices must allow key measurement needs to be satisfied in the face of technical constraints. These aspects are summarized in Table 1.

In general, a sample volume of 0.5 - 1.0 litres would be more than adequate for all purposes except isotope analysis. A depth resolution of 10 m would be acceptable. Sampler designs must take into account the need for analysis on deck, e.g. gases and liquids may require different handling approaches. Sampler construction materials must be selected to minimize the potential for contamination of trace elements.

Permeability is not well characterised in ODP holes and therefore the degree of invasion of drilling fluid (sea water) is not known. Further, ODP is interested in both sedimentary and basement rocks, which means that formation fluids will be sampled through both intergranular and fracture flow. These considerations raise additional questions concerning how much fluid volume should be produced before sampling and how samples should be taken in order to extrapolate the dilution profile back to uncontaminated pore fluids.

The current situation is that soft sedimentary rocks are sampled for pore fluids by advanced piston coring (APC) and squeezing the fluid out of the rocks on recovery. These samples are generally considered to be good, even though some pressure artifacts may exist. Technology is needed for recovering samples from hard sedimentary rocks and from basement rocks, which cannot be squeezed in their recovered form. A possible approach is to grind hard rock with known amounts of distilled water, then to squeeze the ground rock. This might allow useful data to be backed out provided that invaded zones are avoided. Again, in-situ samples would be needed to test the validity of the method. The primary requirement of technology is therefore to bring back pore-fluid samples "live" from both soft and hard rocks. In-situ geochemical measurements may be useful for screening purposes prior to sample taking but they are not adequate for meeting the needs of the geochemist.

4. CURRENT TECHNOLOGY

4.1 ODP Drilling and Sampling Practices

Dave Huey described the ODP leg structure with drilled depths mostly within the range 500 - 1000 m below sea floor. Common drilling/coring strategy is to use the Advanced Piston Corer (APC) in soft sediments, typically 200 m thick, the Extended Core Barrel (XCB) in stiff to hard sediments, and the Rotary Core Barrel (RCB) in basement. In-situ pore fluid sampling is presently limited to use of a probe (WSTP) which can be inserted into soft sediments ahead of the roller cone core bit at selected intervals between 10 m cores. The drilling system is based on a 5 and 5.5 inch drillstring with a 4.125 inch I.D. Sea water is the primary drilling fluid although bentonite mud slugs are spotted occasionally for cuttings removal to the seafloor. Cuttings returns are NOT taken back to the ship, i.e. the system is riserless. This means that fluid extraction from sampled hard rock, using a drilling-fluid tracer to correct for invasion, as practised in the oil industry, is not admissible here.

A wireline retrievable Pressure Core Sampler (PCS) can be deployed when drilling in the XCB mode to take cores of length 1 m which are returned to deck under hydrostatic pressure. The PCS does not yet allow the recovered solid sample to be accessed under pressure although the fluid might be accessed with skilful manifolding.

The Water Sampler/Temperature/Pressure tool (WSTP) is a probe tool that has recently been strengthened. This tool can recover samples from sediments soft enough for direct push-in insertion of a small probe (roughly 2-inch diameter by up to 1 m long). There are doubts about sample integrity although some investigators have reported good results in gathering representative soft/medium sediment pore fluids. The tool has recently been redesigned for durability and improved chemical inertness and may serve in some fashion as an interim sampling device.

A re-entry straddle packer system (TSP) is used occasionally for pulse/permeability tests in the open sections of cased boreholes. This tool would require a fluid sampling and pressure-drawdown capability in order to meet the requirements of an in-situ pore fluid sampler. A key issue is achieving open-hole seals with the two inflatable elements. Sealing is more difficult with sea water in the hole than with conventional drilling mud through which the creation of a mud cake enhances sealing capability. The inflated elements must also hold adequate up- and down-loads to allow for passive heave compensation of the drillstring. The pipe is then heaving relative to the deck of the ship which complicates access to the pipe for water sampler go-devils, electric wirelines and other instrumentation requirements. The TSP has also been used in casing where it was desired to test the entire open hole interval: again, sealing problems have been exposed.

The Motor-Driven Core Barrel (MDCB) diamond-cores a 3.75 inch pilot hole of maximum length 4.5 m through the Bottom-Hole Assembly (BHA) which contains a roller-cone bit. The aim is to deploy the Geoprops Probe, a probe tool designed to inflate packers and sample fluids in this fresh on-gauge hole. The Geoprops Probe is not yet proven technology. The limited lifespan of the large diameter, open-throat (4-inch I.D. between the roller cones) bits in basement rocks suggests that this approach would not constitute a long-term solution unless more durable bits can be developed (possibly anti-whirl PDCs or large kerf diamond bits).

4.2 Wireline Packer

Erich Scholz (Lamont Doherty Geological Observatory) outlined the status of the wireline packer, subcontracted over a three-year period to Stanford University and built by TAM, Inc., of Houston. The tool is of diameter 3.5 inches and is designed to be deployed in medium/hard rock (RCB/XCB cored) through 4-inch drillpipe and to inflate two packers to a diameter of 10-12 inches (Figure 1). Problems have been encountered getting power down to the packer inflation pump motors: a ruggedization of the downhole power supply should solve this problem. The packers are subjected to a very high expansion after which they have tended to stay deformed, preventing the through-pipe recovery of the tool. The total fluid flow path within the tool is 50 ft long and there are two troublesome zones of dead volume which contribute to sample contamination. The wireline packer is in real-time communication with the ship. A sample sensor chamber allows samples to be verified chemically before they are taken.

This project has passed through the prototype development stage and sea trials were attempted on one ODP leg. Following sea trials LDGO-BRG produced a highly detailed report summarizing the deficiencies discovered in the prototype tool and outlining plans for second generation improvements. That report was submitted to DMP. Figure 2 shows the proposed layout for the improved version of the tool. The project is currently dormant awaiting possible further funding (of the order of $100K) to develop a second generation tool. At this time such funds have not been approved.

4.3 Commercial Wireline Formation Fluid Samplers

Peter Wells (Schlumberger) reported that the Schlumberger Repeat Formation Tester (RFT), introduced in 1975, is to be replaced by a Modular Formation Dynamics Tester (MDT), a Phase I version of which is now available as an engineering prototype. The tool has a diameter of 4.75 inches and can be deployed in holes of at least 6 inches in diameter with a maximum practical diameter of 15 inches. Pressure and temperature ratings are 20 000 psi and 400°F, respectively. The MDT uses a "doughnut" packer which can be pressed against the borehole wall with up to 8000 lbs force.

A Phase II version of the tool is to become available within the next 9 months. This will offer two additional modules. The first is a multiprobe module of diameter 6 inches, in which flow can be initiated at one probe and pressure measured at two others, thereby overcoming wellbore damage effects on permeability determinations: the maximum differential pressure is 4000 psi. The second is a multisample module of diameter 4.75 inches which allows several fluid samples to be taken on each descent. The samples can be screened for resistivity and pumped out if not required.

The seals are doughnut packers. The pumpout module is used in reverse for packer inflation. The tool is about 100 ft long. Modules can be put together in any way, so that sampling can be done within 2 ft of the bottom of the hole. The primary goal is, however, better permeability measurement through improved pressure resolution. Development of a slimhole MDT of diameter 2.75 inches would be at least four years away.

A summary of the tool specifications of commercial formation samplers is presented in Table 2. A clear option is to confine ourselves to commercially available tools and to drill dedicated holes to accommodate them or deploy them in re-entry holes (either full-sized cone or mini-cone) where opportunities arise, i.e. in conditions similar to current open-hole straddle-packer work. The tools would probably require modification from doughnut seals to packer seals in order to operate meaningfully in fractured rocks. Peter Wells made it clear that Schlumberger tools are designed specifically for the types of formation typically containing hydrocarbon reserves and are not necessarily optimal for pore fluid sampling under the wide range of conditions that may be encountered in ODP boreholes. Even in the slightly-more-predictable world of oil and gas drilling, the practice of formation fluid sampling is considered by the experts to be more art than science; Schlumberger maintains a "suck and see" philosophy in the general application of their samplers.

None of the commercial tools is capable of operating under standard ODP conditions, i.e. running through a 4-inch I.D. drillpipe and expanding to pack-off an interval of diameter 10-12 inches. However, with modified seals they might work in a dedicated hole. A key issue would be the effectiveness of the packer seals in the absence of a mud cake: some authorities believe the presence of a mud cake on the borehole wall is essential to achieving suitable open-hole packer seals. It remains to be demonstrated whether or not packer seals sufficient for our purpose can be obtained in ODP holes without a mud cake.

4.4 Drill Stem Testing

Lance Rayne (Halliburton Reservoir Services) described state-of-the-art drill stem testing (DST) technology. The drill stem test is an exploratory tool commonly used in the oil patch to clean up the invaded zone surrounding the wellbore and to determine formation-flow and pressure properties relevant to the later production of the well. There are two types of DST: cased hole and open hole. Cased hole DSTs are run when formations are low pressure or water sensitive, or there is not likely to be an adequate packer seat zone. Cased hole DSTs are more expensive and complex. Open hole DSTs are just the opposite, but they are more of a gamble. In the oil industry the gamble is the possibility of stuck pipe, live gas or oil back to surface, and exposing the entire open hole interval to reservoir pressure; in ODP's case the primary problem would relate to the risk of stuck pipe. The type of DST run depends upon the company, the hole, and the formation.

Common practice by Halliburton is to go in with an underbalance using compression-set or inflatable packers of length 4 ft. Small diameter tubing is often used as the deployment string for cased hole DST. Coiled tubing as a conveyance mechanism has been explored and could be an option for ODP, except that the tubing has a 15 000 ft depth limit: this would be restricting for ODP and would, in any case, create a storage problem on board ship. Drillpipe is the conveyance device for open hole DST. Halliburton does possess a slimhole test string of diameter 1.75 inches.

As a means of in-situ pore fluid sampling DST offers proven technology plus the advantage of gaining permeability and formation pressure measurements as well as numerous opportunities for fluid sampling. Flow times to achieve adequate sample sizes of representative formation fluid samples can range from a few minutes to a month or more. This would be the most powerful and, probably, most promising method to achieve in-situ pore fluid samples for ODP holes. It would also be the most expensive and time-consuming approach.

Robert Desbrandes (Louisiana State University) described his US patent for a new DST tool, which can be added to a conventional DST assembly. This tool allows for a very slow decompression of the fluid trapped below the packer instead of the conventional fast pressure drop. As the fluid expands, the pressure decreases linearly with time until the formation pressure is reached. At that point the formation starts to flow and the slope of the pressure curve changes. If surface monitoring is available, it is possible to compute the pressure derivative with respect to time: this helps to determine the start of formation flow. If drawdown is allowed to continue, permeability can be evaluated. The exact formation pressure can be determined by stopping the drawdown as soon as formation flow is detected and observing the subsequent mini-build-up. The new technique is particularly useful in low permeability formations, where a conventional DST can be recorded as "dry".

4.5 Air-Lift Sampling

Karl-Erik Almen (Sweden Nuclear Fuel and Waste Management Company [SKB]) described sampling practices for nuclear waste disposal in 2-inch diameter holes of depths up to 1500 m. Downhole computer-controlled tools are used. These comprise pumps, switching valves, Eh/pH flow-through cell, and water sampler. The tools are operated with an umbilical line. Packers are water-pressure inflated through hoses in the umbilical line. Fluid is air-lifted from between the packers. A tracer is added to the drilling fluid in order that the integrity of the recovered sample might be confirmed.

4.6 Bottom-Hole Core and Test System

Robert Desbrandes described a procedure designed for obtaining pristine fluid samples in oilfield environments. A drillstring with a basal packer is lowered to the bottom of a hole. The bottom-hole rock face is cleaned by circulating (with seawater). A slug of mud may be needed for the packer to make an effective seal. The packer is set and an inner assembly with drilling, coring and sampling capability is lowered through the drillpipe. The inner assembly is linked to the surface by coiled tubing. Underbalance is created by airlifting through a second tube in the upper part of the drillpipe. The in-pipe assembly is used with a small diameter downhole motor to drill beyond the drillstring and the formation is allowed to produce. Formation fluid moves up the annulus between the drillpipe and the assembly where it can be tested and sampled. There is no invasion because of the maintained underbalance.

The system is conceptual at the present time. Engineering studies of the concept are continuing while commercial participation is sought.

5. GENERIC REQUIREMENTS

As an aid to discussion of various proposed fluid sampling tools, technologies and methodologies, the following were identified as essential components of any in-situ pore fluid sampling system that might be devised. Any valid approach to fluid sampling must incorporate the principal elements.

5.1 Isolation of Sampling Zone from Borehole Fluid

Elastomeric packers
Cement bags
Insertion probes
Eutectic metal packer poured in place
Long seal by cement injection
Locally created mud plug to assist packer seals
Tracer detection of invasive drilling fluids to identify isolation failures

5.2 Pressure Differential/Drawdown Methods

Hydrostatic imbalance
Gas lift

Vacuum
Pumps (downhole or on deck)
Piston action (small scale or full pipe swab)
Fluidic motor/pump combination
Explosive suction (gas lift, vacuum)

5.3 Filtering

Sand packs, gradient
Sintered metals, screens

5.4 Sample Receptacle(s)

Stainless
Titanium
Rubber bladder
Glass coated
Transportable

5.5 Downhole Instrumentation

Process verification (resistivity)
Temperature
Pressure

5.6 Running/Retrieving Equipment

Accommodate temperature expansion
Prevent lifting of spring-loaded valves off-seat with subsequent contamination
Must be ODP compatible

6. POSSIBLE APPROACHES

The meeting broke into syndicate groups to consider possible approaches to the problem of in-situ pore fluid sampling. Each attendee was asked to participate in one group selected from the generic categories of possible solutions listed below. The solution groups are prioritized here as most-to-least attractive for ODP from the operational point of view, i.e. how easily they could be assimilated into existing ODP operations and have the least impact on other use of ship's time. Clearly, the easiest/lowest impact plan may not necessarily be the best or most desirable when additional factors are considered, i.e. probability of success, cost, degree of new development required, time to bring to fruition, etc.). Thus, each of the groups is still considered viable until further feasibility analysis work is done.

(i) electric wireline deployable through-pipe tools < 4 inch diameter

(ii) Other tools/probes < 4 inch diameter (not electric wireline deployed)

(iii) Straddle packer with enhancements for water sampling

(iv) "Top Hat" deployment of tools > 4 inch diameter

(v) Conventional or modified drill stem testing methods

The following are summaries of the group deliberations. No one at the meeting opted for group (v), drill stem testing, since the approach in that case was considered self-evident.

6.1 Modified Wireline Packer

A functioning wireline sampler would provide the best of both worlds: everyday use through the drillstring and real-time communication. The development of a second generation tool is a viable alternative. The known problems with the prototype tool must first be rectified by restructuring its layout. The filter must be relocated close to the intake. The sample bottles should be positioned as close to the intake as possible. The remaining problem is that of packer deflation to permit passage back through the drillpipe. In its present form as a stand-alone tool, disposable packers could be used in non re-entry holes. This is feasible because the packers are of low cost and are unlikely to be suitable for re-use. We are currently limited to 350-400 psi maximum pressure differential across packers even though the pumps are capable of providing 1 kbar. This pressure differential could be increased in a smaller hole, e.g. a DCS or an MDCB hole, thereby providing a more effective seal. An alternative solution would be to use the tool as an inner element in conjunction with the drilling-deployed straddle packer. Both options could, of course, be progressed together. Either way, a careful study of the mechanical characteristics of commercially available packers is essential. The traditional supplier may not be the best. Others have suggested that they might be able to supply a packer with significantly higher differential pressure capability.

Other considerations and recommendations are:

Drawdown	-	the tool has a proven pump
Filtering	-	a coarse screen at the primary intake plus a fine filter at each individual sample bottle
Sample Receptacle	-	possibly titanium
Instrumentation	-	surface readout of pressure, temperature and resistivity
	-	quartz gauges for pressure and temperature
Running/Retrieving	-	7-conductor wireline

Development could take place in two stages: Phase I - development of restructured system with pressure, temperature and fluid resistivity sensors; Phase II - addition of advanced chemical sensors.

6.2 Self-Boring Fluid Sampler

This is conceived as a non-wireline tool. The rotary coring system produces a nominal 10-inch hole. There is a 2.31-inch opening in the throat. The concept is to extend a 2-inch diameter self-boring probe out through the roller cone bit and allow it to drill ahead of the bit (perhaps 1 m). One packer element in the form of an extended tapered cork could be used to seal the 2-inch hole. Pressure drawdown could be introduced by imbalanced pistons in a sample bottle within the drilling assembly.

The group accepted that this concept represents much new technology and would take a significant development effort to perfect.

6.3 Straddle Packer with Enhancements

The existence of the TAM Straddle Packer makes it an attractive starting point for enhanced technology to achieve hard-rock formation-fluid samples. A generic problem with packer deployment has been obtaining good seals (although the TSP might fare better than most in this respect). This difficulty would be mitigated somewhat by aiming at more easily sealed formations (hard rock that is no more than slightly fractured) and might be solved by using multiple packers and setting them in redrilled cement plugs. In partially cased holes one packer could be set in the casing shoe.

Drawdown and appropriate sample receptacles would have to be added to the TSP facility to produce a pore fluid sampling capability. Possible means of achieving adequate pressure differential to force the formation to produce into the interval between the packers are:

gas lift using coiled tubing or DCS tubing to introduce high pressure air to the inside of the drillstring a few hundred feet below the keel (there are problems with heave compensation compatibility),

conventional inside-the-pipe swab techniques,

a downhole pump operated by repeated tensioning of the sandline.

6.4 Top-Hat Re-entry Deployment of Large Tools

Downhole tools larger than 3.75 inches in diameter need a method of conveyance to the seafloor other than the standard through-pipe method. The "Top Hat" deployment is an idea or conceptualization whereby the logging tools will be attached to the end of the BHA with an internal female wet-connect which will later latch up to a male wet-connect that will be pumped down the drill pipe after re-entry is achieved. The Top Hat will be needed to protect the tool from damage when stabbing into the re-entry cone. This is visualized as a piece of casing that will cover the tool and latch into the re-entry cone to disconnect itself from the tool so that the tool can be lowered into the hole under its own weight. Another possibility is to allow the tool to remain fixed to the BHA and deploy it downhole by running drillpipe in a manner identical to current logging practices in horizontal wells. In either case the side-entry-sub would be included at the top of the drillstring as shown in Figure 3. The figure shows the side-entry-sub adjacent to the Top Hat as re-entry is about to occur.

The group pointed out that the above technique would be complicated by the problem of the umbilical line to the re-entry TV being present in the water external to the pipe at the same time as the logging line. A better solution might be as follows. The logging tools and BHA are assembled on the rig floor and lowered to the seafloor with the drill pipe. When the assembly is in close proximity to the re-entry cone, the underwater television will be lowered to assist the re-entry process. The Top Hat will stab into the re-entry cone and the TV will then be recovered. The side-entry-sub will then be added to the top of the string and the logging line will be run to the bit and attached via wet connect. By means of a J-latch or some other latching method, the Top Hat will release from the tool and either the assembly will be free to proceed down hole or the pipe will be run into the hole to convey the tool.

After sampling is completed the tool can be brought back to the surface by relatching it into the Top Hat and tripping the pipe until the side-entry-sub reaches the floor. The sub can then be removed, the wet-connect unlatched, and the wireline retrieved. The drill pipe is then tripped out until the tool reaches the surface and the samples are retrieved.

The Top Hat approach is compatible with commercially available formation testers. It might provide important preliminary information on formation permeability and the volume of flow needed to obtain a true pore fluid sample. Doughnut seals may not be adequate for ODP purposes because they are not designed for fractured rocks: a packer tool is needed but this might be achievable through modification of existing commercial tools in the absence of diametral constraints. To ensure adequate sealing it may be necessary to spot about 100 m of cement after logging, to drill through it, and then to deploy a packer formation tester with the upper packer in cement and drawdown created by a pump module up above. Produced fluids could be monitored for resistivity.

6.5 Resume

A summary of the attributes of these four possible approaches is presented as Table 3.

7. FUTURE DIRECTION

The next stage is to set out the fruits of these deliberations for technical scrutiny and advancement. The Messages of Sections 4 and 6, viewed in the light of the generic requirements of Section 5, provide a basis for an engineering feasibility study.

The objective of the feasibility study would be to evaluate the technical and economic feasibility of the identified candidate concepts weighed against their probable ability to produce the desired scientific results. It is anticipated that such a study could and should be completed before the end of calendar year 1992. The feasibility study should be directed by a steering group that contains both scientists and engineers. The feasibility study should be carried out by an appropriate consulting engineering firm, selected by competitive bid, monitored by ODP-TAMU, and reporting to the steering group at the end of the study. Results of such a study should lead to immediate identification of the most promising technological paths which should then be funded and pursued.

APPENDIX

JOIDES WORKING GROUP ON IN-SITU PORE FLUID SAMPLING

LIST OF MEMBERS

			Karl-Erik Almen	(Sweden Nuclear Fuel and Waste Management Co.)
		(D)	Roger N Anderson	(Lamont-Doherty Geological Observatory)
			James T Aumann	(Aumann & Associates)
			Edmond I Bailey	(Stress Engineering Services)
			Greg Bayhurst	(Los Alamos National Laboratory)
(B)			Keir Becker	(RSMAS, University of Miami)
			Ronald Boggess	(Fugro McClelland)
(B)	(C)		Hugh Crocker	(Crocker Data Processing)
	(C)	(D)	Robert Desbrandes	(Louisiana State University)
			Wayne A Dunlap	(Offshore Technology Research Centre, TAMU)
(B)		(D)	Andy Fisher	(ODP, TAMU)
(B)		(D)	Glen Foss	(ODP, TAMU)
			Flip Froelich	(Lamont-Doherty Geological Observatory)
			Bob Green	(Baker Sand Control)
(A)		(D)	David P Huey	(ODP, TAMU)
			Craig Hyland	(Terratek Drilling Labs.)
(B)	(C)		Peter Lysne	(Sandia National Laboratories)
			Raymond Madden	(Madden Systems, Inc)
			Russ McDuff	(University of Washington)

		(D)	Scott McGrath	(ODP, TAMU)
			Dodd Miller	(Baker Oil Tools)
			Jack E Miller	(Stress Engineering Services)
			Bill Mills	(ODP, TAMU)
(B)		(D)	Tom Pettigrew	(ODP, TAMU)
			Eugene C Pollard	(ODP, TAMU)
		(D)	Lance M Rayne	(Halliburton Reservoir Services)
			Kenneth Schmitt	(Stren Co.)
			Erich Scholz	(Lamont-Doherty Geological Observatory)
			Ray Solbau	(Lawrence Berkeley Laboratory)
			Peter K. Swart	(RSMAS, University of Miami)
(A)	(C)	(D)	Paul F Worthington	(BP Research)

(A) Co-convener
(B) Unable to attend working-group meeting: written contribution
(C) Member of JOIDES Downhole Measurements Panel
(D) Provided editorial contribution to the report

TABLE 1

GEOCHEMICAL REQUIREMENTS OF FLUID SAMPLES

Measurement Needs	Classification/Status	Sample Volume	Problems
Major anions/cations (Ca, Mg, Na, K, Cl)	Essential/Routine	Few millilitres	Artifacts Handling protocol
Bioactive/Redox sensitive (C, N, P, S)	Essential/Routine	10 millilitres	Integrity Handling protocol
Gases Inert (especially He) Reactive (e.g. CH_4)	Essential/Routine	50 millilitres (gas tight)	Integrity Handling protocol
Trace Inorganics	Desirable/Research	Few millilitres	Contamination
Trace Organics	Desirable/Research	Few millilitres	Contamination
Isotopic Tracers	Desirable/Research	Tens of litres	Handling protocol

Notes

ARTIFACT = reaction between formation and fluid induced by the act of sampling, e.g. imposition of a pressure gradient

INTEGRITY = samples continue to act in the sampling device as they did in situ, so that they can be studied as they are, not as they have become.

TABLE 2

COMMERCIAL FORMATION TESTERS

Company	Tool	Temp (°F)	Tool Diam. (in.)	Minimum Hole Size (in.)	Maximum Hole Size (in.)
Atlas	FMT	350	5.13	5.88	9.88
			6.25	7.13	12.25
			7.88	8.75	16.00
			9.19	10.13	20.00
BPB*	SRFS	300	3.50	4.00	6.00
Schlumberger	RFT	350	5.20	6.50	15.50
	RFTTN-OH	400	3.38	4.75	6.75
	MDT	400	4.75	6.00	14.25
Halliburton	SFT	375	5.50	6.25	14.25
	SFTT-B	375	4.75	5.50	8.63
			6.50	7.38	19.00

* development phase

FMT - formation multitester
RFT - repeat formation tester
RFTTN-OH - ditto, slimhole, HE
MDT - modular formation dynamics tester
SRFS - slimhole repeat formation sampler
SFT - selective formation tester
SFTT-B - sequential formation tester tool

TABLE 3

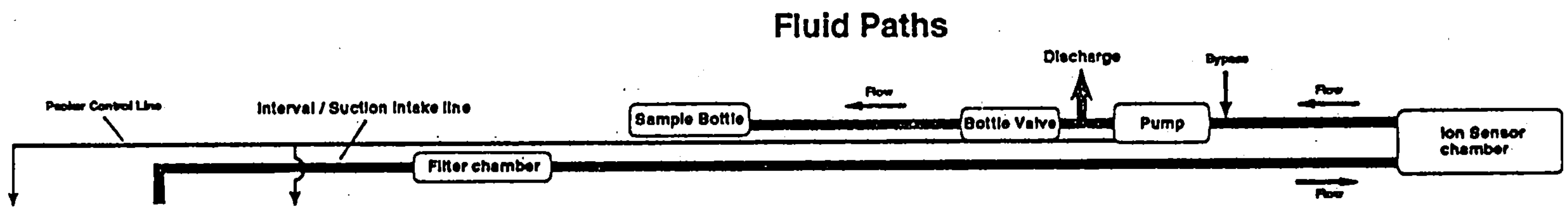
SUMMARY OF OPTIONS

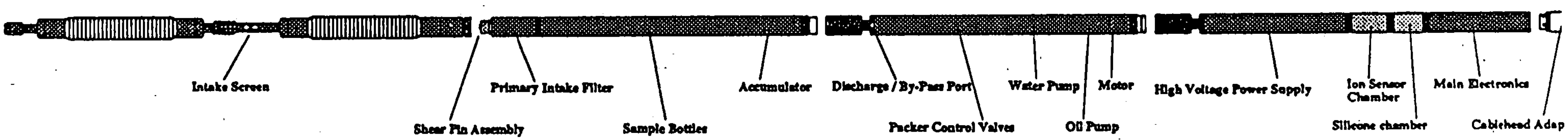
Option	Tool Available Commercially	Rapid Deployment	Real-time Communication	Low Development Costs	Absence of Serious Diametral Constraints	Comments
Modified Wireline Sampler	No	Yes	Yes	No	No	Not in re-entry holes
Self Boring Fluid Sampler	No	Yes	No	Yes	No	Can be used at intermediate depths
Full-Bore Straddle Packer	Yes/No (4)	No	No (3)	Yes/No (4)	Yes	
Top-Hat, Commercial Formation Sampler	Yes (1)	No	Yes	No (2)	Yes	Requires a re-entry hole

(1) with some modification
(2) costs increased by need for a re-entry hole and commercial leasing requirements.
(3) possible if sensor is added to sample receptacle and deployment is by electric wireline as with the straddle-packer/flow-meter.
(4) Straddle packer already exists but the addition of sampler and drawdown capability could become complex and costly.

Existing Wireline Packer Layout:

This figure illustrates the path of the sample fluid flow and the configuration of basic components in the existing system. The Sonde is approx. 45 feet overall, fluid path from Interval to Bottle is approx. 55 feet.





Straddle Packers:
This section consists of the upper and lower packers.

Sample Bottle Section:
This section contains the 4 sample bottles, and the accumulator for the pump/motor section. The lower pressure case contains the primary filter.

Pump / Motor Section:
This section contains the motor, Oil pump, hydraulically driven water pump, and the packer / sample bottle control valves.

HVPS and Main Electronics Section:
From top to bottom, this section is comprised of 4 pressure case. The upper case contains data acquisition and valve control electronics. The middle two cases contain the silicone oil filled sensor pressure compensator and the Ion sensor chamber, respectively

The lower pressure case contains the High Voltage power supply.

Not to Scale

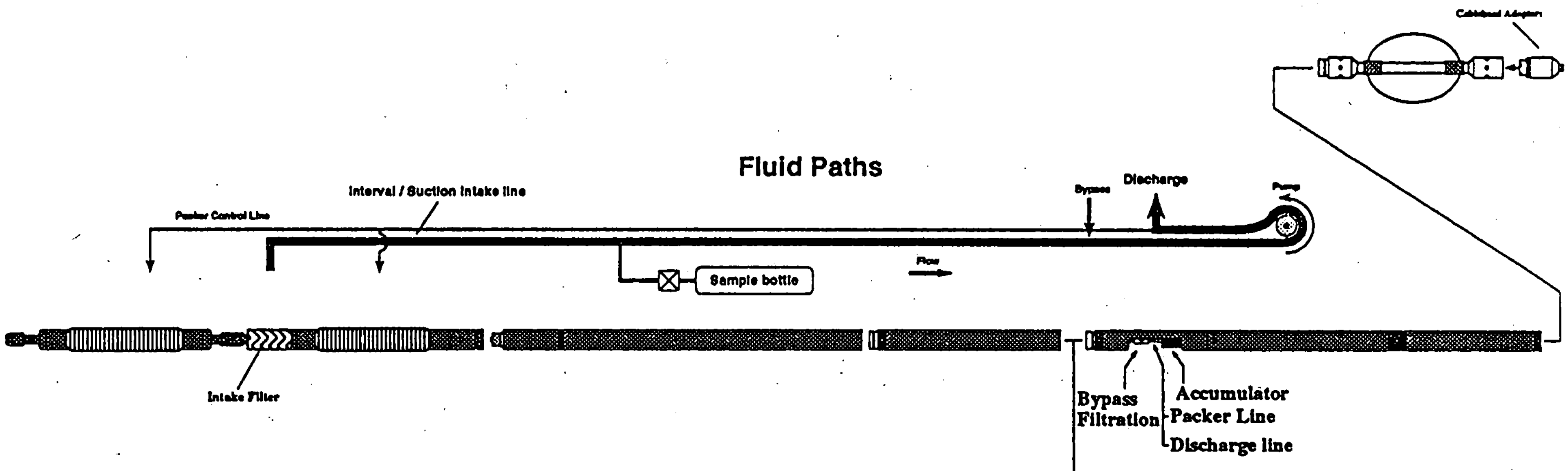
Figure 1

Proposed

Restructured Wireline Packer layout:

This figure illustrates the path of the sample fluid flow and the new configuration of basic components. The design is optimized for minimum tubing length and fluid volume before the sample bottles, and minimum hydraulic and electrical interconnection between cartridges.

NODE #1: PSK Transmission / Centralizer
This cartridge consists of the PSK Transmission system and will include a head tension measurement. The bow spring centralizer will stabilize the sonde when the packers are set and the cable is slacked.



Straddle Packers:
This section consists of the upper and lower packers and the primary intake filters.

NODE #5: Sample Bottle Cartridge
This cartridge consists of the sampling control valves and the sample bottles. Multiple cartridges could be used to increase the number of sample bottles.

NODE #4: Primary Measurement
This cartridge consists of the Data Acquisition System and all Primary transducers.

NODE#2: HVPS and Pump System
This cartridge is comprised of 2 sections. The upper pressure case contains the High Voltage power supply and the packer / pump controls.

The lower pressure case contains the electric motor, oil pump, and the hydraulically operated water pump. Packer control and By-Pass valving is also located in this section. Bypass and fluid discharge to Annulus ports are located in the lower end sub. The lower pressure case will be oil filled and pressure compensated by a piston accumulator also located in the lower end sub.

NODE#3: Auxiliary Measurement
This cartridge could consist of the fluid chemistry, fluid density, Differential Pressure Transducers, and/or other experiments.

Not to Scale

Figure 2

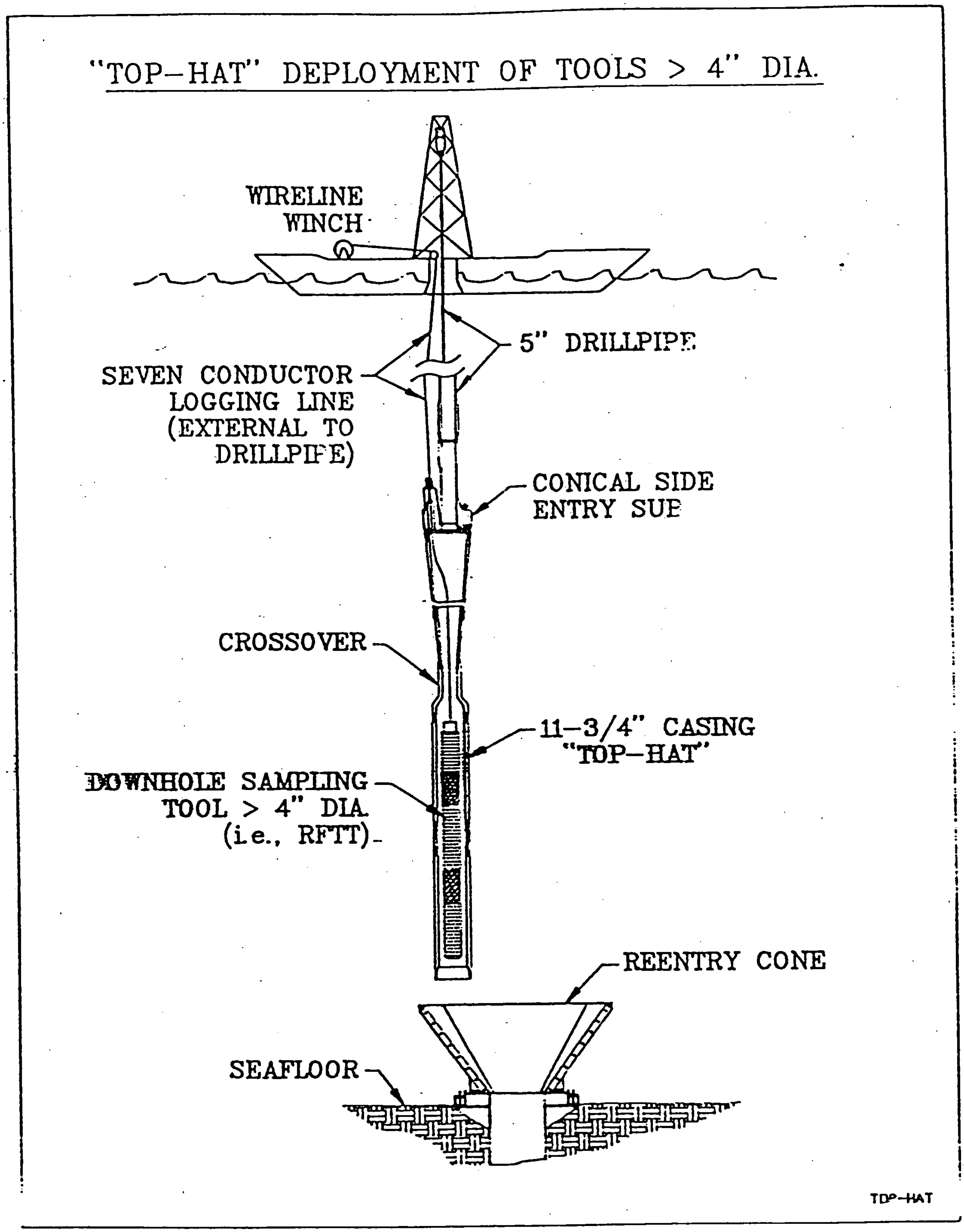

"TOP-HAT" DEPLOYMENT OF TOOLS > 4" DIA.
WIRELINE WINCH
5" DRILLPIPE
SEVEN CONDUCTOR LOGGING LINE (EXTERNAL TO DRILLPIPE)
CONICAL SIDE ENTRY SUB
CROSSOVER
11-3/4" CASING "TOP-HAT"
DOWNHOLE SAMPLING TOOL > 4" DIA. (i.e., RFTT)
REENTRY CONE
SEAFLOOR
TOP-HAT

Figure 3

FY1993 DOWNHOLE MEASUREMENTS PROSPECTUS FOR NORTH ATLANTIC DRILLING

Version 2, October 22, 1991

Table of Contents

Introduction

The contents of the North Atlantic Prospectus have been gleaned from the top-ranked proposals of the JOIDES thematic panels in accordance with global rankings completed at their spring, 1991 meetings. The primary purpose of the North Atlantic Prospectus is to assemble all known highly-ranked programs for work in the North Atlantic and adjacent oceans, in accordance with Year 1 of the 4-year plan passed by PCOM at its April, 1991 meeting in Narraganset, Rhode Island. The thematic panels are being asked to re-review and re-rank the proposal/programs in the Prospectus at their fall, 1991 meetings. The top candidates will then be considered by PCOM for inclusion in the drilling program for FY1993.

The downhole measurements prospectus is intended to provide a structure for development of the downhole measurements program on the North Atlantic drilling legs. Version 1 was given to DMP at its fall, 1991 meeting, for its input to insure that logging, particularly specialty tools, are included in the drilling program at the earliest possible stage of planning. Version 2 of this prospectus incorporates DMP's initial recommendations for all the North Atlantic proposals. Further drafts will be developed as they are needed by the planning process.

ODP Logging Tools

We assume that all of the tools currently used in ODP will be available for FY1993:

1) "Standard logs" (three strings):

a) "Quad " combo, or geophysical tool string - waveform sonic, spectral gamma ray, resistivity, density, neutron porosity, caliper and temperature (low T).

b) Geochemistry - spectral gamma ray, aluminum clay tool, gamma spectrometry, and temperature.

c) FMS - Formation MicroScanner, spectral gamma ray, and general purpose inclinometer;

2) Dual laterolog; A new digital version of this resistivity tool can be run as part of the "Quad" combo instead of the DITE induction tool normally run. High resistivity formations can now be logged without a separate logging run

3) Vertical seismic profile tool : 1-component; individual investigators may bring a 3-component tool

4) Digital borehole televiewer (BHTV);

5) Magnetometer/susceptometer;

6) Barnes water sampler/temperature/pressure.

High-temperature tools:

1) High-temperature temperature tool (500° C) and high-temperature cable (350°C);

2) High-temperature digital televiewer (300°C).

Additional tools with little or no prior ODP use that may be available in FY1993:

1) Fluid sampler (wireline packer ?);

2) Sandia high temperature fluid sampler

2) Lateral stress tool (LAST);

3) Morin/Becker flowmeter;

4) High-temperature resistivity tool.

5) Geoprops probe;

6) Soviet sonic array stress tool (SAST)

We occasionally include other tools in leg objectives and logging tool objectives sections, with assessments of whether the tools are likely to be available.

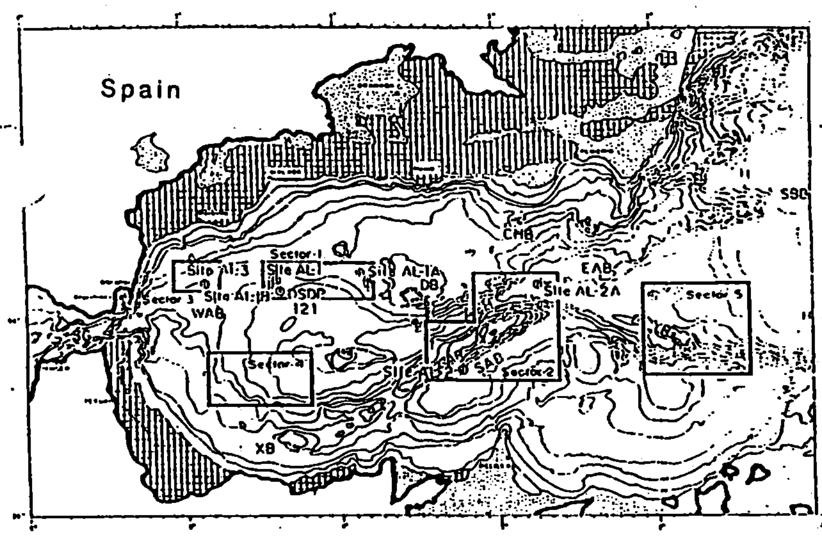
Alboran Basin and the Atlantic-Mediterranean Gateway

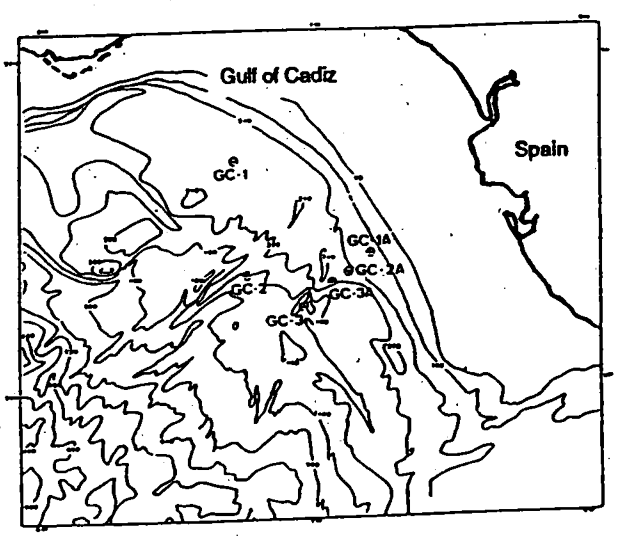
(Information from proposal 323-rev)

This program proposes to study deformation processes at convergent plate boundaries (Alboran Basin), and also reconstruct paleoceanographic changes in the Mediterranean gateway. The proponents are urging a two-leg program to drill the linked but distinctly different programs.

The proposal to examine Neogene evolution of continental basement overthrusting and extension in the Alboran Sea is aimed at understanding the deformation processes at convergent plate boundaries, as well as the dynamics of interaction of extensional and collisional structures.

The Atlantic-Mediterranean Gateway program intends to examine the Late Tertiary history of Atlantic-Mediterranean sea-level oscillations, water exchange and circulation patterns, and investigate the climatic signal in marginal ocean basins. The primary sites are in the Gulf of Cadiz (Atlantic Ocean), but the program also proposes to take advantage of the tectonic sites in the Alboran Basin (Mediterranean Sea) to constrain paleoceanographic reconstructions in the western Mediterranean - Atlantic region.





Site I.D.	Water Depth	Penetration Seds	Penetration Bsmt	Log Time (hrs) Std	BHTV	Fluids	Mag/Susc	Total days
Al-1	1036	3000	>50	60	3.9			2.7*
Al-1A	850	>2200	0	48				2.0*
Al-1B	925	1100	100	33	3.8			1.5*
Al-2	900	1500	0	39				1.6*
Al-2A	1773	1300	0	34				1.4*
Al-3	518	1400	0	35				1.5*
GC-1	550	600	0	23				1.0

GC-1A	350	>500	0	18	0.8
GC-2	570	>500	0	22	0.9
GC-2A	453	>500	0	23	1.0
GC-3	760	>500	0	22	0.9
GC-3A	500	>500	0	21	0.9

*Assumes Side Entry Sub needed at these sites

General Comments:

The proposal as presented contains significantly more than one ODP leg of drilling objectives. Sites have been prioritized, however, to show where the program might be cut. No new logging technology is needed to achieve program objectives.

Leg Objectives

Alboran Basin:

1) The nature and timing of vertical and horizontal displacements. Paleodepth indicators are large forams (cores) and sedimentary facies (cores, FMS, standard logs). Porosity and density from standard logs are useful for backstripping, decompaction.

2) Synchronous basin formation and sedimentation can be determined from continuous intersite correlation via standard logs.

3) Deformation structures. High-resolution structural dip, folding, tilting and delineation of fractures - all oriented - are possible with the FMS.

Mediterranean Gateways:

1) High-resolution paleoclimatology. Physical properties logs (velocity, density, porosity, and resistivity), as well as the high-resolution FMS will be used to detect high frequency variations at Milankovitch or higher frequencies.

2) Paleoproductivity of surface waters. Geochemical and physical properties logs for detecting changes in porosity (from faunal changes), and characterizing the transition from carbonate to siliceous sedimentation.

3) Establish environmental conditions immediately after the Messinian salinity crisis and after the opening of the Atlantic-Mediterranean gateway.

Logging Tool Objectives:

1. Standard logs (geophysical string, geochemical string, FMS): mineralogical variation as a function of time and location; synthetic seismograms for depth/seismic link; structure and deformation of sediments. Chances of success: very good. Hole conditions for logging will

probably be very good, although hole stability may become a problem in the deeper holes.

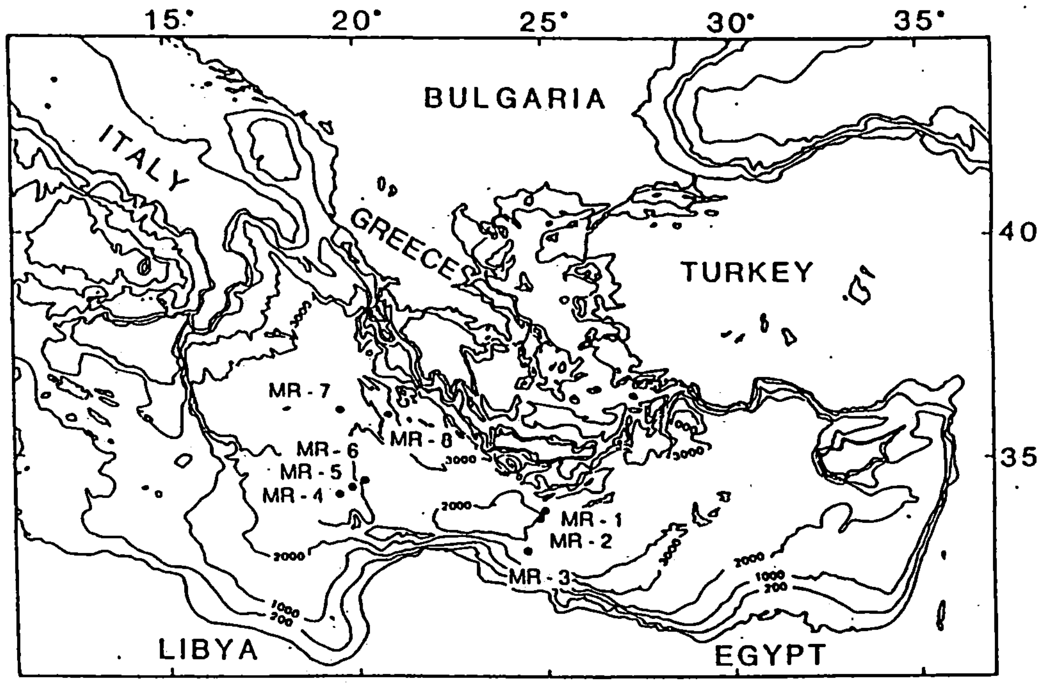
Need for New Logging Technologies:

High-resolution susceptibility tool desirable for correlation with measurements made on core.

Mediterranean Ridge

(Information from proposal 330)

The Mediterranean Ridge is an accretionary prism like the Nankai and Cascadia prisms, but is unique because it is underlain by continental instead of oceanic crust, and is in an incipient collisional context.



Site I.D.	Water Depth	Penetration Seds	Penetration Bsmt	Log Time (hrs) Std	BHTV	Fluids	Mag/Susc	Total days
MR-1	2200	1000	0	33		12		1.9*
MR-2	1900	200	0	21		7		1.2
MR-3	2600	1000	0	34		13		2.0*
MR-4	3900	2000	0	51		22		3.0*
MR-5	3200	1000	0	35		29		2.7*
MR-6	2780	150	0	22		17		1.6
MR-7	3100	150	0	22		18		1.7
MR-8	3100	1000	0	35		28		3.0*

*Assumes Side Entry Sub needed at these sites

General Comments

The downhole measurements requirements for this program are similar to those for the Cascadia Accretionary Prism drilling (Leg 146; see CEPAC Logging Prospectus, 1/14/91). As such, it will need a significant downhole measurement program to be successful. Many of the tools needed for fluid sampling and permeability measurements are still being developed and this program, if drilled, may be one of the early field deployments for them.

Leg Objectives

The major objective of drilling and logging the Mediterranean Ridge is to understand the geometry, kinematics, and mechanics of accretionary processes, with particular emphasis on pore-fluid distribution within the accretionary wedge.

1) Pore pressure, permeability, and fluid flow at a variety of scales. These measurements will be used for determining hydraulic conditions and fluid expulsion pathways. Measurement techniques will depend on depth: LAST at shallow depths, geoprops for intermediate depths, and wireline packer for greater depths.

2)Pore fluid composition,T as an indicator of pore fluid origin, diagenesis, and fluid sources. The Barnes/Uyeda tool can be used for shallow sediments , and geoprops or wireline packer for deeper sediments, and pressure core sampler at various depths.

3) Porosity, both intergranulary and fracture, for comparison with fluid-flow indicators and consequent evaluation of controls on fluid flow. Standard physical properties logs, and FMS.

4) Temperature, heat flow, and thermal conductivity, as indicators of fluid flow and nonlinear thermal gradients. Shallow heat flow measurements will be based on the Barnes/Uyeda probe. Continuous temperature logs, obtained from all logging tool runs, can be used to extrapolate equilibrium thermal gradients. Coupled with a thermal conductivity log from log-based mineralogy, the high-resolution thermal gradient log should detect nonlinear thermal gradients and all zones of active fluid flow.

5) Detailed variations in structural dip and fracture patterns. Obtainable with FMS.

6) Mineralogy, both for depositional history of the ridge, and because of the probable impact of mineralogy (especially clay content) on hydrology. Obtainable from standard logs.

7) Sedimentary facies, particularly identification of slumps and turbidites, for depositional and structural histories of the ridge. Obtainable from standard logs, including the FMS.

8) Stress and strain properties of sediments. Measurements of mechanical and stress state are needed to test models for the evolution of accretionary prisms. In situ measurements of stress and strain properties are possible only for APC cores, using the lateral stress tool (LAST). Maximum horizontal stress direction con be measured with FMS.

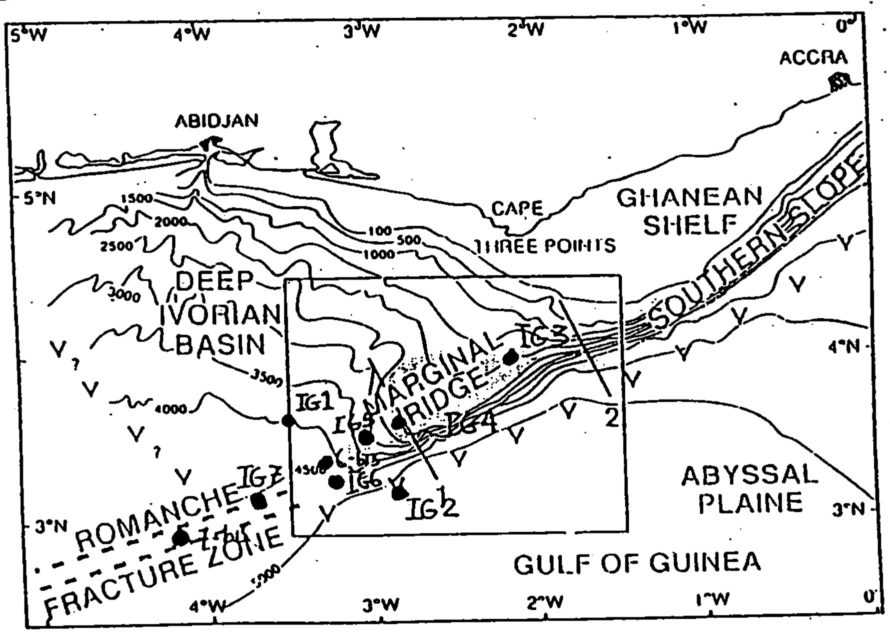
Need For New Logging Technologies

Several tools (wireline packer, geoprops, Navidrill, pressure core sampler) needed for this leg are still under development of have had limited success in the ODP. All will probably be tested in the ODP before this leg.

Eastern Equatorial Atlantic Transect
The Ivory Coast - Ghana Transform Margin

(Information from proposal 346-2)

Transform margins represent the third great category of continent-ocean boundaries but are still poorly understood and await exploration by scientific drilling. Drilling at a transform ("translational") continental margin is needed to understand at these margins the deformational history, vertical tectonics, and the structure of the continent-ocean boundary. A series of holes drilled along the Ivory Coast - Ghana Transform Margin will address how these margins evolve.



Site	Water	Penetration		Log Time (hrs)				Total
I.D.	Depth	Seds	Bsmt	Std	BHTV	Fluids	Mag/Susc	days*
IG-1	4050	1000	100	38	5.8			1.8
IG-2	4935	1400	--	44				1.8
IG-3	2340	900	--	32				1.3
IG-4	2055	1200	--	35				1.5
IG-5	3300	900	100	35	5.2			1.7
IG-6	4650	200	200	29	6.5			1.5
IG-6bis	4320	1100	--	39				1.6
IG-7	4200	200	100	32	5.1			1.3
IG-7bis	4545	250	100	28				1.2

*assumes Side Entry Sub needed on all sites

General Comments:

Three or perhaps four re-entry holes have been proposed for this program. These and the proposed single-bit holes are substantially more than one ODP drilling leg. Logging is an integral part of the program to determine type and structure of sediments and basement and will most probably be the only means to assemble complete stratigraphic sections in the deeper holes, because of poor rotary-core sediment recovery.

Leg Objectives:

1. Transform margin evolution where both extensional and transform mechanisms are interfering

• *Nature of acoustic basement underlying marginal ridges generated at cont./oceanic crust boundary*

The standard logging suite (Geophysical string, Geochemical string, and FMS) will be instrumental to characterize the basement, especially in badly sheared sections where core recovery may be poor. Physical properties measured by logging will be instrumental for constructing synthetic seismograms to link the drill sites to the extensive multichannel seismic data for the surrounding region, while chemical information can be used to identify the types of rocks that make up the basement. FMS will be important to identify basement structure and modern stress directions. Borehole Televiewer logging of basement sections will give more complete hole coverage of basement structure than FMS and will also identify breakout zones caused by the modern stress regime.

• *Type of deformation on marginal ridge and lithology of sediments deposited during its creation*

FMS dipmeter information will be fundamental to identify deformation and to orient recovered core sections for shipboard structural analysis. Sediment lithology can be identified by the geophysical and geochemical logging data, even if core recovery is poor.

• *Results of thermal exchange between cont. and oceanic crust and effects on vertical movements along ridge*

Alteration of continental crust can be identified through changes in the physical properties of the continental material, while fluid exchange will manifest itself by cracks filled with alteration minerals (visible by FMS) or, if the alteration is pervasive, by changes in the bulk chemical properties measured by the geochemical tool string.

• *Timing, rate, and degree of vertical movement from successive onlaps/offlaps*

Logging will be fundamental in placing dated core material in the stratigraphic sequence drilled at each site, especially in intervals of poor core recovery. FMS data and physical properties data from logging will also be important for defining stratigraphic sequences.

• *Physical characteristics, deformation of sediment cover, and nature of basement involved in continent/continent transcurrent motion*

Stress and strain properties of sediments can be obtained with the LAST tool in APC sections. Maximum horizontal stress direction can be measured with the FMS or BHTV. Deformation of sediment cover and basement can be analyzed with FMS structural information, and with BHTV basement images.

- *Age, lithology/paleoenvironment, and diagenesis of different sed. units emplaced during margin evolution*

The ODP standard logging suite is optimally designed to provide information about paleoenvironment and diagenesis. Geochemical logs can be used to define different sedimentary units and to imply paleoenvironment. Physical properties measured by logging can be used to determine the amount of cementation or dissolution that has occurred. They can be also used to make synthetic seismograms to link the drilled sequence to the seismic reflection data for the margin. Finally, FMS can identify sedimentary structures and help identify paleoenvironmental conditions.

- *Consequence of sharp cont./ocean transition on nature of adjacent ocean crust (melting, erosion, underplating)*

FMS data can identify anomalous structures in the ocean crust, and anomalous magmatic events can be identified by their geochemical signature from the standard log suite. Physical properties measurements from the logs will identify anomalous fracture structure.

2. Evolution of Central South Atlantic gateway in mid-Cretaceous and Cenozoic times

- *Age, lithology, and paleoenvironment of oldest sediments resting on ocean crust*

The standard logging suite will provide the same information for the oldest sediments in the ocean sequence as it will provide for the sediments on the marginal ridge, as discussed above. In addition, in these deep sequences where core recovery will probably be 50% or less of the total section, The logging data will provide the only comprehensive information about these oldest sediments.

- *Sedimentation of specific facies during opening phase (especially Cenomanian-Turonian black shales*

Even though the logs don't directly measure organic carbon, organic matter-rich intervals can be identified by their high uranium contents and by anomalous physical properties. Logs will complement core by identifying the number and thickness of black shale sequences even when core recovery is poor.

- *Cenozoic large scale hiatuses, history of deep water circulation, and climatic fluctuations.*

Logging data can be used to reconstruct the seismic signature of large-scale hiatuses identified in core material, and thus will be used to link core measurements to seismic stratigraphy. In addition, Milankovitch-scale climatic fluctuations typically are evidenced by periodic variations in physical/chemical properties of the sediments, detectable by logging.

Logging Tool Objectives:

1. Standard logs (geophysical string, geochemical string, FMS): mineralogical variation as a function of time and location; synthetic seismograms for depth/seismic link; nature of basement; structure and deformation of sediments and basement. Chances of success: very good. Hole conditions for logging will probably be very good, since synrift sands, if found, should be well-lithified.

2. Borehole televiewer: Structure and fracture patterns of basement sequences, modern stress directions. DMP views that the additional structural information obtained by BHTV over FMS (360° acoustic image in the BHTV versus FMS resistivity images of about 1/3 of the borehole circumference) to be important for identifying basement structures and fracture patterns, and to identify the modern stress environment via borehole breakouts. All significant basement sections are planned for BHTV logging.

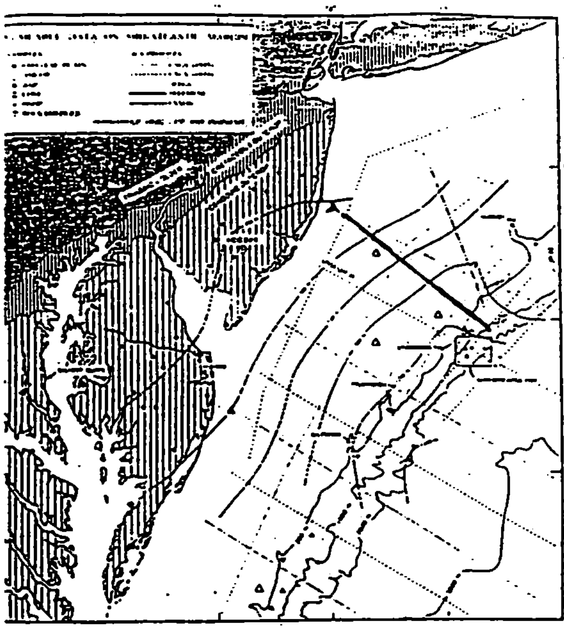
Need for New Logging Technologies

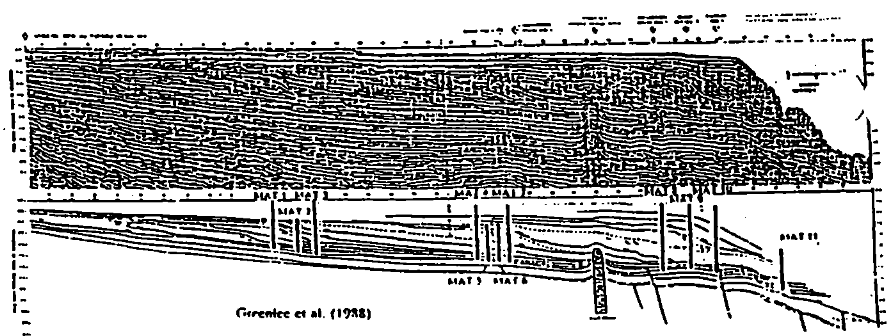
None

New Jersey Sea Level

(Information from proposal 348-add)

Past fluctuations of global (eustatic) sea level have had a profound impact on a wide range of disciplines within the earth sciences, yet the timing and magnitude of eustatic changes is not very well constrained or even understood. At a JOI/USSAC sponsored workshop entitled "The Role of ODP Drilling in the Investigation of Global Changes in Sea Level", a consensus emerged that global sea level is a topic that needs to be built upon with a thorough, publicly available data base. A checklist for selecting passive margin transects for relative sea level changes was established at this workshop. The middle Atlantic margin ranked high on the criteria list. The Workshop also recommended that data collection should concentrate on a period when glacio-eustatic changes (known mechanism and high amplitude) were clearly operating during the Oligocene to Miocene (the "ice-house world").





Site I.D.	Water Depth	Penetration Seds	Penetration Bsmt	Log Time (hrs) Std	BHTV	Fluids	Mag/Susc	Total days
MAT1*	50	788		25				1.1
MAT2*	50	788		25				1.1
MAT3*	50	831		26				1.1
MAT4	100	831		26				1.1
MAT5	100	875		27				1.1
MAT6	100	875		27				1.1
MAT7	100	910		27				1.1

*Drilling these sites will not be possible with the JOIDES Resolution.

Site I.D.	Water Depth	Penetration Seds	Penetration Bsmt	Log Time (hrs) Std	BHTV	Fluids	Mag/Susc	Total days
MAT8	180	1050		27				1.1
MAT9	180	1050		27				1.1
MAT10	180	1050		27				1.1
MAT11	1000	1050		30				1.3

Leg Objectives

The program aims to determine changes in relative sea level recorded in passive margin sediments by the following:

1) extending the DSDP transect on this margin onto the upper slope and continental shelf. Standard logs will provide continuous intersite correlation.

2) determining the geometry and age of Oligocene to Miocene depositional sequences by correlating core with regional seismic lines. Velocity and density logs will provide a link between core depth and seismic traveltime through a synthetic seismogram. The geometries of depositional sequences are governed by depositional environments, which can inferred from FMS data.

3) evaluating the role of relative sea level changes in developing a sedimentary record. Changes in facies, particular turbidite deposition, can be determined by logs that measure physical properties. These logs will be invaluable in delineating changes in grain size and (indirectly) in lithology. Geochemical logs will be very important for determining lithology because core recovery in coarse-grained intervals will be low. Porosity logs will be used in the calculation of compaction and loading on the margin, in order to determine the role of subsidence in generating relative sea level change.

4) evaluating the possible causal link with ice-volume (glacio-eustatic) changes by studying the temporal and lateral changes in deposition.

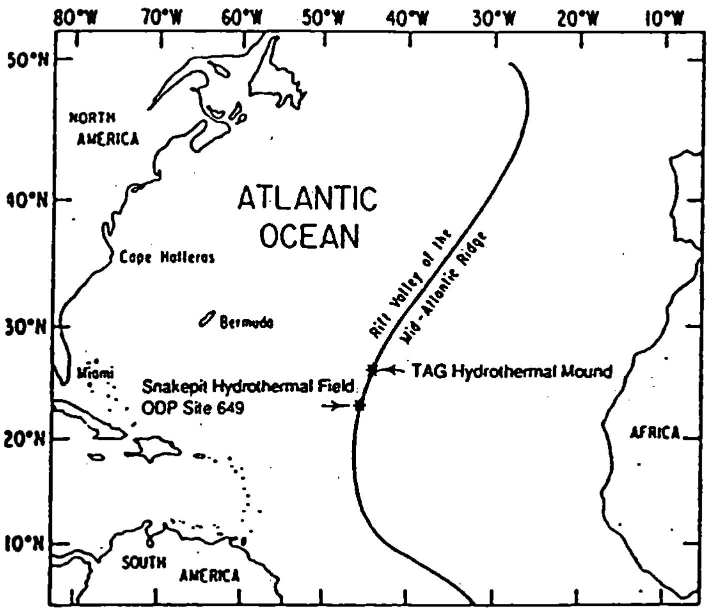
Need for New Logging Technologies:

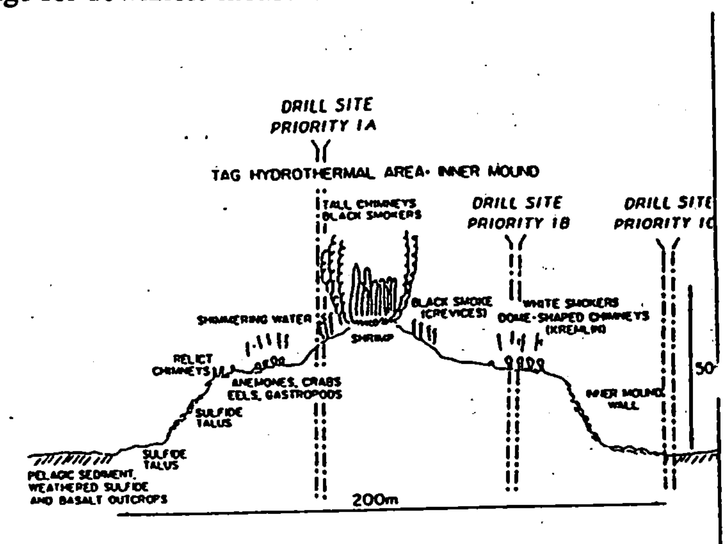
High-resolution susceptibility tool desirable for correlation with measurements made on core.

Drilling Active Hydrothermal Systems, TAG Hydrothermal Field, Mid-Atlantic Ridge 26°N

(Information from proposal 361-Rev)

The TAG hydrothermal field is an extensive, well-surveyed hydrothermal field on slow-spreading ocean crust. It appears to be an active analogue to the Troodos volcanic-hosted massive sulfide deposits. As such it presents an excellent opportunity to study the structure, geology, and tectonics of a modern volcanic-hosted sulfide deposit, as well as to study the dynamics of sulfide deposition and physical characteristics of fluid flow in these systems. Because the system is active, it also presents a severe technical challenge for downhole measurements.





Site I.D.	Water Depth	Penetration Seds	Penetration Bsmt	Log Time (hrs) Std[1]	Fluids[2]	Packer[3]	T/flow[4]	Total days
PRI-1A	3700	--	300	25.7	11.2		6.0	1.8
PRI-1B	3700	--	300	25.7	11.2		6.0	1.8
PRI-1C	3700	--	300	25.7	11.2		6.0	1.8
PRI-2	3700	--	600	30.0	13.0		8.0	2.1
PRI-3	3700	--	2000	50.3	42.7	52	17.4	6.8
PRI-4	3700	--	1000	35.8	30.7	50	10.7	5.3

(1) assumes side entry sub needed for hole cooling, and that holes can be cooled to <150°C

(2) assumes 3 sample runs in holes < 1km; 6 in holes > 1km

(3) assumes 1 pipe trip for each packer emplacement, 2 placements per hole shown

(4) time allotted for 1 high temperature T profile, with flowmeter.

General Comments:

The drilling program at the TAG hydrothermal field is meant to occupy more than one leg -- each priority is roughly one leg of drilling. Technical challenges for downhole measurements will be similar to those faced by the Leg 139 Sedimented Ridge Hydrothermal Drilling, with the exception that the Diamond Coring System may be employed for some or all holes in this program. DCS drilling will limit the downhole measurement program to measurement of fluid temperature and flow, and resistivity. Design of the downhole experiments to study fluid flow should take into account the experience of both 504 B and Leg 139 -- that drilling a hole in an advective system significantly changes the hydrologic regime. Drilling is an active hydrologic experiment, not a means to measure flow in the undisturbed system. For this reason, DMP recommends that these holes be made capable of re-entry and, if possible, be sealed for future studies on the dynamics of an undisturbed system.

Project Objectives:

1. *Nature/distribution of deposits in near-surface discharge zone; dynamics and physical characteristics of flow (1st priority).*

Logging and other downhole measurements will be extremely important in understanding both the nature of the mineral deposit itself and its elationship with the host rock, and for understanding fluid flow within the deposit. Provided that holes can be cooled and are of sufficient size (i.e. DCS holes are reamed) the standard ODP logging suite will provide a variety of useful information. Within the sulfide deposit the resistivity logs and FMS resistivity imaging can be used to estimate the extent of mineralization and to locate fra tures cemented with high resistivity minerals such as the carbonates orite. Open fractures can also be identified on FMS images by their resistivity characteristics. Geochemical logs will provide another means to estimate the extent of mineralization, and the geophysical logs will provide small scale porosity information. The slimhole, high-temperature resistivity tool will be used if the holes are drilled with the Diamond Coring System, and cannot be reamed for logging.

If the host rock is badly brecciated, information about the basalt/sulfide contacts may come only from the logs. Velocity and porosity data from the standard logging suite will measure the extent of wallrock alteration, while FMS will image fractures, mineralization and original structure. Geochemical logs will also determine the extent of alteration in each of the holes.

Fluid flow measurements, with either the low temperature Becker/Morin flowmeter or a high temperature tool, like the JAPEX tool, are needed to understand the permeability structure of the mineral deposit. High temperature fluid sampling capability is a necessity.

2. *Nature/distribution of subseafloor mineralization stockwork/root zones; characteristics of circulating fluid (2nd priority)*

High temperature logging of temperature, combined with fluid sampling capability is needed to achieve this objective. Measurements of porosity by standard logging tools (provided that holes can be cooled) and measurements of structure via FMS and chemistry via the geochemical tool string will be instrumental for understanding alteration processes and mineral deposition in the stockwork zone.

3. *Nature and characteristics of the reaction zone (3rd priority).*

As above, standard logs will provide information about structure (FMS), fracture porosity (FMS, resistivity), alteration of basaltic host rock (density, velocity, chemical composition), and identify mineralized zones (resistivity, chemical composition, density, velocity). High temperature fluid sampling and temperature measurement are needed prior to hole cooling to get information about fluid composition in the system. Provided that the hole can be cooled, packer emplacements will give necessary permeability information for the reaction zone and shallower.

4. *Nature and characteristics of the recharge zone (4th priority).*

Structure, fracture locations, and fracture porosity can be derived from the standard logs, while packer emplacements will define permeability.

Logging Tool Objectives:

1. Standard logs (geophysical string, ge ochemical string, FMS): Mineralogical variation through the massive sulfide section and in the altered stockwork and reaction zones. Fracture spacing, directions, and mineral in-filling. Structure of the stockwork, reaction zone, and unaltered basalt crust. Chances of success: good. Failure of the standard logging program may occur if holes cannot be cooled below 150°C, or if holes are DCS-drilled without reaming to a size larger than the Schlumberger tools.

2. High-T temperature/fluid flow/fluid sampling: Fluid temperature, flow, and composition in a volcanic-hosted massive sulfide deposit. Chances of success: very good. All of these components have been used in high temperature regime on leg 139. An improved wireline High-T temperature/fluid sampler could be developed to better sample annulus fluids.

3. Packers (drillstem: single and straddle): Permeability of ocean crust in recharge zone and through a ridge crest hydrothermal system. Chances of success: good, if holes can be cooled sufficiently for successful packing with higher-T packer elements. Hole cooling may fracture hot rock, however, and change the permeability structure.

Need for New Logging Technologies

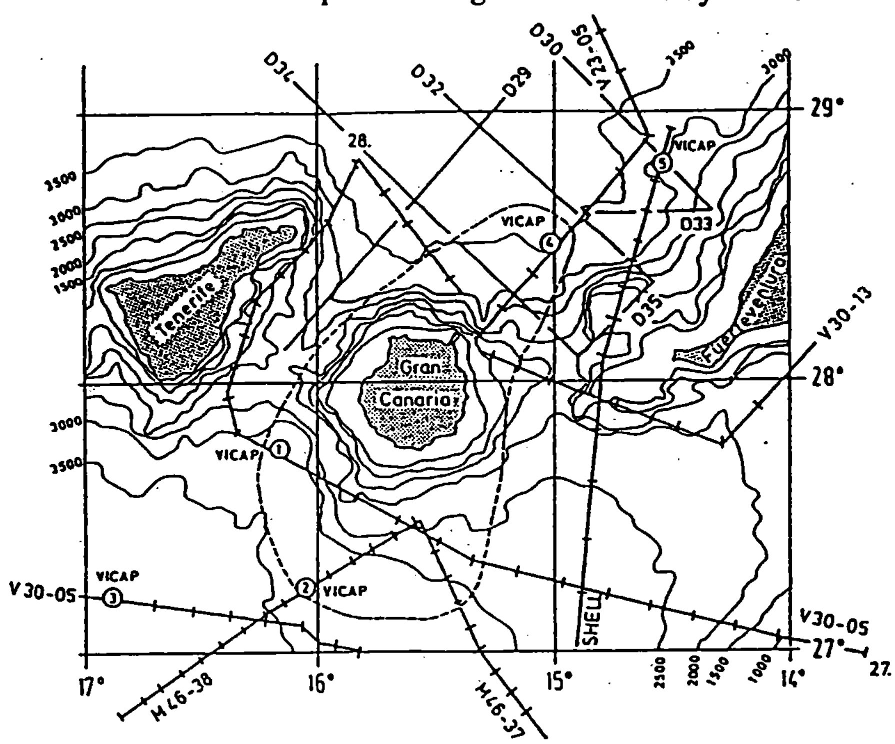
A wireline high-T temperature tool/fluid sampler would provide the best chance to sample uncontaminated hydrothermal fluids. The present Los Alamoshigh-T fluid sampler leaks, but a new sampler design using explosive valve seals may surmount this problem. In addition, this tool could be made in a slim-hole design, to work in DCS holes. Slimhole high-temperature logging tools are needed if DCS becomes the standard drilling procedure for bare rock sites. Increase in operating temperature range for packers is needed for the best permeability measurements in hydrothermal systems.

VICAP Gran Canaria

(Information from proposal 380-Rev2)

The purpose of this project is to study the physical and chemical evolution of a confined system (asthenosphere-lithosphere-seamount-volcanic island-clastic apron-sedimentary basin) by drilling into the proximal, medial and distal facies of a volcaniclastic wedge.

The Gran Canaria island is unique among volcanic islands in that it has experienced high degrees of differentation of magmas during several distinct stages. Determining the geochemical evolution of the ocean island will provide insights into mantle dynamics and evolution.



Site I.D.	Water Depth	Penetration Seds	Bsmt	Log Time (hrs) Std	BHTV	Fluids	Mag/Susc	Total days*
VICAP-1	3200	~900	0	33				1.4
VICAP-2	3400	~500	0	28				1.2
VICAP-3	3600	~800	0	32				1.3
VICAP-4	3400	~500	0	27				1.1
VICAP-5	3100	1250	0	43				1.8
MAP-1	5400	580	50	23	6.0			1.2

*Assumes Side Entry Sub needed at all sites

Leg Objectives

1) Total volumes of clastic contibutions. The three-dimensional growth of the clastic apron through time can be modelled on the basis of physical properties logs, and ages determined from

cores. Linear sedimentation rates between fixed age control points can then be corrected for compaction effects, and a time-dependent bulk accumulation rate can be established.

2) High resolution paleomagnetics of the clastic apron. The French magnetometer,which is scheduled for deployment on Leg 145 (North Pacific Transect) could be deployed in the sediment sections. With the correlation of biostratigraphic data to the paleomagnetics, the proponents hope to detail the island and basin evolution in time slices as detailed as 100,000 years.

3) Geochemical evolution of the volcanic island. Continuous geochemical logs will be used to determine changes in the chemical composition of the volcanic island, particularly between the initial seamount phase, which comprises ca. 95% of the volume of the island, and the subaerial portion of the island.

4) Enhanced levels of stress due to volcanic emplacement. The borehole televiewer (or FMS) can be used to record the orientation of wellbore breakouts to determine the direction of maximum horizontal compressive stress.

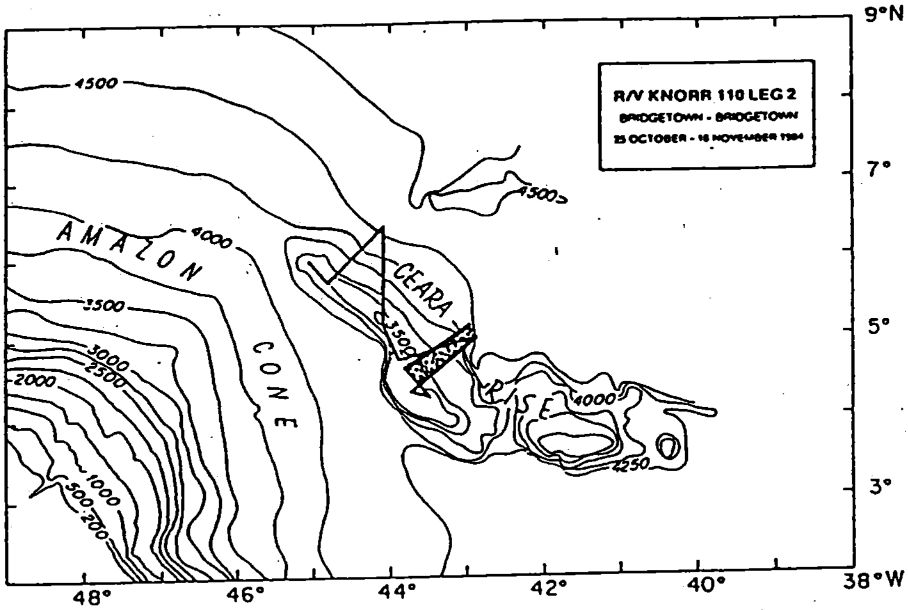
5) Paleoceanographic and -bathymetric reconstructions by identification of dissolution interfaces. FMS would be useful for refined delineation of volcanic units; continuous geochemical logs would delineate changes due to alteration, diagenesis, and facies change.

6) Correlation of turbidites to relative sea level changes and volcanic activity. Delineation of turbidites by the high-resolution FMS, and by physical properties logs (i.e. resistivity, sonic, density) will help to compensate for the anticipated low recovery in coarse-grained turbidite intervals.

Ceara Rise

(Information from proposal 388 and 388-add)

The major focus of this proposal is to obtain a depth transect of sites in order to reconstruct the Cenozoic history of deep water chemistry, carbonate production and dissolution, and deep water circulation. The advantage of the Ceara Rise is that deposition during the last 10 million years has been virtually continuous, and sedimentation rates are high enough to ensure that high-resolution time series of sedimentological and geochemical data can be produced.



Site I.D.	Water Depth	Penetration Seds	Penetration Bsmt	Log Time (hrs) Std	BHTV	Fluids	Mag/Susc	Total days
CEA1*	2800	800		31				1.3
CEA2	3050	200		23				1.0
CEA3	3300	200		24				1.0
CEA4*	3550	800		33				1.4
CEA5	3800	200		25				1.0
CEA6*	4000	800		34				1.4
CEA7	4200	200		26				1.1
CEA8*	4450	800		22				0.9

* These sites will be cored with the Extended Core Barrel to refusal, which is estimated to be at 800 meters below sea floor.

Leg Objectives

1) The history of deep water flow in the Atlantic during the Cenozoic by studying the relationship between deep water circulation, chemistry, and earth's climate.

2) Temporal changes in carbonate dissolution along the transect. Continuous intersite correlation via standard logs will yield continuous records of differential sedimentation rates. If slumping has occurred at any of the sites, the intersite correlation will reveal the anomaly. The FMS in particular, will be able to detect any slumped intervals and prevent possible misinterpretation of core data from such intervals.

3) Cenozoic history of surface water and climate can be addressed by continuous standard logs to detect any fluctuations in faunal abundance (as a function of porosity) at high frequencies (Milankovitch) or from changes in location or intensity of surface water productivity.

Need for New Logging Technologies:

High-resolution susceptibility tool desirable for correlation with measurements made on core.

Mediterranean Sapropel Drilling

(Information from proposal 391)

The accumulation of organic matter-rich sapropelic deposits in the eastern Mediterranean occurred in response to unusual, very distinctive changes of the physical circulation and chemical cycling of the Mediterranean Sea. This proposal aims to use geochemical information from APC sediment cores to investigate whether high primary productivity or bottom water anoxia was the primary cause for formation of the sapropels. No specific targets for drilling have been identified in this proposal.

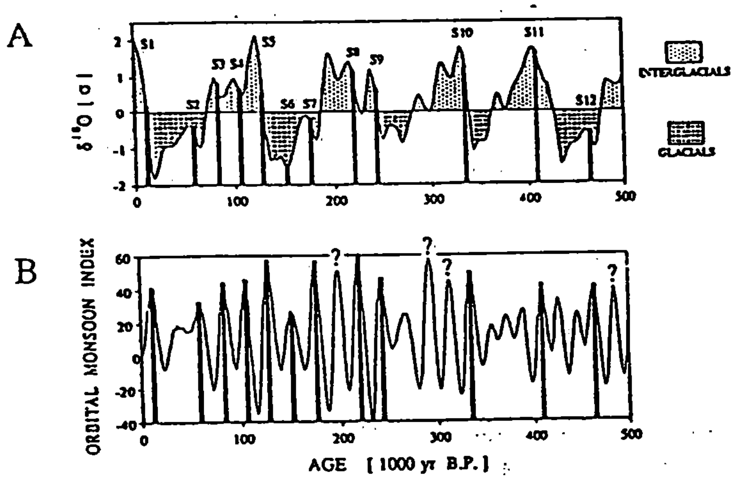


Figure 1. (A) Stratigraphic position of eastern Mediterranean sapropels S1-S12 in the Specmap global mean oxygen isotope record. (B) Distribution through time of the sapropels compared to the orbital monsoon index *sensu* Rossignol-Strick (1983).

No Specific Drill Sites Identified

General Comments:

The idea behind this proposal is to encourage APC drilling along transects in the eastern Mediterranean drilled primarily for tectonic studies (e.g. proposals 330/A and 379/A), though they also suggested that DSDP Sites 374, 377, and 378 are likely candidates for this program. A cursory examination of the DSDP Site Reports shows that each DSDP Site may prove deficient for further high-resolution drilling. We assume that site(s) drilled for this proposal will be approximately 150 meters deep.

Leg Objectives:

1. *Long-term history of sapropel formation in relation to state of global climate and orbital insolation parameters*

Logging can provide the background information needed for high resolution paleoceanographic studies, as demonstrated recently on Leg 138. Comparison of density logs (part of the standard logging suite) to shipboard GRAPE density allows assessment of and correction for the sediment distortion caused by coring. On Leg 138, composite sediment sections from recovered core were typically 10-15% longer than the length of section drilled. Logs are being used to correct the distortion by giving depths to the bulk density stratigraphy.

In addition, physical properties and geochemical properties measured by the standard logging suite also respond to Milankovitch orbital forcing and provide the context to assess conditions for sapropel formation. Sapropels should also have abnormally high water contents and high uranium contents when compared to normal sediments, and can be identified by geochemical logging and FMS logging even below the APC-cored interval where core recovery may be poor.

2. *Contribution of marine vs terrestrial sources to the organic fraction of the sapropels*

No logging input

3. *Water column redox conditions and productivity levels during sapropel formation.*

Geochemical logs can be used to measure the amount of carbonate and estimate the amount of opal in the sedimentary section. Variations in burial rates of different biogenic sediment fractions can help to assess the level of productivity at times of sapropel formation.

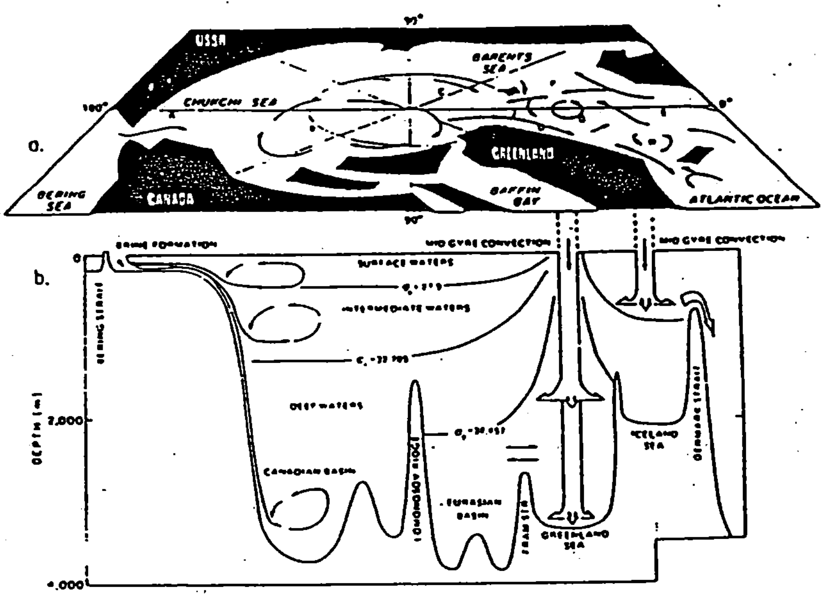
Need for New Logging Technologies

High-resolution susceptibility tool desirable for correlation with measurements made on core.

North Atlantic-Arctic Gateways Drilling

(Information from NAAG DPG report)

Drilling in the high-latitude North Atlantic Ocean and gateways to the Arctic Ocean is highly important for understanding the change from a relatively warm, ice-free world to the present condition where ice dominates the polar regions. The two legs of drilling in the NAAG are also needed for reconstructing the temporal and spatial variability of the oceanic heat budget and for understanding ocean circulation and climate change in a warm ice-free ocean.



Site I.D.	Water Depth	Penetration Seds	Log Time (hrs) Std	BHTV	Fluids	Mag/Susc	Total days
LEG 1							
YERM-1	900	700	36.4				1.5
ALT: YERM-2	1900	700	38.6				1.6
YERM-4	600	500	31.4				1.3
ALT: YERM-3	975	500	32.2				1.3
YERM 5	2850	600	38.6				1.6
? ARC-2A	3500	800	44.3				1.8
FRAM-1B	2500	810	42.4				1.8
ALT:FRAM-1A	2590	675	39.6				1.7

Site I.D.	Water Depth	Penetration Seds	Std*	Log Time (hrs) BHTV	Fluids	Mag/Susc	Total days
EGM-2	3400	750	43.0				1.8
ALT: EGM-1	3250	900	46.0				1.9
OR							
GREEN-2	2500	800	42.1				1.8
ALT: GREEN-1	1600	500	33.6				1.4
ALT: EGM-3	2650	900	44.7				1.9
EGM-4	1500	800	39.9				1.7
ICEP-4	1800	520	34.5				1.4
LEG 2							
FRAM-2	1290	360	29.9				1.2
GREEN-2	2500	800	42.1				1.8
ALT: GREEN-1	1600	500	33.6				1.4
ALT: EGM-3	2650	900	44.7				1.9
OR							
EGM-2	3400	750	43.0				1.8
ALT: EGM-1	3250	900	46.0				1.9
ICEP-1	1950	300	30.0				1.3
ALT: IP-2	2000	550	35.6				1.5
ICEP-2	3250	900	40.5				1.7
ICEP-3	2807	300	31.9				1.3
NIFR-1	2000	1000	45.4				1.9
SIFR-1	1500	500	33.4				1.4
DST-1	2500	500	35.6				1.5
ALT: DENS-1	2500	800	42.1				1.8

*assumes Side Entry Sub used on all logging and standard geophysical, geochemical, and FMS strings

General Comments:

The drilling plan for the two legs of NAAG drilling is highly flexible, to take into account that certain sites may only be drillable for a very brief period of time and certain sites may not be reached in a bad ice year. The standard (geophysical, geochemical, and FMS tool strings) ODP logging suite is planned for all holes.

Program Objectives:

1. *High northern-latitude oceans' role in global climate and ocean circulation*
   - evolution of surface watermasses and fronts
   - evolution of sea-ice cover
   - opening of gateways
   - deep water evolution
   - history of ice cover on surrounding continents
   - sediment budgets and fluxes

The ODP standard logging suite is highly suited to achieving the goals of this two-leg paleoceanographic program. Shipboard logs provide a rapid means to correlate between holes. Logging can also provide the background information needed for high resolution paleoceanographic studies, as demonstrated recently on Leg 138. Comparison of density logs (part of the standard logging suite) to shipboard GRAPE density allows assessment of and correction for the sediment distortion caused by coring. On Leg 138, composite sediment sections from recovered core were typically 10-15% longer than the length of section drilled. Logs are being used to correct the distortion by giving depths to the bulk density stratigraphy.

In addition, most of the physical and geochemical properties measured by the standard logging suite respond to Milankovitch orbital forcing and provide the means to assess climate cycles even in poorly-recovered sedimentary sections. FMS images will also be used for fine-scale sedimentary studies, and can image dropstones in the borehole wall as an indicator of sea-ice.

Logging Tool Objectives:

1. Standard logs (geophysical string, geochemical string, FMS): mineralogical variation as a function of time and location; synthetic seismograms for depth/seismic link; structure and deformation of sediments. Chances of success: excellent. Holes for this study avoid sandy sediments which may cave or collapse the drill hole.

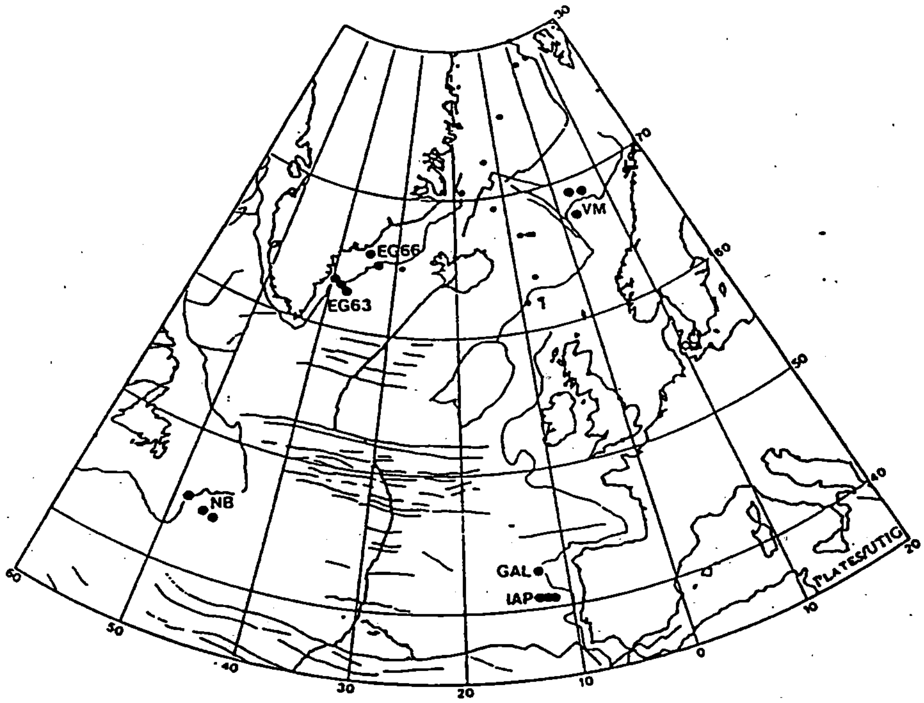
Need for New Logging Technologies

High-resolution susceptibility tool desirable for correlation with measurements made on core.

Drilling North Atlantic Rifted Margins

(Information from NARM DPG report)

Development of rifted continental margin models by extrapolating continental rift models to higher degrees of crustal thinning has proven to be a gross oversimplification, at best, of actual rift processes. The NARM drilling program is designed to compare quantitative results on deformation style and rate, early volcanic productivity and spreading rate, mantle temperatures and magmatic melt histories, and subsidence histories from the two most contrasting types of rifted margins: 1) the thick-crusted volcanic margin, and 2) the thin-crusted, multi-rift, non-volcanic margin.



Site I.D.	Water Depth	Penetration Seds	Penetration Bsmt	Log Time (hrs) Std	Log Time (hrs) BHTV	Log Time (hrs) VSP	Mag/Susc	Total days
VOLCANIC MARGINS								
LEG 1								
EG63-1	520	440	500	29	7.3			1.5
EG63-2	1875	1220	500	43	8.9			2.2
LEG 2								
VM-3	1370	470	800	35	11.2			1.9
VM-5	3180	470	400	33	8			1.7
VM-6	3370	600	50	30				1.3

*assumes Side Entry Sub needed on all holes

Site I.D.	Water Depth	Penetration Seds	Bsmt	Log Time (hrs) Std	BHTV	VSP	Mag/Susc	Total days*
NON-VOLCANIC MARGINS								
LEG 1								
IAP-4	5400	680	100	36				1.5
IAP-2	5200	850	100	38	6.4	16.5		2.5
GAL1	4500	550	100	32				1.3
IAP-3B	5500	850	100	39				1.6
LEG 2								
NB-4A	3940	2250	200	57	8.1	15.7		3.4

*assumes Side Entry Sub needed on all holes

General Comments:

The drilling indicated in the legs listed above is based upon the latest recommendations of the Tectonics Panel and Lith Panel. The non-volcanic margin leg 1 was rated highest priority by Tectonics Panel. IAP-3B will function as an alternate site, if other drilling objectives are reached.

Program Objectives:

In each of the programs below, the standard ODP logging suite will suffice for most of the downhole measurements needed. Borehole televiewer information will be important to study structure in the basement sections of some of the drillholes, however, and vertical seismic profiles may be needed for deep seismic structure in some of the Iberian Abyssal Plain holes, particularly if the holes fail to reach their deep objectives.

Standard logs will provide density and velocity information to make synthetic seismograms for comparison with the extensive seismic reflection data collected around all the sites. Geochemical logs will provide sufficient chemical data to discriminate between sediment types, major classes of volcanic rocks, and to identify alteration. Logging data from the standard suite will also provide means to correlate between holes. FMS, from the standard logging suite, and BHTV will image fractures and identify other strain features in the lithologic column. They will also be used to orient fracture directions.

VOLCANIC MARGINS

1. SE Greenland Transect (EG-63)

- constrain Seaward Dipping Reflector Sequence (SDRS) emplacement mechanism
- temporal development of volcanism
- vertical and horizontal accretion rates

- geochemical composition and variation across archtypical SDRS
- syn-constructional flexure, strain rate, and subsidence; post-constructional subsidence
- Influence of Iceland Hotspot on rift volcanism

2. Vøring Margin Transect (VM)
   - timing of volcanism with respect to breakup process, and transient nature of volcanism
   - testing for possible margin assymetry
   - conditions governing lateral variation in vertical motion of the igneous complex

NON-VOLCANIC MARGINS

3. Iberia Abyssal Plain (IAP)
   - corroboration of geophysically-based predictions for the Ocean-Continent Transition (OCT)
   - existence of peridotite ridge associated with OCT
   - age and subsidence history of sediments overlying the westernmost tilted continental block
   - nature and composition, and rift-related alteration of the westernmost tilted continental block

4. North Newfoundland Basin (NB-4A)
   - nature and age of basement
   - nature and age of synrift 'fill'
   - nature (e.g. subaerial erosion) and age of breakup unconformity
   - gateway paleoceanographic history
   - sea-level record of adjacent Grand Banks
   - History of abyssal circulation in gateway between northern and central North Atlantic Basins

Logging Tool Objectives:

1. Standard logs (geophysical string, geochemical string, FMS): mineralogical variation as a function of time and location; synthetic seismograms for depth/seismic link; structure and deformation of sediments. Chances of success: very good in shallow holes, good in deeper holes. Hole stability may be a problem in the >2 km holes.

2. Borehole televiewer: Structure and fracture patterns of basement sequences, modern stress directions. DMP views that the additional structural information obtained by BHTV over FMS (360° acoustic image in the BHTV versus FMS resistivity images of about 1/3 of the borehole circumference) to be important for identifying basement structures and fracture patterns, and to identify the modern stress environment via borehole breakouts.

3. Vertical Seismic Profile: Depth to thinned continental block, if holes cannot reach deep objectives; structure within thinned continental block. Chances of success: very good.

4. Lateral Stress Tool (LAST): In-situ variations in stress within sediment packages to determine lateral variations across the margin.

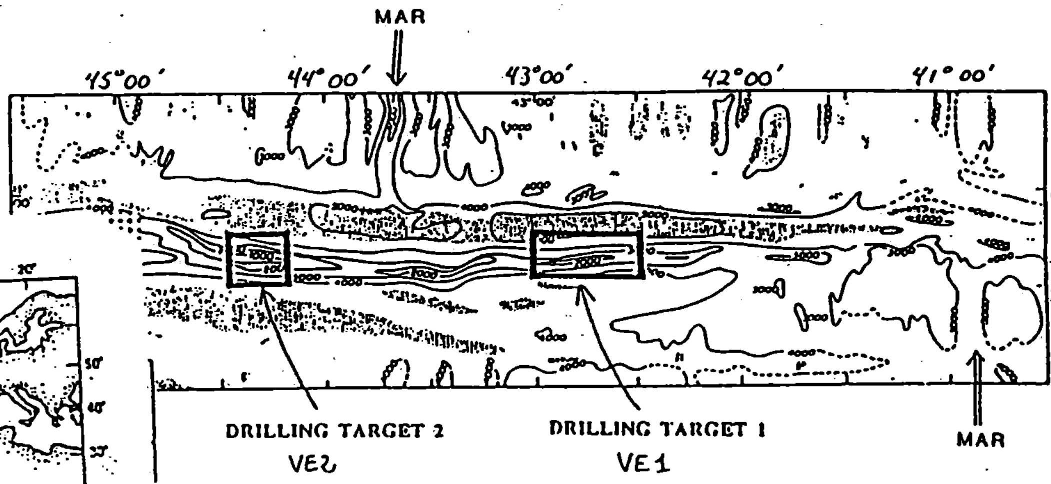
Need for New Logging Technologies

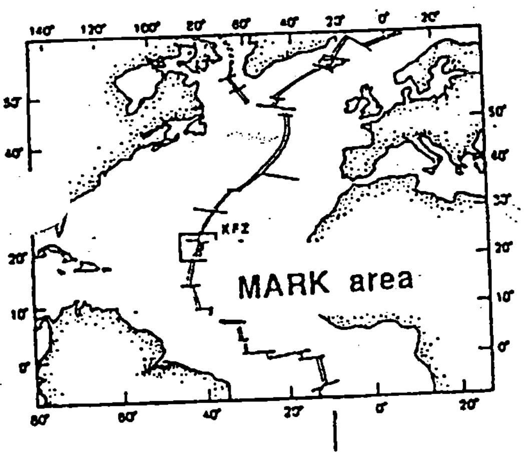
None

Offset Drilling to Study the Oceanic Lithosphere

(Information from Offset Drilling Working Group preliminary report and from proposals 369-rev and 376-rev)

Drilling offset partial segments of tectonically exposed deep crust and shallow upper mantle is a relatively new strategy to recover complete sections through the ocean crust and upper mantle by drilling relatively shallow holes (500-1000 m). Two sites in the Atlantic Ocean, the MARK area and the Vema Fracture Zone, have gabbro or peridotite sections targetted for drilling in this program.





Site I.D.	Water Depth	Penetration Seds	Penetration Bsmt	Std	Log Time (hrs) BHTV	Log Time (hrs) Fluids	Log Time (hrs) Mag/Susc	Total days
369-rev								
MK-1	2500	--	1000	29	8.9		7.7	1.9
MK-2	3500	--	1000	31	11.4		8.4	2.1
376-rev								
IG-3	3500	--	1000	31	11.4		8.4	2.1
IG-4	580	200	10*	14			--	0.7

* to bit destruction.

General Comments:

The Offset Drilling Working Group has not yet had the time to prioritize Atlantic sites nor to develop a complete Offset Drilling program encompassing all of the ocean basins. In whatever holes drilled in this program the standard logging suite will constrain structure and chemical composition of the drilled section, the magnetometer measurements will address magnetization of the ocean crust, and the borehole televiewer will provide structural detail.

Leg Objectives:

1. Mechanisms leading to the formation and exposure of rocks of deep origin (gabbros, mantle peridotites) in the axial valley or fracture zones of slow-spreading mid-ocean ridges

Standard logs will provide composition, alteration and structure of the drilled section, and will be used to extrapolate core measurements to the actual section drilled. Core recovery in massive igneous sections will be good, but will be poor around fractures or breccia zones. Contacts are most likely to be poorly recovered by drilling.

2. Structure, composition, and magnetizaton of lower ocean crust/upper mantle

Standard logs provide information on structure and composition of the drilled sequence. In addition, borehole magnetometer measurements will be used to assess magnetization within the lower crust and upper mantle, and will be used to assess how alteration has affected magnetic properties.

Logging Tool Objectives:

1. Standard logs (geophysical string, geochemical string, FMS): mineralogical variation as a function of time and location; synthetic seismograms for depth/seismic link; structure and deformation of basement and sediments (IG-4). Chances of success: very good. Provided that holes can be drilled, they will be stable and cool.

2. borehole magnetometer: magnetization of lower crust, and changes in magnetization due to alteration. Chances of success: very good. Typical magnetization of basaltic rocks is high, and sensitive instruments are not needed to record a signal.

3. BHTV: imaging of individual fractures (their azimuth, aperture and whether they are filled or open), dip of dikes (if any) and delineation of volcanic units.

Need for New Logging Technologies

None