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MEETING OF JOIDES DOWNHOLE MEASUREMENTS PANEL

Lamont-Doherty Geological Observatory
New York

4-6 June 1991

EXECUTIVE SUMMARY

1. This was the second of three meetings of the JOIDES Downhole Measurements Panel (DMP) planned for 1991. A principal component of the meeting was the joint session with SGPP on 5 June 1991. Other important features were a briefing session with LDGO BRG on log data acquisition, processing and distribution, and the need to identify ahead of the OPCOM meeting on 7 June 1991 those technological developments that the Panel would like to see proposed.

2. Panel considered that, because of the coupled nature of drilling and logging programmes, the Offset Drilling Working Group should include someone with downhole measurements expertise.

3. Panel congratulates the ODP Logging Contractor, the Borehole Research Group of the Lamont-Doherty Geological Observatory, on their fruitful efforts which have brought about a highly favourable recognition of the value of log data within the ODP community.

4. Pursuant upon DMP Recommendation 91/2, the Geoprops Probe should be tested at sea at least two legs ahead of its proposed scientific deployment as Cascadia. Chile Triple Junction affords the only suitable opportunity to conduct a sea trial in an unstressed hole. Time should be made available to test the Geoprops Probe with the Motor-driven Core Barrel during Leg 141.

[DMP Recommendation 91/10: to PCOM, ODP/TAMU, Geoprops Proponent and Leg 141 Co-Chiefs]

5. Third-party downhole tools should be designed with a mass of at least 50 kg if free and 100 kg if constrained by bow-spring centralizers or otherwise, provided that the centralizers still pass freely through the 4-inch diameter drillpipe.

[DMP Recommendation 91/11: to LDGO BRG]

6. Panel encourages the design and development of a universal weighting system for ODP downhole tools to allow the requirements of DMP Recommendation 91/11 to be fully met. The weighting system should be kept on board ship at all times.

7. The joint DMP/SGPP meeting noted that many future ODP legs require high- or low-temperature pore-fluid samples. The technology must be developed to allow this to happen. Substantial engineering input is needed in a brainstorming session as a prelude to an engineering feasibility study of the best option(s). The JOIDES working group meeting on In-Situ Pore-Fluid Sampling, scheduled for 23 August 1991 in Houston, would address the first

stage. It was anticipated that funds would be made available for the engineering feasibility study in early FY92. It is, of course, possible that what we are trying to do cannot be done. However, the effort should be driven by the scientific goals which remain a top ODP priority.

8. All proposed re-entry holes should have casing programmes designed to facilitate wireline re-entry in the long term.

[DMP Recommendation 91/12: to PCOM]

9. The North Atlantic provides a unique opportunity for long-term downhole-measurement science through wireline re-entry. The following re-entry holes, which have not been cased to basement and which are known to have deteriorated, should be cased to basement when the drillship returns to the North Atlantic. The holes in question are 333A, 417A and 418A.

[DMP Recommendation 91/13: to PCOM]

10. Panel encourages the ODP community to prepare an add-on science proposal for the restoration of existing re-entry holes that are known to be at risk in the North Atlantic.

11. Panel wishes to see an increase in the number of re-entry holes drilled by ODP as an enhancement of the long-term scientific legacy of the Programme.

12. In view of the temperature limitations (260°C) imposed by the Vector teflon cable, the logging contractor is urged to continue to seek urgently a high-temperature memory-tool measurement capability for deployment on Leg 139.

[DMP Recommendation 91/14: to LDGO BRG]

13. Panel encourages the initiative to establish a high-temperature test hole for downhole tools on the island of Oahu.

14. In the event of Hess Deep being drilled during Leg 140, the logging programme in each logged hole should be similar to that already carried out at 504B. The (digital) dual laterolog should be run in each logged hole during Leg 140, regardless of which leg option is taken.

[DMP Recommendation 91/15: to PCOM and LDGO BRG]

15. Panel strongly supports the running of the Japanese three-component borehole magnetometer in selected basement holes during the Atolls and Guyots legs.

16. Panel reviewed five technological developments that might be appropriate fur funding through the OPCOM initiative and that would not otherwise be progressed in the short term. These were voted into the following priority order.

    (1) High-temperature resistivity tool with fluid resistivity and temperature capability.

    (2) Fluid sampling capability through the wireline sampler or alternative.

(3) MAXIS 500 data acquisition/analysis system (accelerated introduction to ODP).

(4) Sediment susceptibility tool.

(5) High-resolution geochemical tool.

17. The next meeting of the JOIDES Downhole Measurements Panel is scheduled to take place in Halifax, Nova Scotia, Canada during the period 15-17 October 1991. The meeting will encompass a joint one-day session with SMP to continue the drive towards the integration of core and log data. On Friday 18 October there will be a joint technical workshop for the East Canada community. Kate Moran will host.

PAUL F WORTHINGTON
12 July 1991

MEETING OF JOIDES DOWNHOLE MEASUREMENTS PANEL

Lamont-Doherty Geological Observatory
New York

4-6 June 1991

MINUTES

Present

Chairman:		P F Worthington (UK)
Members:		J Gieskes (USA)
		M Hutchinson (USA)
		D Karig (USA)
		R Morin (USA)
		R Wilkens (USA)
		M Williams (USA)
		H Crocker (Canada/Australia)
		H Draxler (Germany)
		J-P Foucher (France)
		O Stephansson (ESF)
		M Yamano (Japan)
Liaisons:		K Becker (PCOM)
		A Fisher (ODP/TAMU)
		X Golovchenko (LDGO)
		J McClain (LITHP)
	****	J Mienert (SGPP)
Guests:		R N Anderson (LDGO)
	*	C Broglia (LDGO)
	*	J Grau (Schlumberger)
		B Harding (ODP/TAMU)
		R Jarrard (LDGO)
		M Langseth (LDGO)
	**	R Madden (Madden Systems, Inc)
	*	E Pratson (LDGO)
	***	J Schweitzer (Schlumberger)
		E Scholz (LDGO)

Apologies

P Lysne (USA)
C Sondergeld (USA)

* attendance for agenda item 8 only.
** attendance for agenda items 8-15 only.
*** attendance for agenda items 8-10 only.
**** attendance for agenda items 9-15 only

NB Agenda items 9-15 were conducted in joint session with the JOIDES Sedimentary and Geochemical Processes Panel : the minutes pertaining to these items have been agreed jointly.

1. Welcome and Introductory Remarks

The meeting was called to order at 0900 hours on Tuesday 4 June 1991. The Chairman welcomed members, liaisons and guests to the second DMP meeting of the year. Draxler was attending for the first time as the official FRG representative. A principal component of the meeting was the joint session with SGPP on 5 June 1991. Other important features were a briefing session with LDGO BRG on log data acquisition, processing and distribution, and the need to identify ahead of the OPCOM meeting on 7 June 1991 those technological developments that the Panel would like to see proposed.

Review of Agenda and Revisions

Wilkens will report on the Annual Meeting of Co-chiefs under new Agenda Item 4(v).

Agenda item 6(vi) will be expanded to include a discussion of minimum tool weights and sinker bars.

Item 6(vii) on borehole seals will be incorporated within item 11.

Item 22 will be concerned with the formulation of the Panel's input to the JOIDES OPCOM meeting on 7 June 1991.

Panel will reconvene at 0830 hours on 5 June.

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

2. Minutes of Previous DMP Meeting, College Station, Texas, 6-8 February 1991

One modification was proposed : page 18, principal paragraph, line 7 : read 2000 for 200.

With this modification the minutes were adopted as a fair record.

Matters Arising

(i) Item 4 - Oahu Test Hole

LDGO liaison reported that the long-spaced sonic tool (with digital cartridge) was run in the Oahu test hole.

(ii) Item 14 - High-temperature Logging Cable

Morin reported that the USGS high-temperature TFE logging cable cannot be made available to ODP. It had originally been suggested that ODP might purchase from USGS an appropriate length to permit high-temperature logging by splicing. This is no longer an option for offshore use. However, the cable is currently being used on land in the Hawaii geothermal study. It could be used for testing new ODP tools in these geothermal holes, which currently range from 150-300°C and are slim holes at the upper end of this temperature range.

3. PCOM Report

Becker reported on the Spring meeting of PCOM held at the University of Rhode Island on 23-25 April 1991. Three DMP Recommendations had been put forward for discussion by PCOM.

Rec. No.	Description	PCOM Response
91/1	Specialist working group on downhole fluid sampling	Accepted
91/7	Logging of Hole 801C	Being progressed through proposal for add-on science
91/9	Future engineering leg for borehole stability studies	Not discussed

Other DMP Recommendations were made implicitly through PCOM to other parts of the ODP network.

PCOM set the direction of the drilling vessel for the next four years as follows:

1) In the remainder of FY 91, confirmed as in the current programme plan.

2) In FY 92, and beyond to January 1993, confirmed as in the programme plan approved at its November 1990 meeting in Kailua-Kona, Hawaii, through Leg 147, Engineering EPR (in the event that DCS Phase III is not ready, Hess Deep will be substituted), ending in Panama on or about 21 January 1993. The programme plan may include up to 10 days of supplemental science as moved at the November 1990 meeting.

3) Until April 1994, in the North Atlantic. Fiscal Year 1993 programme to be finalized in November 1991 at the Annual Meeting of PCOM with Panel Chairs.

4) In April 1994 through April 1995 in the general direction of highly ranked proposals in the Atlantic Ocean and adjacent seas and the Pacific.

5) PCOM's long-range commitment to engineering development in support of highly ranked thematic objectives must be considered in planning specific cruise tracks.

PCOM re-affirmed its stand that at its Spring 1992 meeting, and at subsequent meetings, it will evaluate again the state of panel recommendations, technological developments, and the overall state of the Ocean Drilling Program, and again set the general direction of the drilling vessel for the subsequent four years, with a relatively firm early track and a relatively flexible later direction.

PCOM prioritized engineering development as follows:

1) Improvement and development of the Diamond Coring System (DCS)

2) Improvement and development of the XCB Coring System

After these major priorities PCOM believes that the development should respond to the needs of scheduled legs. This implies that the next priorities are:

3) Cork/PCS/High temperature preparations, for Leg 139.

4) Orientation needs (hard rock orientation, sonic core monitor, electronic multishot), for Leg 141.

5) Vibra Percussion Corer, for scheduled 1992 SGPP objectives.

6) Motor-driven Core Barrel, for the use of GEOPROPS in the Cascadia drilling.

Each of these development activities should be re-evaluated after testing on the appropriate leg(s). Other active development efforts should continue on an as-possible basis. If there are short-term perturbations of the schedule, PCOM assumes that the engineering development will respond to the schedule. PCOM expects reports on the development schedule in the future so that the priorities can be re-evaluated.

PCOM established an Offset Drilling Working Group to be charged with:

a) establishing and setting priorities for scientific objectives and a drilling strategy of a programme for drilling offset sections of oceanic crust and upper mantle;

b) identifying target areas where specific objectives can be addressed;

c) identifying other survey information necessary to establish the geological context of an offset drilling programme; and

d) identifying the technological requirements to implement the strategy.

DMP Consensus

Because of the coupled nature of drilling and logging programmes, the Offset Drilling Working Group should include someone with downhole measurements expertise.

PCOM recommended that the highest priority for downhole tool acquisition or development be a sensitive downhole magnetic susceptibility tool, ideally one that can be incorporated into each tool string. In the interim, or alternatively, existing susceptibility tools such as the French magnetometers should be used on Leg 141 and subsequent legs to enhance core-log correlation.

PCOM has established an Opportunity Committee (OPCOM) which is to meet for the first time on 7 June 1991 in Washington DC. The brief is to advise on how an additional $2.1 million recently made available to ODP should be spent in FY 92 and perhaps beyond. The additional funds are intended for technology that will allow the scientific goals of the ODP Long Range Plan to be achieved. (See Item 22)

4. Liaison Reports

(i) Lithosphere Panel

McClain reported on the LITHP meeting held in La Jolla on 14-16 March 1991.

LITHP endorsed DMP Recommendation 91/1 to convene a working group to address the issue of downhole fluid sampling. LITHP were especially concerned with high-temperature capabilities. The fluid sampling question was seen as extremely important.

The top four programmes ranked by LITHP in their consideration of proposals were as follows.

Rank	Programme/Theme	Area
1	Offset drilling: Layer 2/3, etc.	Hess Deep
2	Hydrothermal processes at slow spreading ridge	TAG
3	Axial crustal drilling-- EPR II	EPR, 9°30'N
4	Volcanic rifted margins	N. Atlantic

(ii) Shipboard Measurements Panel

The Chairman had attended the March meeting of SMP as liaison from DMP. The actual liaison is Sondergeld, who had been unavailable and whom SMP had requested replace for the time being the previous liaison, Gieskes, because of a shift in SMP's primary interests. The Chairman summarized the key points of the SMP meeting, mostly concerned with the computerization and interactive display of core data, and tabled a more detailed written report (Annexure I).

(iii) Sedimentary and Geochemical Processes Panel

The Chairman had attended the March meeting of SGPP to present a brief overview of the logging characteristics of gas hydrates. Gas hydrates had been the featured subject of a one-day working group meeting run as part of the SGPP meeting. This matter would be discussed more fully under Item 10 and therefore the Chairman gave only a short verbal account but tabled a more detailed written report (Annexure II).

The remainder of the SGPP meeting had principally been concerned with the ranking of proposals. Mienert tabled a list of rankings. The top four were as follows.

Rank	Theme or Area
1	Gas Hydrate
2	Mediterranean, sapropels
3	Sedimented ridges II
4	New Jersey margin

(iv) KTB

Draxler reported that the main hole of diameter 17.5 inches had reached a depth of 3002 m. Logging is being carried out over this interval after which 16-inch casing will be emplaced to total depth. The programme is behind schedule because of learning how to use the vertical drilling systems. The logging programme included both the Formation Microscanner (FMS) and the new Formation Micro-imager (FMI), a new version of the four-arm FMS with 48 electrodes per arm, 24 on the pad itself and 24 on an openable flap adjacent to the pad. There are therefore 192 electrodes in all. The electrodes are buttons of diameter 5 mm. The FMI buttons are smaller and closer together (by a few mm) than those of the FMS. Resolution is therefore sharper. The size of pads is unchanged but the FMI covers slightly more of the circumference due to electrode design differences. The focusing system is the same as for the slim FMS used by ODP. The FMI needs the MAXIS 500 data acquisition/processing system and has a slower logging speed (4-5 m per minute) than does the FMS. Schlumberger have three FMI prototypes located in Paris, Alaska and Asia. KTB acquired the tool for three logging runs.

KTB has recently organized itself into four working groups (there were previously eight). As a consequence of re-unification, a new Lithosphere Research Institute has recently been inaugurated in Potsdam. It is not yet known how this will affect KTB.

(v) Annual Co-chiefs Review

Wilkens reported on the 1991 review meeting of Co-chiefs. The meeting was very supportive of logging and made two requests, that logging data be available earlier on board ship and that more well-qualified logging scientists be actively sought for future legs. The reasons for this strong support were threefold : very little tool down-time, the answering of key scientific questions using log data, and the education of the community.

DMP Consensus

Panel congratulates the ODP Logging Contractor, the Borehole Research Group of the Lamont-Doherty Geological Observatory, on their fruitful efforts which have brought about a highly favourable recognition of the value of log data within the ODP community.

5. Reports of National Representatives

(i) United Kingdom

The Chairman reported that a one-day meeting featuring the scientific results, technological achievements and future direction of ODP had been held in London on 2 May 1991. The meeting, which had highlighted Britain's role in ODP, had been extremely successful and had contributed to a very positive climate within the community.

The Camborne School of Mines had expressed interest in supporting ODP through their geothermal logging expertise and discussions were currently in progress to see how an association might be developed.

(ii) France

Foucher reported that a French ODP day was planned for 5 June 1991. This would be similar to that recently held in the UK.

A principal technical activity was downhole sediment magnetometry. The two high-magnetic-resolution tools, NMRT and SUMT, had been run in more than 20 holes in Europe and Indonesia. The data obtained on Leg 134 are currently being interpreted. A new susceptibility tool with a much sharper vertical resolution (10-20 cm) is being proposed to ODP: the existing tool has a 1 m vertical resolution which can be processed to 50 cm. The approach would be to modify a tool that is already available in the mining industry.

Post-drilling wireline re-entry had been successfully achieved in November 1990 through the DIANAUT re-entry experiment using NAUTILE and NADIA (see Item 16). There is some concern about sealed boreholes, which cannot be re-entered. There is no conflict but the possibility exists of scientific competition. The SISMOBS downhole deployment of broad-band seismometers has been deferred until 1992.

(iii) Japan

Yamano reported on a planned diving programme using the new Japanese submersible. One dive will be dedicated to the ONDO system if weather permits. The aim is to recover data through acoustic transmission between the submersible and the ONDO system. The deployment of seismometers in the Japan Sea has been followed by one data recovery but there is no definite programme for the next data recovery. The resistivity experiments in the Japan Sea will be reported in the Part B volume for Leg 128.

(iv) ESF

Stephansson reported on an ESF science committee meeting held in Stockholm in May 1991. There is a strong interest in ODP now that the ship is returning to the Atlantic. The ESF ODP steering committee meets in mid-June to discuss involvement in Phase 2. Prospects are good. A report is now available on the deep drilling programme in Sweden.

(v) Canada/Australia

Crocker reported that the Australian ODP community awaits a ministerial decision on renewal later this year. The BMR involvement in Leg 133 and the promotional use of the Townsville port call will hopefully augur well for a positive outcome. Canada will be building promotional activity around the September port call in Victoria, BC.

The Australian ODP secretariat is moving in June 1992, possibly to Sydney. Two long-range projects are proposed for the Pacific, the subduction zone off Tasmania and the Northern Australian margin.

(vi) Germany

Draxler reported that a two-day ODP scientific meeting held in March 1991 attracted 140 attendees. At this meeting, membership of ODP Phase 2 was proposed. There were 70 presentations but only one report on logging, the results of BHTV surveys on Leg 135. There is a perceived shortfall in general scientific knowledge about logging : a big drive is needed to raise awareness of the potential benefits.

The digital BHTV was mechanically damaged when returned for repair to DMT (WBK). Anderson commented that the damage had occurred in transit : it seems that the tool, which was transported in a PVC tube, had been damaged at either New York or Frankfurt airport. The tool was repaired and sent out for Leg 137 where it still showed problems. The tool was returned to DMT once again and is due to be delivered to the ship prior to Leg 139.

The next German ODP community meeting is scheduled for Hamburg in March 1992. A KTB/ODP meeting on high-temperature logging will take place in Hannover on 24-25 July 1991.

6. Tool Monitor Reports

(i) Geoprops Probe

Karig reported that his proposal to NSF for additional funds had been accepted and that these would allow further testing of the tool together with the preparation of a manual and the acquisition of spare parts. A bench test is scheduled for the end of June at TAM, Inc. This test should be used not merely to ascertain that the slug valve problem (believed to have been caused by a faulty 'O' ring) has been solved, but also to calibrate the permeability vs pressure decay curve. The bench test will take place in a hole the size of a Motor-driven Core Barrel (MDCB) hole. Beyond this, further land testing is unlikely to answer any further questions. A test is needed at sea. ODP will allow a technician to be trained in Geoprops operation/maintenance at TAM, Inc.

The first scientific deployment of the Geoprops Probe is scheduled for Cascadia (Leg 146). The shipboard test should be carried out at least two legs prior to Cascadia. Furthermore, this test will have to be dovetailed with deployment of the MDCB. Chile Triple Junction (Leg 141) offers a sufficiently deep hole which is unstressed and therefore suggests straightforward hole conditions.

DMP Recommendation 91/10

"Pursuant upon DMP Recommendation 91/2, the Geoprops Probe should be tested at sea at least two legs ahead of its proposed scientific deployment at Cascadia. Chile Triple Junction affords the only suitable opportunity to conduct a sea trial in an unstressed hole. Time should be made available to test the Geoprops Probe with the Motor-driven Core Barrel during Leg 141."

(ii) LAST

Crocker reported on behalf of Moran. LAST II did not go out for testing on Leg 138 because of an intermittent electrical fault detected one week before departure. The problem has now been resolved. It is proposed to test LAST II during the Chile Triple Junction leg.

(iii) BGR Borehole Magnetometer

Draxler reported that a proposal to use the German magnetometer on Leg 140 has been rejected by the German ODP secretariat because the tool is not yet completely tested and because there was no accompanying application for membership of the scientific party. All activity is temporarily at a standstill.

(iv) French Sediment Magnetometer

Foucher reported on the interpretation of data obtained during Leg 134 (Vanuatu). The system comprises two separate tools to measure total magnetic field (NMRT) and susceptibility (SUMT). Both have shown good repeatability. Processing of NMRT data has allowed corrections for the effects of casing and of underlying volcanic basement rocks. The NMRT data are further processed, in conjunction with a surface magnetometer, to separate the present earth's field from the induced field. The SUMT data indicate the remanent magnetism. Normal magnetisation is indicated by a positive correlation of the induced-field NMRT data and the (remanent) SUMT data. Reversed magnetisation is indicated by a negative correlation. Thus the tool can be used to detect reversals. However, more examples should be investigated and these should be related to magnetostratigraphy. It is feasible to use the tool on Leg 145 (North Pacific Transect), as previously recommended by DMP.

Strong interest was expressed in the sediment magnetometer data from Indonesia. Foucher and Crocker will enquire separately about the nature of the data and the possibility of a Schlumberger representative attending the next DMP meeting to make a presentation.

[ACTION : CROCKER, FOUCHER]

(v) Japanese Borehole Magnetometer

Yamano reported that this tool was originally intended to be a high-temperature tool but that now it is targeted at Atolls and Guyots (Legs 143 and 144). Its inclusion in those legs has been accepted by the Atolls and Guyots DPG only if the tool can be run in conjunction with a Schlumberger tool string, because of time considerations. Therefore the tool is being planned as a memory tool at present. The plan is to finish the mechanical design (by August 1991), construct (December 1991), land test (January 1992) and despatch to Leg 143 (March 1992). Tool specifications are 75 mm diameter, temperature rating of 80°C, and resolution of a few nanoTesla. A Phase-2 tool to be built subsequently will have a 96 mm diameter and be rated to 260°C. This will not be a memory tool and it may need a dedicated logging run.

The Chairman pointed out that the logging contractor should verify that third party tools such as this magnetometer do conform to the published guidelines for their deployment.

(vi) Flowmeter

Morin reported that the first attempt at deployment in hole 504B, during Leg 137, had been an operational success but a scientific failure. The tool measured flow, pressure and temperature, but not under the desired conditions. The new modified go-devil worked well. However, the packer deflated during permeability measurements. This was believed to be due to low friction between the casing and the packer which suggests that the inflation pressure was inadequate. In future two packer elements inflated at c. 750 psi will be used for security. The flowmeter tool is to be deployed again during Leg 139 (Sedimented Ridges I). If successful, a test will be attempted again in 504B during Leg 140. Tool deployment is accommodated within the scientific prospectus for each of these legs.

The flowmeter tool at 55 kg had been of critical mass for downhole deployment. Fisher proposed minimum tool masses of 50 kg if free and 100 kg if the tool contains bow-spring contralizers, etc. This could be achieved by clamping sinker bars to the downhole hardware. Draxler commented that standard weights are available for this purpose but that these should be incorporated within the stiff assembly of the tool : they should not be clamped to the cable.

DMP Recommendation 91/11

"Third-party downhole tools should be designed with a mass of at least 50 kg if free and 100 kg if constrained by bow-spring centralizers or otherwise, provided that the centralizers still pass freely through the 4-inch diameter drillpipe."

DMP Consensus

Panel encourages the design and development of a universal weighting system for ODP downhole tools to allow the requirements of DMP Recommendation 91/11 to be fully met. The weighting system should be kept on board ship at all times.

7. <u>Logging Contractor's Report</u>

Becker, who had been a Co-chief on Leg 137, reported (on behalf of the logging contractor) on the downhole measurements carried out at 504B. The junk in the hole was cleared and the hole was deepened by 60m. Then a core barrel was lost. The need to fish for this barrel impacted on the time available for downhole measurements (of permeability and BHTV).

Temperature and fluid sampling (using both the Los Alamos and the Lawrence Berkeley tools) were carried out before milling. These produced the best set of fluids ever sampled from DSDP/ODP holes. A problem was encountered through the contraction of the fluid sample during recovery of the tool. This creates a differential pressure which the valves must be able to withstand. Some contamination did occur. These samplers will be run again on Leg 139 when hopefully this problem will have been resolved. The temperature measurements revealed that downflow is occurring.

Permeability and BHTV measurements were carried out after the engineering work. The flowmeter/permeability experiment has already been described (see Item 6(vi)). The digital German BHTV ran well in casing but only over 100 m of open hole due to an intermittent fault. The tool was subsequently returned to the factory for repair.

Anderson reported that eleven wells have been logged so far in 1991 during Legs 136-138. The FMS is becoming the most commonly used logging tool because it is being requested in holes less than 400 m depth. Of the special tools, temperature is run most often with BHTV proving popular.

Logs run in the Oahu test hole (Leg 136) showed greater SFL than ILD resistivities in the sediments at the bottom of the hole. It is not known whether this is due to fluid invasion or rock heterogeneity. The FMS was run to aid in seismometer location. This was the first ODP leg to be drilled and to have logging carried out in support of another international project (Ocean Seismographic Network). The logging therefore enjoyed a higher priority than coring on this leg.

Anderson reviewed the tool status for upcoming legs. There are problems with the acquisition of high-temperature logging cable for Leg 139, Sedimented Ridges (see Item 17). The digital dual laterolog will be run during Leg 140 at 504B or Hess Deep. All Schlumberger tools will then be digital. The high-spectral-resolution geochemical logging tool, which uses a germanium crystal, is awaiting release from ARCO. They will advise by July whether the tool can be released to Schlumberger. After this, software would have to be developed so it now seems doubtful that the deadlines (for Leg 140) can be met.

The LDGO budget status is that $ 3.95 million has been approved for FY 92 compared to the $ 4.03 million requested and $ 3.57 million for FY 91. The approved figure includes $ 140 000 for high-temperature tool development, $ 58 500 for computer equipment, and $ 1 919 500 for the Schlumberger subcontract. There are no other high technology provisions : the principal purpose of the budget increase is to allow LDGO to meet the demand for log data. In particular, there is no provision for the installation of the MAXIS 500 log data acquisition and processing facility.

Jarrard reported on the LDGO proposals to be tabled at the inaugural meeting of the JOIDES Opportunity Committee (OPCOM) in Washington DC on 7 June 1991. These were:

High-temperature resistivity tool	($ 255 000 total : already have $140 000) for FY 92 : therefore need $ 115 000)
Wireline packer	($ 250 000)
MAXIS 500	($ 150 000)
High-resolution geochemistry tool	($ 100 000)
Sediment susceptibility tool	
- 0.8 m vertical resolution	($ 200 000)
- 0.45 m vertical resolution	($ 260 000)

The sediment susceptibility tool is the highest priority of PCOM for downhole tool development.

8. Log Data Acquisition, Processing and Distribution

(i) Overview of Data Acquisition and Transfer Onboard Ship

Broglia reported that the output from the Schlumberger Cyber Service Unit (CSU) is threefold: proprietary tape (raw), customer tape (edited), and hardcopy blueprints and films. There is interim shipboard processing of the standard logs (see below for FMS). Terralog is used to change scale and plot the data from the customer tapes. An output file is created in ASCII format and this can be loaded onto a MacIntosh (for graphic display and integration with other data) and into the Appleshare on the VAX system. These data include geochemical "field logs" in the form of relative elemental yields based on a limited set of spectral standards, for initial shipboard interpretation. The sonic tool, at the top of the quad-combo, is no longer centred because other tools in the string have to be run eccentred. This can give rise to cycle skipping and noise. These effects are processed out on board ship. FMS data are processed from the proprietary tape on the Vax Station 3200. FMS processing includes a scale change (from feet below rig floor to metres below sea floor), but there is no depth shift with reference to standard logs, and there is rarely any merging of different passes. Raster files are created for the Versatec plotter. User plots can be presented either for caliper plus images at 1:6.42 vertical and horizontal scales, which match core photographs, or for caliper plus images plus dips at 1:40 vertical scale and 1:10 horizontal scale. Other scales are sometimes used for specific purposes.

The availability of logging data to the shipboard party is affected by several time constraints. For example, logs are run last, just before the transit to a new site. Data loading on the Masscomp, editing, and transfer to a MacIntosh all take time. FMS data have to be processed.

The current situation is that logs are plotted in real time, during the recording, with a depth reference in ft brf. Standard logs are available for loading onto Masscomp as soon as the data recording is complete and during tool recovery. FMS/dipmeter digital data are available shortly after the FMS logging run. If the FMS processor is available, processing for the first pass of a 200 m hole can be completed in approximately 24 hours.

(ii) Overview of Data Processing Onshore

Broglia reported that logs are depth-shifted onshore using interactive methods. The aim is to refer all data to one reference run through manual peak-to-peak matching or an auto-correlative technique. Usually the gamma ray forms the basis for depth merging because it is recorded on each logging pass. The depth reference run is chosen on the basis of the best overall quality, the longest recorded interval, cable speed, absence of tool sticking problems, and the presence of prominent lithological markers. All log scales are referred to sea floor. Natural gamma spectral logs and sonic waveform logs are processed routinely. Neutron and density log processing is not performed routinely (beyond the automatic corrections for hole size during recording). Porosity logs, primarily density and sonic, are tied back to core to establish the best porosity distribution for input to geochemical log processing.

Pratson reported that onshore processing of the geochemical log data is required to transform the relative elemental yields into oxide weight fractions using a larger set of spectral standards. Data quality is improved by correcting the data for borehole fluids, logging speed and pipe interference. Borehole effects can account for 75% of the spectra compared to only 25% in a typical oilfield situation.

Grau pointed out potential pitfalls in GLT data reduction. Sources of error are both counting statistics and systematic errors. For the NGT, counting statistics introduce an uncertainty that is a function of total gamma counts. For example, with a total gamma response of 100 API, the uncertainties are K = ±0.2%, U = ±0.6 ppm, Th = ±1.1 ppm. An example of a systematic error is that introduced by the presence of potassium in the borehole. Barite in the drilling mud has a big effect on NGT data. For the ACT, the uncertainty is a function of weight per cent Al. For example, 10 wt% Al might be associated with a statistical precision of ±0.2% (ie 10 ± 0.2 wt% Al), and a total uncertainty including that due to environmental corrections, but excluding sticking effects, of ±1.2%. For the GST, absolute elemental concentrations can be in error if an incomplete set of spectral standards is used. For example, ignoring elements such as gadolinium, as is done in the shipboard processing, can cause drastic overestimates in the amount of silicon. Even onshore, we do ignore Ba, Mn, Na and Mg. The last three of these elements do not contribute much to the spectrum. For example, by failing to account for 2% of Na, the Ca concentration will be 1% too high. Similarly, if 13% of Mg is not accounted for, Gd will be 1.2 ppm too high. Closure errors have to be accommodated. The maximum error is

10% and this is distributed equally amongst all the capture elements. The normalisation factor, used in converting (shipboard) relative elemental yields to absolute concentrations, is strongly affected by the formation capture cross section. These effects are greatest in the presence of high porosity and high salinity.

These comments suggest that shipboard geochemical logs can be in error. A key question is whether the benefit of having these logs onboard ship outweighs the potential pitfalls.

Broglia reported on FMS processing onshore. Initially, a depth-shift of both images and dipmeter is made with reference to standard logs. There is an option to merge image data from different passes after additional manual depth shifting. There are also special procedures for contrast enhancement, eg dynamic normalisation. Raster files are created for a Benson plotter.

(iii) Data Outputs Onshore

Broglia reported that processed standard logs (excluding GLT and FMS) are routinely distributed to the shipboard party as composite logs with a metric scale 1:500 approximately 3 - 4 months after the end of a leg. Logs are also available in digital form (tape, Macintosh/IBM floppy disc). The standard display is included in ODP Proceedings, Initial Reports.

Reprocessed GLT logs in the above formats are available approximately 18 months after the end of a leg. These data are published in ODP Proceedings, Scientific Results.

Reprocessed FMS data are available post-cruise in various formats corresponding to the evolution of ODP technology. At present, images plus caliper are available at a vertical and horizontal scale of 1:6.42, and caliper plus dips plus images are available at scales of 1:40 (vertical) and 1:10 (horizontal), as is the case onboard ship. A microfiche is included in ODP Proceedings, Initial Reports. These plots do not include the gamma ray, the inclusion of which is seen as an area of potential improvement.

(iv) Special Tools

Temperature Tool

Processing is carried out onboard ship using in-house software. Output is digital data (temperature vs time and pressure) in ASCII format.

Multichannel Sonic

Processing is not performed routinely because the tool is not run frequently: software has been developed in house. Outputs are analogue and digital data in LIS or ASCII formats.

Analogue BHTV

Processing is not performed routinely: software has been designed by Stanford University and is installed on a Masscomp. Outputs are a colour graphic display and a black-and-white hard copy.

Digital BHTV

Processing is through SIGMA 2-D software from DMT of FRG available at LDGO BRG and on the ship (from Leg 139 onwards). Software is installed on the VAX. Processing is time-consuming.

A future aim is for BHTV data to be combined with FMS data. We are a long way from that goal, partly because the BHTV is the most unreliable tool in logging. In any case, the digital BHTV software is mainly under third party control. Furthermore, commercial software packages are very expensive. The BHTV provides data that the average scientific users would be unable to handle with their hardware because of the nature and volume of the data: yet, some people do nevertheless request these data.

(v) Data Distribution

Broglia reported that the number of holes logged on ODP Legs 101 - 137 was 114. The number of tool strings run was 267. The number of ODP log data requests has increased greatly since the FMS was introduced. For example, some 170 requests were received during 1990 alone. The greatest user was the USA followed by France, Canada, Japan, UK and Germany. It is now taking two months to respond to a data request. Previously, it was 2 - 3 weeks. Hence the request for additional LDGO BRG staff in the FY 92 budget.

A survey has been undertaken of users to establish their needs. The number contacted was 78: the number of replies was 48 (62.3%). These scientists would like to see the following services improved:

- training for both ODP and JOIDES logging scientists and the shipboard party;
- use of workstations at sea;
- shipboard processing of geochemical data;
- better quality control;
- processing of FMS and BHTV data at sea;
- data transfer by computer (eg E-mail, internet);
- free log analysis software provided along with the data.

The Chairman noted that many of these requests could not be met, partly due to resources and partly because some were impractical. However, there did seem to be a growing interest in log interpretation and it may be that the LDGO logging schools, which have been very successful, should be replaced by longer interpretation schools.

(vi) Resume

The presentations were followed by a demonstration of processing facilities. The Chairman thanked LDGO BRG for providing such a comprehensive overview of the state-of-the-art of ODP log data handling. It was proposed to complement this exposition by visiting the shipboard facilities during the upcoming San Diego port call.

[ACTION:WORTHINGTON]

9. Accuracy of Geochemical Logs

The Chairman described the Geochemical Logging Tool (GLT). This includes an induced gamma spectral tool (GST) which, when run in capture mode, contributes through post-cruise processing eight of the twelve elemental concentrations that the GLT provides. These elements are of primary interest to inorganic geochemists. The GST was actually introduced at the beginning of the 'Eighties when it was run in inelastic mode with an emphasis on organic elements in the form of the infamous carbon/oxygen ratio. The aim had been to evaluate directly the hydrocarbon content of reservoir rocks. The approach did not gain credibility, partly because of the high degree of uncertainty associated with these estimates. Emphasis shifted to capture mode applications thereafter, but carbon/oxygen logs remain a potentially useful service to the oil industry, and they are now benefiting from improved technology.

Anderson reviewed the use of the GLT in ODP. Featured scientific benefits included the recognition and interpretation of the gabbro zone on the Southwest Indian Ridge (Site 735, Leg 118) and establishing the geochemical budget of the Bonin Island Arc through subduction zone studies where core recovery was poor (Site 786, Leg 125). Anderson concluded by noting that the present state-of-the-art in geochemical log applications is to be found at the KTB programme of FRG.

Draxler reported on the geochemical logging programme at the KTB site. The pilot hole (4000 m deep) produced 98% core recovery and this has provided a unique opportunity to check log responses against core. XRD and XRF have been run routinely on core. The GLT data require processing to derive mineralogy from elemental concentrations, using the ELAN package. There are two ELAN processing chains, dry model (no water) and wet model (water). Other logs can be used in conjunction with the GLT to accommodate other minerals that are not usually included in these models. The GLT uses a sodium iodide crystal, which has limited spectral resolution. KTB have also run an advanced tool, the enhanced resolution tool (ERT), with a high-spectral-resolution germanium crystal. This is a cryogenic tool: it could be run for up to 12 hours at pilot-hole temperatures (85°C at 3000 m). Stationary readings had to be taken because of the lower counting efficiency of germanium detectors. The tool was run in delayed activation (INAA) mode and capture (prompt neutron activation analysis) mode. The downhole activation time for the capture-mode readings was about 20 minutes.

Schweitzer compared GLT and ERT spectra and demonstrated the higher spectral resolution achievable with the latter. The ERT allows other minor elements to be studied. Most of these can be inferred from delayed activation mode data. For example, Na can now be measured and procedures for Mg are currently being developed. The carbon/oxygen ratio can be measured with a precision of ±2% but the extraction of carbon remains very difficult. The key question is not "Can we measure more elements?" but rather "Which elements do we need to know and in what range of concentrations?" Then the survey can be planned accordingly. There are two survey procedures that can be used for the ERT. Continuous logging runs have less risk of sticking but might require 20 passes over the same region in order to stack the counts to statistically significant levels. Stationary readings are taken with a greater risk of tool sticking but there is then a need to introduce a "fake" logging speed for processing purposes. In ODP, geochemical logs have been run only in conventional capture and (occasionally) inelastic modes, in which the neutron source and gamma-ray detector are close together. In delayed activity logging the source and detector are physically separated so that a spatial change is used to create a temporal effect.

Several points were raised through discussion. Mg is a key element for SGPP. The minimum Mg concentration required for wireline identification of specific minerals is that which is visible on the GLT log. KTB logs have revealed relatively poor statistics at very low Mg concentrations but it is believed that this situation can be improved. The key question is "Where is it really critical from a geological viewpoint to know whether Mg is present at, say, 0.5% or 1.5%?" Once this question has been answered, a logging programme can be designed.

Elements are apportioned between solids and fluids by trying to exclude elements that are unlikely to occur within the solid rock. Examples are hydrogen and chlorine. The opposite can apply, too, e.g. where Al is present in drilling muds. There is a balance to achieve and the key lies in the integrated use of core and log data.

The Enhanced Resolution Tool (ERT) will allow trace-element concentrations to be determined, e.g. antimony, arsenic, bromine, copper, europium, indium, nickel, scandium. The accuracy will be as good for trace elements as it is for aluminium. The precision is a function of element concentration.

Shipboard geochemical logging data are in the form of relative elemental yields. Oxide data are not available on board ship. The installation of the Schlumberger MAXIS 500, intended to replace eventually the CSU, will lead to absolute elemental concentrations becoming available during the course of a leg.

10. <u>Logging and Log Interpretation In Gas Hydrates</u>

Suess commented that there has been a reversal in ODP with regard to drilling hydrates. Previously the strategy was to avoid them; now it is to drill them. The last SGPP meeting encompassed a workshop on gas hydrates. Hydrates are present on most continental margins and on the Arctic shelf. The current interest has arisen because (i) hydrates are seen as an energy source, (ii) hydrates have an environmental impact through decomposition and thence an accentuation of the greenhouse effect, and (iii) there is scope for integration with other global programmes through an interest in methane budgets.

The SGPP requirements for gas hydrates were described as follows:

- lateral continuity;
- porosity, permeability, velocity;
- composition in terms of C, H, O;
- amount of free gas vs hydrated gas;
- thermal properties, thermal conductivity;
- growth habit, sedimentary fabric, age, direction;
- salinity structure at, above and below the gas hydrate ($CH_4.6H_20$ excludes sea salt during hydrate formation. Where does it go?)

The logging strategy for gas hydrates embraces the following points, some of which are discussed in Annexure II. Casing is usually set at 70-100 m. Most hydrates are deeper than this. The approach is therefore one of open-hole logging. Hydrates can be well characterised by logs and therefore lateral continuity between drill sites can be clearly established from the logging standpoint.

The neutron tool responds to hydrogen and can be calibrated in terms of hydrogen content. This tool will provide a measure of how much hydrate is present provided that the tool response does not "saturate" due to the very high hydrogen concentrations. Conventionally, neutron logs are presented in limestone porosity units because that is the lithology of the primary calibration pits in Houston. However, they can also be presented as count-rate ratios and it might be especially useful to compare thermal (absorption) and epithermal neutron count-rate ratios because the latter will be perturbed by carbon and oxygen due to slowing-down effects. The neutron tool is run with the density tool and they are frequently interpreted as a pair. Resistivity logs will also respond strongly to high hydrate concentrations.

Permeability cannot be measured through logging. Downhole velocity measurements are straightforward.

The geochemical logging tool, run in both inelastic and capture modes, can provide information on C, H and O concentrations. The C/O ratio can be measured more precisely at high porosities. In the hydrate case, we regard the hydrates as part of the porosity within a sedimentary fabric, with a target porosity range of 35-50%. The separate resolution of C and O will require some laboratory measurements.

Gas zones should be identifiable through the neutron-density combination provided that the tool responses are properly calibrated.

Thermal properties might be investigated indirectly using a new tool devised by KTB. This includes a temperature sensor and a heating device; the fluid is heated up and the sensor measures the dissipation of this heat into the formation. If the hydrate layer has a low thermal conductivity, a large perturbation will be observed in the temperature profile.

Logs will only partially contribute to a knowledge of the sedimentary environment in which hydrates occur. The physical characterisation of the locality is important and the key logging tool will be the FMS with its sharp spatial resolution. Again, the integration with core is essential.

Salinity structure can be investigated in several ways. One approach is to interpret the chlorine concentration log from the GLT. Another method might be to run the GST within the GLT string in thermal-decay-time (TDT) mode to obtain a chlorine log. Both of these approaches suffer from large borehole effects. An experiment was suggested to flush seawater out of the borehole, replacing it with freshwater prior to logging. Another approach might be to use the self-potential (SP) log to identify qualitatively changes in pore-fluid salinity. The SP log could be interpreted in conjunction with data from the auxiliary measurement sonde (AMS), which is always run as part of tool strings, and which provides borehole fluid resistivity and borehole temperature logs. Yet another suggestion was to run the borehole gravimeter because of its good lateral investigation characteristics.

The drilling process itself could lead to a change in the physicochemical characteristics of gas hydrates. Logs should be run as soon as possible after drilling. An option is a hole dedicated to gas hydrate studies. Another option is measurement-while-drilling (MWD) although it will be years before an ODP-compatible MWD string is available. Yet again, a push-in tool ahead of the drill bit might avoid drilling damage: this would require knowing the depth of the hydrate layer from site-survey geophysics. For example, the WSTP tool was used in hydrates on DSDP Leg 84. This tool uses a pressure differential which might cause the hydrates to decompose.

The discussion concluded with the observation that the existing logging suite should provide a good deal of useful information about hydrate occurrence and composition. Logging might provide more answers if the tools were recalibrated. DMP should finalise its views on the optimum logging suite for investigating gas hydrates. This suite could be tested during Leg 141 (Chile Triple Junction).

11. Sealed Boreholes

SGPP is interested in sealed boreholes because they prevent contact between borehole waters and the infinite water reservoir above. Unsealed boreholes may collapse more easily. Sealing does not prevent convection in the hole. Sealed holes can be used in three ways:

- free-standing mode with an unequipped head;

- installation of instruments, e.g. seismometers, physical properties, chemical properties, testing of materials, temperature;

- emplacement of tracers for hydrogeological purposes, e.g. NaBr, LiBr, LiCl.

Pressure, temperature and chemistry can be addressed through packer experiments as an alternative, but these would not provide the separation of borehole fluids from the sea. A possibility is to seal different sections of the borehole.

Becker reviewed the status of the ODP instrumented borehole seal. This takes a single sample with the tubing intake near the base of the hole, and would be difficult to modify to take multiple samples at different levels. The seals are scheduled for deployment on Leg 139, Sedimented Ridges I. The objectives are to log temperatures over a long period in order to obtain a reliable downhole temperature within this active geothermal system.

The meeting concluded that the borehole seal initiative had considerable merit and should be progressed. However, there remains the possibility of scientific competition with wireline re-entry.

12. Downhole Measurements at Accretionary Complexes

Fisher reported on downhole measurements successes and failures at the Barbados (Leg 110) and Nankai (Leg 133) accretionary complexes.

(i) Downhole Successes and Failures Leg 110: Barbados Accretionary Complex

WSTP	temperature measurement	generally successful, some failures of electronics, some incomplete deployments
	pressure measurements	some data collected, significance unclear
	water sampling	success less than 50%, possibly due to high clay content of sediments; fluid no different from squeeze-cake fluid
APC tool	temperature measurements	generally successful, occasional operator error, battery failure
logging	three main strings	80 m logs total for leg, borehole instability greatest problem, even with dedicated holes
packer tests	rotatable-packer (first use)	unsuccessful, operator error, poor hole conditions

(ii) Downhole Successes and Failures Leg 131: Nankai Accretionary Complex

WSTP	temperature measurements	generally successful, some failures of electronics, some incomplete deployments
	pressure measurements	unsuccessful, electronics failure, data significance unclear
	water sampling	success less than 20%, very lithified sediments
APC tool	temperature measurements	tool not available, of limited use in lithified sediments
logging	three main strings	160 m logs total for leg, borehole instability greatest problem, even with dedicated holes
packer tests	rotatable-packer (third use)	unsuccessful, poor hole conditions
ONDO	long-term temperature	result unknown, deployment very difficult due to current and poor hole conditions (actually deployed Leg 132)

VSP	seismic profile	largely unsuccessful, current, poor hole conditions (operator error?)
LAST I	in-situ stress	several successful deployments, failures due to operator error, battery failure
Geoprops	in-situ pressure, permeability, temperature	not available
wireline packer	fluid sampling	not used, failed during Leg 133

Jarrard commented on the chances of success of different types of downhole measurement in accretionary complexes, with a particular view towards the upcoming Cascadia leg (146). The major impediment is hole instability. During Legs 110 and 131 fewer than 20% of the downhole measurement goals were met. This figure could exceed 70% at Cascadia, provided that an aggressive logging strategy is adopted, e.g. be prepared to lose a logging tool, a BHA, or maybe more than one of each. A particularly difficult issue is the determination of permeability at Cascadia. Packer measurements have only a 30% success rate in ODP, even in stable holes. Yet, Leg 146 has both packer and flowmeter permeability experiments scheduled. A further problem is downhole fluid sampling. The wireline packer will not be available and it is not clear what the status of the pressure core sampler will be. Permeability and sampling problems are, of course, compounded by hole instability.

Karig pointed out that a primary cause of hole instability is that the material drilled in accretionary complexes is close to stress failure and that the additional stress concentrations introduced by drilling are bound to induce failure. One cannot turn a blind eye to this potential situation at Cascadia. A possibility is to use the side-entry-sub (SES) aggressively and log while pulling pipe. If there is excessive hole closure, it might be desirable to washbore a hole specifically for logging: this would improve logging prospects, but it would still be necessary to use the SES in an aggressive way. The recent DMP subgroup meeting on hole stability proposed heavy muds for formation control. This approach would prove very expensive without return circulation and would degrade the geochemical logs by invalidating the photoelectric factor (Pe) curve (from the lithodensity log) and thence the magnesium correction. There exists rationale to the effect that hole conditions might be better at Cascadia than on Leg 131 (Nankai). This view is partly based on experience with a DSDP hole at Cascadia. However, it has no bearing on a future return to Barbados, where conditions can be expected to be as bad as on Leg 110.

Suess pointed out that two Cascadia sites are dedicated to gas hydrates. It would be desirable to obtain the best possible neutron logs. This would require dividing the quad-combo into two separate tool strings so that the neutron tool can be eccentred by a bow spring. A key question is whether this practice would increase the risk to the tool string. LDGO Liaison responded that if it seems at all feasible to run an eccentred neutron tool, it will be done.

13. Specialised Logging Programmes to Meet SGPP Needs

Mienert reviewed SGPP priority goals. There are four key areas.

(a) Fluid Flow/Gas Hydrates

The environment is one of high pore-water pressure within various lithologies. A potential problem is hole instability. Key questions are permeability, pore-water pressure, fluid conductivity, thermal gradients, gas and fluid composition, salinity structure, and amounts of hydrate and free gas.

(b) Sea Level

The environment is sand and/or coral limestone. Hole instability is again a potential problem. Key issues are the amplitude and frequency of depositional and erosional events.

(c) Palaeocean Chemistry

The environment is one of biogenic material. No specific issues were identified.

(d) Sediment Architecture

The environment is primarily sand, but various lithologies are present. Hole instability is a potential problem. Key issues are physicochemical cyclicity, structure and fracture distribution, magnitude and direction of stress, composition and chemical alteration, hydrogeology, and diagenesis.

The above goals can be distilled into five activity areas, gas, pore water, solids, structure and thermal regime, all providing input to geochronology. High-resolution geochronology requires full logs and complete sampling for interhole correlation and for tying back to seismic data. The required log inputs can be classified into two groups, geochemical and geophysical. In particular, there is sometimes a need to log shallow holes and to obtain good logs in the uppermost sediments. The only logs that can be run to the surface are the nuclear logs: there is data degradation due to casing and pipe. Shear-wave and attenuation log data might assist in relating seismic interpretations to, for example, oxygen isotope stages identified from core fluids. Higher spatial resolution is sought from all logs, except the FMS. For example, should ODP use a thin-bed laterolog such as that used in the coal industry in Germany? The ability to sample sediments after a hole has been drilled would be an advantage. Sidewall wireline drilling tools have a 5-inch diameter and therefore cannot be used through ODP drillpipe. This technology would therefore have to be deployed through wireline re-entry.

In summary, SGPP needs comprehensive geochemical data from logs, e.g. to measure chemical changes in carbonates where core recovery is poor. The elemental data should include Na (to improve the wireline-derived mineralogy) and Mg, and therefore a high-spectral-resolution tool is desirable. The required geophysical logs include FMS, magnetometer, V_p, V_s, porosity and density, and fluid sampling, pore water pressure and permeability through a combination of LAST, Geoprops, etc.

14. Fluid Sampling

Several key issues have to be considered in planning a way forward. These include:

(a) do we wish to sample borehole or pore fluid?

(b) should we drill a smaller diameter dedicated hole for the Wireline Sampler Mark II?

(c) what commercial tools are available?

(d) are there alternative sampling strategies?

We need a minimum of four samples at a given station in order to establish the degree of mixing of pore and borehole fluids and thence to allow chemical extrapolation to the undisturbed pore-fluid state. Other basic requirements are temperature, pressure, fluid conductivity and a turbine flowmeter for permeability.

The principal scientific requirements are to obtain samples of formation fluids in basalt fracture zones, some at high temperatures, and in hard sediments such as cemented carbonate platforms. There is currently no information about pore-water characteristics in these zones. For soft sediments, the APC can be used with pore fluid being obtained by squeezing the sample. This works satisfactorily in all but high-permeability environments. For hard sediments and basement rock, in-situ pore fluid sampling is required.

Scholz reported on the status of the Wireline Sampler, built by TAM, Inc, and overseen by the subcontractor, Stanford University. The tool has an OD of 3.625 inches and the packers have to inflate to 12 - 13 inches. The temperature rating is 100°C and the tool is best suited for RCB holes because the bit is smaller. Although there were problems with packer deflation on Leg 133, the biggest problem is sample contamination because of the way the hydraulic circuit is designed. The tool needs to be redesigned to remove the compromises made during its long evolution. The cost of redesign and of developing two new tools is around $ 350 000. There is nothing in industry to compete with the Wireline Sampler.

Crocker commented on commercial formation testers which offer a doughnut seal with the formation and are therefore unsuitable for fractured rock. Furthermore, good samples are obtainable only where formation permeability exceeds 100 mD. The invading borehole fluids impart exchange ions to the formation and this effect has to be reversed before a pore-fluid sample can be regarded as uncontaminated. This reversal can take several days, an interval which would clearly be unacceptable for ODP purposes.

Draxler developed this theme by stating that even substantial pre-production may not guarantee an uncontaminated sample. The volume of fluid sampled is a critical issue. In the past 100 cc has been identified as desirable, but the geochemical community would now consider even 10 cc to be tolerable. Nevertheless, the large discrepancy between the pre-production volume of fluids (tens to hundreds and even thousands of litres) and the final volume of (hopefully pristine) pore-fluid sample remains a major issue to be resolved.

Possible alternative sampling tools are the Pressure Core Sampler and the OBCAT tool developed in the UK for use with the ODP drillstring packer.

Crocker noted that there is a misperception that a low-technology sample will not satisfy high-technology needs. For example, a possible approach is to use gas lift by compressed air over, say, 1000 m. This would allow sampling with time and an estimate of formation permeability. Furthermore, by sampling a significant formation interval, we would obtain a substantial sample, especially if a zone of high permeability happens to be included. A potential problem is iron contamination from the drillpipe, but this problem might be overcome by using a go-devil with sample bottles to avoid having to pass the sample up the drillpipe. This approach would also work in hot holes. A disadvantage is the depth resolution that the method implies, but sampling could be carried out at intermediate stages of drilling. A vertical resolution of 10 m would be acceptable to the geochemical community. The whole approach needs to be subject to a cost and feasibility study by a drilling engineer.

The meeting noted that many future ODP legs require high- or low-temperature pore-fluid samples. The technology must be developed to allow this to happen. Substantial engineering input is needed in a brainstorming session as a prelude to an engineering feasibility study of the best option(s). The JOIDES working group meeting on In-Situ Pore-Fluid Sampling, scheduled for 23 August 1991 in Houston, would address the first stage. It was anticipated that funds would be made available for the engineering feasibility study in early FY92. It is, of course, possible that what we are trying to do cannot be done. However, the effort should be driven by the scientific goals which remain a top ODP priority.

15. Priorities for Remedial Technology

Alt outlined SGPP technology needs.

(i) Drilling Capabilities and Core Recovery

Drilling and sampling thin sediment cover, e.g. < 50 m on upper ridge flanks.

Deep stable holes, 2.5 - 3.0 km on continental margins.

Hole stability and core recovery in alternating lithologies, sulphides, coarse rubble and loose sand.

Hot holes.

(ii) Sampling and Measurements

Recover sediments, fluids and gases at in-situ temperature and pressure (Geoprops, WSTP, Pressure Core Sampler).

Measure in-situ pore pressures, temperature, pH, dissolved constituents.

Wireline sidewall corer.

Core ahead of the bit for sampling and measurement of undisturbed material.

Sample and measure volatiles.

Borehole seals (e.g. Leg 139).

Passive tracers in sealed holes (e.g. NaBr - Leg 137).

Hot holes: upgrade tools and samplers.

Geochemical logs, leading towards enhanced resolution.

Core logs, e.g. expanded MST.

Wireline sampler.

(iii) Long-term Experiments and Monitoring

Steady-state vs episodic fluid flow (e.g. 504 B - Leg 137).

Temperature, pressure and strain gradients.

Temperature, pressure, chemistry and strain in sealed holes.

(iv) Top Priorities

Fluid sampling capability in indurated sediments and hard rock, for a wide range of in-situ temperatures.

Pressure core sampling capability, eg PCS Phase II with multiple sampling chambers, etc.

16. Wireline Re-entry

Morin reported on the French wireline re-entry operations (DIANAUT) in which logging at three DSDP sites in the North Atlantic has been successfully carried out from the submersible NAUTILE using the logging shuttle NADIA.

The logging shuttle has 1000 m of seven-conductor cable. A logging tool is fixed to the cable. Maximum tool length is 4 m. The tube for housing the tool is of 25 cm diameter so there are no restrictions on tool diameter. Nadia is lowered to the sea bed under free fall with no connection to the surface. Nautile picks up Nadia, places it over the re-entry cone and lowers it into place. Nadia is connected to Nautile which, because it contains the control electronics, becomes a subsea "logging truck". After logging, ballast is released and Nadia floats back to the surface with the tool. Logging tools cannot be changed subsea: each different logging-tool run requires a separate trip with Nadia. In the case of stuck tools, there is a weak link at the cablehead and also a facility for cutting the cable. The cost of operations is about $ 35 000 per day.

The aim was to run five logs; temperature, fluid sampler, flowmeter, BHTV and magnetometer. Each of these required one day for deployment since Nadia could not be recovered at night. Target holes were 333A, 395A and 534A. Scientific objectives were hydrogeological. All five logs were run in 395A but 333A was logged only for temperature. This hole had not been cased to basement and there had been some collapse. The consequences were lost opportunities.

DMP Recommendation 91/12

"All proposed re-entry holes should have casing programmes designed to facilitate wireline re-entry in the long term."

Gieskes pointed out that the North Atlantic contains a number of re-entry holes fairly close together. These holes potentially constitute a set of laboratories in which downhole measurements can be made using new technology in order to pursue further scientific goals, but only if the long-term stability of the holes can be secured. It is therefore worth revisiting and casing those holes which are at risk.

DMP Recommendation 91/13

"The North Atlantic provides a unique opportunity for long-term downhole-measurement science through wireline re-entry. The following re-entry holes, which have not been cased to basement and which are known to have deteriorated, should be cased to basement when the drillship returns to the North Atlantic. The holes in question are 333A, 417A and 418A."

DMP Recommendation 91/13 can only be progressed through a community proposal for add-on science.

DMP Consensus

Panel encourages the ODP community to prepare an add-on science proposal for the restoration of existing re-entry holes that are known to be at risk in the North Atlantic.

Foucher commented that ODP should take a long-term view of re-entry as a contribution to the Programme's scientific legacy. All future sites should have a re-entry capability. For example, the SGPP interest in the long-term monitoring of fluid flow can now be achieved technically provided that drilling and completion programmes are planned accordingly.

Wilkens noted that there are precedents for this type of vision. For example, the Ocean Seismographic Network includes about twenty re-entry holes that are cased to basement.

DMP Consensus

Panel wishes to see an increase in the number of re-entry holes drilled by ODP as an enhancement of the long-term scientific legacy of the Programme.

17. <u>High Temperature Technology</u>

(i) <u>Tool Status for Leg 139</u>

Jarrard reported that, in response to a JOI trawl, a French company, Plastelec, had approached ODP with a proposal to provide 350°C logging cable. LDGO had ordered 1 km of this cable for delivery by the end of June. The aim was to connect this high-temperature cable to the new standard (Vector NA) logging cable. The manufacture of the high-temperature cable was to be overseen by Gable of BRGM. LDGO have since been informed that the delivery date cannot now be met and that the high-temperature cable will not be available in time for Leg 139, Sedimented Ridges. This non-delivery impacts on the entire logging programme for Leg 139. The available Vector cable is rated to 230°C (260°C for short-term use) and yet the expected formation temperatures on Leg 139 are 350°C.

The second disappointment, which also concerns Gable of BRGM, is the non-availability of the high-temperature tool with cablehead that LDGO commissioned for the downhole measurement of temperatures up to 500°C. Unfortunately during testing at 500°C the metal/ceramic hybrid cablehead shattered because of the uneven distribution of heat due to a rapid rise in temperature. Gable had been out on Leg 137, for the deployment of a lower-temperature version of the tool in 504B, and this absence had contributed to delays in the development of the tool and its pressure casing. Further work is needed to develop a new ceramic cablehead. For this reason, the LDGO tool will be kept in France in the near term. For Leg 139, Gable is offering a version of the new tool but without a ceramic cablehead. The tool will be limited to 260°C because of the need to use a Gearhart cablehead and because of the cable limitations mentioned earlier.

The Japanese high-temperature pressure, temperature and flowmeter tool, designed to operate in 300°C environments for three hours, will be out on Leg 139 but this tool is also limited to 260°C by the cablehead and cable situations. This tool has not yet been delivered to LDGO and time is getting short.

There is now a safety consideration. PPSP have approved operations on Leg 139 only up to 350°C. Yet, there is now no way in which temperatures of this order can be measured.

Because of the cable problems, Sandia have been approached to ascertain whether a memory tool might be leased for Leg 139. This option might require having a Sandia technician on board for (part of) the cruise. Another alternative might be to commission the building of a new memory tool from Madden Systems, who built a Sandia tool and could build another within five weeks, provided that a dewared pressure casing could be secured on loan. Both of these options involve a risk to someone else's components. A strategic way forward would be to purchase a high-temperature memory tool now, to replace the Sandia tool if lost and otherwise to become an ODP tool in the long term. This would require additional funds now and LDGO is overspent for FY91. The option would only be feasible if JOI would agree to the funds now ($ 20 000 - 30 000).

The Chairman expressed concern that the limitations imposed by the cable and cablehead could compromise the scientific objectives of Leg 139. He had received a letter from Earl Davis, one of the Co-chiefs for Leg 139, sharing that concern. Panel formulated the following recommendation.

DMP Recommendation 91/14

"In view of the temperature limitations (260°C) imposed by the Vector teflon cable, the logging contractor is urged to continue to seek urgently a high-temperature memory-tool measurement capability for deployment on Leg 139."

Draxler reminded the Panel of other high-temperature cables that are commercially available. The Italians have a seven-conductor mineral-insulated cable rated to 400°C. JAPEX have a four-conductor MgO-insulated cable, made by the UK company BICC and rated to 600°C. JAPEX also have a cablehead. These cables are difficult to handle and they may have transmission limitations but they do constitute a viable alternative to the French cable.

The high-temperature digital BHTV developed by DMT (WBK) of FRG, rated to 260°C and possibly with further testing to 300°C, is tentatively due to be received by the end of June, just nine days before the ship sails. It is a low priority tool for Leg 139. LDGO have the DMT software installed on the VAX for processing and hardcopy output with some display capability. An LDGO scientist has been trained in its use. Data will be processed at LDGO. The software will be in competition with FMS processing with respect to micro-VAX capacity.

The Chairman reminded Panel that he would be visiting the JOIDES Resolution during the San Diego port call and would be able to ascertain the tool situation for Leg 139 first hand.

(ii) Resistivity Tool

Jarrard reported on the search for a high-temperature formation resistivity tool which, along with the DCS, fluid sampling technology and temperature logging, was essential to address the (hydrogeological) objectives of EPR legs. The Camborne School of Mines (CSM) of the UK, who have a track record in geothermal energy through their Hot Dry Rock project, have submitted a proposal to build a high-temperature resistivity tool, rated to 350°C for 3-4 hours. The tool would be a focused resistivity device with the option to use it as a short normal. The design provides for five modules each of length 10 ft: fluid conductivity/thermistor assembly, electrode array, dewared electronics housing, spacer housing and cablehead. An analogue tool can be built within six months. The quote is $ 255 000 for one tool and $ 100 000 for a second. The UK Department of Energy would provide funds for the second tool if ODP committed to the first. This commitment could not be made with existing budgets. OPCOM funds need to be injected: OPCOM is meeting in Washington DC immediately after this DMP meeting. The CSM proposal will be evaluated and discussions can be expected to continue.

(iii) Fluid Sampling

Fisher reported on the testing on Leg 137 of the Los Alamos National Laboratory (LANL) and the Lawrence Berkeley Laboratory (LBL) high-temperature fluid samplers. Both tools were affected by leakage due to the contraction of samples during tool recovery. Both LANL and LBL see the removal of leakage as a development project. LANL have two tools of diameter 1.625 inches, which are not in electrical contact with the surface during deployment. One tool is made of titanium, the other of stainless steel. The latter is now fitted with a redesigned valve assembly to reduce leakage. LANL used self-machined valves rather than bought ones. The LBL tool, of diameter 2.25 inches, uses one conductor of the logging cable. It is made of stainless steel and contains a bellows assembly that accommodates the volume change on cooling and thereby reduces leakage. This tool leaked less than the LANL tools during Leg 137. LBL propose to make the bellows larger so that they will be more effective.

LANL and LBL have agreed in principle to their tools being run on Leg 139 without their technicians present. ODP technicians will be trained in the use of these tools: some training was given during Leg 137. There is a possibility of the LBL tool being required elsewhere at this time. The long-term strategy is to establish the design that works best and then to produce a tool with the appropriate mixture of technology.

(iv) High-temperature Test Facility

Wilkens reported on a geothermal hole on Oahu, Hawaii, which is 2 km deep and has a BHT of 300°C. It will cost $ 200 000 to close this down commercially. An option is to clean the hole, for a cost of $ 100 000, and have it maintained as a test or experimental facility for high-temperature tools by the University of Hawaii. The facility is currently supported by the USGS. There is otherwise limited scope for testing high-temperature tools.

DMP Consensus

Panel encourages the initiative to establish a high-temperature test hole for downhole tools on the island of Oahu.

18. Shipboard Integration of Core and Log Data

Fisher reported the progress to date under the following three headings: hardware, software and staffing.

(i) Hardware

Following completion of the WSTP upgrade for Leg 139, the next in-house project for electronics/technical staff will be the evaluation, design and construction of a natural gamma-ray detector for the MST. The prototype sonic core monitor is being replaced by a full production tool, extensively redesigned and upgraded, with new electronics, hardware, packaging, power supply and software. First sea tests are scheduled for Leg 141 (Chile Triple Junction).

(ii) Software

MST (GRAPE and susceptibility) data are now being processed in near-real time for hole-to-hole, and core-to-log correlation. On the current Leg 138, other core laboratory data are being written regularly to ASCII files and moved to the fileserver (where all MACs, PCs and VAXs can gain access) where depths are added. Through the use of a new ADJUST.DEPTH program, a set of composite log/core depths are calculated by the scientific party and added to the ASCII summary data set. Logging data are also available as ASCII files on the fileserver within a few days of logging: all have access. CORPAC experiments are underway to assist with intersite correlations.

(iii) Staffing

On leg 138, an 'extra' system manager has been sailed as Assistant Lab Officer (Bill Meyer). This is a temporary solution to the need for a second system manager, and it cannot be repeated. Leg 138 may be unusual in that many shipboard scientists are familiar with, and are qualified to make decisions concerning, core-log integration. The issue of who is ultimately responsible for the integration has not been decided.

19. FY92 Logging Programme

Golovchenko reported on the following three items.

(i) Leg 140: Hole 504B or Hess Deep

The main proposal is to revisit 504B with Hess Deep as an alternative. The logging programme at Hess Deep has previously been recommended by DMP to be similar to that already run at 504B. The leg prospectus does not appear to reflect this recommendation. A key question concerns the dual laterolog which was recommended for Leg 140 and which performs better than the induction log in resistive formations. The Panel reiterated its position.

DMP Recommendation 91/15

"In the event of Hess Deep being drilled during Leg 140, the logging programme in each logged hole should be similar to that already carried out at 504B. The (digital) dual laterolog should be run in each logged hole during Leg 140, regardless of which leg option is taken."

(ii) Legs 143 and 144: Atolls and Guyots I & II

The Atolls and Guyots DPG has accepted in principle a Japanese proposal to run their borehole magnetometer during Legs 143 and 144. However, this has not previously been debated by DMP.

DMP Consensus

DMP strongly supports the running of the Japanese three-component borehole magnetometer in selected basement holes during the Atolls and Guyots legs.

(iii) Hole 801C: Old Pacific Crust

A proposal for the logging of 801C as add-on science to the FY92 programme is currently being evaluated. This exercise would be undertaken around Legs 143 and 144.

20. Panel Membership

The Chairman reported that two of the three persons identified as possible replacements for Bobb Carson had indicated that they would accept an invitation to join DMP. Their names and resumes would now be forwarded to PCOM Chairman.

[ACTION: WORTHINGTON]

21. Next DMP Meetings

The next meeting of the JOIDES Downhole Measurements Panel is scheduled to take place in Halifax, Nova Scotia, Canada during the period 15-17 October 1991. The meeting will encompass a joint one-day session with SMP to continue the drive towards the integration of core and log data. On Friday 18 October there will be a joint technical workshop for the East Canada community. Kate Moran will host.

The following DMP meeting will take place in Hawaii during the second half of January 1992. Roy Wilkens will host.

The subsequent DMP meeting is tentatively scheduled for Windischeschenbach, FRG, in May or June 1992. This meeting would allow a joint session with KTB.

22. Recommendations for the JOIDES Opportunity Committee

The Panel reviewed five technological developments that might be appropriate for funding through the OPCOM initiative and that would not otherwise be progressed in the short term. These were voted into the following priority order.

(1) High-temperature resistivity tool with fluid resistivity and temperature capability.

(2) Fluid sampling capability through the wireline sampler or alternative.

(3) MAXIS 500 data acquisition/analysis system (accelerated introduction to ODP).

(4) Sediment susceptibility tool.

(5) High-resolution geochemical tool.

The Chairman undertook to convey the highest priorities to OPCOM.

[ACTION: WORTHINGTON]

23. Close of Meeting

The Chairman thanked Panel Members, Liaisons and Guests for their contribution to the meeting, the Directorate of the Lamont-Doherty Geological Observatory for the provision of meeting facilities, the LDGO Borehole Research Group for their kind hospitality, and Rich Jarrard for his gracious hosting. On behalf of the Panel, the Chairman wished Jarrard everything of the best for his new appointment at the University of Utah. The meeting closed at 1425 hours on Thursday 6 June 1991.,

PAUL F WORTHINGTON
30 June 1991

MEETING OF JOIDES SHIPBOARD MEASUREMENTS PANEL

Texas A & M University

College Station

19-21 March 1991

1. <u>Preamble</u>

This meeting was attended in the capacity of Liaison from the JOIDES Downhole Measurements Panel (DMP) to the JOIDES Shipboard Measurements Panel (SMP). The SMP meeting included a joint session with the JOIDES Information Handling Panel (IHP). These notes relate specifically to those aspects of the meeting that have implications for the ODP downhole measurements programme.

2. <u>Integration of Core and Log Data - Strategy</u>

The joint session of SMP and IHP addressed the shipboard integration of core and log data. The goal is a fully integrated, user friendly computer database that is interactive and widely accessible. This would allow shipboard scientists to take data from beyond their immediate disciplines. The requirements are a common reference depth, standard compatible ASCII formats, integration software, shipboard data availability, and post-cruise data storage and access. Key questions are how to handle increasingly larger datasets and how the data can be accessed by the community in the future. It was considered especially important to have some readily extractable quality indicators associated with the data.

Work on shipboard data integration began during Leg 134 with a drive to integrate all the core data. The second stage will be to integrate the merged core data with log data. Looking further ahead, an ultimate goal would be to integrate the merged core-log data with geophysical data.

Several problems were identified during Leg 134. These included time constraints on the Shipboard System Manager who is also responsible for routine system maintenance and cannot handle both this and the data itegration initiative. Similar comments apply to the shipboard scientists who also have their routine assignments. There is a need for data processing software tools. Finally, a key issue is the adoption of a reference depth.

IHP and SMP agreed that the currrent shipboard data acquisition and data processing system should be modified to allow for the implementation of core-log data integration. The most important addition to the current process is the ability to manipulate and edit ASCII data files, which comprise the integrated database and which receive input from the S1032 automated raw database, from other shipboard measurements, and from the Terralog data manipulation package. The ASCII files should be made available one year post-cruise as a database for user access.

Specific tasks must be performed to implement core-log data integration. Therefore, IHP and SMP recommended addition of the following: a second sea-going computer system manager and one person-year to develop software tools for data processing. IHP also supported the earlier SMP/DMP recommendation that a core-log data correlation specialist be identified as part of the scientific party for each leg.

It is noteworthy that the joint IHP/SMP panel meeting was conducted without a PCOM liaison present. This absence placed the meeting at a disadvantage.

3. <u>Integration of Core and Log Data - Implementation</u>

The following requirements were identified.

(a) <u>Hardware</u>

Core natural gamma sensor
Magnetic susceptibility log (for more meaningful reference depths)
Sonic core monitor (Leg 141 et seq)
Electrical resistivity core imager
Automation of physical properties laboratory (including software)
Core-log data integration work station
Macintosh PC for physical properties and palaeomagnetics.

(b) <u>Software</u>

Core data interpolation/integration software
Common shipboard spreadsheet
Barrel-sheet computerisation (Leg 138 et seq)
Depth-conversion software for sonic core monitor (SCM).

The following procedure for merging to a reference-depth scale was provisionally identified. The data sets were presumed to be SCM, core and log data, and marker horizons.

Step 1 Nominal core depth is corrected using software for SCM data.

Step 2 Core/log data correlation
Specialist user software (eg Corepac) to determine reference depth.
Correlation parameters are: natural gamma, magnetic susceptibility, density, and P-wave velocity.

A realistic time schedule for implementing the above is being formulated by ODP/TAMU staff. The data correlation specialist should receive two days' basic training at ODP/TAMU prior to sailing.

4. Sonic Core Monitor

The SCM is designed for use with the RCB/XCB. The concept is now proven. This allows the positioning and orientation of hard rock when core recovery is incomplete. The existing tool is a memory device. A Mark-II version is being developed with improved electronics and a (MWD) capability to transmit the data in real time, with an ASCII format output. The new tool is scheduled for deployment during Leg 141.

5. Pressure Core Sampler

This is a version of the XCB: it has a one-metre core capacity. The core chamber is sealed by a ball valve preserving borehole hydrostatic pressure, not in-situ pore pressure. Thus far the PCS has been run five times of which two were successful. A disadvantage is that one cannot access the solid core under pressure: it is necessary to depressurise. Further, core cannot be shipped under pressure.

6. Motor Driven Core Barrel

This is a wireline-deployable miniature core barrel within the drillstring. It is designed to core up to 4.5m ahead of the main bit. The MDCB failed its test on Leg 135 and further deployment has been deferred until Leg 141. This means that the Geoprops Probe, which is designed to operate within a MDCB hole, cannot be tested on Leg 139 as a prelude to scientific deployment on Leg 141. Instead Geoprops will be deployed at sea for the first time on Leg 141.

7. Core Handling Study

This study was undertaken during Leg 134. The core/liners bend when transferring from the rig floor to he core walk. Other sources of core disturbance certainly exist. Physical properties are affected. As a result of this study, recommended practices for improved core handling have been formulated.

8. Physical Properties Equipment

(a) Natural Gamma Sensor

It has been recommended that this be purchased. The Core Laboratories equipment is to be evaluated for prospective purchase.

(b) Resistivity Imaging Equipment

This is on the shelf at TAMU. SMP strongly supported its recommissioning and/or upgrading.

(c) Multisensor Track

Alternative technologies are to be evaluated with a view to upgrading the MST. In particular, GRAPE needs to be calibrated.

9. **Units**

A prerequisite for data integration is a common system of units. It was proposed that both shipboard and downhole measurements should be reported in SI units. This should be an across-the-board implementation unless there is good reason to do otherwise.

10. **Leg 139 - Sedimented Ridges I**

The safety panel require that drilling terminate at 350°C. This is unfortunate because the aim is to drill into a hydrothermal reservoir with an estimated temperature of 370°C. Subsea vents have temperatures up to 350°C, so the safety panel embargo might become effective at comparatively shallow depths and thereby prevent the scientific goals from being attained. At present, the effectiveness of hole cooling by circulation is being examined.

11. **Legs 143/144 - Atolls and Guyots**

Previous drilling in similar environments has resulted in low core recovery. Chemical characterisation is likely to rely on the geochemical logs. These should be calibrated via XRF and XRD. Carbon is measured routinely in the geochemistry laboratory. The geochemical log, run in C/O mode, might provide an additional diagnostic capability for carbonates, where core recovery is sparse.

12. **Next Meetings**

The next SMP meeting had been proposed to take place in Victoria, BC from 11-13 September 1991, during the ship port-call. This meeting had been planned to encompass a joint session with DMP. However, SMP Chair is no longer available on those dates. The next SMP meeting has therefore been rescheduled for 15-18 October 1991 in Halifax, Nova Scotia. In view of the strong PCOM encouragement for DMP and SMP to retain especially close liaison during the data-integration phase, DMP will also try to meet in Halifax at the same time, provided that this new arrangement does not impact on any plans already made. Topics for discussion at the joint DMP/SMP meeting would include:-

(i) Innovation in collecting core and log data: i.e. log first, core later.

(ii) Strategy for problem holes, i.e. poor core recovery, incomplete logs.

The subsequent SMP meeting is provisionally scheduled for Honolulu, Hawaii, in March 1992, to coincide with a ship port-call. It is proposed that this meeting be followed by a working group session on Physical Properties.

Paul F Worthington
25 March 1991

ANNEXURE II

REPORT ON MEETING OF JOIDES SEDIMENTARY AND GEOCHEMICAL PROCESSES PANEL

TEXAS A & M UNIVERSITY

COLLEGE STATION

5 - 6 JUNE 1991

1. I attended SGPP in my capacity as Chairman of the JOIDES Downhole Measurements Panel. Input from DMP had been requested by SGPP Chairman specifically for a workshop on "Gas Hydrates and Ocean Drilling" held as part of the SGPP meeting. These notes relate to the downhole measurements aspects of the meeting.

2. Hydrates are hydrogen-bonded water lattices that physically entrap other molecules. In natural gas hydrates the "guest" molecules can be any common constituent of natural gas. Methane is the most prolific. There are two types of crystal structure for natural gas hydrates, conventionally known as Type 1 and Type 2, which have different physical properties. Type 1 is the more common. Hydrates can be disseminated in pore spaces, or occur in nodular (2 mm to 2 cm), layered (15 cm) or massive (several metres) form. They can occur within all types of sediments.

3. $1m^3$ of methane hydrate produces 0.81 m^3 water plus 170 m^3 methane. The global resource of hydrate is estimated as 10^4 Gt (1 Gt = 10^{15} g methane carbon). Approximately 2 to 4 Mt/year of methane are being released to the atmosphere, mostly from Arctic offshore permafrost which has experienced a temperature rise due to seawater coverage and is allowing the hydrate to decompose. The decomposition is giving rise to a new sea-floor topography through subsidence. The ratio of gas-hydrate methane to atmospheric methane is 10 000:1 so that a small change in the former could have a big effect on the latter. Thus, there are implications for global climatic and environmental change.

4. Essentially there are two geophysical models that seek to describe the occurrence and manifestation of gas (methane) hydrates. Key aspects are the relationship of hydrate occurrence to the bottom-simulating reflector (BSR) and whether or not a free gas is present below the hydrate stability zone. Clear seismic reflections are seen only from the base of the hydrate layer, not from the top. We need to design experiments to test the geophysical model.

5. Downhole measurements are capable of distinguishing between different pore-filling substances. They have been used for this purpose in the oil industry for over 60 years. Used

qualitatively, single logs can be informative. For quantitative application, logs are affected (like all geophysical measurements) by the principle of equivalence, ie non-uniqueness of interpretation. Equivalence can be resolved through the conjunctive use of several different logging tools.

6. Borehole logs are depth records of physical measurements presented in terms of physico-chemical parameters. The parametric values are averages over the zones of investigation of the various tools. If this average does not change with depth, the log(s) will show constancy. Logs can be constant even if there is a change in the proportion or distribution of constituents, through the principle of equivalence.

7. In order to assess the potential of logs to distinguish between solid hydrates, water and gas, we need to know the responses of standard logging tools to each of these constituents. These are listed below, together with sandstone and limestone matrix values for comparison.

TOOL	HYDRATE TYPE 1	WATER	GAS	SANDSTONE (SiO_2)	LIMESTONE ($CaCO_3$)
Sonic (km/s)	3.73	1.6	0.3*	5.5	6.29
Density (g/cc)	0.90	1.0	0.2*	2.65	2.71
Neutron (lst ϕ)	1.07	1.0	0.0015*	0.04	0
Resistivity (Ω m)	Inf	0.04-10.0	Inf	Inf	Inf
Gamma (API)	0	0	0	15-30	10-20

*Nominal values:function of compression. Inf = infinity.

Thus, we see that the sonic log responds distinctly to hydrate, the density and neutron logs to gas, and the resistivity log to water. The natural gammma ray log allows us to classify formations as clean (< 30 API units) or clay-mineral-bearing (30-200 API units). Interpretation procedures are different for these two cases.

8. Where hydrate is present within the pore spaces of a clean formation, it can be recognised by high sonic velocities and formation resistivities, relative to values recorded in a water zone. Gas can be recognised by relatively low sonic velocities,

low density and neutron responses, and high resistivities. These statements presuppose that there are no lithological changes between the hydrate or gas zones and the reference water zone, and they do not necessarily apply in clay-mineral-bearing formations.

9. For quantitative interpretation, the density and neutron logs, drawn to compatible limestone scales, can be used to provide a quick-look porosity estimate in clean formations. This allows a formation factor F to be calculated using Archie's first law (in reverse). A value of water resistivity Rw is needed from a nearby water zone, from a recovered sample, or from log analysis. The value so derived might not be the same as that of the brine in hydrate zones. If a value of formation resistivity Rt is known from electric logs, the water saturation (the fraction of pore space filled with water) can be evaluated by inputting F, Rw and Rt to Archie's second law. We determine 1-Sw to give the fraction of pore space filled with hydrate or gas. Note that isolated pockets of brine, surrounded by hydrate, will not be seen by resistivity logs which respond to continuous conducting paths.

10. To distinguish between hydrate, water and gas, we can use crossplots of neutron vs density responses to diagnose free gas and density vs sonic velocity to estimate the amount of hydrate. Unlike standard oil industry crossplots, which specify a fluid type and diagnose lithology, we need to specify a lithology with constant matrix properties and then diagnose fluid type. Quantatitive evaluations are achievable. The procedures become much more complex if the formations contain clay minerals.

11. Paragraphs 5 to 10 refer to standard borehole logs. Alternative approaches might be required in order to circumnavigate the need for a representative value of Rw. A possibility is to run the Geochemical Logging Tool (GLT) in inelastic mode to determine a ratio of carbon-to-oxygen elemental concentrations. In this mode, the tool will respond both to hydrate and to free methane gas. It should be possible to distinguish between the two occurrences.

12. Hydrates will be encountered during Legs 141 (Chile Triple Junction) and 146 (Cascadia). In both cases we need to know the amount of hydrate, the amount of free gas, gas composition, the porosity-velocity calibration for the geophysical model(s), the permeability of the hydrate layer (inferred from the quantities of methane above and below) and the source of the methane. Neither of these legs is a hydrates leg. It is therefore especially important to know the details of the hydrate-targeted logging programme when the cruise is being designed. The pre-cruise meeting for leg 141 is scheduled for May 1991. A logging scheme will be needed before then.

PAUL F WORTHINGTON
7th March 1991