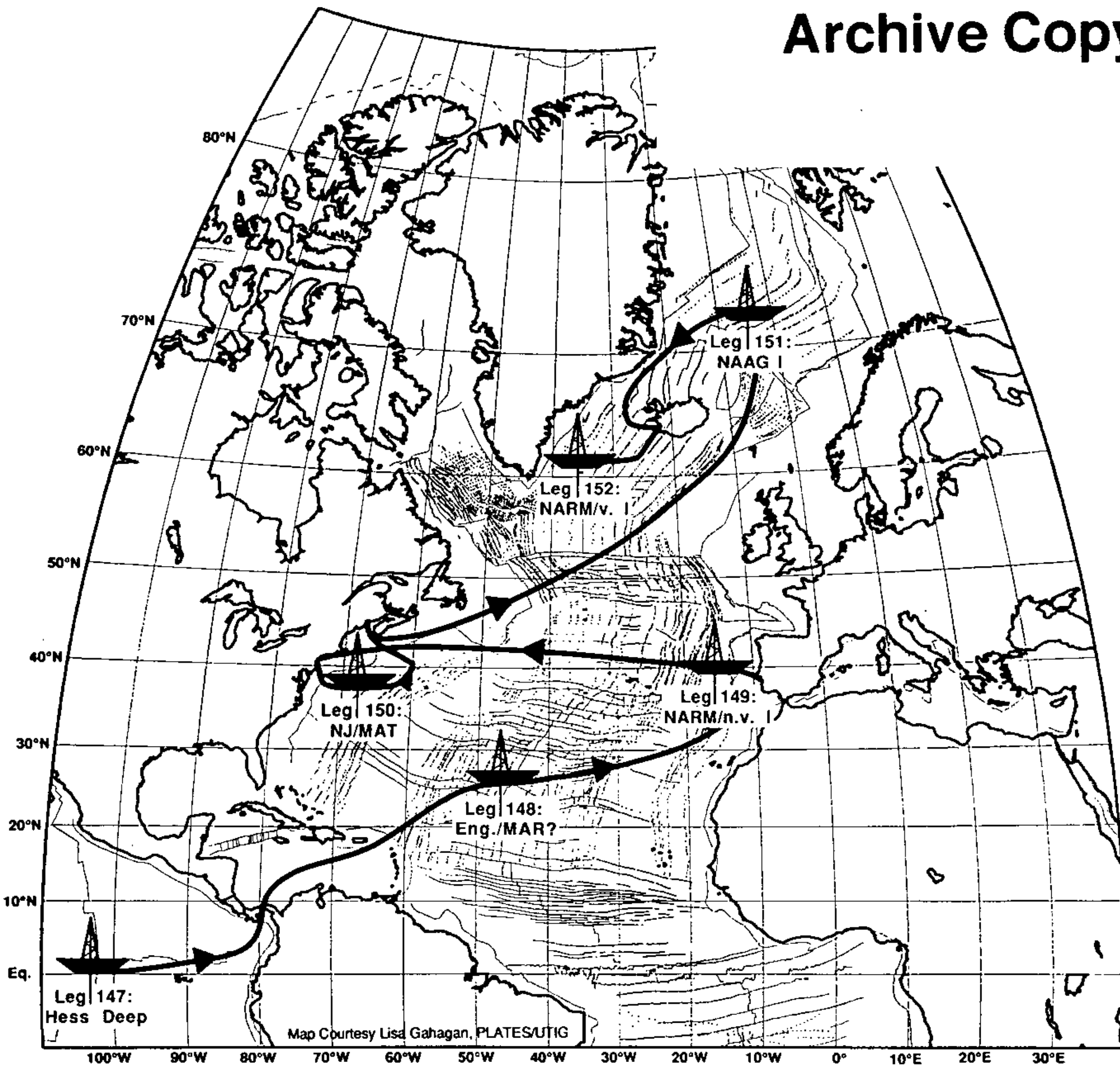
Joint Oceanographic Institutions for Deep Earth Sampling

JOIDES Journal

Volume 18, Number 1, February 1992



ODP Fiscal Year 1993 Drilling Schedule

November 1992 - November 1993

(See inside front cover for key to abbreviations)

FRONT COVER:

ODP Fiscal Year 1993 Drilling Schedule

Magnetic anomaly map of the North Atlantic (courtesy L. Gahagan, Project PLATES, University of Texas Institute for Geophysics) on which the ODP FY93 schedule has been superimposed. The schedule was set by JOIDES Planning Committee at its Annual Meeting in December 1991. Designated ports-of-call are preliminary, and ship track and drilling locations are schematic. For more detailed information, contact the JOIDES Office.

Abbreviations:

Eng/MAR?	Engineering - Diamond Coring System (DCS) Phase IIB; assuming Mid-Atlantic Ridge operation. (Back-up leg: Hole 504B.)
NAAG I	North Atlantic Arctic Gateways, Leg I.
NARM/n.v. I	North Atlantic Rifted Margins (non-volcanic), Leg I, Iberian Abyssal Plain.
NARM/v. I	North Atlantic Rifted Margins (volcanic), Leg I, East Greenland Margin.
NJ/MAT	New Jersey/Middle Atlantic Transect.

Joint Oceanographic Institutions for Deep Earth Sampling

JOIDES Journal

Volume 18, Number 1, February 1992

Contents

Focus

February finds the *JOIDES Resolution* busy testing (we hope successfully!) the Diamond Coring System (DCS) at 9° 30' N on the sunny East Pacific Rise (Leg 142), while here in Texas we slowly sink into the mud caused by almost continuous rainfall (---- that El Niño, anyway!).

The renewal front is considerably brighter than the scene outside my office window. Both Australia and the United Kingdom have decided to continue their participation in ODP beyond 1993, and progress towards similar decisions is being made by all of the partner nations, including the United States. The issue should be decided by the end of the summer, so stay tuned. You may hear it here first!

The Planning Committee, ably aided by JOIDES Panel Chairs, constructed the Fiscal Year (late November, 1992 - late November, 1993) drilling schedule here in Austin in early December. Hess Deep will constitute Leg 147; activities there may form the template for drilling offset sections of oceanic lithosphere in the North Atlantic and elsewhere in years to come. Inaugural legs on both nonvolcanic (Leg 149) and volcanic (Leg 152) passive continental margins, as dictated by the North Atlantic Rifted Margins Detailed Planning Group (kudos to chair Hans-Christian Larsen for a great job of presenting the NARM-DPG's program to the assembled multitude), should give us an opportunity to begin to maximize the stated capabilities of ODP's drillship for deeper objectives. (By the way, scientific ocean drilling has finally reached the 2 km plateau - Leg 140 deepened Hole 504B to 2000.4 mbsf. Congratulations to Henry Dick, Jörg Erzinger and the rest of the Shipboard Party for that accomplishment, and for leaving Hole 504B clean!) Leg 150, a "Middle Atlantic Transect" across the shelf and slope off New Jersey, will continue to implement an evolving global strategy for the study of sea-level change which is being kicked off shortly by legs 143 and 144 on Western Pacific atolls and guyots. The first leg of what could be a multi-leg effort to understand the paleoceanographic history of North Atlantic - Arctic Gateways ("NAAG") will bring the *Resolution* to the near Arctic during Leg 151. Last but not least, Leg 148 is presently scheduled as a further test of the DCS; leading candidates for the test site include a return to the EPR, the carbonate-capped transverse ridge at the Vema Fracture Zone, and the MARK (Mid-Atlantic Ridge - Kane Fracture Zone) area. PCOM will make the final decision on Leg 148 at its next meeting in Corvallis in April.

The Executive Committee has recently received draft reports from the third Performance Evaluation Committee (PEC-III) and its own subcommittee on "future organization and management of ODP", and is in the midst of very productive discussions on the status of additional platforms and subcontracting issues related to the second (post-1993) phase of ODP. Among other actions, EXCOM has mandated an independent review of the JOIDES scientific advisory structure, and a group to begin that task is presently being selected. More on that in my next report.

Jamie

James A. Austin, Jr.
Planning Committee Chairman

Science Operator Report

Leg 140: Return to Hole 504B

During Leg 140, *JOIDES Resolution* achieved the deepest hole ever drilled into oceanic crust by deepening Hole 504B to a total depth of 2000.4 m below the seafloor (mbsf). Hole 504B is perhaps the most important reference hole for the composition and structure of "normal" oceanic crust. It represents the best opportunity for sampling the transition between the sheeted dike complex and the underlying gabbros in the context of a complete crustal section. As a result of Leg 140 drilling, Hole 504B may have reached the lower part of the sheeted dike section.

Introduction

The primary objective of Leg 140 was to revisit Hole 504B in the eastern equatorial Pacific to deepen it into the sheeted dike complex through the dike/gabbro and/or seismic layer 2/3 transitions. Site 504 is located 201 km south of the Costa Rica Rift, the easternmost arm of the Galapagos Spreading Center (at 1°13.611'N, 83°43.818'W, with a water depth of 3460 m), in 5.9 m.y.-old crust. Hole 504B is by far the deepest hole ever drilled into oceanic crust, and provides our most important *in situ* reference section for shallow ocean-crust structure (Figure 1). It was temporarily abandoned at the end of Leg 111, ending within a 295-m section of sheeted dikes beneath 1/2 km of extrusive pillow lavas. A vertical seismic profile conducted in Hole 504B during Leg 111, however, indicated a reflector between 1660 and 1860 mbsf, only 100-300 m below the bottom of the hole. This reflector was interpreted as the transition between the sheeted dikes of seismic layer 2C and gabbros of seismic layer 3 and provided a major incentive for ODP to return to Hole 504B. Although the sheeted dike/gabbro transition has been sampled and observed by submersibles in tectonic exposures in both the Atlantic and the Pacific, this transition has never been sampled in an undisrupted section, and its equivalence to the seismic 2/3 transition never directly confirmed. As a result, the JOIDES Planning Committee (PCOM) committed two legs to reoccupy Hole 504B. A 41-day engineering leg, Leg 137, cleaned out a large diamond bit and other hardware lost in the hole at the end of Leg 111, as well as conducting a suite of downhole measurements. Leg 140 devoted 40 days to cleaning, deepening and logging the hole.

Drilling History

Leg 140 was the seventh leg of DSDP/ODP to occupy Hole 504B. An early pilot hole, Hole 501, was drilled 73 m into basement during Leg 68. Hole 504B was spudded in October 1979 during DSDP Leg 69, several hundred meters east of Hole 501. Hole 504B was subsequently deepened and/or logged during parts of five other legs, including Leg 70 (1979), Leg 83 (1981-1982), Leg 92 (1983), Leg 111 (1986) and Leg 137 (1991), as shown in Figure 1. These legs provided a wealth of scientific results.

Although previous coring, logging and geophysical programs at Hole 504B achieved unprecedented scientific success, the operational history of the hole was marred by repeated downhole hardware losses and by disappointing rates of core recovery. These problems have increased with depth and were a particular problem during Leg 111, which experienced four significant losses of hardware in the hole, and a rash of premature bit failures. Leg 137 successfully fished and milled the junk left in the hole from Leg 111, and succeeded in deepening it by 59.2 m. Operations throughout the leg showed no indication of previously supposed problems with casing. Unfortunately, an 18-m outer core barrel with a diamond drilling bit broke off and was lost at the bottom of the hole near the end of Leg 137. Leg 137 was not able to fish this junk because of a defective fishing tool, and a lack of time to obtain and deploy any further appropriate tools. As the new junk in the hole was not deemed a serious

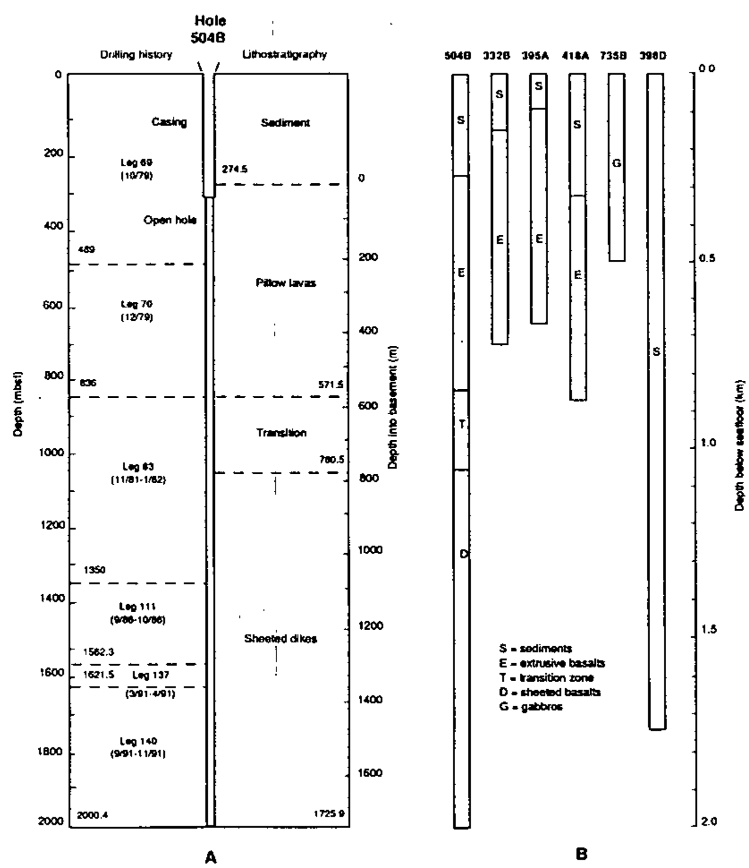


Figure 1. A) Generalized drilling history and lithostratigraphy of Hole 504B as drilled during Legs 69, 70, 83, 111, 137, and 140 (Leg 92 is not included because Hole 504B was logged only on that leg). B) Generalized lithostratigraphy of selected DSDP/ODP holes.

impediment, fishing operations were scheduled to be completed by Leg 140, which would return to the hole with new fishing tools.

Drilling Results

JOIDES Resolution left Victoria, Canada, 15 September 1991, and started operations after arriving at Site 504 on 1 October 1991. After 1 day of logging (temperature and formation microscanner, FMS), 10 days were needed to fish the core barrel lost at the bottom of Hole 504B at the end of Leg 137, and to clean the hole for further coring. Coring (26 days) and more downhole measurements (3 days), including temperature, acoustic velocity, resistivity, digital borehole televiewer, geochemical combination and a permeability test, were performed before the ship left Site 504 for Panama on 10 November 1991.

By deepening Hole 504B to a total depth of 2000.4 mbsf, Leg 140 has established the most complete reference section to date through the upper oceanic crust. Hole 504B is now the deepest hole ever drilled by DSDP/ODP, and extends almost three times as deep into oceanic basement as any other hole.

The temperature profile recorded between 200 and 550 mbsf, before fishing and coring operations were begun, is characterized by a gradient inversion between 283 and 288 mbsf, possibly due to local fluid inflow from the basement into the borehole (Figure 2). Below 288 mbsf, a downhole flow of ocean bottom-water into basement, also observed during earlier legs, is still active, but has decayed considerably since Leg 137. The linear temperature gradient in the deeper part of the hole is still 61°C/km, which extrapolates to a temperature of 195°C at 2000 mbsf. The FMS produced two good images from 290 to 940 mbsf and 1563 to 1575 mbsf.

Coring was straightforward, without any unexpected drilling problems. The penetration rate of <2 m/hr and recovery of 13% were low, but adequate. Hole 504B remains stable, with negligible evidence of hole ellipticity, and it was left open and clean for further deepening.

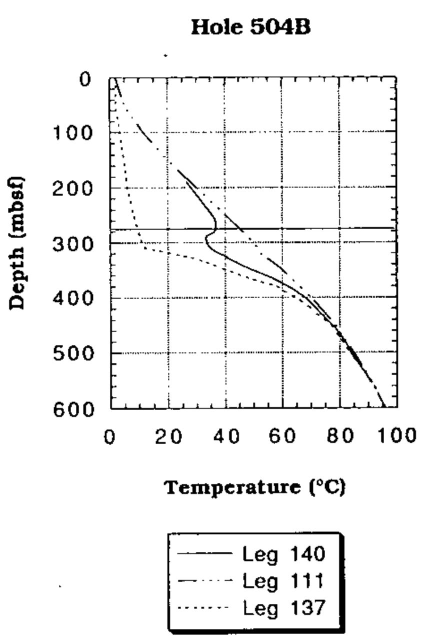


Figure 2. Temperature profiles in Hole 504B from legs 111, 137 and 140. Note temperature inversion observed on Leg 140.

At present, Hole 504B extends through 274.5 m of sediment and 1725.9 m into basement, and is the only hole which clearly penetrates through the extrusive pillow lavas and into the sheeted dike complex predicted from studies of ophiolites. The Hole 504B basement section includes 571.5 m of pillow lavas and minor flows, underlain by a 209-m transition zone of mixed pillow lavas, thin flows and dikes, and 945.4 m of sheeted dikes and massive units.

Coring on Leg 140 recovered 47.69 m, of which 11.4% is aphyric, 18.6% sparsely phyric, and 70% moderately phyric plagioclase-pyroxene-olivine diabase, which has been divided into 59 lithological units. The coarsest unit identified has an average grain size of 1.5 mm, but in terms of texture and grain size, it is clearly a diabase and not a gabbro. Although there is not a simple systematic increase in grain size with depth, coarser grained diabases do become more common, and glassy chilled margins virtually disappear, consistent with emplacement of dikes at greater depth and at higher temperatures. Phenocrysts include plagioclase, augite, olivine and Cr-rich augite. Groundmass is dominated by plagioclase, augite and magnetite. In a few units, Cr-spinel is present as inclusions in olivine and plagioclase. Most of the rocks examined are seriate porphyritic, a texture in which there is a continuous range of grain sizes from phenocrysts down to groundmass. A variety of "gabbroic" clots were observed in hand specimen and thin section. Some individual clots contain up to 20% Fe-Ti oxide minerals, and many contain small fine-grained patches with up to 50% Fe-Ti oxide minerals. These patches are interpreted to be crystallized pockets of trapped Fe-Ti-rich magma.

In hand specimen, there is no evidence for any pervasive deformation, and the rock exhibits well-preserved primary characteristics. The rocks are generally isotropic, both in hand specimen and in thin section, and there is no evidence for extensive recrystallization associated with ductile deformation. No significant fault-rocks have been recovered, and there is little evidence for local increases in intensity of microfaulting, so it is unlikely that a major fault zone has been drilled, but not recovered.

Chemically, Leg 140 rocks can be classified as olivine tholeiites, with compositions that are similar to moderately evolved mid-ocean-ridge basalts (MgO = 7.7-10.1%, $Fe_2O_3^{total}$ = 8.1-11.4%, Ni = 79-189 ppm, Mg value = 0.60-0.75). However, Leg 140 rocks are strongly depleted in incompatible elements (TiO_2 = 0.67-1.1%, Nb ≤ 0.3-0.7 ppm, Zr = 35-58 ppm). These characteristics encompass >98% of all investigated samples recovered from Hole 504B, through 2000 mbsf. There appear to be no major igneous enrichment or depletion trends with depth, nor are there large-scale fractionation trends throughout this crustal section. However, Zn content decreases systematically from an average of 70 ppm at 1500 mbsf to 30 ppm at 2000 mbsf.

All recovered rocks are mineralogically and chemically altered to some extent and exhibit a pervasive slight "background" alteration. Locally more extensively altered zones occur around veins and in cm-sized patches. Background alteration is characterized by a 10%-20% replacement of primary minerals by secondary phases. Olivine in most of the rocks is completely altered; pseudomorphs have been interpreted to reflect multiple stages of alteration, with early formation of talc + magnetite, followed later by chlorite or mixed-layer clay. Fresh olivine is present in some samples. Clinopyroxene is partly replaced by actinolite. Plagioclase is generally only slightly altered to albite and chlorite along fractures and grain boundaries. A characteristic feature of Leg 140 rocks is the common presence of cm-sized, green to light-gray "patches" of alteration, similar to those identified on previous legs. These patches comprise 8% of the core recovered. Irregularly shaped amygdules, 0.1-2.0 mm in size and filled with actinolite and chlorite, are surrounded by alteration halos (2-10.0 mm wide) in which the rock is extensively altered (~80%) to actinolite, chlorite, albite and titanite. Rocks from 1710 to 1790 mbsf, however, are characterized by generally slight alteration, with lower abundances of actinolite and chlorite, by the presence of talc replacing olivine, and by the presence of relict igneous olivine in the rocks. These rocks also lack cm-sized patches of more extensively altered rock and are interpreted to reflect alteration at relatively low water/rock ratios. Such rocks occur sporadically at the bottom of the hole, and the deepest sample recovered is among the least altered. Alteration is strongly influenced by local permeability. Although secondary mineralogy of Leg 140 and Leg 111 rocks is generally the same, the proportion of actinolite is greater in Leg 140 rocks, actinolite veins are more abundant, and Leg 140 rocks are slightly more altered.

Penetration by hydrothermal fluids resulted in pervasive, but heterogeneous, veining of at least five macroscopic vein types (chlorite, chlorite/actinolite, actinolite, epidote/quartz and chlorite/pyrite) ranging from ≤0.5 to 2 mm in width. The only consistent crosscutting sequence established among these vein types indicates that epidote/quartz veins formed relatively late. Apparently random orientation of veins suggests that their genesis is mainly influenced by local stress regime, dominated by contractional cooling. Dips of open fractures fall into two dominant groups, one shallow and one steep. Both features seem to be late, associated with the drilling process. Most fractures are shallow and dip <30°. Some shallow-dipping veins exhibit typical saddle morphology of disking fractures which may reflect the *in-situ* stress field. Borehole ellipticity measured by FMS calipers supports these interpretations. Steeply-dipping fractures mostly strike east-southeast, a trend which again generally corresponds to initial interpretations of FMS data, and perhaps also reflects the *in-situ* stress field.

Several chilled dike contacts were observed, and some have been oriented using paleomagnetic stable remanence. Oriented dikes indicate an east-west strike, subparallel to the spreading axis of the ridge. Dikes dip between 79° and 85° to the north, so the crustal sequence has probably tilted by only a few degrees. Natural remanent magnetization of Leg 140 samples is of moderate intensity (2.6-3.0 A/m) and stability. Range of stable magnetic inclination values (-57° to 43°) is similar to that observed in the upper part of the hole. Thus, the mean value observed in Leg 140 samples falls within the range predicted by normal variations of the geomagnetic field for Site 504, and does not indicate significant tilting or rotation of the crustal section.

Mean value of magnetic susceptibility (0.016 SI units) for these samples is nearly identical to the mean value from the upper part of the dike section (1055 to 1570 mbsf). However, the range of susceptibility values is much wider than previously observed. This suggests that, for significant parts of the newly-drilled section, degree of hydrothermal alteration varies dramatically.

Compressional wave velocities in 50 horizontally-oriented and water-saturated minicore samples have a mean of 5719 ± 257 m/s. This average is lower than values measured from samples obtained during later stages of Legs 111 and 137. If two highly altered samples are excluded, mean value of the average wet bulk density is 2.98 g/cm^3 ± 0.023 g/cm^3. This value is higher than the average determined during Leg 111 (2.91 g/cm^3 ± 0.06 g/cm^3). Excluding altered samples, mean wet porosity is 0.52% ± 0.60%, and average thermal conductivity of 2.410 W/mK (homogeneous samples) is considerably higher than the mean value of 2.01 W/mK obtained during Leg 111. Downhole distribution of physical rock properties shows an increase in velocity at 1600 mbsf, and a porosity and conductivity minimum at 1720 and 1800 mbsf, respectively.

A vertical seismic profile experiment conducted in Hole 504B during Leg 111 shows a relatively weak seismic reflector between 1660 and 1860 mbsf. This reflector was interpreted by the Leg 111 Shipboard Scientific Party as the transition between sheeted dikes in seismic layer 2C and gabbros in layer 3. Leg 140 clearly penetrated through this depth section. Observed changes in intensity of alteration and in physical rock properties may have caused an impedance difference somewhere around 1750 mbsf, which resulted in the observed reflector. This "boundary" was clearly not the transition from the dike complex into the gabbros at Site 504. Changes in alteration mineralogy, increasing average grain size, general increase in actinolite abundance, and absence of glassy, chilled dike margins in the newly drilled section of Hole 504B may indicate that Leg 140 has reached the lower part of the sheeted dike section.

FINAL LOGGING

After drilling was terminated, an additional temperature log was run from seafloor to the bottom of Hole 504B (2000.4 mbsf) to determine the temperature rebound after 5 weeks of operations. The maximum temperature recorded was 142°C, near the bottom of the hole; temperature at the bottom increased at a rate of 1.96°C/hr (Figure 2). Next, the geochemical combination tool logged from 1811 to 1896 and from 1350 to 1686 mbsf with good data recovery. The resistivity/sonic log was successfully conducted from 275 to 1990 mbsf. The first run of the digital borehole televiewer (BHTV) failed, but following repair of the cable head, sections from 1885 to 1985 mbsf and 1485 to 1685 mbsf were successfully logged. A flowmeter was then deployed to test permeability of the upper basement, and finally the geochemical combination tool was run again to log the missing section of Hole 504B from 1648 to 1826 mbsf.

Leg 141: Chile Triple Junction

ODP Leg 141 drilled and cored five sites (859-863) in two transects of the ridge/trench collision zone of the Chile Triple Junction (CTJ). Leg objectives focused on investigating ridge-crest subduction, to test the model of "accelerated subduction erosion" and explore mechanisms responsible for subduction erosion. Figure 1 indicates the position of the ridge relative to South America, 18 Ma to Present.

Site 859

[45°53.734'S, 75°51.191'W, Water Depth: 2760 m]

Site 859 was occupied from 1930 hrs, 28 November 1991 through 1530 hrs, 8 December 1991. Hole 859A was cored to a total depth of 146.5 mbsf with APC, PCS and XCB coring systems. Hole 859B was cored to a total depth of 476.1 mbsf with the RCB coring system and logged using seismic stratigraphy, geochemistry and FMS tool strings.

Drilling at Site 859 achieved almost complete penetration of a small accretionary wedge at the leading edge of South American forearc basement. The accretionary wedge is composed of a uniform suite of fine-grained terrigenous clastic sediments of late Pliocene age, and is overlain by a thin lower trench slope cover sequence of Pleistocene age. The main source area of the sediment is the nearby Andean volcanic arc and crystalline basement. Glacial rock flour makes a significant contribution to the sediment. Microfauna suggest a middle to lower bathyal depositional realm. A cold-water marine paleoenvironment existed in early Pleistocene, followed by temperate to subtropical conditions in late Pleistocene. Cold water dominated throughout late Pliocene, interrupted by three short periods of temperate water conditions. The Brunhes/Matuyama reversal of magnetic polarity was detected near 30 mbsf, the Matuyama/Gauss reversal at 300 mbsf, and the Gauss/Gilbert reversal at ~400 mbsf. Pleistocene cover sediments are folded, with axial orientations perpendicular to direction of plate convergence. Below 200 mbsf, Pliocene sediments show signs of pervasive brecciation and shearing. Physical properties were measured on structurally intact subspecimens of core. The most important discoveries were high average grain densities (2.8 g/cm^3), low porosities (an average of 48% near the mudline, decreasing to an average of 15% at 470 mbsf), and consequently wet water contents as low as 5% at this depth. Anomalously high porosities were found in intervals of 200-240 mbsf (up to 55%, 20% above local background) and 380-420 mbsf (up to 37%, 15% above local background).

Chemical analysis of interstitial water samples and WSTP (water sampler temperature probe) samples shows a pronounced chlorinity and salinity minimum between 30 mbsf and 70 mbsf. This may represent dilution of pore fluids with fresh water liberated by decomposition of gas hydrate. Chlorinity profile does not show diffusion gradients, suggesting that gas hydrate decomposition was triggered by drilling, and that gas hydrates are stable *in situ*. In this case, it can be estimated that ~25% of pore volume is filled with gas hydrates. A second chemical discontinuity was intersected ~240 mbsf. This is a zone of marked increase in Ca, matching decrease in Mg, and minimum in alkalinity of interstitial water. In the absence of dolomitization, this chemical signature is characteristic of fluid resulting from alteration of oceanic basement. Low K contents corroborate this interpretation.

Headspace and vacutainer analyses of gases trapped in the coreliner indicate a microbial, biogenic gas source in the upper part of Site 859. A significant component of thermogenic gas is evident from analyses of cores from the lower part of Hole 859B. Solid organic matter contents are lower than 0.5% throughout and degree of maturity is generally low. Thus, the thermogenic gas component must have migrated to its present location, probably from deeper parts of the accretionary prism downdip in the subduction zone.

Downhole temperature measurements with the WSTP revealed an approximate geothermal gradient of 200°C/km for the upper 50 mbsf. Below this depth, an extremely disturbed temperature profile was recorded, including a zone of downward decrease in temperature between 130 mbsf and 220 mbsf. At 240 mbsf a downhole temperature of 62°C was recorded, which may relate to an ambient rock temperature of 42°C and hot fluids entering the borehole nearby through a closely-defined aquifer. Wireline logs in Hole 859B show disturbances in temperature of the downhole mud column with positions that roughly correspond to WSTP measurements. Temperatures of the mud at terminal depth (TD) were ~50°C, constraining an overall thermal gradient of 100°C/km. Sonic velocities in the upper part of the hole are 1.8-2.2 km/s, with a smooth downward increase. From 180 mbsf to 250 mbsf, they vary irregularly between 1.6 and 2.2

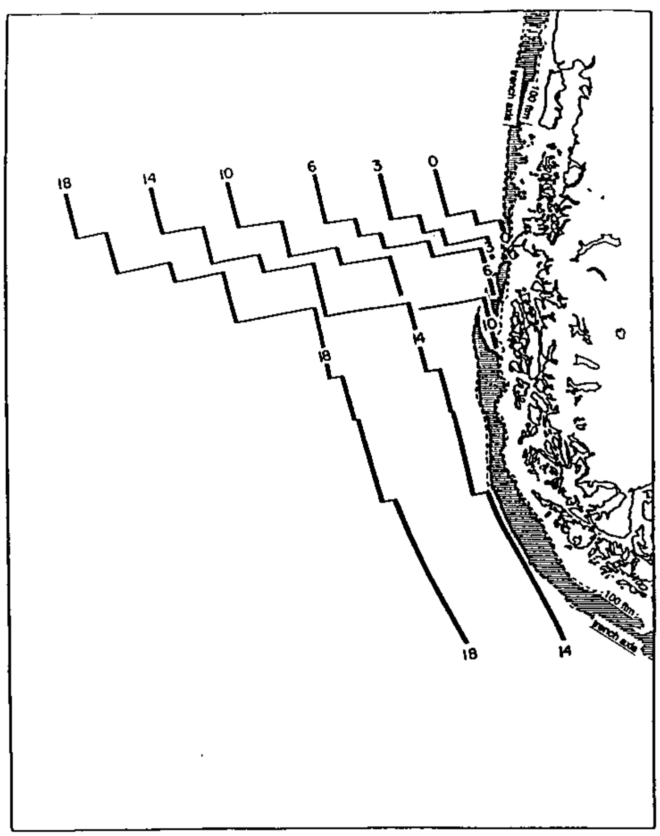


Figure 1. Position of ridge relative to South America, 18 Ma to Present.

km/s. Below 250 mbsf, there are variations between 2.3 and 2.8 km/s, with a smooth downhole increase.

SITE 860

[45°51.972'S, 75°45.101'W, Water Depth: 2113 m]

Site 860 was occupied from 0300 hrs, 9 December 1991 through 0300 hrs, 17 December 1991. Hole 860A was cored to a total depth of 9.5 mbsf with the APC coring system. Hole 860B was cored to a total depth of 617.8 mbsf with APC, PCS and XCB coring systems and logged using sonic and resistivity tool strings.

Drilling at Site 860 penetrated and sampled the seaward flank of a forearc basin and the accretionary wedge upon which forearc basin sediments were deposited. Ages of both forearc basin strata and fault wedges drilled in the underlying accretionary wedge range from upper Pliocene to lower Pliocene, with just 12-15 m of Quaternary slope hemipelagic material overlying older units. Pliocene age of this portion of the accretionary wedge is identical to that drilled at Site 859, at the base of the trench slope. Age of formation of the accretionary wedge at these sites corresponds to a period of rapid uplift and shallowing of paleo-water depths on the shelf in this region.

Three lithologic units were identified at Site 860:

Unit I (0 - 87.7 mbsf): Quaternary to upper Pliocene, clayey silt to silty clay with calcareous nannofossils, graded silt and sand interbeds, and a 10 m-thick massive sand unit at the base.

Unit II (87.7 - 242.5 mbsf): upper Pliocene to lower Pliocene, claystone to silty claystone (lapilli bed) plus sandstones and thin conglomerate beds.

Unit III (242.5 - 617.8 mbsf): upper Pliocene to lower Pliocene, divided into two subunits:

Subunit IIIA (242.5 - 309.8 mbsf): upper Pliocene to lower Pliocene, clayey siltstone, silty claystone, ± nannofossils plus sandy silty claystone (diamictite) with thin conglomerate beds.

Subunit IIIB (309.8 - 617.8 mbsf): upper Pliocene to lower Pliocene, gravel, clayey siltstone, silty claystone ± nannofossils plus sandy silty claystone (diamictite) in three intervals, and thin conglomerate beds.

The upper section of Unit I is interpreted to be the result of hemipelagic sedimentary processes, with high- and low-density distal (fine-grained) turbidites dominating the lower section. The massive sand unit that defines the base of Unit I is the result of a single grain flow depositional event.

Unit II is characterized in its upper section by hemipelagic sedimentation mixed with mud turbidite deposition. Unit II also exhibits evidence of traction transport and reworking by bottom current flow.

The upper section of Subunit IIIA is characterized by hemipelagic and fine-grained turbidite depositional units, while the lower part of this subunit is composed of high-density fine-grained turbidites with signs of reworking. Subunit IIIB exhibits a grain-flow event accompanied by background hemipelagic deposition in its upper section, with successions of high-density fine-grained turbidites in its lower section. Subunit IIIB also shows signs of bottom-current reworking. Unit III contains at least 5 repetitions of sedimentary sequences, probably the result of imbrication by thrust faults.

Microfossil abundance and preservation are better than at Site 859. Diatoms are moderately well-preserved at the top of Hole 860, but are sparse between 10 mbsf and 150 mbsf. Below 150 mbsf, there are no diatoms. Radiolarian abundances are similar to those of diatoms, with many barren cored intervals. However, 80% of Hole 860B core-catcher samples contain foraminifers, and 87% of these samples contain benthic forms, providing a solid basis for both biostratigraphic age determinations and paleo-water depth estimates.

Pleistocene-Pliocene boundary occurs at ~10 mbsf, with the depth interval 20-640 mbsf of Pliocene age. Two apparent age reversals are observed: at 240 mbsf and at 310 mbsf. Another possible age reversal may occur at 360 mbsf. All age reversals are characterized by upper Pliocene strata appearing beneath a lower Pliocene section. Lowermost Pliocene foraminifers were recovered from Core 70X, at 640 mbsf.

Paleo-water depth determinations from benthic foraminiferal analysis indicate that Site 860 experienced uplift during the Pliocene. The upper 60 m of drilled section was deposited in outer shelf to upper bathyal water depths. From ~60 mbsf to 435 mbsf, paleo-water depths were upper bathyal to lower bathyal. Below ~435 mbsf, paleo-water depths were lower bathyal to abyssal.

Approximately 65% of the sediment drilled was not sampled. Thus, a reliable correlation with magnetic reversal sequence is not possible at this site. A large magnetic susceptibility excursion occurs at 42-49 mbsf, exceeding by 6-7 times the susceptibility elsewhere in the cores. A similar but lower-amplitude susceptibility anomaly occurs at ~8 mbsf.

Three structural domains are defined at Site 860.

Domain I (0-100 mbsf): near-surface slump deformation.

Domain II (100-420 mbsf): thrust stack.

Domain III (420 mbsf - T.D.): broken formation and stratal disruption.

Based on structural observations, faults are inferred at 240 mbsf(?), 310 mbsf, 420 mbsf(?), 520 mbsf and 580 mbsf. All bedding laminations below 420 mbsf are deformed or sheared. Bedding above 420 mbsf is shallowly-dipping 10° SE in oriented APC cores. Thrust faults must be flats or shallow ramps at this location and must have large (hundreds of m) offsets to produce observed stratal repetitions within observed shallowly-dipping beds.

Some short sections of coherent core yield a sequence of deformation events. Earliest deformation is characterized by flat-lying deformation bands. Intermediate-aged deformation is manifested by shear surfaces with moderate dips and normal offsets. Last observed deformation event is expressed by high-angle deformation bands showing reverse offsets. This sequence applies to at least 90 m of core.

Site 860 contains two deformation domains:

1) zones with deformation bands with random orientations;

2) zones with deformation bands with flat-lying orientations and reverse offset. The deformation mechanism in domain 2 is simple shear, and comprises shear zones themselves. Domain 1 represents regions between shear zones, and reflects bulk deformation of rock bodies between shear zones that allows blocks to change shape during slip on non-planar faults. Cementation in deformation bands is different from that in the host rock, and varies with depth. This may reflect fluid flow along deformation bands.

The upper 200 m of Site 860 contains biogenic hydrocarbon gas, while below 200 mbsf the gas has a clear thermogenic component. There was no methane in the top core, and below this the methane level was relatively constant at ~10k ppm to T.D. First appearance of ethane occurred at 60 mbsf, and propane first appeared at 250 mbsf.

Inorganic geochemical trends do not display typical equilibrium profiles at Site 860. Sulfate quickly drops from typical seawater values to near 0 above 60 mbsf, but then maintains a level of ~5 - 10 mM to T.D. Chlorine decreases below 100 mbsf, and has local minima at 140 mbsf, 200 mbsf and 360 mbsf. Chlorine profile might reflect relict hydrate formation, which would increase chlorinity of water not incorporated into the hydrate. Other explanations include fresh water transport from land along subsurface aquifers, or fluid migration from downdip along thrust faults.

Bulk density measurements on discrete samples show a local minimum at 100 mbsf. Thrust faults identified by other criteria have no apparent signature in bulk density, perhaps suggesting that there has been no recent movement on faults. Grain density shows a local increase at 40-50 mbsf, the same interval that contains a peak in magnetic susceptibility, suggesting that high-density and strongly-magnetic minerals may be concentrated at this depth interval. Site 860 displays a compaction profile more typical of marine sediments than that at Site 859.

A combination of Adara piston core shoe and WSTP/Uyeda temperature measurements established a geothermal gradient of ~140°C/km in the upper 70 m of Hole 860B, but one apparently reliable measurement at ~130 mbsf suggests that the gradient is ~30°C/km at depth.

Logging attempts at Site 860 were hampered by poor hole conditions and mechanical problems with both drillstring and logging tools. As a result, the only logging data acquired at Site 860 are sonic velocity data from 70 mbsf to 185 mbsf, resistivity over the same depth interval, and LDGO temperature tool data from inside the drillpipe from the interval between 70 mbsf and 607 mbsf.

Sonic data show a relative high velocity interval at 120 mbsf. The bottom-hole temperature was 26°C, establishing an overall geothermal gradient of ~38°C/km for the drilled interval.

Site 861

[45°51.041'S, 75°41.420'W, Water Depth: 1663.5 m]

Site 861 was occupied from 0100 hrs, 17 December 1991 through 2030 hrs, 22 December 1991. Holes 861A and 861B were cored to a total depth of 9.5 mbsf with the APC coring system. Hole 861C was cored to a total depth of 353.1 mbsf with APC, PCS and XCB coring systems. Hole 861D was cored to a total depth of 496.3 mbsf with the RCB coring system.

Drilling at Site 861 penetrated and sampled forearc basin strata on the middle trench slope of the South American continental margin. These are underlain by deformed sediments that may represent the top of an eastward extension of the accretionary wedge already intersected at sites 859 and 860.

Three lithological units were identified at Site 861:

Unit I (0 - 43.8 mbsf): Quaternary silty clays and clayey silts, containing nannofossils. Depositional environment is one of hemipelagic sedimentation, interrupted by inflow of turbidites with hemipelagic tops of sequence.

Unit II (43.8 - 351.9 mbsf): Pleistocene to upper Pliocene, divided into two subunits:

Subunit IIA (43.8 - 208.9 mbsf): Pleistocene and upper Pliocene silty clays and clayey silts, containing intercalations of silt, sand and gravel layers. This subunit has a transitional boundary with Subunit IIB.

Subunit IIB (208.9 - 351.9 mbsf): upper Pliocene claystones and graded siltstones with intercalations of matrix-supported conglomerates. Boundary between subunits IIA and IIB is not determined by a marked change in rock composition, facies or depositional environment, but is coincident with downhole increase in degree of lithification. Deposition of sediments of Unit II was in an environment more proximal to source area than Unit I, as suggested by presence of coarser clastics and intraformational conglomerates in Unit II.

Unit III (351.9 - 496.3 mbsf): hard silty claystone to clayey siltstone. Unit III reflects fine-grained hemipelagic sedimentation with very distal turbidites.

Microfossil preservation at Site 861 is poor, but better than at sites 859 and 860. Pleistocene ages were determined for the upper 65 mbsf. One precise time mark was found in the interval of 50-60 mbsf, yielding an age of 1.02-1.07 Ma. However, only 10 m below this depth, at the bottom of Core 141-861C-8H (69.5 mbsf), the boundary between foraminifer zones N22 and N21 was identified, indicating an age of 1.9 Ma. Thus, the section between 60 mbsf and 69.5 mbsf either contains a biostratigraphic hiatus or reflects continuous sedimentation at extremely slow rates. Below 69.5 mbsf is a long and apparently continuous section of upper Pliocene age down to 425 mbsf. Below 425 mbsf, sediments are assigned to foraminifer zone N19/N20 and are of lower Pliocene age.

A reliable correlation of biostratigraphic and magnetostratigraphic data can be made for the Pleistocene section. The Brunhes/Matuyama reversal was detected at ~40 mbsf, and the Jaramillo event near the end of the Matuyama chron was also preserved. Below this level, reliable evaluation of the magnetostratigraphic dataset is not possible. A distinct positive anomaly in magnetic susceptibility was found at ~45 mbsf, which correlates with a high-density, perhaps magnetite-bearing sand layer.

Sediments recovered at Site 861 can be subdivided into three structural domains.

Domain I (0 - 210 mbsf): horizontal to gently inclined bedding, with development of an incipient fissility in clay-rich materials below 150 mbsf.

Domain II (210 - 390 mbsf): gently to moderately inclined sedimentary beds, and isolated deformation bands.

Domain III (390 - 496.3 mbsf): characteristics of "broken formation" with abundant deformation bands and stratal disruption, similar to structural associations found in lower sections of sites 859 and 860.

Porosities of sediments show an almost linear downhole decrease from an average 60% near the mudline to ~35% at TD. Anomalously low porosities are found associated with sands near 45 mbsf, and a small downhole offset towards lower porosities is observed at the boundary between Lithostratigraphic Units IIA and IIB (208.9 mbsf). Grain densities show a very constant downhole average of 2.75 g/cc. P-wave velocities between ~1.8 and 2.0 km/s are found on cores in the depth range of 250-350 mbsf, and between ~2.1 and 2.45 km/s at 460-490 mbsf.

Chemical analysis of interstitial waters and WSTP samples gives no indication of the presence of stable gas hydrates in the form of salinity and chlorinity minima. Generally, interstitial waters at Site 861 are more saline than sea water, with a maximum of 15% above sea water near TD. Ca contents are lower than sea water, perhaps indicating Ca scavenging in the entire section by formation of authigenic calcite. A marked discontinuity in Ca content is found at 200 mbsf. A maximum in Mg content at 60 mbsf probably relates to volcanic ash found in the section at this depth. Sulfate contents are zero or very low, with 10-15% of sea water concentration found below 200 mbsf. B and K profiles suggest that there is a sink for these elements below 200 mbsf.

Headspace and vacutainer analyses of gases trapped in the core liner provide evidence for a dominantly biogenic gas source down to 200 mbsf. Below this depth, methane/ethane ratio drops to values between 100 and 1000, indicating a contribution of thermogenic gas to the sediment. Composition of gases and condensates here is very similar to those in deeper parts of holes 859B and 860B. Total organic carbon contents are generally <0.5%, except for the upper 20 mbsf, where contents are between 0.5 and 1.0%. Solid organic matter is immature and has a terrigenous source. Coincidence of immature solid organic matter and thermogenic gaseous hydrocarbons again indicates that the latter have migrated.

Downhole temperatures determined with WSTP and ADARA tools to 250 mbsf show an almost linear downhole increase, defining a bulk temperature gradient of ~55°C/km at Site 861. Downhole logging could not be attempted at Site 861 due to an emergency pull-out. Very rough weather conditions at the time of pull-out made deployment of a free fall funnel impossible and, therefore, Hole 861D could not be reoccupied.

Site 862

[46°30.475'S, 75°49.603'W, Water Depth: 1260 m]

Site 862 was occupied from 1642 hrs, 24 December 1991, through 0000 hrs, 27 December 1991. Hole 862A was cored to a total depth of 22.1 mbsf with APC and XCB coring systems. Hole 862B was cored to a total depth of 42.9 mbsf with the XCB coring system. Hole 862C was cored to a total depth of 102.1 mbsf with the RCB coring system.

Site 862 is located near the crest of Taitao Ridge, a prominent bathymetric ridge that juts out from the South American continental margin ~25 km south of the present location of the CTJ. Because of close proximity of Taitao Ridge to Taitao ophiolite, exposed 20 km to the east on Taitao Peninsula, and inferences from marine geophysical data, Taitao Ridge was anticipated to be of oceanic origin, and perhaps to be in the process of accretion to the Chile Trench forearc. Drilling at Site 862 confirmed that Taitao Ridge is underlain by mafic igneous material of oceanic affinity, but the apparent youthful age of Taitao Ridge (<~1 Ma) and recovery of likely andesitic materials from the ridge, indicate that origin and tectonic evolution of Taitao Ridge is more complex than originally hypothesized.

Two rock units were identified in three holes drilled at Site 862.

Unit I represents thin sediment cover that blankets Taitao Ridge, and is divided into three subunits.

Subunit IA, ~1.5 m thick, is composed of silty clay that grades to clayey silt and silty-fine sand with clay.

Subunit IB represents an increase in lithification of Subunit IA materials, comprising claystone and silty claystone, and sandstone.

Subunit IC represents the same lithology as Subunit IB, but with addition of hydrothermal alteration deposits immediately above basement. Total sediment thickness at Site 862 is ~23 meters.

Unit II is composed of apparently intercalated submarine basalt and andesite flows with occasional sediment interbeds. Core 141-862B-2X recovered the depositional contact between Unit I sediment and igneous basement, and shows a clear 2 cm-thick hydrothermal reaction zone in basal sediment. Igneous clasts display vesicular glassy chilled margins that, in some instances, can be observed to grade to variolitic plagioclase textures. Recognition of intrasertal, subophitic and ophitic textures suggests that a range of depths within cooling units was recovered.

Olivine/pyroxene ratio observed in thin sections was used to distinguish basalt from andesite. Hornblende phenocrysts often display pristine borders where they abut plagioclase phenocrysts, but are altered where they border groundmass. This suggests that hornblende was a primary phase in the magma chamber that erupted this material, and implies an andesitic magma composition.

Drilling may have recovered a sequence of interlayered basalt and andesite flows, but the small size of many recovered clasts may have allowed an order of recovery in core liner that no longer reflects original stratigraphy. However, it is clear that basement of Taitao Ridge is composed of both basaltic and andesitic eruptive materials.

Biostratigraphic observations from Site 862 indicate a Neogene age for all recovered sediment, and paleo-water depth estimates from benthic foraminifers bracket the present depth of Taitao Ridge. All samples from sediments of Taitao Ridge show normal magnetizations, indicating that the entire sediment section is younger that the Matuyama/Brunhes boundary, considered to be 0.73 Ma. Observed magnetic inclinations, however, are 30-35° shallower than expected for this latitude.

Deformation of the sediment section at Site 862 is dominated by structures related to normal faulting. Both faults and bedding are often mineralized, providing dramatic planar markers for structural analysis. Based on core reorientations using viscous remanent magnetizations, faults strike roughly north-south, crudely parallel to the spreading ridge north of the CTJ. Local topography surrounding Site 862 is very steep, suggesting that gravity sliding may be an important element of the deformational driving force. Recognition of boudinage of sand layers, implying some degree of brittle behavior of sediments, suggests that deformation postdates lithification to a large extent. No igneous samples were recovered in original orientation, so no structural analyses could be performed on those lithologies.

Total organic carbon content of the sediment section at Site 862 was never observed to exceed 0.25%. CPI analysis indicates that all sediment samples are highly mature, as does presence of some gasoline hydrocarbons. The high level of thermal maturity in such young, thin sediments that have never been deeply buried indicates deposition on hot, volcanic basement with vigorous hydrothermal activity. This relationship supports the inference that Taitao Ridge cannot be much older than its sediment cover.

Seismic velocity of the sediment drilled is ~1600 m/s throughout the thin sequence, and both bulk density and grain density are constant downsection. Similarities in these properties suggest that sediment at Site 862 is of similar provenance to that at sites 859 and 861.

Pleistocene age of Taitao Ridge is significantly younger that the 3-4 Ma age of Taitao ophiolite on land. Hence, it is unlikely that Taitao Ridge represents an offshore extension of the ophiolite onshore. In addition, Taitao Ridge is probably at least 0.5 m.y. younger than the age of the oceanic crust at its off-axis distance from the spreading ridge, as predicted by marine magnetic anomalies further north. This implies that Taitao Ridge may be the result of off-ridge volcanism, perhaps related to "leaky transform" extension along Taitao Fracture Zone. Alternatively, since the roughly north-south orientation of extensional structures sampled at Site 862 are sub-parallel to extensional structures associated with Chile Rise, an on-axis volcanic origin for Taitao Ridge is possible. Either model for the origin of Taitao Ridge is consistent with the ridge presently being attached either to the Antarctic plate or the South American plate. Geochemical studies of the igneous rocks sampled at Site 862 may further constrain models for tectonic evolution of this enigmatic feature of the CTJ region.

Site 863

[46°14.210'S, 75°46.371'W, Water Depth: 2564 m]

Site 863 was occupied from 0245 hrs, 29 December 1991, through 1100 hrs, 09 January 1992. Hole 863A was cored to a total depth of 297.3 mbsf with APC and XCB coring systems. Hole 863B was cored to a total depth of 742.9 mbsf with XCB, MDCB and RCB coring systems. Logging was successful using seismic stratigraphy, geochemical, FMS and gamma porosity tool strings.

Site 863 is located at the base of the trench slope of the Chile Trench at the point where the Chile Ridge is being subducted. The purpose of drilling at Site 862 was to determine lithologies and depositional environments of sediment sequences at the base of the trench slope that have been modified by hydrothermal circulation and near-trench volcanism, and to identify structural fabrics and deformation caused by rift subduction. Extremely vigorous hydrothermal effects were anticipated at Site 863 because the rift axis has been subducted ~3 km beneath the base of the trench slope there. While evidence of fluid flow, cementation and mineralization were recognized in the sediment section drilled at Site 863, temperature gradient was not as steep as anticipated.

Two lithostratigraphic units were defined at Site 863:

Unit 1 is composed of silt- and clay-sized sediment, both lithified and unlithified, to a depth of 104.4 mbsf. Unit 1 is further divided into three subunits:

Subunit 1A (0 - 3.9 mbsf) is composed of Quaternary, unlithified, undeformed silty clay to clayey silt with a minor sand component interpreted to have been deposited as slope cover on the more intensely deformed sediments of the accretionary wedge.

Subunit 1B (3.9 - 46.6 mbsf) is upper Pliocene sulfide/organic-rich silty clay to clayey silt, with minor sand. Subunit 1B is strongly deformed, with steep to vertical bedding, deformation bands and broken formation.

Subunit 1C (46.6 - 104.4 mbsf) is upper Pliocene silty claystone to clayey siltstone, with minor sandstone.

Unit II (104.4 - 742.9 mbsf) is composed of upper Pliocene sandstone and bioturbated siltstone, with sandy silty claystone. Bedding in Unit 2 is steep to vertical, with intervals of broken formation that mark fault zones.

Diatoms and radiolarians are poorly preserved at Site 863, except in APC cores. Only the most robust foraminifer forms are preserved, but they have often been completely replaced by silica during diagenesis. Pyritized shelf benthic species were recovered. The entire drilled section at Site 863 is upper Pliocene in age.

Multishot reorientation of Cores 141-863A-4H, -5H and -6H allows for orientation of structures in the geographic coordinate system: both bedding and faults strike NW-SE in these cores, at a large angle to both local topographic slopes and to plate convergence direction.

Magnetic inclinations are uniformly very steep throughout Site 863, including the interval that also has steeply-inclined bedding. This relationship clearly demonstrates at least one component of post- depositional magnetic overprinting.

Inorganic geochemical observations suggest that four zones are present at Site 863: from the seafloor to 60 mbsf is a zone of sulfate diagenesis that is typical of microbial hemipelagic diagenesis. A methanogenic layer exists between ~60 mbsf and 147 mbsf, where Ca content drops to 20% of seawater. In the zone between 147 mbsf and 400 mbsf, like the uppermost layer, sulfate diagenesis is the dominant process, but apparently there is no active pyrite production. Another zone of methanogenesis is present between 400 mbsf and 490 mbsf.

Below 490 mbsf, fluids comprise a strongly-alkaline brine: chlorine contents are up to 15% above seawater, pH goes up to 10.5 in the lower 150 m of the hole, and calcium reaches concentrations up to 150 mM, suggesting nearby reactions with basalt.

Organic geochemical data define zones dominated by either biogenic gas or thermogenic gas likely to have migrated into the region of Site 863. The depth interval between 0 mbsf and 60 mbsf contains little methane or other hydrocarbon gases. Some biogenic gas is present between 60 mbsf and 125 mbsf, with C1/C2 ratios of ~800. Starting at ~50 mbsf, there is an increase in ethane, and C1/C2 ratio drops to ~5. Propane and higher hydrocarbons up to and beyond C_7 appear in the interval between 460 mbsf and TD. Organic matter content of the drilled section between 0 mbsf and 350 mbsf comprises both terrestrial and marine components. Bitumen is generally immature.

Carbonate cementation is the dominant control over gradients in physical properties at Site 863. Porosity decreases from ~60% to 35% between the seafloor and 150 mbsf, reflecting cementation with carbonate (micritic) cement. Compressional wave velocities are 1600 m/s at the seafloor, linearly increasing from 1750 m/s to 3200 m/s between 250 mbsf and TD. Some calcareous units have velocities up to 4500 m/s.

Overall temperature gradient of the top 250 meters of Site 863 is 80°C/km to 100°C/km. The range of gradients is based on estimated curve-fitting errors associated with individual data points.

Despite a stuck pipe during logging, four successful logging runs were completed.

Legs 143/144 Prospectus: Atolls and Guyots A/B

Abstract

Legs 143 and 144 constitute an integrated campaign of drilling Cretaceous reef-bearing guyots of the Western Pacific, with the objective of using them as monitors of relative sea-level changes and thereby of combined effects of tectonic subsidence (and uplift) history of seamounts and of global fluctuations of sea level. By comparing records from widely separated guyots, tectonic effects may be separable from eustatic effects. Cores from the volcanic edifice under the reefs will provide data for estimating paleolatitude of formation of guyots and for assessing long-term history of the Dupal isotopic anomaly in the Pacific. Ten drill sites are planned on seven guyots across about 30° of latitude, one site will be drilled on a sediment apron built during three stages of reef development on the adjacent guyot and atoll, and one site will be an engineering test in the lagoon of a living atoll. Planned ship track is given in Figure 1.

Introduction

The Western Pacific is strewn with chains and clusters of Cretaceous seamounts, many of which are now flat-topped guyots with summit depths of ~1500 m. A large proportion of these are capped by shallow-water reefal sediments overlying volcanic substrate. These reefs can serve as "dip sticks" to monitor relative changes in sea level during times of reef development, when upward reef growth paced tectonic subsidence of their foundations. Reefal sediments record in their mineralogy textures, and fossils the timing and sense of rises and falls of relative sea level. Volcanic foundations of reefs contain in their mineralogy and chemistry clues to the nature of parent mantle material, processes of melt extraction and differentiation, and time of emplacement of lavas. Guyots thus should yield constraints on a broad range of fundamental questions of Pacific tectonics, global sea-level history and the enigma of carbonate platform drowning. Guyot drilling on legs 143 and 144 is an attempt to realize this potential harvest of new data.

Background/Drilling Objectives

Volcanic Edifices

Beginning in the late Barremian (~120 Ma), a large region of the Pacific, measuring perhaps 3000 km in diameter, was repeatedly, perhaps almost continuously, the scene of large-scale, mid-plate volcanism. Although the source of this volcanism is not certain, it may be represented today by the cluster of Neogene volcanic chains and modern active volcanoes in the Southeast Pacific. It is part of the great southern hemisphere belt of volcanism having an isotopic signature termed the "Dupal Anomaly". During the Early Cretaceous, the Ontong Java Plateau may have been an important part—even perhaps the dominant feature—of this South Pacific region of volcanism.

Horizontal and Vertical Tectonic Motions

As new volcanoes formed successively in this region of the central South Pacific, motions of the Pacific plate carried them along zigzag horizontal trajectories progressively farther northwest by as much as 30° of latitude to their present locations. Some volcanoes formed over persistent hot spots that generated linear seamount chains, but the origins of most are still uncertain. Changes in plate motion have produced intersecting and overprinting of chains in some places, resulting in complicated geologic histories for some seamounts. The Cretaceous part of this plate-motion history is poorly constrained by existing data.

The more northerly guyots preserve a history of subsidence, followed by emergence above sea level, then resubmergence. Guyots of the Japanese Group (e.g., Seiko Guyot), at 30°-35°N, have summits with drowned barrier reefs and terraced carbonate banks. They have no more than ~200 m of reefal sediments, and radiometric and paleontological dates place them as of probable Albian age. Farther south, in the band about 18°-28°N, reef-bearing guyots are drowned mature atolls

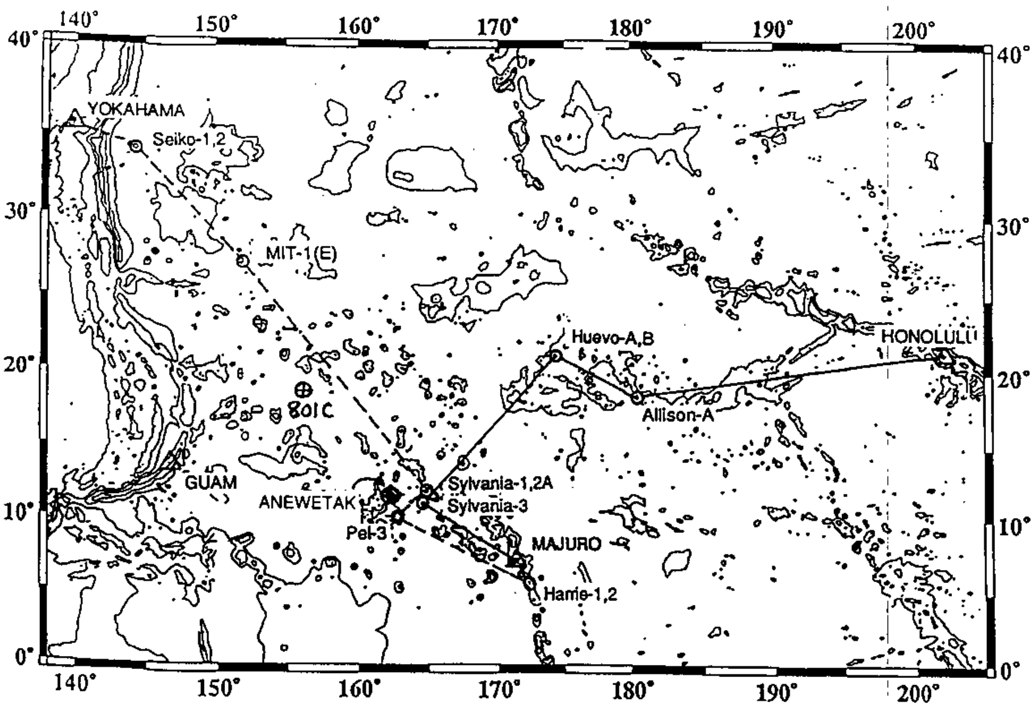


Figure 1. Ship track recommended for legs 143 (solid line) and 144 (dashed line) by JOIDES Atolls & Guyots Detailed Planning Group.

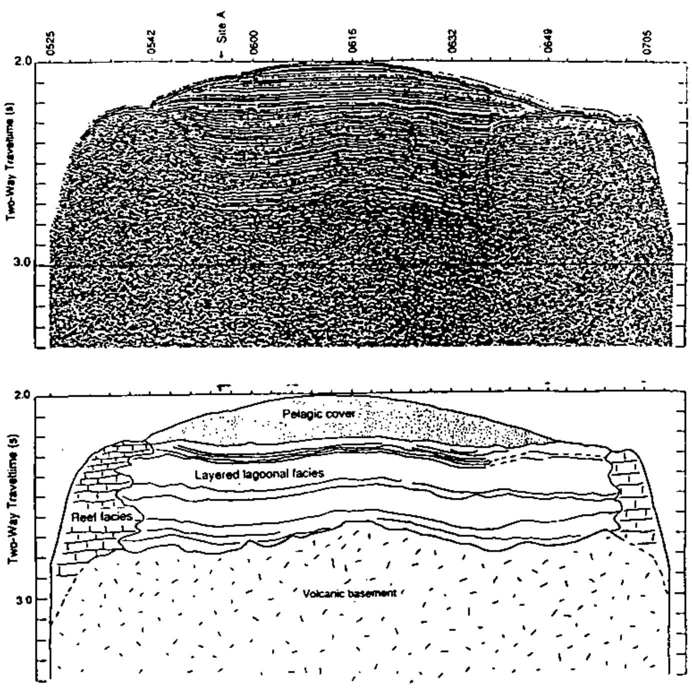


Figure 2. Single-channel seismic reflection profile and geological interpretation of Allison Guyot. Data collected by *R/V Thomas Washington* during Leg 10 of the SIO Roundabout Expedition in December 1988.

with perimeter reefs and lagoonal sediments as much as 700 m thick (e.g., Allison, "Huevo," and "MIT" guyots; Figures 2 and 3). Available dates suggest that these have foundations of late Barremian-Aptian age and reefal sediments that may extend into the Albian. Both of these northern bands of guyots were emergent (to as much as 200 m above sea level) and developed a karstic topography prior to their final drowning in the mid-Cretaceous. South of ~20°N, late Albian (?) and younger pelagic sediments overlie reefal strata; farther north, where these pelagic sediments are absent, reefal strata are encrusted by phosporite and manganese oxides.

To the south, in the Marshall Islands region, reef-bearing guyots show an even more complex history of vertical motions, with as many as three epochs of reef growth. There are numerous modern atolls in the region, and drilling on two of these (Pikinni [formerly called Bikini] and Anewetak [formerly Enewetak and Eniwetok]) shows they have been growing since Eocene times. Dredges from several guyots in the Marshalls, and drilling results from nearby basinal sites, show the presence of rudist reefs of Late Cretaceous (Campanian and Maastrichtian) age. Moreover, on Wodejebato (formerly Sylvania) Guyot, reefal fossils from a still older reef of Early Cretaceous age have been dredged.

Platform Drowning

Northwest Pacific Cretaceous guyots present the "paradox of platform drowning" in classic form: why do carbonate platforms drown, when the growth potential of healthy platforms is one or two orders of magnitude higher than documented long-term (10^6 yr) tectonic-subsidence or sea-level-rise rates? Why does one platform reef drown when another on an adjacent edifice survives? Why was platform drowning so widespread in the mid-Cretaceous.

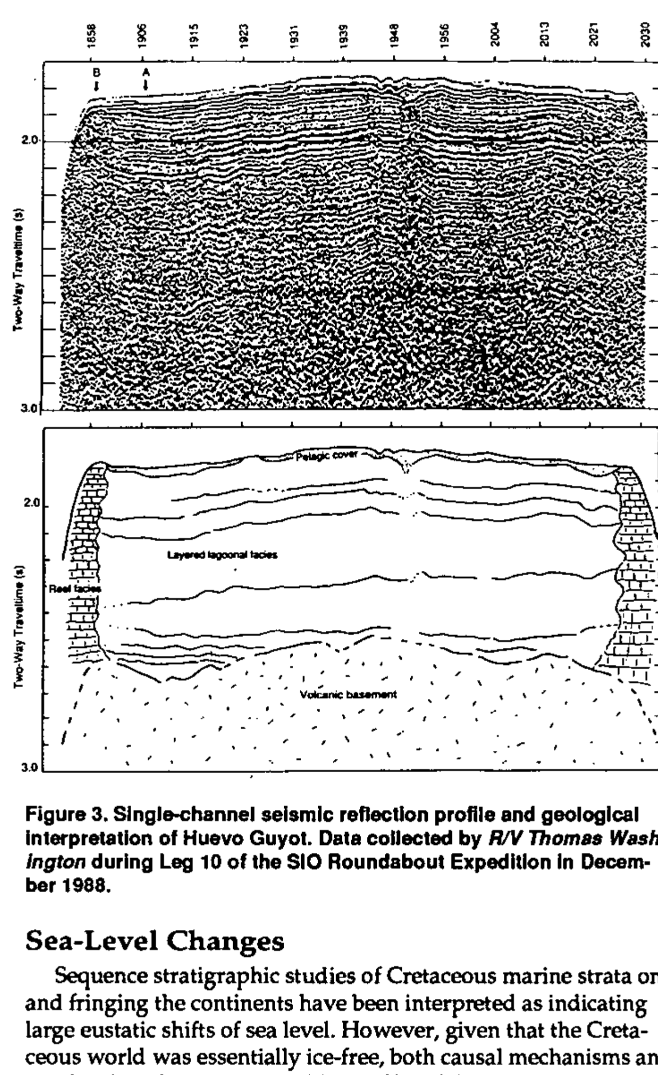


Figure 3. Single-channel seismic reflection profile and geological interpretation of Huevo Guyot. Data collected by *R/V Thomas Washington* during Leg 10 of the SIO Roundabout Expedition in December 1988.

Sea-Level Changes

Sequence stratigraphic studies of Cretaceous marine strata on and fringing the continents have been interpreted as indicating large eustatic shifts of sea level. However, given that the Cretaceous world was essentially ice-free, both causal mechanisms and amplitudes of eustasy are subjects of hot debate; some even question eustasy itself. Reefal sediments of guyots are essentially antipodal in geography to continent-tied sequences, and in a wholly different tectonic setting. It is, therefore, of great interest to obtain sea-level records from a number of coeval Cretaceous guyots, to test and quantify the eustatic hypothesis. Seismic reflection records of lagoonal facies on guyots (some with sediments ~600-800 m thick) show many continuous reflectors, reminiscent of reflectors in Cenozoic atoll lagoons which drilling has shown to correlate with sea-level falls.

Biotic Provinces and Migration Routes

Western Pacific Cretaceous guyots were very far from the main rudist reef regions of Tethys seaways, circum-Mediterranean and Caribbean provinces. Affinities of shallow-water assemblages of the oceanic Pacific are imperfectly known and drilling should provide clues to their degree of provinciality and migration routes.

Post-Reef History

Biogenic sediments of pelagic caps, deposited well above the carbonate compensation depth (CCD), should provide not only a good estimate of the age of drowning of the platform, but also a reliable oceanic stable-isotope record, especially for the Upper

Cretaceous and Paleogene, which are now represented in the Pacific by dissolved samples, mainly from deeper water. Occurrence of high-fertility indicators in planktonic biotas from pelagic caps can be used to track post-reef horizontal trajectories of guyots.

Summary

By coring selected guyots and flanking basinal sites, we can address in a relatively straightforward way fundamental problems of:

- Ages of volcanic edifices, as clues to directions and rates of age progression.
- Longevity of the mantle source for Dupal lavas.
- Seamount latitude changes, as recorded in paleomagnetism of lagoon sediments, as well as in the underlying volcanics.
- Timing and causes of platform drowning.
- Timing and amplitude of relative changes in sea level and their relation to regional tectonics and to sea-level changes recorded in other parts of the globe.
- Bioprovinciality of Cretaceous reefal organisms and post-reefal paleoceanographic reconstruction.

Drilling Strategy and Logistics

A set of targets, divided amongst major seamount groups and spanning ~30° of latitude, and selected after weighing all available reflection seismic, bathymetric, side-scan, magnetic, gravity, dredge and drill data, has been chosen for drilling to address the aforementioned problems. These scientific targets comprise 11 primary sites on 7 different guyots and 1 basinal fan.

- One guyot (site Seiko-1) in the Japanese Group.
- Three guyots (sites Allison-A, "Huevo"-A and -B, and "MIT"-1E) in the 18°-28°N band.
- Three guyots (sites Sylvania-1 and -2A, Harrie-1 and -2, and PEL-3) and one basinal apron site (Sylvania-3) in the Marshall Group.

In addition, an engineering test of *JOIDES Resolution's* shallow-water drilling capabilities is planned (Anewetak lagoon).

Leg 143 (Atolls & Guyots A)

For logistical reasons, the work is divided between legs 143 and 144. Leg 143 is scheduled to embark from Honolulu, Hawaii, on 24 March 1992. Its main target is "Huevo" Guyot, in the western part of the Mid-Pacific Mountains, where seismic data show ~950 m of Lower Cretaceous reefal cap with a karstic summit. There will be a multiple-reentry site in the lagoon, about 1 km inward from the perimeter reef (HUE-A; called Huevo-A in the original proposal), and another single-bit site to a depth of ~300 mbsf (to reach levels beneath the karsted summit zone) on the perimeter reef (HUE-B). Substantial penetration into igneous basement is planned at HUE-A to obtain paleomagnetic and petrologic data. On the way to "Huevo", *JOIDES Resolution* will drill a single-bit site through the pelagic cap and ~300 m of lagoonal sediments (more if drilling rates permit) near the edge of the lagoon on Allison Guyot, in the central Mid-Pacs (ALL-A). A major objective there is to compare seismic stratigraphy of lagoonal sediments with that at "Huevo." After "Huevo", the drillship will go to a basinal fan site (SYL-3) southwest of Wodejebato [Sylvania] Guyot in the central Marshall Islands, downslope from Pikinni Atoll. About 800 m of sediment is visible on the seismic profile, and the site should yield not only a (redeposited) record of Early Cretaceous and Campanian-Maastrichtian reefing on Wodejebato, but a record of Eocene-Holocene reefing on Pikinni. After completing operations at SYL-3, the drillship will enter the lagoon at Anewetak Atoll for an engineering test, to learn whether *JOIDES Resolution* can be kept positioned for drilling in very shallow water (~30 m) at proposed site ANE-1 (Figures 4

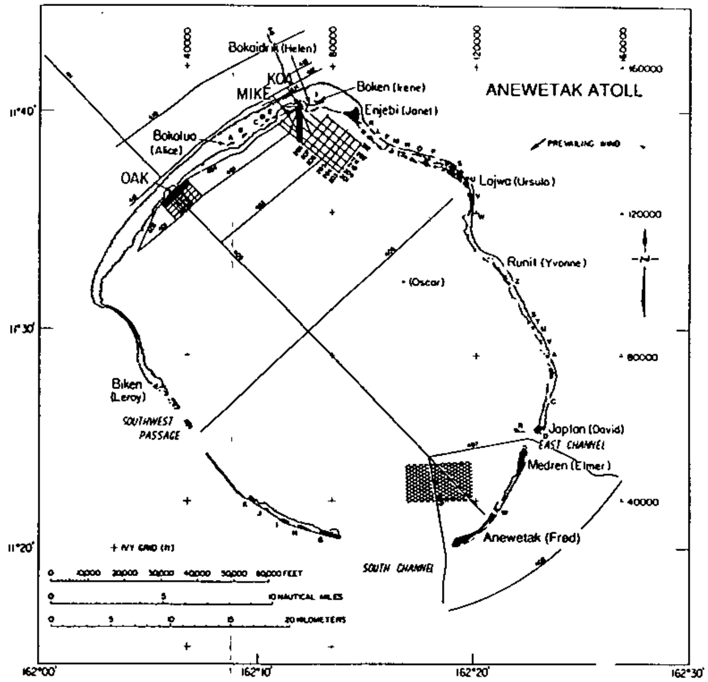


Figure 4. Sites of USGS refraction profile and multi-channel seismic-reflection profiles in Anewetak Atoll, 1984. Proposed Site ANE-1 is to be drilled within the shaded area.

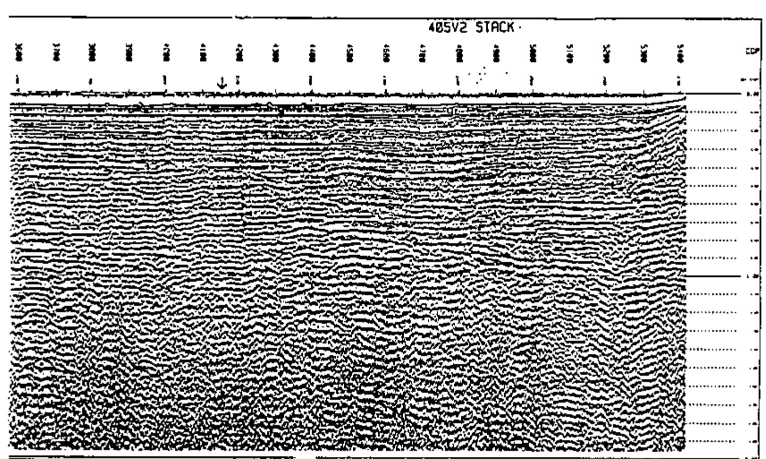


Figure 5. Line 405 seismic profile of Anewetak Atoll obtained by USGS in 1984. Proposed Site ANE-1 is to be drilled near the area indicated by the arrow.

and 5). We anticipate that cores will be taken in the upper part of lagoonal sediments. The drillship will arrive in port at Majuro, Marshall Islands, ending Leg 143, on 20 May 1992. No alternate sites have been formally identified for Leg 143. The two reasons for this are (1) the JOIDES Pollution Prevention and Safety Panel has given permission to move the proposed sites to other locations on the same edifice, and (2) several Leg 144 sites are within a short distance from Leg 143 sites (e.g., SYL-1, SYL-2A, SYL-4, and PEL-3) and could be drilled on Leg 143, if time permits.

Leg 144 (Atolls & Guyots B)

JOIDES Resolution is scheduled to leave Majuro on 25 May 1992 and head south to Limalok (formerly Harrie) Guyot to drill a potential back reef site (HAR-1) and a more centrally-located lagoonal site (HAR-2). Eocene reefal rocks have been dredged at Limalok, but there may be older reefs beneath. From Limalok, the drillship will transit to Lo-En (formerly Hess) Guyot, in the western Marshalls southeast of Anewetak Atoll, to core a 180 m-thick pile of pelagic sediments that caps underlying (Paleogene?) reefal rocks at PEL-3. About 270 m of penetration through the carbonate platform and 50 m into basement is also planned. Lo-En Guyot has a distinctly different seismic profile from other Leg 143 and Leg 144 guyots; a carbonate platform or bank is present but there is no apparent perimeter reef. Lo-En Guyot is on the same volcanic pedestal as its living sibling Anewetak. U.S. Geological Survey deep borehole data from Anewetak document existence of an Eocene bank on top of volcanic basement. A major objective is to compare stratigraphy and facies of Lo-En Guyot with Anewetak. Another major objective is study of the pelagic cap in order to relate acoustic stratigraphy of the cap to its depositional and diagenetic history and correlate reflectors with those seen in other settings. Two single-bit sites will be drilled at Wodejebato Guyot: SYL-1, near the edge of the lagoon, and SYL-2A, a more centrally-located lagoonal site. Before leaving this guyot, a possible additional site, SYL-4, may be drilled into the reef crest in order to investigate the extent and effects of sea level changes on the reef. Following operations at Wodejebato, a multiple-reentry site (MIT-1) will be drilled near the edge of the lagoon at "MIT" Guyot (at ~28°N, 152°W). Seismic profiles show ~500-650 m of lagoonal sediment, and multibeam mapping reveals a spectacular karst topography. Substantial penetration (200 m) into igneous basement is planned at MIT-1. Finally, a single-bit site will be drilled at Seiko Guyot (SEI-1), where seismic profiles and SeaBeam data show a karsted summit, a reef wall 100-200 m high encircling a nearly empty lagoon, and a volcanic hill in the center of the guyot. If time remains, SEI-2 will be drilled into the perimeter reef using a mini hard rock guidebase in order to examine effects of sea-level changes on the reef. During the transit from Wodejebato to MIT Guyot, Hole 801C, drilled into Middle Jurassic oceanic basalt during Leg 129, may be reentered to log the lower 150 m, comprising the lowest sedimentary layers and underlying basement rocks. *JOIDES Resolution* will enter port at Yokohama, Japan, at the end of Leg 144, on 20 July 1992. The Pollution Prevention and Safety Panel has given permission to shift proposed sites to other locations on the same edifice if necessary.

Wireline Services Report

Leg 136: OSN-1

Primary objective of Leg 136 was to drill a basement hole capable of supporting a seismometer emplaced for the Ocean Seismic Network (OSN). At Site 843, a 70 m crustal hole was drilled into basalt through 244 m of sediment for this purpose. Nature and variability of basement rock, anisotropy of its physical properties, and general characterization of the shape and size of the hole are important questions for evaluation of this hole's potential as an OSN site. After successfully acquiring an extensive suite of downhole experiments, nine passes of four different logging tool strings in all, the shipboard scientific party of Leg 136 is using the downhole data to critically evaluate the site.

Seismic stratigraphic, geochemical, formation microscanner (FMS), borehole televiewer (BHTV), and temperature combination tools were used at Site 843. Refer to the ODP Wireline Logging Manual for detailed descriptions of the tool strings. In basement, in-gauge borehole wall exists over limited intervals as identified by the mechanical caliper log, and hole washout occurs in three intervals to diameters as large as 18.5 in (Figure 1). These significant enlargements of the hole were apparent below the casing at locations where the drill bit was positioned for an extended time. Calibrated BHTV data show these washouts to be as much as 50% deeper, with typical variation ranging from 10 to 15 in throughout the drilled section. No high-angle features or breakouts were observed in BHTV data.

In Figure 1, log data over the basement interval show variations in physical properties as a function of depth. Log data (not shown) in the pilot sedimentary hole show variations in physical properties due to interbedded chert and clay-rich sediments. Resistivities decrease by an order of magnitude over the deepest 40 m of the hole and gamma-ray values correspondingly increase. Without considering variability on a fine-scale, these trends indicate an overall increase in conductive mineral abundance due to alteration and fracturing in the crust as a function of depth.

Unfortunately, the gamma-ray sensor is too shallow to measure the deepest 20 m of the hole. The density log shows slight variation between 2.7 and 2.85 g/cm^3 in the in-gauge open-hole intervals and large variations at cement and casing boundaries. A sharp decrease in density at about 244 mbsf is due to the contrast between basalt and sediment within the casing. The velocity log was reprocessed and measures between 4.8 and 5.2 km/s in basalt, but no sonic waveforms were successfully recorded. A deviation log shows that the hole was drilled within about 0.75° of vertical, enabling the FMS to image accurately fracture orientation and interconnected basalt flows and pillows.

In summary, geophysical logs indicate considerable variability in physical properties of the basement section at Site 843 and careful log evaluation by the Leg 136 shipboard party is continuing as plans for OSN instrumentation of the site are developed.

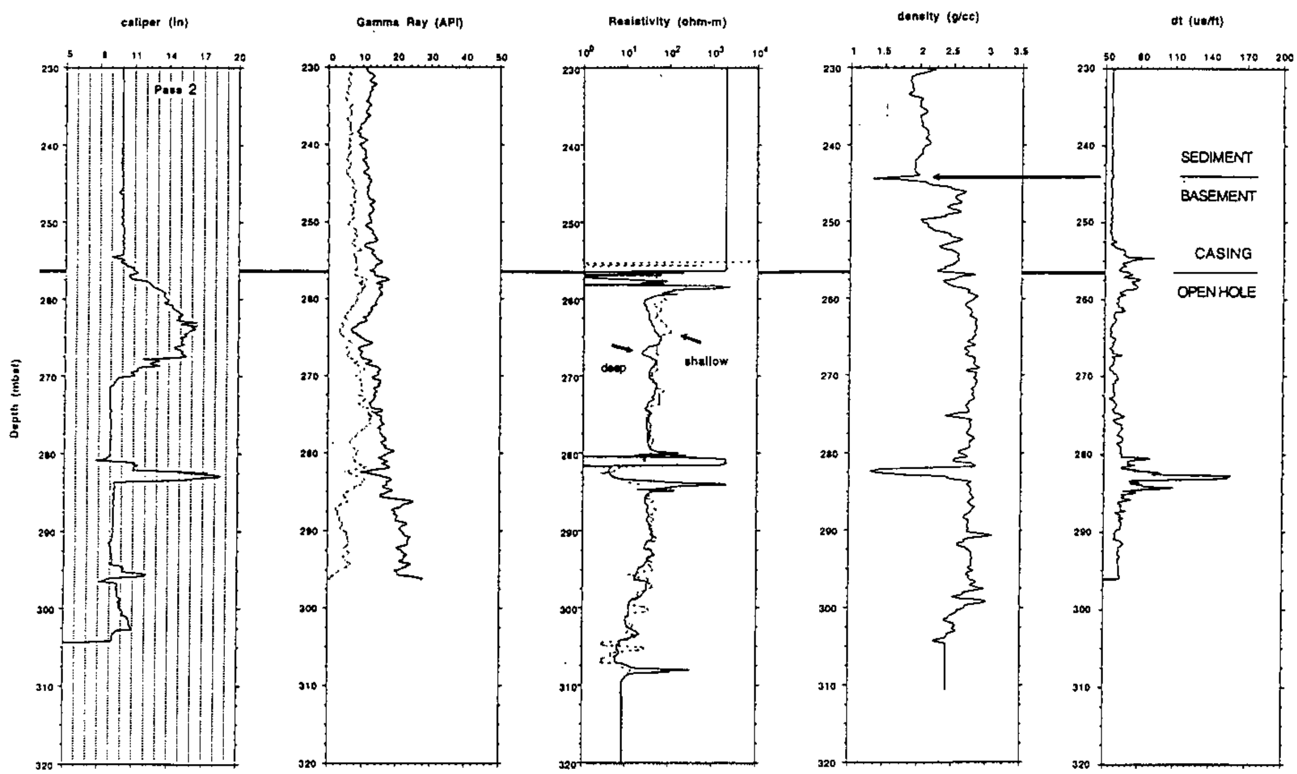


Figure 1. Geophysical logs in the basement section of Hole 843B: track 1, caliper; track 2, gamma ray; track 3, resistivity; track 4, density; track 5, slowness (V_p^{-1}).

The Arctic Ocean Record: Key to Global Change

Science Committee of the Nansen Arctic Drilling Program

The Initial Science Plan of the Nansen Arctic Drilling Program (NAD) has been submitted for publication to the journal *Polarforschung* of the German Society of Polar Research. (To obtain copies of the complete plan, contact members of the Science Committee of NAD.) ODP maintains formal liaison with NAD. It is, therefore, appropriate that a brief synopsis of NAD's future plans be included here, to foster optimal communications between different parts of the global scientific ocean drilling community.

Introduction

Rationale

Profound influence of the Arctic Ocean on global environment, rapid fluctuations of Arctic ice cover and its consequences for *global change*, and unresolved tectonic problems of the Northern Hemisphere have resulted in growing pressure toward attempting to drill the deep-sea floors of the ice-covered Arctic Ocean. Sediments beneath the Arctic Ocean are a recorder of long- and short-term Northern Hemisphere cooling and its linkages to bottom water renewal and faunal adaptation. Underlying basement rocks will reflect the origin and tectonics of the basin and its ridges and plateaus, which are unsampled and of unknown composition.

One of the major unsolved questions in earth sciences is the paleoceanographic and paleoclimatic evolution of Arctic deep-sea basins. Today, dense, cold Arctic surface waters sink and flow southward, filling deep-sea basins of the Atlantic and Pacific oceans with consequent major climatic implications. Identifying greenhouse warming within historical records requires quantifying magnitudes, frequencies and rates of natural climatic change. Of hundreds of samples collected in the Arctic Ocean, only seven contain sediments that predate the onset of cold climatic conditions. There are no Arctic deep-sea data covering the time span 5-40 Ma when climate cooled, and thus there is no information available to decipher forcing functions or time of onset of Cenozoic glacial conditions in the Arctic.

Origin of the Arctic Basin is linked to evolution of adjacent ocean basins and continents. Understanding past and present plate movements in the Arctic is necessary before a complete model of plate motions and paleogeography in the Northern Hemisphere can be constructed. Cenozoic tectonic history of the Eurasian Basin is relatively well known, since the Eurasian and North American plates have been studied extensively to the south. The basin also contains a well-documented and decipherable magnetic lineation history. Little is known about much of the rest of the Arctic Ocean, with evolution of the Amerasia Basin a major unresolved problem.

Therefore, the highest scientific priorities of NAD are to understand:

- climatic and paleoceanographic evolution of the Arctic region and its effects on global climate, biosphere and dynamics of the world's ocean and atmosphere; and
- nature and evolution of major structural features of the Arctic Ocean and circum-Arctic continental margins.

NAD proposes in its science plan to the international scientific community to join forces to start in preparing for *expeditions* to the Arctic, with the ultimate aim of exploring natural properties and history of some of the *least known, most hostile ocean basins of our planet through deep-sea drilling techniques.*

Why Nansen Arctic Drilling?

New and major scientific enterprises should carry an easily identifiable symbol. Why should this drilling program not be devoted to the memory of F. Nansen, the great Norwegian Polar Explorer, who prepared, organized and executed the well-known *Fram* expedition to the Arctic Ocean during 1893-1896? He was truly *interdisciplinary*, for as a biologist he also brought with him the first sediment samples from Arctic deep-sea floors, and made important scientific contributions to meteorology, geography, geology, oceanography and biology. He was *daring and courageous*, and truly *international*. The centennial of the first *Fram* expedition will come during 1993-1996, which will allow time for preparations, but barely enough to generate a scientific effort of the complexity and magnitude of deep-sea drilling in the permanently ice-covered Arctic (Figure 1).

NAD Organization and Membership

Objectives of NAD were derived from several workshops, national and international funding agencies, institutions of all Arctic rim nations and a number of other interested countries.

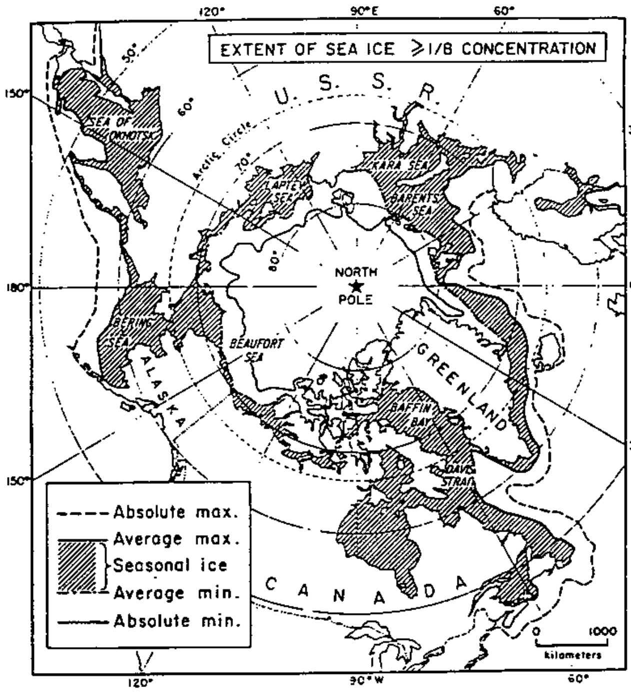


Figure 1. Average and extreme seasonal limits of Arctic sea ice extent for ice concentrations $\geq 1/8$.

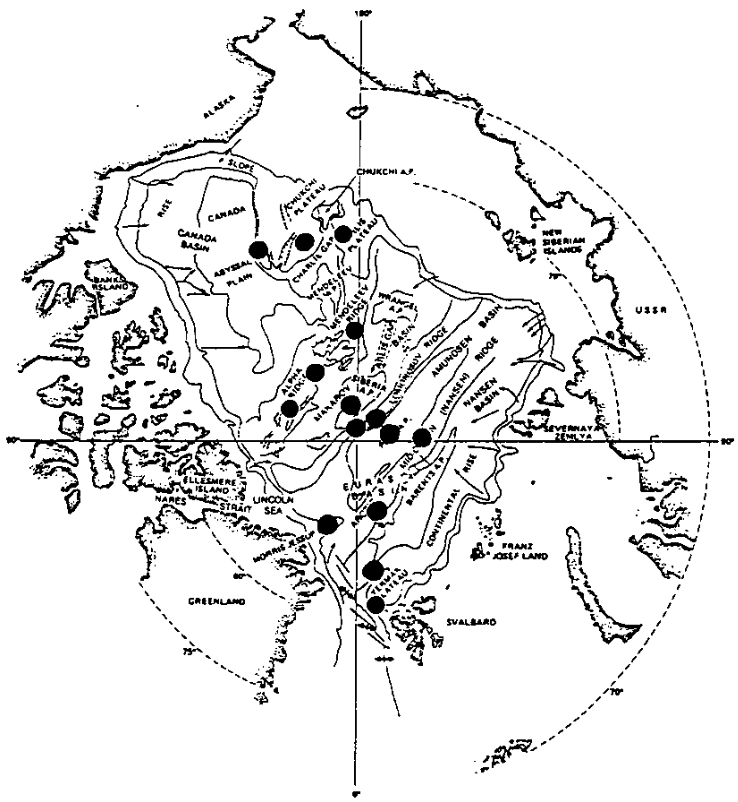


Figure 2. Locations of proposed drill sites for NAD Program.

Scientific background for NAD has been prepared by the SCOR (Scientific Committee in Ocean Research) Working Group 82 "Polar Deep-Sea Paleoenvironments" and several workshops and meetings of the IUGS (International Union of Geological Sciences), CMG (Commission for Marine Geology), as well as the ICL (International Commission on the Lithosphere) Subcommittee on the Arctic. Arctic deep-sea drilling has been emphasized during the COSOD (JOIDES-sponsored Conference on Scientific Ocean Drilling) conferences; it achieved a high priority in the working group on "Changes in the Global Environment" of COSOD II (1987).

NAD was founded on the occasion of the International Geological Congress in Washington, 1989. It presently consists of an *Executive Committee* with *Science* and *Technology committees*. Membership is from interested countries. NAD maintains a formal liaison office (funded by participating countries) with JOI, Inc. (Washington, DC).

Further comments and active participation from the scientific community are solicited. NAD has established formal linkages with ODP and the IGBP paleoclimate core program PAGES.

The NAD Initial Science Plan

The principal purpose of this document is to provide interested readers with an overview of scientific perspectives and priorities of drilling in the ice-covered Arctic Ocean. Many technical aspects of site surveying and deep-sea drilling in ice-covered waters will be dealt with in a report of the NAD *Technology Committee* . Objectives were defined at the first NAD meeting in Washington, DC during the International Congress in 1989. Further discussions were held at a NAD meeting in October 1990 in Stockholm, Sweden after the preparation of the cruise plans for *Arctic 91*. Discussions in Stockholm also led to formation of a *Site Survey Subcommittee* under the leadership of Yngve Kristoffersen (University of Bergen) . Options to establish an *Arctic Data Bank* are presently being evaluated by Garret Brass (RSMAS, Miami).

This science plan addresses deep-sea drilling in the central Arctic. The program is interdisciplinary and international in scope and participation, as only by a cooperative effort can Arctic deep-sea drilling be achieved. Arctic continental margin drilling is now under active planning and a separate science plan will be constructed. The North Atlantic-Arctic Gateways Detailed Planning Group (NAAG-DPG) of ODP has developed a drilling prospectus for the Norwegian-Greenland Sea and, if ice conditions permit, the Yermak Plateau in the Arctic Ocean (see *JOIDES Journal*, June 1991).

The Scientific Objectives of NAD

The reader is directed to Table 1 and Figure 2, which list in priority order sites which have been proposed as initial targets. This list will certainly be revised once additional site survey data become available.

Sites have been selected to address the following scientific themes: 1) Cenozoic paleoceanography; 2) Mesozoic paleoceanography; 3) Evolution of polar marine biota; and 4) Age and nature of major Arctic structural units.

Cenozoic Paleoceanography

Arctic Ocean Cenozoic paleoceanography can be subdivided into three widely different phases of which only the last one can

Table 1. Listing of proposed NAD Arctic drill sites.

Proposed Site No.	General Area	Position		Priority (1-3)*
ARC 1	Yermak Plateau	80°53'N	7°19'E	1
ARC 2	Yermak Plateau	82°42'N	9°33'E	1
ARC 3	Lomonosov Ridge	89°3'N	172°W	2
ARC 4	Lomonosov Ridge	89°6'N	168°W	2
ARC 5	Mendeleev Ridge	79°50'N	174°20'W	1
ARC 6	Chukchi Plateau	76°20'N	166°30'W	1
ARC 7	Northwind Ridge	75°45'N	156°20'W	1
ARC 8	Alpha Ridge	85°50'N	109°W	2
ARC 9	Alpha Ridge	85°53'N	108°W	2
ARC 10	Alpha Ridge	85°55'N	130°30'W	2
ARC 11	Makarov Basin	88°25'N	169°20'W	3
ARC 12	Amundsen Basin	85°-87°N	90°-100°E	3
ARC 13	Gakkel Ridge	85°-86°N	15°-20°E	3
ARC 14	Arlis Plateau	78°-80°N	176°-178°W	1
ARC 15	Barents Abys. Plain	83°5'N	11°50'E	3
ARC 16	Morris Jessup Rise	85°29'N	25°11'W	3

* 1 has highest priority

be documented to some degree in the Arctic Ocean proper:

- Paleogene and early Neogene "preglacial" time spans;
- onset of a "glacial" type oceanography in the Arctic and sub-Arctic deep-sea basins; and
- development of fully glacial/interglacial conditions in the Arctic Ocean.

Detailed correlation of lithostratigraphy to the Late Cenozoic chronostratigraphic framework is very weak when sediments beyond the range of radiocarbon dating are analyzed. Any interpretation of Cenozoic paleoceanographic history of the Arctic Ocean is therefore tentative at best. Stratigraphic problems encountered make recovery of undisturbed, large volume sediment cores mandatory.

Selection of sites to address these questions will be difficult. Arctic Ocean sedimentation rates are relatively low, thus limiting availability of temporal resolution. On the other hand, low sedimentation rates permit looking at long time series with relatively short cores. Depending on capability of the sampling system used, it may be necessary to mix sites with high and low sedimentation rates. Ideally, with the ability to recover relatively long cores, one should restrict sampling to areas of high sedimentation rates and thus maximize temporal resolution. One should also try areas where sedimentation has been as continuous as possible and where the sediment has a large biogenous component (so that there is enough material for isotopic and SST studies). The strong paleomagnetic signal in Arctic Ocean sediments will be extremely helpful in providing detailed and consistent stratigraphies that are essential to spectral analysis. To be relatively removed from influence of turbidites and to help isolate eolian components, some sites will be sought in deep basins on local highs (Figure 2 and Table 1).

Mesozoic Paleoceanography

There are only 7 Mesozoic and Lower Cenozoic rock/sediment cores from the Arctic deep-sea floor available (Figure 3). There are no interpreted high quality seismic reflection lines available. Age and nature of magnetic anomalies which have been used to reconstruct paleogeography of Arctic Mesozoic basins are questionable. For the entire Mesozoic, the Arctic Ocean remained restricted from deep-water exchange with the world ocean. Based mostly on circumstantial evidence, two properties important for depositional environment are evident from most reconstructions of the Mesozoic Arctic, namely a) that the Arctic remained one or two isolated basins during the entire Mesozoic, and b) that major marginal basins as well as ridge systems of the western Arctic underwent considerable change and subsidence throughout this time span.

Four areas of potential drilling for Mesozoic pelagic sequences have been selected because they document the ice-free polar Arctic Ocean: 1) Chukchi Plateau and Northwind Ridge; 2) Arlis Plateau; 3) the unknown sediment sequence of Mendeleev Ridge; and 4) locations close to site localities of previously sampled Cretaceous sediments on Alpha Ridge. Attempts should be made to establish a transect of cores from deeper, possibly, older parts of Alpha Ridge towards its shallower part. It remains unknown if any Mesozoic sequences can be obtained on or close to Lomonosov Ridge.

The choice of localities has been guided by the idea that marginal plateaus and some structural highs might contain condensed sequences of younger sediments, which would then allow the drill to reach Mesozoic sequences with relatively little effort. Lack of seismic profiles has prevented any more precise

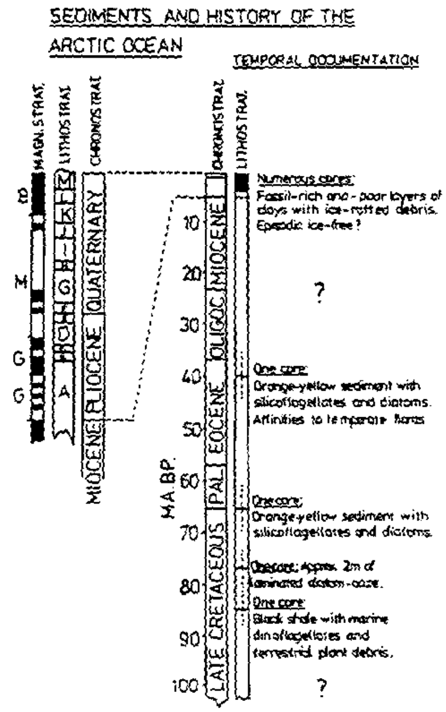


Figure 3. Available records of sediments and history of the Arctic Ocean. Recent coring by the USGS on Northwind Ridge has added to the Cretaceous record.

definition of these localities.

Evolution of Marine Polar Biota

Marine faunas of polar regions display less species diversity than tropical faunas, and many polar species typically have long geologic records. Planktic marine organisms found in polar regions are characterized by life histories which make them uniquely adapted to their environment. Organisms living at the poles must be adapted to subfreezing temperatures, dark polar winter, and strong seasonality of food supply.

These conditions favor life histories which include a seasonal resting stage, and an opportunistic vegetative stage which is active during summer. For example, polar planktic foraminifers can live encased in sea ice, and polar diatoms have a benthic resting stage. Marine benthos must also be adapted to a strongly seasonal food supply from a single summer plankton bloom.

Survival strategy of polar biota enables them to play an important role in evolution of the world's biota. For example, following mass extinctions of low latitude calcareous plankton associated with the Cretaceous/Tertiary boundary event, which may have included an extended period of darkness, the world ocean was recolonized by *Coccolithus pelagicus*, a species which is still the dominant coccolithophore in the Arctic Ocean today.

Studies of Arctic piston cores have produced an overview of Pliocene-Pleistocene paleoceanography of the Arctic but have provided a mere glimpse of its early history. The crucial gap in our knowledge is the Eocene to Miocene history of the Arctic and its associated biota. This is the time when tectonic events in the Norwegian Sea and Fram Strait areas shaped the present configuration of ocean basins and gateways, and set in motion the current circulation patterns in the northern ...

ing program to collect reference sections in the Arctic Ocean will provide data on these and other topics, such as:

- paleoceanography of the Arctic Ocean,
- nature and evolution of polar biota, and
- timing and magnitude of marine connections with the Atlantic.

To address these problems properly, a drilling plan should include sites on both sides of Fram Strait. Highest priority should be placed on obtaining records from the southern part of Yermak Plateau and Barents Abyssal Plain.

Age and Nature of Major Structural Units

The Arctic Ocean has, during its evolution since the Jurassic, been divided into several ocean basins by major transpolar submarine ridges: Alpha-Mendeleev Ridge, Lomonosov Ridge and the presently active Gakkel Ridge. During the last 60 m.y., the ocean has undergone steady extension on the Eurasian side as a result of seafloor spreading. Except for the modern spreading center (Gakkel Ridge), the origin of basement highs and age and nature of basement rocks are unknown and can only be resolved by drilling.

Locations whose basement objectives can be drilled are spread over the entire Arctic Ocean (Figure 2). However, in most cases they will be combined with drilling for paleoenvironmental objectives.

Strategy for Arctic Deep-Sea Drilling

Preparation for Arctic deep-sea drilling will necessitate extensive operations for site surveying in major parts of the Arctic Ocean, whereas drill sites will be confined to a few well-chosen localities over some of the most prominent basement structures in the central Arctic. For both operations, logistic support will be established, which could also be used by many other polar science disciplines. This science plan for Arctic deep-sea drilling should therefore lead to a general increase in the Arctic research effort, involving not only geosciences but other polar research disciplines as well which can profit from expanded logistic effort.

Finances and Funding

Before final selection of a drilling platform, it will be impossible to assess accurately financial requirements of planned operations, which will have to include scientific evaluation of collected samples and data. It is clear that Arctic deep-sea drilling will be very costly, on the order of funds needed for ODP, approximately $30-50 million/year (excluding capital investment). Presently, NAD does not expect to find one single country which would be willing to cover these costs, but is interested in forming a consortium of circum-Arctic and sub-Arctic countries (possibly including industry and international organizations).

Technical Drilling Requirements

Desirability of Arctic deep-sea drilling has been discussed for more than a decade, first under the auspices of the Deep Sea Drilling Project (DSDP) and more recently of ODP. Both drillships employed by these projects, first *Glomar Challenger*, more recently *JOIDES Resolution*, have drilled successfully in ice-infested waters. However, during these attempts it also became quite clear that these vessels, which are not sufficiently ice-strengthened, could not enter permanently ice-covered waters.

The question of how deep-sea drilling could be carried out in ice-covered waters has been considered for many years. In late 1986, international scientific organizations (IUGG-ICL, IUGS-CMG, SCOR WG 82) called for a workshop (in Halifax) to assess technical feasibility of Arctic deep-sea drilling. With the help of industry personnel with many years experience with high Arctic hydrocarbon exploration, it was quickly shown that such drilling would be very costly, very complicated, but *technically feasible.*

Regardless of the platform finally chosen, it will have to cope with the usually slow, but variable movements of Arctic ice cover. Water depths will range from 1000-4000 m, allowing for some (limited) lateral drift of the drilling platform. Relatively thin sediment sequences (estimated 500-1000 m) above Arctic basement can be penetrated within a few days, if efficiency of the platform is close to that of *JOIDES Resolution.*

In terms of coring techniques, it is agreed that continuous riserless coring techniques developed by ODP should be adopted to any of the drilling platforms considered. Reentry capability would not be required. Single-bit holes penetrating the entire sedimentary section up to 50 m into underlying basement are the goal.

Logistic requirements would be complicated and difficult to fulfill. Operations would have to be subdivided into legs of some 2-3 months in duration. In between these periods, personnel would have to be exchanged (probably by aircraft) and supplies and spares would have to be replenished. Complexity of drilling operations will require establishment of an extensive, capable and dependable logistic network to manage operations.

Since most of the time the drilling platform will be located in regions which are only accessible with difficulty, it is evident that the platform should also offer space to experiments from many other polar research disciplines, such as marine biology, physical oceanography, meteorology, geophysics, geochemistry, etc. It is presently considered that the entire effort should be interdisciplinary in nature, even though geoscientific investigations will receive highest priority.

Existing Data and Needs for Site Surveys

Existing seismic reflection data in the central Arctic Ocean presently do not fulfill requirements of site surveys for deep-sea drilling . Site surveying of proposed drillsites poses a major problem, both for surveys before and after drilling. The NAD Science Committee has recently established a subcommittee for reviewing site surveying activity as well as the establishment of an Arctic geoscientific data bank; separate reports on these activities are in preparation.

Environmental Protection

Planned operations (here only considered for Arctic deep-sea basins and not for shallow gas-hydrate infested peri-Arctic shelf seas) will have to satisfy several aspects of environmental concern.

First, the entire suite of activities will have to be carried out with minimal disturbance of the natural environment; that this can be done to a certain degree has been successfully demonstrated by ice-island stations, which have been occupied for many consecutive years by researchers from both eastern and western countries. However, extensive seismic reflection surveys have not been carried out in the central Arctic; their environmental impact has to be considered. This also applies to planned drilling operations.

Second, selected sites must satisfy scrutiny of safety reviews, involving the best scientific and technical knowledge, such as is presently represented in JOIDES and ODP safety panels, as well

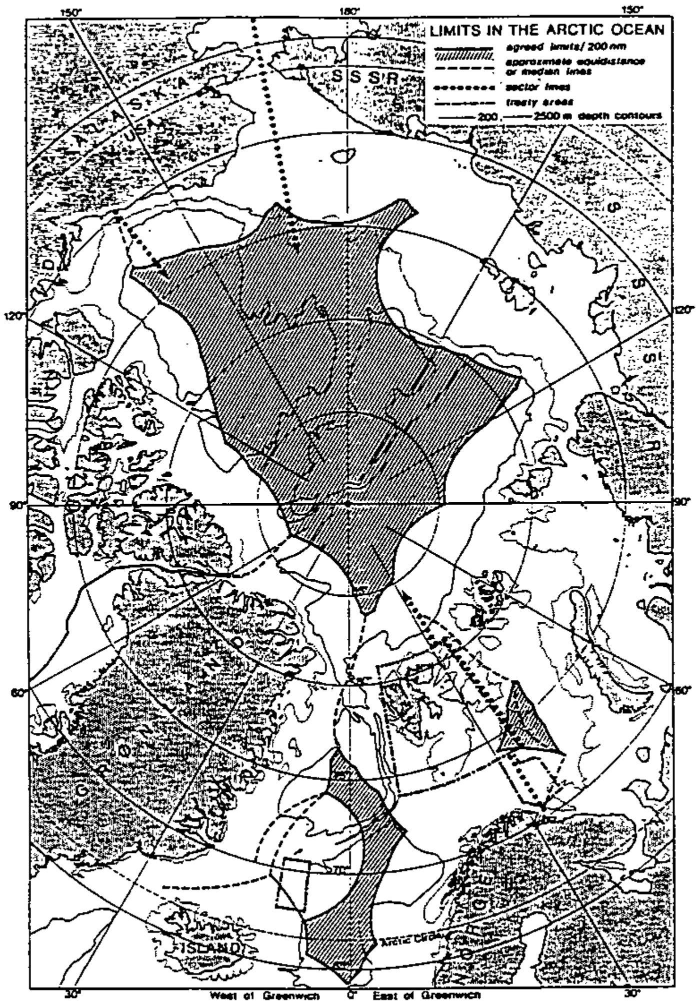


Figure 4. Examples of political considerations for research licenses from Arctic deep-sea drilling close to continental margins.

as any national safety regulations, before approval for drilling can be granted.

Political Feasibility

Political situations of countries bordering the Arctic Ocean itself, and differences in opinion about validity of their claims to economic zones adjacent to shelf regions, are complex (Figure 4) and will probably remain so for some time. Different, and possibly unresolved, regional claims might exist in other parts of the Arctic Ocean.

Perspective

Drillsites have been proposed to sample most major basement units of the Arctic Ocean and to describe Late Mesozoic and Cenozoic depositional environments, selecting both high and low sedimentation rate areas. The scientific ocean drilling community is on the brink of technical feasibility of Arctic deep-sea drilling. *NAD proposes a stepwise approach over several years to combine heavy coring, light and heavy drilling to obtain an undisturbed sampled record of properties of basement rocks and of the history of the Arctic Ocean depositional environment.*

Scientific exploration of the central Arctic with operations as complex and dangerous as deep-sea drilling in permanently ice-covered waters cannot be achieved without active participation and assistance of all major potential partners. The ODP community, with its acknowledged experience and success in deep-sea drilling, will be the most important partner for NAD.

NAD Science Committee

Jan Backman, University of Stockholm; Garret Brass, Rosenstiel School of Marine and Atmospheric Sciences, Miami; Yngve Kristoffersen, University of Bergen; Yves Lancelot, Université Pierre et Marie Curie, Paris; Birger Larsen, Geological Survey of Denmark, Copenhagen; Alexander Lisitsyn, Shirshov Institute of Oceanology, Moscow; Larry Mayer, Centre for Ocean Mapping, University of New Brunswick; Nicholas Shackleton, Cambridge University; Jorn Thiede, GEOMAR Research Center for Marine Geosciences, Kiel; Jan E. van Hinte, Free University of Amsterdam.

(J. Thiede and A. Lisitsyn are chairman and secretary, respectively, of the NAD *Science Committee.*)

JOIDES Committee Reports

Planning Committee

PCOM met on 4 - 7 December 1991 at the University of Texas at Austin. The following decisions, with broad relevance to the scientific community, were made.

FY92 Planning

- PCOM supports TEDCOM's recommendation that coring time with DCS IIB be paramount during Leg 142. *[Note: Consensus]*
- With respect to the program for drilling Atolls and Guyots II, Leg 144:

  Logging at Hole 801C will remain as an alternate activity if time is available after the following conditions are met (or attempted) as part of the prospectus program (in order of precedence):

  1) that MIT-1 is maintained as a basement penetration site;

  2) that Seiko-1, basement site, be retained to provide required latitudinal spread in basement sites;

  3) that Harrie-2 be included to provide paired sites on Limalok (Harrie) to accomplish sea level/paleoceanographic (dipstick) objectives;

  4) that site Syl-4 be an alternate to Syl-2A to maintain paired pelagic cap site philosophy and to optimize recovery for those objectives.
- Because of its impact on Leg 145 drilling, PCOM declines the request to include OSN-2 in the FY92 Program Plan. PCOM continues, however, to endorse the concept of dedicated holes for ocean floor seismic observatories and looks forward to receiving from FDSN a global plan for prioritized testing and implementation.
- PCOM endorses the plan to dedicate no more than 1.5 days during Leg 146 to replace the sensor string in Hole 857D. PCOM requests the co-chiefs of Leg 146 to provide information on the impact of this on the scientific plan for Leg 146, for PCOM to evaluate at its April, 1992 meeting.
- PCOM thanks the Panel Chairs and endorses PANCHM's recommendations. (See Panel Chairs Meeting Summary, p. 21.) *[Note: Consensus]*

FY93 Program Plan

- PCOM approves the following drilling schedule for Fiscal Year 1993 (assuming 56 day legs, 5 day port calls):

147	Hess Deep	26 Nov. 1992 - 21 Jan. 1993
148	Engineering - DCS Phase IIB Back-up: Hole 504B	26 Jan. 1993 - 23 Mar. 1993
149	NARM non-volcanic, Leg 1	28 Mar. 1993 - 23 May 1993
150	New Jersey / Middle Atlantic Transect	28 May 1993 - 23 July 1993
151	NAAG, Leg 1	28 July 1993 - 22 Sept.1993
152	NARM volcanic, Leg 1	27 Sept 1993 - 22 Nov.1993

- PCOM moves that the NARM-DPG strategy for drilling the first non-volcanic leg be adopted.
- PCOM thanks the North Atlantic Rifted Margins Detailed Planning Group (NARM-DPG) for its expeditious and informative report. PCOM considers NARM-DPG to have fulfilled its charge and accordingly disbands NARM-DPG. *[Note: Consensus]*

Deep Drilling

- PCOM confirms the necessity of carrying out feasibility studies for deep drilling as soon as possible. PCOM asks ODP-TAMU to draft a RFP, in consultation with the PCOM chair, for the hiring of one or more consultants, to carry out such studies, using candidate sites recommended by thematic panels as a basis. The draft RFP will need to be reviewed by TEDCOM at its next meeting in April, 1992.

Fluid Sampling Steering Group

- PCOM authorizes the formation of a steering group for *in-situ* fluid sampling, to be constituted as a subset of DMP effective at its January, 1992, meeting. PCOM approves the mandate and membership of the group as described in DMP recommendation 91/17, and urges that it meet in conjunction with normally-scheduled DMP meetings.

Data-Handling Working Group Mandate

- PCOM endorses a 1.5-day Data-Handling Working Group to meet in eastern North America in early March, 1992, and advise PCOM on:

  1) a new database structure for ODP to cope with the rapidly-expanding needs of the project, and particularly to facilitate core/log data integration;

  2) an appropriate hardware/software environment for ODP in the 1990's, compatible with 1).

A written report will be prepared and ready for PCOM review at its April, 1992, meeting. *[Note: Consensus]*

Personnel

- PCOM endorses SMP's recommendation to increase technical support staff on board *JOIDES Resolution* by up to 2 personnel/leg. PCOM requests that ODP-TAMU provide BCOM information by January, 1992 on the continuing costs of hiring and staffing the ship with these additions, with commensurate reductions in scientific participation, to evaluate its impact on the FY93 budget.
- In view of her imminent departure from ODP/TAMU, PCOM, on behalf of the international scientific ocean drilling community, expresses thanks to Audrey Meyer, Manager of Science Operations ODP, as she leaves this position after 5 years of service to ODP. In particular, PCOM recognizes the unique manner in which Dr. Meyer has handled the process of scientific shipboard staffing, involving considerable insight into the nature of the program, and the complexities that thereby arise. PCOM offers her best wishes for the future. *[Note: Consensus]*
- PCOM thanks Nick Shackleton, who is leaving the chairmanship of the prestigious Ocean History thematic panel of ODP, for his long-lasting, inspiring, perseverant leadership. *[Note: Consensus]*

Panel Chairs

The thematic and service panel chairs held their annual meeting (PANCHM) on 3 December 1991, immediately preceding PCOM, in Austin, Texas.

Issues of Concern

Ocean History Panel (N. Shackleton)

PANCHM encourages participating countries to set up a clear mechanism for ensuring that an alternate receives an invitation when the designated member is unavailable. Although designated alternates are often able to contribute less, Panel Chairs welcome their presence.

Supplemental Science proposals

PANCHM recommends that "less-than-a-leg" proposals continue to be an option, even though supplemental science proposals are now discontinued. Incorporation of highly-ranked short proposals into drilling legs will be accomplished through the thematic panels prior to their inclusion in a prospectus for ranking to determine drilling schedules. Projects that are included in the prospectus will already be packaged into one-leg units and each leg will form an integrated program.

The Proactive/Reactive Roles of the Panel: Reviewing Procedures

The Panels are concerned about the dichotomy they face in their roles of actively accomplishing a set of scientific objectives—which may involve them in writing proposals—and their other task of reviewing proposals; this situation can be viewed as a potential source of conflict of interest.

PANCHM recognizes the paramount need for preservation of fairness and openness in the program. There is clearly a potential for conflict of interest for panel members who are proponents. However, excluding panel members from voting and ranking procedures removes areas of expertise from important discussions. Proponents should be clearly identified and not permitted to vote for their own proposals. Panel Chairs should prevent any lobbying activities; consequently, proponents can be asked to leave the room at the discretion of the Chair.

Panels will continue to be proactive in soliciting proposals and in encouraging refinement of those proposals that address high-priority objectives in order to accomplish the goals of the Panels.

Voting and Ranking Procedures

PANCHM recommends to the JOIDES Office that the numbers be removed from the ranking boxes on the proposal review forms.

For ranking of prospectus proposals that occurs in the fall, the following guidelines have been put into place:

a) each Panel will decide which of those proposals fall within their mandate and will be included in the ranking (some Panels may include all, others only a few);

b) proposals will be ranked by each Panel member, with the top ranked receiving the highest number of votes (e.g., if there are ten proposals being ranked, then the top choice receives ten points); proponents will not vote for their own proposal;

c) total scores will then be divided by the number of individuals who were permitted to vote for that proposal.

Proposals - Deadlines and Sizes

PANCHM recommends that the JOIDES Office set the following deadlines for receipt of proposals to be included in the Panels' review processes: 1 January and 1 August. These need to be adhered to by everyone—including the thematic panels.

Meeting Schedule

The following schedule was set up:

PANEL	SPRING	FALL
Thematic	Late Feb/Early March	Mid-October
SSP	Early April	September
PCOM	Mid-late April	Late Nov-Dec
ACTIVITY:	Global Ranking/ Drillability Assessment	Prospectus Ranking/ SSP Input from Initial Data

SSP will impose a 1 August deadline for submission of available site survey data for highly-ranked global proposals likely to be included in the fall rankings, so that SSP can provide feedback to the Panels for the fall meetings.

Core-Log Data Integration

It is currently not possible to cross-correlate core and log data routinely on board the drill-ship.

The service panels will produce an action plan for the effort needed to be presented to PCOM, and PANCHM will endorse this plan. (See report, p. 27.)

Funding for Panel Chairs

PANCHM again request an increase in the level of support for expenses provided for Panel-related activities to $2500/year.

Lithosphere Panel

LITHP met in Nicosia, Cyprus, on 9-11 October 1991.

Liaison Reports

Ocean History Panel

In response to OHP's request, LITHP reviewed the Santa Barbara supplemental science proposal for APC coring in the upper 200 m of sediments. Although the proponents' main interest is to obtain a high-resolution marine record to investigate climate change and the carbon cycle—an objective not within LITHP's mandate—there is some interest in drilling this area, based on potential implications for ore deposit formation. Sediment-hosted ore deposits often form by venting into a stratified anoxic water column. Near the Channel Islands, there has been enough faulting and fluid flow to generate hydrothermal barite deposits. Although this aspect of the coring is not developed, it could prove interesting. LITHP also suggests that the proponents include individuals interested in the tectonics of the S. California borderland in planning. LITHP could be interested in drilling in this area, but would like to see it treated as an "add-on" proposal rather than subtracting from Leg 146.

Downhole Measurements Panel

In response to this report, LITHP made the following recommendation:

LITHP supports the acquisition of a memory tool for temperature measurements during upcoming legs. Even though drilling disturbs the formation temperatures, it is still a critical measurement. Acquisition of the tool should be accompanied by an effort to determine how to calculate formation temperatures from these measurements.

OPCOM

LITHP is delighted that development of the DCS system is the top priority, and that PCOM recognizes the urgent need for this system in order to accomplish many of LITHP's objectives. LITHP also views the current formation fluid sampling and hydrologic property measurement situation as serious, and has made a strong joint recommendation with TECP concerning development of these capabilities (see joint LITHP-TECP Meeting Summary, p. 24).

LITHP's other major concern is deep drilling, which is a critical aspect of its Long Range Plan. ODP-TAMU presented their studies to TEDCOM in September, and expect to report to PCOM in December on the status of their studies.

LITHP endorses a feasibility study for deep drilling. It is disappointed with the lack of response by TEDCOM to the deep drill site submitted to them for consideration. For future planning, LITHP needs to determine whether its goal of a continuous section through the oceanic crust is realistic in terms of time, technology and cost.

LITHP therefore recommends that a feasibility study be commissioned as soon as possible to evaluate the time, technology, and cost of drilling: (i) a 4 km hole and (ii) a 6 km hole, both in oceanic crust.

LITHP wants this assessment to culminate in a report as soon as possible, and will make one panel member—D. Moos—available to work with a consultant whenever necessary. LITHP requests that other panels interested in deep drilling do the same, and would like a progress report at its March, 1992 meeting.

Supplemental Science Proposals

Proposal S-2: Downhole Measurements in Jurassic Oceanic Crust of Hole 801C

LITHP supports logging of Hole 801C and its incorporation into Leg 144, and is willing to give up 3.5 days of basement drilling to accomplish the logging programs. However, LITHP is not willing to give up planned basement drilling at MIT-1.

In terms of the logging, LITHP feels that the packer is of highest priority and the geochemical tool of lowest priority. Other logging should be done according to operational logistics.

Proposal S-3: Proposal for a Cased Hole with Re-entry Cone for Deployment of OSN Observatory

LITHP considers it unacceptable to devastate Leg 145 by removing 10 days from its schedule and feels this is a subversion of the planning process.

LITHP is willing to give up the lithospheric objectives of Leg 145 in order to drill OSN-2. In so doing, LITHP notes the following:

- there is not enough drilling of LITHP interest in Leg 145 to provide the necessary time to complete OSN-2;
- the willingness of LITHP to accommodate drilling OSN-2 is due to Leg 145 not addressing high priority LITHP; objectives
- LITHP strongly encourages development of a relation with interested Japanese parties, and instrumentation of the hole as soon as possible.

Ranking of Proposals in the North Atlantic Prospectus

Nine legs of the proposed programs from the North Atlantic Prospectus were included in rankings, with the following results:

Rank	Proposal	Total Votes	Members Voting/ Possible Votes	Percent
1	TAG	85	11/99	85.9
2	Volcanic Rifted Margins - Leg I	107	14/126	84.9
3	North Atlantic Offset Drilling - Leg I	104	13/117	82.5
4	Non-volcanic Rifted Margins - Leg I	95	14/126	75.4
5	VICAP	60	13/117	51.3
6	Alboran Basin	55	14/126	43.7
7	Equatorial Atlantic Transform	51	14/126	40.5
8	Mediterranean Ridge	37	14/126	29.4
9	NAAG - Leg I	30	14/126	23.8

Two potential PCOM action items arose from this procedure:

A) LITHP recommends that a TAG-DPG be set up immediately (whether or not drilling is scheduled in FY'93) to:

i) examine all available data to determine the locations of appropriate drilling sites and their priorities;

ii) consider structural controls on hydrothermal systems and determine how to address those through drilling.

B) LITHP recommends that the next meeting of the Offset Drilling Working Group (OD-WG) be specifically charged with developing an initial drilling strategy for the Atlantic and laying out a provisional schedule for Atlantic drilling. This may require both an extra day of meetings, plus involvement of those proponents with interests specifically in the Atlantic. If offset drilling is scheduled for FY'93, this may better be handled by a North Atlantic Offset Drilling Detailed Planning Group. LITHP expects a progress report at its March, 1992 meeting.

Tectonics Panel

TECP met in Nicosia, Cyprus, on 9-11 October 1991.

OPCOM

OPCOM has recommended feasibility studies for deep drilling and TECP places very high priority on deep drilling on rifted continental margins. Therefore, TECP requests that specific attention be directed toward drilling improvements that would increase efficiency of drilling, enhance core recovery, and increase ultimate likelihood of success at deep sites such as those proposed for North Atlantic rifted margins.

Supplemental Science Proposals

S-2: Hole 801C

TECP places high priority on the logging of Hole 801C. TECP's main interest in legs 143 and 144 is in questions of plate kinematics. These involve the preservation of a latitudinal spread of basement penetrations. TECP believes that the time allotted to Atolls and Guyots is generous. If something must be cut, however, TECP recommends that basement penetration be sacrificed at mid-latitude sites, preserving the maximum latitudinal spread of basement samples.

S-3: OSN-2

Establishment of the global seismic net is extremely important for the long-term objectives of TECP, of ODP, and, indeed, of the global geoscience community. TECP strongly supports drilling of OSN-2.

Concerning what should be dropped from Leg 145 to make time for S-3, TECP offers the following. Tectonic objectives are secondary on Leg 145, but TECP does have interests in obtaining basement ages at the ocean floor sites and age and paleolatitude information at the seamount sites. If necessary, TECP would give up any time that might have been devoted to these objectives. However, TECP does feel that some potential tectonic objectives are more important than others, so TECP lists the following priorities, from lowest to highest:

Lowest: Information from seamount site PMI and sea floor sites NWIA and NW4A are least likely to produce tectonically significant results.

Intermediate: Basement information from NW3A is likely to produce tectonically significant results for models of North Pacific plate evolution (Chinook plate hypothesis), so it is of medium priority.

Highest: On Detroit Seamount (DS sites), significant basement penetration supplying paleolatitude and age information is very important for models of Pacific plate motions, as well as for global questions concerning true polar wander and fixity of hotspots. Thus, these sites are of high priority to TECP.

Proposal and North Atlantic Prospectus Review

TECP reviewed all 26 new proposals and re-reviewed appropriate proposals in the North Atlantic Prospectus. In keeping with PCOM's requirements, proponents were absent from the room during discussion and grading of proposals. Then TECP discussed the NARM-DPG report from the tectonic point of view. Both Co-Chairs of the DPG were absent from this discussion.

TECP Ranking of North Atlantic Prospectus Programs

Rank	Proposal	Score
1	NARM non-volcanic, leg 1 (IAP 4, 2, and 3A, and GAL l)	7.4
2	NARM volcanic, leg 1 (EG 63-1 and 63-2)	6.1
3	346-Rev2: Transform Margin (Ivory Coast-Ghana Margin)	5.7
4	323-Rev: Alboran Sea (Comas, et al.)	4.8
5	403: K/T boundary, Gulf of Mexico	4.0
6	376: Layer 2/3 boundary, Vema F.Z.	3.2
7	369-Rev: MARK Area	2.5
8	399: Alboran Sea (Watts, et al.)	2.3

Letters of Intent

TECP suggests that the present "Letter of Intent" process should be strengthened and somewhat formalized. TECP suggests that letters of intent should be encouraged (e.g., by advertisement in *JOIDES Journal*, or publications with broader readership, such as *EOS*, *GSA Today*, or *Terra Nova*), all thematic panels should receive the letters, and authors should receive a written response. This latter could include suggestions for additional proponents, experts to be consulted, and/or details of data sources. Encouragement from thematic panels at the critical stage might also help with funding of related site surveys, etc.

Offset Drilling

TECP recommends that either a Detailed Planning Group be formed or that the Offset Drilling Working Group (OD-WG) be charged with the task of coming up with a coherent, balanced proposal for Atlantic offset drilling. This proposal should include an integration of tectonic and lithospheric themes, and it should include all the site survey and geological setting information outlined in the OD-WG minutes.

Watchdogs

Stimulating exciting tectonics drilling objectives is one of TECP's main concerns. To foster this, TECP's watchdogs on various thematic issues are starting to take a more active role in enhancing communication between the panel and proposal proponents.

Joint Lithosphere Panel - Tectonics Panel

In conjunction with their meetings in Nicosia, Cyprus, on 9-11 October 1991, LITHP and TECP held a joint meeting to discuss issues of common concern.

Liaison Reports

North Atlantic Rifted Margin Detailed Planning Group Report

After reviewing all the proposals for drilling passive margins in the ODP files, NARM-DPG concurred with PCOM's decision to concentrate rifted margin drilling in the North Atlantic at this time. The DPG report, proposing 8 legs of drilling, was generally well received.

LITHP and TECP are concerned about the ability to date volcanic rocks from these margins accurately enough to achieve the desired precision in proposed spreading rate determination.

Offset Drilling Working Group Preliminary Report

LITHP and TECP noted a bias in target areas, selected from 22 possible locations by OD-WG, towards fracture zone sites. Fracture zones are their own tectonic environments and do not represent faulted segments of "normal" oceanic crust.

There is a critical need for site surveys. A key site-survey goal should be to identify boundaries away from the exposure, so the relation between the exposed section and"normal" crust can be determined.

Downhole Logging and Sampling

Fluid Sampling

LITHP and TECP jointly believe that the current inability to sample formation fluids and measure pore pressure, permeability and temperature, in both standard and slim holes, is jeopardizing the success of ODP, especially such legs as Cascadia (Leg 146) and EPR II. LITHP/TECP strongly urge that a group be formed immediately to investigate and resolve this problem using OPCOM money for tool development.

Beyond this immediate crisis, LITHP and TECP strongly feel that an integrated strategy is required to develop the routine ability to make such measurements in various geologic environments of concern to each of the thematic panels.

Downhole Logging Measurements

A major lack in downhole measurements is the determination of bulk density. This would require substantial modification of existing tools.

TECP - LITHP Common Objectives

TECP and LITHP will consider putting out a joint RFP in U.S. and non-U.S. publications for proposals that address coupled volcanic-tectonic systems. Another way to encourage proposals that address both panels' objectives would be ODP-sponsored symposia at AGU, GSA and EGU meetings specifically on drilling for volcanic and tectonic objectives.

At present, LITHP and TECP feel that their interests are well represented on both panels, and that current liaisons are appropriate.

Proposal Submission Deadlines

TECP and LITHP jointly urge the JOIDES office to set a submission deadline sufficiently in advance of panel meetings (six weeks?) so as to ensure that all panel members receive copies of appropriate prospectuses and/or proposals in time to read them, and so that Panel Chairs do not have to resort to expensive express mail and courier services.

Joint Meetings and Field Trips

All members of LITHP and TECP agreed that joint meetings that include a pre-meeting field trip are extremely valuable in enhancing coordination between panels, improving communication, etc. The panels agreed to try to schedule a joint meeting every year or one and one half years. These joint meetings should be preceded by carefully-selected field trips that ideally visit on-land examples of topics of high common interest.

Ocean History Panel

OHP met on 1-3 October 1991 in Yamagata, Japan.

Meeting Authorization

OHP, regretting the absence of Dmitriev (unable to obtain a visa in time) urges JOIDES Office to authorize thematic panel meetings as of the PCOM meeting at which the minutes proposing the next meeting are received, so that meeting notices can go out in good time and local hosts can make plans.

Supplemental Science Proposals

OHP, while disappointed at the response to the call for S-proposals, urges PCOM to retain the experiment, pointing out that all three proposals received a fairer hearing than they would have done had they been made "informally".

OHP urges PCOM to incorporate a very brief coring of the Santa Barbara Basin in the 1992 drilling plan, despite the fact that a formal S-proposal was not received for this site.

OHP urges PCOM *not* to schedule proposal S-3 (cased hole for emplacing a seismometer). It clearly cannot be accomplished within the guidelines published for S-proposals and thus would take a disproportionate amount of the time available for scientific drilling on Leg 145. If PCOM finds it essential to schedule this, the time should be divided among several legs so that no one leg loses more time than was allotted when the S-proposal concept was agreed upon. A change of port-call to Anchorage might be a way of alleviating the imbalance.

If PCOM does schedule S-3, it will at least require dropping either all but the APC coring at Site DS-3 (eliminating the major Mesozoic opportunity for Leg 145) or dropping all but the APC coring at Site DS-1 (eliminating the major Paleogene opportunities for Leg 145). OHP were almost evenly split as to which of these is the more important; the final decision should be taken in consultation with the co-chiefs.

North Atlantic Drilling

OHP's ranking of programs in the North Atlantic Prospectus is:

1. North Atlantic Gateways Leg 1 (unanimous)
2. New Jersey Sea Level
3. Ceara Rise
4. NARM-volcanic leg 1, E Greenland
5. Equatorial Atlantic
6. NARM-non-volcanic leg 1
7. Alboran Sea

OHP draws attention to two important opportunities in the North Atlantic to achieve very exciting science with very little drilling time:

1. Bermuda Rise (from proposal 404) a single APC site giving ultra-high resolution records that will be comparable with records from the Greenland Ice Core drilling in progress.

2. Hatton-Rockall Bank, location as Site 116 (from proposal 372, but also satisfying a major part of proposal 406), again will have important impact outside the ODP community.

OHP recommends that PCOM schedule these if the opportunity arises.

Other Business

OHP makes the following recommendations based on the successful completion of Leg 138: a digital color scanner should be purchased for *JOIDES Resolution*, the shipboard computing system should be upgraded and a second shipboard computer systems manager provided, flexibility in technician assignments should be increased, APC and XCB should be improved to reduce core stretching, and the shipboard paleontology reference collection should be rebuilt and maintained.

OHP strongly recommends to PCOM and EXCOM that the MOU should be reworded to eliminate the obligation for TAMU to invite a co-chief from each non-US member each year. All non-US members present individually supported this motion, urging that while the right to participate is immensely valuable, the right to act as co-chief scientist is not.

OHP will be delighted if PCOM appoints Peggy Delaney to replace Nick Shackleton in the Chair.

Sedimentary & Geochemical Processes Panel

SGPP met at the Geological Institute, ETH-Zentrum, Zürich, Switzerland, on 8-9 November 1991.

OPCOM Money and Fluid Sampling

SGPP expresses its concern that adequate progress has not been made in development of new technologies required for *in-situ* pore fluid sampling and downhole property measurements, such as pressure, permeability and temperature. SGPP strongly recommends that some OPCOM money be allocated for development of needed tools. SGPP proposes an integrated approach to the fluid sampling problem by maximizing use of currently-available technology to address short-term goals, while continuing to develop new tools for improving and extending capabilities to reach long-term scientific objectives. SGPP supports continued development of GEOPROPS by B. Carson, but would also propose that funds be allocated for testing the Top Hat device during FY92. SGPP emphasizes that, even without GEOPROPS, important fluid sampling objectives outlined for Leg 146, Cascadia Margin drilling, can be achieved using available tools (WSTP, PCB, CORK) and conventional techniques (squeezing and rinsing). SGPP made specific recommendations and widely circulated a technical plan for processing water and gas samples obtained with the pressure core sampler (PCS Phase II) (see minutes of 5-7 March 1991 meeting at College Station [meeting summary published in *JOIDES Journal*, June 1991] and Gas Hydrate Workshop Report [*JOIDES Journal*, October 1991]). SGPP supports and seconds the TECP/LITHP joint motion on fluid sampling and endorses the report of the JOIDES Working Group on *In-Situ* Pore Fluid Sampling.

Supplemental Science Proposals

SGPP supports PCOM's decision to discontinue supplemental science proposals. SGPP strongly encourages continued submission of less-than-one-leg proposals to be handled under normal ODP review policy and introduced into planning of legs at an earlier stage. SGPP recognizes that certain "emergency" cases involving technical problems or opportunities to rectify or enhance scientific objectives will arise from time to time, and urges that a certain amount of flexibility be maintained in the drilling schedule to accommodate such operations.

S-2: Downhole Measurements in Jurassic Oceanic Crust in Hole 801C

SGPP supports supplemental science proposal S-2 to log Hole 801C during Leg 144 because of the potentially valuable scientific information that will be obtained from downhole measurements to be performed on the oldest drilled oceanic crust. SGPP recommends that logging of Hole 801C be given first priority status on the condition that logging time be gained through the sacrifice of drilling time for basement penetration at mid-latitude sites, as specified by LITHP/TECP during their fall meeting.

S-3: Ocean Seismic Network (ONS-2)

SGPP does not support supplemental science proposal S-3 because the necessary experimentation at the first hole has not been made and the need for drilling a second hole does not seem to be warranted at this time. In addition, the 6-8 days needed to complete ONS-2 do not meet the time criteria of a supplemental science proposal. Although SGPP has no thematic interest associated with OSN, it recognizes its scientific importance and encourages the submission of less-than-one-leg proposals to drill future dedicated OSN holes.

Proposal/North Atlantic Prospectus Review

SGPP reviewed 9 new proposals and 13 new additions or revisions to older proposals. In addition, SGPP discussed contents of the North Atlantic Prospectus. In its ranking of proposals in the Prospectus, SGPP elected to include a new proposal (Amazon Deep-Sea Fan, No. 405) and to vote separately on the two Mediterranean proposals (Alboran Basin/Gateway (No. 323)) and Mediterranean Ridge (No. 330). The N. Atlantic Rifted Margins (NARM) report was divided into non-volcanic and volcanic components for ranking. Thus, SGPP ranked a total of 13 proposals. As required by PCOM, proponents left the room during discussion of their proposals and did not rank their own proposals for FY93.

SGPP Ranking of North Atlantic Prospectus/New Proposals

Rank	Proposals	Score
1	New Jersey Sea Level (348)	12.2
2	Mediterranean Sapropels (391)	9.7
3	Amazon Deep-Sea Fan (405)	9.5
4	Mediterranean Ridge (330)	8.4
5	TAG Hydrothermal (361)	8.0
6	Ceara Rise (388)	7.4
7	Alboran Basin (323)	7.0
8	VICAP Gran Canaria (380)	6.4
9	N. Atlantic Arctic Gateways (NAAG)	5.7
10	N. Atlantic Rifted Margins volcanic (NARM)	5.3
11	MAR Offset Drilling (OD-WG)	3.6
12	Eq. Atlantic Transect (346)	3.5
13	N. Atlantic Rifted Margins non-volcanic (NARM)	3.4

Core-Log Integration Implementation Plan

Joint Meeting: Downhole Measurements Panel & Shipboard Measurements Panel

DMP and SMP met jointly on 17 October 1991 as part of their fall 1991 meetings. The purpose of the joint meeting was to review and prepare an implementation plan for core-log data integration. Both DMP and SMP agreed that routine shipboard integration of core and log data is a very high priority and that implementation should proceed immediately. The following DMP/SMP consensus was formulated.

Shipboard Integration of Core and Log Data

There are four important areas of activity which have to be optimized if shipboard integration of core and log data is to be progressed: (l) Integration Philosophy and Personnel; (2) Equipment; (3) Reference Depth; and (4) Data Handling.

(l) Integration Philosophy and Personnel

Key factors are **motivation, correlation specialist, approach to integration (reporting of data) and leg scenarios.**

(a) Motivation

Motivation for using the core-log system lies in recognition of the opportunity provided by benefits of shared information. Potential impediments are time limitations on board ship and competition among the shipboard party, either with each other generally, or with the data correlation specialist in particular. Solutions are to make data available to the Shipboard Party as soon as possible in formats that are compatible with standard shipboard and shore-based hardware (MAC/PC or workstation), and to provide a data set as a manipulatable product that is transportable. Further, the Co-Chiefs will need to be able to sell advantages to the Scientific Party. In particular, the correlation specialist should be promoted as a facilitator.

(b) Correlation Specialist

The correlation specialist serves the Scientific Party and, as such, should be a member of that party. The position of data correlation specialist should be identified in the shipboard manual and should be filled by the Co-Chiefs in the usual way. ODP should offer a training course/workshop in philosophy and methodology. Data smoothing software should be applied where appropriate, especially to core data in order to harmonize different resolutions of core and log measurements.

(c) Reporting of Data

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

(d) Leg Scenarios

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

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

(2) Equipment

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

(a) Natural gamma equipment for measurement of cores[1] (Leg 145).

(b) Magnetic susceptibility downhole logging tool (required as soon as possible—acquisition date unknown).

(c) Sonic core monitor (Leg 141).

(d) Automation of the physical properties laboratory[1] (March 1993).

(e) Core/log data integration workstation[1] (Feb 1992).

(f) Resistivity imaging equipment (acquisition date unknown).

[[1] previous SMP recommendation]

(3) Reference Depth

Key factors in developing a reference are the need for a **reference datum,** knowledge of the **length of pipe,** defining a **log-to-pipe tie-in,** establishing a **core-log correlation,** and the flexibility to handle **other scenarios.**

(a) Reference Datum

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

(b) Length of Pipe

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

(c) Log-to-Pipe Tie-In

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

(d) Core-Log Correlation

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

(e) Other Scenarios

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

(4) Data Handling

Three key areas were defined under this requirement: **data structure, software requirements, and hardware.**

(a) Data Structure

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

(b) Software Requirements

Software needs can be described in terms of a set of modules, each of which has its own specific function. Software modules are required for: vertically adjusting two or more data sets so that they match; stretching and squeezing two or more data sets to match; interpolation of data from sparse data sets to output a complete data set; averaging, smoothing and regression to facilitate correlation; providing scientists with output data from the data structure in several different formats; generating graphics of various types; interrogating the database, e.g., for a particular lithology; calling in all data that pertain to a particular reference depth or depth range.

Although these modules are discrete, their bounds should be transparent to the scientific user.

(c) Hardware

Hardware must be defined that meets requirements for the software and data sizes listed above. The first requirement is for a networked group of workstations on the ship. To choose the hardware, first assess software availability and then select the best hardware option to match the software.

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

A summary list of critical tasks which must be addressed to implement routine shipboard core-log data integration (recommendation to PCOM, ODP-TAMU) successfully is as follows:

- **quantify methods of depth measurement for drillpipe and wireline,**
- **refer all depths to the gamma log,**
- **develop interactive graphics for depth matching,**
- **establish a relational database with an adequate structure for shipboard and shorebased access of core and log data,**
- **create the position of *Data Correlation Specialist* as a member of the Shipboard Scientific Party,**
- **disseminate data to the Scientific Party in a readily transportable format, and**
- **support related development work currently taking place at ODP-TAMU.**

Shipboard Measurements Panel Recommendations on Organic Geochemistry Samples

At its 1990 Annual Meeting, PCOM endorsed the recommendation of the Ocean History Panel that whole-round sampling for organic geochemistry (OG) be discontinued, and that frozen 30-cm whole round core sections, presently in the repositories stored as OG samples, be returned to the regular collection.

SMP conducted a survey of the geochemistry community on this and other issues. Results of the survey indicate that the geochemistry community concurs with PCOM's decision to terminate routine OG sampling. Non-routine sampling will still, however, be required, and therefore facilities for sampling, shipping and storage, both aboard ship and ashore, should be maintained. In addition, the existing collection of frozen samples (through Leg 134) should be retained and kept frozen, pending the results of: a) degradation studies, and b) advertising the existence of the collection.

Existence of this collection should be advertised as widely as possible to the community. ODP should consider cataloging these samples (lithologies and C_{org} contents) and making this catalog widely available. Cataloging and advertising the collection should increase the number of sample requests. If not, samples could be returned to the collection after some minimum time period (e.g., 10 years).

Proposal News

JOIDES Proposal Submission Guidelines
February 1992

Introduction

The purpose of the JOIDES scientific advisory structure is to formulate the most productive ocean drilling plan which will answer scientific questions about present-day and past processes of the earth. Drilling is based on proposals from the entire earth science community.

The Planning Committee (PCOM) monitors and directs the proposal review process, reviews recommendations made by advisory panels, decides the fate of proposals, sets ship tracks, and schedules drilling legs in two continuous and interrelated planning phases: setting a general four-year ship track based on highly-ranked proposals, and detailed scheduling two years in advance based on further thematic panel prioritization of the four-year plan, maturity of existing programs, and logistical considerations. PCOM depends primarily on its four thematic panels for advice on scientific objectives. Detailed Planning Groups (DPGs) may also be formed and mandated by PCOM to help thematic panels translate broad thematic programs and highly ranked proposals into concrete, prioritized drilling plans. The service panels, the Science Operator (TAMU: Texas A&M University), Wireline Logging Services (LDGO: Lamont-Doherty Geological Observatory), and Site Survey Data Bank (LDGO) also provide advice on optimum, safe drill sites. The general schedule of planning procedures for a drilling leg is shown in Figure 1.

JOIDES accepts drilling proposals into the formal review process that include an outline of thematic objectives and drilling strategies, information on site survey data, and meet some other requirements (see below). If a proposal is accepted by the JOIDES Office, proponent(s) will receive copies of thematic panel reviews within six months.

If a proposal is not complete as defined above, but contains ideas or prospects for such a follow-up document, it is accepted by the JOIDES Office as a Letter of Intent, which is then forwarded to thematic panels for information but not for procedural review. Response by thematic panels to authors of letters of intent is encouraged by the JOIDES Office.

Requirements for a Drilling Proposal

ODP proposals must be submitted to the JOIDES Office, which rotates every two years among the ten JOI institutions. The JOIDES Office is responsible for proposal handling, and is the primary ODP proposal archive. Proposals submitted directly to thematic panels are not reviewed. An ODP drilling proposal has to meet the following requirements in order to be accepted and forwarded to the four thematic panels by the JOIDES Office:

Thematic

- Scientific objectives must be outlined, and preferably linked to COSOD or ODP Long Range Plan (LRP) themes. (These documents are available from JOI, Inc. in Washington, D.C.)
- Drilling strategies must be tied to stated scientific objectives.
- Choice of sites must be supported by site-specific objectives within the framework of the stated drilling strategy.

Site-specific

- Proposed sites must be given a site name, latitude and longitude, water depth, sediment thickness, proposed penetration depths and site-specific objectives. For each proposed site, a site summary form (see next page) must be included (the form is available on floppy diskette as Macintosh/Word table from the JOIDES Office).
- Information on existing and/or in-progress site survey data, with reference to site survey standards (see "site survey review" below), must be provided. (The ODP Site Survey Data Bank at the Lamont-Doherty Geological Observatory may assist.)
- Statement of known potential safety (see "safety review" below) and other (i.e., weather, physical oceanographic conditions, territorial jurisdiction, etc.) problems must be included.

Other

- A proposal must include an abstract of less than 400 words.
- A list summarizing scientific objectives (not more than 150 words) must be included in the proposal.
- Ten copies of the entire proposal must be submitted to the JOIDES Office.
- The JOIDES Office appreciates to receive proposal texts, including abstract, (no figures, no references) via electronic mail or on floppy disc (if possible: Macintosh).

New deadlines for proposal submission:

1 January and 1 August

In Order that proposals will arrive sufficiently in advance of the periods when panels meet, permitting effective proposal-handling and review, the Panel Chairs have agreed on a stricter proposal submission/review deadline policy at their annual Panel Chair Meeting in Austin, December 3, 1991.

Proposals must be submitted to the JOIDES Office.

Proposals submitted directly to panels are not reviewed.

Deadlines for Proposal Submission

Drilling proposals can be submitted at any time of year to the JOIDES Office. Thematic panels review proposals twice a year, once around March and once around October. Proposals received by the JOIDES Office not later than 1 January will be reviewed in March, and those received not later than 1 August will be reviewed in October. These deadlines have been established by the Panel Chairs at their Annual Meeting in December, 1991, in order to guarantee sufficient time for proposal distribution and proper review prior to panel meetings. The deadlines for proposal forwarding by the JOIDES Office to the Panel Chairs will strictly be applied.

ODP Site Summary Form 6/91

Fill out one form for each proposed site and attach to proposal

Title of Proposal:	
Site-specific Objective(s) (List of general objectives must be inc. in proposal)	

	Proposed Site	Alternate Site
Site Name:		
Area:		
Lat./Long.:		
Water Depth:		
Sed. Thickness:		
Total penetration:		

	Sediments	Basement
Penetration:		
Lithology(ies):		

Coring (check):	1-2-3-APC	VPC*	XCB	MDCB*	PCS	RCB	DCS*	Re-entry
Downhole measurements:								

*Systems currently under development

Target(s) (see Proposal Submission Guidelines): A B C D E F G (check)

Site Survey Information (see Proposal Submission Guidelines for details and requirements):

		Check	Details of available data and data that is still to be collected
01	SCS deep penetration		
02	SCS High Resolution		
03	MCS and velocity		
04	Seismic grid		
05	Refraction		
06	3.5 or 12 kHz		
07	Swath bathymetry		
08	H.-res side-looking sonar		
09	Photography/video		
10	Heat flow		
11	Magnetics/gravity		
12	Coring		
13	Rock sampling		
14	Current meter		
15	Other		

Weather, Ice, Surface Currents:

Territorial Jurisdiction:

Other Remarks:

	Name/Address	Phone/FAX/Email
Contact Proponent:		

Years before drilling	Summary of Review/Planning Procedures	Action
2-?	Review of all incoming proposals; proponents are sent a completed review form from each panel within about six months after submission of their proposal to the JOIDES Office.	Thematic panels at spring and fall meetings
2-?	Global ranking of all "active" proposals; relative rank of a proposal/program may change at subsequent meetings; new, exciting and mature proposals along the general ship track may get onto the drilling schedule within the same year, and get drilled two years after submission	Thematic panels at early spring meetings
2-4	General ship track determined, based on thematically highly-ranked proposals and programs, with relatively firm early track (<2 years) and relatively flexible later direction (>2 years); refined at subsequent meetings based on reevaluation of panel recommendations, technological developments, and overall state of the ODP.	PCOM at spring meeting
	Merging of proposals or formation of Detailed Planning Groups (DPGs) may be recommended by thematic panels and approved by PCOM	Thematic panels and PCOM
	Preliminary site survey data assessment and specific recommendations for highly ranked proposals/programs	SSP
	Preliminary safety review of highly ranked proposals/programs	PPSP
	Thematic prioritization of previously highly ranked proposals/programs	Thematic panels at fall meetings
1-2	Proposals/programs get on schedule based on thematic prioritization, and consideration of logistics, site survey status, technological developments, and balance of general ODP themes.	PCOM at Annual Meeting (Nov/Dec)
	Monitoring of scheduled proposals/programs	PCOM
	Preparations for drilling (staffing, equipment)	Sci. Operator
0.5	Final safety review	PPSP
	Final approval, if necessary, after PPSP changes	PCOM
0	Program/proposal is drilled	

Figure 1. General schedule of planning procedures for a drilling leg

Thematic review

Proposals submitted to the JOIDES Office are logged if proposal submission requirements outlined above are met. Proponents will then receive an acknowledgement. Although it is unlikely that all panels have interest in any specific proposal, all thematic panels are requested to review all proposals in order to maintain a fair, proposal-generated and thematically-controlled drilling program. Informational copies of proposals are sent to JOI, Inc. in Washington, D.C., the Science Operator at TAMU, and the Site Survey Data Bank at LDGO.

Thematic evaluations are based on individual panel mandates, COSOD white papers, the LRP, experience and judgement of panel members, and long-term scientific strategies of panels. Proposal reviews are summarized in panel meeting minutes and on Proposal Review Forms (PRF). Each panel returns a completed PRF for each proposal to the JOIDES Office. The JOIDES Office then forwards PRFs to proponents. PRF comments may include suggestions on how to enhance strength of a proposal, or may request additional information (in which cases *revised proposals* or *addenda* are expected). Panels may also suggest merging similar or related proposals into one drilling program (i.e., incorporating proposals of limited scope into thematically or regionally related proposals of broader scope), or they may discourage proponents from pursuing a proposal with no prospect of being drilled within the present ODP. Thematic panels may also propose formation of Detailed Planning Groups (DPGs) to PCOM, with specific mandates to prioritize a drilling program incorporating two or more highly-ranked proposals, or formation of a Working Groups, with the mandate to develop strategic white papers for major objectives insufficiently covered by existing drilling proposals.

Global ranking of proposals

Each spring, each thematic panel prioritizes all active proposals within its mandate. Global rankings are published in the (June) JOIDES Journal.The JOIDES Office summarizes these global rankings and PCOM sets a general four-year ship track based on these global priorities, with relatively firm early track (<2 years) and relatively flexible later direction (>2 years). The ship track is further refined at subsequent PCOM meetings, based on reevaluation of panel recommendations, technological developments, and overall state of the ODP program. On the one hand, complete and scientifically exciting proposals theoretically can become a top priority within one year, and could be drilled within two years after submission. On the other hand, relatively highly-ranked proposals may not get onto the drilling schedule at all, or stay on a waiting list, because final prioritization by thematic panels and scheduling by PCOM must take into account other criteria, such as technological feasibility and balance of major ODP themes.

Site survey review for highly ranked proposals

Proposals prioritized by thematic panels as being highly ranked are monitored by the Site Survey Panel (SSP). The time required for a thematically prioritized proposal to become part of a drilling plan depends to a large degree on completeness of required site survey data. Proponents are therefore urged to submit as complete a data package as possible as early as possible, once their proposals are highly ranked. If survey data is still to be collected, the timing of cruises, firmness of funding, and period required for data processing before submission to the Data Bank should all be noted.

Site survey data standards

SSP review is based on identification of drilling target categories and site survey techniques that can provide the optimal data set for each target. The target/techniques table used by SSP members monitoring proposals is shown in Figure 2

Target categories describe broad types of drilling objectives. Individual sites with multiple objectives may be required to meet the standards of two target categories. For example, sites frequently have shallow APC objectives (target A) and deeper sedimentary or basement objectives (target D or E). The Site Survey Panel member monitoring a proposal ("watchdog") will inform proponent(s) of the target category of each proposed site:

	DATA TYPE	A	B	C	D	E	F	G
		DRILLING ENVIRONMENT (TARGET)						
		Paleoenvironment or Fan (APC/XCB)	Passive Margin	Active Margin	Open Oceanic Crust (>400m Sediment Cover)	Open Oceanic Crust (<400m Sediment Cover)	+Bare-rock Drilling	Topographically Elevated Feature
1	Deep Penetration SCS	(X)	(X)	(X)	X or 3			(X)*
2	High Resolution SCS	X	(X)	(X)*	(X)	X	X	X
3	MCS & Velocity Determination		X	X	X or 1		(X)*	(X)*
4	Grid of Intersecting Seismic Lines	(X)*	X	X	(X)*	(X)	(X)	(X)*
5	Refraction		(X)*	(X)*	(X)*	(X)	(X)*	(X)*
6	3.5 kHz or 12 kHz	X	X	X	X	X	X	X
7	Swath Bathymetry	(X)*	(X)*	X or 8	(X)	(X)*	X	(X)*
8	High Resolution Side-looking Sonar	(X)*	(X)*	X or 7			(X)*	(X)*
9	Photography or Video			(X)			X	(X)*
10	Heat Flow		(X)*	(X)*		(X), H	(X), H	
11	Magnetics & Gravity		(X)	(X)	(X)*	(X)*	(X)*	(X)
12	Cores: Paleoenvironmental/geotechnical	X	(X), R	(X), R	R	R, H	X	(X)*, R
13	Rock Sampling					(X)*	X	(X)*
14	Current Meter (for Bottom Shear)	(X)*	(X)*	(X)*			(X)*	(X)*

X = Vital
(X) = Desirable
(X)* = Desirable, but may be required in some cases
R = Vital for re-entry sites
H = Required for high temperature environments

+ Requirements/recommendations for bare rock drilling and for drilling crustal sections exposed in tectonic windows are undergoing revision. Please contact the JOIDES Office for additional information if you are proposing a drilling program in one of these environments.

Figure 2. Site survey requirements

Target A: Generally APC/XCB penetration.

Target B: Greater penetration than a few hundred meters on a passive margin.

Target C: Greater penetration than a few hundred meters on an accretionary wedge, fore-arc, or sheared margin.

Target D: Greater penetration than a few hundred meters on oceanic crust. Often includes basement penetration.

Target E: Sediment thicknesses of less than a few hundred meters on oceanic crust

Target F: Bare rock drilling, e.g., ridge crest, fracture zone ridge.

Target G: Elevated features with widely varying sediment thicknesses, e.g., seamount, fracture zone ridge, plateau. Sediment slumping may be a problem on flanks. Basement is often an objective.

All geophysical techniques are not appropriate for all sites, and specific combinations are chosen to get maximum useful information for minimum cost. Figure 4 shows site survey requirements for each target environment.

1. Deep penetration SCS: large sound source-single channel seismic.
2. High resolution SCS: watergun single-channel seismic (or small chamber airgun in some situations).
3. MCS and velocity determination: velocity determination (stacking velocity and semblance plots) when accurate depths are critical; velocity analysis to determine sediment thickness over proposed sites.
4. Grid of intersecting seismic lines: required density of seismic grid and/or crossing lines over proposed site depends on each particular situation.
5. Refraction: sonobuoy or OBS refraction profiles; expanding spread or wide-angle refraction profiles; near-bottom sources and receivers may be desirable for highest resolution.
6. 3.5 or 12 kHz: to resolve small-scale sea floor morhological features and type of bottom material.
7. Swath bathymetry: as from a multi-narrow-beam echo sounder or an interferometric side-looking sonar system; required for all bare-rock drilling sites; may be required for any site with steep or complex topography; areas where slumping may occur should have swath bathymetry and/or side-looking sonar data.
8. High resolution side looking sonar: imagery-acoustical reflectivity from towed sonar devices is needed on fans and in topographically complex terrains; areas where slumping may occur should have multibeam bathymetry and/or side-looking sonar.
9. Video or still seafloor photography: visual imagery from towed vehicle or submersible is needed to site bare rock guidebase, and may be desirable to understand the tectonic or volcanic setting of some drill sites
10. Heat flow: pogo-type profiles or piston core heat flow measurements in detail, with *in-situ* thermal conductivity for highest accuracy, as appropriate to the scientific problem.
11. Magnetics and gravity: regional magnetics if magnetic age of crust is important; gravity for subsidence studies; SEASAT data may complement regional magnetic picture.

12. Coring: near paleoenvironmental sites. All re-entry sites should be supported by cores, core description and geotechnical measurements (contact Science Operator at TAMU for geotechnical requirements).
13. Rock sampling: dredging, submersible sampling, and/or rock coring may be required when basement drilling is included in the objectives.
14. Current meters: information on bottom currents will be required when bottom shear might be a problem. Shallow water sites may need tidal current information as well.

Physical Oceanographic Conditions

Information on ice, weather and near-surface currents, which might have a serious impact on the viability of a drill site, is also required at this stage. Information on ice conditions must be provided with high-latitude proposals, and on near-surface currents for some continental margin locations.

Data Deposition

Supporting data for proposals must be deposited in the ODP Site Survey Data Bank to ensure that a proposal stays viable. Data may be deposited in stages, while informing the Data Bank on data still to be collected. Guidelines for submission of data to the Site Survey Data Bank are detailed in the *JOIDES Journal Special Issue, Vol. XIV, No. 4, 1988* (p. 49).

Safety Review

The most critical safety and pollution hazards in scientific ocean drilling are possible release of hydrocarbons from a subsurface reservoir or penetration into a superheated hydrothermal system. The presence of gas hydrates or high concentrations of H_2S in pore waters may also sometimes constitute a hazard. In most deep-sea regions, the risk of hydrocarbon release can be reduced or eliminated by careful planning, judicious choice of drilling locations based on proper site surveys, and by taking special precautions when coring at potentially hazardous sites.

Although primary responsibility for documenting hazardous sub-seafloor conditions rests with the co-chief scientists, proponents can ensure at an early stage that adequate technical data are obtained and processed for examination by the Pollution Prevention and Safety Panel (PPSP) by becoming familiar with guidelines for safety reviews.

Safety review is a critical element in the process of planning a drilling leg. In addition to the PPSP, the Science Operator at TAMU also has an independent group of safety advisors. Advice and recommendations from both groups are incorporated into the final decision by the Science Operator on whether or not a proposed site will be drilled. PPSP guidelines are detailed in the *JOIDES Journal Special Issue, Vol. XIV, No. 4, 1988* (p. 33); they are being updated this year and will be published in an upcoming special issue of the *JOIDES Journal*.

Other information for preparation of detailed drilling plan

Preliminary Time Estimates for Coring and Logging Operations

Guidelines have been prepared by both the Science Operator and the Wireline Logging Services Contractor for estimating ODP coring and logging times. TAMU has compiled and revised curves for estimating these times in the following publication:

Preliminary Time Estimates for Coring Operations, ODP Technical Note No. 1 (Revised December 1986; available from ODP/TAMU).

In this publication, drill string and wireline trip time curves reflect actual operating times on ODP Legs 103 through 108 (excluding Leg 106, which was not considered representative of routine operations). Curves for drill string trip time and rotary (RCB), advanced piston (APC), and extended core barrel (XCB) coring cycles are included. They can be used for estimating times in both single-bit and re-entry holes.

These curves, along with procedures for calculating approximate coring and logging times, are available to assist proponents in developing realistic drilling times. Whenever possible, time estimates for ODP holes should be based on data from similar locations and/or lithologies.

Because of the complexity of ODP operations, however, these estimates should not be used for detailed operational planning. Once a site has been approved and its objectives defined, detailed planning becomes the responsibility of the Science Operator.

List of publications relevant to proposal submission, and where to get them

- Proposal submission guidelines: JOIDES Office
- COSOD II Report: JOI, Inc.
- ODP Long Range Plan: JOI, Inc.
- Thematic panel mandates: *JOIDES Journal Special Issue, Vol. XIV, No. 4, 1988*; JOI, Inc.
- Thematic panel white papers: various *JOIDES Journal* issues (1989/90), JOI, Inc. or JOIDES Office
- Guidelines for submission of data to the Site Survey Data Bank: *JOIDES Journal Special Issue, Vol. XIV, No. 4, 1988*; JOI, Inc.
- Guidelines for safety review: *JOIDES Journal Special Issue, Vol. XIV, No. 4, 1988*; JOI, Inc.
- Preliminary Time Estimates for Coring Operations: *ODP Technical Note No. 1*; ODP/TAMU

List of active drilling proposals

According to PCOM (August 1991 meeting; see *JOIDES Journal* October 1991 issue), "active" proposals are those which have been submitted or updated within the period including three full calendar years before the present calendar year and the present year (i.e., since January 1, 1989 for 1992 activities, to roll to January 1, 1990 for 1993 activities, etc.). Only "active" proposals are considered for planning in general, and for global ranking at the thematic panels' spring meetings in particular. At present, there are 93 active proposals in the system (from a total of 599 received since the beginning of ODP). They include reviewed proposals, some of which have been globally ranked last spring, and proposals in review (i.e., submitted or updated since mid-September 1991). Thematic panels will reconsider these proposals, according to their mandates, expertise of their membership, and longer-term strategies in achieving major scientific goals, and globally rank those of high potential for drilling within future years. Based on the advice of the thematic panels, PCOM will decide on a general ship track up to fiscal year 1995, the earlier part being more firm than the later part.

JOIDES Office, UTIG Page 1 Feb 17, 1992

"Active" ODP Proposals for Global Ranking 1992 (Sorted by "Ref. No")

Ref.No	Received	Abbreviated Title	Contact	Status
059-Rev3	01/30/92	Cont. margin sed. instability: sea level & basinal analysis	Weaver, P.P.E.	In Review
142-Rev	04/05/89	Ontong Java Plateau	Mayer, L.	**Leg 130**
253-Rev	06/19/91	Deposition of organic carbon-rich strata, ancestral Pacific	Sliter, W.V.	**Ranked 1991**
265----	12/04/86	Western Woodlark Basin	Scott, S.D.	**Ranked 1991**
265-Add	06/04/90	Addendum to Woodlark Basin proposal	Scott, S.D.	**Ranked 1991**
271-Rev2	09/22/89	Limited APC coring on seamounts off California Coast	Barron, J.A.	Reviewed
319----	02/21/89	Extinct hydroth. system, E Galpagos Rift/Inca transform	Jonasson, I.R.	Reviewed
322----	03/28/89	Ontong Java Plateau kimberlites	Nixon, P.H.	Reviewed
323-Rev	02/11/91	Alboran basin and Atlantic-Mediterranean gateway	Comas, M.C.	**Ranked 1991**
324----	04/20/89	Mediterranean tectonic evolution	Cita-Sironi, M.B.	Reviewed
325----	05/09/89	High-T hydrothermal site, Endeavour Ridge	Johnson, H.P.	**Ranked 1991**
326----	05/11/89	Continental margin drilling, Morocco/Northwest Africa	Hinz, K.	Reviewed
327----	05/24/89	Argentine continental rise	Hinz, K.	**Ranked 1991**
329-Rev	07/14/89	Formation of the Atlantic Ocean	Herbin, J.P.	Reviewed
330----	07/17/89	Accretionary prism and collision, Mediterranean Ridge	Cita-Sironi, M.B.	**Ranked 1991**
330-Add	01/22/90	Accretionary prism in collisional context, Med. Ridge	Cita-Sironi, M.B.	**Ranked 1991**
330-Add2	09/10/91	Accretionary prism in collisional context, Med. Ridge	Cita-Sironi, M.B.	**Ranked 1991**
331----	07/25/89	Extinct spreading axis, Aegir Ridge, Norwegian Sea	Whitmarsh, R.B.	Reviewed
332-Rev3	02/04/92	Florida Escarpment drilling transect	Paull, C.K.	In Review
333----	07/27/89	Evolution of pull-apart basin, Cayman Trough	Mann, P.	**Ranked 1991**
333-Add	02/04/92	Update to Cayman Trough transect	Mann, P.	In Review
337----	07/31/89	Tests of Exxon sea-level curve, New Zealand	Carter, R.M.	**Ranked 1991**
338----	08/03/89	Sea-level fluct., Marion carbonate plateau, NE Australia	Pigram, C.J.	Reviewed
340----	08/07/89	Tectonic, climatic, oceano. change, N Australian margin	Symonds, P.	**Ranked 1991**
341----	08/08/89	Late Wisconsinian climatic changes, off E Canada	Syvitski, J.P.M.	Reviewed
343----	08/08/89	Window of Cret. volcanic formation, Caribbean Zone	Mauffret, A.	**Ranked 1991**
344----	08/08/89	Jurassic Magnetic Quiet Zone, W North Atlantic	Sheridan, R.E.	Reviewed
345----	08/11/89	Sea level and paleoclimate, W Florida margin	Joyce, J.E.	**Ranked 1991**
345-Add	10/05/90	Addenda to West Florida margin sea level and paleo.	Joyce, J.E.	**Ranked 1991**
346-Rev2	08/14/91	Ivory Coast - Ghana transform margin	Mascle, J.	**Ranked 1991**
347----	08/15/89	L. Cenozoic paleoceanography, south-equatorial Atlantic	Wefer, G.	**Ranked 1991**
351----	09/06/89	Bransfield Strait	Storey, B.C.	Reviewed
352----	09/13/89	Layer 3 of East Pacific crust, Mathematician Ridge	Stakes, D.S.	Reviewed
353-Rev	09/13/89	Antarctic Peninsula, Pacific margin	Barker, P.F.	Reviewed
354-Rev	01/30/92	Benguela Current and Angola/Namibia upwelling	Wefer, G.	In Review
355-Rev2	08/30/90	Formation of a gas hydrate	Von Huene, R.	**Ranked 1991**
356-Rev	05/01/91	Oceanogr./climatic changes, North Greenland Sea	Smolka, P.P.	Reviewed
360----	12/06/89	Hydrothermal activity and metallogenesis, Valu Fa Ridge	Von Stackelberg,	**Ranked 1991**
361-Rev	03/01/91	Hydroth. system, slow-spread. ridge, MAR 26°N (TAG)	Thompson, G.	**Ranked 1991**
361-Add	10/25/91	Site survey, TAG hydrothermal field, MAR 26°N	Thompson, G.	In Review
363----	01/18/90	Plume volcanism and rift/drift, Grand Banks-Iberia	Tucholke, B.E.	**Ranked 1991**
363-Add	02/18/91	Paleoceanographic record at sites NR1, NR2, and NR3	Tucholke, B.E.	**Ranked 1991**
364----	01/22/90	Thrust units of cont. basement, Sardinian-African Strait	Torelli, L.	Reviewed
365-Add	05/28/91	Geothermal measurements, Newfoundland/Iberia transects	Louden, K.E.	Reviewed
367----	02/07/90	Cool water carbonate margin, southern Australia	James, N.P.	**Ranked 1991**
368----	02/12/90	Jurassic Pacific crust: A return to Hole 801C	Larson, R.L.	**Ranked 1991**
369-Rev	09/09/91	Generation of oceanic lithosphere, MARK area	Casey, J.F.	**Ranked 1991**

"Active" ODP Proposals for Global Ranking 1992 (Sorted by "Ref. No")

Ref.No	Received	Abbreviated Title	Contact	Status
369-Add	09/16/91	MK2: deep hole in oceanic upper mantle	Mevel, C.	**Ranked 1991**
370----	02/22/90	Magmatic processes and natural tracers, MAR	Dick, H.J.B.	Reviewed
372----	02/26/90	Cenozoic circulation and chem. gradients, N Atlantic	Zahn, R.	**Ranked 1991**
373----	03/01/90	Stress, hydrol. circ. and heat flow, Site 505 revisited	Zoback, M.D.	**Ranked 1991**
374----	03/06/90	Mantle heterogeneity, Oceanographer FZ	Dick, H.J.B.	**Ranked 1991**
376-Rev	09/16/91	Layer 2/3 boundary and vertical tectonics, VEMA F.Z.	Mevel, C.	**Ranked 1991**
378-Rev	03/12/90	Growth and fluids evol., Barbados accretionary wedge	Westbrook, G.K.	**Ranked 1991**
379----	03/12/90	Scientific drilling in the Mediterranean Sea	Mascle, J.	**Ranked 1991**
380-Rev2	09/12/91	VICAP, Gran Canaria	Bednarz, U.	**Ranked 1991**
381----	03/19/90	Drilling on continental shelf and slope, Argentina	Huber, B.T.	Reviewed
383----	05/22/90	Extension and continent-continent collision, Aegean Sea	Kastens, K.A.	Reviewed
384-Rev	07/18/90	Pacific-Atlantic connection, Venezuela basin, Aruba Gap	Mauffret, A.	Reviewed
386-Rev	08/10/90	Paleoceanography and deformation, California margin	Lyle, M.	**Ranked 1991**
388----	10/01/90	Neogene deep water circ. and chemistry, Ceara Rise	Curry, W.B.	**Ranked 1991**
388-Add	09/06/91	Add. to Neogene deep water circ. and chem., Ceara Rise	Curry, W.B.	**Ranked 1991**
389----	10/29/90	Cretaceous traverse, Western South Atlantic	Malmgren, B.A.	Reviewed
390----	11/12/90	Drilling in the Shirshov ridge region	Milanovsky, V.E.	**Ranked 1991**
391----	01/02/91	Formation of sapropels, eastern Mediterranean	Zahn, R.	**Ranked 1991**
391-Add	09/12/91	Formation of sapropels, eastern Mediterranean	Zahn, R.	**Ranked 1991**
392----	01/29/91	Mantle plume origin, North Atlantic volcanic margins	Larsen, H.C.	**Ranked 1991**
394----	02/04/91	Pre/syn-volcanic extensinal basins on passive margins	Kiørboe, L.V.	**Ranked 1991**
395----	02/11/91	Compressional tectonics on a passive volcanic margin	Boldreel, L.O.	**Ranked 1991**
397----	02/20/91	Mantle plume and multiple rifting, North Atlantic	Gudlaugsson, S.T	Reviewed
398----	02/22/91	Quat. paleoceanography, Grand Banks, Newfoundland	Piper, D.J.W.	Reviewed
399----	05/03/91	Tectonic evolution of the Alboran Sea	Watts, A.B.	Reviewed
400----	09/03/91	Mass balance/def. mech., Middle Am. Trench/Costa Rica	Silver, E.A.	Reviewed
401----	09/05/91	Evolution of a Jurassic Seaway, SE Gulf of Mexico	Buffler, R.T.	Reviewed
402----	09/09/91	Geochemical anomaly in MAR basalts between 12°-18°N	Sobolev, A.V.	Reviewed
403-Rev	02/03/92	KT boundary, Gulf of Mexico	Alvarez, W.	In Review
404----	09/11/91	Neogene paleo. from W North Atlantic sediment drifts	Keigwin, L.D.	Reviewed
405----	09/12/91	Amazon fan growth and climate, denudation, sea-level	Flood, R.D.	Reviewed
406----	09/16/91	North Atlantic climatic variability	Oppo, D.	Reviewed
407----	09/16/91	North Atlantic shallow mantle at geochemical anomaly	Dick, H.J.B.	Reviewed
408----	09/16/91	Testing two new interpretations, N Nicaragua Rise	Droxler, A.W.	Reviewed
409----	10/04/91	Late Quaternary paleo., Santa Barbara Basin	Kennett, J.P.	In Review
410----	12/02/91	Deepening Hole 504B, core/log dike/gabbro boundary	Erzinger, J.	In Review
411----	12/09/91	The Caribbean Basalt Province - an oceanic basalt plateau	Donnelly, T.W.	In Review
412----	01/28/92	Bahamas transect: Neogene/Quat. sea level and fluid flow	Eberli, G.P.	In Review
413----	02/03/92	Magmatic/tectonic evol. of oceanic crust: Reykjanes Ridge	Murton, B.J.	In Review
414----	02/03/92	Structural and fluid proc., N Barbados Ridge acc. prism	Moore, J.C.	In Review
415----	02/03/92	Cretaceous-Tertiary boundary in the Caribbean Sea	Sigurdsson, H.	In Review
Bering	09/07/90	Bering Sea history (Pacific Prospectus)	CEPAC	**Ranked 1991**
EPR	01/09/91	East Pacific Rise DPG Report	Davis, E.E.	**Legs 142/147**
NAAG	04/11/91	North Atlantic - Arctic Gateways DPG Report	Ruddiman, W.F.	**Leg 151**
NARM	09/10/91	North Atlantic Rifted Margins DPG Report	Larsen, H.C.	**Legs 149/152**
SR	10/30/89	Sedimented Ridges DPG Report	Detrick, R.S.	**Leg 139**

Bulletin Board

ANNOUNCEMENTS

JOI/USSAC OCEAN DRILLING GRADUATE FELLOWSHIPS

JOI/US Science Advisory Committee is seeking doctoral candidates of unusual promise and ability who are enrolled in U.S. institutions to conduct research compatible with that of the Ocean Drilling Program. Both two-year and one-year fellowships are available. The award is $20,000 per year to be used for stipend, tuition, benefits, research costs and incidental travel, if any. Applicants are encouraged to propose innovative and imaginative projects. Applications are available from the JOI office and should be submitted according to the following schedule:

Leg 147: Hess Deep	5/1/92
Leg 149: Iberian Abyssal Plain	5/1/92
Leg 150: New Jersey Sea Level	5/1/92
Leg 151: North Atlantic Arctic Gateways	5/1/92
Leg 152: East Greenland Margin	5/1/92
Shorebased Work (regardless of leg)	12/1/92

These legs will be staffed in the next few months. Students interested in participating as shipboard scientists must apply to the ODP Manager of Science Operations at Texas A&M University. An application form is available in the JOI/USSAC application packet.

For more information and to receive an application packet, contact:

JOI/USSAC Ocean Drilling Fellowship Program
Joint Oceanographic Institutions, Inc.
1755 Massachusetts Ave., NW, Suite 800
Washington, DC 20036-2102.
For additional information,call:
Robin Smith, 202-232-3900.

ECOD Workshop 1992, Copenhagen

Theme: Drilling towards the 21st Century: ODP in the Atlantic

Purpose: To create a "second wave" of drilling proposals, hopefully in the spirit of the ODP Long Range Plan, that are focussed on the Atlantic and aimed at the mid- to late 1990's.

Excursion 1:		Iceland 3 days (arrive 1 May, depart for Copenhagen 5 May).
6 May	9:00 AM:	Opening remarks and welcome by Danish Minister of Education and Science. Introduction by ESCO chairperson (M.B Cita). Pep talk by PCOM chairperson (J. Austin). Setting the thematic scene for future drilling: four, 30-minute talks by thematic panel chairpersons: Susan Humphris (LITHP). Peggy Delaney (OHP). Eldridge Moores (TECP). Judy McKenzie (SGPP).
	3:00 PM:	Split into four thematic working groups, chaired by ECOD thematic panel delegates (old/new).
7 May	8:30 AM:	Plenum talk by ODP Deputy Director (Tim Francis). Working groups continue.
	3:30 PM:	Excursion 2 to Stevns Klint (K/T boundary).
	Evening:	Dinner at Danish Country "Kro".
8 May	8:30 AM:	Talk by Yves Lancelot: new platform? Working groups continue.
	1:00 PM:	Presentation of working group highlights.
	3:30 PM:	Departure for ferry to Oslo.
	Evening:	Talk by Jorn Thiede: Nansen Arctic Drilling Program.
Excursion 3:		9-10 May, Oslo region. (Day 1 by ship, day 2 by bus.)

Workshop concludes following Excursion 3, at 5:00 PM, May 10. Participants may return by night ferry to Copenhagen. Report deadline: mid- autumn 1992, to be published by Danish Geol. Survey.

GEOLOGY OF THE OCEANS

Proceedings

Copies of the volume containing the Proceedings of the International Conference *Geology of the Oceans* held in Terrasini (Palermo), May 14-16, 1990, are now available from the ISCO Secretariat.

The volume has been printed by SGI (Società Geologica Italiana) with the support of ESF (European Science Foundation) and contains 19 papers from Italian, European and Russian scientists on various subjects concerning deep sea drilling and ODP.

To obtain a copy of the volume ($25 US per single volume), please contact:

ESCO Secretariat, Department of Earth Sciences, Via Mangiagalli, 34
I-20133 MILANO, ITALY
Tel: +39 (2) 23698240. Fax: +39 (2) 70638261

CONTENTS

IN SEARCH OF THE LOST OCEAN

Geological and cultural images of Nepal

This video highlights the high mountain trekking and geological discoveries of the 1991 "Lost Ocean Expedition". Geologists from Canada, Germany, Italy, Japan, Norway and U.S.A. followed the Kali Gandaki river northward through the deepest valley on earth into the remote Mustang District of northern Nepal. Their objective was to find types of rocks and fossils that carried evidence for the Tethys Ocean and the break-up, 150 m.y. ago, of the supercontinent of Gondwana. This landmass of India, Australia, Antarctica and Africa, all welded together, faced the giant Tethys Ocean to the north. The continental drift of India and Nepal, and its collision with central Asia led to the disappearance of Tethys and the emergence and uplift of the Himalayan mountain chain.

The discoveries of the expedition provide new pieces in the puzzle of plate tectonics and the origin of the Himalayas. The film also features authentic Nepali music and blends beautiful cultural and geological images of a unique country and its mountain people in a story of "The Lost Ocean".

Video: 28 minutes (Umatic or VHS format)
Producer: Felix Gradstein, Canada
Co-producers: Inger Lise Kristiansen, Norway, and Massimo Sarti, Italy
Technical realization: Ivan Ardizzoni, Antenna Verde Studios, Ferrara, Italy
Distributed by: Ms. Grazia, c/o Imp. Sarti, 115 Corso Porta Reno, 1-44100 Ferrara, Italy (Fax: 39 532 760020)

The producing team of In Search of the Lost Ocean gratefully acknowledges the participation of the expedition members, the people of Nepal, the Sherpa Society (Nepal), geoscientists of the Sahni and Wadia Institutes (India), Gary Grant and Gary Cook (Canada), Morten Johnsen (Norway), Richard Zorewsky (Canada), Jean-Yves Royer (France), Lisa Gahagan (PLATES Project, University of Texas Institute for Geophysics, USA), Laura Tizzano (Italy).

CENOZOIC GLACIATION: THE MARINE RECORD ESTABLISHED BY OCEAN DRILLING

A SUPPLEMENT TO UNDERGRADUATE CURRICULA

Eugene Domack and Cynthia Domack, Hamilton College

A new course supplement, Cenozoic Glaciation: The Marine Record Established by Ocean Drilling, will be available for use in the fall 1991 semester. The booklet, sponsored by JOI/USSAC, covers the results of five ODP high-latitude legs: two in the northern hemisphere (legs 104 and 105) and three in the southern hemisphere (legs 113, 119 and 120). Cenozoic Glaciation is intended for use as a supplement to regular class materials in courses such as oceanography, glacial geology, marine geology, and sedimentology, and is designed specifically for undergraduates. A coordinated color poster illustrating the core intervals described in the text is included.

Copies of the booklet and poster are available from JOI.

If you would like a sample copy, contact Mary Reagan, Joint Oceanographic Institutions, Inc., 1755 Massachusetts Ave., NW, Suite 800, Washington, DC 20036-2102; (202) 232-3900.

Available from: Karen Riedel, ODP, Public Relations, Texas A&M University, 1000 Discovery Drive, College Station, TX 77840.

Coring Poster

ODP has a poster: "Scientific Coring Beneath the Sea," available for distribution. The poster features individual coring systems developed for scientific ocean drilling including the rotary core bit, advanced piston coring and extended core barrel. Eric Schulte of Engineering and Drilling Operations designed and produced the poster.

Brochures

Updated ODP brochures in English, French, Spanish, and German are now available. A brochure featuring engineering developments is also available.

Reprints

Reprints of the 1990 Offshore Technology Conference paper, *"The Ocean Drilling Program: After five years of field operations,"* is available from Karen Riedel. The paper, written by P.D. Rabinowitz, L.E. Garrison, et al., features the significant results of Legs 100-124. The paper also describes in detail Legs 124E-135. An ODP Operations Summary outlines the data from each cruise including number of sites, number of holes and percent recovery.

ODP Long Range Plan

The ODP Long Range Plan portfolio is available from the JOI office. If you would like to receive a copy, contact:
Jenny Granger, JOI, Inc.
1755 Massachusetts Ave., NW, Suite 800
Washington, DC 20036-2102
Phone: 202-232-3900, FAX: 202-232-8203

Report on National Workshop on Gas Hydrates

Workshop held in April 1991, organized by: US Navy, Naval Research Laboratory; USGS; US Dept. of Energy, Morgantown Energy Technology Center.

Report available from: National Technical Information Service, US Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

ODP Open Discussion via Bitnet

The ODP BITNET LISTSERVER is an open discussion service to which individuals subscribe *via* Bitnet. It permits exchange of information among all subscribers. Currently, the list administrator sends a report of the previous week's shipboard scientific and operations activities to all subscribers. Site summaries are distributed as soon as they are received at ODP from the ship, usually the day after a site is completed. Periodically, an updated cruise schedule and brief descriptions of upcoming cruises are sent out. Any subscriber may send files to the list for distribution. A file sent *via* Bitnet to the list address (ODP-L@TAMVM1) will be distributed automatically to all subscribers.

Anyone with a Bitnet computer link can subscribe. At present there are subscribers in the U.S., Canada, Europe, Australia and Japan. There is no charge for subscribing to the listserver.

To subscribe, send a brief Bitnet command to LISTSERV@TAMVM1 consisting of the words "SUBSCRIBE ODP-L YOUR_NAME" (where YOUR_NAME really is your first and last names). For example, people on VAX/VMS systems using the JNET networking software will send a command that looks like this: $SEND LISTSERV@TAMVM1 "SUBSCRIBE ODP-L YOUR_NAME" but it may be different according to the command language your computer system uses. If you have any questions, your own friendly local system manager should be able to help. As a last resort, you may send a Bitnet message to Anne Graham (ANNIEG@TAMODP) requesting that you be added to the ODP-L subscription list.

Funding for Site Survey Augmentation

JOI/U.S. Science Support Program has Site Survey Augmentation funds available to supplement drilling site data sets that are in all phases of planning. This program element includes support for:

- acquiring and/or processing data for sites being considered by JOIDES;
- mini-workshops that would bring together scientists to coordinate site-specific data for integration into a mature drilling proposal;
- "augmentation" surveys on ships of opportunity that would significantly enrich drilling-related science and/or acquire needed site survey data;
- U.S. scientists to participate in non-U.S. site surveys.

Site Survey Augmentation proposals may be submitted at any time. Priority will be given to augmentation of sites and/or themes that are high priority within JOIDES. As with all JOI/USSSP activities, it is important to clearly state how the work would contribute to U.S. plans or goals related to the Ocean Drilling Program. Note that the Site Survey Augmentation funds cannot be used to supplement NSF/ODP funded work.

Contact Ellen Kappel, JOI office, for further information and proposal guidelines: (202) 232-3900.

Micropaleontological Reference Centers

Located at eight sites on four continents, the Micropaleontological Reference Centers (MRC) provide scientists around the world an opportunity to examine, describe, and photograph microfossils of various geological ages and provenance. The collections contain specimens from four fossil groups—foraminifers, calcareous nannofossils, radiolarians, and diatoms—selected from sediment samples obtained from the Deep Sea Drilling Project (DSDP). The processing of samples from DSDP legs 1 through 82 has been overseen by John Saunders, Supervisor of the Western Europe Center, and William Riedel, Supervisor of the facility on the US West Coast. These samples have been prepared, divided into eight identical splits, and distributed to each MRC. Future plans include the addition of samples from the later legs of DSDP, and from the Ocean Drilling Program (ODP) as well.

All fossil material maintained by MRCs remains the property of the US National Science Foundation and is held by the MRCs on semipermanent loan.

The establishment of identical paleontological reference collections around the world will help researchers to unify studies on Pelagic biostratigraphy and paleoenvironments, and to stabilize taxonomy of planktonic microfossils. Researchers visiting these centers may observe the quality of preservation and the richness of a large number of Microfossils, enabling them to plan their own requests for either ODP or DSDP deep-sea samples more carefully. Visitors to MRCs also may compare actual, prepared faunas and floras (equivalent to type material) with figures and descriptions published in DSDP *Initial Reports* or ODP *Proceedings* volumes.

Facilities at MRCs

All MRCs maintain complete, identical collections of microfossil specimens. In addition, the following materials and equipment are available for visitor use:

- secure storage and display areas
- binocular microscope and work space
- reference set of DSDP *Initial Reports* and ODP *Proceedings* volumes
- lithologic smear slides accompanying each fossil sample
- microfiche listings of samples available.

For more information about MRCs, or to schedule a visit, contact the supervisor on site.

Locations of MRCs

US East Coast
Lamont-Doherty Geological Observatory
Palisades, NY 10964
Supervisor: Ms. Rusty Lotti
Phone: (914) 359-2900
Telex: 7105762653 LAMONTGEO

US National Museum
US National Museum of Natural History
Dept. of Paleobiology
Smithsonian Institution
Washington, D.C. 20560
Supervisor: Dr. Brian Huber
Phone: (202) 786-2658
Telex: 264729
Fax: (202) 786-2832

US Gulf Coast
Texas A&M University
Dept. of Oceanography
College Station, TX 77843
Supervisor: Dr. Stefan Gartner
Phone: (409) 845-8479

US West Coast
Scripps Institution of Oceanography
La Jolla, CA 92093
Supervisor: Dr. William Riedel
Phone: (619) 534-4386
Telex: 910337127 IUC WWD SIOSDG

Western Europe
Natural History Museum
CH-4001 Basel
Switzerland
Supervisor: Mr. John Saunders
Phone: 061-29-55-64

USSR
Institute of the Lithosphere
Staromonet 22
Moscow 109180, USSR
Supervisor: Dr. Ivan Basov
Phone: 231-48-36

Japan
National Science Museum
Dept. of Geology
3-23-1 Hyakunin-cho
Shinjuku-ku
Tokyo, 160, Japan
Supervisor: Dr. Y. Tanimura
Phone: 03-364-2311
Telemail: 03-364-2316

New Zealand
DSIR Geology & Geophysics
PO Box 30 368
Lower Hutt, New Zealand
Supervisor: Dr. C.P. Strong
Phone: (04) 569-9059
Fax: (04) 569-5016

JOI/USSAC Workshops and other Reports

Joint Oceanographic Institutions, Inc.
1755 Massachusetts Ave. NW, Suite 800, Washington, D.C. 20036-2102, Tel (202) 232-3900

Scientific Seamount Drilling, Tony Watts and Rodey Batiza, conveners.

Vertical Seismic Profiling (VSP) and the Ocean Drilling Program (ODP), John Mutter and Al Balch, conveners.

Dating Young MORB?, Rodey Batiza, Robert Duncan and David Janecky, conveners.

Downhole Seismometers in the Deep Ocean, Mike Purdy and Adam Dziewonski, conveners.

Science Opportunities Created By Wireline Reentry of Deep-Sea Boreholes, Marcus G. Langseth and Fred N. Speiss, conveners.

Wellbore Sampling, Richard K Traeger and Barry W. Harding, conveners

South Atlantic and Adjacent Southern Ocean Drilling, James A. Austin, Jr., convener.

Measurements of Physical Properties and Mechanical State in the Ocean Drilling Program, Daniel K. Karig and Matthew H. Salisbury, conveners.

Paleomagnetic Objectives for the Ocean Drilling Program, Kenneth L. Verosub, Maureen Steiner and Neil Opdyke, conveners.

Cretaceous Black Shales, Michael A. Arthur and Philip A. Meyers, conveners.

Caribbean Geological Evolution, Robert C. Speed, convener.

Drilling the Oceanic Lower Crust and Mantle, Henry J.B. Dick, convener.

Role of ODP Drilling in the Investigation of Global Changes in Sea Level, Joel S. Watkins and Gregory S. Mountain, conveners.

Ocean Drilling and Tectonic Frames of Reference, Richard Carlson, William Sager and Donna Jurdy, conveners.

ODP Shipboard Integration of Core and Log Data, Kate Moran and Paul Worthington, conveners.

Drilling of the Gulf of California, Berndt Simoneit and J. Paul Dauphin, Conveners.

East Pacific Rise Petrology Data Base (Vols. I-III), Charles Langmuir, compiler.

Report of the Second Conference on Scientific Ocean Drilling (COSOD II), JOIDES, sponsor.

Geochemistry Progress and Opportunities, Miriam Kastner and Garrett Brass, Conveners.

Proceedings of a Workshop on the Physical Properties of Volcanic Seafloor, G.M. Purdy and G.J. Fryer, Conveners.

College
Cumul
Volum
A
of the
ing P
TAM
form
RO
pac
inc
a s
in
sc

ODP BIBLIOGRAPHY AND DATABASES

ODP Science Operator

Texas A&M University, 1000 Discovery Drive, College Station, Texas 77845-9547

Cumulative Index to 96 DSDP Volumes Now Available

A cumulative index to all 96 volumes of the Initial Reports of the Deep Sea Drilling Project is now available from ODP/TAMU. The index is presented in two formats: an electronic version on CD-ROM, and a printed version. Both are packaged together in a sturdy slipcase.

The index is in three parts: (1) a subject index, (2) a paleontological index, and (3) a site index. The three parts reflect the interwoven nature of the marine geoscience subdisciplines.

The electronic version of the index is the more complete of the two, containing up to eight hierarchies of entries. The 1072-page printed index volume contains three hierarchies of entries and was condensed from the electronic version. Both versions of the index were prepared by Wm. J. Richardson Associates, Inc.

The CD-ROM containing the electronic index was manufactured under the auspices of the Marine Geology and Geophysics Division of the National Geophysical Data Center, National Oceanic and Atmospheric Administration, and U.S. Department of Commerce. In addition to the three-part index, the CD-ROM contains (1) a bibliography of authors and titles, (2) citations to DSDP exclusive of the Initial Reports, (3) proposals to DSDP, (4) site-summary information, (5) an inventory of DSDP underway geophysical data, (6) an inventory of downhole-logging data, and (7) data-documentation files.

Many persons contributed to the indexing project, including those at Scripps Institution of Oceanography and Texas A&M University. The U.S. National Science Foundation funded preparation and publication.

Index sets can be obtained from the Publications Distribution Center, Ocean Drilling Program, 1000 Discovery Drive, College Station, Texas 77845-9547, U.S.A. (telephone, 409-845-2016). The price is US $50.00 postpaid.

Proceedings of the Ocean Drilling Program, Initial Reports and Scientific Results

	Initial Reports		Scientific Results	
	Vol.	Published	Vol.	Publ.
Leg 101	101/102	Dec 86	101/102	Dec 88
Leg 102	101/102	Dec 86	101/102	Dec 88
Leg 103	103	Apr 87	103	Dec 88
Leg 104	104	July 87	104	Oct 89
Leg 105	105	Aug 87	105	Oct 89
Leg 106	106/109/111	Feb 88	106/109	Jan 90
Leg 107	107	Oct 87	107	Feb 90
Leg 108	108	Jan 88	108	Dec 89
Leg 109	106/109/111	Feb 88	106/109	Jan 90
Leg 110	110	Apr 88	110	May 90
Leg 111	106/109/111	Feb 88	111	Dec 89
Leg 112	112	Aug 88	112	May 90
Leg 113	113	Sept 88	113	Aug 90
Leg 114	114	Nov 88	114	Feb 91
Leg 115	115	Nov 88	115	Sept 90
Leg 116	116	Jan 89	116	Sept 90
Leg 117	117	June 89	117	Feb 91
Leg118	118	May 89	118	July 91
Leg 119	119	Sept 89	119	Sept 91
Leg 120	120	Nov 89		
Leg 121	121	Nov 89	121	Nov 91
Leg 122	122	Jan 90		
Leg 123	123	June 90		
Leg 124	124	June 90	124	Sept 91
Leg 125	125	Aug 90		
Leg 126	126	Aug 90		
Leg 127	127	Sept 90		
Leg 128	128	Sept 90		
Leg 129	129	Dec 90		
Leg 130	130	Mar 91		
Leg 131	131/132	June 91		
Leg 132	131/132	June 91		
Leg 133	133	Sept 91		
Legs136/137	36/37	Jan 92		

Scientific Prospectuses and Preliminary Reports

	Prospectuses		Prelimin. Rpts.	
	Vol.	Published	Vol.	Published
Leg 134	34	June 90	34	Jan 91
Leg 135	No 35	Sept 90	35	May 91
Leg 136	36	Dec 90	36	May 91
Leg 137	No 37	Jan 91	37	May 91
Leg 138	38	Jan 91	38	Sept 91
Leg 139	39	Mar 91	39	Nov 91
Leg 140	40	June 91	40	Jan 92
Leg 141	41	Aug 9		
Legs143/144	43/44	Jan 92		

Engineering Prospectuses and Preliminary Reports

	Prospectus		Prelimin. Rpts.	
	Vol.	Published	Vol.	Published
Leg 142	3	Nov 91		

Technical Notes

No. 1: Preliminary time estimates for coring operations (Revised Dec 86)

No. 3: Shipboard Scientist's Handbook (Revised 1990)

No. 6: Organic Geochemistry aboard *JOIDES Resolution*- An Assay (Sept 86)

No. 7: Shipboard Organic Geochemistry on *JOIDES Resolution* (Sept 86)

No. 8: Handbook for Shipboard Sedimentologists (Aug 88)

No. 9: Deep Sea Drilling Project data file documents (Jan 88)

No. 10: A Guide to ODP Tools for Downhole Measurement (June 88)

No. 11: Introduction to the Ocean Drilling Program (Dec 88)

No. 12: Handbook for Shipboard Paleontologists (June 89)

No. 14: A Guide to Formation Testing using ODP Drillstring Packers (1990)

No. 15: Chemical Methods for Interstitial Water Analysis on *JOIDES Resolution*

No. 16: Hydrogen Sulfide-High Temperature Drilling Contingency Plan (1991)

Publications Office, Fabiola Byrne
Phone: (409) 845-2016; Fax: (409) 845-4857
Bitnet: FABIOLA@TAMODP

Other Items Available

Brochure: The Data Base Collection of the ODP - Database Information

Ocean Drilling Program brochure (English, French, Spanish, German or Japanese)

ODP Sample Distribution Policy

Micropaleontology Reference Center brochure

Instructions for Contributors to ODP *Proceedings* (Revised Oct 90)

ODP Engineering and Drilling Operations (New)

Multilingual brochure with a synopsis of ODP (English, French, Spanish, German and Japanese)

ODP Posters (Ship and coring systems posters)

ODP After Five Years of Field Operations (Reprinted from the 1990 Offshore Technology Conference proceedings)

Brochure: On Board *JOIDES Resolution*

Public Information Office, Karen Riedel
Phone: (409) 845-9322; Fax: (409) 845-0876
Bitnet: KAREN@TAMODP

Sample Distribution

The materials from Legs 132 through 134 are now available for sampling by the general scientific community. This means that the twelve-month moratorium on cruise-related sample distribution is complete for Ocean Drilling Program legs 101-134. Scientists who request samples from these cruises are no longer required to contribute to *ODP Proceedings* volumes, but must publish in the open literature.

All sample requests received at ODP are entered into the Sample Investigations Database. Anyone may request a search. Some common types of searches include on-going research for particular holes or legs, current research in a specified field of interest, or publications resulting from DSDP or ODP samples. For details contact:

Assistant Curator, Chris Mato
Phone: (409) 845-4819, Fax: (409) 845-4857
Bitnet: CHRIS@TAMODP

The Assistant Curator reviews each request in approximately one week. The amount of time required to process sample requests (from date of request until samples are sent) was reduced during the period 1 January 1991 through 1 December 1991:

Repository	No. Weeks Processing	Total No. Samples
East Coast	3	18,756
Gulf Coast	2	35,633
West Coast	4	11,758

ODP Data Available

ODP databases currently available include all DSDP data files (Legs 1-96), geological and geophysical data from ODP Legs 101-131, and all DSDP/ODP core photos (Legs 1-131). More data are available as paper and microfilm copies of original data collected aboard the *JOIDES Resolution*. Underway geo-physical data are on 35 mm microfilm; all other data are on 16 mm microfilm.

All DSDP data and most ODP data are contained in a computerized database (contact the ODP Librarian to find out what data are available electronically). Data can be searched on almost any specified criteria. Files can be cross-referenced so a data request can include information from multiple files.

Computerized data are currently available on hard-copy printouts, magnetic tape, or through BITNET.

Photos of ODP/DSDP cores and seismic lines are available. Seismic lines, whole core and close-up core photos are available in black and white 8x10 prints. Whole core color 35-mm slides are available.

The following are also available: (1) ODP Data Announcements containing information on the database; (2) Data File Documents containing information on specific ODP data files; (3) ODP Technical Note No. 9, "Deep Sea Drilling Project Data File Documents," which includes all DSDP data file documents.

Data Base Librarian
Phone: (409) 845-8495, Fax: (409) 845-0876
BITNET: DATABASE@TAMODP

Small requests can be answered quickly, free of charge. If a charge is made, an invoice will be sent and must be paid before the request is processed.

Data Available from the National Geophysical Data Center (NGDC)

Computerized data from the DSDP are now available through NGDC in compact-disc read-only-memory (CD-ROM) format. The DSDP CD-ROM data set consists of two CD-ROMs and custom, menu-driven, access software developed by NGDC with support from JOI/USSSP. 500 complimentary copies of the DSDP CD-ROMs are being offered to U.S. researchers in academia and government, courtesy of JOI/USSSP. An additional 200 copies of the set are available on a cost recovery basis.

Volume I of the 2-disc set contains all computerized sediment/hardrock files, the Cumulative Index (Paleontology, Subject, and Site), bibliographic information, age and fossil codes dictionaries, an index of DSDP microfilm, sediment chemistry reference tables, and copies of DSDP documentation for each data and reference file.

Volume II contains all digital downhole logging data from the DSDP, including some data digitized for the CD-ROM set by the Woods Hole Oceanographic Institution under contract to JOI/USSSP. All of the data are in the Schlumberger Log Information Standard (LIS) format, some ASCII and Gearhart-Owen data have been translated to LIS by WHOI for the CD-ROM. All DSDP underway and geophysical data are on disc 2, including bathymetry, magnetics, and navigation in the MGD77 format (no data for Legs 1-3; navigation only for Legs 4, 5, 10, 11; SEG-Y single channel seismic data not included). Volume II also contains the DSDP Core Sample Inventory and color/monochrome shaded relief images from several ocean views.

DSDP data files can be provided on magnetic tape according to user specifications (see table below). NGDC can also provide correlative marine geological and geophysical data from other sources. NGDC will provide a complimentary inventory of data available on request. Inventory searches are tailored to users' needs.

Information from DSDP Site Summary files is fully searchable and distributable on floppy diskette, as computer listings and graphics, and on magnetic tape. NGDC is working to make all DSDP data files fully searchable and available in PC-compatible form. Digital DSDP geophysical data are fully searchable and available on magnetic tape. In addition, NGDC can provide analog geological and geophysical information from DSDP on microfilm. Two summary publications are available: (1) *Sedimentology, Physical Properties, and Geochemistry in the Initial Reports of Deep Sea Drilling Project Vols. 1-44: An Overview*, Rept. MGG-1; (2) *Lithologic Data from Pacific Ocean Deep Sea Drilling Project Cores*, Rept. MGG-4.

Costs for services are: $90/2-disc CD-ROM data set, $90/magnetic tape, $30/floppy diskette, $20/microfilm reel, $12.80/copy of Rept. MGG-1, $10/copy of Rept. MGG-4. Costs for computer listings and custom graphics vary. Prepayment is required by check or money order (drawn of a U.S. bank), or by charge to VISA, Mastercard, or American Express. A $10 handling fee is added to all shipments ($20 for foreign shipments), and a $15 fee is added to all rush orders. Data Announcements describing DSDP data sets are available at no charge, as are inventory searches of correlative (non-DSDP) geological and geophysical data available from NGDC. For details contact:

Marine Geology and Geophysics Division, NOAA/NGDC, E/GC3, Dept. 334, 325 Broadway, Boulder, CO 80303; Tel (303) 497-6339; Fax 303-497-6513); Internet cjm@ngdc1.colorado.edu.

AVAILABLE DATA

Data Available	Data Source	Description	Comments
1. LITHOLOGIC and STRATIGRAPHIC DATA			
Visual Core Descriptions			
-Sediment/sedimentary rock	Shipboard data	Information about core solor, sedimentary structures, disturbance, large minerals and fossils, etc.	
-Igneous/metamorphic rock	Shipboard data	Information about lithology, texture, structure, mineralogy, alteration, etc.	
Smear slide descriptions	Shipboard data	Nature and abundance of sedimentary components.	
Thin section descriptions	Shipboard data	Petrographic descriptions of igneous and metamorphic rock. Includes information on mineralogy, texture, alteration, vesicles, etc.	
Paleontology	*Initial Reports, Proceedings*	Abundance, preservation and location for 26 fossil groups The "dictionary" consists of more than 12,000 fossil names.	
Screen	Processed data	Computer-generated lithologic classifications. Basic composition data, average density, and age of layer.	
2. PHYSICAL PROPERTIES			
G.R.A.P.E. (gamma ray attenuation porosity evaluator)	Shipboard data	Continuous whole-core density measurements.	
Grain Size	Shore laboratory	Sand-silt-clay content of a sample.	Legs 1-79 only
Index properties: bulk and grain density, water content, and porosity	Shipboard data	Gravimetric and volumetric measurements from a known volume of sediment	
Liquid and plastic limits	Shipboard data	Atterberg limits of sediment samples.	
Shear-strength measurements	Shipboard data	Sediment shear-strength measurements using motorized and Torvane instruments.	
Thermal conductivity	Shipboard data	Thermal conductivity measurements of sediments using a thermal probe.	
Velocity measurements	Shipboard data	Compressional and shear-wave velocity measurements.	
Downhole measurements			
-Heatflow	Shipboard data	*In-situ* formation temperature measurements.	
-Pressure	Shipboard data	*In-situ* formation and hydrostatic pressure.	
3. SEDIMENT CHEMICAL ANALYSES			
Carbon-carbonate	Shipboard data, shore laboratory	Percent by weight of the total carbon, organic carbon, and carbonate content of a sample.	Hydrogen percents for Legs 101,103, 104, 106-108; nitrogen percents for Legs 101, 103, 104, 107, 108.
Interstitial water chemistry	Shipboard data, shore laboratory	Quantitative ion, pH, salinity, and alkalinity analyses of interstitial water.	
Gas chromatography	Shipboard data	Hydrocarbon levels in core gases.	
Rock evaluation	Shipboard data	Hydrocarbon content of a sample.	
4. IGNEOUS AND METAMORPHIC CHEMICAL ANALYSES			
Major element analyses	Shipboard data, shore laboratory	Major element chemical analyses of igneous, metamorphic, and some sedimentary rocks composed of volcanic material.	
Minor element analyses	Shipboard data, shore laboratory	Minor element chemical analyses of igneous, metamorphic, and some sedimentary rocks composed of volcanic material.	
5. X-RAY MINERALOGY			
X-ray mineralogy	Shore laboratory	X-ray diffraction	Legs 1-37 only
6. PALEOMAGNETICS			
Paleomagnetics	Shipboard data, shore laboratory	Declination, inclination, and intensity of magnetization for discrete samples and continuous whole core. Includes NRM and alternating field demagnetization.	
Susceptibility	Shipboard data	Discrete sample and continuous whole-core measurements.	
7. UNDERWAY GEOPHYSICS			
Bathymetry	Shipboard data	Analog records of water-depth profile	Available on 35-mm continuous microfilm
Magnetics	Shipboard data	Analog records and digital data.	Available on 35-mm continuous microfilm
Navigation	Shipboard data	Satellite fixes and course and speed changes that have been run through a navigation smoothing program, edited on the basis of reasonable ship and drift velocities, and later merged with the depth and magnetic data.	Available in MGD77 exchange format
Seismics	Shipboard data	Analog records of sub-bottom profiles and unprocessed signal on magnetic tape	Available on 35-mm continuous microfilm
8. SPECIAL REFERENCE FILES			
Leg, site, hole summaries	Shipboard data initial core descriptions	Information on general leg, site, and hole characteristics (i.e. cruise objectives, location, water depth, sediment nature, drilling statistics).	
DSDP Guide to Core Material	*Initial Reports*, prime data files	Summary data for each core: depth of core, general paleontology, sediment type and structures, carbonate, grain size, x-ray, etc.	Legs 1-85 only
AGEPROFILE	*Initial Reports*, hole summaries	Definition of age layers downhole.	
COREDEPTH	Shipboard summaries	Depth of each core. Allows determination of precise depth (in m) of a particular sample.	
9. AIDS TO RESEARCH			
ODASI	A file of ODP-affiliated scientists and institutions. Can be cross-referenced and is searchable.		
Keyword Index	A computer-searchable bibliography of DSDP- and ODP-related papers and studies in progress.		
Sample Records	Inventory of all shipboard samples taken.		
Site Location Map	DSDP and ODP site positions on a world map of ocean topography.		
Thin Section Inventory	Inventory of all shipboard thin sections taken.		

ODP Wireline and Logging Services

Lamont-Doherty Geological Observatory, Palisades, NY 10964.

Wireline Logging Manual (New Edition, Sept 1990).

To obtain a copy, contact Dave Roach (Tel: (914) 359-2900, ext. 330. Fax: (914) 365-3182).

ODP Site Survey Data Bank

Lamont-Doherty Geological Observatory, Palisades, NY 10964.

The JOIDES/ODP Data Bank received the following data between September 1, 1991 and December 31, 1991. For additional information on the ODP Data Bank, please contact Mr. Carl Brenner at Lamont-Doherty Geological Observatory, Columbia University, Palisades, NY 10964.

- From N. Bangs (LDGO): selected, processed, *Conrad 2901* multichannel seismic profiles from the Chile Triple Junction area, in support of Leg 141 drilling.

- From D. Bergerson (Hawaii): processed *Moana Wave* seismic profiles with supplemental maps, in support of upcoming Atolls & Guyots drilling program.

- From E. Vera (LDGO): *Conrad 2607* multichannel lines 561 and 571, in support of Leg 142 EPR drilling.

- From K. Louden (Dalhousie, Canada): sidescan sonar image of the Oregon Margin area, in support of Cascadia drilling.

- From D. DuBois (WHOI): SeaBeam topographic map of the EPR drilling area.

- From W. Jokat (AWI, Germany): multichannel seismic profiles from *Polarstern* cruise in the Yermak Plateau area, in support of North Atlantic Arctic Gateways drilling proposal.

- From J. Austin (UTIG): multichannel seismic profiles from *Conrad 2510* cruise in the Newfoundland Basin area, in support of North Atlantic Rifted Margins drilling proposal.

- From C. Moore (UCSC): navigation plot of *Geotide* seismic lines in the Oregon Margin area.

- From G. Boillot (Universite Pierre et Marie, France): for Iberian Abyssal Plain drilling area: MCS profiles LG 6 and LG 12 and navigation plot (from LUSIGAL cruise of *Suroit*).

- From R.B. Whitmarsh (IOS, UK): for Iberian Abyssal Plain drilling area: bathymetry, gravity and magnetics charts; core locations and log summaries; MCS line DISCOVERY 161 and navigation; *Sonne* 75 MCS lines 15 to 22 and navigation.

ODP EDITORIAL REVIEW BOARDS (ERB)

For each ODP cruise, an editorial board is established to handle review of the manuscripts intended for publication in the "Scientific Results" volume of the *Proceedings of the Ocean Drilling Program.* These boards consist of the Co-Chief Scientists (*) and the ODP Staff Scientist (**) for that cruise, one outside scientist (***) selected by the Manager of ODP Science Operations in consultation with the cruise Co-Chief Scientists, and an ODP Editor. These boards are responsible for obtaining adequate reviews and for making decisions concerning the acceptance or rejection of papers. The names of scientists serving on ERBs for Legs 117 through 131 are listed below.

Leg117:
Dr. Nobuaki Niitsuma* (Shizuoka Univ., Japan)
Dr. Warren Prell* (Brown Univ.)
Dr. Kay-Christian Emeis** (Kiel Univ., F.R.G.)
Dr. Phil Meyers*** (Univ. of Michigan)

Leg 118:
Dr. Paul T. Robinson* (Dalhousie Univ., Canada)
Dr. Richard P. Von Herzen* (WHOI)
Dr. Amanda P. Julson** (ODP/TAMU)
Dr. Paul J. Fox*** (URI)

Leg 119:
Dr. John Barron* (USGS, Menlo Park)
Dr. Birger Larsen* (Technical Univ. of Denmark, Denmark)
Dr. Jack Baldauf** (ODP/TAMU)
Dr. John B. Anderson*** (Rice Univ.)

Leg 120:
Dr. Roland Schlich* (Institut de Physique du Globe, Strasbourg, France)
Dr. Sherwood W. Wise, Jr.* (Florida State Univ.), Chairman
Dr. Amanda Palmer Julson** (ODP/TAMU)
Dr. Ellen Thomas*** (Wesleyan Univ., Connecticut)

Leg 121:
Dr. John Peirce* (Petro Canada, Calgary)
Dr. Jeffrey Weissel* (LDGO), Chairman
Dr. Elliott Taylor** (Univ. of Washington, Seattle)
Dr. Jeffrey Alt*** (Washington Univ., St. Louis)

Leg 122:
Dr. Bilal Haq* (National Science Foundation, Washington, DC)
Dr. Ulrich von Rad* (Bundesanstalt fur Geowissenschaften und Rohstoffe, FRG), Chairman
Dr. Suzanne O'Connell** (Wesleyan Univ., Conn.)
Dr. Robert B. Kidd*** (University College of Swansea, U.K.)

Leg 123:
Dr. Felix Gradstein* (Bedford Institute of Oceanography, Canada), Chairman
Dr. John Ludden* (Univ. of Montreal, Canada)
Dr. Andrew Adamson** (ODP/TAMU)
Dr. Wylie Poag*** (USGS, WHOI)

Leg 124:
Dr. Eli Silver* (UC Santa Cruz),
Dr. Claude Rangin* (Univ. Pierre et Marie Curie)
Dr. Marta Von Breymann** (ODP/TAMU)
Dr. Martin Fisk*** (OSU)

Leg 125:
Dr. Patricia Fryer* (Univ. Hawaii)
Dr. Julian Pearce* (Univ. Newcastle-Upon-Tyne, U.K.)
Dr. Laura Stokking** (ODP/TAMU)
Dr. Patrick*** (Cottesloe, Western Australia)

Leg 126:
Dr. Brian Taylor* (Univ. Hawaii), chairman
Dr. Kantaro Fujioka* (Univ. Tokyo, Japan)
Dr. Thomas Janecek** (ODP/TAMU)
Dr. Charles Langmuir*** (LDGO)

Leg 127:
Dr. Kensaku Tamaki* (Univ. Tokyo, Japan), chairman
Dr. Kenneth Pisciotto*(El Cerrito, CA)
Dr. James Allan** (ODP/TAMU)
Dr. John Barron***(USGS, Menlo Park, CA)

Leg 128:
Dr. James Ingle* (Stanford Univ.)
Dr. Kiyoshi Suyehiro* (Univ. of Tokyo, Japan)
Dr. Marta von Breymann** (ODP/TAMU)
Dr. Michael McWilliams*** (Stanford Univ.)

Leg 129:
Dr. Roger Larson* (Univ. of Rhode Island)
Dr. Yves Lancelot*(Univ. Pierre et Marie Curie)
Dr. Andrew Fisher** (ODP/TAMU)
Dr. Edward L. Winterer***(Scripps Inst. of Oceanography, UCSD)

Leg 130:
Dr. Loren Kroenke* (Univ. Hawaii)
Dr. Wolfgang Berger*(Univ. Bremen, West Germany)
Dr. Thomas Janecek** (ODP/TAMU)
Dr. William Sliter***(USGS, Menlo Park, CA)

Leg 131
Dr. Asahiko Taira* (Univ. Tokyo, Japan)
Dr. Ian Hill* (Univ. of Leicester, U.K.)
Dr. John Firth** (ODP/TAMU)
Dr. Peter Vrolijk*** (Exxon, Houston, TX)

A chairman for each ERB, usually a Co-Chief Scientist, has been elected since Leg 120.

ODP/JOIDES Directory

Membership Listings

Committees

Executive Committee (EXCOM)

Member (Chair)	Alternate	Liaison to
Bogdanov, N.		
Boillot, G.		
Briden, J.C.	Summerhayes, C.P.	
Caldwell, D.R.	Small, L.	
Dorman, C.E.	Gagosian, R.B.	
Duce, R.A.		
Dürbaum, H.J.	Beiersdorf, H.	
Eaton, G.P.	Hayes, D.E.	
Falvey, D.A.	Riddihough, R.	
Frieman, E.A.	Moss, M.	
Heath, G.R.	Nowell, A.	
Helsley, C.E.	Taylor, B.	
Kobayashi, K.		
Leinen, M.	Schilling, J.G.	
<u>Maxwell, A.E.</u>	Davies, T.A.	
Merrell, W.J.	Rowe, G.	
Rosendahl, B.R.	Harrison, C.G.A.	
Westgaard, L.	Almazan, J.L.	

Planning Committee (PCOM)

Member (Chair)	Alternate	Liaison to
<u>Austin, J.A.</u>		EXCOM/PPSP
Becker, K.	Swart, P.K.	DMP/TEDCOM
Berger, W.H.	Kastner, M.	IHP
Cita-Sironi, M.B.	Backman, J.	SGPP/SMP
Duncan, R.A.	Levi, S.	OHP
Fox, P.J.		SMP
Jenkyns, H.	Kidd, R.	OHP
Lancelot, Y.		IHP/SSP
Lewis, B.		
Malpas, J.	Crawford, T.	LITHP
Mutter, J.	Langseth, M.	LITHP
Sharaskin, A.A.		
Taira, A.	Suyehiro, K.	TECP
Taylor, B.	Moberly, R.	TECP, OD-WG
Tucholke, B.E.	Curry, W.B.	TECP
Von Rad, U.	Beiersdorf, H.	SGPP
Watkins, J.		SSP, SL-WG

Technology & Engineering Dev. Committe (TEDCOM)

Member (Chair)	Alternate	Liaison to
Combes, J.S.		
Fujimoto, H.	Kasahara, J.	
Gelfgat, M.Y	Nikolaev, A.V.	
Manchester, K.	Christ, R.	
Marx, C.	Deutsch, U.	
Millheim, K.		
Rischmüller, H.		
Schuh, F.J.		
Shanks, F.E.		
Shatto, H.L.		
Skinner, A.C.	Grassick, D.	
<u>Sparks, C.</u>		
Svendsen, W.W.		
Texier, M.	Collin, R.	
Thorhallsson		

Thematic Panels

Lithosphere Panel (LITHP)

Member (Chair)	Alternate	Liaison to
Bender, J.F.		InterRIDGE
Bloomer, S.H.		
Brocher, T.		
Cannat, M.		
Cloetingh, S.	Bostrøm, K.	TECP, SL-WG, NARM
Erzinger, Jörg	Herzig, P.M.	
Franklin, J.M.	Green, D.	InterRIDGE
<u>Humphris, S.E.</u>		OD-WG
Kempton, P.	Pearce, J.A.	
McClain, J.		DMP
Moos, D.		TEDCOM
Smith, G.M.		OHP
Tatsumi, Y.		
Tsvetkov, A.A.	Zonenshain, L.P.	
Zierenberg, R.A.		SGPP

Ocean History Panel (OHP)

Member (Chair)	Alternate	Liaison to
Barron, J.A.		
Bralower, T.		
Channell, J.E.T.		
Davies, P.J.	Pedersen, T.	
<u>Delaney, M.L.</u>		
Dmitriev, L.V.	Krasheninnikov, V.A.	
Herbert, T.D.		
Hine, A.C.		
Jansen, E.	Primoli-Silva, I.	
Loutit, T.S.		TECP
Okada, H.	Saito, T.	
Pratt, L.M.		
Raymo, M.E.		
Vincent, E.		
Weaver, P.P.E.		
Wefer, G.	Gersonde, R.	
Zachos, J.C.		SGPP

Sedimentary and Geochemical Processes Panel (SGPP)

Member (Chair)	Alternate	Liaison to
Alt, J.C.		LITHP
Bahr, J.M.		
Boulègue, J.		OD-WG
Christie-Blick, N.		
Elderfield, H.		
Farrimond, P.		
Flood, R.D.		
Hay, W.W.		
Hiscott, R.N.	Von der Borch, C.	TECP
Lisitsyn, A.P.	Kurnosov, V.B.	
<u>McKenzie, J.A.</u>	Vorren, T.	
Mienert, J.	Emeis, K.C.	
Paull, C.K.		
Sayles, F.L.		
Soh, W.	Yagishita, K.	
Suess, E.	Emeis, K.C.	
Swart, P.K.		OHP

Tectonics Panel (TECP)

Atwater, T.M.		
Behrmann, J.H.	Von Huene, R.	
Bourgois, J.		
Cande, S.C.		
Karson, J.A.		OD-WG, LITHP
Larsen, H.C.	Wortel, R.	
Moore, J.C.		DMP
<u>Moores, E.M.</u>		OD-WG
Ogawa, Y.	Tamaki, K.	
Peyve, A.A.	Labkovsky, L.M.	
Purdy, G.M.		FDSN
Robertson, A.H.F.		SGPP
Sawyer, D.S.		TEDCOM
Symonds, P.		
Zoback, M.D. (Sabbatical)		

SERVICE PANELS

Member (<u>Chair</u>)	Alternate	Liaison to

Downhole Measurements Panel (DMP)

Crocker, H.	Nobes, D.	
Desbrandes, R.		
Draxler, J.K.	Villinger, H.	
Foucher, J-P.	Pascal, G.	
Gieskes, J.		SMP
Hutchinson, M.W.		
Karig, D.E.		
Kuznetsov, O.L.	Skvortsov, A.T.	
Lysne, P.		
Morin, R.H.		
Sondergeld, C.		
Stephansson, O.	Balling, N.	
Wilkens, R.		
Williams, D.M.		
<u>Worthington, P.</u>	Lovell, M.A.	TEDCOM
Yamano, M.	Kinoshita, H.	

Information Handling Panel (IHP)

Basov, I.A.	Shreider, A.A.	
Fryer, P.		
Funnel, B.	Jones, M.T.	
<u>Gibson, I.L.</u>		
Ingersoll, R.V.		
Loughridge, M.S.		
Moore, T.C.		
Riedel, W.R.		
Rock, N.	Gibson, I.L.	
Sager, W.W.		
Saito, T.		
Saunders, J.	Hedberg, D.	
Schaaf, A.		
Spall, H.		
Spiess, V.	Brückmann, W.	
Wise, S.W.		

Pollution Prevention and Safety Panel (PPSP)

Aoki, Y.		
<u>Ball, M.M.</u>		SSP
Claypool, G.E.		
Delas, C.		
Deluchi, L.	Hovland, M.	
Fortier, M.	Powell, T.	
Gamsakhurdia, G.R.		
Garrison, L.		
Green, A.R.		
Horn, D.		
Katz, B.		
MacKenzie, D.B.		
Roberts, D.G.	Blanchard, J.	

Shipbord Measurement Panel (SMP)

Chaney, R.C.		
King, J.W.		
Konyukhov, B.A.	Pechersky, D.M.	
<u>Moran, K.</u>		SSP
Mottl, M.J.		
Rhodes, J.M.		
Richards, A.	Solheim, A.	IHP
Thomas, E.		
Tokuyama, H.		
Valet, J.-P.		
Whitmarsh, R.B.	Brereton, N.R.	

Site Survey Panel (SSP)

Farre, J.A.		
Hinz, K.		
Hirata, N.	Suyehiro, K.	
Kastens, K.A.		
<u>Kidd, R.B.</u>	Sinha, M.C.	
Larsen, B.	Sartori, R.	
Louden, K.E.	Symonds, P.	
Moore, G.F.		
Mountain, G.		
Pautot, G.	Renard, V.	
Trehu, A.M.		
Von Herzen, R.P.		
Zverev, S.M.	Neprochnov, Y.P.	

DPGs and WGs

Sea Level Working Group (SL-WG)

Member (Chair)	JOIDES Panel
Aissaoui, D.	
Aubry, M.-P.	
Carter, R.M.	
Christie-Blick, N.	SGPP
Crevello, P.	
Davies, P.	OHP
Droxler, A.W.	
Eberli, G.P.	
Flood, R.D.	SGPP
Halley, R.B.	
Kendall, C.G.	
Loutit, T.S.	OHP
Miller, K.G.	
Mountain, G.	SSP
Sager, W.W.	IHP
Sarnthein, M.	
Van Hinte, J.E.	
Watts, A.B.	
Winterer, E.L.	

Offset Drilling Working Group (OD-WG)

Member (Chair)	JOIDES Panel
Bonatti, E.	
Cann, J.	
Casey, J.F.	
Dick, H.J.B.	
Fox, P.J.	PCOM
Hinz, K.	SSP
Mevel, C.	
Natland, J.H.	
Ozawa, K.	
Robinson, P.	
Taylor, B.	PCOM
Varga, R.J.	
Vine, F.J.	
Zonenshain, L.P.	

Data Handling Working Group (DH-WG)

Member (Chair)	JOIDES Panel
Backman, J.	
Bryan, W.B.	
Chayes, D.	
Courtney, B.	
Coyne, J.	
Fisher, A.	
Foster, J.	
Gibson, I.L.	IHP
Hobart, M.	
Jackson, P.	
Lewis, B.	PCOM
Mefferd, M.	
Moore, G.F.	SSP
Moran, K.	SMP
Worthington, P.	DMP
Hc	
Jac	
Lev	

ODP Services

Science Operator

Member	Liaison to
Allen, J.	LITHP
Baldauf, J.	SMP, SSP
Coyne, J.	DH-WG
Fisher, A.	DMP, DH-WG
Francis, T.J.G.	PCOM, PPSP
Foster, J.	DH-WG
Graham, D.	SMP
Harding, B.	
Janecek, T.	OHP
Merrill, R.B.	IHP
Rabinowitz, Ph.	EXCOM
Stokking, L.	SGPP
Storms, M.	TEDCOM
Musgrave, R.	TECP

Site Survey Data Bank (SSDB)

Member	Liaison to
Brenner, C.	SSP, PPSP

Wireline Logging Services (WLS)

Member	Liaison to
Anderson, R.N.	EXCOM
Golovchenko, X.	PCOM, DMP
Lyle, M.	SGPP

JOIDES Office

Member	Liaison to
Austin, J.A.	PCOM Chairperson
Blum, P.	SSP
Fulthorpe, C.S.	SGPP, SL-WG
Moser, K.	

Other Representatives

ODP Council (ODPC)

Member	Liaison to
Almazan, J.L.	(E)
Asai, T.	(J)
Babcock, E.A.	(CAN)
Bogdanov, N.	(USSR)
Bosellini, A.	(I)
Cailliau, E.	(F)
Egelund, S.	(DK)
Fratta, M.	(ESF)
Fricker, P.	(CH)
Goror, N.	(TR)
Heinrichs, D.	(US)
Ignatius, H.	(SF)
Knill, J.L.	(UK)
Magnusson, M	(IS)
Maronde, D.	(G)
Michot, J.	(B)
Ottosson, M.O.	(S)
Rutland, R.	(AUS)
Stel, J.H.	(NL)
Veis, G.	(GR)
Westgaard, L.	(N)

National Science Foundation (NSF)

Member	Liaison to
Dauphin, P.	PCOM
Heinrichs, D.	EXCOM, ODPC
Malfait, B.	PCOM

Joint Oceanographic Inst., Inc. (JOI)

Member	Liaison to
Baker, D.J.	EXCOM
Burns, A.	
Kappel, E.	
Pyle, T.	PCOM
Smith, R.	

Budget Committee (BCOM)

Member	Liaison to
Austin, J.A.	EXCOM/PPSP
Briden, J.C.	
Dürbaum, H.J.	
Lewis, B.	
Nowell, A.	

Member Country Administration Officers

Member	Liaison to
Aghib, F.S.	(ESF/I)
Compte, M.A.	(ESF)
Crawford, T.	(AUS)
Deveau, S.	(CAN)
Kay, R.L.F.	(UK)
Kinoshita, C.	(J)
Röhl, U.	(G)
Torchigina, L.A.	(USSR)

Alphabetical Directory

Country codes used in this directory

AUS	Australia
B	Belgium
CAN	Canada
CH	Switzerland
DK	Denmark
E	Spain
F	France
G	Germany
GR	Greece
I	Italy
IS	Iceland
J	Japan
N	Norway
NL	Netherlands
S	Sweden
SF	Finland
TR	Turkey
UK	United Kingdom
US	United States of America
USSR	Soviet Union

Please note that all ODP/JOIDES mail to Soviet members should go to the Office of N.A. Bogdanov. Also, our experience is that telex communication works better than FAX. Telex numbers are on the ODP/JOIDES telex list printed in the JOIDES Journal, June 1991 issue; the telex list is not reprinted in this issue.

Aghib, Fulvia S.
ESCO Secretariat
Universita di Milano
Via Mangiagalli 34
I-20133 Milano (I)
Tel: 39 (2) 236-981
Fax: 39 (2) 236-4393

Aissaoui, Djafar
Lab. de Géochimie des Roches Sédiment.
Université Paris-Sud
Bâtiment 504
91405 Orsey Cedex (F)
Tel: 33 (1) 6941-6122
Fax: 33 (1) 6446-5938

Allen, Jamie
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-0506
Fax: 1 (409) 845-0876
Omnet: Ocean.Drilling.TAMU

Almazan, Jose Luis
SECEG
c/Estebanez Calderon 3
E-28020 Madrid 20 (E)
Tel: 34 (1) 572-0088
Fax: 34 (1) 279-6086

Alt, Jeffrey C.
Department of Geological Sciences
University of Michigan
1006 C.C. Little Building
Ann Arbor, MI 48109-1063 (US)
Tel: 1 (313) 764-8380
Fax: 1 (313) 763-4690

Anderson, Roger N.
Borehole Research Group
Lamont-Doherty Geological Observatory
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900 x335
Fax: 1 (914) 365-3182
Omnet: Borehole

Aoki, Yutaka
Akasaka Twin Tower Bldg., East 3F
JAPEX Geoscience Institute, Inc.
2-17-22 Akasaka, Minato-ku
Tokyo 107 (J)
Tel: 81 (3) 3584-0511
Omnet: ORI.Tokyo

Asai, Tomio
Ocean Research Institute
University of Tokyo
1-15-1 Minamidai, Nakano-ku
Tokyo 164 (J)
Tel: 81 (3) 3376-1251 X201
Fax: 81 (3) 3375-6716
Omnet: ORI.Tokyo

Atwater, Tanya M.
Department of Geological Sciences
University of California
Santa Barbara, CA 93106 (US)
Tel: 1 (805) 893-4483
Fax: 1 (805) 893-2314

Aubry, Marie-Pierre
Département des Sciences de la Terre
Université Claude Bernard
27-43 Blvd du 11 Novembre
69622 Villeurbanne cedex (F)
Tel: 33 (72) 44-83-67
Fax: 33 (72) 44-84-36

Austin, James A.
Institute for Geophysics
University of Texas at Austin
8701 Mopac Boulevard
Austin, TX 78759-8345 (US)
Tel: 1 (512) 471-0450
Fax: 1 (512) 471-0999
Omnet: JOIDES.UTIG

Babcock, E.A.
Geological Survey of Canada
Energy, Mines & Resources
601 Booth Street, Rm. 217
Ottawa, Ontario K1A 0E8 (CAN)
Tel: 1 (613) 992-5910
Fax: 1 (613) 995-3082

Backman, J.
Department of Geology
University of Stockholm
S-10691 Stockholm (S)
Tel: 46 (8) 164-720
Fax: 46 (8) 345-808

Bahr, Jean M.
Department of Geology and Geophysics
University of Wisconsin-Madison
Weeks Hall, 1215 W Dayton St.
Madison, Wisconsin 53706 (US)
Tel: 1 (608) 262-5513
Fax: 1 (608) 262-0693
Internet: geodept@geology.wisc.edu

Baker, D. James
Joint Oceanographic Institutions Inc.
1755 Massachusetts Ave., NW, Suite 800
Washington, DC 20036-2102 (US)
Tel: 1 (202) 232-3900
Fax: 1 (202) 232-8203
Omnet: J.Baker.JOI

Baldauf, Jack
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-9297
Fax: 1 (409) 845-0876
Omnet: Ocean.Drilling.TAMU

Ball, Mahlon M.
Petroleum Geology Branch
U.S. Geological Survey
Box 25046, MS-940, Denver Fedl. C.
Denver, CO 80225 (US)
Tel: 1 (303) 236-5784
Fax: 1 (303) 236-8822

Balling, N.
Laboratoriet for Geofysik
Finlandsgade 8
8200 Århus N (DK)
Tel: 45 (6) 161-666

Barron, John A.
U.S. Geological Survey
345 Middlefield Road, MS-915
Menlo Park, CA 94025 (US)
Tel: 1 (415) 329-4971
Fax: 1 (415) 329-5110

Basov, Ivan A.
Institute of Lithosphere
Staromonetny per., 22
Moscow 109180 (USSR)
Tel: 7 (095) 230-7783
Fax: 7 (095) 233-5590

Becker, Keir
Rosenstiel School of Marine & Atm. Sci.
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149 (US)
Tel: 1 (305) 361-4661
Fax: 1 (305) 361-4632
Omnet: K.Becker

Behrmann, Jan H.
Inst. f. Geowiss. und Lithosphärenforschung
Universität Giessen
Senckenbergstrasse 3
D-6300 Giessen (G)
Tel: 49 (641) 702-8367
Fax: 49 (641) 39265

Beiersdorf, Helmut
Bundesanstalt für Geowiss. u. Rohstoffe
Stilleweg 2, Postfach 510153
D-3000 Hannover 51 (G)
Tel: 49 (511) 643-2412
Fax: 49 (511) 643-2304

Bender, John F.
Dept. of Geography and Earth Sciences
University of North Carolina, Charlotte
Charlotte, NC 28223 (US)
Tel: 1 (704) 597-2293
Fax: 1 (704) 547-2767

Berger, Wolfgang H.
Scripps Institution of Oceanography
Univ. of California, San Diego, A-008
La Jolla, CA 92093-2015 (US)
Tel: 1 (619) 534-2750

Blanchard, James
Enterprise Oil, plc.
Grand Buildings, Trafalgar Square
London WC2N 5AE (UK)
Tel: 44 (71) 930-1212
Fax: 44 (71) 930-0321

Bloomer, S.H.
Department of Geology
Boston University
675 Commonwealth Avenue
Boston, Massachusetts 02215 (US)
Tel: 1 (617) 353-2532

Blum, Peter
JOIDES Office
Univ. of Texas, Inst. for Geophysics
8701 Mopac Blvd.
Austin, TX 78759-8345 (US)
Tel: 1 (512) 471-0476
Fax: 1 (512) 471-0999
Omnet: JOIDES.UTIG
Internet: joides@utig.ig.utexas.edu

Bogdanov, Nikita
Institute of Lithosphere
Staromonetny per., 22
Moscow 109180 (USSR)
Tel: 7 (095) 233-5588/230-7771
Fax: 7 (095) 233-5590

Boillot, Gilbert
Technopolis 40
IFREMER
155, rue Jean-Jacques Rousseau
92138 Issy-les-Moulineaux Cedex (F)
Tel: 33 (1) 4648-2100
Fax: 33 (1) 4648-2224
Omnet: IFREMER.ODP

Bonatti, Enrico
Istituto di Geologia Marina (CNR)
Via Zamboni 65
I-40127 Bologna (I)
Tel: 39 (51) 244-004
Fax: 39 (51) 229-704

Bosellini, Alfonso
Instituto di Geologia
Universita di Ferrara
Via Ercole I d'Este 32
I-44100 Ferrara (I)
Tel: 39 (532) 35-968
Fax: 39 (532) 62-8244

Bostrøm, Kurt
Geological Institute
University of Stockholm
S-10691 Stockholm (S)
Tel: 46 (8) 317-409

Boulègue, Jacques
Geochimie et Metallogenie
Université Pierre et Marie Curie
4 Place Jussieu, Boîte 124
75252 Paris Cedex 05 (F)
Tel: 33 (1) 4427-5006
Fax: 33 (1) 4427-5141

Bourgois, Jacques
Departement de Geotectonique
Université Pierre et Marie Curie
4, Place Jussieu, Tour 26-00, E1
75252 Paris Cedex 05 (F)
Tel: 33 (1) 4427-5990
Fax: 33 (1) 4427-5085

Bralower, Timothy
Department of Geology, CB#3315
University of North Carolina
Mitchell Hall
Chapel Hill, NC 27599-3315 (US)
Tel: 1 (919) 962-0704
Fax: 1 (919) 966-4519

Brass, Garrett W.
Division of Marine Geology & Geophysics
Rosenstiel School of Marine & Atmos. Scis.
Miami, FL 33149 (US)
Tel: 1 (305) 361-4663
Fax: 1 (305) 361-4632

Brenner, Carl
JOIDES/ODP Site Survey Data Bank
Lamont-Doherty Geological Observatory
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900 x542
Fax: 1 (914) 365-2312
Internet: odp@lamont.ldgo.columbia.edu

Brereton, N.R.
British Geological Survey
Keyworth
Nottingham NG12 5GG (UK)
Tel: 44 (060) 776-111
Fax: 44 (060) 776-602

Briden, James C.
Natural Environment Research Council
Polaris House, North Star Ave.
Swindon SN2 1EU (UK)
Tel: 44 (793) 411-730
Fax: 44 (793) 411-584
Omnet: NERC.Science.HQ

Brocher, Thomas
U.S. Geological Survey
345 Middlefield Road, MS-977
Menlo Park, CA 94025 (US)
Tel: 1 (415) 329-4737
Fax: 1 (415) 329-5163
Internet: brocher@andreas.menlo.usgs.gov

Brückmann, Warner
GEOMAR
Research Center for Marine Geoscience
Wischhofstrasse 1-3, Geb. 4
D-2300 Kiel 14 (G)
Tel: 49 (0431) 720-2148
Fax: 49 (0431) 725-650

Bryan, Wilfred B.
Department of Geology and Geophysics
Woods Hole Oceanographic Institution
McLean Laboratory
Woods Hole, MA 02543 (US)

Burns, Allison
Joint Oceanographic Institutions Inc.
1755 Massachusetts Ave., NW, Suite 800
Washington, DC 20036-2102 (US)
Tel: 1 (202) 232-3900
Fax: 1 (202) 232-8203
Omnet: JOI.Inc

Cailliau, Etienne
Technopolis 40
IFREMER
155 rue Jean-Jacques Rousseau
92138 Issy-les-Moulineaux Cedex (F)
Tel: 33 (1) 4648-2100
Fax: 33 (1) 4648-2224

Caldwell, Douglas R.
College of Oceanography
Oregon State University
Corvallis, OR 97331 (US)
Tel: 1 (503) 737-3504
Fax: 1 (503) 737-2400
Omnet: D.Caldwell

Cande, Steven C.
Lamont-Doherty Geological Observatory
Columbia University
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900
Fax: 1 (914) 359-2931

Cann, Joe
Department of Earth Sciences
University of Leeds
Leeds LS2 9JT (UK)
Tel: 44 (532) 335-200
Fax: 44 (532) 335-259

Cannat, Mathilde
Département Sciences de la Terre
UBO, Fac. des Sciences
6, Avenue Le Gorgeu
29287 Brest Cedex (F)
Tel: 33 (98) 316-316
Fax: 33 (98) 316-131

Carter, Robert M.
Department of Geology
James Cook University
Townsville, Queensland 4811 (AUS)
Tel: 61 (077) 81-4546
Fax: 61 (077) 25-1501

Casey, John F.
Department of Geosciences
University of Houston
Houston, TX 77204-5503 (US)
Tel: (713) 749-1803
Fax: (713) 747-4526

Chaney, Ronald C.
Dept. of Environmental Resources Eng.
Humboldt State University
Arcata, CA 95521 (US)
Tel: (707) 826-3619

Channell, James E.T.
Department of Geology
University of Florida
1112 Turlington Hall
Gainesville, FL 32611 (US)
Tel: 1 (904) 392-2231

Chayes, Dale
Lamont-Doherty Geological Observatory
Columbia University
Palisades, NY 10964 (US)

Christ, Roxanne P.A.
Faculty of Engineering
Monash University
Clayton, Victoria 3168 (AUS)
Tel: 61 (3) 565-3402
Fax: 61 (3) 543-4061

Christie-Blick, Nicholas
Lamont-Doherty Geological Observatory
Columbia University
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900 x221
Fax: 1 (914) 359-5215

Cita-Sironi, Maria B.
Dipartimento di Scienze della Terra
University of Milan
Via Mangiagalli 34
I-20133 Milano (I)
Tel: 39 (2) 236-98207
Fax: 39 (2) 706-38261

Claypool, George E.
Mobil E&P Services Inc.
P.O. Box 650232
Dallas, TX 75265-0232 (US)
Tel: 1 (214) 951-2837
Fax: 1 (214) 951-2265

Cloetingh, Sierd
Instituut voor Ardwetenschappen
Vrije Universiteit
Postboks 7161
NL-1007 MC Amsterdam (NL)
Tel: 31 (20) 548-4741
Fax: 31 (20) 462-457

Collin, Robert
Elf-Aquitaine (Production)
Tour Elf, Cedex 45
92078 Paris La Defense (F)
Tel: 33 (1) 4744-4546

Combes, John S.
Drilling Technology Center
Chevron Services Co.
Oil Center Court
Houston, TX 77210 (US)
Tel: 1 (713) 230-2657
Fax: 1 (713) 230-2669

Compte, M.-Aimée
European Consortium for Ocean Drilling
European Science Foundation
1 quai Lezay-Marnésia
67000 Strasbourg (F)
Tel: 33 (88) 35-30-63
Fax: 33 (88) 37-05-32

Courtney, Bob
Atlantic Geoscience Centre
Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, NS B2Y 4A2 (CAN)

Coyne, John
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-

Crawford, Tony
ODP Secretariat
University of Tasmania
GPO Box 252C
Hobart, Tasmania 7001 (AUS)
Tel: 61 (002) 202-490
Fax: 61 (002) 232-547

Crevello, Paul
Denver Research Center
Marathon Oil Company
P.O. Box 269
Littleton, CO 80160 (US)
Tel: 1 (303) 794-2601 x420
Fax: 1 (303) 794-1720

Crocker, Hugh
Unit 6, R+D Center
Crocker Data Processing Inc.
1, Sarich Way, Technology Park
Bentley, W. Australia 6102 (AUS)
Tel: 61 (9) 470-5004
Fax: 61 (9) 470-5003

Curry, William B.
Department of Geology and Geophysics
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 (US)
Tel: 1 (508) 457-2000 x2591
Fax: 1 (508) 457-2187
Omnet: WHOI.Geol.Geoph

Dauphin, Paul
National Science Foundation
1800 G Street, NW, Room 609
Washington, DC 20550 (US)
Tel: 1 (202) 357-9849
Fax: 1 (202) 357-7621
Omnet: NSF.OCE.ODP

Davies, Peter
Department of Geology
University of Sydney
Sydney, NSW 2006 (AUS)
Tel: 61 (2) 692-2912
Fax: 61 (2) 692-0184

Delaney, Margaret L.
Institute of Marine Sciences
University of California, Santa Cruz
Santa Cruz, CA 95064 (US)
Tel: 1 (408) 459-4736
Fax: 1 (408) 459-4882
Omnet: M.Delaney

Delas, Claude
Total/CFP
Cedex 47
92069 Paris La Defense (F)
Tel: 33 (1) 4291-3704
Fax: 33 (1) 4291-4052

Deluchi, Lucio
AGIP S.p.A.
San Donato Milanese, P.O. Box 12069
20120 Milano (I)
Tel: 39 (2) 520-5189
Fax: 39 (2) 5202-2065

Desbrandes, Robert
Dept. of Petroleum Engineering
Louisiana State University
Baton Rouge, LA 70803-6417 (US)
Tel: (504) 388-5215
Fax: (504) 388-5990

Deutsch, Ulrich
Inst. Tiefbohrkunde u. Erdölgewinnu.AN)
TU Clausthal
Agricolastrasse 10
D-3392 Clausthal-Zellerfeld (G)
Tel: 49 (5323) 722-450

Deveau, Stuart
Canadian ODP Secretariat
Memorial University
Centre for Earth Resources Research
St. John's, Newfoundland A1B 3X5 (CAN
Tel: 1 (709) 737-4708
Fax: 1 (709) 737-4702
Omnet: J.Malpas
Internet: ODP@MUN

Dick, Henry J.B.
Department of Geology and Geophysics
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 (US)
Tel: 1 (508) 457-2000
Fax: 1 (508) 457-2187
Omnet: WHOI.Geol.Geoph

Dmitriev, Leonid V.
V.I. Vernadsky Inst. of Geochemistry
and Analytical Chemistry
Kosygina Street, 19
Moscow V-334, 117975 (USSR)
Tel: 7 (095) 137-5836
Fax: 7 (095) 938-2054

Dorman, Craig E.
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 (US)
Tel: 1 (508) 457-2000 x2500
Fax: 1 (508) 457-2000
Omnet: C.Dorman.WHOI

Draxler, Johann K.
Niedersächs. Landesamt f. Bodenforschung
Postfach 510153
D-3000 Hannover 51 (G)
Tel: 49 (511) 643-2673
Fax: 49 (511) 643-2304

Droxler, Andre W.
Department of Geology and Geophysics
Rice University
6100 Main Street
Houston, TX 77251 (US)
Tel: 1 (713) 527-4880
Fax: 1 (713) 285-5214

Duce, Robert A.
Coll. Geosciences & Maritime Studies
Texas A&M University
College Station, TX 77843 (US)
Tel: 1 (409) 845-3651
Fax: 1 (409) 845-0056

Duncan, Robert A.
College of Oceanography
Oregon State Univerity
Oceanography Admin. 104
Corvallis, OR 97331-5503 (US)
Tel: 1 (503) 737-2296
Fax: 1 (503) 737-2064

Dürbaum, Hans J.
Bundesanstalt für Geowiss. u. Roh
Stilleweg 2, Post

Eaton, Gordon P.
Lamont-Doherty Geological Observatory
Columbia University
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900
Fax: 1 (914) 359-2931

Eberli, Gregor P.
Rosenstiel School of Marine & Atm. Sci.
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149 (US)
Tel: 1 (305) 361-4678
Fax: 1 (305) 361-4632

Egelund, Susanne
Department of Research
H.C. Andersons Boulevard 40
DK-1553 Copenhagen V (DK)
Tel: 45 (33) 114-300
Fax: 45 (33) 323-501

Elderfield, Henry
Department of Earth Sciences
University of Cambridge
Downing Street
Cambridge CB2 3EQ (UK)
Tel: 44 (223) 333-406
Fax: 44 (223) 333-450
Omnet: H.Elderfield

Emeis, Kay-Christian
Geologisch-Paläontolog. Inst. und Museum
Olshausenstr. 40
D-2300 Kiel (G)
Tel: 49 (431) 880-2085
Fax: 49 (431) 880-4376

Erzinger, Jörg
Inst. f. Geowiss. und Lithosphärenforschung
Universität Giessen
Senckenbergstrasse 13
D-6300 Giessen (G)
Tel: 49 (641) 702-8390
Fax: 49 (641) 39-265

Falvey, David A.
Marine Science Division
Bureau of Mineral Resources
GPO Box 378
Canberra, ACT 2601 (AUS)
Tel: 61 (062) 499-111
Fax: 61 (062) 488-178

Farre, John A.
EXXON Production and Research
P.O. BOX 2189
Houston, TX 77252-2189 (US)
Tel: 1 (713) 966-6149

Farrimond, Paul
Organic Geochem., Dept. of Geology
University of Newcastle Upon Tyne
Drummond Building
Newcastle Upon Tyne NE1 7RU (UK)
Tel: 44 (91) 222-6000 x6605
Fax: 44 (91) 261-1182

Fisher, Andrew
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-2197
Fax: 1 (409) 845-0876
Omnet: Ocean.Drilling.TAMU

Flood, Roger D.
Marine Sciences Research Center
State University of New York
Stony Brook, NY 11794-5000 (US)
Tel: 1 (516) 632-6971
Fax: 1 (516) 632-8820
Bitnet: RFlood@sbccmail

Fortier, Mimi
Dept. of Indian and Northern Affairs
Northern Oil and Gas Directorate
10 Wellington Street
Hull, Quebec KIA 0H4 (CAN)
Tel: 1 (819) 953-8722
Fax: 1 (819) 953-5828

Foster, Jack
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-9323
Fax: 1 (409) 845-0876
Omnet: Ocean.Drilling.TAMU

Foucher, Jean-Paul
Centre de Brest
IFREMER
B.P. 70
29263 Plouzane Cedex (F)
Tel: 33 (98) 224-040
Fax: 33 (98) 224-549

Fox, P. Jeff
School of Oceanography
University of Rhode Island
Kingston, RI 02881 (US)
Tel: 1 (401) 792-6222
Fax: 1 (401) 792-6160
Omnet: J.Fox

Francis, Tim J.G.
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-8480
Fax: 1 (409) 845-0876
Omnet: Ocean.Drilling.TAMU

Franklin, James M.
Geological Survey of Canada
601 Booth Street
Ottawa, Ontario K1A 0E8 (CAN)
Tel: 1 (613) 995-4137
Fax: 1 (613) 996-9990
Bitnet: JimFrank@Carleton

Fratta, Michele
European Science Foundation
1 quai Lezay-Marnésia
F-67000 Strasbourg (F)
Tel: 33 (88) 353-063
Fax: 33 (88) 370-532

Fricker, Peter
Swiss National Science Foundation
Postfach 2338
CH-3001 Bern (CH)
Tel: 41 (31) 245-424
Fax: 41 (31) 233-009

Frieman, Edward A.
SIO, Director's Office, 0210
Univ. of California, San Diego
9500 Gilman Drive
La Jolla, CA 92093-0210 (US)
Tel: 1 (619) 524-2826
Fax: 1 (619) 453-0167
Omnet: E.Frieman

Fryer, Patricia
Planetary Geoscience Division, SOEST
University of Hawaii
2525 Correa Road
Honolulu, HI 96822 (US)
Tel: 1 (808) 956-3146
Fax: 1 (808) 956-6322

Fujimoto, Hiromi
Ocean Research Institute
University of Tokyo
1-15-1 Minamidai, Nakano-ku
Tokyo 164 (J)
Tel: 81 (3) 3376-1251
Fax: 81 (3) 3375-6716
Omnet: ORI.Tokyo

Fulthorpe, Craig S.
JOIDES Office
Univ. of Texas, Inst. for Geophysics
8701 Mopac Blvd.
Austin, TX 78759-8345 (US)
Tel: 1 (512) 471-0459
Fax: 1 (512) 471-0999
Omnet: JOIDES.UTIG
Internet: joides@utig.ig.utexas.edu

Funnel, Brian
Scool of Environmental Sciences
University of East Anglia
Norwich NR4 7TJ (UK)
Tel: 44 (603) 592-841
Fax: 44 (603) 507-719

Gagosian, Robert B.
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 (US)
Tel: 1 (508) 457-2000
Fax: 1 (508) 457-2000

Gamsakhurdia, Georgy R.
P.P. Shirshov Institute of Oceanology
Krasikova Street, 23
Moscow 117218 (SU)
Tel: 7 (095) 124-7985

Garrison, Lou
8503 Amethyst Court
College Station, TX 77845 (US)
Tel: 1 (409) 764-7473 or 845-4857
Omnet: Ocean.Drilling.TAMU

Gelfgat, Michael Ya.
VNIIBT
6 Leninsky Prospect
017957 Moscow (USSR)
Tel: 7 (095) 235-1186
Fax: 7 (095) 236-2071

Gersonde, Rainer
Alfred-Wegener-Institut für
Polar- und Meeresforschung
Postfach 120161
D-2850 Bremerhaven (G)

Gibson, Ian L.
Department of Earth Sciences
University of Waterloo
Waterloo, Ontario N2L 3G1 (CAN)
Tel: 1 (519) 885-1211 x2054
Fax: 1 (519) 888-4521
Internet: guelph2@watdcs.UWaterloo.ca

Gieskes, Joris M.
Scripps Institution of Oceanography
University of California, San Diego
La Jolla, CA 92093-2015 (US)
Tel: 1 (619) 534-4257
Fax: 1 (619) 534-0784

Golovchenko, Xenia
Borehole Research Group
Lamont-Doherty Geological Observatory
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900 x336
Fax: 1 (914) 365-3182

Goror, Naci
Scientific and Technical Res. Coun.
Ataturk Bulvar. No. 221
Kovaklidere, 0610D
Ankara (TR)

Graham, Dennis
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-2445
Fax: 1 (409) 845-4857
Omnet: Ocean.Drilling.TAMU

Grassick, David
Enterprise Oil, plc.
Grand Buildings, Trafalgar Square
London WC2N 5AE (UK)
Tel: 44 (71) 930-1212
Fax: 44 (71) 930-0321

Green, Arthur R.
Basin Exploration Division
EXXON
P.O. Box 2189
Houston, TX 77001 (US)
Tel: 1 (713) 965-4172

Green, David
Geology Department
University of Tasmania
GPO Box 252C
Hobart, Tasmania 7001 (AUS)
Tel: 61 (002) 202-476
Fax: 61 (002) 232-547

Hålenius, Ulf
Swedish Natural Sci. Res. Council
Box 6711
S-11385 Stockholm (S)
Tel: 46 (8) 610-0700
Fax: 46 (8) 610-0740

Harding, Barry
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-2024
Fax: 1 (409) 845-4857
Omnet: Ocean.Drilling.TAMU

Harrison, Christopher G.A.
Rosenstiel School of Marine & Atm. Sci.
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149 (US)
Tel: 1 (305) 361-4610
1 (305) 361-4711

Hay, William W.
GEOMAR
Research Center for Marine Geoscience
Wischhofstrasse 1-3
D-23 Kiel 14 (G)
Tel: 49 (431) 720-0249
Fax: 49 (431) 725-391

Hayes, Dennis E.
Lamont-Doherty Geol. Observatory
Columbia University
Department of Geological Sciences
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900 X470
Fax: 1 (914) 359-0718

Heath, G. Ross
College of Ocean & Fishery Sciences
University of Washington, HN-15
Seattle, WA 98195 (US)
Tel: 1 (206) 543-6605
Fax: 1 (206) 543-6393
Omnet: R.Heath

Heinrichs, Donald
National Science Foundation, OCE
1800 G Street, NW, Room 609
Washington, DC 20550 (US)
Tel: 1 (202) 357-9639
Fax: 1 (202) 357-7621
Omnet: D.Heinrichs

Helsley, Charles E.
School of Ocean and Earth Sci. & Techn.
University of Hawaii at Manoa
1000 Pope Road
Honolulu, HI 96822 (US)
Tel: 1 (808) 956-3188
Fax: 1 (808) 956-2538
Omnet: Hawaii.Inst

Herbert, Timothy D.
Scripps Institution of Oceanography
University of California, San Diego
La Jolla, CA 92093-2015 (US)
Tel: 1 (619) 534-4199

Herzig, Peter Michael
Institut für Mineralogie und
Lagerstättenlehre der RWTH
Wüllnerstr. 2
D-5100 Aachen 1 (G)
Tel: 49 (241) 805-773
Fax: 49 (241) 804-413

Hickman, Stephen H.
Branch of Tectonophysics
U.S. Geological Survey
345 Middlefield Road, MS 977
Menlo Park, CA 94025 (US)
Tel: 1 (415) 329-4807
Fax: 1 (415) 329-5163

Hine, Albert C.
Department of Marine Science
University of South Florida
St. Petersburg, FL 33701 (US)
Tel: 1 (813) 893-9161
Fax: 1 (813) 893-9189

Hinz, Karl
Bundesanstalt für Geowiss. u. Rohstoffe
Stilleweg 2, Postfach 510153
...nover 51 (G)

Hirata, Naoshi
Department of Earth Sciences
Chiba University
1-33 Yayoi-cho
Chiba 260 (J)
Tel: 81 (472) 511-111
Fax: 81 (472) 565-793
Internet: nsg2a23@cuipc.ipc.chiba-u.ac.jp

Hiscott, Richard N.
Environmental Marine Geology
AGC-BIO
P.O. Box 1006
Dartmouth, Nova Scotia B2Y 4A2 (CAN)
Fax: 1 (902) 426-4104

Hobart, Mike
Lamont-Doherty Geological Observatory
Columbia University
Borehole Research Group
Palisades, NY 10964 (US)

Horn, Dietrich
DEMINEX
Dorotheenstrasse 1
4300 Essen (G)
Tel: 49 (201) 726-3905

Hovland, M.
STATOIL
P.O. Box 300
4001 Stavanger (N)
Tel: 47 (4) 807-130
Fax: 47 (4) 806-212

Humphris, Susan E.
Chemistry Department
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 (US)
Tel: 1 (508) 457-2000 x2523
Fax: 1 (508) 457-4673
Omnet: WHOI.Geol.Geoph

Hutchinson, Mark W.
1000 South Pine, Suite 8443 RDW
Ponca City, OK 74603 (US)
Tel: 1 (405) 767-3166
Fax: 1 (405) 767-4014

Ignatius, Heikki
Geological Survey of Finland (GTK)
Kivimiehentie 1
SF-02150 Espoo 15 (SF)
Tel: 358 (0) 469-31

Ingersoll, Raymond V.
Dept. of Earth and Space Sciences
University of California
Los Angeles, CA 90024-1567 (US)
Tel: 1 (213) 825-8634
Fax: 1 (213) 825-2779

Jackson, Peter
Geological Survey
Keyworth
Nottingham (UK)

Janecek, Tom
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-0879
Fax: 1 (409) 845-0876
Omnet: Ocean.Drilling.TAMU

Jansen, Eystein
Department of Geology, Sect. B
University of Bergen
Allegt. 41
N-5007 Bergen (N)
Tel: 47 (05) 213-491
Fax: 47 (05) 315-729
Omnet: E.Jansen

Jenkyns, Hugh
Department of Earth Sciences
University of Oxford
Parks Road
Oxford, OX1 3PR (UK)
Tel: 44 (865) 272-023
Fax: 44 (865) 272-072

Jones, Merion T.
Proudman Ocean. Lab., Bidston Observ.
British Oceanographic Data Centre
Birkenhead
Merseyside L43 7RA (UK)
Tel: 44 (51) 653-8633
Fax: 44 (51) 653-6269
Omnet: IOS.Bidston

Kappel, Ellen
Joint Oceanographic Institutions Inc.
1755 Massachusetts Ave., NW, Suite 800
Washington, DC 20036-2102 (US)
Tel: 1 (202) 232-3900
Fax: 1 (202) 232-8203
Omnet: E.Kappel

Karson, Jeffrey A.
Geology Department
Duke University
329 Old Chemistry Building
Durham, NC 27706 (US)
Tel: 1 (919) 684-5847
Fax: 1 (919) 684-5833

Kasahara, Junzo
Earthquake Research Institute
University of Tokyo
1-1-1 Yayoi, Bunkyo-ku
Tokyo 113 (J)
Tel: 81 (3) 3812-2111 X5713
Fax: 81 (3) 3812-6979

Kastens, Kim A.
Lamont-Doherty Geological Observatory
Columbia University
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900 x236
Fax: 1 (914) 365-0718
Internet: Kastens@lamont.ldgo.coumbia.edu

Kastner, Miriam
Scripps Institution of Oceanography
University of California, San Diego
La Jolla, CA 92093-2015 (US)
Tel: 1 (619) 534-2065
Fax: 1 (619) 534-0784
Omnet: M.Kastner

Katz, Barry
TEXACO EPTD
P.O. Box 770070
Houston, TX 77215-0070 (US)
Tel: 1 (713) 954-6093
Fax: 1 (713) 954-6113

Kay, R.L.F.
Earth Sciences Directorate
Natural Environment Res. Council
Polaris House, North Star Ave.
Swindon, SN2 1EU (UK)
Tel: 44 (793) 411-521
Fax: 44 (793) 411-584
Internet: RLFK@UK.AC.NWL.IA

Kempton, Pamela
NERC Isotope Geosciences Laboratory
c/o British Geological Survey
Keyworth
Nottingham NG12 5GG (UK)
Tel: 44 (6077) 6111
Fax: 44 (6077) 6805

Kendall, Christopher G.
Dept. of Geological Sciences
University of South Carolina
Columbia, SC 29208 (US)
Tel: 1 (803) 777-4535
Fax: 1 (803) 777-6610
Internet:
kendall@gondwana.geol.scarolina.edu

Kidd, Robert B.
Department of Geology
Univ. of Wales, Coll. of Cardiff
P.O. Box 914, Cathays Park
Cardiff CF1 3YE (UK)
Tel: 44 (222) 874-830
Fax: 44 (222) 874-326
Internet: Kiddr@geology.cardiff.ac.uk

King, John W.
Graduate School of Oceanography
University of Rhode Island
Narragansett, RI 02882-1197 (US)
Tel: 1 (401) 792-6594
Fax: 1 (401) 792-6160
Omnet: J.King

Kinoshita, Chizuru
Ocean Research Institute
University of Tokyo
1-15-1 Minamidai, Nakano-ku
Tokyo 164 ()
Tel: 81 (3) 3376-1251 x256
Fax: 81 (3) 3375-6716
Omnet: ORI.Tokyo

Kinoshita, H.
Department of Earth Sciences
Chiba University
1-33 Yayoi-cho
Chiba 260 (J)
Tel: 81 (472) 511-111
Fax: 81 (472) 565-793

Knill, J.L.
Natural Environment Research Council
Polaris House, North Star Avenue
Swindon SN2 1EU (UK)
Tel: 44 (793) 411-653
Fax: 44 (793) 411-691
Omnet: NERC.Science.HQ

Kobayashi, Kazuo
Ocean Research Institute
University of Tokyo
1-15-1 Minamidai, Nakano-ku
Tokyo 164 (J)
Tel: 81 (3) 3376-1251
Fax: 81 (3) 3375-6716
Omnet: ORI.Tokyo

Konyukhov, Boris A.
Oceanological Institute
Far East Branch of USSR Academy of Scis.
Radio Street, 7
Vladivostok 690032 (USSR)
Tel: 7 (423) 229-6500

Krasheninnikov, Valery A.
Geological Institute
Pyhevsky pers., 7
Moscow 109017 (USSR)
Tel: 7 (095) 230-8129

Kurnosov, Victor B.
Geological Institute
Pyzhevsky pers., 7
Moscow 109017 (USSR)
Tel: 7 (095) 230-8004

Kuznetzov, Oleg L.
Institute for Geoinformsystems
Varshavskoye Shosse, 8
Moscow 113105 (USSR)
Tel: 7 (095) 234-5350
Fax: 7 (095) 230-3711

Labkovsky, Leopold
P.P. Shirshov Institute of Oceanology
Krasikova Street, 23
Moscow 117218 (USSR)
Tel: 7 (095) 129-2181

Lancelot, Yves
Laboratoire de Géologie du Quaternaire
CNRS-Luminy, Case 907
13288 Marseille Cedex 9 (F)
Tel: 33 (91) 269-650
Fax: 33 (91) 266-638
Omnet: Y.Lancelot

Langseth, Marcus
Lamont-Doherty Geological Observatory
Columbia University
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900 x518
Fax: 1 (914) 365-0718
Omnet: M.Langseth

Larsen, Birger
Geological Survey of Denmark
Thoravej 8
DK-2400 Copenhagen (DK)
Tel: 45 (31) 106-600
Fax: 45 (31) 196-868

Larsen, Hans Christian
Geological Survey of Greenland
Øster Voldgade 10
DK-1350 København (DK)
Tel: 45 (33) 118-866
Fax: 45 (33) 935-352

Larson, Roger L.
Graduate School of Oceanography
University of Rhode Island
Narragansett, RI 02882 (US)
Tel: 1 (401) 792-6165
Fax: 1 (401) 792-6160
Omnet: R.Larson

Leinen, Margaret
Graduate School of Oceanography
University of Rhode Island
Narragansett, RI 02882-1197 (US)
Tel: 1 (401) 792-6268
Fax: 1 (401) 792-6160
Omnet: M.Leinen

Levi, Shaul
College of Oceanography
Oregon State University
Corvallis, OR 97331 (US)
Tel: 1 (503) 737-2296
Fax: 1 (503) 737-2400

Lewis, Brian
School of Oceanography
University of Washington, WB-10
Seattle, WA 98195 (US)
Tel: 1 (206) 543-7419
Fax: 1 (206) 543-6073
Omnet: B.Lewis

Lisitsyn, Alexander P.
P.P. Shirshov Institute of Oceanology
Krasikova Street, 23
Moscow 117218 (USSR)
Tel: 7 (095) 124-8528

Louden, Keith E.
Department of Oceanography
Dalhousie University
Halifax, Nova Scotia B3H 4J1 (CAN)
Tel: 1 (902) 424-3557
Fax: 1 (902) 424-3877
Omnet: Dalhousie.Ocean
Internet: louden@ac.dal.ca

Loughridge, Michael S.
Marine Geology and Geophysics Div.
Natl. Geophys. Data Center, E/GC3, NOAA
325 Broadway
Boulder, CO 80303 (US)
Tel: 1 (303) 497-6487
Fax: 1 (303) 497-6513
Internet: smtp%'msl@ngdc1.colorado.edu'

Loutit, Tom S.
EXXON Production Research Co.
3120 Buffalo Speedway
Houston, TX 77252-2189 (US)
Tel: 1 (713) 966-6114
Fax: 1 (713) 965-4497 or 966-6026

Lovell, M.A.
Department of Geology
University of Leicester
Leicester (UK)
Tel: 44 (533) 522-522
Fax: 44 (533) 522-200

Lysne, Peter
Division 6252
Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185 (US)
Tel: 1 (505) 844-8885
Fax: 1 (505) 844-3952

MacKenzie, David B.
1000 Ridge Road
Littleton, CO 80120 (US)
Tel: 1 (303) 794-4750

Magnusson, Magnus
Icelandic Council of Science
Barugötu 3
IS-101 Reykjavik (IS)
Tel: 354 (1) 102-23
Fax: 354 (1) 213-31

Malfait, Bruce
... Foundation
Tel: 1 (202) 357-9849
Fax: 1 (202) 357-7621
Omnet: NSF.OCE.ODP

Malpas, John
Canadian ODP Secretariat
Memorial Univ., Earth Res. Res. Center
Elizabeth Ave.
St. John's, Newfoundland A1B 3X5 (CAN)
Tel: 1 (709) 737-4708
Fax: 1 (709) 737-4702
Omnet: J.Malpas

Manchester, Keith
Atlantic Geoscience Center
Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, Nova Scotia B2Y 4A2 (CAN)
Tel: 1 (902) 426-3411
Fax: 1 (902) 426-4266
Omnet: Bedford.Inst

Maronde, Dietrich
Deutsche Forschungsgemeinschaft
Kennedy-Allee 40
5300 Bonn 2 (G)
Tel: 49 (228) 885-2328
Fax: 49 (228) 885-2221

Marx, Claus
Inst. Tiefbohrkunde u. Erdölgewinnung
TU Clausthal
Agricolastrasse 10
D-3392 Clausthal-Zellerfeld (G)
Tel: 49 (5323) 722-239

Maxwell, Arthur E.
Institute for Geophysics
University of Texas at Austin
8701 Mopac Boulevard
Austin, TX 78759-8345 (US)
Tel: 1 (512) 471-0411
Fax: 1 (512) 471-8844
Omnet: A.Maxwell

McClain, James
Department of Geology
University of California, Davis
Davis, CA 95616 (US)
Tel: 1 (916) 752-7093
Fax: 1 (916) 752-6363
Omnet: J.McClain

McKenzie, Judith A.
Geologisches Institut
ETH-Zentrum
Sonneggstrasse 5
CH-8092 Zürich (CH)
Tel: 41 (01) 256-3828
Fax: 41 (01) 252-0819

Mefferd, Matt
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-2483
Fax: 1 (409) 845-0876
Omnet: Ocean.Drilling.TAMU

Merrell, William J.
Mitchell Campus
Texas A&M University at Galveston
P.O. Box 1675
Galveston, TX 77553-1675 (US)
Tel: 1 (409) 740-4403
Fax: 1 (409) 740-4407

Merrill, Russ
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-9324
Fax: 1 (409) 845-4857
Omnet: Ocean.Drilling.TAMU

Mevel, Catherine
Petrologie Metamorphique
Université Pierre et Marie Curie
4 Place Jussieu, Tour 26, E3e
75252 Paris Cedex 05 (F)
Tel: 33 (1) 44-27-51-93
Fax: 33 (1) 44-27-39-11

Michot, Jean
Lab. Associés, Geologie-Petrologie
Université Libre de Bruxelles
50 Avenue F.D. Roosevelt
B-1050 Bruxelles (B)
Tel: 32 (2) 642-2236

Mienert, Jürgen
GEOMAR
Research Center for Marine Geoscience
Wischhofstrasse 1-3, Geb. 4
D-2300 Kiel 14 (G)
Tel: 49 (431) 720-2249
Fax: 49 (431) 720-2293

Miller, Kenneth G.
Department of Geological Sciences
Rutgers, The State University
New Brunswick, NJ 08903 (US)
Tel: 1 (908) 932-3622
Fax: 1 (908) 932-3374

Millheim, Keith
AMOCO Production Co.
P.O. Box 3385
Tulsa, OK 74102 (US)
Tel: 1 (918) 660-3381
Fax: 1 (918) 660-3310

Moberly, Ralph
School of Ocean and Earth Sci. & Techn.
University of Hawaii at Manoa
2525 Correa Road
Honolulu, HI 96822 (US)
Tel: 1 (808) 956-8765
Fax: 1 (808) 956-2538
Omnet: R.Moberly

Moore, Gregory F.
Department of Geology and Geophysics
University of Hawaii
2525 Correa Road
Honolulu, HI 96822 (US)
Tel: 1 (808) 956-6854
Fax: 1 (808) 956-2538
Internet: moore@kalani.soest.hawaii.edu

Moore, J. Casey
Earth Sciences Board of Studies
University of California, Santa Cruz
Santa Cruz, CA 95064 (US)
Tel: 1 (408) 459-2574
Fax: 1 (408) 426-0146
Bitnet: Casey@ucsc

Moore, Ted C.
Cent. for Great Lakes & Aquatic Sci.
University of Michigan
2200 Bonisteel Blvd.
Ann Arbor, MI 48109-2099 (US)

Ge
Ur
Dε
Tε
Fε

Moc
Tel: 1 (313) 747-2742
Fax: 1 (313) 747-2748
Omnet: T.Moore
Internet: Ted_Moore@um.cc.umich.edu

Moores, Eldridge M.
Geology Department
University of California, Davis
Davis, CA 95616 (US)
Tel: 1 (916) 752-0352
Fax: 1 (916) 752-0951

Moos, Daniel
Department of Geophysics
Stanford University
Stanford, CA 94305 (US)
Tel: 1 (415) 723-3464
Fax: 1 (415) 725-7344
Internet: moos@pangea.stanford.edu

Moran, Kate
Department of Civil Engineering
Technical University of Nova Scotia
1360 Barrington Street
Halifax, Nova Scotia B3J 2X4 (CAN)
Tel: 1 (902) 420-7917
Fax: 1 (902) 420-7551

Morin, Roger H.
U.S. Geological Survey
MS 403, Denver Federal Center
Denver, CO 80225 (US)
Tel: 1 (303) 236-5913

Moser, Kathy
JOIDES Office
Univ. of Texas, Inst. for Geophysics
8701 Mopac Blvd.
Austin, TX 78759-8345 (US)
Tel: 1 (512) 471-0471
Fax: 1 (512) 471-0999
Omnet: JOIDES.UTIG
Internet: joides@utig.ig.utexas.edu

Motti, Michael J.
School of Ocean and Earth Sci. & Techn.
University of Hawaii at Manoa
1000 Pope Road
Honolulu, HI 96822 (US)
Tel: 1 (808) 956-7006
Fax: 1 (808) 956-2538

Mountain, Gregory
Lamont-Doherty Geological Observatory
Columbia University
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900 x541
Fax: 1 (914) 365-2312

Musgrave, Robert
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845 (US)
Tel: (409) 845-2673
Fax: (409) 845-4857

Mutter, John
Lamont-Doherty Geological Observatory
Columbia University
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900 x525
1 (914) 365-3181

Natland, James H.
Rosenstiel School of Marine & Atm. Sci.
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149 (US)
Tel: 1 (305) 361-4661
Fax: 1 (305) 361-4632

Neprochnov, Yury, P.
P.P. Shirshov Institute of Oceanology
Krasikova Street, 23
Moscow 117218 (USSR)
Tel: 7 (095) 124-8540

Nowell, Arthur
College of Ocean & Fishery Sciences
University of Washington, HA-40
Seattle, WA 98195 (US)
Tel: 1 (206) 543-6605
Fax: 1 (206) 543-6073

Ogawa, Yujiro
Department of Geology
Kyushu University
33 Hakazaki
Fukuoka 812 (J)
Tel: 81 (92) 641-1101 x4320
Fax: 81 (92) 631-4233
Omnet: ORI.Tokyo

Okada, Hisatake
Department of Earth Sciences
Yamagata University
Kojirakawa-cho
Yamagata 990 (J)
Tel: 81 (236) 31-1421 x2588
Fax: 81 (236) 32-8384

Ottosson, Mats Ola
Swedish Natural Sci. Res. Council
Box 6711
S-11385 Stockholm (S)
Tel: 46 (8) 610-0700
Fax: 46 (8) 610-0740

Ozawa, Kazuhito
Dept. of Geology & Geophysics
Woods Hole Oceanographic Inst.
Woods Hole, MA 02543 (J)
Tel: 1 (508) 457-2000
Fax: 1 (508) 457-2187
Omnet: WHOI.Geol.Geoph

Pascal, Georges
Laboratoire de Geophysique Marine
Univ. de Brest, Fac. des Sci. et Tech.
6 Avenue le Gorgeu
29283 Brest Cedex (F)
Tel: 33 (98) 462-521
Fax: 33 (98) 040-573

Paull, Charles K.
Department of Geology
University of North Carolina
213 Mitchell Hall
Chapel Hill, NC 27599-3315 (US)
Tel: 1 (919) 966-4516
Fax: 1 (919) 966-4519

Pautot, Guy
Centre de Brest
IFREMER
B.P. 70
[illegible] (F)

Pearce, Julian A.
Department of Geological Sciences
University of Durham
South Road
Durham, DH1 3LE (UK)
Tel: 44 (91) 374-2528
Fax: 44 (91) 374-3741

Pechersky, Diamar M.
Institute of Earth's Physics
B. Gruzinskaya Street, 10
Moscow D-242, 123810 (USSR)
Tel: 7 (095) 254-9105
Fax: 7 (095) 253-9283

Pedersen, Tom F.
Department of Oceanography
University of British Columbia
Vancouver, B.C. V6T 1W5 (CAN)
Tel: (604) 228-5984
Fax: (604) 228-6091
Omnet: UBC.OCGY
Internet: T.F.Pedersen@mtsg.ubc.ca

Peyve, Alexander A.
Geological Institute
Pyzhevsky per., 7
Moscow 109017 (USSR)
Tel: 7 (095) 230-8147

Powell, Trevor
Division of Continental Geology
Bureau of Mineral Resources
GPO Box 378
Canberra, ACT 2601 (AUS)
Tel: 61 (62) 499-397
Fax: 61 (62) 488-178

Pratt, Lisa M.
Department of Geology
Indiana University
Bloomington, IN 47405 (US)
Tel: 1 (812) 855-9203
Fax: 1 (812) 855-7899

Primoli-Silva, Isabella
Dipartimento di Scienza della Terra
University of Milan
Via Mangiagalli 34
I-20133 Milano (I)
Tel: 39 (2) 2369-8248

Purdy, G. Michael
Department of Geology and Geophysics
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 (US)
Tel: 1 (508) 457-2000 x2826
Fax: 1 (508) 457-2187
Omnet: WHOI.Geol.Geoph

Pyle, Thomas
Joint Oceanographic Institutions Inc.
1755 Massachusetts Ave., NW, Suite 800
Washington, DC 20036-2102 (US)
Tel: 1 (202) 232-3900
Fax: 1 (202) 232-8203
Omnet: T.Pyle

Rabinowitz, Philip
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-2673
Fax: 1 (409) 845-4857
Omnet: Ocean Drill[illegible]

Raymo, Maureen E.
Department of Geology and Geophysics
University of California, Berkley
Berkley, CA 94720 (US)
Tel: 1 (510) 642-2575
Fax: 1 (510) 643-9980
Internet: mer@maray.berkley.edu

Rhodes, J. Mike
Department of Geology and Geography
University of Massachusetts
Amherst, MA 01003 (US)
Tel: 1 (413) 545-2841
Fax: 1 (413) 545-1200

Richards, Adrian
Adrian Richards Company
Uiterweg 309
1431 AJ Aalsmeer (NL)
Tel: 31 (29) 774-0012
Fax: 31 (29) 774-0723

Riddihough, Robin
Geology Survey of Canada
Energy, Mines and Resources
601 Booth Street, Rm 240
Ottawa, Ontario K1A 0E8 (CAN)
Tel: 1 (613) 995-4482
Fax: 1 (613) 996-8059

Riedel, William R.
Scripps Institution of Oceanography
University of California, San Diego
La Jolla, CA 92093-0220 (US)
Tel: 1 (619) 534-4386
Fax: 1 (619) 534-0784
Internet: wriedel@ucsd.edu

Rischmüller, Heinrich
Niedersächs. Landesamt f. Bodenforschung
Postfach 510153
D-3000 Hannover 51 (G)
Tel: 49 (511) 643-2669
Fax: 49 (511) 643-2686

Roberts, David G.
BP Exploration Operating Co. Ltd.
4/5 Long Walk Road, Stockley Park
Uxbridge, Middlesex UB11 1BP (UK)
Tel: 44 (81) 750-0759

Robertson, Alastair H.F.
Grant Institute of Geology
University of Edinburgh
West Mains Rd.
Edinburgh EH9 3JW (UK)
Tel: 44 (31) 667-1081 x3569
Fax: 44 (31) 668-3184

Robinson, Paul T.
Centre for Marine Geology
Dalhousie University
Halifax, Nova Scotia B3H 3J5 (CAN)
Tel: 1 (902) 494-2361
Fax: 1 (902) 494-6785

Rock, Nicholas
Department of Geology
University of Western Australia
Nedlands, Western Australia 6009 (AUS)
Tel: 61 (9) 380-2669
Fax: 61 (9) 380-1037
Internet: N_Rock@fennd.cc.uwa.oz.au

Röhl, Ursula
Bundesanstalt f. Geowiss. und Rohstoffe
Stilleweg 2, Postfach 510153
D-3000 Hannover 51 (G)
Tel: 49 (0511) 643-2785
Fax: 49 (0511) 643-2304

Rosendahl, Bruce R.
Rosenstiel School of Marine & Atm. Sci.
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149 (US)
Tel: 1 (305) 361-4000
Fax: 1 (305) 361-4711
Omnet: RSMAS.Dean

Rutland, Roye
Bureau of Mineral Resources
GPO Box 378
Canberra, ACT 2601 (AUS)
Tel: 61 (62) 499-111
Fax: 61 (62) 488-178

Sager, William W.
Department of Oceanography
Texas A&M University
College Station, TX 77843-3146 (US)
Tel: 1 (409) 845-9828
Fax: 1 (409) 845-6331
Internet: "Sager@triton.tamu.edu

Saito, Tsunemasa
Department of Earth Sciences
Yamagata University
Koshiragawa-cho
Yamagata 990 (J)
Tel: 81 (236) 31-1421 X2585

Sarnthein, Michael
Geologisch-Paleont. Inst. und Museum
Universität Kiel
Olshausenstrasse 40
D-2300 Kiel (G)
Tel: 49 (0431) 8800
Fax: 49 (0431) 880-4376

Sartori, Renzo
IGM/CNR
Via Zamboni 65
I-40127 Bologna (I)
Tel: 39 (51) 225-444

Saunders, John
Naturhistorisches Museum Basel
Augustinergasse 2
CH-4001 Basel (CH)
Tel: 41 (61) 266-55-64
Fax: 41 (61) 266-55-46

Sawyer, Dale S.
Department of Geology and Geophysics
Rice University
P.O. Box 1892
Houston, TX 77251 (US)
Tel: 1 (713) 285-5106
Fax: 1 (713) 285-5214
Internet: dale@rice.edu

Sayles, Frederick L.
Department of Chemistry
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 (US)
Tel: 1 (508) 457-2000 x2561
Fax: 1 (508) 457-4673
Omnet: F.Sayles

Schaaf, André
Dept. des Sciences de la Terre
Université Claude Bernard Lyon I
15-43, Bd. du 11 Novembre, Bât. 402
69622 Villeurbanne Cedex (F)
Tel: 33 (72) 448-416
Fax: 33 (72) 440-597

Schilling, Jean-Guy
School of Oceanography
University of Rhode Island
Kingston, RI 02881 (US)
Tel: 1 (401) 792-6222
Fax: 1 (401) 792-6160

Schuh, Frank J.
Drilling Technology Inc.
5808 Wavertree, Suite 1000
Plano, TX 75075 (US)
Tel: 1 (214) 380-0203

Shanks, F. Earl
Drilling Technology
Mobil Exploration and Prod. Serv. Inc.
P.O. Box 650232
Dallas, TX 75265-0232 (US)
Tel: 1 (214) 951-3271
Fax: 1 (214) 951-2512

Sharaskin, Anatoly A.
Geological Institute
Pyzhevsky per., 7
Moscow 109017 (USSR)
Tel: 7 (095) 230-8110

Shatto, Howard L.
444 Knipp Oaks 1
Houston, TX 77024-5055 (US)
Tel: 1 (713) 467-8616
Fax: 1 (713) 465-1716 (call first)

Shreider, Anatoly A.
P.P. Shirshov Institute of Oceanology
Krasikova Street, 23
Moscow 117218 (USSR)
Tel: 7 (095) 129-2181

Sinha, M.C.
Department of Earth Sciences
Cambridge University, Bullard Labs.
Madingley Road
Cambridge CB3 0EZ (UK)
Tel: 44 (223) 333-400
Fax: 44 (223) 332-332

Skinner, Alister C.
Marine Geophys. & Offshore Serv. Progr.
British Geological Survey
Murchison House, West Mains Road
Edinburgh EH9 3LA (UK)
Tel: 44 (31) 667-1000
Fax: 44 (31) 668-2683

Skvortsov, Alexey T.
Acoustics Institute
Shvernika Street, 4
Moscow 117036 (SU)

Smith, Robin
Joint Oceanographic Institutions Inc.
1755 Massachusetts Ave., NW, Suite 800
Washington, DC 20036-2102 (US)
Tel: 1 (202) 232-3900
Fax: 1 (202) 232-8203

oh, Wonn
Institute of Geosciences
Shizuoka University
Oya
Shizuoka, 422 (J)
Tel: 81 (54) 237-1111 ex.5818
Fax: 81 (54) 238-0491

Solheim, Anders
Norwegian Polar Research Institut
P.O. Box 158
1330 Oslo Lufthavn (N)
Tel: 47 (2) 123650

Sondergeld, Carl
AMOCO Production Co.
P.O. Box 3385
Tulsa, OK 74102 (US)
Tel: 1 (918) 660-3917
Fax: 1 (918) 660-4163

Spall, Henry
Office of Scientific Publications
U.S.G.S., National Center, MS-904
12201 Sunrise Valley Drive
Reston, VA 22092 (US)
Tel: 1 (703) 648-6078
Fax: 1 (703) 648-6138
Bitnet: HSpall.ISDRES

Sparks, Charles
Institut Français du Petrole
1 et 4, avenue de Bois-Préau, B.P. 311
92506 Rueil-Malmaison Cedex (F)
Tel: 33 (1) 4752-6395
Fax: 33 (1) 475-27002

Spiess, Volker
Fachbereich Geowissenschaften
Universität Bremen
Postfach 330440
D-2800 Bremen 33 (G)
Tel: 49 (421) 218-3387
Fax: 49 (421) 218-3116

Stel, Jan H.
Netherlands Marine Res. Foundation
Laan van Nieuw Oost Indie 131
2593 BM The Hague (NL)
Tel: 31 (70) 344-0780
Fax: 31 (70) 832-173

Stokking, Laura
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77840 (US)
Tel: 1 (409) 845-5218
Fax: 1 (409) 845-0876
Omnet: Ocean.Drilling.TAMU

Storms, Michael
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845 (US)
Tel: 1 (409) 845-2101
Fax: 1 (409) 845-4857

Suess, Erwin
GEOMAR
Research Center for Marine Geoscience
Wischhofstrasse 1-3
D-2300 Kiel 14 (G)
Tel: 49 (431) 720-2233
Fax: 49 (431) 720-2293

Summerhayes, C.P.
Institute of Oceanographic Science
Brook Road, Wormley, Godalming
Surrey GU8 5UB (UK)
Tel: 44 (42) 879-4141
Fax: 44 (42) 879-3066
Omnet: IOS.Wormley

Suyehiro, Kiyoshi
Ocean Research Institute
University of Tokyo
1-15-1 Minamidai, Nakano-ku
Tokyo 164 (J)
Tel: 81 (3) 3376-1251
Fax: 81 (3) 3375-6716
Omnet: ORI.Tokyo

Svendsen, Walter W.
1276 Highview Drive
New Brighton, MN 55112 (US)

Swart, Peter K.
Rosenstiel School of Marine & Atm. Sci.
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149 (US)
Tel: 1 (305) 361-4663
Fax: 1 (305) 361-4632

Symonds, Phil
Division of Marine Geoscience
Bureau of Mineral Resources
GPO Box 378
Canberra, ACT 2601 (AUS)
Tel: 61 (62) 499-490
Fax: 61 (62) 488-178

Taira, Asahiko
Ocean Research Institute
University of Tokyo
1-15-1 Minamidai, Nakano-ku
Tokyo 164 (J)
Tel: 81 (3) 3376-1251 x256
Fax: 81 (3) 3375-6716
Omnet: ORI.Tokyo

Tatsumi, Yoshiyuki
Department of Geology and Mineralogy
Kyoto University
Oiwake-cho, Sakyo-ku
Kyoto, 606 (J)
Tel: 81 (75) 753-4163
Fax: 81 (75) 753-4189

Taylor, Brian
School of Ocean & Earth Sci. & Tech.
University of Hawaii
2525 Correa Road
Honolulu, HI 96822 (US)
Tel: 1 (808) 956-6649
Fax: 1 (808) 956-2538
Omnet: B.Taylor
Internet: taylor@kiawe.soest.hawaii.edu

Texier, Michel
Research and Technology
Elf Exploration Inc.
1000 Louisiana, Suite 3800
Houston, TX 77002 (US)
Tel: 1 (713) 739-2166
Fax: 1 (713) 650-1789

Thomas, Ellen
Department of Earth Sciences
Cambridge University
Downing Street
Tel: 44 (223) 333-428
Fax: 44 (223) 333-450
Internet: ET103@UK.AC.CAM.PHX

Thorhallsson, Sverrir
Orkustofnun
Grensásvegur 9
IS-103 Reykjavik (IS)
Tel: 354 (1) 813-600
Fax: 354 (1) 688-896
Internet: s@os.is

Tokuyama, Hidekazu
Ocean Research Institute
University of Tokyo
1-15-1 Minamidai, Nakano-ku
Tokyo 164 (J)
Tel: 81 (3) 3376-1251
Fax: 81 (3) 3375-6716
Omnet: ORI.Tokyo

Torchigina, Lucy A.
ODP Office
Institute of Lithosphere
Staromonetny Per., 22
Moscow 109180 (USSR)
Tel: 7 (095) 223-5588
Fax: 7 (095) 223-5590

Trehu, Anne M.
College of Oceanography
Oregon State University
Oceanography Admin. Bldg. 104
Corvallis, OR 97331-5503 (US)
Tel: 1 (503) 737-3504
Fax: 1 (503) 737-2064
Omnet: Oregon.State

Tsvetkov, Andrey A.
IGEM, USSR Academy of Sciences
Staromonetny per., 35
Moscow 109017 (USSR)
Tel: 7 (095) 135-6019
Fax: 7 (095) 230-2179

Tucholke, Brian E.
Department of Geology and Geophysics
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 (US)
Tel: 1 (508) 457-2000 x2494
Fax: 1 (508) 457-2187
Omnet: B.Tucholke

Valet, Jean-Pierre
Inst. de Physique du Globe
Université Pierre et Marie Curie
4, Place Jussieu, Tour 24-25
75252 Paris Cedex 05 (F)
Tel: 33 (1) 4427-3566
Fax: 33 (1) 4427-3373

Van Hinte, Jan E.
Instituut voor Aardwetenschappen
Vrije Universiteit
Postboks 7161
NL-1007 MC Amsterdam (NL)
Tel: 31 (20) 548-3511
Fax: 31 (20) 462-457

Varga, Robert J.
Unocal Science & Technology
376 South Valencia
Brea, CA 92621 (US)
Tel: 1 (714) 528-7201 X1623
Fax: 1 (714) 528-3520

Veis, George
National Technical University
9 Heroon Polytechniou
GR-15773 Zographou, Athens (GR)
Tel: 30 (1) 777-3613

Villinger, Heinrich
Alfred-Wegener Institut
Columbusstrasse, Postfach 120161
D-2850 Bremerhaven 12 (G)
Tel: 49 (0471) 483-1215
Fax: 49 (0471) 483-1149
Omnet: Alfred.Wegener

Vincent, Edith
Laboratoire de Géologie du Quaternaire
CNRS-Luminy, Case 907
13288 Marseille Cedex 9 (F)
Tel: 33 (91) 269-630
Fax: 33 (91) 266-638
Omnet: Y.Lancelot

Vine, F.J.
School of Environmental Sciences
University of East Anglia
Norwich NR4 7TJ (UK)
Tel: 44 (603) 592-842
Fax: 44 (603) 507-719

Von Herzen, Richard P.
Department of Geology and Geophysics
Woods Hole Oceanographic Institution
Woods Hole, MA 02543 (US)
Tel: 1 (508) 457-2000 x2465
Fax: 1 (508) 457-2187
Omnet: WHOI.Geol.Geoph
Internet: rvonh@red.whoi.edu

Von Huene, Roland
GEOMAR
Research Center for Marine Geoscience
Wischhofstrasse 1-3, Geb. 4
D-2300 Kiel 14 (G)
Tel: 49 (431) 720-2272
Fax: 49 (431) 720-2293

Von Rad, Ulrich
Bundesanstalt für Geowiss. u. Rohstoffe
Stilleweg 2, Postfach 510153
D-3000 Hannover 51 (G)
Tel: 49 (0511) 643-2785
Fax: 49 (0511) 643-2304

Vorren, Tore O.
Institute of Biology and Geology
University of Tromsö
Dramsveien 201
N-9001 Tromsø (N)
Tel: 47 (83) 44-000
Fax: 47 (83) 71-961

Vrellis, Gregory
Drilling Department
Public Petroleum Co., (DEP-EKY-S.A)
199 Kiffissias Avenue
15124 Maroussi, Athens (GR)
Tel: 30 (1) 806-9314

Watkins, Joel
Department of Geophysics
Texas A&M University
1000 Discovery Drive
College Station, TX 77843 (US)
Tel: 1 (409) 845-1371
Fax: 1 (409) 845-6780

Watts, A.B.
Department of Earth Sciences
University of Oxford
Parks Road
Oxford, OX1 3PR (UK)
Tel: 44 (0865) 272-032
Fax: 44 (0865) 272072

Weaver, Philip P.E.
Institute of Oceanographic Sciences
Deacon Laboratory
Brook Rd., Wormley, Godalming
Surrey GU8 5UB (UK)
Tel: 44 (428) 684-141
Fax: 44 (428) 683-066

Wefer, Gerold
Fachbereich Geowissenschaften
Universität Bremen
Bibliothekstrasse
D-2800 Bremen 33 (G)
Tel: 49 (421) 218-3389

Weigel, Wilfried
Institut für Geophysik
Universität Hamburg
Bundesstrasse 55
D-2000 Hamburg 13 (G)
Tel: 49 (40) 4123-2981

Westgaard, Leif
NAVF
Sandakerveien 99
N-0483 Oslo (N)
Tel: 47 (2) 15-70-12
Fax: 47 (2) 22-55-71

Whitmarsh, Robert B.
Institute of Oceanographic Sciences
Deacon Laboratory
Brook Rd.
Wormley, Surrey GU8 5UB (UK)
Tel: 44 (0428) 684-141
Fax: 44 (0428) 683-066
Omnet: IOS.Wormley
Internet: rbw@uk.ac.nwo.ia

Wilkens, Roy
School of Ocean and Earth Sci. & Techn.
University of Hawaii at Manoa
1000 Pope Road
Honolulu, HI 96822 (US)
Tel: 1 (808) 956-5228
Fax: 1 (808) 956-2538

Williams, D. Michael
Research Dept., Dallas Research Lab
Mobil Research and Development Corp.
P.O. Box 819047
Dallas, TX 75381-9047 (US)
Tel: 1 (214) 851-8589
Fax: 1 (214) 851-8185

Winterer, Edward L.
Scripps Institution of Oceanography
University of California, San Diego
La Jolla, CA 92093-2015 (US)
Tel: 1 (619) 534-2360
Fax: 1 (619) 534-0784

Wise, Sherwood W.
Department of Geology, Rm. 221
Florida State Universtiy
Tallahassee, FL 32306-3026 (US)
Tel: 1 (904) 644-6265
Fax: 1 (904) 561-1405

Wortel, R.
Institute of Earth Sciences
P.O. Box 80-021
3508 TA Utrecht (NL)
Tel: 31 (30) 535-086

Worthington, Paul
Exploration and Product Divison
BP Research Centre
Chertsey Rd., Sunbury-on-Thames
Middlesex TW16 7LN (UK)
Tel: 44 (932) 763-263
Fax: 44 (932) 764-459

Yagishita, Koji
Department of Geology
Iwate University
3-18-33 Uyeda
Morioka, 020 (J)
Tel: 81 (196) 235-171 ex.2430
Fax: 81 (196) 544-214

Yamano, Makoto
Earthquake Research Institute
University of Tokyo
1-1-1 Yayoi, Bunkyo-ku
Tokyo 113 (J)
Tel: 81 (3) 3812-2111
Fax: 81 (3) 3812-6979

Zachos, James C.
Department of Geological Sciences
University of Michigan
1006 C.C. Little Building
Ann Arbor, MI 48109-1063 (US)
Tel: 1 (313) 764-1453
Fax: 1 (313) 763-4690

Zierenberg, Robert A.
Branch of Western Mineral Resources
U.S. Geological Survey
345 Middlefield Road, MS-901
Menlo Park, CA 94025 (US)
Tel: 1 (415) 329-5437
Internet: robert@pmgvax.wr.usgs.gov

Zoback, Mark D.
Department of Geophysics
Stanford University
Stanford, CA 94305 (US)
Tel: (415) 725-9295
Fax: (415) 725-7344

Zonenshain, Lev P.
P.P. Shirshov Institute of Oceanology
Krasikova Street, 23
Moscow 117218 (SU)
Tel: 7 (095) 124-7942

Zverev, Sergey M.
Institute of Earth's Physics
B. Gruzinskaya Street, 10
Moscow 109017 (USSR)
Tel: 7 (95) 254-6895
Fax: 7 (95) 253-9283

Telex List

Alfred-Wegener Institut, Bremerhaven (G)	238695/POLAR D
AMOCO Production Co., Tulsa, OK (US)	200654/AMOCO UR
AMOCO Production Co., Tulsa, OK (US)	284255/CDFTU UR
Bedford Inst. of Oceanogr., Atl. Geosci. C., Dartmouth, NS (CAN)	01931552/BIO DRT
BP Research Centre, Exploration & Production Div., Middlesex (UK)	296041/BPSUNA G
British Geological Survey, Nottingham (UK)	378173/BGSKEY G
British Oceanogr Data Centre, Proudman Oc. Lab., Merseyside (UK)	628591/OCEANB G
Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover (G)	923730/BGR HA D
Bureau of Min. Res., Marine Geosci. Div., Canberra, ACT. (AUS)	62109/AA
Cambridge Univ., Geosciences, Cambridge (UK)	81240/CAMSPL G
Canadian Oil & Gas Lands Admin., Res. Eval. Branch, Ottawa (CAN)	0534366/EMR RMCB OTT
Chiba Univ., School of Lib. Arts, Dept. of Earth Sci., Chiba 260 (J)	25607/ORIUT J
Columbia Univ., Lamont-Doherty Geol. Observ., Palisades, NY (US)	258294/MCSP UR
Columbia Univ., Lamont-Doherty Geol. Observ., Palisades, NY (US)	7105762653/LAMONTGEO
Cornell Univ., Dept. of Geol. Sciences, Ithaca, NY (US)	6713054/CORNELL ITCA
Dalhousie Univ., Dept. of Oceanogr., Halifax, Nova Scotia (CAN)	01921863/DALUNIVLIB HFX
Deacon Laboratory, Inst. of Oceanogr. Sciences, Surrey (UK)	858833/OCEANS G
DEMINEX, 4300 Essen (G)	8571141/DX D
Deutsche Forschungsgemeinschaft, Bonn (G)	17228312/DFG
Drilling Technology Inc., Plano, TX (US)	794784/ARCO PLNO
Earth Sci. Sec., Dept. of Energy, Mines & Resources, Ottawa (CAN)	0533117/EMAR OTT
Elf-Aquitaine (Production), Paris La Defense (F)	615400/ELFA F
ETH-Zentrum, Geologisches Institut, Zürich (CH)	817379/EHHG CH
European Science Foundation, Strasbourg (F)	890440/ESF F
EXXON, Basin Explor. Div., Houston, TX (US)	9108813649/USEPR TEX HOU
EXXON Company Intern., Houston, TX (US)	774169
EXXON Production Res. Co., Houston, TX (US)	9108815579/USEPRTX HOU
Geological Institute, Moscow (SU)	411848/GIN SU
Geological Survey of Canada, Ottawa (CAN)	0533117/EMAR OTT
Geological Survey of Finland (GTK), Espoo (SF)	123185/GEOLO SF
Geological Survey of Greenland, København (DK)	19066/GGUTEL DK
IFREMER, Plouzane (F)	940627/OCEAN F
IFREMER, Technopolis 40, Issy-les-Moulineaux (F)	631912/F
IGM/CNR, Bologna (I)	511350/I
Indiana Univ., Dept. of Geology, Bloomington, IN (US)	272279/Indiana Ubloom
Institute of Earth's Physics, Moscow (SU)	411196/IFZAN SU
Institute of Earth Sciences, TA Utrecht (NL)	40704/VMRLU NL
Institut Français du Petrole, Rueil-Malmaison (F)	203050/IFP A F
Institute of Lithosphere, Moscow (SU)	411484/LITOS SU
Istanbul Technical Univ., Faculty of Mining, Istanbul (TR)	23706/UTU TR
James Cook Univ., Dept. of Geol., Townsville, Q (AUS)	47009/AA
JAPEX Geosci. Inst., Inc., Akasaka Twin Tower Bldg, Tokyo .(J)	25607/ORIUT J
Joint Oceanographic Inst., Inc, Washington, DC (US)	7401433/BAKE UC
Kyushu University, Department of Geology, Fukuoka (J)	25607/ORIUT J
Laboratoriet for Geofysik, Århus N (DK)	64767/AAUSCI
Lamont-Doherty Geological Observatory, Palisades, NY (US)	7105762653/LAMONTGEO
Lehigh Univ., Dept. of Geol. Sciences, Bethlehem, PA (US)	7106701086/OSU COVS
Memorial U., Earth Res. C., Can. ODP Secr., St. John's, NF (CAN)	0164101/MEMORIAL SNF
Mobil Research & Production Corp., Dallas, TX (US)	205638/MDRL DAL
National Science Foundation, Washington, DC (US)	7401424/NSFO UC
National Technical Univ., Zographou, Athens (GR)	215032/GEO GR
National Geophysical Data Center, Boulder, CO (US)	258169/WDCA UR
Natural Environment Research Council, Swindon (UK)	444293/ENVRE G
Niedersächsisches Landesamt für Bodenforschung, Hannover (G)	923730/BGR HA D
Norwegian Polar Research Institut, Oslo Lufthavn (N)	74745/POLAR N

Oceanological Institute, Vladivostok (SU)	213121/SVT SU
Oregon State Univ., College of Oceanography, Corvallis, OR (US)	5105960682/OSU COVS
Oxford Univ., Dept. of Earth Sciences, Oxford (UK)	83147/EARTH
P.P. Shirshov Institute of Oceanology, Moscow (SU)	411968/OCEAN SU
Public Petroleum Co., Drilling Dept., Maroussi, Athens (GR)	219415/DEP GR
Rice Univ., Dept. of Geol. and Geophysics, Houston, TX (US)	62013673
Sandia National Labs., Div. 6252, Albuquerque, NM (US)	169012/SANDIA LABS
SECEG, Madrid (E)	48207/SCEG E
St. Louis Univ., Dept. of Earth and Atm. Sci., St. Louis, MO (US)	550132/STL UNIV STL
STATOIL, Stavanger (N)	73600/STAST N
Swedish Natural Sci. Res. Council, Stockholm (S)	13599/RESCOUN S
Swiss National Science Foundation, Bern (CH)	912423/CH
Texas A&M Univ., Dept. of Oceanography, College Station, TX (US)	258781/GRITUR
Texas A&M Univ., Ocean Drilling Program, College Station, TX (US)	62760290/ESL UD
Total/CFP, Paris La Defense (F)	615700/F
TU Clausthal, Inst. Tiefbohrk. u. Erdölgew., Clausthal-Zellerfeld (G)	953813/TU ITE D
U.S. Geological Survey, , Denver, CO 80225 (US)	9109370740/GSA FTS LKWD
U.S. Geological Survey, Menlo Park, CA (US)	171449/PCS USGS MNPK
U.S. Geol. Survey, Petroleum Geol., Denver, CO (US)	9102504346/PETROL D Q
U.S. Geol. Survey, Natl. Center , Sci. Publ., Reston, VA (US)	160443/USGS UT
Univ. de Brest, Fac. desSci. et Tech., Lab. de Geoph. Mar., Brest (F)	940627/OCEAN F
Univ. of Texas, Inst. for Geoph., JOIDES Office, Austin, TX (US)	7408994/JOID UC
Univ. of Wales, Coll. of Cardiff, Dept. of Geol., Cardiff (UK)	48358/UCSWAN G
Univ. di Ferrara, Instituto di Geologia, Ferrara (I)	510850/UNIV FE I
Univ. Bremen, Fachbereich Geowissenschaften, Bremen (G)	245811/UNI D
Univ. Giessen, Geowissenschaften, Giessen (G)	482956/UNI GI D
Univ. Hamburg, Inst. für Geophysik, Hamburg (G)	214732/UNI HH D
Univ. Libre de Bruxelles, Lab. Associés, Geol.-Petr., Bruxelles (B)	23069/BODPC
Univ. Pierre et Marie Curie, Geosciences, Paris (F)	200145/UPMC SIX F
Univ. of Bergen, Dept.of Geology, Bergen (N)	8441023 UIBTA N
Univ. of Birmingham, School of Earth Sciences, Birmingham (UK)	333762/UOBHAM G
Univ. of California, Dept/Earth & Space Sci., Los Angeles, CA (US)	3716012/UCLA LSA
Univ of California, Davis, Geology Department, Davis, CA (US)	9105310785/UCDAVIS
Univ. of Calif., S.D., Scripps Inst. of Oceanogr., La Jolla, CA .(US)	9103371271/UCWWD SIO SDG
Univ. of Calif., S.C., Geo/Marine Sciences, Santa Cruz, CA .(US)	7607936/UCSC UC
Univ. of Cambridge, Dept. of Earth Sciencesw, Cambridge (UK)	81240/CAMPSL G
Univ. of Durham, Department of Geological Sciences, Durham, (UK)	53654/UNINEW G
Univ. of Edinburgh, Grant Institute of Geology, Edinburgh (UK)	727442/UNIVED G
Univ. of Hawaii, Manoa, Geosciences, Honolulu, HI (US)	7238861/HIGCY HR
Univ. of Miami, Rosenstiel Sch/Marine & Atm. Sci., Miami, FL (US)	317454/VOFM RSMAS MIA
Univ. of Milan, Dipartimento di Scienza della Terra, Milano (I)	320484/UNIMI I
Univ. of Milan, Dipartimento di Scienze della Terra, Milano (I)	312800/PP MI I
Univ. of Oslo, Dept. of Geology, Oslo (N)	79367/ESCON N
Univ. of Rhode Island, Grad. Sch/Oceanogr., Narragansett, RI (US)	257580/KNAU UR
Univ. of Tasmania, Geology Dept., Hobart, Tasmania (AUS)	58150/AA
Univ. of Texas at Austin, Inst.for Geophysics, Austin, TX (US)	9108741380/UTIG AUS
Univ. of Tokyo, Ocean Research Institute, Tokyo (J)	25607/ORIUT J
Univ. of Tromsö, Institute of Biology and Geology, Tromsø (N)	64251/N
Univ.of Washington, Coll/Ocean & Fishery Sci., Seattle, WA (US)	9104740096/UW UI
Univ. of Washington, Dept. of Geological Sci., Seattle, WA (US)	9104740096/UW UI
Univ.of Waterloo, Dept.of Earth Sciences, Waterloo, Ontario (CAN)	06955259/U OF W WTLO
USSR Academy of Science, Inst. of Oceanology, Moscow (SU)	411968/OKEN SU
Vrije Universiteit, Instituut voor Aardwetenshappen, Amsterdam (NL)	10399/INTVU NL
Woods Hole Oceanographic Institution, , Woods Hole, MA (US)	951679/OCEANIST WOOH
Yamagata University, Department of Earth Sciences, Yamagata (J)	25607 ORIUT J

Publication Statement

• Comments and suggestions concerning the content of this or future issues of the *JOIDES Journal* should be directed to the editorial staff:

c/o JOIDES Planning Office
Institute for Geophysics
The University of Texas at Austin
8701 Mopac Blvd.
Austin, TX 78759-8345
Tel: (512) 471-0471
Fax: (512) 471-0999

• Additional copies of the current issue and available back issues should be requested from:

Joint Oceanographic Institutions, Inc.,
1755 Massachusetts Ave., NW, Suite 800
Washington, D.C. 20036-2102
Tel: (202) 232-3900
Fax: (202) 232-8203

The *JOIDES Journal* is edited by JOIDES Office staff. The JOIDES Office is located at the Institute for Geophysics, University of Texas, from October 1990 to September 1992. During this period the *JOIDES Journal* is edited by Craig S. Fulthorpe and Peter Blum.

The *JOIDES Journal* is printed and distributed by the Joint Oceanographic Insitutions (JOI), Inc., Washington, D.C., for the Ocean Drilling Program (ODP) under the sponsorship of the National Science Foundation and participating countries. The material is based upon research supported by the National Science Foundation under Prime Contract OCE 83-17349.

The purpose of the *JOIDES Journal* is to serve as a means of communication among the JOIDES advisory structure, the National Science Foundation, the Ocean Drilling Program, JOI subcontractors thereunder, and interested earth scientists.

Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

The information contained within the *JOIDES Journal* is preliminary and priviledged and should not be cited or used except within the JOIDES organization or for purposes associated with ODP. This journal should not be used as a basis for other publications.

Publication History

The *JOIDES Journal* is published in yearly volumes which normally consist of three issues published in February (No. 1), June (No. 2), and October (No. 3). Publication commenced in 1975 with Volume I and has continued since then.
In addition, there are occasional special issues of the *JOIDES Journal* which are listed below:

Special Issue No. 1: Manual on Pollution Prevention and Safety, 1976 (Vol. II)
Special Issue No. 2: Initial Site Prospectus, Supplement One, April 1978 (Vol. III)
Special Issue No. 3: Initial Site Prospectus, Supplement Two, June 1980 (Vol. VI)
Special Issue No. 4: Guide to the Ocean Drilling Program, September 1985 (Vol. XI)
Special Issue No. 4: Guide to the Ocean Drilling Program, Suppl. One, June 1986 (Vol. XII)
Special Issue No. 5: Guidelines for Pollution Prevention and Safety, March 1986 (Vol. XII)
Special Issue No. 6: Guide to the Ocean Drilling Program, December 1988 (Vol. XIV)

JOIDES Resolution Operations Schedule

Leg	Program	Cruise Dates	Days Transit	Days On Site	Days Total	In Port
142	Engineering, EPR	18 Jan.-19 Mar. 1992	25	36	61	Honolulu, 19-23 Mar. 1992
143	Atolls & Guyots A	24 Mar.-19 May	12	44	56	Majuro, 20-24 May
144	Atolls & Guyots B	25 May-20 July	12	44	56	Yokohama, 20-24 July
145	North Pacific Transect	25 July-21 Sept.	18	41	59	Victoria, 21-25 Sept.
146	Cascadia	26 Sept.-21 Nov.	6	50	56	San Diego, 21-25 Nov.
147	Hess Deep	26 Nov. '92-21 Jan. 1993	14	42	56	Panama, 21-25 Jan. 1993
148	*Engineering, DCS IIB	26 Jan.-23 March	18	38	56	Lisbon, 23-27 March
149	Iberian Abyssal Plain	28 March-23 May	12	44	56	New York, 23-27 May
150	New Jersey Sea Level	28May-23 July	5	51	56	St. Johns, 23-27 July
151	Atlantic Arctic Gateway	28 July-22 Sept.	14	42	56	Reykjavik, 22-26 Sept.
152	East Greenland Margin	27 Sept.-22. Nov			56	

* Assumes Mid Atlantic Ridge operation. Definition of leg awaits outcome of Leg 142. Back-up: Hole 504B

JOIDES Meeting Schedule

Date	Place	Committee/Panel
1992		
March 5-7	St. Petersburg, FL	OHP
March 5-6	Toronto, Canada	DH-WG
March 6-8	Miami, FL	SGPP
March 10-11	Palisades, NY	PPSP
March 18-20	Davis, CA	LITHP
March 20-22	Honolulu, HI	SMP
March 23-25	Las Vegas, NV	TECP
April 1-3	College Station, TX	IHP
April 1-3	Palisades	SSP
April 21-23	Corvallis, Oregon	PCOM
May 7-8	College Station	TEDCOM
May 18-20*	Paris, France	OD-WG
June 15-18	Washington, DC	EXCOM
June*	Europe	SL-WG
August 11-13	Canada	PCOM
September*	Marseilles, France	IHP
Nov/Dec	Bermuda	PCOM

* Meeting not yet formally requested and/or approved

JOI, Inc.
Prime Contractor
Joint Oceanographic Institutions Inc.
1755 Massachusetts Ave.
NW, Suite 800
Washington, DC 20036-2102 (US)
Tel: 1 (202) 232-3900
Fax: 1 (202) 232-8203
Omnet: JOI.Inc

··· ODP publications ···
··*JOIDES Journal* distribution ··

JOIDES Office
Science Planning
Institute for Geophysics
University of Texas at Austin
8701 Mopac Boulevard
Austin, TX 78759-8345 (US)
Tel: 1 (512) 471-0450
Fax: 1 (512) 471-0999
Omnet: JOIDES.UTIG
Internet: joides@utig.ig.utexas.edu

··· Proposal submissions ···
··· *JOIDES Journal* editor ···

ODP/TAMU
Science Operations
ODP/Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547 (US)
Tel: 1 (409) 845-2673
Fax: 1 (409) 845-4857
Omnet: Ocean.Drilling.TAMU

· ODP/DSDP sample requests ·
··· Leg staffing ···

ODP/LDGO
Wireline Logging Services
Borehole Research Group
Lamont-Doherty Geol. Observatory
Palisades, NY 10964 (US)
Tel: 1 (914) 359-2900 x335
Fax: 1 (914) 365-3182
Omnet: Borehole

··· Logging information ···
··· Logging Schools ···