Leg 35, Southeast Pacific Ocean

A. Generalized lithologic column and selected core photographs from Site 323. Photograph scales in cm.

   a. *Core 18 Section 4, 100-125 cm* (698 meters below the sea floor) Zeolitic claystone consisting of 10-50% zeolites (clinoptilolite and laumontite) and 5-20% Fe aggregates. This late Cretaceous unit was deposited in a tranquil environment, probably beneath the carbonate compensation depth. White specks are agglutinated foraminifers. Fossil burrows also occur (*Zoophycos,* 110 cm) and some are filled with zeolitic minerals.

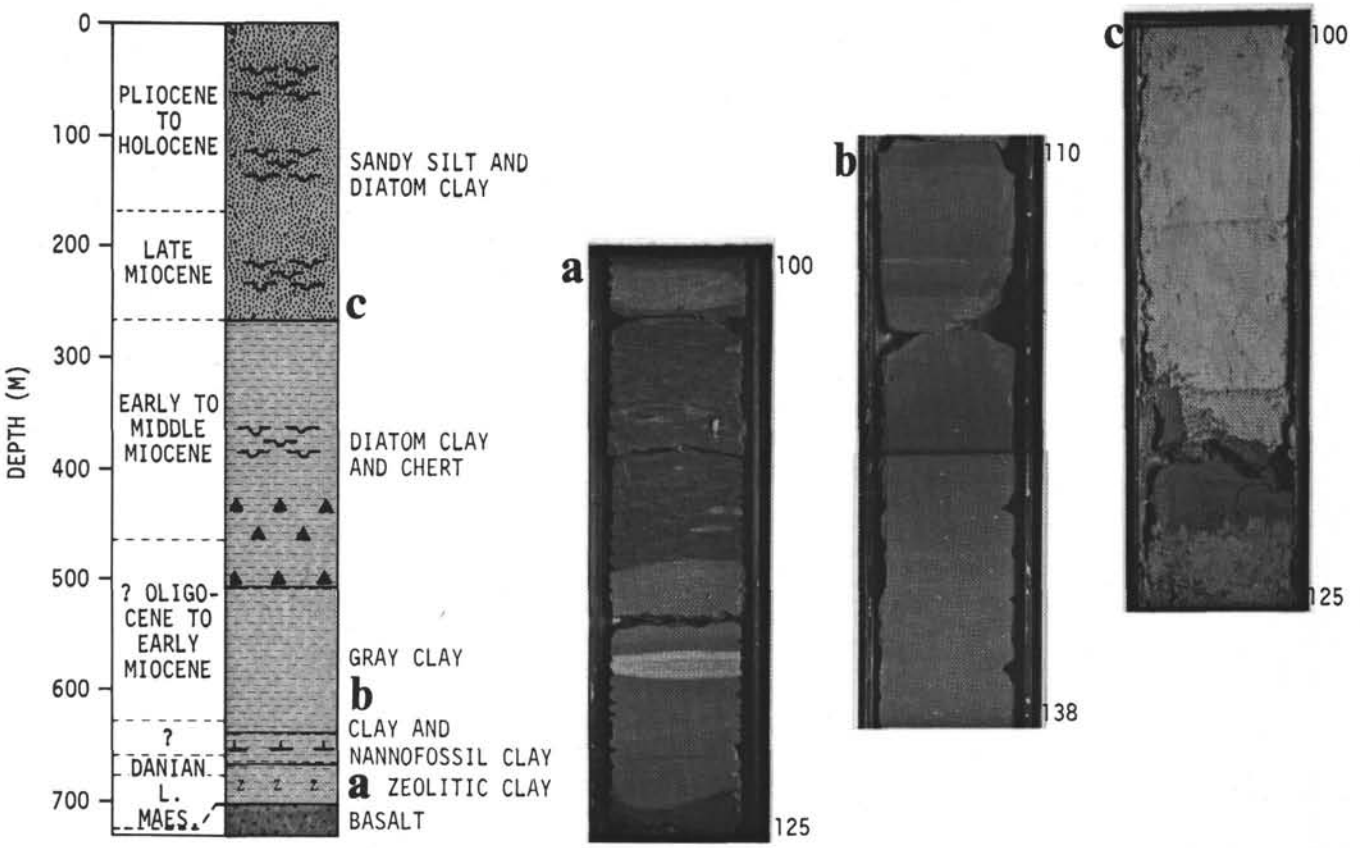
   b. *Core 12 Section 2, 110-138 cm* (600 meters below the sea floor) Olive gray claystone with faint wavy banding of early Miocene to (?)Oligocene age. Silt layer at 115 cm contains 70% quartz, 20% clay minerals, 3% heavy minerals, and 5-7% pyrite. The increase in detrital components, compared to the underlying sediments, suggests the initiation of circumpolar circulation at this time. However, the circumpolar productivity was insufficient to cause the deposition of biogenic, silica-rich sediments.

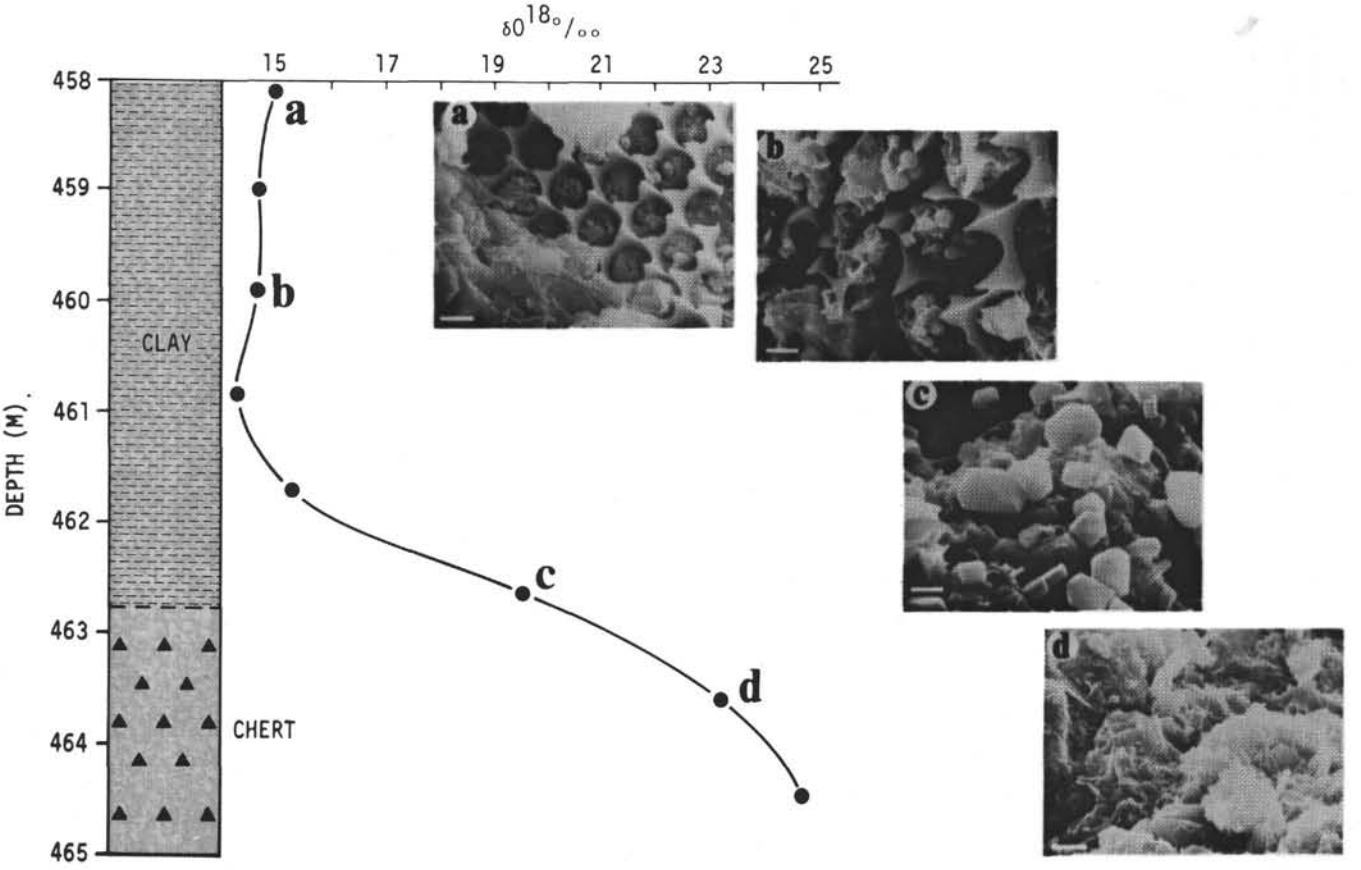
   c. *Core 3 Section 2, 100-125 cm* (260 meters below the sea floor) Quartz-rich silty sand layer in diatom bearing claystone. This late Miocene section reflects depositional conditions similar to those existing at present. Relatively large amounts of detrital sediment are a result of turbidity current and iceberg transport. The abundance of biogenic silica in this and overlying sections is a result of high productivity due to the intensification of circumpolar circulation.

B. Site 323 $\delta\, 0^{18}$ values from claystones and underlying chert show progressive diagenesis. Silicification of claystone proceeds by dissolution of radiolarian tests (a); further dissolution of radiolarian tests accompanied by a precipitation of opal-CT (cristobalite, tridymite) lepispheres, and formation of authigenic smectite (b); formation of authigenic K-feldspar (c); and formation of a porcellanite layer (d). White lines in lower left represent 2 μm for a and d, 1.6 μm for b, and 1.2 μm for c. The variation in oxygen isotopes in the siliceous minerals, $\delta\, 0^{18}$, is defined as

$$\left(\frac{0^{18}/0^{16}}{0^{18}/0^{16}\ \text{std}} - 1\right) 1000$$

where the standard is taken as the isotopic ratio in standard mean ocean water (SMOW). Values are in per mil, ‰.


DEPTH (M)
0
100
200
300
400
500
600
700
PLIOCENE TO HOLOCENE
LATE MIOCENE
EARLY TO MIDDLE MIOCENE
? OLIGOCENE TO EARLY MIOCENE
?
DANIAN
L. MAES.
SANDY SILT AND DIATOM CLAY
c
DIATOM CLAY AND CHERT
GRAY CLAY
b
CLAY AND NANNOFOSSIL CLAY
a ZEOLITIC CLAY
BASALT
a
100
125
b
110
138
c
100
125


δ0^18‰
15
17
19
21
23
25
DEPTH (M)
458
459
460
461
462
463
464
465
CLAY
CHERT
a
b
c
d

Initial Reports of the Deep Sea Drilling Project

A Project Planned by and Carried Out With the Advice of the
JOINT OCEANOGRAPHIC INSTITUTIONS FOR DEEP EARTH SAMPLING (JOIDES)

Volume XXXV

covering Leg 35 of the cruises of the Drilling vessel *Glomar Challenger*
Callao, Peru to Ushuaia, Argentina
February-March 1974

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Prepared for the
NATIONAL SCIENCE FOUNDATION
National Ocean Sediment Coring Program
Under Contract C-482
By the
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References to this Volume

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Foreword

For the three and one-half years between 1872 and 1876, the H.M.S. CHALLENGER—after which D/V GLOMAR CHALLENGER is named—undertook the world's first major oceanographic expedition. It is fitting that our century should have its counterpart to that famous ship a century ago whose voyages helped established oceanography as a science. It is equally fitting that GLOMAR CHALLENGER should be plying the same waters one century later seeking answers to new questions concerning the history of our planet and the life it supports. The fundamental advancement of our knowledge of the earth will lead to enhanced capabilities to understand its processes and to use its natural resources intelligently.

The Deep Sea Drilling Project is being undertaken within the context of the National Science Foundation's Ocean Sediment Coring Program. The Foundation is funding the project by means of a contract with the University of California, and the Scripps Institution of Oceanography is responsible for its management. The University has, in turn, subcontracted with Global Marine Incorporated for the services of the drilling ship, GLOMAR CHALLENGER.

Scientific planning is conducted under the auspices of the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES). The JOIDES consortium has convened advisory panels for that purpose, consisting of a large number of distinguished scientists from the academic institutions, Government agencies, and private industry of many countries. Altogether, the project has involved the active interest and participation of many of the world's best scientists and technologists.

The first ocean coring operations for the Deep Sea Drilling Project began on August 11, 1968. During the ensuing years of drilling operations in the Atlantic, Pacific, and Indian Oceans, the Gulf of Mexico, Caribbean Sea, and Mediterranean Sea, and Antarctic waters, the scientific objectives that had been set forth were successfully accomplished. Primarily, the age of the ocean basins and their processes of development were determined. Emphasis was placed on broad reconnaissance and on testing the involvement of the mid-oceanic rise systems in the development of the ocean basins.

From these concepts come major interpretations of the results of the drilling as they bear on patterns of sedimentation and physical and chemical characteristics of the ancient oceans.

As a result of the success of the Deep Sea Drilling Project, the National Science Foundation extended its contract with the University of California to encompass an additional 36 months of drilling, allowing GLOMAR CHALLENGER to continue operations throughout the oceans of the world in exploring the deep ocean floors for a period presently extending one full decade. Scientific interest will involve major effort in drilling deeply into the oceanic crustal igneous rocks to study the processes and mechanisms leading to the formation of the oceanic crust.

These reports contain the results of initial studies of the recovered core material and the associated geophysical information. The contribution to knowledge has been exceedingly large and future studies of the core material over many years will contribute much more.

The importance of the work of the Deep Sea Drilling Project and D/V GLOMAR CHALLENGER is internationally recognized. In response to this recognition, a number of nations have expressed interest in full joint participation. Effective January 1974, the USSR and the Federal Republic of Germany entered into agreements with the United States for such joint participation and support. Similar arrangements were agreed to by Japan in July 1975, the United Kingdom in September 1975, and France in January 1976.

All people, in their lives, activities, and industry, should benefit greatly from the project —from the technological advances that are being made and through the information being obtained on natural resources.

H. Guyford Stever
Director

Washington, D.C.
April 1976

Preface

Recognizing the need in the oceanographic community for scientific planning of a program to obtain deep sedimentary cores from the ocean bottoms, four of the major oceanographic institutions that had strong interests and programs in the fields of marine geology and geophysics, formed in May 1964, the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES). This group, Lamont-Doherty Geological Observatory; Rosenstiel School of Marine and Atmospheric Science, University of Miami; the Scripps Institution of Oceanography, University of California at San Diego; and the Woods Hole Oceanographic Institution, expressed an interest in undertaking scientific planning and guidance of the sedimentary drilling program. It was the purpose of this group to foster programs to investigate the sediments and rocks beneath the deep oceans by drilling and coring. The membership of this original group was later enlarged in 1968 when the University of Washington became a member.

Through discussions sponsored by the JOIDES organization, with support from the National Science Foundation the Lamont-Doherty Geological Observatory operated a drilling program with Dr. J. Lamar Worzel as Principal Investigator. This successful drilling effort early in the summer of 1965, on the Blake Plateau region off Jacksonville, Florida, used the drilling vessel, *Caldrill I*.

With this success in hand, planning began for a more extensive deep sea effort. This resulted in the award of a contract by the National Science Foundation to the University of California for an eighteen-month drilling program in the Atlantic and Pacific Oceans, termed the Deep Sea Drilling Project. Operations at sea began in August 1968.

The goal of the Deep Sea Drilling Project is to gather scientific information that will help determine the age and processes of development of the ocean basins. The primary strategy is to drill deep holes into the ocean floor, relying largely on technology developed by the petroleum industry.

Through the efforts of these five principal organizations and of the panel members which were drawn from a large cross section of leading earth scientists and associates, a scientific program was developed.

Cores recovered from deep beneath the ocean floor will provide reference material for a multitude of future studies in fields such as biostratigraphy, physical stratigraphy, and paleomagnetism, that will afford a new scope for studies of the physical and chemical aspects of sediment provenance, transportation, deposition, and diagensis. In-hole measurements, as feasible, should provide petrophysical data to permit inference of lithology of intervals from which no cores were recovered.

A report, describing the core materials and information obtained both at sea and in laboratories on shore, is published as soon as possible after the completion of each cruise. These reports are a cooperative effort of the scientists participating in the cruise and are intended primarily to be a compilation of results which, it is hoped, will be the starting point for many future new and exciting research programs. Preliminary interpretations of the data and observations taken at sea, are also included.

Core materials and data collected on the cruise will be made available to qualified scientists through the Curator of the Deep Sea Drilling Project, following a Sample Distribution Policy (p. xvii) approved by the National Science Foundation.

The advent of *Glomar Challenger,* with its deep-water drilling ability, is exceedingly timely. It has come when geophysical investigation of the oceans has matured through 20 to 30 years of vigorous growth to the point where we have some knowledge about much of the formerly unknown oceanic areas of our planet. About one million miles of traverses had been made which tell us much about the global pattern of gravity, magnetic and thermal anomalies, and about the composition, thickness and stratification of the sedimentary cover of the deep-sea and continental margin. The coverage with such data has enabled the site selection panels to pick choice locations for drilling. The knowledge gained from each hole can be extended into the surrounding area. Detailed geophysical surveys were made for most of the selected locations prior to drilling.

The earth sciences have recently matured from an empirical status to one in which substantial theories and hypotheses about major tectonic processes are flourishing. Theories about the origin of magnetic fields and magnetic reversals, about ocean floor spreading and continental drift, and about the thermal history of our planet, have led to specific predictions that could be tested best by an enlightened program of sampling of deep-sea and continental margin sediments and underlying rocks.

The members of JOIDES and the scientists from all interested organizations who have served on the various advisory panels are proud to have been of service to the Nation and believe that the information and core materials that have been obtained will be of value to students of earth sciences and all humanity for many years to come.

Deep Sea Drilling Project

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Rosenstiel School of Marine and Atmospheric Science, University of Miami

Scripps Institution of Oceanography, University of California

P. P. Shirshov Institute of Oceanology, Academy of Science of the U.S.S.R.

University of Washington

Woods Hole Oceanographic Institution

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N. T. Edgar

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* Includes member organizations during time of the cruise.

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Deep Sea Drilling Project
SAMPLE DISTRIBUTION POLICY*

Distribution of Deep Sea Drilling samples will be undertaken in order to (1) provide supplementary data for inclusion in the appropriate Initial Report to support *Glomar Challenger* scientists in achieving the scientific objectives of their particular cruise, and (2) provide individual investigators with material to conduct detailed studies beyond the scope of the Initial Reports.

The National Science Foundation has established a Sample Distribution Panel to advise on distribution of core material. This panel is chosen in accordance with usual Foundation practices, in a manner that will assure advice in the various disciplines leading to a complete and adequate study of the core and related materials. Funding for the proposed research is handled separately by the investigator, not through the Deep Sea Drilling Project.

Distribution of samples for contributions to Initial Reports

Any investigator who wishes to contribute a paper to a given volume of the Initial Reports may write to the Curator, Deep Sea Drilling Project, Scripps Institution of Oceanography, University of California, at San Diego, La Jolla, California 92037, requesting samples from a forthcoming cruise. The request should include the nature of the study, and type, size, number of samples, particular sampling techniques or equipment that might be required, and an estimate of the time required to complete the study. The requests will be reviewed by shipboard scientists, and, if they are deemed suitable and pertinent to the objectives of the leg, and shipboard workload permits, the requested samples will be taken during the cruise (provided, of course, material suitable to the investigation is obtained during the drilling). In case of multiple requests to perform the same investigation, selection of investigator will be made by the shipboard scientific party. Proposals should be of a scope appropriate to complete the sampling and study in time for publication in the Initial Reports. Studies deemed acceptable will be referred to the Curator who will, with the consent of the NSF Sample Distribution Panel, authorize distribution of the samples. The Sample Distribution Panel and the Deep Sea Drilling Project will strive to ensure that there is a reasonable degree of continuity in the investigations among the various cruises, that the studies are pertinent to goals of the cruise, and that they are consistent with the publication policy for the Initial Reports. Subject to these same provisions, the shipboard scientific party may elect to have special studies of selected core samples of its recently completed cruise made by other investigators.

Investigations not completed in time for inclusion in the Initial Report may not be published in other journals until publication of the Initial Report for which it was intended, though it is expected that they will normally be published as an appendix in a later Initial Report volume.

Distribution of Samples for publication other than in Initial Reports

1. Researchers intending to request samples for studies beyond the scope of the Initial Reports should first obtain a sample request form from the Curator, Deep Sea Drilling Project, Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92037. Requests should specify the quantities and intervals of the core required, a statement of the proposed research, the possibility of returning residue to the Curator, the estimated time required to complete and publish the results, and the availability or need of funding and availability of equipment and space foreseen for the research.

   In order to ensure that requests for highly desirable but limited samples can all be considered, approval of requests and distribution of samples will not be made prior to 12 months after date of completion of the cruise that collected the cores. Prior to the publication of an Initial Report, requests for samples from a cruise can be based on the preliminary shipboard core logs. Copies of these logs will be kept on open file at Scripps Institution of Oceanography and other designated institutions. The only exceptions to this policy will be for specific instances involving ephemeral properties.

   Requests for samples from researchers in industrial laboratories will be handled in the same manner as those from academic organizations, and there will be the same obligation to publish results promptly. Requests from foreign scientists or organizations will also be considered.

2. The Deep Sea Drilling Project's Curator has the responsibility for distributing samples, controlling quality of samples, and preserving core material. He also has the responsibility for maintaining a record of requests for samples that have been

*Revised June 1972.

processed and filled indicating the investigator and subjects to be studied. This record will be available to investigators.

The distribution of samples will be made directly from the two repositories at Lamont-Doherty Geological Observatory and Scripps Institution of Oceanography by the Curator or his designated representative.

3. (a) Samples up to 50 cc/meter of core length can be automatically distributed by the Curator, Deep Sea Drilling Project, or his authorized representative to any qualified investigator who requests them. The Curator will refrain from making automatic distribution of any parts of the cores which appear to be in particularly high demand or limited supply, and any requests for these parts of the cores will be referred to the Sample Distribution Panel for review. Requests for samples from stratigraphic boundaries will also generally require Panel review.

   (b) All requests for samples in excess of 3(a) above will be referred to the Sample Distribution Panel.

   (c) If, in the opinion of scientific investigators, certain properties they wish to study may deteriorate prior to the normal availability of the samples, such investigators may request that the normal waiting period not apply. All such requests must be approved by the Sample Distribution Panel.

4. Samples will not be provided prior to assurance that funding for sample studies either exists or is not needed. However, neither formal approval of sample requests nor distribution of samples will be made until the appropriate time (Item 1). If a sample request is dependent, either wholly or in part, on proposed funding, the Curator will provide to the organization to whom the funding proposal has been submitted any information on the availability (or potential availability) of samples that it may request.

5. Investigators receiving samples are responsible for:

   i) promptly publishing significant results;

   ii) acknowledging, in publications, that samples were supplied through the assistance of the National Science Foundation;

   iii) submitting four (4) copies of all reprints of published results to the Curator, Deep Sea Drilling Project, Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92037;

   iv) notifying the Curator of any work done on the samples that is additional to that stated in the original request for samples;

   v) returning, in good condition, the remainders of samples after termination of research, if requested by the Curator.

6. Cores will be made available at repositories for investigators to examine and specify exact samples in such instances as this may be necessary for the scientific purposes of the sampling, subject to the limitations of 3 (a), (b), (c), and 5, above, and with the specific permission of the Curator or his delegate.

7. Cores of igneous and metamorphic rocks will also remain at the repositories where they will be available for observation and description and where selected samples may be taken for thin-section preparation and other work.

8. The Deep Sea Drilling Project routinely processes by computer most of the quantitative data presented in the Initial Reports. Space limitations in the Initial Reports preclude the detailed presentation of all such data. However, copies of the computer readout are available for those who wish the data for further analysis or as an aid in selecting samples.

   Magnetics, seismic reflection and bathymetric data collected underway by the *Glomar Challenger* will also be available for distribution twelve months after completion of the cruise.

   Requests for these data may be made to:

   Assoc. Chief Scientist for Science Services
   Deep Sea Drilling Project, A-031
   Scripps Institution of Oceanography
   University of California at San Diego
   La Jolla, California 92093

   A charge may be made to recover the expenses of responding to individual requests. Estimated charges can be furnished before the request is processed, if required.

9. This policy has the approval of the National Science Foundation and is designed to help ensure that the greatest possible scientific benefit is gained from the materials obtained, and that samples will be made widely available to interested geologists.

CONTENTS

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