



Lithofacies distribution pattern for surface sediments in the South Atlantic Ocean in the Miocene. The data points are from Deep Sea Drilling Project results through Leg 39, plus a great number of pre-Pleistocene piston cores in the collection of the Lamont-Doherty Geological Observatory. The palinspastic base map is adapted from "The Age of the Ocean Basins", a map compiled by Pitman, Larson, and Herron and published by the Geological Society of America. For a discussion of lithofacies distribution patterns in the Early Cretaceous, Late Cretaceous, and each epoch of the Tertiary, see McCoy and Zimmerman, this volume. The sediment distribution patterns for each of the seven time slices are shown in color in a plate in a pocket at the back of this volume.

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 XXXIX

covering Leg 39 of the cruises of the Drilling Vessel *Glomar Challenger*
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PARTICIPATING SCIENTISTS

Katherina Perch-Nielsen, Peter R. Supko,
Yury P. Neprochnov, Herman B. Zimmerman, Floyd McCoy,
Naresh Kumar, Jörn Thiede, Enrico Bonatti, Ron Fodor,
Anne Boersma, Menno G. Dinkelman, Richard L. Carlson

SCIENCE EDITOR

Peter R. Supko

Prepared for the
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UNIVERSITY OF CALIFORNIA
Scripps Institution of Oceanography
Prime Contractor for the Project

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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 are providing partial support. Effective January 1974, the USSR and the Federal Republic of Germany entered into agreements with the United States for 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.



Richard C. Atkinson
Director

Washington, D. C.
October 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, and again in 1975 when University of Hawaii Institute of Geophysics, the Oregon State University School of Oceanography, the University of Rhode Island Graduate School of Oceanography, and Texas A&M University Department of Oceanography became members.

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 diagenesis. 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

MEMBER ORGANIZATIONS OF THE JOINT OCEANOGRAPHIC INSTITUTIONS FOR DEEP EARTH SAMPLING (JOIDES):*

Bundesanstalt für Geowissenschaften und Rohstoffe,
Federal Republic of Germany

Lamont-Doherty Geological Observatory, Columbia
University

Rosenstiel School of Marine and Atmospheric
Science, University of Miami

Scripps Institution of Oceanography, University of
California

USSR Academy of Sciences

University of Washington

Woods Hole Oceanographic Institution

OPERATING INSTITUTION:

Scripps Institution of Oceanography
University of California at San Diego
La Jolla, California
W. A. Nierenberg, Director

DEEP SEA DRILLING PROJECT

Project Chief Scientist
N. T. Edgar

Principal Investigator and
Project Manager
M. N. A. Peterson

* Includes member organizations during time of the
cruise.

Participants Aboard

GLOMAR CHALLENGER for Leg Thirty Nine:

Dr. Katharina Perch-Nielsen
Co-Chief Scientist & Paleontologist
Eidg. Technische Hochschule Zurich
Geologisches Institut
CH-8006 Zurich
Sonneggstrasse 5
Switzerland

Dr. Peter R. Supko
Co-Chief Scientist & Editorial Representative
Scripps Institution of Oceanography
Deep Sea Drilling Project
La Jolla, California 92093

Dr. Yury P. Neprochnov
Sedimentologist
P. P. Shirshov Institute of Oceanology
USSR Academy of Sciences
1, Letnyaya, Lublino
Moscow, 109387, USSR

Dr. Herman B. Zimmerman
Sedimentologist
Union College
Civil Engineering Department
Schenectady, New York 12308

Dr. Floyd McCoy
Sedimentologist
Lamont-Doherty Geological Observatory
Palisades, New York 10964

Dr. Naresh Kumar
Sedimentologist
Lamont-Doherty Geological Observatory
Palisades, New York 10964

Dr. Jörn Thiede
Sedimentologist
Department of Oceanography
Oregon State University
Corvallis, Oregon 97331

Dr. Enrico Bonatti
Igneous Petrologist
University of Miami
Rosenstiel School of Marine and
Atmospheric Sciences
10 Rickenbacker Causeway
Miami, Florida 33149

Dr. Ron Fodor
Igneous Petrologist
Department of Geology
University of New Mexico
Albuquerque, New Mexico 87106

Dr. Anne Boersma
Paleontologist
Lamont-Doherty Geological Observatory
Palisades, New York 10964

Dr. Menno G. Dinkelman
Paleontologist
Geology Department
The Florida State University
Tallahassee, Florida 32306

Mr. Richard L. Carlson
Physical Properties Specialist
University of Washington
Department of Geological Sciences
Seattle, Washington 98195

Mr. David L. Edmiston
Cruise Operations Manager
Atlantic Richfield Company
1225 Ashland Drive
Dallas, Texas 75080

Mr. Melvin Fields
Meteorologist
NOAA-National Weather Service
East Coast Weather Patrol
439 West York Street
Norfolk, Virginia 23510

Captain J. A. Clarke
Captain of the Drilling Vessel
(6 October-20 December 1974)
Global Marine, Inc.
Los Angeles, California

Mr. Jim Ruddell
Drilling Superintendent
(6 October-20 December 1974)
Global Marine, Inc.
Los Angeles, California

Captain Loyd Dill
Captain of the Drilling Vessel
(21 December 1974-15 February 1975)
Global Marine, Inc.
Los Angeles, California

Mr. Cotton Guess
Drilling Superintendent
(21 December 1974-15 February 1975)
Global Marine, Inc.
Los Angeles, California

Mr. Michael Lehman
Laboratory Officer
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Mr. Dennis Graham
Chemist
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Mr. Allen Porter
Electronics Technician
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Mr. Robert Byrne
Electronics Technician
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Mr. John Dewar
Marine Technician
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Mr. Craig Dootson
Marine Technician
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Ms. Ann Gilbert
Marine Technician
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Mr. Donald Marsee
Marine Technician
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Ms. Trudy Wood
Paleontological Preparation
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Mr. Orrin Russie
Photographer
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Ms. Louise Henry
Yeoman
Deep Sea Drilling Project
Scripps Institution of Oceanography
La Jolla, California 92093

Senior Project Personnel

Dr. Melvin N. A. Peterson
Principal Investigator and
Project Manager

Mr. Frank C. MacTernan
Principal Engineer and
Deputy Project Manager

Dr. David G. Moore
Chief Scientist

Dr. Stan M. White
Associate Chief Scientist for
Science Operations

Dr. John L. Usher
Associate Chief Scientist for
Science Services

Mr. William R. Riedel
Curator

Mr. Valdemar Larson
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Project Development Engineer

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Ruhr-Universität Bochum

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*** Deceased

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Mobil Oil Corporation

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Institute of Geochemistry, USSR

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Massachusetts Institute of Technology

Dr. Nikolas Christensen
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Dr. Gleb Udintsev
P. P. Shirshov Institute of Oceanology, USSR

Advisory Panel on Ocean Margin (Active)

Dr. Seiya Uyeda
Lamont-Doherty Geological Observatory

Dr. Joe S. Creager
University of Washington

Dr. I. P. Kosminskaya
Institute of the Physics of the Earth, USSR

Dr. Loren W. Kroenke
University of Hawaii

Dr. Creighton A. Burk
*Mobile Oil Corporation
Princeton, New Jersey*

Dr. William J. Ludwig
Lamont-Doherty Geological Observatory

Dr. Gordon Packham
University of Sydney

Academician A. P. Pieve
Institute of Geology, USSR

Dr. David W. Scholl
U.S. Geological Survey

Dr. Roland Von Huene
U.S. Geological Survey

Advisory Panel on Ocean Margin (Passive)

Dr. Joseph R. Curray
Scripps Institution of Oceanography

Dr. A. W. Bally
Shell Oil Company

Academician V. V. Belousov
Soviet Geophysical Committee

Professor Daniel Bernoulli
Geologisch-Palaontologisches Institut, Basel

Professor Dr. Hans Closs
Bundesanstalt für Geowissenschaften und Rohstoffe

Mr. John Ewing
Lamont-Doherty Geological Observatory

Dr. K. Hinz
Bundesanstalt für Geowissenschaften und Rohstoffe

Dr. Lucien Montadert
Institut Français du Pétrole

Mr. David G. Roberts
Institute of Oceanographic Sciences

Dr. E. Seibold
Geologisch-Palaontologisches Institut, Universität-Kiel

Dr. Von Stackleberg
Bundesanstalt für Geowissenschaften und Rohstoffe

Advisory Panel on Ocean Paleoenvironment

Professor Hans M. Bolli
Technische Hochschule, Zurich

Dr. Thomas A. Davies
Scripps Institution of Oceanography

Mr. Jacques Debyser
CNEXO, Paris

Dr. William W. Hay
Rosenstiel School of Marine & Atmospheric Science

Dr. Valeri A. Krasheninnikov
Geological Institute, USSR

Dr. Alexander Lisitzin
P. P. Shirshov Institute of Oceanology, USSR

Dr. Isabella Premoli-Silva
University of Milano

Mr. William R. Riedel
Scripps Institution of Oceanography

Dr. H.-J. Schrader
*Geologisch-Palaontologisches
Institut der Universität Kiel*

Dr. Tj. H. Van Andel
Oregon State University

Professor Thomas J. Worsley
University of Washington

Advisory Panel on Site Surveying

Dr. Brian T. R. Lewis
University of Washington

Dr. Mahlon Ball
Rosenstiel School of Marine & Atmospheric Science

Dr. Elizabeth Bunce
Woods Hole Oceanographic Institution

Dr. Edgar S. Driver
Gulf Global Exploration Company

Mr. John Ewing
Lamont-Doherty Geological Observatory

Dr. Karl Hinz
Bundesanstalt für Geowissenschaften und Rohstoffe

Dr. Donald M. Hussong
Hawaii Institute of Geophysics

Dr. L. Kogan
Southern Branch of the Institute of Oceanology, USSR

Dr. I. P. Kosminskaya
Institute of the Physics of the Earth, USSR

Dr. Marcus Langseth
Lamont-Doherty Geological Observatory

Dr. Vince Renard
Centre Oceanologique de Bretagne

Dr. G. Stober
Deminex, Dusseldorf

Dr. Gleb Udintsev
P. P. Shirshov Institute of Oceanology, USSR

Dr. Roland Von Huene
U.S. Geological Survey

Dr. Joe S. Watkins
University of Texas

Dr. Edward L. Winterer
Scripps Institution of Oceanography

Deep Sea Drilling Project SAMPLE DISTRIBUTION POLICY*

Distribution of Deep Sea Drilling samples for investigation will be undertaken in order to (1) provide supplementary data to support GLOMAR CHALLENGER scientists in achieving the scientific objectives of their particular cruise, and in addition to serve as a mechanism for contributions to the *Initial Reports*; (2) provide individual investigators with materials that are stored with samples for reference and comparison purposes.

The National Science Foundation has established a Sample Distribution Panel to advise on the distribution of core materials. 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 cores and their contents. Funding for the proposed research must be secured separately by the investigator. It cannot be provided through the Deep Sea Drilling Project.

The Deep Sea Drilling Project's Curator is responsible for distributing the samples and controlling their quality, as well as preserving and conserving core material. He also is responsible for maintaining a record of all samples that have been distributed, shipboard and subsequent, indicating the recipient, and the nature of the proposed investigation. This information is made available to all investigators of DSDP materials as well as other interested researchers on request.

The distribution of samples is made directly from one of the two existing repositories, Lamont-Doherty Geological Observatory and Scripps Institution of Oceanography, by the Curator or his designated representative.

1. *Distribution of Samples for Research Leading to Contributions to Initial Reports*

Any investigator who wishes to contribute a paper to a given volume of the *Initial Reports* may write to the Chief Scientist, Deep Sea Drilling Project (A-031) Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093, U.S.A., requesting samples from a forthcoming cruise. Requests for a specific cruise should be received by the Chief Scientist two months in advance of the departure of the cruise in order to allow time for the review and consideration of all requests and to establish a suitable shipboard sampling program. The request should include a statement of the nature

of the study proposed, size and approximate number of samples required to complete the study, and any particular sampling technique or equipment that might be required. The requests will be reviewed by the Chief Scientist of the Project and the cruise co-chief scientists; approval will be given in accordance with the scientific requirements of the cruise as determined by the appropriate JODIES Advisory Panel(s). If approved, the requested samples will be taken, either by the shipboard party if the workload permits, or by the curatorial staff shortly following the return of the cores to the repository. Proposals must be of a scope to ensure that samples can be processed and a contribution completed in time for publication in the *Initial Reports*. Except for rare, specific instances involving ephemeral properties, sampling will not exceed one-quarter of the volume of core recovered, with no interval being depleted and one-half of all core being retained as an archive. Shipboard sampling shall not exceed approximately 100 igneous samples per investigator; in all cases co-chief scientists are requested to keep sampling to a minimum.

The co-chief scientists may elect to have special studies of selected core samples made by other investigators. In this event the names of these investigators and complete listings of all materials loaned or distributed must be forwarded, if possible, prior to the cruise or, as soon as possible following the cruise, to the Chief Scientist through the DSDP Staff Science Representative for that particular cruise. In such cases, all requirements of the Sample Distribution Policy shall also apply.

If a dispute arises or if a decision cannot be reached in the manner prescribed, the NSF Sample Distribution Panel will conduct the final arbitration.

Any publication of results other than in the *Initial Reports* within twelve (12) months of the completion of the cruise must be approved and authored by the whole shipboard party and, where appropriate, shore-based investigators. After twelve months, individual investigators may submit related papers for open publication provided they have submitted their contributions to the *Initial Reports*. Investigations not completed in time for inclusion in the *Initial Reports* for a specific cruise may not be published in other journals until final publication of that *Initial Report* for which it was intended. Notice of submission to other journals and a copy of the article should be sent to the DSDP Chief Science Editor.

* Revised October 1976

2. *Distribution of Samples for Research leading to Publication other than in Initial Reports*

- A. Researchers intending to request samples for studies beyond the scope of the *Initial Reports* should first obtain sample request forms from the Curator, Deep Sea Drilling Project (A-031), Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093, U.S.A. On the forms the researcher is requested to specify the quantities and intervals of the core required, make a clear statement of the proposed research, state time required to complete and submit results for publication, specify the status of funding and the availability of equipment and space foreseen for the research.

In order to ensure that all requests for highly desirable but limited samples can be considered, approval of requests and distribution of samples will not be made prior to 2 months after publication of the Initial Core Descriptions (I.C.D.). ICD's are required to be published within 10 months following each cruise. The only exceptions to this policy will be for specific instances involving ephemeral properties. Requests for samples can be based on the Initial Core Descriptions, copies of which are on file at various institutions throughout the world. Copies of original core logs and data are kept on open file at DSDP and at the Repository at Lamont-Doherty Geological Observatory, Palisades, New York. Requests for samples from researchers in industrial laboratories will be handled in the same manner as those from academic organizations, with the same obligation to publish results promptly.

- B. (1) The DSDP Curator is authorized to distribute samples to 50ml per meter of core. Requests for volumes of material in excess of this amount will be referred to the NSF Sample Distribution Panel for review and approval. Experience has shown that most investigations can be accomplished with 10ml sized samples or less. All investigators are encouraged to be as judicious as possible with regard to sample size and, especially, frequency within any given core interval. The Curator will not automatically distribute any parts of the cores which appear to be in particularly high demand; requests for such parts will be referred to the Sample Distribution Panel for review. Requests for samples from

thin layers or important stratigraphic boundaries will also require Panel review.

(2) If investigators wish to study certain properties which may deteriorate prior to the normal availability of the samples, they may request that the normal waiting period not apply. All such requests must be reviewed by the curators and approved by the NSF Sample Distribution Panel.

- C. 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 A). If a sample request is dependent, either wholly or in part, on proposed funding, the Curator is prepared to 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.
- D. Investigators receiving samples are responsible for:
- (1) publishing significant results; however contributions shall not be submitted for publication prior to 12 months following the termination of the appropriate leg;
 - (2) acknowledging, in publications, that samples were supplied through the assistance of the U.S. National Science Foundation and others as appropriate;
 - (3) submitting five (5) copies (for distribution to the Curator's file, the DSDP Repositories, the GLOMAR CHALLENGER's Library, and the National Science Foundation) of all reprints of published results to the Curator, Deep Sea Drilling Project (A-031), Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093, U.S.A.;
 - (4) returning, in good condition, the remainders of samples after termination of research, if requested by the Curator.
- E. Cores are made available at repositories for investigators to examine and to specify exact samples in such instances as may be necessary for the scientific purposes of the sampling, subject to the limitations of B (1 and 2) and D, above, with specific permission of the Curator or his delegate.

F. Shipboard-produced smear slides of sediments and thin sections of indurated sediments, igneous and metamorphic rocks, will be returned to the appropriate repository at the end of each cruise or at the publication of the *Initial Reports* for that cruise. These smear slides and thin sections will form a reference collection of the cores stored at each repository and may be viewed at the respective repositories as an aid in the selection of core samples.

G. 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 on selecting samples. A charge will be made to recover expenses in excess of \$50.00 incurred in filling requests.

3. *Other Records*

Magnetics, seismic reflection, downhole logging, and bathymetric data collected by the GLOMAR CHALLENGER will also be available for distribution at the same time samples become available.

Requests for data may be made to:

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

A charge will be made to recover the expenses in excess of \$50.00 in filling individual requests. If required, estimated charges can be furnished before the request is processed.

4. *Reference Centers*

As a separate and special category, samples will be distributed for the purpose of establishing up to five reference centers where paleontologic materials will be available for reference and comparison purposes. The first of these reference centers has been approved at Basel, Switzerland.

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It is almost customary in Initial Report volumes to credit the Global Marine officers and crew and the DSDP marine technicians; we take particular pleasure in doing so with a great deal of justification. Leg 39 has been the longest DSDP cruise in terms of miles steamed or days at sea. Halfway through the long deadhead from our last planned site, 358 in the Argentine Basin, to Cape Town, we dropped the beacon for an unplanned site, 359, on the southwestern Walvis Ridge. At the time, the rig floor had been secured, drilling subassemblies painted, and scientific laboratories secured and cleaned thoroughly. After a period of initial shock, the ship's crew, drilling crew, and marine technicians pitched in with their usual high level of professionalism to make Site 359 a successful end to a profitable expedition.