

Selected significant findings during Leg 63 drilling off southern California and Baja California.

The core photo at left illustrates interbedded clayey chalk (light) and cross-bedded and graded lithic lapilli tuff (dark) recovered at Site 467. The volcanic rocks signal an important middle Miocene volcanic episode that postdates most borderland volcanism.

The volcanoclastic breccia recovered at Site 469 (center core photo) contains principally angular basalt, andesite, and pumice fragments along with minor bioclastic and sedimentary rock fragments. The breccia thickens eastward toward the continental margin and may reflect uplift and subaerial erosion of the margin as it was met by the ancestral East Pacific Rise.

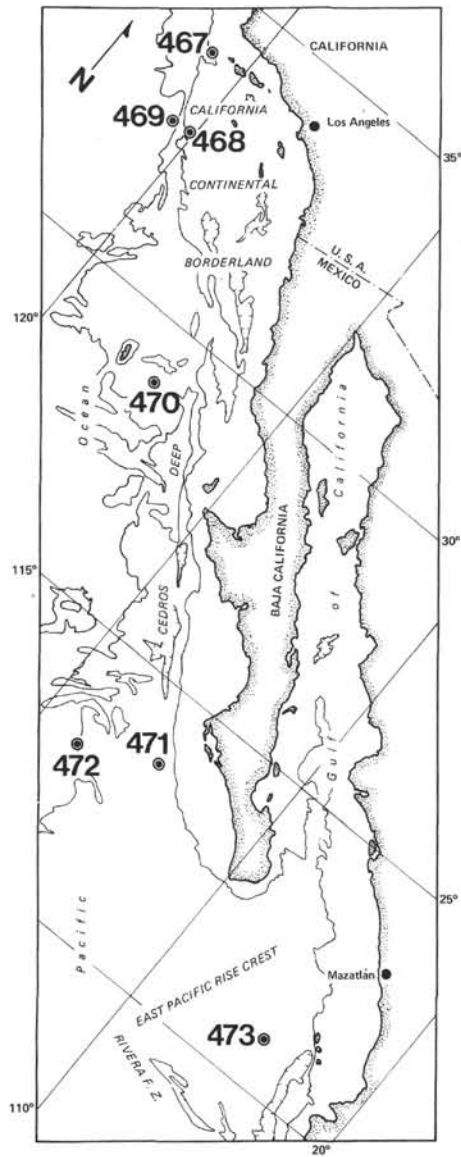
The basement contact sequence at Site 471 illustrated in the core photo at right shows abundant dark chalcopyrite- and sphalerite-bearing sediments and associated red, metalliferous sediment and black chert overlying highly altered diabase. This occurrence may be an ancient analogue for modern sulfide deposits found along the East Pacific Rise Crest and related fracture zones.



SITE 467, CORE 79,  
SECTION 2, 60–100 cm



SITE 469, CORE 33,  
SECTION 1, 94–106 cm



SITE 471, CORE 79,  
SECTION 1, 70–110 cm

# Initial Reports of the Deep Sea Drilling Project

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

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## VOLUME LXIII

covering Leg 63 of the cruises of the Drilling Vessel *Glomar Challenger*  
Long Beach, California to Mazatlán, Mexico  
October–November 1978

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### PARTICIPATING SCIENTISTS

Robert S. Yeats, Bilal U. Haq,  
John A. Barron, David Bukry, James Crouch,  
Charles Denham, A. G. Douglas, Vladimir I. Grechin, Margaret Leinen,  
Alan Niem, Surendra Pal Verma, Kenneth A. Pisciotta,  
Richard Z. Poore, Tsugio Shibata, and  
Reinhard Wolfart

Shipboard Science Representative

Kenneth A. Pisciotta

Editor

Susan Orlofsky

Prepared for the  
NATIONAL SCIENCE FOUNDATION  
National Ocean Sediment Coring Program  
Under Contract C-482

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

This material is based upon research supported by the National Science Foundation under Contract No. C-482.

Any opinions, findings, and 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.

It is recommended that reference to the whole or to part of this volume be made in one of the following forms, as appropriate:

Yeats, R. S., Haq, B. U., et al., 1981. *Init. Repts. DSDP, 63*: Washington (U.S. Govt. Printing Office).

Pisciotta, K. A., and Mahoney, J. J., 1981. Isotopic survey of diagenetic carbonates, Deep Sea Drilling Project Leg 63. *In* Yeats, R. S., Haq, B. U., et al., *Init. Repts. DSDP, 63*: Washington (U.S. Govt. Printing Office), 595-610.

#### Effective Publication Dates of DSDP *Initial Reports*

According to the International Code of Zoological Nomenclature, the date of publication of a work and of a contained name or statement affecting nomenclature is the date on which the publication was mailed to subscribers, placed on sale, or when the whole edition is distributed free of charge, mailed to institutions and individuals to whom free copies are distributed. The mailing date, *not the printed date*, is the correct one.

Mailing dates of the more recent *Initial Reports of the Deep Sea Drilling Project* are as follows:

Volume 54—December, 1980  
Volume 55—September, 1980  
Volume 56, 57—Part 1, November, 1980  
                  Part 2, November, 1980  
Volume 58—August, 1980  
Volume 59—January, 1981

Printed September 1981

Library of Congress Catalog Card Number 74—603338

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For sale by the Superintendent of Documents, U.S. Government Printing Office  
Washington, D.C. 20402

## Foreword

Between 1872 and 1876, the H.M.S. CHALLENGER undertook the world's first major oceanographic expedition. That expedition greatly expanded man's knowledge of the world's oceans and revolutionized his ideas about this planet earth. A century later, over the course of the past decade, another vessel, also named CHALLENGER, has continued to expand man's knowledge of the world ocean, and has revolutionized his concepts of how the seafloor and continents were formed and continue to change. The D/V GLOMAR CHALLENGER is plying the same waters as its historic counterpart, seeking answers to new questions concerning the history of our planet and the life it supports. The continued advancement of knowledge about the fundamental processes and dynamics of the earth will lead to a greater understanding of our planet and more intelligent use of its resources.

Since 1968, the Deep Sea Drilling Project has been supported by the National Science Foundation, primarily through a contract with the University of California which, in turn, subcontracts to Global Marine Incorporated for the services of the drillship D/V GLOMAR CHALLENGER. Scripps Institution of Oceanography is responsible for management of the University contract.

Through contracts with Joint Oceanographic Institutions, Inc. (JOI, Inc.), the National Science Foundation supports the scientific advisory structure for the project and funds some pre-drilling site surveys. Scientific planning is conducted under the auspices of the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES). The JOIDES advisory group consists of over 250 members who make up 24 committees, panels or working groups. The members are distinguished scientists from academic institutions, government agencies and private industry in many countries.

In 1975, the International Phase of Ocean Drilling (IPOD) began. IPOD member nations, USSR, Federal Republic of Germany, Japan, United Kingdom and France, provide partial support of the project. Each member nation takes an active role in the scientific planning of the project through organization membership in JOIDES. Scientists from these countries also participate in the field work aboard the D/V

GLOMAR CHALLENGER and post-cruise scientific studies.

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, Mediterranean Sea, and Antarctic waters, the scientific objectives that had been proposed were successfully accomplished. Primarily, the age of the ocean basins and their processes of development were determined. The validity of the hypothesis of sea floor spreading was firmly demonstrated and its dynamics studied. Emphasis was placed on broad reconnaissance and testing the involvement of mid-oceanic ridge systems in the development of the ocean basin. Later legs of the CHALLENGER's voyages concentrated on the nature of the oceanic crust, the sedimentary history of the passive ocean margins, sediment dynamics along active ocean margins and other areas of interest. The accumulated results of this project have led to major new interpretations of the pattern of sedimentation and the physical and chemical characteristics of the ancient oceans.

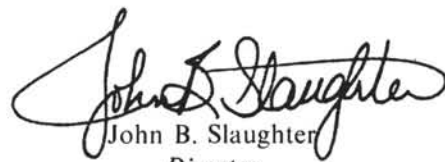
As a result of the continued success of the Deep Sea Drilling Project, the National Science Foundation has presently extended the project through fiscal year 1982. The latest contract extends the period of exploration of the deep ocean floors of the world by GLOMAR CHALLENGER to a total of over 14 years.

A new dimension of scientific discovery has been added to the project, the detailed study of paleoenvironment. With the introduction of the

hydraulic piston corer in 1979; virtually undisturbed cores of the soft sediment layers can now be obtained. This technological advance, together with the new pressure core barrel, has greatly enhanced the ability of the project to study ancient ocean climates as recorded by the micro flora and fauna preserved in the sedimentary layers.

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. Future studies of the core material over many years will contribute much more.

People of our planet, in their daily living and work activities will benefit directly and/or indirectly from this research. Benefits are derived from the technological advances in drilling, coring, position-keeping and other areas as well as through the information being obtained about natural resources and their origins. As with the original H.M.S. CHALLENGER oceanographic expedition, this second CHALLENGER expedition will have profound effects of scientific understanding for many years to come.



John B. Slaughter  
*Director*

Washington, D.C.  
June 1981

## 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. In accordance with international agreements, institutions of participating nations became members of JOIDES. Thus, during 1974 to 1976, the Bundesanstalt für Geowissenschaften und Rohstoffe of the Federal Republic of Germany, the Centre National pour l'Exploitation des Océans of France, the National Environmental Research Council of the United Kingdom, the University of Tokyo of Japan, and Academy of Sciences of the USSR became JOIDES members.

Through discussions sponsored by the JOIDES organization, with support from the National Science Foundation, Columbia University's Lamont-Doherty Geological Observatory operated a drilling program in the summer of 1965, on the Blake Plateau region off Jacksonville, Florida.



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 Scripps Institution of Oceanography, University of California at San Diego for an eighteen-month drilling program in the Atlantic and Pacific Oceans, termed the Deep Sea Drilling Project (DSDP). Operations at sea began in August 1968, using the now-famous drilling vessel, the *Glomar Challenger*.

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 the 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 provide reference material for a multitude of studies in fields such as biostratigraphy, physical stratigraphy, and paleomagnetism, that afford a new scope for studies of the physical and chemical aspects of sediment provenance, transportation, deposition, and diagenesis. In-hole measurements, as feasible, 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 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 each cruise will be made available to qualified scientists through the Curator of the Deep Sea

Drilling Project, following a Sample Distribution Policy (p. xix) 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 stratigraphy 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.

In October 1975, the International Phase of Ocean Drilling (IPOD) began. This international interest, and the true participation of both the scientists and governments of a number of nations, is elegant testimony of the importance of the work being done by the Deep Sea Drilling Project.

The members of JOIDES and DSDP and the scientists from all interested organizations and nations who have served on the various advisory panels are proud to have been of service 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

University of California at San Diego,  
Scripps Institution of Oceanography

Centre National pour l'Exploitation des Oceans, Paris

Columbia University, Lamont-Doherty Geological  
Observatory

University of Hawaii, Hawaii Institute of Geophysics

University of Miami, Rosenstiel School of Marine and  
Atmospheric Science

Natural Environment Research Council, London

Oregon State University, School of Oceanography

University of Rhode Island, Graduate School of  
Oceanography

Texas A&M University, Department of Oceanography

University of Tokyo, Ocean Research Institute

University of Washington, Department of  
Oceanography

U.S.S.R. Academy of Sciences

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**

Dr. W. A. Nierenberg  
Principal Investigator

Dr. M. N. A. Peterson  
Project Manager

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

Dr. Yves Lancelot  
Chief Scientist

Dr. Matthew H. Salisbury  
Associate Chief Scientist for  
Science Operations

Dr. William R. Riedel  
Curator

Mr. Stanley T. Serocki  
Project Development Engineer

Mr. Barry Robson  
Operations Manager

Mr. William T. Soderstrom  
Finance Administrator

Mr. Robert Olivas  
Logistics Officer

Ms. Sue Strain  
Personnel Officer

\*Includes member organizations during time of cruise.

# Participants aboard GLOMAR CHALLENGER for Leg Sixty-three

Dr. Robert S. Yeats

Co-Chief Scientist

*Department of Geology  
Oregon State University  
Corvallis, Oregon 97331*

Dr. Bilal U. Haq

Co-Chief Scientist

*Department of Geology  
Woods Hole Oceanographic Institution  
Woods Hole, Massachusetts 02543*

Dr. John Barron

Paleontologist (diatom)

*U.S. Geological Survey  
345 Middlefield Road  
Menlo Park, California 94025*

Dr. David Bukry

Paleontologist (nannofossil)

*U.S. Geological Survey, A-015  
Scripps Institution of Oceanography  
La Jolla, California 92093*

Mr. James Crouch

Sedimentologist and Geophysicist

*U.S. Geological Survey, A-015  
Scripps Institution of Oceanography  
La Jolla, California 92093*

Dr. Charles Denham

Paleomagnetist

*Department of Geology  
Woods Hole Oceanographic Institution  
Woods Hole, Massachusetts 02543*

Dr. A. G. Douglas

Geochemist (organic)

*Department of Geology  
The University  
Newcastle-upon-Tyne  
NE1 7RU  
United Kingdom*

Dr. Vladimir I. Grechin

Sedimentologist

*Geological Institute  
U.S.S.R. Academy of Sciences  
Moscow 109017  
U.S.S.R.*

Ms. Margaret Leinen

Sedimentologist and Geochemist

*Graduate School of Oceanography  
Narragansett Bay Campus  
University of Rhode Island  
Kingston, Rhode Island 02881*

Dr. Alan Niem

Sedimentologist

*Department of Geology  
Oregon State University  
Corvallis, Oregon 97331*

Dr. Surendra Pal Verma

Geochemist (inorganic)

*Instituto Geofísica  
Universidad Nacional Autónoma de México  
México 20, D. F.  
México*

Mr. Kenneth A. Pisciotto

Physical Properties Specialist,  
Sedimentologist, and Shipboard  
Science Representative

*Deep Sea Drilling Project, A-031  
Scripps Institution of Oceanography  
La Jolla, California 92093*

Dr. Richard Z. Poore

Paleontologist (foraminifer)

*Branch of Paleontology and Stratigraphy  
U.S. Geological Survey  
345 Middlefield Road  
Menlo Park, California 94025*

Dr. Tsugio Shibata

Igneous Petrologist

*Department of Earth Sciences  
Okayama University  
Tsushima, Okayama 700  
Japan*

Dr. Reinhard Wolfart

Paleontologist (radiolarian)

*Bundesanstalt für Geowissenschaften  
und Rohstoffe  
Postfach 510153  
3 Hannover 51  
Federal Republic of Germany*

Mr. Glen Foss  
Cruise Operations Manager  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

Mr. Melvin Fields  
NOAA—National Weather Service  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

Captain Loyd Dill  
Captain of the Drilling Vessel  
*Global Marine, Inc.*  
*Los Angeles, California 90017*

Mr. Otis Winton  
Drilling Superintendent  
*Global Marine, Inc.*  
*Los Angeles, California 90017*

Mr. Ted Gustafson  
Laboratory Officer  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

Mr. Edwin L. Denton  
Logging Engineer  
*Gearhart-Owen Industries, Inc.*  
*P.O. Box 1936*  
*Fort Worth, Texas 76101*

Mr. Joe Taverner  
Logging Technician  
*Gearhart-Owen Industries, Inc.*  
*P.O. Box 1936*  
*Fort Worth, Texas 76101*

Mr. Richard Myers  
Chemist  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

Ms. Kathleen O'Neill  
Curatorial Representative  
*Lamont-Doherty Geological Observatory*  
*Columbia University*  
*Palisades, New York 10964*

Mr. Paul Laughlin  
Electronics Technician  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

Mr. William Brennan  
Marine Technician  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

Mr. Victor Sotelo  
Marine Technician  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

Mr. Ken Thompson  
Marine Technician  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

Ms. Trudy Wood  
Marine Technician  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

Mr. Dennis Graham  
Photographer  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

Ms. Louise Henry  
Yeoperson  
*Deep Sea Drilling Project, A-031*  
*Scripps Institution of Oceanography*  
*La Jolla, California 92093*

## Deep Sea Drilling Project Publications Staff

*Publications Manager*  
Marianna Lee

*Editors*  
Rosemary Amidei  
Susan Orlofsky  
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Larry N. Stout

*Production Manager*  
Raymond F. Silk

*Production Assistants*  
Elaine M. Bruer  
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*Production Coordinators*  
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(this volume)

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*U.S. Geological Survey*
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*Scripps Institution of Oceanography*
- Dr. Samuel M. Savin  
*Case Western Reserve University*
- Dr. Erwin Suess (ex-officio)  
*Oregon State University*
- Dr. Y. Tardy  
*Laboratoire de Pédologie et Géochemie, Toulouse*
- Dr. K. K. Turekian  
*Yale University*
- Dr. K. H. Wedepohl  
*Geochemisches Institut der Universität, Göttingen*

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*Continental Oil Company*
- Professor Vsevolod V. Fedynskiy  
*Ministry of Geology of the U.S.S.R.*
- Mr. Melvin J. Hill  
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- Dr. Ing. Guenter Peterson  
*Deutsche Schachtbau und Tiefbohrergesellschaft mbh*
- Monsieur Gilbert Rutman  
*Société Nationale des Pétroles d'Aquitaine*
- Mr. G. Williams  
*United Kingdom Offshore Operators Association, Ltd.*

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*University of Newcastle*
- Dr. J. L. Bischoff  
*U.S. Geological Survey*
- Dr. N. A. Bogdanov  
*Academy of Sciences of the U.S.S.R.*
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*Scripps Institution of Oceanography*
- Dr. John Orcutt  
*Scripps Institution of Oceanography*
- Dr. M. Ozima  
*University of Tokyo*
- Dr. H.-U. Schmincke  
*Ruhr-Universität, Bochum*
- Dr. John Tarney  
*University of Birmingham*
- Dr. M. Treuil  
*Institut Physique du Globe*

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- Dr. Michael A. Arthur (ex-officio)  
*Scripps Institution of Oceanography*
- Dr. Michael Audley-Charles  
*Queen Mary College*

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*Université de Bretagne Occidentale*
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*Gulf Science and Technology Company*
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*Woods Hole Oceanographic Institution*
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*Bundesanstalt für Geowissenschaften und Rohstoffe*
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*Institut Français du Pétrole*
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*Exxon Production Research Company*  
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*Scripps Institution of Oceanography*

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Dr. D. Bukry  
*U.S. Geological Survey*  
Dr. P. Cepek  
*Bundesanstalt für Geowissenschaften und Rohstoffe*  
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*University of Southern California*  
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*Sedgwick Museum, Cambridge*  
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*Scripps Institution of Oceanography*  
Dr. J. B. Saunders  
*Naturhistorisches Museum, Basel*  
Dr. J. L. Usher  
*Scripps Institution of Oceanography*



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*Victoria Geophysical Observatory*

Dr. Heinz Beckmann  
*Technische Universität Clausthal*

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*Scripps Institution of Oceanography*

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*Texas A&M University*

Dr. N. Christensen  
*University of Washington*

Mr. A. H. Jageler  
*Amoco Production Research Company*

Dr. D. H. Matthews  
*University of Cambridge*

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# 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 to 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 JOIDES 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*. A paper too late for inclusion in the *Initial Reports* for a specific cruise may not be published elsewhere until publication of that *Initial Reports* for which it was intended. Notice of submission to other journals and a copy of the article should be sent to the DSDP Staff Science Representative for that leg.

\*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, and 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 (ICD). 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 50 ml 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 samples 10 ml or smaller. 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 Curator 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; 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.

### 3. 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.

## Data Distribution Policy

Data gathered on board D/V *Glomar Challenger* and in DSDP shore laboratories are available to all researchers 12 months after the completion of each cruise. The files are part of a coordinated computer database, fully searchable and coordinated to other files. Data sets representing a variety of geologic environments can be arranged for researchers who may wish to manipulate the database directly.

Most data requests are filled free of charge, except if they are unusually large or complex and direct costs exceed \$50.

When data are used for publication, the National Science Foundation must be acknowledged and DSDP provided with five reprints for inclusion in the DSDP index of publications and investigations. Requests for data should be submitted to:

Data Manager, Deep Sea Drilling Project  
Scripps Institution of Oceanography (A-031)  
University of California, San Diego  
La Jolla, California 92093

Telephone: (714) 452-3526  
Cable Address: SIOCEAN

I. The database includes files generally available both in digital form on magnetic tape and as microfilm copies of the original observation forms.

A. Geophysical data include underway bathymetry, magnetics, and sub-bottom profiles; bathymetry data exist both as 12-kHz and 3.5-kHz records. Underway data are processed by DSDP and the Geological Data Center at Scripps Institution of Oceanography (SIO). Seismic records are available in microfilm and photographic prints.

B. Physical property data obtained on board *Glomar Challenger* include:

Analytical water content, porosity, and density  
Density and porosity by Gamma Ray Attenuation Porosity Evaluator (GRAPE)  
Acoustic velocity by Hamilton Frame Method  
Thermal conductivity  
Heat flow (*in situ*)  
Natural gamma radiation (discontinued after Leg 19)  
Well logs

C. Sediment data obtained on board ship and from core samples in DSDP shore laboratories include:

Core photographs  
Visual core descriptions  
Smear slide descriptions  
X-ray diffraction  
X-ray fluorescence  
Total carbon, organic carbon, and carbonate determinations  
Grain-size determinations (sand, silt, clay)  
Interstitial water chemistry  
Gas chromatography

D. Igneous rock data include:

Core photographs  
Visual core descriptions  
Rock chemistry  
Paleomagnetism  
Thin-section descriptions

E. Paleontologic data include fossil names, abundance, preservation, and age of sample and are available, for selected sites, for Tertiary and Mesozoic taxa. Range charts can be generated from the database, using the line printer. A glossary of fossil names is available on microfiche or magnetic tape.

F. Ancillary files include:

Site positions  
Sub-bottom depths of cores  
Master Guide File (a searchable core data summary file)

II. Additional publications, aids to research, are periodically updated and distributed to libraries. Single copies, at no charge, are distributed on microfiche at 48X magnification, except for the Data Datas (C, opposite), which are at 24X. They include:

A. Guides to DSDP Core Materials, a series of printed summaries containing maxima, minima, and typical values for selected observations. Guides are available for each of the

major ocean basins and for Phases I, II, and III of the drilling program. The source data summary file is also available.

- B. Index to *Initial Reports* and Subsequent Publications and Investigations is a comprehensive key word index to chapters of the *Initial Reports* and to papers and investigations in progress which cite DSDP samples or data. The Index and its annotated bibliography serve to inform researchers of other investigators working on similar projects. Each paper is assigned key words for field of study, material, geographic area, and geologic age. A complete citation, including the assigned key words, is printed in the bibliography. Key words are permuted to form a comprehensive cross-index to the author reference list.
- C. Data Data, a series of informal memoranda providing a quick reference to accessible data, is available on microfiche. Also available is a site position map to assist researchers in large-area studies. (Site positions are plotted on a bathymetry map compiled by the SIO Geologic Data Center.)
- D. Data Retrieval and Application Computer Programs to perform data management and retrieval functions and a set of programs designed to provide special graphic displays of data are available; they may be of limited use because of differences in computer hardware. All current programs are written in ALGOL for a Burroughs 7800 computer system. Software inquiries may be addressed to the Data Manager.



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## ACKNOWLEDGMENTS

Many months of planning by the JOIDES Ocean Paleoenvironment Panel (OPP) and the Planning Committee (PCOM) went into the preparation for Leg 63. We wish to acknowledge our gratitude to the members of OPP and PCOM, and particularly to Jim Ingle of Stanford University, who was the leading proponent of the sites chosen for Leg 63.

Drilling in waters off the coast of southern California and Baja California required the close coordination and cooperation of many individuals in the United States and Mexico. Both areas are regions of possible future exploration for petroleum, and both areas are sensitive to environmental problems associated with drilling. The cooperation and helpful suggestions of the Pollution Prevention and Safety Panel were essential to the selection of drilling sites. On the basis of the recommendations of this panel, the U.S. Geological Survey vessel *S.P. Lee* ran a multichannel seismic survey over a proposed drilling site in the Tanner Basin. The results of this survey led us to relocate the site on Patton Ridge, where it was drilled as Site 468. Drilling off Mexico required coordination with many agencies in the Government of Mexico, which benefited by the assistance of Guillermo Salas, Consejo de Recursos Minerales, and Agustín Ayala Castañares of UNAM, and David G. Moore and M. N. A. Peterson of DSDP. People who shared their unpublished data with us to help in site planning included Jim Crouch, Bill Normark, and Jack Vedder of the U.S. Geological Survey, Jacqueline Mamerickx of Scripps, and Gordon Ness and Dick Couch of Oregon State University.

Shipboard operations were remarkably trouble-free, and we were consistently ahead of schedule, thanks to the hard work and level heads of Captain Loyd Dill and the rest of the GMI crew. Site 472 was possible only because we saved so much time on the earlier sites, and it is truly a monument to their efforts. Glen Foss's "game plans" consistently anticipated our problems and kept us out of trouble. The round-the-clock monitoring of gas shows on Sites 467 and 471 by Archie Douglas allowed us to core these sites with confidence that operations were being conducted safely and without fear of pollution hazards. Leg 63 set a record for the number of cores taken in a single leg, but despite this, Ted Gustafson, Lou Henry, and the DSDP lab technicians kept up with the work with efficiency and good cheer.

The editing of the volume has been done with great skill by Susan Orlofsky; the efforts of Mary Young, Janice Bowman, and Nancy Durham have also helped to complete the volume in a timely fashion. We are also grateful to Elaine Bruer, Madeleine Mahnken, Alice Thompson, and Virginia Roman for their expert drafting and compilation of many of the figures in this volume. And we thank Lola Boyce for typing the site chapters.