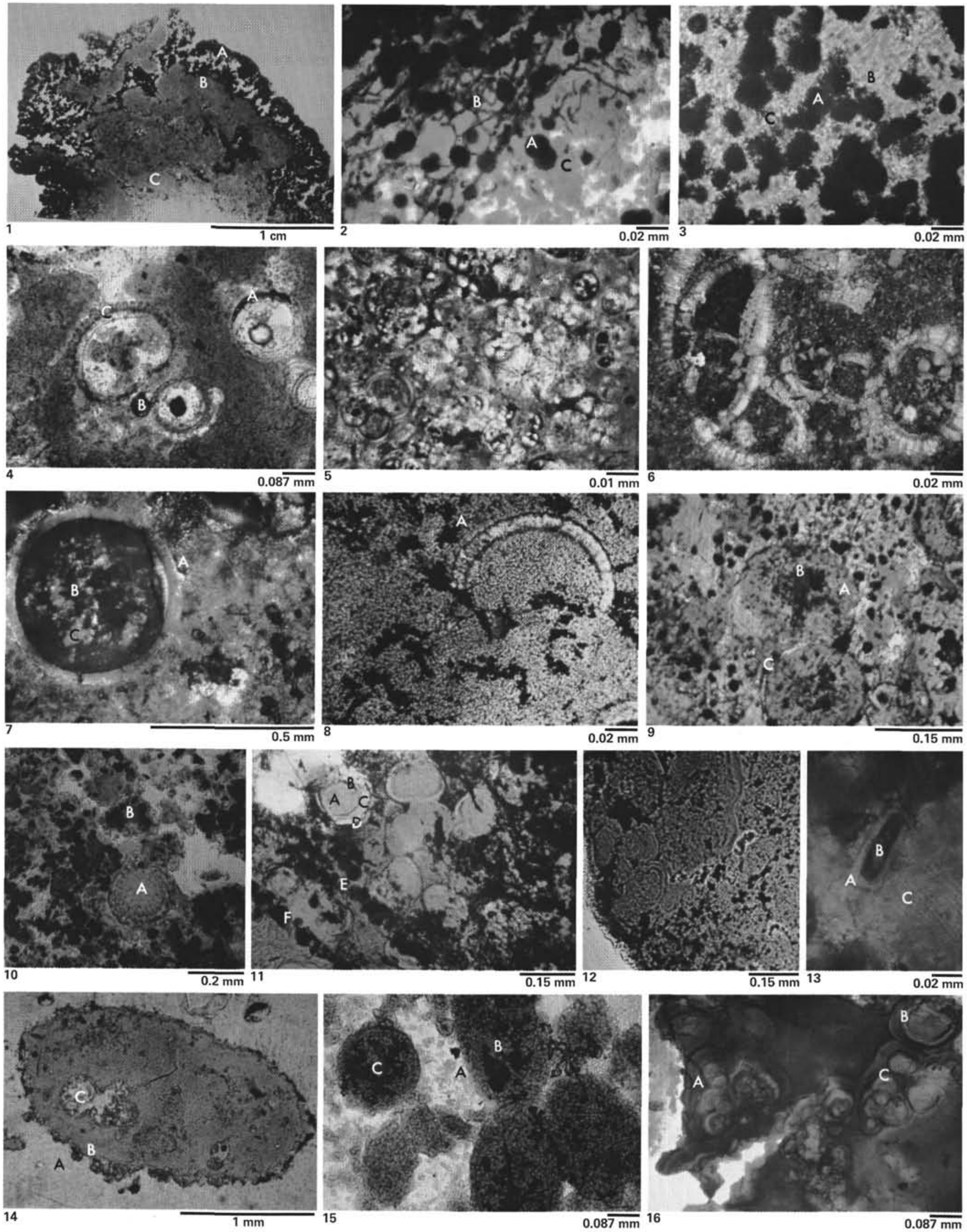
Hydrothermal mounds sediments, Leg 70 (plane light). (For a discussion, see Borella et al., this volume.)

1. **Iron–manganese oxyhydroxide, Sample 570D-1-1, 14–20 cm.** The outermost layer (A) is composed of opaque Fe–Mn oxyhydroxides (todorokite?); the inner orange (B) and yellow zones (C) are composed of iron oxides.
2. **Manganese-oxide micronodules in smectite, Sample 506-6-1, 94–96 cm.** The opaque Fe–Mn micronodules (A) found at depth are linked by a network of opaque stringers (B). The matrix material (C) is smectite, most likely nontronite.
3. **Opaque manganese micronodules (A) in a smectite matrix (B), Sample 509B-3,CC (4–6 cm).** Note the indistinct and jagged boundaries around the isolated micronodules and clots, suggesting that nontronite is replacing the manganese oxides. The area under (C) may be what is left of a stringer that once connected micronodules and has been replaced by smectite.
4. **A brown oxidized surface pelagic sediment, Sample 507D-1-1, 63–64 cm.** This section contains foraminifer–nannofossil ooze with amorphous Fe–Mn (A) coating and infiltrating fossil foraminifers (C). Opaque manganese micronodules (B) and clots are scattered throughout the thin section.
5. **A brown oxidized relict layer, Sample 506D-6-2, 3–5 cm.** This thin section is taken from buried surface, brown oxidized, foraminifer–nannofossil ooze. Note the opaque Fe–Mn oxides coating and infilling fossil grains. This is very similar to the surface oxidized layer.
6. **A nontronitic mottle with nontronite infiltrating and replacing foraminifer fragments, Sample 506-6-2, 20–21 cm.** Notice that the green nontronite invades and replaces the fossil grains from the exterior and interior surfaces. In many places the green nontronite completely crosscuts the fossil grains.
7. **Opaque infilling in granular nontronitic clay immediately beneath manganese-oxide crust layer, Sample 509B-1-2, 143–144 cm.** The fossil foraminifer (A) is partially dissolved and replaced by nontronite. The opaque infilling (B) also contains zones of nontronite (C), suggesting that the nontronite may be replacing the opaque infilling.
8. **Partially replaced and dissolved foraminifer in hydrothermal sediment, Sample 509B-3,CC (4–6 cm).** Note the green nontronite (A) crosscutting the fossil grain. The opaque envelope coating the fossil grain may be the result of boring fungi and bacteria. Scattered throughout the nontronite are patches of opaque material (manganese oxides?).
9. **Hydrothermal nontronite, Sample 507D-4,CC (5–7 cm).** The rounded grains (A) may have been the opaque infilling of a fossil foraminifer(?). Most of the original (manganese oxides?) infilling (B) has been replaced by nontronite. A little of the original test remains in the area around (C). Notice the other isolated nodules and patches of opaque minerals.
10. **A radiolarian which has been completely converted to nontronite, Sample 506-6-1, 94–96 cm.** The fossil grain (A) has been completely converted to nontronite and is in optical continuity with the remaining nontronite. Isolated globes and patches of opaque minerals (B) are also present.
11. **Hydrothermal smectite (Section 509B-3,CC).** Note the growth pattern in the concentric and spherulitic nontronite. The original nucleus (A) has a relict opaque coating surrounding it. This in turn is surrounded by an overgrowth of nontronite (C), which again is surrounded by an opaque overgrowth or envelope. Areas E and F contain stringers of opaque manganese-oxide(?) clots, nodules, or pellets.
12. **Multicolored nontronite with opaque (manganese oxides?) areas scattered throughout, Sample 509B-3,CC (4–6 cm).** Notice the concentric or spherulitic growth pattern.
13. **A nontronite overgrowth (A) on a dark-green fragmental grain (B) in a matrix of nontronite (C), Sample 507D-5-1, 100–102 cm.**
14. **An elliptical fecal pellet which has been completely converted to nontronite, Sample 506C-2-2, 130 cm.** The lighter nontronite (A) surrounding the darker nontronitic fecal pellet is apparently replacing and invading the borders (B) of the fecal pellet. The patch within the fecal pellet resembles the outline of a foraminifer fragment, which could have been ingested and incorporated into the fecal pellet before it was converted into nontronite and/or dissolved.
15. **Elliptical and circular fecal pellets in hydrothermal sediments, Sample 509B-1-2, 143–144 cm.** The lighter nontronite (A) appears to be invading both the elliptical (B) and circular (C) fecal pellets, which are also composed of hydrothermal smectites.
16. **Fire-red hydrothermal smectite in various stages of possible oxidation, Sample 506-6-1, 96 cm.** Note the concentric growth rings alternating dark and light in areas (A), (B), and (C). This thin section is from a transitional hydrothermal layer (i. e., a boundary between pelagic and hydrothermal sediments).


1
A
B
C
1 cm
2
B
A
C
0.02 mm
3
B
A
C
0.02 mm
4
C
A
B
0.087 mm
5
0.01 mm
6
0.02 mm
7
A
B
C
0.5 mm
8
A
0.02 mm
9
B
A
C
0.15 mm
10
B
A
0.2 mm
11
B
A
C
D
E
F
0.15 mm
12
0.15 mm
13
B
A
C
0.02 mm
14
C
B
A
1 mm
15
C
B
A
0.087 mm
16
B
A
C
0.087 mm

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 LXX

covering Leg 70 of the cruises of the Drilling Vessel *Glomar Challenger*
Balboa, Panama to Callao, Peru
November–December, 1979

PARTICIPATING SCIENTISTS

Jose Honnorez, Richard P. Von Herzen,
Timothy J. Barrett, Keir Becker, Michael L. Bender,
Peter E. Borella, Hans-Wolfgang Hubberten, Steven C. Jones, Shun-ichiro Karato,
Christine Laverne, Shaul Levi, Areg A. Migdisov,
S. Anthony Moorby, and Ed L. Schrader

SHIPBOARD SCIENCE REPRESENTATIVE

Peter E. Borella

EDITOR

Rosemary Amidei

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.

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

Honnorez, J., Von Herzen, R. P. et al., 19 . *Init. Repts. DSDP*, 70: Washington (U.S. Govt. Printing Office).

Bender, M. L., 19 . Pore-water chemistry, Sites 506-509, Deep Sea Drilling Project. *In* Honnorez, J., Von Herzen, R. P., et al., *Init. Repts. DSDP*, 70: Washington (U.S. Govt. Printing Office), 343-354.

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 59—January, 1981
Volume 60—February, 1982
Volume 61—August, 1981
Volume 62—December, 1981
Volume 63—September, 1981
Volume 66—March, 1982

April, 1983

Library of Congress Catalog Card Number 74—603338

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 on 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 Institututions 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 the 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 the 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, who 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 investigating 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 onshore, is published after the completion of each cruise. These reports are a cooperative effort of shipboard and shore-based scientists 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.xvii) approved by the National Science Foundation.

The advent of *Glomar Challenger*, with its deep-water drilling capability, 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 have 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, are eloquent testimony to 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 to 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 Océans, 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

*Includes member organizations during time of cruise.

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. Russell B. Merrill
Associate Chief Scientist for
Science Services

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

Mr. Robert Bower
Contracts Officer

Ms. Sue Strain
Personnel Officer

Participants aboard GLOMAR CHALLENGER for Leg Seventy

Dr. Jose Honnorez
Co-Chief Scientist
School of Marine and Atmospheric Sciences
University of Miami
Miami, Florida 33149

Dr. Richard P. Von Herzen
Co-Chief Scientist
Department of Geology and Geophysics
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

Dr. Timothy J. Barrett
Sedimentologist
Abt. Geochemie
Mineralogisches Institut
Universität Tübingen
D-7400 Tübingen 1
Federal Republic of Germany

Dr. Keir Becker
Geophysicist
Marine Physical Laboratory, A-005
Scripps Institution of Oceanography
La Jolla, California 92093

Dr. Michael L. Bender
Inorganic Geochemist
Graduate School of Oceanography
University of Rhode Island
Kingston, Rhode Island 02881

Dr. Peter E. Borella
Sedimentologist and Shipboard Science Representative
Deep Sea Drilling Project, A-031
Scripps Institution of Oceanography
La Jolla, California 92093

Dr. Hans-Wolfgang Hubberten
Igneous Petrologist
Institut für Petrographie und Geochemie
der Universität Karlsruhe
D-7500 Karlsruhe 1
Federal Republic of Germany

Dr. Steven C. Jones
Paleontologist (nannofossils)
Department of Geology
Florida State University
Tallahassee, Florida 32306

Dr. Shun-ichiro Karato
Physical Properties Specialist
Ocean Research Institute
University of Tokyo
Nakano-ku, Tokyo
Japan

Dr. Shaul Levi
Paleomagnetist
School of Oceanography
Oregon State University
Corvallis, Oregon 97331

Dr. Christine Laverne
Igneous Petrologist
Laboratoire de Géologie
Université de l'Océan Indien
97490 Ste. Clotilde (Réunion)
France

Dr. Areg A. Migdisov
Sedimentologist and Inorganic Geochemist
V. I. Vernadsky Institute of Geochemistry
and Analytical Chemistry
U.S.S.R. Academy of Sciences
117334 Moscow
U.S.S.R.

Dr. S. Anthony Moorby
Inorganic Geochemist
Department of Geology
Imperial College
London SW7 2BP
United Kingdom

Dr. Ed L. Schrader
Igneous Petrologist
Department of Geology and Geography
University of Alabama
University, Alabama 35486

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

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

Captain Joseph A. Clarke
Captain of the Drilling Vessel
Global Marine, Inc.
8369 Vickers Street
San Diego, California 92111

Mr. James Ruddel
Drilling Superintendent
Global Marine, Inc.
8369 Vickers Street
San Diego, California 92111

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

Ms. Kathleen O'Neill
Curatorial Representative
Deep Sea Drilling Project,
East Coast Repository
Lamont-Doherty Geological Observatory
Columbia University
Palisades, New York 10964

Mr. James Pine
Chemist
Deep Sea Drilling Project, A-031
Scripps Institution of Oceanography
La Jolla, California 92093

Mr. David Collart
Logging Engineer
Gearhart-Owen Wire Line
P.O. Box 1258
Fort Worth, Texas 76101

Ms. Odile Corre
XRF Technician
Centre Océanologique de Bretagne
B.P. 337
29273 Brest Cedex
France

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

Mr. Perry Dempsey
Re-entry Technician
Deep Sea Drilling Project, A-031
Scripps Institution of Oceanography
La Jolla, California 92093

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

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

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

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

Mr. Kevin Reid
Photographer
Deep Sea Drilling Project, A-031
Scripps Institution of Oceanography
La Jolla, California 92093

Ms. Shoshanna Mermel
Yeoperson
Deep Sea Drilling Project, A-031
Scripps Institution of Oceanography
La Jolla, California 92093

Deep Sea Drilling Project Publications Staff

Principal Editor
Jan Blakeslee

Editors
Rosemary Amidei
Marian Bailey
Susan Orlofsky
Elizabeth Whalen

Production Manager
Raymond F. Silk

Production Assistants
Elaine Bruer
Madeleine A. Mahnken

Production Coordinators
Mary A. Young
Nancv Durham

Art-Photo Supervisor
Virginia L. Roman

Illustrators
Myrtali Anagnostopoulos
Vicki Cypherd
Tommy F. Hilliard
Elizabeth Peters (this volume)
Alice N. Thompson

JOIDES Advisory Groups*

Executive Committee

Dr. John Steele
Woods Hole Oceanographic Institution

Dr. James D. Baker, Jr.
University of Washington

Professor Dr. F. Bender
Bundesanstalt für Geowissenschaften und Rohstoffe

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

Dr. G. Ross Heath
Oregon State University

Dr. Charles E. Helsley
Hawaii Institute of Geophysics

Sir Peter Kent, F.R.S.
Natural Environment Research Council

Dr. John A. Knauss
University of Rhode Island

Dr. Ryuzo Marumo
University of Tokyo

Dr. William A. Nierenberg
Scripps Institution of Oceanography

Dr. Worth D. Nowlin, Jr.
Texas A&M University

Dr. M. N. A. Peterson (ex-officio)
Scripps Institution of Oceanography

Monsieur Gerard Piketty
Centre National pour l'Exploitation des Océans

Dr. A. V. Sidorenko
Academy of Sciences of the U.S.S.R.

Dr. Manik Talwani
Lamont-Doherty Geological Observatory

Planning Committee

Dr. John Ewing
Woods Hole Oceanographic Institution

Dr. Helmut Beiersdorf
Bundesanstalt für Geowissenschaften und Rohstoffe

Dr. William R. Bryant
Texas A&M University

Dr. Joe R. Cann
University of Newcastle

Dr. Joe S. Creager
University of Washington

Dr. J. Dymond
Oregon State University

Dr. Dennis E. Hayes
Lamont-Doherty Geological Observatory

Dr. Xavier LePichon
Centre National pour l'Exploitation des Océans

Dr. Ralph Moberly
Hawaii Institute of Geophysics

Dr. David G. Moore (ex-officio)
Scripps Institution of Oceanography

Dr. T. C. Moore, Jr.
University of Rhode Island

Dr. Noriyuki Nasu
University of Tokyo

Dr. L. Nikitin
Academy of Sciences of the U.S.S.R.

Dr. William Riedel (ex-officio)
Scripps Institution of Oceanography

Dr. Wolfgang Schlager
University of Miami

Dr. E. L. Winterer
Scripps Institution of Oceanography

Advisory Panel on Sedimentary Petrology and Physical Properties

Dr. A. Richards
Lehigh University

Dr. R. Bennett
National Oceanic and Atmospheric Administration

Dr. C. J. Clausen
Norges Geotekniske Institutt

Dr. J. Conolly
ERA North America Inc.

Dr. John W. Handin
Texas A&M University

Dr. George deVries Klein
University of Illinois

Dr. I. N. McCave
University of East Anglia

Dr. Frédéric Mélières
Université Pierre et Marie Curie

Dr. Ralph Moberly (ex-officio)
Hawaii Institute of Geophysics

Dr. O. H. Pilkey
Duke University

Dr. Peter Rothe
Geographisches Institut der Universität Mannheim

Dr. Matthew H. Salisbury (ex-officio)
Scripps Institution of Oceanography

* Membership at time of cruise.

Advisory Panel on Organic Geochemistry

Dr. Keith Kvenvolden
U.S. Geological Survey

Dr. Earl W. Baker
Florida Atlantic University

Dr. Geoffrey Eglinton (ex-officio)
University of Bristol

Dr. J. Gordon Erdman
Phillips Petroleum Company

Dr. Eric M. Galimov
Academy of Sciences of the U.S.S.R.

Dr. John M. Hunt
Woods Hole Oceanographic Institution

Dr. John W. Kendrick
Shell Development Company

Dr. Bernd R. T. Simoneit
University of California, Los Angeles

Dr. Erwin Suess
Oregon State University

Dr. B. Tissot
Institut Français du Pétrole

Dr. Dietrich Welte
Lehrstuhl für Geologie, Geochemie, und Lagerstatten des Erdöls und der Kohle

Dr. Stan White (ex-officio)
Scripps Institution of Oceanography

Dr. E. L. Winterer (ex-officio)
Scripps Institution of Oceanography

Advisory Panel on Information Handling

Dr. M. A. Rosenfeld
Woods Hole Oceanographic Institution

Dr. D. W. Appleman
Smithsonian Institution

Dr. Thomas A. Davies
Middlebury College

Dr. H. Glashoff
Bundesanstalt für Geowissenschaften und Rohstoffe

Dr. John C. Hathaway
U.S. Geological Survey

Dr. A. Loeblich, Jr.
University of California, Los Angeles

Dr. M. S. Loughridge
National Oceanic and Atmospheric Administration

Dr. T. C. Moore, Jr. (ex-officio)
University of Rhode Island

Mr. Peter Woodbury (ex-officio)
Scripps Institution of Oceanography

Dr. V. V. Zdorovenin
Academy of Sciences of the U.S.S.R.

Industrial Liaison Panel

Mr. W. A. Roberts
Phillips Petroleum Company

Mr. R. L. Adams
Conoco Incorporated

Dr. N. P. Budnikov
Ministry of Geology of the U.S.S.R.

Mr. Melvin J. Hill
Gulf Oil Corporation

Dr. Ing. Guenter Peterson
Deutsche Schachtbau und Tiefbohrergesellschaft mbH

M. Gilbert Rutman
Société Nationale des Pétroles d'Aquitaine

Mr. G. Williams
United Kingdom Offshore Operators Association, Ltd.

Advisory Panel on Ocean Crust

Dr. Paul J. Fox
State University of New York at Albany

Dr. James L. Bischoff
U.S. Geological Survey

Dr. N. A. Bogdanov
Academy of Sciences of the U.S.S.R.

Dr. Robert G. Coleman
U.S. Geological Survey

Dr. J. Dymond (ex-officio)
Oregon State University

Dr. Rolf Emmerman
Universität Karlsruhe

Dr. Jean Francheteau
Centre National pour l'Exploitation des Océans

Dr. H. P. Johnson
University of Washington

Dr. Roger L. Larson
Lamont-Doherty Geological Observatory

Dr. Ralph Moberly (ex-officio)
Hawaii Institute of Geophysics

Dr. James H. Natland (ex-officio)
Scripps Institution of Oceanography

Dr. John Orcutt
Scripps Institution of Oceanography

Dr. M. Ozima
University of Tokyo

Dr. John Tarney
University of Birmingham

Dr. M. Treuil
Institut Physique du Globe

Advisory Panel on Ocean Margin (Active)

Dr. Roland von Huene
U.S. Geological Survey

Dr. Michael Audley-Charles
Queen Mary College

Dr. René Blanchet
Université de Bretagne Occidentale

Dr. Joe S. Creager (ex-officio)
University of Washington

Dr. W. R. Dickinson
University of Arizona

Dr. Y. I. Dmitriev
Academy of Sciences of the U.S.S.R.

Dr. D. M. Hussong
Hawaii Institute of Geophysics
Dr. Daniel Karig
Cornell University
Dr. Kazuo Kobayashi
University of Tokyo
Dr. Keith Kvenvolden (ex-officio)
U.S. Geological Survey
Dr. Xavier LePichon (ex-officio)
Centre National pour l'Exploitation des Océans
Dr. Thomas Shipley (ex-officio)
Scripps Institution of Oceanography
Dr. H. W. Walther
Bundesanstalt für Geowissenschaften und Rohstoffe
Dr. Joel S. Watkins
Gulf Research and Development Company

Advisory Panel on Ocean Margin (Passive)

Dr. Robert E. Sheridan
University of Delaware
Dr. Helmut Beiersdorf (ex-officio)
Bundesanstalt für Geowissenschaften und Rohstoffe
Dr. William R. Bryant (ex-officio)
Texas A&M University
Dr. Joseph R. Curray
Scripps Institution of Oceanography
Mr. John I. Ewing (ex-officio)
Woods Hole Oceanographic Institution
Mr. John A. Grow
U.S. Geological Survey
Dr. K. Hinz
Bundesanstalt für Geowissenschaften und Rohstoffe
Dr. John M. Hunt (ex-officio)
Woods Hole Oceanographic Institution
Dr. H. Kagami
University of Tokyo
Dr. L. Montadert
Institut Français du Pétrole
Dr. David G. Moore (ex-officio)
Scripps Institution of Oceanography
Professor V. Nalivkin
Liteynyi Prospect, Leningrad
Dr. D. G. Roberts
Institute of Oceanographic Sciences, Surrey
Professor Dr. E. Seibold
Universität Kiel
Dr. S. Snelson
Shell Development Company
Dr. J. Thiede
Universitetet i Oslo
Dr. P. R. Vail
Exxon Production Research Company

Advisory Panel on Pollution Prevention and Safety

Dr. Louis E. Garrison
U.S. Geological Survey
Dr. N. I. Beliy
Ministry of Gas Industry, U.S.S.R.
Dr. George Claypool
U.S. Geological Survey
Dr. R. G. Douglas (ex-officio)
University of Southern California
Dr. Paul J. Fox (ex-officio)
State University of New York at Albany
Dr. H. Grant Goodell
University of Virginia
Dr. Arthur E. Green
Exxon Production Research Company
Dr. J. R. Heirtzler (ex-officio)
Woods Hole Oceanographic Institution
Mr. J. Laherrère
Compagnie Français des Pétroles
Dr. A. E. Maxwell (ex-officio)
Woods Hole Oceanographic Institution
Dr. A. Mayer-Gurr
Urach, Federal Republic of Germany
Dr. Robert E. Sheridan (ex-officio)
University of Delaware
Dr. G. D. Taylor
British Petroleum Company, Ltd.
Dr. Roland von Huene (ex-officio)
U.S. Geological Survey
Dr. S. White (ex-officio)
Scripps Institution of Oceanography

Advisory Panel on Inorganic Geochemistry

Dr. Joris M. Gieskes
Scripps Institution of Oceanography
Dr. W. B. Clarke
McMaster University
Dr. D. S. Cronan
Royal School of Mines, London
Dr. J. Dymond (ex-officio)
Oregon State University
Dr. Margaret Leinen
University of Rhode Island
Dr. Frank T. Manheim
U.S. Geological Survey
Dr. Kenneth A. Pisciotto (ex-officio)
Scripps Institution of Oceanography
Dr. I. D. Ryabchikov
Academy of Sciences of the U.S.S.R.
Dr. Samuel M. Savin
Case Western Reserve University
Dr. Erwin Suess
Oregon State University

Dr. Y. Tardy
Laboratoire de Pédologie et Géochimie, Toulouse

Dr. K. H. Wedepohl
Geochemisches Institut der Universität, Göttingen

Stratigraphic Correlations Panel

Dr. R. H. Benson
Smithsonian Institution

Dr. I. Basov
Academy of Sciences of the U.S.S.R.

Dr. P. Čepek
Bundesanstalt für Geowissenschaften und Rohstoffe

Dr. Joe S. Creager (ex-officio)
University of Washington

Dr. D. Graham Jenkins
Open University, Buckinghamshire

Dr. Catherine Nigrini
La Habra Heights, California

Dr. Richard Z. Poore
U.S. Geological Survey

Dr. J. B. Saunders
Naturhistorisches Museum, Basel

Dr. J. L. Usher (ex-officio) (deceased)
Scripps Institution of Oceanography

Downhole Measurements Panel

Dr. R. Hyndman
Pacific Geoscience Centre, Sidney, BC

Dr. Heinz Beckmann
Technische Universität Clausthal

Mr. R. E. Boyce (ex-officio)
Scripps Institution of Oceanography

Dr. William R. Bryant (ex-officio)
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

Dr. Yuri Neprochnov
Academy of Sciences of the U.S.S.R.

Dr. Vince Renard
Centre National pour l'Exploitation des Océans

Dr. A. Richards
Lehigh University

Mr. J. R. Severns
McCulloh Oil Corporation

Advisory Panel on Ocean Paleoenvironment

Dr. Robert G. Douglas
University of Southern California

Dr. Charles Adelseck, Jr. (ex-officio)
Scripps Institution of Oceanography

Dr. Wolfgang Berger
Scripps Institution of Oceanography

Dr. G. Eglinton (ex-officio)
University of Bristol

Dr. James C. Ingle
Stanford University

Dr. Hugh C. Jenkyns
University of Oxford

Dr. James P. Kennett
University of Rhode Island

Dr. Yves Lancelot
Centre National pour l'Exploitation des Océans

Dr. T. C. Moore, Jr. (ex-officio)
University of Rhode Island

Dr. Michael Sarnthein
Universität Kiel

Dr. N. Shackleton
University of Cambridge

Dr. W. V. Sliter
U.S. Geological Survey

Dr. Y. Takayanagi
Tohoku University

Dr. P. P. Timofeev
Academy of Sciences of the U.S.S.R.

Dr. E. L. Winterer (ex-officio)
Scripps Institution of Oceanography

Advisory Panel on Site Surveying

Dr. E. J. W. Jones
University of London

Dr. Paul J. Fox (ex-officio)
State University of New York at Albany

Dr. Dennis E. Hayes (ex-officio)
Lamont-Doherty Geological Observatory

Dr. Yves Lancelot (ex-officio)
Centre National pour l'Exploitation des Océans

Dr. Brian T. R. Lewis
University of Washington

Dr. Shozaburo Nagumo
University of Tokyo

Dr. Philip D. Rabinowitz (ex-officio)
Lamont-Doherty Geological Observatory

Dr. Wolfgang Schlager (ex-officio)
University of Miami

Dr. Roland Schlich
Université Louis Pasteur

Dr. Robert E. Sheridan (ex-officio)
University of Delaware

Dr. A. A. Schreider
Academy of Sciences of the U.S.S.R.

Dr. Roland von Huene (ex-officio)
U.S. Geological Survey

Dr. Wilfried Weigel
Universität Hamburg

Dr. S. White (ex-officio)
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 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
- Paleomagnetics
- 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.

CONTENTS

ACKNOWLEDGMENTS

The successful program of mounds drilling on Leg 70 obviously depended entirely on the expertise provided by the officers and crew of the D/V *Glomar Challenger*, operated by Global Marine, Inc. under contract to the University of California. The nearly flawless operation of the hydraulic piston corer, developed at the Deep Sea Drilling Project, was also crucial to our success. We thank all of the members of the Deep Sea Drilling Project shipboard technical staff for their dedication to the achievement of our scientific aims. Mr. Robert Knapp, DSDP Operations Manager for Leg 70, provided the valuable expertise required for the smooth functioning of a complex operation.

We are grateful to James Hall and the JOIDES Ocean Cruise Panel for initiating and sponsoring this program.