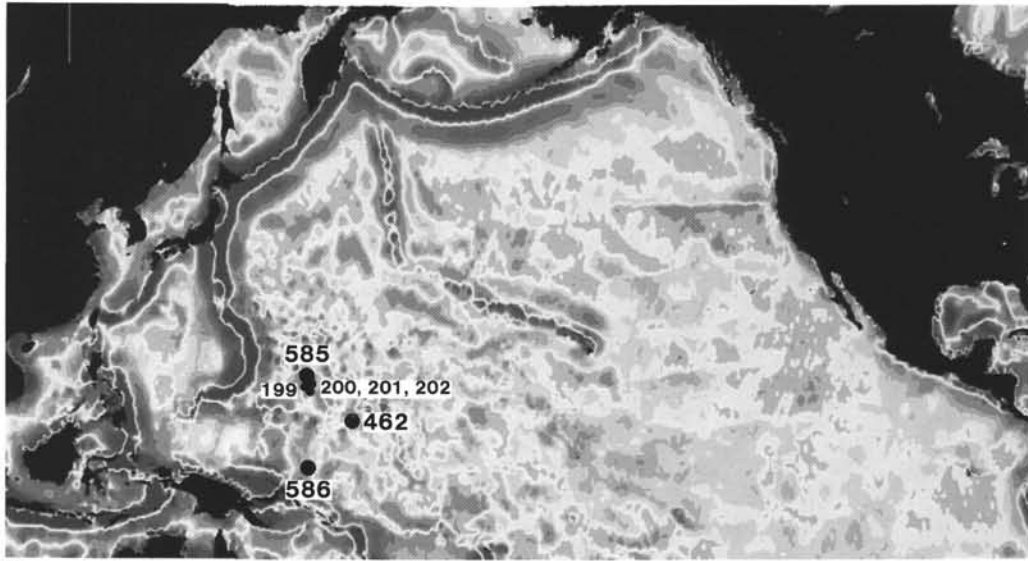
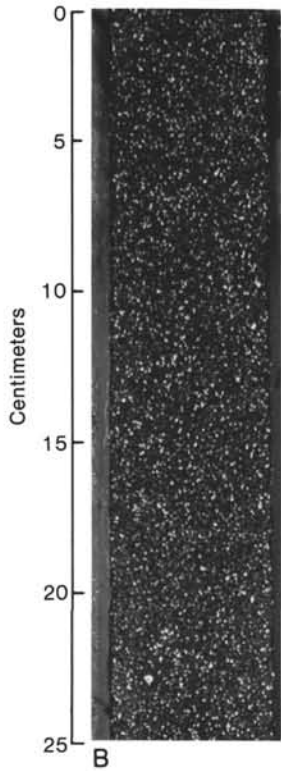
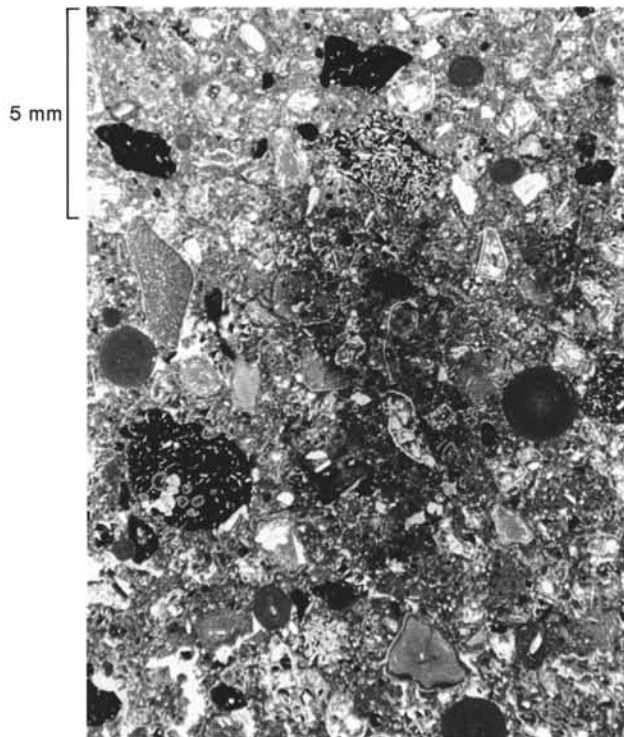




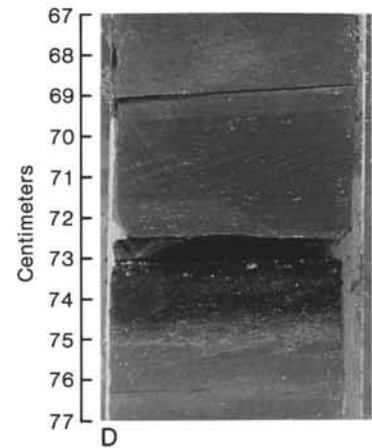
A



B



C



D

A. Seasat altimetry image of the North Pacific showing DSDP Leg 89 and other DSDP sites. Color contours showing variation of tens of centimeters reflect seafloor relief on the order of tenths of kilometers; red is shallower, blue deeper water. DSDP Site 585 is located among surrounding Cretaceous seamounts. (Photo courtesy of Tim Dixon, Jet Propulsion Laboratory.) B. Mid-Cretaceous volcanoclastic turbidite from Sample 585A-18-4, 0–22 cm. Note celadonite alteration rims around volcanic fragments. C. Shallow-water ooids and shell fragments from the volcanoclastic turbidites at the base of Holes 585 and 585A (Sample 585A-19-3, 15–18 cm). D. The striking black band at 72–74 cm in Section 585-32-3 (from the Mariana Basin) is a sapropelic "oil shale" containing 9.9% organic carbon content. The occurrence of this black band (and of a similar one cored in Hole 585A) at the Cenomanian/Turonian boundary suggests that the black band is a manifestation of the Cenomanian–Turonian oceanic anoxic event.

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 LXXXIX

covering Leg 89 of the cruises of the Drilling Vessel *Glomar Challenger*
Yokohama, Japan, to Noumea, New Caledonia
October–November, 1982

PARTICIPATING SCIENTISTS

Ralph Moberly, Seymour O. Schlanger, Miriam Baltuck, James A. Bergen,
Walter Dean, Peter A. Floyd, Naoyuki Fujii, Janet A. Haggerty,
James G. Ogg, Isabella Premoli Silva, André Schaaf,
Rainer G. Schaefer, William V. Sliter, and Jill M. Whitman

SHIPBOARD SCIENCE REPRESENTATIVE

Miriam Baltuck

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:

Moberly, R., Schlanger, S. O., et al., 19___. *Init. Repts. DSDP*, 89: Washington (U.S. Govt. Printing Office).

Baltuck M., 19___. Authigenic silica in Tertiary and Upper Cretaceous sediment in the East Mariana Basin, Site 585. *In* Moberly, R., Schlanger, S. O., et al., *Init. Repts. DSDP*, 89: Washington (U.S. Govt. Printing Office), ___-___.

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 80—March, 1985
Volume 81—January, 1985
Volume 82—June, 1985
Volume 83—April, 1985
Volume 84—May, 1985
Volume 85—October, 1985

Printed September 1986

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

The world's first major oceanographic expedition took place between 1872 and 1876. This expedition, aboard the H.M.S. *Challenger* covering nearly 70,000 nautical miles and gathering oceanographic data from 362 stations, expanded our knowledge of the ocean and provided a solid foundation for future studies in marine geology. A century later, another vessel also named *Challenger* continued to expand our knowledge of the world's ocean and helped revolutionize our concepts of how the seafloor and the continents form and change. The drilling vessel *Glomar Challenger* sailed 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 is leading to a greater understanding of our planet and more intelligent use of its resources.

Since 1968, the Deep Sea Drilling Project (DSDP) has been supported by the National Science Foundation, primarily through a contract with the University of California which, in turn, subcontracted to Global Marine Incorporated for the services of the D/V *Glomar Challenger*.

Through contracts with Joint Oceanographic Institutions, Inc. (JOI, Inc.), the National Science Foundation supported the scientific advisory structure for the project and funded predrilling geophysical site surveys. Scientific planning was conducted under the auspices of the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES). The JOIDES advisory group consisted of over 250 members who made up 24 committees, panels, and working groups. The members were distinguished scientists from academic institutions, government agencies, and private industry all over the world.

In 1975, the International Phase of Ocean Drilling (IPOD) began. The IPOD member nations, Federal Republic of Germany, Japan, United Kingdom, Soviet Union, and France, partially supported the project. Each member nation actively participated in the scientific planning of the project through membership in JOIDES. Scientists from these countries also took part in the field work aboard the D/V *Glomar Challenger* and postcruise 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.

Technological advances have provided new tools which in turn have opened new dimensions of scientific discovery. The introduction of the Hydraulic Piston Corer in 1979 permitted virtually undisturbed cores of soft sediment layers to be obtained. This technological advance has greatly enhanced the ability of scientists to study ancient ocean environments, as recorded by sediment characteristics and flora and fauna preserved in these deposits.

A second major advance has been the use of the hole after drilling. The project routinely log-

ged holes and performed geophysical and geochemical studies before, during, and after drilling. Long-term downhole geophysical seismic monitoring devices have been implanted successfully in DSDP holes. These new listening devices and geophysical studies have provided valuable information about the origin and nature of the dynamic processes of plate tectonics.

These reports contain the results of the initial studies of the recovered core material and the associated geophysical information. All the world's people benefit either directly or indirectly from this fundamental research. Knowledge about past and present conditions and processes are the foundations for future predictions and developments. Both short- and long-term benefits are obtained by advances in drilling technology and instrumentation. Information is being obtained about the origin and geographic distribution of natural resources. Just as the H.M.S. *Challenger* had a profound impact on scientific thought for over a century, this second *Challenger* expedition has given a greater understanding of the oceans and the processes that form and shape the earth.



Erich Bloch,
Director

Washington, D.C.

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 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 Drill-

ing 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):¹

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 Sciences²

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

Mr. Robert S. Bower
Assistant Project Manager for
Administration and Contracts

Dr. Yves Lancelot
Chief Scientist

Mr. Ed Dean
Finance Administrator

Ms. Sue Strain
Personnel Officer

¹ Includes member organizations during time of cruise.

² This institution and its committees and panel members were noncontributing members of JOIDES at time of cruise.

Participants aboard GLOMAR CHALLENGER for Leg Eighty-nine

Dr. Ralph Moberly
Co-Chief Scientist
*Hawaii Institute of Geophysics
University of Hawaii
Honolulu, Hawaii 96822*

Dr. Seymour O. Schlanger
Co-Chief Scientist
*Department of Geological Sciences
Northwestern University
Evanston, Illinois 60201*

Dr. Miriam Baltuck
Sedimentologist/Staff Science
Representative
*Deep Sea Drilling Project, A-031
Scripps Institution of Oceanography
La Jolla, California 92093*

Mr. James A. Bergen
Paleontologist (nannofossils)
*Department of Geology
Florida State University
Tallahassee, Florida 32306*

Dr. Walter Dean
Sedimentologist
*U.S. Geological Survey
Denver, Colorado 80225*

Dr. Peter A. Floyd
Igneous Petrologist
*Department of Geology
University of Keele
Keele, Staffordshire ST5 5BG
United Kingdom*

Dr. Naoyuki Fujii
Physical Properties Specialist
*Department of Earth Science
Kobe University
Rokkodai-cho, Kobe 657, Japan*

Dr. Janet A. Haggerty
Sedimentologist
*Department of Geosciences
University of Tulsa
Tulsa, Oklahoma 74104*

Dr. James G. Ogg
Paleomagnetist/Sedimentologist
*Department of Geology and Geophysics
University of Wyoming
Laramie, Wyoming 82071*

Dr. Isabella Premoli Silva
Paleontologist (foraminifers)
*Istituto di Paleontologia
Milano 20133, Italy*

Dr. André Schaaf
Paleontologist (radiolarians)
*Institut de Géologie
67084 Strasbourg Cedex, France*

Dr. Rainer G. Schaefer
Organic Geochemist
*Institut für Erdöl und Organische Geochemie,
KFA Jülich
D-5170 Jülich
Federal Republic of Germany*

Dr. William V. Sliter
Paleontologist (foraminifers)
*Branch of Paleontology and Stratigraphy
U.S. Geological Survey
Reston, Virginia 22092*

Ms. Jill M. Whitman
Sedimentologist
*Geological Research Division, A-008
Scripps Institution of Oceanography
La Jolla, California 92093*

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

Mr. Robert Connolly
Weatherman
*Deep Sea Drilling Project, A-031
Scripps Institution of Oceanography
La Jolla, California 92093*

Captain Sydney M. Shuman
Master of the Drilling Vessel
*Global Marine Drilling Co.
San Diego, California 92111*

Mr. A. C. Wheeler, Jr.
Drilling Superintendent
*Global Marine Drilling Co.
San Diego, California 92111*

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

Mr. Tom Birtley
System Programmer
Deep Sea Drilling Project, A-031
Scripps Institution of Oceanography
La Jolla, California 92093

Ms. Paula Weiss
Curatorial Representative
Deep Sea Drilling Project/ECR
Lamont-Doherty Geological Observatory
Columbia University
Palisades, New York 10964

Mr. Bradley de Flon Julson
Chemist
Deep Sea Drilling Project, A-031
Scripps Institution of Oceanography
La Jolla, California 92093

Mr. James Noakes
Logging Engineer
Nippon Schlumberger K.K.
Shinjuku-ku, Tokyo 160, Japan

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

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

Mr. William M. Meyer
Marine Technician/Computer Technician
Deep Sea Drilling Project, A-031
Scripps Institution of Oceanography
La Jolla, California 92093

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

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

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

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

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

Deep Sea Drilling Project Publications Staff

Publications Manager
Jan H. Blakeslee

Editors
Marian G. Bailey
Susan Orlofsky
Katie L. Turner

Production Manager
Raymond F. Silk

Production Assistants
Patricia Duley
Madeleine A. Mahnken

Production Coordinators
Carolina Bertling
Mary A. Young

Art-Photo Supervisor
Virginia L. Roman

Illustrators
Aileen Bobryk (this volume)
Vicki Cypherd
Kathleen Sanderson (this volume)
Alice N. Thompson

JOIDES Advisory Groups *

Executive Committee

- Dr. D. James Baker, Jr.
University of Washington
- Prof. Dr. Friedrich Bender
Bundesanstalt für Geowissenschaften und Rohstoffe
- Dr. Alan Berman, Chairman
Rosenstiel School of Marine and Atmospheric Science
- Dr. John C. Bowman
Natural Environment Research Council
- Dr. Jacques Debyser
Centre National pour l'Exploitation des Océans
- Dr. G. Ross Heath
Oregon State University
- Dr. Charles E. Helsley
Hawaii Institute of Geophysics
- Dr. Jose Honnorez (ex-officio)
Planning Committee Representative)
Rosenstiel School of Marine and Atmospheric Science
- Dr. John A. Knauss
University of Rhode Island
- Dr. Arthur Maxwell
University of Texas at Austin
- Dr. Noriyuki Nasu
University of Tokyo
- Dr. William A. Nierenberg
Scripps Institution of Oceanography
- Dr. Melvin N. A. Peterson (ex-officio)
Scripps Institution of Oceanography
- Dr. Barry Raleigh
Lamont-Doherty Geological Observatory
- Dr. Robert D. Reid
Texas A&M University
- Dr. Alexander V. Sidorenko
U.S.S.R. Academy of Sciences
- Dr. John Steele
Woods Hole Oceanographic Institution

Planning Committee

- Dr. Jean Aubouin
Université Pierre et Marie Curie
- Dr. Helmut Beiersdorf
Bundesanstalt für Geowissenschaften und Rohstoffe
- Dr. William R. Bryant
Texas A&M University
- Dr. Richard Buffler
University of Texas at Austin
- Dr. Joe R. Cann
The University of Newcastle-upon-Tyne
- Dr. Joe S. Creager
University of Washington

- Dr. Dennis E. Hayes
Lamont-Doherty Geological Observatory
- Dr. Jose Honnorez, Chairman
Rosenstiel School of Marine and Atmospheric Science
- Dr. James P. Kennett
University of Rhode Island
- Dr. Kazuo Kobayashi
University of Tokyo
- Dr. Yves Lancelot (ex-officio)
Scripps Institution of Oceanography
- Dr. Ralph Moberly
Hawaii Institute of Geophysics
- Dr. Lev Nikitin
U.S.S.R. Academy of Sciences
- Dr. Hans Schrader
Oregon State University
- Dr. Richard von Herzen
Woods Hole Oceanographic Institution
- Dr. Edward L. Winterer
Scripps Institution of Oceanography

Advisory Panel on Sedimentary Petrology and Physical Properties

- Dr. Richard Bennett
National Oceanic and Atmospheric Administration
- Mr. Robert E. Boyce (ex-officio)
Scripps Institution of Oceanography
- Dr. Richard Carlson
Texas A&M University
- Dr. Walter E. Dean, Jr.
U.S. Geological Survey
- Dr. George deVries Klein, Chairman
University of Illinois, Urbana
- Dr. Leland Kraft
McClelland Engineers, Inc.
- Dr. Michael T. Ledbetter
University of Georgia, Athens
- Dr. I. Nick McCave
University of East Anglia
- Dr. Frédéric Mélières
Université Pierre et Marie Curie
- Dr. Ralph Moberly (ex-officio)
Hawaii Institute of Geophysics
- Dr. Gregory Mountain
Lamont-Doherty Geological Observatory
- Dr. Peter Rothe
Universität Mannheim
- Dr. Peter P. Timofeev
U.S.S.R. Academy of Sciences

*Membership at time of cruise.

Advisory Panel on Organic Geochemistry

- Dr. Earl W. Baker
Florida Atlantic University
- Dr. Miriam Baltuck (ex-officio)
Scripps Institution of Oceanography
- Dr. Simon C. Brassell
The University of Bristol
- Dr. Egon T. Degens
University of Hamburg
- Dr. Eric Galimov
U.S.S.R. Academy of Sciences
- Dr. John M. Hunt
Woods Hole Oceanographic Institution
- Dr. Keith A. Kvenvolden
U.S. Geological Survey
- Dr. Philip A. Meyers
The University of Michigan
- Dr. Hans Schrader (ex-officio)
Oregon State University
- Dr. Bernd R. T. Simoneit, Chairman
Oregon State University

Advisory Panel on Information Handling

- Dr. Daniel E. Appleman, Chairman
Smithsonian Institution
- Dr. Joe S. Creager (ex-officio)
University of Washington
- Dr. John C. Hathaway
U.S. Geological Survey
- Dr. Alfred Loeblich, Jr.
University of California, Los Angeles
- Dr. Michael S. Loughridge
National Oceanic and Atmospheric Administration
- Dr. Marthe Melguen
Bureau National des Données Océaniques
- Dr. Russell Merrill (ex-officio)
Scripps Institution of Oceanography
- Mrs. Judit Nowak
Bundesanstalt für Geowissenschaften und Rohstoffe
- Dr. John B. Saunders
Naturhistorisches Museum Basel
- Dr. Valery V. Zdrovenin
U.S.S.R. Academy of Sciences

Industrial Liaison Panel

- Mr. R. L. Adams
Conoco, Inc.
- Prof. Nikolai P. Budnikov
Ministry of Geology of the U.S.S.R.
- Mr. Melvin J. Hill
Gulf Oil Exploration and Production Company
- Dr. Ing. Guenter Peterson
Gewerkschaft Walter
- Mr. W. A. Roberts, Chairman
Energy Concepts, Inc.

- Dr. Gilbert Rutman
Société Nationale des Pétroles d'Aquitaine
- Mr. G. Williams
United Kingdom Offshore Operators Association, Ltd.

Advisory Panel on Ocean Crust

- Dr. Roger N. Anderson
Lamont-Doherty Geological Observatory
- Dr. Henri Bougault
Centre Océanologique de Bretagne (CNEXO)
- Dr. John R. Delaney
University of Washington
- Dr. Donald Elthon
University of Houston
- Prof. Dr. Rolf Emmermann
University of Giessen
- Dr. Kenneth C. MacDonald
University of California, Santa Barbara
- Dr. Ralph Moberly (ex-officio)
Hawaii Institute of Geophysics
- Dr. James Natland (ex-officio)
Scripps Institution of Oceanography
- Dr. Minoru Ozima
University of Tokyo
- Dr. Paul Robinson, Chairman
Dalhousie University
- Dr. Hans Schouten
Woods Hole Oceanographic Institution
- Dr. Ralph Stephen
Woods Hole Oceanographic Institution
- Dr. John Tarney
The University of Leicester
- Dr. Andrei A. Tsvetkov
U.S.S.R. Academy of Sciences
- Advisory Panel on Ocean Margin (Active)**
- Dr. Peter F. Barker
The University of Birmingham
- Dr. Jean-Paul Cadet
Université d'Orleans
- Dr. William T. Coulbourn (ex-officio)
Scripps Institution of Oceanography
- Dr. Darrel Cowan
University of Washington
- Dr. Joe S. Creager (ex-officio)
University of Washington
- Dr. Yury I. Dmitriev
U.S.S.R. Academy of Sciences
- Dr. Dennis E. Hayes (ex-officio)
Lamont-Doherty Geological Observatory
- Dr. Donald M. Hussong, Chairman
Hawaii Institute of Geophysics
- Dr. Daniel Karig
Cornell University
- Dr. John W. Ladd
Lamont-Doherty Geological Observatory

Dr. Kazuaki Nakamura
University of Tokyo

Dr. Roland von Huene
U.S. Geological Survey

Dr. Hansjust Walther
Bundesanstalt für Geowissenschaften und Rohstoffe

Advisory Panel on Ocean Margin (Passive)

Dr. Mikhail E. Artemiev
U.S.S.R. Academy of Sciences

Dr. Arnold H. Bouma
Gulf Science and Technology Company

Dr. William R. Bryant (ex-officio)
Texas A&M University

Dr. Karl Hinz
Bundesanstalt für Geowissenschaften und Rohstoffe

Dr. Hideo Kagami
University of Tokyo

Dr. Charlotte Keene
Geological Survey of Canada

Dr. Yves Lancelot (ex-officio)
Scripps Institution of Oceanography

Dr. Lucien Montadert
Institut Français du Pétrole

Dr. David G. Roberts, Chairman
British Petroleum Co., Ltd.

Dr. William B. F. Ryan
Lamont-Doherty Geological Observatory

Dr. Sigmund Snelson
Shell Oil Company

Dr. Jørn Thiede
Universitetet i Oslo

Dr. Brian E. Tucholke
Woods Hole Oceanographic Institution

Dr. Peter R. Vail
EXXON Production Company

Dr. Jan E. van Hinte
Vrije Universiteit

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

Advisory Panel on Pollution Prevention and Safety

Dr. Nikolai I. Beliy
Ministry of Gas Industry, U.S.S.R.

Dr. Rustum Jean Byramjee
Compagnie Française des Pétroles

Dr. George Claypool
U.S. Geological Survey

Dr. Louis E. Garrison, Chairman
U.S. Geological Survey

Dr. Arthur E. Green
EXXON Production Research Company

Dr. Jose Honnorez (ex-officio)
Rosenstiel School of Marine and Atmospheric Science

Prof. A. J. Horn
Atherton, California

Dr. Ernst Hotz
Deminex, Essen, Federal Republic of Germany

Dr. Yves Lancelot (ex-officio)
Scripps Institution of Oceanography

Dr. David B. MacKenzie
Marathon Oil Company

Mr. Geoffrey D. Taylor
British Petroleum Company, Ltd.

Advisory Panel on Inorganic Geochemistry

Dr. Miriam Baltuck (ex-officio)
Scripps Institution of Oceanography

Dr. Stephen E. Calvert
University of British Columbia

Dr. Joe R. Cann (ex-officio)
The University of Newcastle-upon-Tyne

Dr. Henry Elderfield
The University of Leeds

Dr. Michel Hoffert
Université de Bretagne Occidentale

Dr. Miriam Kastner, Chairman
Scripps Institution of Oceanography

Dr. Margaret Leinen
University of Rhode Island

Dr. Igor D. Ryabchikov
U.S.S.R. Academy of Sciences

Dr. Sam Savin
Case Western Reserve University

Dr. Fred L. Sayles
Woods Hole Oceanographic Institution

Dr. Hubert Staudigel
Lamont-Doherty Geological Observatory

Dr. Karl-Heinz Wedepohl
Universität Göttingen

Stratigraphic Correlations Panel

Dr. Ivan Basov
U.S.S.R. Academy of Sciences

Dr. Lloyd H. Burckle
Lamont-Doherty Geological Observatory

Dr. D. Graham Jenkins
The Open University, Buckinghamshire

Dr. James P. Kennett (ex-officio)
University of Rhode Island

Prof. Dr. Erlend Martini
Universität Frankfurt

Dr. Catherine Nigrini
La Habra Heights, California

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

Dr. Ellen Thomas (ex-officio)
Scripps Institution of Oceanography

Downhole Measurements Panel

- Dr. Keir Becker (ex-officio)
Scripps Institution of Oceanography
- Dr. William Bryant (ex-officio)
Texas A&M University
- Dr. Nikolas I. Christensen
University of Washington
- Dr. Timothy J. G. Francis
Natural Environment Research Council
- Dr. Roy Hyndman
*Department of Energy, Mines and Resources,
British Columbia*
- Mr. Alfred H. Jageler
Amoco Production Research Company
- Dr. Reinhard Jung
Bundesanstalt für Geowissenschaften und Rohstoffe
- Dr. Hajimu Kinoshita
Chiba University
- Dr. Mark Mathews
Los Alamos National Laboratory
- Dr. Yury Neprochnov
U.S.S.R. Academy of Sciences
- Dr. Lev Nikitin (ex-officio)
U.S.S.R. Academy of Sciences
- Dr. Vincent Renard
Centre National pour l'Exploitation des Océans
- Dr. Richard P. Von Herzen, Chairman
Woods Hole Oceanographic Institution

Advisory Panel on Ocean Paleoenvironment

- Dr. Michael Arthur, Chairman
University of South Carolina, Columbia
- Dr. Helmut Beiersdorf (ex-officio)
Bundesanstalt für Geowissenschaften und Rohstoffe
- Dr. Hervé Chamley
Université des Sciences et Techniques de Lille
- Dr. Robert G. Douglas
University of Southern California
- Dr. Dieter Fütterer
Universität Kiel

- Dr. Robert E. Garrison
University of California, Santa Cruz
- Dr. James D. Hays
Lamont-Doherty Geological Observatory
- Dr. James P. Kennett (ex-officio)
University of Rhode Island
- Dr. Robert B. Kidd
Natural Environment Research Council
- Dr. Theodore C. Moore, Jr.
EXXON Production Research Company
- Dr. Seymour O. Schlanger
Northwestern University
- Dr. Yokichi Takayanagi
Tohoku University
- Dr. Fritz Theyer
Hawaii Institute of Geophysics
- Dr. Ellen Thomas (ex-officio)
Scripps Institution of Oceanography
- Dr. Peter P. Timofeev
U.S.S.R. Academy of Sciences
- Advisory Panel on Site Surveying**
- Dr. Helmut Beiersdorf (ex-officio)
Bundesanstalt für Geowissenschaften und Rohstoffe
- Mr. Carl Brenner (ex-officio)
Lamont-Doherty Geological Observatory
- Dr. LeRoy M. Dorman
Scripps Institution of Oceanography
- Dr. Dennis Hayes (ex-officio)
Lamont-Doherty Geological Observatory
- Dr. E. John W. Jones, Chairman
University College, London
- Dr. Shozaburo Nagumo
University of Tokyo
- Dr. Vincent Renard
Centre Océanologique pour l'Exploitation des Océans
- Dr. Matthew Salisbury (ex-officio)
Scripps Institution of Oceanography
- Dr. Alexander A. Schreider
U.S.S.R. Academy of Sciences
- Dr. Wilfried Weigel
Universität Hamburg

SAMPLE DISTRIBUTION POLICY *

Distribution of Ocean Drilling Program and of Deep Sea Drilling Project samples is undertaken in order to (1) provide support to shipboard scientists in achieving the scientific objectives of their cruise, and support shorebased investigators who are preparing contributions to DSDP and ODP reports; (2) provide individual investigators with materials to conduct detailed studies beyond the scope of ODP reports; (3) provide paleontological reference centers with samples for reference and comparison purposes; and (4) provide educators with samples for teaching purposes.

Funding for sample-related activities must be secured by the investigator independently of requesting the samples.

The Ocean Drilling Program Curator is responsible for distributing samples and for preserving and conserving core material. The Curator, who may accept advice from chairmen of the appropriate JOIDES advisory panels, is responsible for enforcing the provisions of this sample distribution policy. He is responsible for maintaining a record of all samples that have been distributed, both onboard ship and subsequently from the repositories, indicating the recipients and the nature of investigations proposed. This information is available to interested investigators on request.

Every sample distributed from the ship or from a repository is labeled with a standard identifier, which includes leg number, hole number, core and section numbers, and interval within the section from which the sample was removed. It is imperative that this standard identifier be associated with all data reported in the literature, and that residues of the sample remain labeled throughout their lives, so that later workers can relate the data to the cores.

Distribution of sample materials is made directly from the repositories (Lamont-Doherty Geological Observatory, Scripps Institution of Oceanography, or Texas A&M University) by the Curator or his designated representative.

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

Any investigator who wishes to contribute to the reports of a scheduled cruise may write to the Curator, Ocean Drilling Program, Texas A&M University, College Station, Texas 77843-3469, U.S.A., in order to request samples from that cruise. Requests for a specific cruise must be received by the Curator at least

TWO MONTHS in advance of the departure of that cruise, in order to allow time for the review of the request in conjunction with other requests, so that a suitable shipboard sampling program can be assembled. The request should include a statement of the nature of the proposed research, size and approximate number of samples required to complete the study, and any particular sampling technique or equipment which may be required. Requests will be reviewed by the staff representative and co-chief scientists of the cruise and by the Curator. Approval/disapproval will be based upon the scientific requirements of the cruise as determined by the appropriate JOIDES advisory panel(s). The scope of a request must be such that samples can be processed, that proposed research can be completed, and that the paper can be written in time for submission to the relevant ODP cruise report.

Except for rare, specific instances involving ephemeral properties, the total volume of samples removed during a cruise-related sampling program will not exceed one-quarter of the volume of core recovered, and no interval will be depleted. One-half of all recovered materials will be retained in the archives in as pristine a condition as is practicable. Investigators requesting shipboard samples of igneous materials may receive a maximum of 100 igneous samples per cruise.

Because many sample requests are received for shipboard work and because the time of the shipboard party is at a premium, co-chief scientists are strongly urged to limit shipboard sampling to the minimum necessary to accomplish the cruise objectives. Shore-based investigators whose requests for cruise-related samples are approved should expect that they will receive the samples after the cores are returned to the repository, and should schedule research activities accordingly.

Co-chief scientists may invite investigators who are not cruise participants to perform special studies of selected core samples in direct support of shipboard activities. If this occurs, the names and addresses of these investigators and details of all samples loaned or distributed to them must be forwarded to the Curator, via the ODP Staff Representative to that cruise, immediately after the cruise. These investigators are expected to contribute to the cruise reports as though they had been cruise participants. All requirements of the Sample Distribution Policy apply.

Any publication of results other than in ODP reports within twelve (12) months of completion of the

* Revised October 1984.

cruise must be approved and authored by the whole shipboard party and, where appropriate, shorebased investigators. After twelve months, individual investigators may submit related papers for open publication provided they have already submitted their contributions to ODP reports. Investigations which are not completed in time for inclusion in ODP reports for a specific cruise may be published in a later edition of ODP reports; however, they may not appear in another journal until the ODP report for which they were intended has been published.

2. *Distribution of Samples for Research Leading to Publication Outside of the DSDP and ODP Reports*

- A. Researchers who wish to use samples for studies beyond the scope of the DSDP or ODP reports should obtain sample request forms from the Curator, Ocean Drilling Program, Texas A&M University, College Station, Texas 77843-3469, U.S.A. Requestors are required to specify the quantities and intervals of core required, to make a clear statement of the nature of the proposed research, to state the time which will be required to complete the work and to submit results for publication, and to specify funding status and the availability of equipment and space for the research.

Additionally, if the requestor has received samples from ODP or from DSDP previously, he/she will be required to account for the disposition of those samples by citing published works, six (6) copies of which must be sent to the Curator. If no report has been published, this requirement can be fulfilled by sending a brief (two or three page) report of the status of the research. Unused and residual samples should be returned and data should be sent to the Curator if the project has terminated. Paleontological materials may be returned either to the Curator at ODP or to one of the designated paleontological reference centers. If material is returned to a reference center, notify the Curator when it is sent.

Requests for samples from researchers in industrial laboratories will be honored in the same manner as those from academic organizations. Industrial investigators have the same obligations as other investigators to publish all results promptly in the open literature and to provide the Curator with copies of all reports published and of all data acquired in their research.

In order to ensure that all requests for highly desirable but limited samples can be consid-

ered together, approval of requests and distribution of samples will be delayed until twelve (12) months after completion of the cruise or two (2) months after official publication of the core descriptions, whichever occurs earlier. The only exceptions to this policy will be made for specific requests involving ephemeral properties. Requests for samples may be based on core descriptions published in ODP reports produced by the shipboard party, 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 ODP, and at the repositories at Lamont-Doherty Geological Observatory and at Scripps Institution of Oceanography.

- B. Most investigations can be accomplished handily with sample volumes of 10 ml or less. Investigators must provide explicit justification of requests for larger sample sizes or for frequent intervals within a core. Requests which exceed reasonable size or frequency limits will require explicit justifications and more time to process, and are unlikely to be granted in their entirety.

Requests for samples from thin layers, from stratigraphically important boundaries, from sections which are badly depleted or in unusually high demand may be delayed in order to coordinate requests from several investigators or while the Curator seeks advice from the community. Investigators who submit such requests may expect to receive suggestions for alternative sampling programs or that they join a research consortium which will share the samples. In any event, such exceptional requests will require more time for processing than will more routine requests.

Investigators who wish to study ephemeral properties may request a waiver of the waiting period; however, such requests will be referred automatically to the relevant co-chiefs. If approved, the investigator will join the shore-based contributors to the shipboard science effort, and will incur the obligations thereof (see section 1).

- C. Samples will not be provided until the requestor assures the Curator that funding for the proposed research is available or unnecessary. If a sample request is dependent in any way upon proposed funding, the Curator is prepared to provide the proposed funding organization with information on the availability (or potential availability) of suitable samples.

D. Investigators who receive samples incur the following obligations:

(1) To publish significant results promptly; however, no contribution may be submitted for publication prior to twelve (12) months following the termination of the relevant leg unless it is approved and authored by the entire shipboard party.

(2) To acknowledge in all publications that the samples were supplied through the assistance of the international Ocean Drilling Program and others as appropriate.

(3) To submit six (6) copies of reprints of all published works to the Curator, Ocean Drilling Program, Texas A&M University, College Station, Texas 77843-3469, U.S.A. These reprints will be distributed to the repositories, to the ship, to the National Science Foundation, and to the Curator's reprint file.

(4) To submit all final analytical data obtained from the samples to Data Base Manager, Ocean Drilling Program, Texas A&M University, College Station, Texas 77843-3469, U.S.A. Please consult recent issues of the JOIDES Journal or call (409-845-2673) for information on acceptable data formats. Investigators should be aware that they may have other data obligations under NSF's Ocean Science Data Policy or under relevant policies of other funding agencies which require submission of data to national data centers.

(5) To return all unused or residual samples, in good condition and with a detailed explanation of any processing they may have experienced, upon termination of the proposed research. In particular, all thin sections and smear slides manufactured onboard the vessel or in the repositories are to be returned to the Curator. Paleontological materials may be returned either to the Curator at ODP or to one of the designated paleontological reference centers.

Failure to honor these obligations will prejudice future applications for samples.

E. Cores are available for examination by interested parties at the repositories. Investigators are welcome to visit the repositories in order to inspect cores and to specify sample locations when that is required for their research; however, time and space in the workrooms are limited, so advance appointments are required. Occasionally, the space may be fully booked several weeks in advance, so investigators are urged to call for appointments well ahead in

order to avoid disappointment. Only the Curator or his delegate may actually remove samples from the cores.

F. A reference library of thin sections, smear slides, and archive photographs is maintained in the repositories for the use of visiting investigators. All thin sections and smear slides produced onboard the ship or in the repositories belong to this library.

3. *Distribution of Samples to Paleontological Reference Centers*

As a separate and special category of repository activity, selected samples are being distributed to paleontological reference centers, where the prepared material may be studied by visitors. As of this writing (mid-1984), Foraminifera and Calcareous Nannofossils can be viewed; Radiolaria and Diatoms will be prepared in the future. The present centers are Scripps Institution of Oceanography, California (W. R. Riedel, tel. 619-452-4386); Basel Natural History Museum, Switzerland (J. B. Saunders, tel. 061-25.82.82); and New Zealand Geological Survey, Lower Hutt, New Zealand (A. R. Edwards, tel. 699.059). Future centers are likely to include Texas A&M University, College Station, Texas (S. Gartner, tel. 409-845-8479); Smithsonian Institution, Washington, D.C.; Lamont-Doherty Geological Observatory, Palisades, New York; and an as yet undesignated center in Japan.

Further details concerning the paleontological reference centers are reported periodically in the JOIDES Journal.

4. *Distribution of Samples for Educational Purposes*

Samples may be available in limited quantities to college-level educators for teaching purposes. Interested educators should request application forms from the Curator, Ocean Drilling Program, Texas A&M University, College Station, Texas 77843-3469, U.S.A. Requestors are required to specify preferred sample size and location, to make a very clear statement of the nature of the coursework in which the samples will be used, to explain how the core samples will be prepared and how they will be used in the classroom, to explain in detail why they cannot use similar materials derived from outcrops or dredge hauls (it is NOT acceptable to argue that it requires less effort for the requestor to obtain samples from ODP than to assemble them from other sources), and to certify that funds are available to prepare the materials for classroom use. In general, only samples of materials which are abundant in the collection and which are in little demand for research purposes should be requested for educational purposes. The Curator will not ap-

prove requests for materials which are limited in supply or for which demand (real or potential) is great, including most paleontological materials.

5. Distribution of Data

The Deep Sea Drilling Project and the Ocean Drilling Program routinely capture much of the data generated onboard ship and published in Program reports. Additionally, data supplied by investigators who have received samples are incorporated into the data bases, so data sets which are larger than can be published are available to investigators. Magnetism, downhole logging, seismic reflection, bathymetric data, and other data collected by the drilling vessel become available for distribution to investigators at the same time as core samples.

At least through mid-1986, DSDP data will continue to be distributed by the Data Base Manager, Deep Sea Drilling Project, A-031, University of California, San Diego, California 92093, U.S.A. A charge will be made to recover expenses in excess of \$50.00 incurred in filling individual requests. If required, estimates of charges can be furnished before the work is performed. As DSDP phases down, DSDP data will be available primarily from the National Geophysical Data Center, Boulder, Colorado.

Requests for ODP data should be addressed to the Data Base Manager, Ocean Drilling Program, Texas A&M University, College Station, Texas 77843-3469, U.S.A. Many varieties of DSDP data will be included in ODP data bases. Information on sources of DSDP data will be available from the ODP Data Base Manager.

CONTENTS

Chapter	Page	Chapter	Page
ACKNOWLEDGMENTS	1	PART III: SEDIMENTOLOGY	
PART I: INTRODUCTION AND SITE REPORTS		10. TURBIDITE SEDIMENTOLOGY AND HISTORY OF THE EAST MARIANA BASIN.....	365
1. INTRODUCTION AND EXPLANATORY NOTES, LEG 89	5	J. M. Whitman, M. Baltuck, J. A. Haggerty, and W. Dean	
M. Baltuck, R. Moberly, and S. O. Schlanger		11. AUTHIGENIC SILICA IN TERTIARY AND UPPER CRETACEOUS SEDIMENTS OF THE EAST MARIANA BASIN, DEEP SEA DRILLING PROJECT SITE 585	389
2. SITE 585	29	M. Baltuck	
Shipboard Scientific Party		12. OOIDS AND SHALLOW-WATER DEBRIS IN APTIAN-ALBIAN SEDIMENTS FROM THE EAST MARIANA BASIN, DEEP SEA DRILLING PROJECT SITE 585: IMPLICATIONS FOR THE ENVIRONMENT OF DEPOSITION OF THE OOIDS	399
3. SITE 462	157	J. A. Haggerty and I. Premoli Silva	
Shipboard Scientific Party		13. CRETACEOUS INTERACTIONS BETWEEN VOLCANISM AND SEDIMENTATION IN THE EAST MARIANA BASIN, FROM MINERALOGICAL, MICRO-MORPHOLOGICAL, AND GEOCHEMICAL INVESTIGATIONS, DEEP SEA DRILLING PROJECT SITE 585	413
4. SITE 586	213	H. Chamley, H. Coulon, P. Debrabant, and T. Holtzapffel	
Shipboard Scientific Party		PART IV: IGNEOUS PETROLOGY AND GEOCHEMISTRY	
PART II: PALEONTOLOGY		14. GLASSY AND BASALTIC FRAGMENTS WITHIN GRADED VOLCANICLASTIC SEDIMENTS, EAST MARIANA BASIN, DEEP SEA DRILLING PROJECT LEG 89 ...	433
5. NANNOFOSSIL BIOSTRATIGRAPHY AT SITE 585, EAST MARIANA BASIN	285	P. A. Floyd	
J. A. Bergen		15. GEOCHEMISTRY AND PROVENANCE OF BASALTIC CLASTS WITHIN VOLCANICLASTIC DEBRIS FLOWS, EAST MARIANA BASIN, DEEP SEA DRILLING PROJECT SITE 585	449
6. LATE APTIAN AND CENOMANIAN-TURONIAN PLANKTONIC FORAMINIFERS FROM DEEP SEA DRILLING PROJECT SITE 585, LEG 89, EAST MARIANA BASIN	297	P. A. Floyd	
I. Premoli Silva and W. V. Sliter			
7. A NEW BIOSTRATIGRAPHIC INTERPRETATION OF THE SEDIMENTARY RECORD RECOVERED AT SITE 462, LEG 61, NAURU BASIN, WESTERN EQUATORIAL PACIFIC	311		
I. Premoli Silva			
8. RADIOLARIA FROM DEEP SEA DRILLING PROJECT LEG 89	321		
A. Schaaf			
9. CRETACEOUS REDEPOSITED BENTHIC FORAMINIFERS FROM DEEP SEA DRILLING PROJECT SITE 585 IN THE EAST MARIANA BASIN, WESTERN EQUATORIAL PACIFIC, AND IMPLICATIONS FOR THE GEOLOGIC HISTORY OF THE REGION	327		
W. V. Sliter			

Chapter	Page	Chapter	Page
16. CHEMISTRY OF PRIMARY AND SECONDARY PHASES IN INTRAPLATE BASALTS AND VOLCANICLASTIC SEDIMENTS, DEEP SEA DRILLING PROJECT LEG 89	459	23. LOW-MOLECULAR-WEIGHT HYDROCARBONS IN SEDIMENTS OF DEEP SEA DRILLING PROJECT LEG 89, SITES 585, EAST MARIANA BASIN, AND 586, ONTONG-JAVA PLATEAU	577
P. A. Floyd and G. Rowbotham		R. G. Schaefer and D. Leythaeuser	
17. PETROLOGY AND GEOCHEMISTRY OF OCEANIC INTRAPLATE SHEET-FLOW BASALTS, NAURU BASIN, DEEP SEA DRILLING PROJECT LEG 89	471	PART V: GEOPHYSICS	
P. A. Floyd		24. SEISMIC STRATIGRAPHIC SECTIONS: EAST MARIANA BASIN (SITE 585), NAURU BASIN (SITE 462), AND ONTONG-JAVA PLATEAU (SITE 586)	589
18. GEOCHEMISTRY OF BASALTS FROM THE NAURU BASIN, DEEP SEA DRILLING PROJECT LEGS 61 AND 89: IMPLICATIONS FOR THE ORIGIN OF OCEANIC FLOOD BASALTS	499	J. M. Whitman	
A. D. Saunders		25. DOWNHOLE FLOW OF BOTTOM WATER: IMPLICATIONS FROM TEMPERATURE LOGGING AT HOLE 462A, NAURU BASIN, DEEP SEA DRILLING PROJECT LEG 89	597
19. ⁴⁰ Ar/ ³⁹ Ar GEOCHRONOLOGICAL STUDIES OF BASALTS FROM HOLE 462A, NAURU BASIN, DEEP SEA DRILLING PROJECT LEG 89	519	N. Fujii	
Y. Takigami, S. Amari, M. Ozima, and R. Moberly		26. SITE SURVEYS IN THE WESTERN PACIFIC CONDUCTED ABOARD THE <i>KANA KEOKI</i> , CRUISE KK810626 LEG 4	603
20. Rb-Sr ISOTOPE SYSTEMATICS AND Sr/Ca-Ba/Ca RATIOS OF NAURU BASIN BASALTS, DEEP SEA DRILLING PROJECT LEG 89	523	L. D. Petersen, F. K. Duennebier, and T. H. Shipley	
K. Notsu, N. Onuma, and N. Fujii		27. PALEOLATITUDES AND MAGNETO-STRATIGRAPHY OF CRETACEOUS AND LOWER TERTIARY SEDIMENTARY ROCKS, DEEP SEA DRILLING PROJECT SITE 585, EAST MARIANA BASIN, WESTERN CENTRAL PACIFIC.....	629
21. PRIMARY COMPOSITION, ALTERATION, AND ORIGIN OF CRETACEOUS VOLCANICLASTIC ROCKS, EAST MARIANA BASIN (SITE 585, LEG 89)	529	J. G. Ogg	
L. G. Viereck, M. Simon, and H.-U. Schminke		28. ANISOTROPY OF BASALTS, HOLE 462A, NAURU BASIN, DEEP SEA DRILLING PROJECT LEG 89	647
22. PETROLOGY AND GEOCHEMISTRY OF NAURU BASIN IGNEOUS COMPLEX: LARGE-VOLUME, OFF-RIDGE ERUPTIONS OF MORB-LIKE BASALT DURING THE CRETACEOUS	555	N. Fujii and Y. Hamano	
P. Castillo, R. Batiza, and R. J. Stern		PART VI: SYNTHESIS	
		29. SEDIMENTARY AND VOLCANIC HISTORY: EAST MARIANA BASIN AND NAURU BASIN.....	653
		S. O. Schlanger and R. Moberly	

ACKNOWLEDGMENTS

The background and operations history of each of the three Leg 89 sites vary greatly. Successful drilling at Site 585 presented the difficulty of pursuing objectives without the full complement of facilities that had been anticipated in planning the site operations. Despite the inability to reenter a hole we were able to core and identify the nature of targeted seismic reflectors in two single-bit holes. Hole 462A had been surveyed and cored years before we returned to deepen the hole; successful reentry after four and a quarter years allowed us to reassess the nature and extent of Pacific mid-Cretaceous volcanism. Site 586 (of Cenozoic interest) was cored and described in four holes by the parties of both Legs 89 and 90.

We thank the many scientists, technicians, and crews of earlier surveys and drilling operations in Leg 89 regions for their contribution to the planning of this leg. For giving us the opportunity to return to the oldest part of the western Pacific, we thank the JOIDES planning committee. We wish to thank Captain Shuman and the crew of the *Glomar Challenger*, the drillers and engineers of Global Marine and the Deep Sea Drilling Project, and the DSDP shipboard technical staff led by Gus Gustafson for their support during the cruise. Onshore the sharp eyes of editors Susan Orlofsky and James Shambach and the skilled hands of illustrators Kathleen Sanderson and Aileen Bobryk turned our manuscripts and drawings into beautifully illuminated chapters.