

Scanning electron micrograph of delicate coccoliths preserved in an Aptian braarudosphaerid-micrantonolith chalk from Site 330 (Sample 330-3-2, 115 cm). A highlight of Leg 36 drilling was the recovery of exceptionally well preserved high latitude microfossil assemblages in older sediments. (Photograph by F.H. Wind and William Miller, III, X9,000.)

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 XXXVI

covering Leg 36 of the cruises of the Drilling Vessel *Glomar Challenger*
Ushuaia, Argentina to Rio De Janeiro, Brazil
April-May 1974

PARTICIPATING SCIENTISTS

Peter Barker, Ian W. D. Dalziel,
Menno G. Dinkelman, David H. Elliott, Andrew M. Gombos, Jr.,
Alberto Lonardi, George Plafker, John Tarney,
Robert W. Thompson, R. C. Tjalsma,
Christopher C. von der Borch, Sherwood W. Wise, Jr.

SCIENCE EDITOR

Sherwood W. Wise, Jr.

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

References to this Volume

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

Barker, P. F., Dalziel, I.W.D. et al., 1976. Initial Reports of the Deep Sea Drilling Project, Volume 36, Washington (U.S. Government Printing Office), 1080 p.

Wise, S. W., Jr. and Wind, F. H., 1976. Mesozoic and Cenozoic Calcareous Nannofossils Recovered by DSDP Leg 36 Drilling on the Falkland Plateau, Southwest Atlantic Sector of the Southern Ocean. *In* Barker, P. F., Dalziel, I.W.D. et al., 1976. Initial Reports of the Deep Sea Drilling Project, Volume 36, Washington (U.S. Government Printing Office), p. 269-492.

Printed: January 1977

Library of Congress Catalog Card Number 74-603338

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price \$21.00
Stock Number 038-000-00301-1

Foreword

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

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

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

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

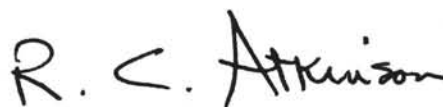
From these concepts come major interpretations of the results of the drilling as they bear on patterns of sedimentation and physical and chemical characteristics of the ancient oceans.

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

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

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

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



Richard C. Atkinson
Acting Director

Washington, D. C.
October 1976

Preface

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

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

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

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

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

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

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

Core materials and data collected on the cruise will be made available to qualified scientists through the Curator of the Deep Sea Drilling Project, following a Sample Distribution

Policy (p. xvii) approved by the National Science Foundation.

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

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

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

Deep Sea Drilling Project

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

Bundesanstalt für Geowissenschaften und Rohstoffe,
Federal Republic of Germany

Lamont-Doherty Geological Observatory, Columbia
University

Rosenstiel School of Marine and Atmospheric
Science, University of Miami

Scripps Institution of Oceanography, University of
California

USSR Academy of Sciences

University of Washington

Woods Hole Oceanographic Institution

OPERATING INSTITUTION:

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

DEEP SEA DRILLING PROJECT

Project Chief Scientist
N. T. Edgar

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

* Includes member organizations during time of the
cruise.

Participants Aboard

GLOMAR CHALLENGER for Leg Thirty Six:

Dr. Peter Barker
Co-Chief Scientist
The University of Birmingham
Department of Geology
Birmingham B15 2TT, England

Dr. Ian W. D. Dalziel
Co-Chief Scientist
Lamont-Doherty Geological
Observatory of Columbia University
Palisades, New York 10964

Dr. David H. Elliot
Sedimentologist
Institute of Polar Studies
The Ohio State University
125 South Oval Drive
Columbus, Ohio 43210

Dr. Christopher C. von der Borch
Sedimentologist
School of Physical Sciences
The Flinders University
Bedford Park
South Australia 5042

Dr. Robert W. Thompson
Sedimentologist
School of Natural Resources
Humboldt State College
Arcata, California 95521

Dr. George Plafker
Sedimentologist
U.S. Geological Survey
Alaskan Mineral Resources Branch
345 Middlefield Road
Menlo Park, California 94025

Dr. R. C. Tjalsma
Paleontologist
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

Dr. Sherwood W. Wise, Jr.
Paleontologist
Department of Geology
The Florida State University
Tallahassee, Florida 32306

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

Mr. Andrew M. Gombos, Jr.
Paleontologist
Chevron Oil Company
P.O. Box 51743
Lafayette, Louisiana 70501

Dr. Alberto Lonardi
Specialist—Argentine Basin
CONICET
Rivadavia 1917
Buenos Aires, Argentina

Dr. John Tarney
Igneous Petrologist
Department of Geology
University of Birmingham
Birmingham B15 2TT, England

Mr. Otis Moore
Cruise Operations Manager
AMOCO Prod. Co.
P.O. Box 51921 OCS
Lafayette, Louisiana 70501

Mr. Robert J. Connolly
Meteorologist
NOAA—National Weather Service
219 A. Customs House
San Francisco, California 94111

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

Mr. Cotton Guess
Drilling Superintendent
Global Marine, Inc.
Los Angeles, California

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

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

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

Mr. Lloyd Russill
Electronics Technician
Scripps Institution of Oceanography
La Jolla, California 92093

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

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

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

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

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

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

Senior Project Personnel

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

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

Mr. William T. Soderstrom
Finance Administrator

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

Mr. William R. Riedel
Curator

Mr. Robert Olivas
Logistics Officer

Dr. David G. Moore
Chief Scientist

Mr. Valdemar Larson
Operations Manager

Mr. Robert S. Bower
Contracts Officer

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

Mr. Stanley T. Serocki
Project Development Engineer

Ms. Sue Strain
Personnel Officer

Deep Sea Drilling Project Publications Staff

Dr. Ansis G. Kaneps
Science Editor

Mr. James Shambach
Copy Editor

Ms. Virginia L. Roman
Art Supervisor

Ms. Paula Worstell
Science Editor

Mr. Ray Silk
Production Manager

Ms. Jody Spear
Production Coordinator

JOIDES Advisory Groups*

Executive Committee

- Dr. Manik Talwani
Lamont-Doherty Geological Observatory
- Dr. Warren S. Wooster
Rosensteil School of Marine and Atmospheric Science
- Dr. William A. Nierenberg
Scripps Institution of Oceanography
- Dr. Arthur E. Maxwell
Woods Hole Oceanographic Institution
- Dr. Maurice Rattray
University of Washington
- Academician Andrie S. Monin
P. P. Shirshov Institute of Oceanology
- Prof. Dr. F. Bender
Bundesanstalt für Bodenforschung
- Dr. Hans Closs **
Bundesanstalt für Bodenforschung
- Mr. John I. Ewing
Lamont-Doherty Geological Observatory
- Dr. Paul M. Fye
Woods Hole Oceanographic Institution
- Dr. Charles J. Merdinger
Scripps Institution of Oceanography
- Dr. Gleb Udintsev
P. P. Shirshov Institute of Oceanology
- Dr. Melvin N. A. Peterson (Ex-Officio)
Scripps Institution of Oceanography

Planning Committee

- Mr. John I. Ewing
Lamont-Doherty Geological Observatory
- Dr. William W. Hay
Rosensteil School of Marine and Atmospheric Science
- Dr. Joe S. Creager
University of Washington
- Mr. William R. Riedel
Scripps Institution of Oceanography
- Dr. James R. Heirtzler
Woods Hole Oceanographic Institution
- Dr. Gleb Udintsev
P. P. Shirshov Institute of Oceanology
- Dr. Hans Closs
Bundesanstalt für Bodenforschung

* Includes members during time of Leg 36 (April-May 1974)

** Alternate

- Dr. N. Terence Edgar (Ex-Officio)
Scripps Institution of Oceanography

Atlantic Advisory Panel

- Mr. John I. Ewing
Lamont-Doherty Geological Observatory
- Dr. William A. Berggren
Woods Hole Oceanographic Institution
- Dr. Dennis E. Hayes
Lamont-Doherty Geological Observatory
- Dr. Xavier Le Pichon
Centre National pour l'Exploitation des Océans
- Dr. Kenneth S. Deffeyes
Princeton University
- Dr. Anthony S. Laughton
Institute of Oceanographic Sciences
- Dr. Fabrizio Aumento
Dalhousie University
- Dr. Enrico Bonatti
Rosensteil School of Marine and Atmospheric Science
- Dr. Gleb Udintsev
P. P. Shirshov Institute of Oceanology
- Dr. Karl Hinz
Bundesanstalt für Bodenforschung
- Dr. Charles D. Hollister
Woods Hole Oceanographic Institution

Mediterranean Advisory Panel

- Dr. Kenneth J. Hsü
Geologisches Institut der E.T.H.
- Dr. William B. F. Ryan
Lamont-Doherty Geological Observatory
- Dr. Enrico Bonatti
Rosensteil School of Marine and Atmospheric Science
- Dr. David A. Ross
Woods Hole Oceanographic Institution
- Dr. Maria Bianca Cita
University of Milano
- Dr. Lucien Montadert
Institut Francais du Pétrole
- Dr. Frank H. Fabricius
Technische Universität München
- Dr. Hans Closs
Bundesanstalt für Bodenforschung

Antarctic Advisory Panel

- Dr. Dennis E. Hayes
Lamont-Doherty Geological Observatory
- Dr. Robert H. Rutford
University of Nebraska
- Dr. James P. Kennett
University of Rhode Island
- Dr. Ian W. D. Dalziel
Lamont-Doherty Geological Observatory
- Dr. David W. Scholl
United States Geological Observatory
- Dr. James R. Heirtzler
Woods Hole Oceanographic Institution
- Dr. William G. Melson
Smithsonian Institution
- Dr. Peter Barker
University of Birmingham
- Dr. David J. W. Piper
Dalhousie University
- Prof. A. P. Lisitzin
P. P. Shirshov Institute of Oceanology
- Dr. A. V. Zhivago
P. P. Shirshov Institute of Oceanology

Advisory Panel on Igneous and Metamorphic Petrography

- Dr. Ian D. MacGregor
University of California at Davis
- Dr. Nikolas I. Christensen
University of Washington
- Dr. Leonid Dmitriev
USSR Academy of Sciences
- Dr. Frederick A. Frey
Massachusetts Institute of Technology
- Dr. Stanley R. Hart
Carnegie Institution of Washington
- Dr. James R. Heirtzler
Woods Hole Oceanographic Institution
- Dr. William G. Melson
Smithsonian Institution
- Dr. Akiho Miyashiro
State University of New York at Albany
- Dr. H. U. Schmincke
Ruhr-Universitat Bochum
- Dr. Tracy Vallier (Ex-Officio)
Scripps Institution of Oceanography
- Dr. W. Schreyer
Ruhr-Universitat Bochum

Advisory Panel on Sedimentary Petrology and Physical Properties

- Dr. George H. Keller
NOAA Atlantic Oceanographic and Meteorological Laboratories

- Dr. Edwin L. Hamilton
Naval Undersea Research Center
- Dr. Alexander P. Lisitzin
USSR Academy of Sciences
- Prof. Dr. G. Muller
Laboratorium für Sedimentforschung, Heidelberg
- Dr. Adrian P. Richards
Lehigh University
- Dr. Nahum Schneidermann
Gulf Research and Development Company
- Dr. Tjeerd H. Van Andel
Oregon State University
- Dr. John T. Whetten
University of Washington
- Dr. Joe S. Creager
University of Washington
- Dr. Harry E. Cook
United States Geological Survey
- Dr. Alfred G. Fischer
Princeton University
- Mr. Henry L. Gill
Naval Civil Engineering Laboratory

Advisory Panel on Paleontology and Biostratigraphy

- Dr. William Berggren
Woods Hole Oceanographic Institution
- Dr. C. W. Drooger
University of Utrecht
- Dr. William W. Hay
Rosenstiel School of Marine and Atmospheric Science
- Dr. Eric G. Kauffman
Smithsonian Institution
- Dr. Valeri Krasheninnikov
USSR Academy of Sciences
- Dr. Helen Loeblich
University of California at Los Angeles
- Dr. Emile A. Pessagno
University of Texas at Dallas
- Dr. Tsunemasa Saito
Lamont-Doherty Geological Observatory
- Dr. Maria G. Petrushevskaya
USSR Academy of Sciences
- Dr. Alan Shaw
Amoco Production Company

Advisory Panel on Organic Geochemistry

- Dr. Keith A. Kvenvolden
NSAS Ames Research Center

Dr. Earl W. Baker
Northeast Louisiana University

Dr. Ellis E. Gray
Mobil Oil Company

Dr. N. A. Eremenko
*Institute of Geology and Exploration of
 Combustible Mineral Resources*

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

Dr. Richard D. McIver
Esso Production Research Laboratory

Dr. John M. Hunt
Woods Hole Oceanographic Institution

Dr. J. Gordon Erdman
Phillips Petroleum Company

Advisory Panel on Information Handling

Dr. Melvin A. Rosenfeld
Woods Hole Oceanographic Institution

Dr. Daniel W. Appleman
Smithsonian Institution

Dr. Jack G. Barr
Standard Oil Company of California

Dr. James C. Kelley
University of Washington

Dr. Peter R. Supko
Scripps Institution of Oceanography

Mr. William R. Riedel
Scripps Institution of Oceanography

Dr. I. Mikhaltsev
P. P. Shirshov Institute of Oceanology

**Advisory Panel on Pollution Prevention
 and Safety**

Dr. Hollis D. Hedberg
Princeton University

Mr. William F. Allinder
Texaco Inc.

Mr. John I. Ewing
Lamont-Doherty Geological Observatory

Dr. Louis E. Garrison
United States Geological Survey

Dr. Manik Talwani
Lamont-Doherty Geological Observatory

Dr. Edward L. Winterer
Scripps Institution of Oceanography

Dr. Dennis E. Hayes
Lamont-Doherty Geological Observatory

Mr. Oscar Weser
Scripps Institution of Oceanography

Dr. John E. Sherborne ***
Union Oil Company of California

Dr. H. Grant Goodell
University of Virginia

Advisory Panel on Inorganic Geochemistry

Dr. Heinrich D. Holland
Hoffman Laboratory

Dr. Wallace S. Broecker
Lamont-Doherty Geological Observatory

Mr. John I. Ewing
Lamont-Doherty Geological Observatory

Dr. Joris M. Gieskes
Scripps Institution of Oceanography

Dr. Ian R. Kaplan
University of California at Los Angeles

Dr. Frank T. Manheim
University of South Florida

Dr. Karl K. Turekian
Yale University

Dr. Igor M. Varentsov
The USSR Academy of Sciences

Dr. Gleb N. Baturin
The USSR Academy of Sciences

Industrial Liaison Panel

Mr. W. A. Roberts
Phillips Petroleum Company

Mr. Fred C. Ackman
Esso Exploration Inc.

Mr. Melvin J. Hill
Gulf Oil Corporation

Mr. John D. Moody
Mobil Oil Corporation

*** Deceased

Deep Sea Drilling Project

SAMPLE DISTRIBUTION POLICY*

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

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

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

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

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

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

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

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

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

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

* Revised October 1976

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

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

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

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

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

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

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

- D. Investigators receiving samples are responsible for:

(1) publishing significant results; however contributions shall not be submitted for publication prior to 12 months following the termination of the appropriate leg;

(2) acknowledging, in publications, that samples were supplied through the assistance of the U.S. National Science Foundation and others as appropriate;

(3) submitting five (5) copies (for distribution to the Curator's file, the DSDP Repositories, the GLOMAR CHALLENGER's Library, and the National Science Foundation) of all reprints of published results to the Curator, Deep Sea Drilling Project (A-031), Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California 92093, U.S.A.;

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

- E. Cores are made available at repositories for investigators to examine and to specify exact samples in such instances as may be necessary for the scientific purposes of the sampling, subject to the limitations of B (1 and 2) and D, above, with specific permission of the Curator or his delegate.

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

G. The Deep Sea Drilling Project routinely processes by computer most of the quantitative data presented in the *Initial Reports*. Space limitations in the *Initial Reports* preclude the detailed presentation of all such data. However, copies of the computer readout are available for those who wish the data for further analysis or as an aid on selecting samples. A charge will be made to recover expenses in excess of \$50.00 incurred in filling requests.

3. *Other Records*

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

Requests for data may be made to:

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

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

4. *Reference Centers*

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

CONTENTS

Chapter	Page	Chapter	Page
ACKNOWLEDGMENTS	xxiii	10. CRETACEOUS FORAMINIFERS FROM THE SOUTHWESTERN ATLANTIC OCEAN, LEG 36, DEEP SEA DRILLING PROJECT	519
DEDICATION	1	William V. Sliter	
PART I: INTRODUCTION	3	11. PALEOGENE AND NEOGENE DIATOMS FROM THE FALKLAND PLATEAU AND MALVINAS OUTER BASIN: LEG 36, DEEP SEA DRILLING PROJECT	575
1. INTRODUCTION	5	Andrew M. Gombos, Jr.	
Peter F. Barker, Ian W. D. Dalziel, and Sherwood W. Wise, Jr.		12. ARCHAEOMONADS AS EOCENE AND OLIGOCENE GUIDE FOSSILS IN MARINE SEDIMENTS	689
PART II: SITE REPORTS	17	Andrew M. Gombos, Jr.	
2. SITE 326	19	13. SILICOFLAGELLATE STRATIGRAPHY, DEEP SEA DRILLING PROJECT, LEG 36	697
Peter Barker, Ian W. D. Dalziel, Menno G. Dinkelman, David H. Elliot, Andrew M. Gombos, Jr., Alberto Lonardi, George Plafker, John Tarney, Robert W. Thompson, R. C. Tjalsma, Christopher C. von der Borch, and Sherwood W. Wise, Jr.		Karen Eason Busen and Sherwood W. Wise, Jr.	
3. SITE 327	27	14. CALCAREOUS NANNOPLANKTON BIOGEOGRAPHY AND ITS PALEOCLIMATIC IMPLICATIONS: CENOZOIC OF THE FALKLAND PLATEAU (DSDP LEG 36) AND MIOCENE OF THE ATLANTIC OCEAN	745
The Shipboard Scientific Party		Bilal U. Haq, G. P. Lohmann, and Sherwood W. Wise, Jr.	
4. SITE 328	87	15. PALYNOLOGY OF CORES FROM DEEP SEA DRILLING SITES 327, 328, AND 330, SOUTH ATLANTIC OCEAN	761
The Shipboard Scientific Party		Wayne K. Harris	
5. SITE 329	143	16. STRATIGRAPHIC PALYNOLOGY OF SELECTED MESOZOIC SAMPLES DSDP HOLE 327A AND SITE 330	817
The Shipboard Scientific Party		Richard W. Hedlund and Dan Beju	
6. SITE 330	207	17. JURASSIC SCOLECODONT-LIKE MICROFOSSILS FROM THE FALKLAND PLATEAU (DEEP SEA DRILLING PROJECT SITE 330)	829
The Shipboard Scientific Party		F. H. Wind, M. G. Dinkelman, and S. W. Wise, Jr.	
7. SITE 331	259	18. MESOZOIC MEGAFOSSILS FROM DSDP HOLE 327A AND SITE 330 ON THE EASTERN FALKLAND PLATEAU	845
The Shipboard Scientific Party		David L. Jones, George Plafker	
PART III: SHORE LABORATORY STUDIES	267		
8. MESOZOIC AND CENOZOIC CALCAREOUS NANNOFOSSILS RECOVERED BY DSDP LEG 36 DRILLING ON THE FALKLAND PLATEAU, SOUTHWEST ATLANTIC SECTOR OF THE SOUTHERN OCEAN	269		
Sherwood W. Wise, Jr. and Frank H. Wind			
9. CENOZOIC FORAMINIFERA FROM THE SOUTH ATLANTIC, DSDP LEG 36	493		
R. C. Tjalsma			

Chapter	Page	Chapter	Page
19. PALEOGLACIAL IMPLICATIONS OF COARSE DETRITUS IN DSDP LEG 36 CORES George Plafker, Susan Bartsch-Winkler, A. T. Ovenshine	857	28. CORRELATIONS BETWEEN SITES ON THE EASTERN FALKLAND PLATEAU BY MEANS OF SEISMIC REFLECTION PROFILES, LEG 36, DSDP P. F. Barker	971
20. CONE-IN-CONE AND BEEF-IN-SHALE TEXTURES FROM DSDP SITE 330, FALKLAND PLATEAU, SOUTH ATLANTIC John Tarney and B. Charlotte Schreiber	865	PART IV: CRUISE SYNTHESIS	991
21. VOLCANIC GLASS IN SOME DSDP LEG 36 CORES D. H. Elliot, C. M. Emerick	871	29. EVOLUTION OF THE SOUTHWESTERN ATLANTIC OCEAN BASIN: RESULTS OF LEG 36, DEAP SEA DRILLING PROJECT The Shipboard Scientific Party Together with Wayne Harris and William V. Sliter	993
22. MESOZOIC SEDIMENTATION ON THE EASTERN FALKLAND PLATEAU Robert W. Thompson	877	PART V: APPENDICES	1015
23. PETROLOGY, MINERALOGY, AND GEOCHEMISTRY OF THE FALKLAND PLATEAU BASEMENT ROCKS, SITE 330, DEEP SEA DRILLING PROJECT John Tarney	893	I. X-RAY MINERALOGY DATA FROM THE ARGENTINE BASIN—LEG 36 DEEP SEA DRILLING PROJECT I. Zemmels, Patrick J. Harrold, and H. E. Cook	1017
24. Re-Sr AND K-Ar AGE DETERMINATIONS ON SAMPLES OF THE FALKLAND PLATEAU BASEMENT AT SITE 330, DSDP R. D. Beckinsale, J. Tarney, D. P. F. Darby- shire, M. J. Humm	923	II. MEASUREMENT OF CHEMICAL/ PHYSICAL PROPERTIES Alberto Lonardi	1033
25. MINOR ELEMENT GEOCHEMISTRY OF SEDIMENTS AT SITE 328, FALKLAND OUTER BASIN AND SITE 329, FALKLAND PLATEAU, LEG 36, DEEP SEA DRILLING PROJECT J. Tarney and N. C. B. Donnellan	929	III. GRAIN-SIZE AND CARBON/ CARBONATE ANALYSES, LEG 36 Donald H. Cameron	1047
26. CONTENT, COMPOSITION, AND THERMAL HISTORY OF ORGANIC MATTER IN MESOZOIC SEDIMENTS, FALKLAND PLATEAU J. B. Comer and R. Littlejohn	941	IV. OPERATIONS RESUME, DSDP, LEG 36 .. Otis M. Moore	1051
27. UNDERWAY GEOPHYSICAL OBSERVATIONS, LEG 36, DEEP SEA DRILLING PROJECT P. F. Barker	945	V. DEEP SEA DRILLING PROJECT PROCEDURES FOR SHEAR STRENGTH MEASUREMENT OF CLAYEY SEDIMENT USING MODIFIED WYKEHAM FARRANCE LABORATORY VANE APPARATUS Robert E. Boyce	1059
		PART VI: VOLUME 28 CHAPTER	1069
		1. POTASSIUM-ARGON DATING OF GLAUCONITE FROM A GREENSAND DRILLED AT SITE 270 IN THE ROSS SEA, DSDP LEG 28 Ian McDougall	1071
		INDEX	1073

ACKNOWLEDGMENTS

Members of the Scientific Party aboard *Glomar Challenger* during Leg 36 wish to express their appreciation to all those who contributed to the considerable scientific achievements that resulted from a logistically taxing cruise. The late Dr. Maurice Ewing and Dr. Dennis E. Hayes of Lamont-Doherty Geological Observatory of Columbia University first drew attention to the outstanding significance of the general scientific problems that could be addressed by drilling in the Southern Ocean. The members of the Joides Antarctic Advisory Panel identified specific goals and planned a drilling program to attack them. DSDP planning personnel and members of the staff of the National Science Foundation's Office of Polar Programs worked hard to provide the special logistic support necessary for operation of *Glomar Challenger* in the polar environment. However, without the skill, dedication, and enthusiasm of Captain Lloyd Dill, Cruise Operations Manager Otis Moore (on loan from Amoco Production Company, Lafayette, Louisiana), Drilling Superintendent Cotton Guess, and the ship and drilling crews, there would have been little to show for all our efforts.

We are also most grateful to the DSDP shipboard laboratory staff under the direction of Michael Lehmann for their assistance once the core was received onboard and to Marge MacCarty for her help in the preparation of the shipboard reports.

DEDICATION

While *Glomar Challenger* was drilling at Site 330 on the eastern end of the Falkland (Malvinas) Plateau, word of the sudden death of Dr. Maurice Ewing was received onboard. Founding Director of Lamont-Doherty Geological Observatory of Columbia University, "Doc" conducted much of his early work at sea in the southwestern Atlantic, and throughout his life he continued to study the region. In recognition of his outstanding contribution to earth science, and in particular his roles in the study of the southwestern Atlantic Ocean Basin, and in the initiation of the Deep Sea Drilling Project, this volume is dedicated to him. The Shipboard Scientific Party of DSDP Leg 36 proposes that the eastern prolongation of the Falkland (Malvinas) Plateau, on which Sites 327, 329, and 330 are located, be named the *Maurice Ewing Bank*.