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Peter J. Davies, Judith A. McKenzie, Amanda A. Palmer-Julson,
Christian Betzler, Thomas C. Brachert, Min-Pen Philip Chen,
Jean-Pierre Crumière, George R. Dix, André W. Droxler, David A. Feary,
Stefan Gartner, Craig R. Glenn, Alexandra Isern, Peter D. Jackson,
Richard D. Jarrard, Miriam E. Katz, Kenji Konishi, Dick Kroon, John W. Ladd,
José Manuel Martín, Donald F. McNeill, Lucien F. Montaggioni,
Daniel W. Müller, Sheraz Khan Omarzai, Chris J. Pigram, Peter K. Swart,
Philip A. Symonds, Keith F. Watts, Wuchang Wei
Shipboard Scientists

Amanda A. Palmer-Julson
Shipboard Staff Scientist

Prepared by the
OCEAN DRILLING PROGRAM
TEXAS A&M UNIVERSITY

Sondra K. Stewart and Diana Kennett
Volume Editors

in cooperation with the
NATIONAL SCIENCE FOUNDATION
and
JOINT OCEANOGRAPHIC INSTITUTIONS, INC.

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Foreword

By the National Science Foundation

The scientists of the Ocean Drilling Program (ODP) have embarked on what could prove to be one of the most important earth science initiatives of the decade—an initiative rivaling in scope and impact the exploration of the frontiers of outer space. The program explores our planet's last frontier—the Earth's structure and history as it is revealed beneath the oceans. The scope of the program's scientific goals excites the imagination, challenges the intellect, and enhances the spirit of cooperation among peoples in countries around the world.

Between 1872 and 1876, HMS *Challenger* undertook the world's first major oceanographic expedition. That expedition greatly expanded man's knowledge of the world's oceans and revolutionized our ideas about planet Earth. From 1968 to 1983, another ship named *Challenger* logged more than 375,000 miles on 96 voyages across every ocean for the Deep Sea Drilling Project (DSDP), operated by Scripps Institution of Oceanography. Among the project's many remarkable discoveries were the confirmation of seafloor spreading and the establishment of the relative youth of the seafloor, thus verifying the dynamic and changing nature of the Earth's crust.

Today, the Ocean Drilling Program, which began in 1983, brings new resources to bear on scientific ocean drilling. A new drillship is in operation—the *JOIDES Resolution*—one of the world's most modern and best equipped drillships with enhanced capability for drilling and coring in polar areas and rough weather, expanded laboratory space, facilities for more scientists, and a major drill-hole logging program. The name of the ship was derived from the international scientific partnership that directs the program—the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES)—and from the flagship of Captain Cook's second voyage to the Pacific Ocean in the late 18th century. Texas A&M University is responsible for science operations in the program, and Lamont-Doherty Geological Observatory is responsible for the logging program.

The Ocean Drilling Program truly has international participation. In 1975, the International Phase of Ocean Drilling began with member nations—the U.S.A., U.S.S.R., Federal Republic of Germany, Japan, United Kingdom, and France—all providing funds and scientific guidance for the project. Today, ODP partners include the U.S.A., the Canada/Australia Consortium for the Ocean Drilling Program, France, the Federal Republic of Germany, Japan, the United Kingdom, and the European Science Foundation, which represents Sweden, Finland, Norway, Iceland, Denmark, Belgium, the Netherlands, Spain, Switzerland, Italy, Greece, and Turkey. The National Science Foundation,

with funds contributed by the United States and international partners, supports the scientific operations and planning for the ODP through a contract with Joint Oceanographic Institutions, Inc. (JOI).

The information gained by the program leads to a better understanding of the Earth and its dynamic processes. Drilled sediment cores and logs reveal clues to past climatic history and tie into parallel studies of paleoclimates from glacial ice cores drilled on the continents. Understanding these sediment cores will enable scientists to complete the map of major geologically active regions of the Earth, and to identify processes that lead to dynamic change such as earthquakes, volcanic eruptions, and mountain and continental growth. We are far from being able to predict such changes accurately now; but with the new tools and understanding, the accuracy of such predictions can be improved. This better understanding of the Earth's system(s) will allow us to identify regions of potential mineral and energy resource development, an issue of worldwide human interest. The Ocean Drilling Program is not in itself aimed at finding resources, but the knowledge of the Earth's processes that is gained through such a basic research program will inevitably provide pieces of information required for such resource discovery and exploitation.

The program is fully under way in its aim to further the understanding of the Earth's dynamic systems. People of our planet will benefit directly and indirectly from this research in both their daily living and work activities. This multinational endeavor will perhaps foster other cooperative efforts in science or among societies. The Ocean Drilling Program has distinguished ancestors in the original *Resolution* and *Challenger* expeditions and the Deep Sea Drilling Project. The National Science Foundation is proud to be playing a leading role in this program, and we are looking forward to significant and innovative science for many years to come.



Erich Bloch
Director
National Science Foundation

Washington, D.C.

Foreword

By Joint Oceanographic Institutions, Inc.

This volume presents results from the Ocean Drilling Program (ODP), where scientists use a specially equipped ocean drilling ship to sample and measure the properties of the submerged part of the Earth's crust. These data are then synthesized with other information to yield new insights into earth processes.

These results address the scientific goals of the program, which include providing a global description of geological and geophysical structures and materials, studying in detail areas of major geophysical activity such as mid-ocean ridges and the associated hydrothermal circulations, and studying passive and active continental margins. In addition, the ODP data support the study of sea-level and ocean-circulation changes, the effects of the Earth's orbital variations on climate, and the study of processes and mechanisms of evolution from the biological records in the cores which are recovered from drilling.

The Ocean Drilling Program is a partnership of scientists and governments. Overall scientific policy and management guidance is provided by Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES), which consists of committees and panels made up of representatives of the participating institutions and other scientific and engineering experts. The JOIDES Executive Committee (EXCOM) provides general oversight; the JOIDES Planning Committee (PCOM) is the focal point for all scientific planning for the ODP and is key to the scientific success of the program.

The PCOM has a network of panels and working groups which screen drilling proposals, evaluate instrumentation and measurement techniques, and assess geophysical survey data and other safety and siting information. PCOM uses the recommendations of these panels and committees to select drilling targets, to specify the major scientific objectives of each two-month drilling segment or leg, and to provide the science operator with nominations for co-chief scientists. The science operator, Texas A&M University, in turn is responsible for planning the detailed ship's operations, actual drilling schedules, and final scientific rosters, which are developed in close cooperation with PCOM and the cognizant panels.

Many of the scientific goals can be met only with new technology. Thus the program has identified engineering goals, which include the ability to start a hole and to core on bare rock at mid-ocean ridge sites, to drill in high-temperature and corrosive regions typical of hydrothermal areas, and to core in high latitudes with minimum interference from high seas and sea ice. To meet these needs, the program operates a specially equipped drillship, the *JOIDES Resolution*, which contains laboratories and equipment that are state-of-the-art, and carries a major new logging program.

The ship, registered as SEDCO/BP 471 after her owners and her length in feet (144 meters), is 70 feet (21 meters) wide, and has a displacement of 16,595 long tons. Her derrick towers 200 feet (61 meters) above the waterline, and a computer-controlled dynamic-positioning system stabilizes the ship over a specific location while drilling in water depths up to 27,000 feet (8230 meters). The drilling system collects cores from beneath the seafloor with a derrick and drawworks that can handle 30,000 feet (9144 meters) of drill pipe. More than 12,000 square feet (1115 square meters) of space distributed throughout the ship is devoted to scientific laboratories and equipment. The ship sails with a scientific and technical crew of 50 and a ship's crew of 65.

Logging is a major part of the overall operation. The program provides a full suite of geochemical and geophysical measurements for every hole deeper than 1300 feet (400 meters). For each such hole, there are lowerings of basic oil-industry tools: nuclear, sonic, and electrical. In addition, a borehole televiewer is available for imaging the well-bore wall, a 12-channel logging tool provides accurate velocity and elastic property measurements as well as sonic waveforms for spectral analysis of energy propagation near the well bore, and a vertical seismic profiler records reflectors from below the total depth of the hole.

Texas A&M University serves as science operator for the Ocean Drilling Program. In this capacity, they operate and staff the drillship to collect cores from JOIDES-designated sites from around the world. The science operator also ensures that adequate scientific analyses are performed on the cores by maintaining the shipboard scientific laboratories and by providing logistical and technical support for shipboard scientific teams. Onshore, Texas A&M manages scientific activities after each leg, is curator for the cores, distributes samples, and coordinates the editing and publication of the scientific results. Lamont-Doherty Geological Observatory (LDGO) of Columbia University manages the program's logging operations, which include processing the data and provision of assistance to scientists in data analysis. The ODP Data Bank, a repository for geophysical data, is also managed by LDGO. Core samples from ODP and the previous Deep Sea Drilling Project are stored for future investigation at three sites: ODP Pacific and Indian Ocean cores at Texas A&M University, ODP and DSDP Atlantic and Antarctic cores at Lamont-Doherty Geological Observatory, and DSDP Pacific and Indian Ocean cores at Scripps Institution of Oceanography.

International oversight and coordination are provided by the ODP Council, a governmental consultative body of partner country representatives, chaired by the United States, which periodically reviews the general progress of the program and discusses financial plans and other management issues. Joint Oceanographic Institutions, Inc., a nonprofit consortium of U.S. oceanographic institutions, serves as the National Science Foundation's prime contractor and manages the ODP. JOI is responsible for seeing that the scientific objectives and plans are translated into scientific operations consistent with JOIDES recommendations and budgetary constraints.

Scientific achievements of the ODP already include new data on early seafloor spreading and how continents separate and their margins evolve. We have new insight into glacial cycles and the fluctuations of currents throughout geological time. Technical achievements include the first bare-rock coring, and logging data more accurate and complete than ever before. JOI is pleased to have played a facilitating role in the Ocean Drilling Program.



D. James Baker
President
Joint Oceanographic Institutions, Inc.

Washington, D.C.

OCEAN DRILLING PROGRAM

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

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Woods Hole Oceanographic Institution
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France, Institut Français de Recherche pour l'Exploitation de la Mer
Japan, University of Tokyo, Ocean Research Institute
United Kingdom, Natural Environment Research Council

PRIME CONTRACTOR

Joint Oceanographic Institutions, Inc.
Washington, D.C.
Thomas E. Pyle
Director, Ocean Drilling Programs

OPERATING INSTITUTION

College of Geosciences
Texas A&M University
College Station, Texas
Melvin Friedman
Principal Investigator

OCEAN DRILLING PROGRAM

Philip D. Rabinowitz
Director
Timothy J.G. Francis
Deputy Director
Richard G. McPherson
Administrator
Audrey W. Meyer, Manager
Science Operations
Barry W. Harding, Manager
Engineering and Drilling Operations
Russell B. Merrill, Curator and Manager
Science Services
Robert E. Olivas, Manager
Technical and Logistics Support

LOGGING OPERATOR

Borehole Research Group
Lamont-Doherty Geological Observatory
Columbia University
Palisades, New York
Roger N. Anderson, Head

PARTICIPANTS ABOARD THE JOIDES RESOLUTION FOR LEG 133*

Peter J. Davies
Co-Chief Scientist

*Division of Marine Geosciences
Bureau of Mineral Resources, Geology and Geophysics
P.O. Box 378
Canberra City, ACT 2601
Australia*

Judith A. McKenzie
Co-Chief Scientist

*Geologisches Institut
Eidgenössische Technische Hochschule
Sonneggstrasse 5
CH-8092 Zurich, Switzerland*

Amanda A. Palmer-Julson
ODP Staff Scientist/Sedimentologist/Physical Properties Specialist

*Ocean Drilling Program
Texas A&M University
1000 Discovery Drive
College Station, Texas 77845-9547*

Christian Betzler
Paleontologist (foraminifers)

*Geologisch-Paläontologisches Institut
Johann Wolfgang Goethe-Universität Frankfurt
Senckenberganlage 32-34
D-6000 Frankfurt am Main 11
Federal Republic of Germany*

Thomas C. Brachert
Sedimentologist

*Institut für Geowissenschaften
Johannes Gutenberg Universität Mainz
Postfach 3980
D-6500 Mainz
Federal Republic of Germany*

Min-Pen Philip Chen
Physical Properties Specialist
*Institute of Oceanography
National Taiwan University
P.O. Box 23-13 Taipei
Taiwan, Republic of China*

Jean-Pierre Crumière
Organic Geochemist

*Laboratoire de Sédimentologie
Université Claude Bernard
27-43 Bd du 11 Novembre
F 69622 Villeurbanne
France*

George R. Dix
Sedimentologist

*Department of Geological Sciences
University of British Columbia
6339 Stores Road
Vancouver, British Columbia V6T 2B4
Canada*

André W. Droxler
Sedimentologist

*Department of Geology and Geophysics
Rice University
P.O. Box 1892
Houston, Texas 77251-1892*

David A. Feary
Sedimentologist

*Division of Marine Geosciences
Bureau of Mineral Resources, Geology and Geophysics
P.O. Box 378
Canberra City, ACT 2601
Australia*

Stefan Gartner
Paleontologist (nannofossils)
*Department of Oceanography
Texas A&M University
College Station, Texas 77843*

Craig R. Glenn
Sedimentologist

*Hawaii Institute of Geophysics
University of Hawaii
2525 Correa Road
Honolulu, Hawaii 96822*

Alexandra Isern
Inorganic Geochemist
*Graduate School of Oceanography
University of Rhode Island
Narragansett Bay Campus
Narragansett, Rhode Island 02882-1197*

Peter D. Jackson
Logging Scientist
*British Geological Survey
Keyworth, Nottingham NG12 5GG
United Kingdom*

Richard D. Jarrard
LDGO Logging Scientist
*Borehole Research Group
Lamont-Doherty Geological Observatory
Columbia University
Palisades, New York 10964*

Miriam E. Katz
Paleontologist (foraminifers)
*Lamont-Doherty Geological Observatory
Columbia University
Palisades, New York 10964*

Kenji Konishi
Sedimentologist
*Department of Earth Sciences
Kanazawa University
Kanazawa City 920
Ishikawa
Japan*

*Participants at time of cruise.

Dick Kroon
Paleontologist (foraminifers)
*Grant Institute of Geology
University of Edinburgh
West Mains Road
Edinburgh EH9 3JW
United Kingdom*

John W. Ladd
Physical Properties Specialist
*Ocean Drilling Program
National Science Foundation
1800 G Street, NW
Washington, DC 20550*

José Manuel Martín
Sedimentologist
*Departamento de Estratigrafía y Paleontología
I.A.G.M. Universidad Granada-C.S.I.C.
Campo de Fuentenueva s.n.
18002 Granada
Spain*

Donald F. McNeill
Paleomagnetist
*Division of Marine Geology and Geophysics
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, Florida 33149-1098*

Lucien F. Montaggioni
Sedimentologist
*Centre de Sédimentologie et Paléontologie
U.R.A.-C.N.R.S.
Université de Provence
Place Victor Hugo
13331 Marseille Cedex 3
France*

Daniel W. Müller
Sedimentologist
*Geologisches Institut
Eidgenössische Technische Hochschule
Sonneggstrasse 5
CH-8092 Zurich
Switzerland*

Sheraz Khan Omarzai
Paleomagnetist
*Earth Sciences Board of Studies
University of California, Santa Cruz
Santa Cruz, California 95064*

Chris J. Pigram
Sedimentologist
*Department of Geology
Australian National University
G.P.O. Box 4
Canberra City, ACT 2601
Australia*

Peter K. Swart
Inorganic Geochemist
*Division of Marine Geology and Geophysics
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, Florida 33149-1098*

Philip A. Symonds
Geophysicist
*Division of Marine Geosciences
Bureau of Mineral Resources, Geology and Geophysics
P.O. Box 378
Canberra City, ACT 2601
Australia*

Keith F. Watts
Sedimentologist
*Department of Geology and Geophysics
University of Alaska
Fairbanks, Alaska 99775*

Wuchang Wei
Paleontologist (nannofossils)
*Department of Geology
Florida State University
Tallahassee, Florida 32306*

SEDCO OFFICIALS

Captain Anthony Ribbens
Master of the Drilling Vessel
*Underseas Drilling, Inc.
707 Texas Avenue South
Suite 103D
College Station, Texas 77840-1917*

Jack Tarbutton
Drilling Superintendent
*Underseas Drilling, Inc.
707 Texas Avenue South
Suite 103D
College Station, Texas 77840-1917*

ODP ENGINEERING AND OPERATIONS PERSONNEL

Jack Pheasant	Development Engineer
Eugene Pollard	Operations Superintendent

ODP TECHNICAL AND LOGISTICS PERSONNEL

Roger Ball	Electronics Technician
Daniel Bontempo	Marine Technician
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Scott Chaffey	Chemistry Technician
Jo Claesgens	Yeoperson
Joe DeMorett	Marine Technician
Edwin Garrett	Computer Systems Manager
Burney Hamlin	Laboratory Officer
Gretchen Hampt	Curatorial Representative
Chester Jones	Marine Technician/Storekeeper
Kazushi ("Kuro") Kuroki	Marine Technician
Eric Meissner	Electronics Technician
Michael Moore	Marine Technician
Frank Peerdeman	Marine Technician
Joan Perry	Marine Technician
Joe Powers	Assistant Laboratory Officer
Ahmet Tandircioglu	Marine Technician
John Tenison	Photographer

Ocean Drilling Program Publications Staff

Publications Supervisor
William D. Rose

Chief Editor
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Editors
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- Hole 812B: Pass 1 depth range, 88–297.8 mbsf
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- Hole 816B: Pass 2 depth range, 80.6–204.4 mbsf
- Hole 817D: Pass 2 depth range, 88.2–268.2 mbsf; Pass 1 depth range, 254.6–695.4 mbsf
- Hole 820B: Pass 2 depth range, 64–357 mbsf
- Hole 821A: Pass 1 depth range, 78–389 mbsf
- Hole 822A: Pass 1 depth range, 84–177 mbsf
- Hole 823C: Pass 1 depth range, 188–954.2 mbsf

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