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Paul T. Robinson, Richard P. Von Herzen, Andrew C. Adamson,
Keir Becker, Sherman H. Bloomer, Mathilde Cannat, Henry J.B. Dick,
Rolf F. K. Emmermann, Gunilla Gard, David Goldberg, Rejean Hebert,
Jan G. H. Hertogen, Hartley Hoskins, Gerardo J. Iturrino, J. Dirk C. Kassenaar,
Pamela D. Kempton, Eiichi Kikawa, Stephen H. Kirby, Peter S. Meyer,
James H. Natland, Kazuhito Ozawa, Janet H. Pariso,
James H. Scott, Debra S. Stakes, and Stephen A. Swift
Participating Scientists

Andrew C. Adamson
Shipboard Staff Scientist

Prepared by the
OCEAN DRILLING PROGRAM
Texas A&M University

Sondra K. Stewart
Volume Editor

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., the Federal Republic of Germany, Japan, the United Kingdom, and France—all providing funds and scientific guidance for the project. Today, ODP partners include the U.S.A., Canada, 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):¹

University of California at San Diego, Scripps Institution of Oceanography

Columbia University, Lamont-Doherty Geological Observatory

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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

Louis E. Garrison
Deputy Director

Sylvia Cecile DeVoge
Administrator

Audrey W. Meyer, Manager
Science Operations

Barry 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

¹ Includes member organizations during time of cruise.

PARTICIPANTS ABOARD JOIDES RESOLUTION FOR LEG 118

- Paul T. Robinson
Co-Chief Scientist
*Centre for Marine Geology
Dalhousie University
Halifax, Nova Scotia
Canada B3H 3J4*
- Richard P. Von Herzen
Co-Chief Scientist
*Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543*
- Andrew C. Adamson
ODP Staff Scientist/Igneous Petrologist
*Ocean Drilling Program
Texas A&M University
College Station, Texas 77843*
- Keir Becker
Downhole Hydrogeophysicist
*Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, Florida 33149-1098*
- Sherman H. Bloomer
Igneous Petrologist
*Department of Geology
Duke University
Box 6729, College Station
Durham, North Carolina 27708
(current address:
Department of Geology
675 Commonwealth Avenue
Boston University
Boston, Massachusetts 02215)*
- Mathilde Cannat
Igneous Petrologist
*Laboratoire de Pétrologie
Université de Bretagne Occidentale
6 Avenue Le Gorgue
29287 Brest Cedex
France*
- Henry J. B. Dick
Igneous Petrologist
*Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543*
- Rolf F. K. Emmermann
Geochemist
*Institute für Geowissenschaften und
Lithosphärenforschung
Universität Giessen
Senckenbergstrasse 3
D-3600 Giessen
Federal Republic of Germany*
- Gunilla Gard
Paleontologist
*Department of Geology
University of Stockholm
S-10691 Stockholm
Sweden*
- David Goldberg
LDGO Logging Scientist
*Lamont-Doherty Geological Observatory
Columbia University
Palisades, New York 10964*
- Rejean Hebert
Igneous Petrologist
*Département de Géologie
Université Laval
Québec G1K 7P4
Canada*
- Jan G. H. Hertogen
Geochemist
*Fysico-chemische Geologie
University of Leuven
B-3030 Leuven
Belgium*
- Hartley Hoskins
VSP Scientist
*Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543*
- Gerardo J. Iturrino
Physical Properties Specialist
*Department of Earth and Atmospheric Sciences
Purdue University
Lafayette, Indiana 47907*
- J. Dirk C. Kassenaar
Logging Scientist
*Department of Earth Sciences
University of Waterloo
Waterloo, Ontario
Canada N2L 3G1*
- Pamela D. Kempton
Igneous Petrologist
*Department of Earth Sciences
The Open University
Milton Keynes MK7 6AA
United Kingdom*

Eiichi Kikawa
Paleomagnetist
*Earthquake Research Institute
University of Tokyo
1-1-1 Yayoi, Bunkyo-ku
Tokyo 113
Japan
(current address:
Marine Geology
Geological Survey of Japan
1-1-3 Higashi, Tsukuba
Ibaraki 3065
Japan)*

Stephen H. Kirby
Physical Properties Specialist
*Branch of Tectonophysics
U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025*

Peter S. Meyer
Igneous Petrologist
*Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543*

James H. Natland
Igneous Petrologist
*Geological Research Division
Scripps Institute of Oceanography
University of California, San Diego
La Jolla, California 92093*

Kazuhito Ozawa
Igneous Petrologist
*Geological Institute
University of Tokyo
Hongo 7-3-1, Bunkyo-Ku
Tokyo 113
Japan*

Janet H. Pariso
Paleomagnetist
*School of Oceanography
University of Washington
Seattle, Washington 98195*

James H. Scott
Downhole Magnetics Specialist
*Lamont-Doherty Geological Observatory
Columbia University
Palisades, New York 10964
(currently at:
12372 W. Louisiana Avenue
Lakewood, Colorado 80228)*

Debra Stakes
Igneous Petrologist
*Department of Geological Sciences
University of South Carolina
Columbia, South Carolina 29208*

Stephen A. Swift
Sedimentologist/Logging Scientist
*Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543*

SEDCO OFFICIALS

Captain Gerard Kuster
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

| | |
|----------------|---------------------------|
| Charles Hanson | Operations Superintendent |
| Steve Howard | Special Tools Engineer |
| Barry Harding | Operations Specialist |

ODP TECHNICAL AND LOGISTICS PERSONNEL

| | |
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TABLE OF CONTENTS

VOLUME 118—INITIAL REPORTS

SECTION 1: INTRODUCTION

1. INTRODUCTION AND EXPLANATORY NOTES 3
Shipboard Scientific Party
2. ADVANCES IN HARD-ROCK DRILLING AND CORING TECHNIQUES,
ODP LEG 118..... 25
Steven P. Howard

SECTION 2: SITE REPORTS

3. SITE 732..... 41
Shipboard Scientific Party
4. SITE 733..... 59
Shipboard Scientific Party
5. SITE 734..... 77
Shipboard Scientific Party
6. SITE 735..... 89
Shipboard Scientific Party

SECTION 3: CORES

Core description forms and core photographs for:

- Site 732 225
- Site 733 243
- Site 734 251
- Site 735 259

SECTION 4: POLICY

- JOIDES ADVISORY GROUPS..... 819
- SAMPLE-DISTRIBUTION POLICY 825