ERRATUM
for

Volume 147 of the *Scientific Results* of the *Proceedings of the Ocean Drilling Program*

After final pages had been printed for Volume 147 of the *Scientific Results* of the ODP *Proceedings,* an error was found in Chapter 28, *Tectonics of Hess Deep: A Synthesis of Drilling Results from Leg 147:*

On pages 470–471, the captions for Figures 9 and 11 are reversed.

PROCEEDINGS OF THE OCEAN DRILLING PROGRAM

VOLUME 147
SCIENTIFIC RESULTS
HESS DEEP RIFT VALLEY

Covering Leg 147 of the cruises of the Drilling Vessel *JOIDES Resolution*,
San Diego, California, to Balboa Harbor, Panama, Sites 894–895,
22 November 1992–21 January 1993

Catherine Mével, Kathryn M. Gillis, James F. Allan,
Shoji Arai, Françoise Boudier, Bernard Célérier, Henry J.B. Dick,
Trevor J. Falloon, Gretchen Früh-Green, Gerardo J. Iturrino,
Deborah S. Kelley, Paul Kelso, Lori A. Kennedy, Eiichi Kikawa,
Christophe M. Lécuyer, Christopher J. MacLeod, John Malpas, Craig E. Manning,
Mark A. McDonald, D. Jay Miller, James Natland, Janet E. Pariso,
Rolf-Birger Pedersen, Hazel M. Prichard, Harald Puchelt, Carl Richter
Shipboard Scientists

James F. Allan
Shipboard Staff Scientist

Prepared by the
OCEAN DRILLING PROGRAM
TEXAS A&M UNIVERSITY

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

This publication was prepared by the Ocean Drilling Program, Texas A&M University, as an account of work performed under the international Ocean Drilling Program, which is managed by Joint Oceanographic Institutions, Inc., under contract with the National Science Foundation. Funding for the program was provided by the following agencies at the time of this cruise:

Canada/Australia Consortium for the Ocean Drilling Program, Department of Energy, Mines and Resources (Canada), and Department of Primary Industries and Energy (Australia)
Deutsche Forschungsgemeinschaft (Federal Republic of Germany)
European Science Foundation Consortium for Ocean Drilling (Belgium, Denmark, Finland, Greece, Iceland, Italy, The Netherlands, Norway, Spain, Sweden, Switzerland, and Turkey)
Institut Français de Recherche pour l'Exploitation de la Mer (France)
National Science Foundation (United States)
Natural Environment Research Council (United Kingdom)
University of Tokyo, Ocean Research Institute (Japan)

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, the participating agencies, Joint Oceanographic Institutions, Inc., Texas A&M University, or Texas A&M Research Foundation.

Reference to the whole or to part of this volume should be made as follows:

Print citation:

Mével, C., Gillis, K.M., Allan, J.F., and Meyer, P.S. (Eds.), 1996. *Proc. ODP, Sci. Results,* 147: College Station, TX (Ocean Drilling Program).

Pedersen, R.B., Malpas, J., and Falloon, T., 1996. Petrology and geochemistry of gabbroic and related rocks from Site 894, Hess Deep. *In* Mével, C., Gillis, K.M., Allan, J.F., and Meyer, P.S. (Eds.), *Proc. ODP, Sci. Results,* 147: College Station, TX (Ocean Drilling Program), 3–19.

Electronic citation:

Mével, C., Gillis, K.M., Allan, J.F., and Meyer, P.S. (Eds.), 1996. *Proc. ODP, Sci. Results* [CD-ROM], 147. Available: Ocean Drilling Program, Texas A&M University, College Station, TX 77845-9547, U.S.A.

Pedersen, R.B., Malpas, J., and Falloon, T., 1996. Petrology and geochemistry of gabbroic and related rocks from Site 894, Hess Deep. *In* Mével, C., Gillis, K.M., Allan, J.F., and Meyer, P.S. (Eds.), *Proc. ODP, Sci. Results* [CD-ROM], 147, 3–19. Available: Ocean Drilling Program, Texas A&M University, College Station, TX 77845-9547, U.S.A.

Effective Publication Dates of ODP *Proceedings*

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.

The mailing dates of recent *Proceedings of the Ocean Drilling Program* are as follows:

Volume 158 (*Initial Reports*): January 1996
Volume 159/159T (*Initial Reports*): March 1996
Volume 160 (*Initial Reports*): March 1996
Volume 145 (*Scientific Results*): December 1995
Volume 146, Pt. 1 (*Scientific Results*): December 1995
Volume 148 (*Scientific Results*): March 1996

Distribution

Copies of this publication may be obtained from Publications Distribution Center, Ocean Drilling Program, 1000 Discovery Drive, College Station, Texas 77845-9547, U.S.A. Orders for copies will require advance payment. See current ODP publication list for price and availability of this publication.

Printed April 1996

ISSN 0884-5891
Library of Congress 87-642-462

Printed in Canada by Friesens

The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences–Permanence of Paper for Printed Library Materials, ANSI Z39.48–1984∞™

Foreword

By the National Science Foundation

The National Science Foundation is proud to play a leading role in partnership with the U.S. oceanographic community in the operation and management of the Ocean Drilling Program (ODP). We are equally proud of the cooperation and commitment of our international partners, who contribute both financial and intellectual resources required to maintain the high quality of this unique program. The Ocean Drilling Program, like its predecessor, the Deep Sea Drilling Project (DSDP), is a model for the organization and planning of research to address global scientific problems that are of high priority internationally and of long-term interest to the scientific community and general public.

Major scientific themes guiding the development of specific drilling cruises range from determining the causes and effects of oceanic and climatic variability to understanding the circulation of fluids in the ocean crust and the resultant formation of mineral deposits. Although such studies are at the forefront of basic scientific inquiry into the processes that control and modify the global environment, they are equally important in providing the background for assessing man's impact on the global environment or for projecting resource availability for future generations.

The transition from the DSDP to the ODP was marked by a number of changes. The 471-foot *JOIDES Resolution,* which replaced the *Glomar Challenger,* has allowed larger scientific parties and the participation of more graduate students, a larger laboratory and technical capability, and operations in more hostile ocean regions. The *JOIDES Resolution* has drilled in all of the world's oceans, from the marginal ice regions of the Arctic to within sight of the Antarctic continent. Over 1,200 scientists and students from 26 nations have participated on project cruises. Cores recovered from the cruises and stored in ODP repositories in the United States and Europe have provided samples to an additional 1,000 scientists for longer term post-cruise research investigations. The downhole geochemical and geophysical logging program, unsurpassed in either academia or industry, is providing remarkable new data with which to study the Earth.

In 1994, NSF and our international partners renewed our commitment to the program for its final phase. Of the 20 countries that supported ODP initially, only one, Russia, has been unable to continue for financial reasons. As the reputation and scientific impact of the program continue to grow internationally, we hope to add additional members and new scientific constituencies. This global scientific participation continues to assure the program's scientific excellence by focusing and integrating the combined scientific knowledge and capabilities of its member nations.

We wish the program smooth sailing and good drilling!

Neal Lane
Director
National Science Foundation

Arlington, Virginia

Foreword

By Joint Oceanographic Institutions, Inc.

This volume presents scientific and engineering results from the Ocean Drilling Program (ODP). The papers presented here address the scientific and technical goals of the program, which include providing a global description of geological and geophysical structures including passive and active margins and sediment history, and studying in detail areas of major geophysical activity such as mid-ocean ridges and the associated hydrothermal circulations.

The Ocean Drilling Program, an international activity, operates a specially equipped deep-sea drilling ship, the *JOIDES Resolution* (Sedco/BP 471), which contains state-of-the-art laboratories, equipment, and computers. The ship is 471 feet (144 meters) long, is 70 feet (21 meters) wide, and has a displacement of 18,600 short tons. Her derrick towers 211 feet (64 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 51 and a ship's crew (including the drill crew) of 62. The size and ice-strengthening of the ship allow drilling in high seas and ice-infested areas as well as permit a large group of multidisciplinary scientists to interact as part of the scientific party.

Logging, or measurements in the drilled holes, is an important part of the program. ODP 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 Formation MicroScanner is available for high-resolution imaging the wall of the hole, 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 wall of the hole, and a vertical seismic profiler can record reflectors from below the total depth of the hole.

The management of the Ocean Drilling Program involves a partnership of scientists and governments. International oversight and coordination are provided by the ODP Council, a governmental consultative body of the partner countries, which is chaired by a representative from the United States National Science Foundation (NSF). The ODP Council periodically reviews the general progress of the program and discusses financial plans and other management issues. Overall scientific and management guidance is provided to the operators of the program by representatives from the group of institutions involved in the program, called the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES).

The Executive Committee (EXCOM), made up of the administrative heads of the JOIDES institutions, provides general oversight for ODP. The Planning Committee (PCOM), with its advisory structure, is made up of working scientists and provides scientific advice and detailed planning. PCOM has a network of panels and working groups that screen drilling proposals, evaluate instrumentation and measurement techniques, and assess geophysical-survey data and other safety and siting information. PCOM uses the recommendations of the panels and committees to select drilling targets, to specify the location and major scientific objectives of each two-month drilling segment or leg, and to provide the science operator with nominations for co-chief scientists.

Joint Oceanographic Institutions, Inc. (JOI), a nonprofit consortium of U.S. oceanographic institutions, serves as the National Science Foundation's prime contractor for ODP. JOI is responsible for seeing that the scientific objectives, plans, and recommendations of the JOIDES committees are translated into scientific operations consistent with scientific advice and budgetary constraints. JOI subcontracts the operations of the program to two universities: Texas A&M University and Lamont-Doherty Earth Observatory

of Columbia University. JOI is also responsible for managing the U.S. contribution to ODP under a separate cooperative agreement with NSF.

Texas A&M University (TAMU) serves as science operator for ODP. In this capacity, TAMU is responsible for planning the specific ship operations, actual drilling schedules, and final scientific rosters, which are developed in close cooperation with PCOM and the relevant panels. The science operator also ensures that adequate scientific analyses are performed on the cores by maintaining the shipboard scientific laboratories and computers and by providing logistical and technical support for shipboard scientific teams. Onshore, TAMU manages scientific activities after each leg, is curator for the cores, distributes samples, and coordinates the editing and publication of scientific results.

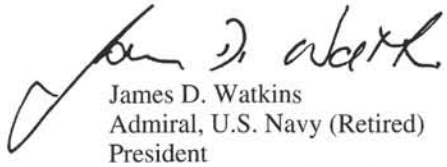
Lamont-Doherty Earth Observatory (LDEO) of Columbia University is responsible for the program's logging operation, including processing the data and providing assistance to scientists for data analysis. The ODP Data Bank, a repository for geophysical data, is also managed by LDEO.

Core samples from ODP and the previous Deep Sea Drilling Project are stored for future investigation at four sites: ODP Pacific and Indian Ocean cores at TAMU, DSDP Pacific and Indian Ocean cores at the Scripps Institution of Oceanography, ODP and DSDP Atlantic and Antarctic cores through Leg 150 at LDEO, and ODP Atlantic and Antarctic cores since Leg 151 at the University of Bremen, Federal Republic of Germany.

Scientific achievements of ODP include new information on early seafloor spreading and how continents separate and the margins evolve. The oldest Pacific crust has been drilled and sampled. We have new insights into glacial cycles and the fluctuations of ocean currents throughout geological time. ODP has also provided valuable data that shed light on fluid pathways through the lithosphere, global climate change both in the Arctic and near the equator, past sea-level change, seafloor mineralization, the complex tectonic evolution of oceanic crust, and the evolution of passive continental margins.

Many of the scientific goals can be met only with new technology; thus the program has focused on engineering as well as science. To date, ODP engineers have demonstrated the capability to drill on bare rock at mid-ocean-ridge sites and have developed techniques for drilling in high-temperature and corrosive regions typical of hydrothermal vent areas. A new diamond coring system promises better core recovery in difficult areas. In a close collaborative effort between ODP engineers and scientists, a system has been developed that seals selected boreholes ("CORKs") and monitors downhole temperature, pressure, and fluid composition for up to three years. When possible, ODP is also taking advantage of industry techniques such as logging while drilling, to obtain continuous downhole information in difficult-to-drill formations.

JOI is pleased to have been able to play a facilitating role in the Ocean Drilling Program and its cooperative activities, and we are looking forward to many new, exciting results in the future.



James D. Watkins
Admiral, U.S. Navy (Retired)
President
Joint Oceanographic Institutions, Inc.

Washington, D.C.

Preface

The *Scientific Results* volumes of the *Proceedings of the Ocean Drilling Program* contain specialty papers presenting the results of up to one and one-half years of research in various aspects of scientific ocean drilling. I acknowledge with thanks the authors of the papers published in this volume, who thereby have enabled future investigators to gain ready access to the results of their research.

Each of the papers submitted to a *Scientific Results* volume undergoes rigorous peer review by at least two specialists in the author's research field. A paper typically goes through one or more revision cycles before being accepted for publication. Our goal is to maintain a peer-review system comparable to those of the most highly regarded journals in the geological sciences.

The Editorial Review Board for a *Scientific Results* volume is responsible for obtaining peer reviews of papers submitted to the volume. This board usually is made up of the two co-chief scientists for the cruise, the ODP staff scientist for the cruise, and one external specialist who is familiar with the geology of the area investigated. In addition, the ODP staff editor assigned to the volume helps with any manuscripts that require special attention, such as those by authors who need assistance with English expression.

Scientific Results volumes may also contain short reports consisting of good data that are not ready for final interpretation. Papers in this category are segregated in a section in the back of the volume called Data Reports. Although no interpretation is permitted, these papers ordinarily contain a section on methodology or procedures. Data Report papers are read carefully by at least one specialist to make sure they are well organized, comprehensive, and discuss the techniques thoroughly.

In acknowledgment of the contributions made by this volume's Editorial Review Board, the members of the Board are designated Editors of the volume and are listed on the title page as well. Reviewers of manuscripts for this volume, whose efforts are so essential to the success of the publication, are listed in the front portion of the book, without attribution to a particular manuscript.

On behalf of the Ocean Drilling Program, I extend sincere appreciation to members of the Editorial Review Boards and to the reviewers for giving so generously of their time and efforts in ensuring that only papers of high scientific quality are published in the *Proceedings.*

Philip D. Rabinowitz
Director
Ocean Drilling Program
Texas A&M University

College Station, Texas

REVIEWERS FOR THIS VOLUME

Susan Agar
Pierre Agrinier
Jeffrey C. Alt
Colleen A. Barton
John Bender
Patricia A. Berge
Daniel Bideau
Jean-Louis Bodinier
Enrico Bonatti
Paul Browning
Wilfred Bryan
Elizabeth A. Burton
John F. Casey
P.R. Castillo
R. Grant Cawthorne
Lung S. Chan
Arthur Cheng
Michael Clynne
M.J. Daines
Gregor P. Eberli
Brooks B. Ellwood
Jörg Erzinger
Eileen van der Flier-Keller
Paul J. Fox
Frederick Frey
Glenn Gaetani
Jacques Girardeau
R.T. Gregory
Bradley Hacker
Emilio Herrero-Bervera
Bernard A. Housen
Peter B. Kelemen
Rosamond J. Kinzler
Stephen C. Komor
Yves Lagabrielle
Christine Laverne
Charles E. Lesher
John A. Madsen
Joseph Meert
Karlis Muehlenbachs
Richard H. Naslund
Pierre Nehlig
Richard J. Nevle
David S. O'Hanley
Kazuhito Ozawa
Thomas Pearce
Philippe Pezard
Peter J. Saccocia
Matthew H. Salisbury
Peter Schiffman
R.C. Searle
Timothy Shaw
T.W. Sisson
Norman H. Sleep
Guy Smith
William Stone
John Tarduno
Paul Toft
Jan Tullis
David A. Vanko
Riccardo Vannucci
Laurel Woodruff
Michael L. Zientek

OCEAN DRILLING PROGRAM

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

University of California at San Diego, Scripps Institution of Oceanography

Columbia University, Lamont-Doherty Earth Observatory

University of Hawaii, School of Ocean and Earth Science and Technology

University of Miami, Rosenstiel School of Marine and Atmospheric Science

Oregon State University, College of Oceanic and Atmospheric Sciences

University of Rhode Island, Graduate School of Oceanography

Texas A&M University, College of Geosciences and Maritime Studies

University of Texas at Austin, Institute for Geophysics

University of Washington, College of Ocean and Fishery Sciences

Woods Hole Oceanographic Institution

Canada/Australia Consortium for the Ocean Drilling Program, Department of Energy, Mines and Resources (Canada) and Department of Primary Industries and Energy (Australia)

European Science Foundation Consortium for Ocean Drilling (Belgium, Denmark, Finland, Greece, Iceland, Italy, The Netherlands, Norway, Spain, Sweden, Switzerland, and Turkey)

Federal Republic of Germany, Bundesanstalt für Geowissenschaften und Rohstoffe

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.

David A. Falvey
Director, Ocean Drilling Programs

OPERATING INSTITUTION

College of Geosciences and Maritime Studies
Texas A&M University
College Station, Texas

Robert A. Duce
Dean

OCEAN DRILLING PROGRAM

Paul J. Fox
Director

Timothy J.G. Francis
Deputy Director

Richard G. McPherson
Administrator

Jack G. Baldauf, Manager
Science Operations

Ann Klaus, Manager
Publications

Russell B. Merrill, Curator and Manager
Information Services

Robert E. Olivas, Manager
Technical and Logistics Support

LOGGING OPERATOR

Borehole Research Group
Lamont-Doherty Earth Observatory
Columbia University
Palisades, New York

David Goldberg, Head

PARTICIPANTS ABOARD THE *JOIDES RESOLUTION* FOR LEG 147*

Catherine Mével
Co-Chief Scientist
Laboratoire de Pétrologie
CNRS URA 736
Université Pierre et Marie Curie
4, Place Jussieu
75252 Paris Cedex 05
France

Kathryn M. Gillis
Co-Chief Scientist
Department of Geology and Geophysics
Woods Hole Oceanographic Institution
Quissett Campus
Woods Hole, Massachusetts 02543
U.S.A.

James F. Allan
ODP Staff Scientist
Ocean Drilling Program
Texas A&M University Research Park
1000 Discovery Drive
College Station, Texas 77845-9547
U.S.A.

Shoji Arai
Igneous Petrologist
Department of Earth Sciences
Kanazawa University
Kanazawa 920-11
Ishikawa
Japan

Françoise Boudier
Structural Petrologist
Laboratoire de Tectonophysique
Université Montpellier II
Place Eugene Bataillon
F-34095 Montpellier Cedex 5
France

Bernard Célérier
LDEO Logging Scientist
Laboratoire de Tectonique et Géochronologie
Université de Montpellier II
Case courrier 58
F-34095 Montpellier Cedex 5
France

Henry J.B. Dick
Igneous Petrologist
Department of Geology and Geophysics
Woods Hole Oceanographic Institution
Quissett Campus
Woods Hole, Massachusetts 02543
U.S.A.

Trevor J. Falloon
Igneous Petrologist
Department of Geology
University of Bristol
Wills Memorial Building
Queen's Road
Bristol BS8 1RJ
United Kingdom

Gretchen Früh-Green
Metamorphic Petrologist
Institut für Mineralogie und Petrographie
Eidgenössische Technische Hochschule
Sonneggstrasse 5
CH-8092 Zürich
Switzerland

Gerardo J. Iturrino
Physical Properties Specialist
Division of Marine Geology and Geophysics
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, Florida 33149-1098
U.S.A.

Deborah S. Kelley
Metamorphic Petrologist
School of Oceanography, WB-10
University of Washington
Seattle, Washington 98195
U.S.A.

Paul Kelso
Paleomagnetist
Institute for Rock Magnetism
293 Shepard Laboratories
100 Union Street S.E.
Minneapolis, Minnesota 55455-0128
U.S.A.

Lori A. Kennedy
Structural Petrologist
Center for Tectonophysics
Texas A&M University
College Station, Texas 77843
U.S.A.

Eiichi Kikawa
Paleomagnetist
Department of Marine Geology
Geological Survey of Japan
1-1-3 Higashi
Tsukuba, Ibaraki 305
Japan

Christophe M. Lécuyer
Metamorphic Petrologist
Laboratoire de Géochimie Isotopique
CNRS UPR 4661
Géosciences Rennes
Université de Rennes 1
Campus de Beaulieu
F-35042 Rennes
France

Christopher J. MacLeod
Structural Geologist/JOIDES Logging Scientist
Institute of Oceanographic Sciences
Brook Road
Wormley, Godalming
Surrey GU8 5UB
United Kingdom

* Addresses at time of cruise.

John Malpas
Igneous Petrologist
Centre for Earth Resources Research
Memorial University
St. John's, Newfoundland A1B 3X5
Canada

Craig E. Manning
Metamorphic Petrologist
Department of Earth and Space Sciences
University of California, Los Angeles
Los Angeles, California 90024-1567
U.S.A.

Mark A. McDonald
Physical Properties/Geophysics Specialist
Scripps Institution of Oceanography, 0205
University of California, San Diego
La Jolla, California 92093
U.S.A.

D. Jay Miller
Igneous Petrologist
Department of Earth and Atmospheric Sciences
Purdue University
West Lafayette, Indiana 47907-1397
U.S.A.

James Natland
Igneous Petrologist
Division of Marine Geology and Geophysics
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, Florida 33149-1098
U.S.A.

Janet E. Pariso
Paleomagnetist
School of Oceanography, WB-10
University of Washington
Seattle, Washington 98195
U.S.A.

Rolf-Birger Pedersen
Igneous Petrologist
Geologisk Institutt
Universitetet i Bergen
Allegaten 41
N-5007 Bergen
Norway

Hazel M. Prichard
Igneous Petrologist
Department of Earth Sciences
The Open University
Walton Hall
Milton Keynes, MK7 6AA
United Kingdom

Harald Puchelt
Igneous Petrologist
Institut für Petrographie und Geochemie
der Universität Karlsruhe
Kaiserstrasse 12
D-7500 Karlsruhe 1
Federal Republic of Germany

Carl Richter
Paleomagnetist/Structural Geologist
Department of Geological Sciences
University of Michigan
1006 C.C. Little Building
Ann Arbor, Michigan 48109-1063
U.S.A.

SEDCO OFFICIALS

Captain Edwin G. Oonk
Master of the Drilling Vessel
Overseas Drilling Ltd.
707 Texas Avenue South, Suite 213D
College Station, Texas 77840-1917
U.S.A.

Kenneth D. Horne
Drilling Superintendent
Overseas Drilling Ltd.
707 Texas Avenue South, Suite 213D
College Station, Texas 77840-1917
U.S.A.

ODP ENGINEERING AND OPERATIONS PERSONNEL

Eugene Pollard	Operations Superintendent
Michael A. Storms	Development Engineer

ODP TECHNICAL AND LOGISTICS PERSONNEL

Roger Ball	Marine Electronics and Downhole Tools Specialist
Barry Cochran	Marine Laboratory Specialist/Photography
Mary Ann Cusimano	Marine Laboratory Specialist/X-ray
Edwin Garrett	Marine Computer Specialist/System Manager
Ted ("Gus") Gustafson	Marine Laboratory Specialist/Thin Section
Burney W. Hamlin	Laboratory Officer
Michiko Hitchcox	Marine Laboratory Specialist/Yeoperson
Joel Huddleston	Marine Computer Specialist/System Manager
Robert Kemp	Marine Laboratory Specialist/Underway Geophysics
Jean Mahoney	Marine Laboratory Specialist/Physical Properties
Eric Meissner	Marine Electronics and Downhole Tools Specialist
Claudia Müller	Marine Laboratory Specialist
Chieh Peng	Marine Laboratory Specialist/Chemistry
Philip Rumford	Marine Laboratory Specialist/Chemistry
Don Sims	Marine Laboratory Specialist/Assistant Laboratory Officer
Lorraine Southey	Marine Laboratory Specialist/Curatorial Representative
Monica Sweitzer	Marine Laboratory Specialist/Paleomagnetics

Ocean Drilling Program Publications Staff*

Manager of Publications
Ann Klaus

Editors
Lona Haskins Dearmont
Eva M. Maddox
Jennifer A. Marin
Angeline T. Miller
Ruth N. Riegel

Chief Production Editor
Jennifer Pattison Hall

Production Editors
Karen O. Benson
Jaime A. Gracia (this volume)
Amy Knapp
Christine M. Miller
William J. Moran

Senior Publications Coordinator
Gudelia ("Gigi") Delgado

Publications Coordinator
Shelley René Cormier

Publications Specialist
M. Kathleen Phillips

Data Entry/Copier Operator
Ann Yeager

Senior Photographer
John W. Beck

Photographer
Bradley James Cook

Chief Illustrator
Deborah L. Partain

Illustrators
Melany R. Borsack
L. Michelle Briggs
Katherine C. Irwin
Nancy H. Luedke

Production Assistants
Sharon L. Dunn
William T. Harper
Mary Elizabeth Mitchell

Student Assistants
Pamela Ivette Baires, Marla Barbéy, Katherine Jackson, Lisa Larson, Weyland M.A. Simmons, Alan Toon, Yvonne C. Zissa

*At time of publication.

PUBLISHER'S NOTES

Current policy requires that artwork published in *Scientific Results* volumes of the *Proceedings of the Ocean Drilling Program* be furnished by authors in final camera-ready form.

Abbreviations for names of organizations and publications in ODP reference lists follow the style given in *Chemical Abstracts Service Source Index* (published by American Chemical Society).

TABLE OF CONTENTS

VOLUME 147—SCIENTIFIC RESULTS

SECTION 1. IGNEOUS PETROLOGY

SECTION 2. METAMORPHIC PETROLOGY

SECTION 3. STRUCTURAL GEOLOGY

SECTION 4. MAGNETISM

SECTION 5. PHYSICAL PROPERTIES

SECTION 6. SEDIMENTS

SECTION 7. SYNTHESES

SECTION 8. DATA REPORTS

SECTION 9: INDEX

(For JOIDES Advisory Groups and ODP Sample and Data Distribution Policy, please see *ODP Proceedings, Scientific Results,* Volume 148, pp. 497–500.)