

The cover features a photograph of a ship's hull, likely a research vessel, with a blue and white color scheme. The hull is wet, reflecting the sky and water. On the right side of the hull, there is a vertical list of numbers: 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. The text "VOLUME 189" and "SCIENTIFIC RESULTS" is printed in large, bold, yellow letters at the top left.

VOLUME 189
SCIENTIFIC RESULTS

**THE TASMANIAN GATEWAY:
CENOZOIC CLIMATIC AND
OCEANOGRAPHIC
DEVELOPMENT
SITES 1168–1172**

**PROCEEDINGS OF THE
OCEAN DRILLING PROGRAM**

Prepared by the
OCEAN DRILLING PROGRAM,
TEXAS A&M UNIVERSITY,
in cooperation with the
NATIONAL SCIENCE FOUNDATION
and
JOINT OCEANOGRAPHIC INSTITUTIONS, INC.

PROCEEDINGS OF THE OCEAN DRILLING PROGRAM

Volume 189

Scientific Results

The Tasmanian Gateway: Cenozoic Climatic and
Oceanographic Development

Covering Leg 189 of the cruises of the Drilling Vessel *JOIDES Resolution*
Hobart, Tasmania, to Sydney, Australia
Sites 1168–1172
11 March–6 May 2000

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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.

Current policy requires that all figures published in *Scientific Results* volumes of the *Proceedings of the Ocean Drilling Program* be provided by the authors.

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).

This volume includes a site map showing the drilling locations for this leg and maps showing the drilling locations of all Ocean Drilling Program (ODP) and Deep Sea Drilling Project (DSDP) drilling sites in PDF format. These maps were produced using Generic Mapping Tools (GMT) of Paul Wessel and Walter H.R. Smith (gmt.soest.hawaii.edu).

Cover photograph is of the *JOIDES Resolution* in Hobart, Tasmania, by ODP Photographer John Beck.

FOREWORD

BY JOINT OCEANOGRAPHIC INSTITUTIONS, INC.

This volume presents scientific and engineering results from the Ocean Drilling Program (ODP). These results address the scientific and technical goals of the program, which are focused on the study of the dynamics of Earth's interior and environment, the evolution of oceanic crust, the fluctuations of climate, and the study of the Earth's deep biosphere.

Although ODP ended operations in 2003, science results from ODP's expeditions on the *JOIDES Resolution* continue to emerge. The results represent the contributions of scientists and research institutions from 22 ODP member countries. International oversight and coordination of the program was provided by the ODP Council, which was made up of representatives from the member countries. Scientific and management guidance was provided by representatives from the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES).

Joint Oceanographic Institutions, Inc. (JOI), a nonprofit consortium of 20 U.S. oceanographic institutions, serves as the National Science Foundation's prime contractor for ODP. JOI implemented scientific objectives, plans, and recommendations of the JOIDES committees through subcontracts to Texas A&M University (TAMU) for science operations and to Lamont-Doherty Earth Observatory (LDEO) of Columbia University for geochemical and geophysical well-logging services.

JOI, TAMU, and LDEO worked together successfully for many years to manage the Ocean Drilling Program. We look forward to many exciting discoveries and continued international collaboration on the Integrated Ocean Drilling Program as we further our scientific mission.

Steven R. Bohlen

President of the Joint Oceanographic Institutions and Executive Director of the Ocean Drilling Programs
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PREFACE

THE VOYAGES OF DISCOVERY

The *Scientific Results* volumes of the *Proceedings of the Ocean Drilling Program* are about Earth and her oceans.

These volumes contain contributions to a better understanding of the history of our planet through time. This exploration of Earth's past is based on scientific analyses of layers of strata sampled by the *JOIDES Resolution* at key locations throughout the global ocean. These volumes are a tribute to the scientific exploration carried out by the men and women who contributed to these voyages of discovery. Like the pioneering exploration and research of Captain Cook aboard the first *Resolution*, these volumes are a credit to the human spirit, which sees no boundaries.

The papers in this volume are published in a new online format that will be archived on CD-ROM. The *Proceedings* contents are available to students, scientists, and the public throughout the world. Volumes, once housed in the libraries of the member nations of ODP, are now published on the Internet for a worldwide audience and are also available in CD-ROM format. This electronic publication enables future investigators to gain easier access to the results of ocean drilling research. I acknowledge and thank the authors for their contributions and willingness to participate in this new venture.

Each *Scientific Results* volume has an Editorial Review Board that 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 investigated area. ODP staff coordinate the peer-review process and also edit and produce each paper.

Each *Scientific Results* volume contains one leg synthesis paper and other peer-reviewed papers that present the results of extensive research in various aspects of scientific ocean drilling related to each leg. Each paper submitted to a *Scientific Results* volume undergoes rigorous peer review by at least two specialists in the author's research field. Volumes may also contain short reports of useful data. These Data Reports do not include interpretation of results and are peer-reviewed by at least one specialist. We seek to maintain a peer-review system comparable to those of the most highly regarded journals in the geological sciences.

To acknowledge the contributions made by this volume's Editorial Review Board, the Board members are designated Editors of the volume. Reviewers of manuscripts for this volume, whose efforts are so essential to the success of the publication, are listed without attribution to any particular manuscript.

On behalf of the Ocean Drilling Program, I extend sincere appreciation to the members of the Editorial Review Board and to the reviewers for generously contributing their time and effort. This process ensures that only papers of high scientific quality are published in the *Scientific Results* volumes.

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S. Audra Stant, Jonathan Lara, Kristeen L. McGonigal, and Bryan C. Ladner
Manuscript number: 189SR-109

7. Data Report: Miocene Calcareous Nannofossil Biostratigraphy, ODP Leg 189, Tasmanian Seaway

Kristeen L. McGonigal and Wuchang Wei
Manuscript number: 189SR-110

8. Data Report: Paleogene Calcareous Nannofossil Biostratigraphy of ODP Leg 189 (Australia-Antarctica Gateway)

Wuchang Wei, Kristeen L. McGonigal, and Shilan Zhong
Manuscript number: 189SR-103

9. Integrated Age Models for the Early Oligocene–Early Miocene, Sites 1168 and 1170–1172

Helen A. Pfuhl and I. Nicholas McCave
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10. Late Cretaceous–Quaternary Biomagnetostratigraphy of ODP Sites 1168, 1170, 1171, and 1172, Tasmanian Gateway

C.E. Stickley, H. Brinkhuis, K.L. McGonigal, G.C.H. Chaproniere, M. Fuller, D.C. Kelly, D. Nürnberg, H.A. Pfuhl, S.A. Schellenberg, J. Schoenfeld, N. Suzuki, Y. Touchard, W. Wei, G.L. Williams, J. Lara, and S.A. Stant
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11. Data Report: Bulk and Clay Mineral Assemblages of the Tasmanian Area, Maastrichtian–Pleistocene, ODP Leg 189

Christian Robert
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12. Data Report: Sediment Geochemical Results from ODP Leg 189, Site 1171—Eocene to Present

Jennifer C. Latimer and Gabriel M. Filippelli
Manuscript number: 189SR-102

13. Data Report: Oxygen and Carbon Stable Isotope Records of the Miocene Calcareous Microfossils from ODP Leg 189 Sites 1170 (South Tasman Rise) and 1172 (East Tasman Plateau)

Atsuhito Ennyu and Michael A. Arthur
Manuscript number: 189SR-112

CD-ROM CONTENTS: DRILLING LOCATION MAPS

A site map showing the drilling locations for this leg and maps showing the drilling locations of all Ocean Drilling Program (ODP) and Deep Sea Drilling Project (DSDP) drilling sites are available in PDF format.

[ODP Leg 189 Site Map](#)

[ODP Map](#) (Legs 100–189)

[DSDP Map](#) (Legs 1–96)

CD-ROM CONTENTS: INDEX TO LEG 189 *INITIAL REPORTS AND SCIENTIFIC RESULTS* VOLUMES

The index covers both the *Initial Reports* and *Scientific Results* portions of Volume 189 of the *Proceedings of the Ocean Drilling Program*. The index contains a subject and taxonomic index.

[Index to Leg 189](#)

CD-ROM CONTENTS: COMPILED ELECTRONIC INDEX

The Compiled Electronic Index of the *Proceedings of the Ocean Drilling Program* contains the indexes of Volumes 101–178, 180–183, 186, 188, and 189. The indexes are contained in the directory titled ODPINDEX and are named ###NDX.PDF (### = the leg number). These indexes can be searched individually or collectively. For information on using the Acrobat search function, see "[Searching a PDF Document](#)" in README.PDF.

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(Drilling location maps)

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