U.S. Department of the Interior
U.S. Geological Survey

Beyond the Golden Gate—Oceanography, Geology, Biology, and Environmental Issues in the Gulf of the Farallones

Edited by
Herman A. Karl, John L. Chin, Edward Ueber, Peter H. Stauffer, and James W. Hendley II

Circular 1198 (full-length technical version)

U.S. Department of the Interior
Gale A. Norton, Secretary

U.S. Geological Survey
Charles G. Groat, Director

U.S. Geological Survey, Reston, Virginia: 2001

For additional copies please contact:

USGS Information Services
Box 25286
Denver, CO 80225

This report and any updates to it are available at
http://geopubs.wr.usgs.gov/circular/c1198/

Additional USGS publications can be found at
http://geology.usgs.gov/products.html

For more information about the USGS and its products:

Telephone: 1-888-ASK-USGS (1–888–275–8747)
World Wide Web: http://www.usgs.gov

ISBN 0-607-95030-7

Published in the Western Region, Menlo Park, California

Manuscript approved for publication June 18, 2000

Production and design by Sara Boore and Susan Mayfield

Text and illustrations edited by Peter H. Stauffer,
James W. Hendley II, and George A. Havach

CD-ROM prepared by Michael F. Diggles

Cooperating Organizations

Bodega Marine Laboratory (University of California at Davis)

British Geological Survey

California Department of Health Services

Environmental Protection Agency

Kernfysisch Versneller Instituut, Groningen, The Netherlands

National Oceanic and Atmospheric Administration
Gulf Of The Farallones National Marine Sanctuary
Cordell Bank National Marine Sanctuary
National Marine Fisheries Service

National Park Service

Point Reyes Bird Observatory

U.S. Army Corps of Engineers

U.S. Geological Survey

U.S. Navy

Contributors

Bodega Marine Laboratory (University of California at Davis)
Stephen R. Wing

British Geological Survey
David G. Jones
Philip D. Roberts

California Department of Health Services
Gregg W. Langlois
Patricia Smith

Environmental Protection Agency
Allan Ota

Kernfysisch Versneller Instituut Groningen, The Netherlands
Johannes Limburg

National Oceanic and Atmospheric Administration
Gulf of the Farallones National Marine Sanctuary
Jan Roletto
Edward Ueber
Cordell Bank National Marine Sanctuary
Dan Howard
National Marine Fisheries Service
Peter Adams
Tom Laidig

National Park Service
Scot Anderson

Point Reyes Bird Observatory
Scot Anderson
Peter Pyle

U.S. Geological Survey
John L. Chin
Walter E. Dean
James V. Gardner
Russell W. Graymer
James W. Hendley II
Herman A. Karl
Kaye Kinoshita
Marlene A. Noble
Stephanie L. Ross
Holly F. Ryan
William C. Schwab
Peter H. Stauffer
Florence L. Wong

Table of Contents

Foreword

Both scientists and decisionmakers have become increasingly aware of the need to understand the complexity of natural systems when considering actions that affect individual aspects of resources and the environment. The interconnectedness of the physical and biological elements of a natural system is often appreciated in the abstract, but sometimes not as much as it should be in scientific studies. Too frequently, how the interaction of all elements of a system influence the organism, habitat, or process being focused on is given only lip service or general observations. Although not intended to be an integrated study, this report on oceanographic, geological, biological, and environmental aspects of the Gulf of the Farallones is an excellent example of a study describing the many facets of a complex marine system.

In marine systems, the geologic foundation and sediment dynamics of the sea floor define the basic environment for communities of bottom-dwelling organisms, which are influenced by circulation patterns that also affect organisms living in the water column. Decreased light penetration caused by turbidity affects the plankton, the base of the marine food web, and thus affects fish and other marine populations. We sometimes consider the most dynamic and influential elements of marine systems to be the currents, waves, and mobile species that are monitored regularly because they change frequently on a human time scale. However, this report demonstrates how geologic processes, including crustal processes manifested as earthquakes, can also be influential on the same time scale. The inclusion of a chapter on tectonics brings this point home.

This report also demonstrates the impact that a past tendency towards an "out of sight, out of mind" approach to the use of the ocean floor for waste disposal has had on future use of marine resources and how new technology can improve the situation. Concerns over possible leakage from drums of radioactive waste dumped until about 1970 on the ocean floor in the Gulf of the Farallones affected the marketability of fish caught in the area. Technology has only recently enabled scientists to locate the drums and begin assessing the actual risk. Similarly, new technology has allowed proposed sites for disposal of dredged material to be evaluated with a more thorough understanding of bottom conditions and processes.

Studies that help provide an integrated knowledge of complex natural systems, like these on the Gulf of the Farallones, give decisionmakers and the public an enhanced ability to avoid the mistakes of the past and promote sustainable use of important environments and resources.

Charles G. Groat
Director, U.S. Geological Survey