



A Paradox of Power: Voices of Warning and Reason in the Geosciences

Edited by Charles W. Welby and Monica E. Gowan



Geological Society of America

REVIEWS IN ENGINEERING GEOLOGY • VOLUME XII

REVIEWS IN ENGINEERING GEOLOGY
VOLUME XII

A PARADOX OF POWER: VOICES OF WARNING AND REASON IN THE GEOSCIENCES

Edited by

CHARLES W. WELBY
Department of Marine, Earth, and Atmospheric Sciences
North Carolina State University
Raleigh, North Carolina 27695-8208

and

MONICA E. GOWAN
GeoLogic Co.
P.O. Box 5237
Glacier, Washington 98224

Access to power must be confined to those who are not in love with it.
——Plato



The Geological Society of America, Inc.
3300 Penrose Place, P.O. Box 9140
Boulder, Colorado 80301
1998

Copyright © 1998, The Geological Society of America, Inc. (GSA). All rights reserved. GSA grants permission to individual scientists to make unlimited photocopies of one or more items from this volume for noncommercial purposes advancing science or education, including classroom use. Permission is granted to individuals to make photocopies of any item in this volume for other noncommercial, nonprofit purposes provided that the appropriate fee (\$0.25 per page) is paid directly to the Copyright Clearance Center, 27 Congress Street, Salem, Massachusetts 01970, phone (508) 744-3350 (include title and ISBN when paying). Written permission is required from GSA for all other forms of capture or reproduction of any item in the volume including, but not limited to, all types of electronic or digital scanning or other digital or manual transformation of articles or any portion thereof, such as abstracts, into computer-readable and/or transmittable form for personal or corporate use, either noncommercial or commercial, for-profit or otherwise. Send permission requests to GSA Copyrights.

Copyright is not claimed on any material prepared wholly by government employees within the scope of their employment.

The Reviews in Engineering Geology series was expanded in 1997 to include Engineering Geology Case Histories, 11 volumes of which were published by the Geological Society of America from 1957 to 1978 with ISBNs from 0-8137-4001-0 to 0-8137-4011-8. Beginning with Volume XI, Reviews in Engineering Geology may include both reviews and case histories, under the ISBN 0-8137-4111-4 and subsequent numbers.

Published by The Geological Society of America, Inc.
3300 Penrose Place, P.O. Box 9140, Boulder, Colorado 80301

Printed in U.S.A.

GSA Books Science Editor Abhijit Basu

Library of Congress Cataloging-in-Publication Data

A paradox of power : voices of warning and reason in the geosciences /
edited by Charles W. Welby and Monica E. Gowan.

p. cm. -- (Reviews in engineering geology ; v. 12)

Includes bibliographical references.

ISBN 0-8137-4112-2

1. Engineering geology. 2. Environmental health. 3. Health risk
assessment. 4. Environmental geology. 5. Environmental
geotechnology. I. Welby, Charles W. II. Gowan, Monica E.

III. Series.

TA705.R4 vol. 12

624.1'51 s

[624.1'51] --DC21

98-9275

CIP

Contents

<i>Preface</i>	v
<i>Introduction</i>	vii
<i>Acknowledgments</i>	ix
<i>1. The dilemma of the geologist: Earth resources and environmental policy</i>	1
Lee C. Gerhard	
<i>2. Resolving environmental complexity: A geologic appraisal of process-response elements and scale as controls of shoreline erosion along southeastern Lake Ontario, New York</i>	9
Paul R. Pinet, Charles E. McCledden, and Laura J. Moore	
<i>3. Colonial impacts to wetlands in Lebanon, Connecticut</i>	23
Robert M. Thorson, Andrew G. Harris, Sandra L. Harris, Robert Gradie III, and M. W. Lefor	
<i>4. Presentation of radon potential maps to the public: A case history for Portland, Oregon</i>	43
Scott F. Burns, Stuart G. Ashbaugh, Ray Paris, and George Toombs	
<i>5. An outbreak of coccidioidomycosis (valley fever) caused by landslides triggered by the 1994 Northridge, California, earthquake</i>	53
Randall W. Jibson, Edwin L. Harp, Eileen Schneider, Rana A. Hajjeh, and Richard A. Spiegel	
<i>6. Sewage sludge (biosolids) land disposal in a southeastern U.S. Piedmont setting: Ground-water pollution potential</i>	63
Charles W. Welby	
<i>7. Seismic microzonation in the Pacific Northwest, with an example of earthquake hazard mapping in southwest British Columbia</i>	75
Victor M. Levson, Patrick A. Monahan, Daniel G. Meldrum, Bryan D. Watts, Alex Sy, and Li Yan	

8. Asbestos monitoring and regulation in public drinking-water supplies: A case history from North Carolina	89
Jeffrey C. Reid and Robert H. Carpenter	
9. Evaluating debris-flow hazards in Davis County, Utah: Engineering versus geological approaches	97
Jeffrey R. Keaton and Mike Lowe	
10. Preliminary assessment of the seismicity of the Malibu Coast Fault Zone, southern California, and related issues of philosophy and practice	123
Vincent S. Cronin and Keith A. Sverdrup	
11. Glacial geology, law, and the Love Canal trial	157
Jodi A. Feld, Robert Emmet Hernan, and David M. Mickelson	
12. Expectations of geological science: Yucca Mountain site characterization, Nevada	165
Thomas W. Bjerstedt	
13. Providing valid long-term projections of geologic systems for policy decisions: Can we succeed? Should we try?	177
Jeremy M. Boak and Holly A. Dockery	
Afterword	185

Preface

Power (pou'er): 1. The ability or capacity to act or perform effectively. 2. . . . 3. Strength or force exerted or capable of being exerted; might. 4. The ability or official capacity to exercise control; authority. (*American Heritage Dictionary*)
Enlightenment (en-lit' n-ment): The state of possessing knowledge and truth. (*American Heritage Dictionary* synonyms for "knowledge")

This volume is about the power of geoscience in the context of environmental issues. Most North Americans consider themselves environmentalists on one level or another. Many seek environmental enlightenment; others wish to be perceived as environmentally enlightened. Yet there are a myriad of views on what constitutes "enlightenment." We live and work in a world of ideological conflict over "true" environmental enlightenment where clashes between epistemological and theological belief systems can produce seemingly intractable situations. Often these conflicts are a struggle for power rather than insight.

Into this conflict steps the geoscientist. Because of our knowledge and professional judgment we are often asked by stakeholders to provide assistance for a magnanimous purpose: to sort out conflicts of fact and value; to protect public safety; to find resources; to help design or engineer solutions; or to provide scholarly answers. We are also asked to provide Machiavellian means to achieve certain ends. Whether the power struggle is social, economic, legal, or political, we are asked and sometimes expected to provide counsel that helps a client, agency, or organization "win" its wars. For either purpose the inescapable result is that stakeholders place us in a position where we can control or influence opinions and decisions.

Herein lies the paradox of geoscience knowledge. It puts us in a position of power, allowing us to use our knowledge as a tool or weapon. This power shoulders us with seemingly antithetical responsibilities to provide wise counsel in warning of potential risk or error yet to counter hysteria with discriminating thought or reason. Often we must meet these responsibilities with limited knowledge or conflicting evidence. This paradox challenges our ethics in our relationships with others, with the Earth, and with ourselves. It tests our steadfastness to truth, purpose, responsibility, and trust.

Out of this paradox and its concomitant challenges to ethics and soundness arose two theme sessions, Environmental Geology: The Voice of Warning and Environmental Geology: The Voice of Reason, which the Geological Society of America's Institute for Environmental Education (IEE) and the Committee on Geology and Public Policy sponsored at the 1992–1995 annual meetings. The sessions sought to focus on how geoscientists can meet this challenge by helping create an informed citizenry and by assisting decision-makers on environmental matters.

Many excellent presentations discussed new ways to express difficult concepts, to engage the public intellectually, to assess the viability of analytical methods, and to provide approaches to achieving conflict resolution. Some papers highlighted issues of data reliability and relevance and difficulties in determining causal relationships. Others clarified misconceptions of risk and offered philosophical perspectives on ethical, legal, pedagogical, social, economic, and political aspects of environmental issues. Thirteen of these papers have been selected for publication in this volume. They share an awareness that political realities can render the value of geoscience information moot if it does not provide the answers sought, yet they aspire to assist the citizen and decision-maker in asking the right questions. It is hoped that these papers provide insight on the application of geology to public policy issues and guidance for implementing effec-

tive approaches with personal integrity and scientific expertise. Perhaps they will also spawn valuable insight into the reader's own professional challenges and provoke a little philosophical musing on how the geoscience profession can best serve society.

The intent in developing the *Voices* sessions was to provide a forum for discussion on how geoscientists can be problem solvers in environmental conflicts. The sessions were guided by the belief that the best chance for creative solutions might lie in educating the public and decision-makers on *how to think* more than on *what to think* about environmental geoscience issues. Fred A. Donath, past executive director of IEE, supported the idea and saw it as complementary to IEE's goal of applying geology to the "wise use of Earth." David Gross, a former member of GSA's Committee on Geology and Public Policy, also believed in the idea and provided the support of the committee. Charles W. Welby and the Engineering Geology Division of GSA recognized the value of sharing a collection of papers in a publication. From this support of the *Voices* sessions came the current volume. It is my hope that you will find it valuable and a stepping stone to further discussion on the positive power of the science for which we share a passion.

Monica E. Gowan
November 1996

Introduction

In preparing this volume the editors have chosen papers to form chapters of the volume that examine the issues of public health and welfare from different aspects. We have placed the chapters into four major groupings to emphasize these aspects.

The first group addresses issues related to decision-making about land use and natural resources. The first two chapters provide a framework for decision-making—based in part on the variability of temporal and spatial scales in the geologic environment—that can be a tool for resolving environmental complexity. Gerhard calls for establishment of priorities and rejection of spurious issues through a matrix approach that analyzes environmental issues at the global through local level of interest. Pinet et al. apply a hierarchical classification to process-response elements of geomorphic systems to assist in assessing the impact of environmental effect. In the third chapter, Thorson et al. discuss how the public perception of environmental *wildness* may be incongruous with the true *naturalness* of wetlands in New England. Their emphasis is on the need to incorporate the geological perspective in the evolution of wetlands and in their attributed value.

Geology and health provide the context for several “voice of warning” discussions. Burns et al. illustrate a case history of public education about radon potential in Portland, Oregon, which empowered citizens to heighten their personal awareness of their relationship to environmental hazards. Jibson et al. document the first case of an outbreak of coccidioidomycosis (valley fever) being related unequivocally to an earthquake and attendant natural phenomena, opening a new area of concern in natural hazard preparation and response. Welby discusses the risk of ground-water contamination from application of biosolids to agricultural lands and the need for decision-makers to contemplate future possible uses of the land when considering biosolid land disposal. Levson et al. discuss concepts related to earthquake damage mitigation and the methodology by which regional potential hazards maps can be developed from existing information supplemented by additional geologic data. These maps can be used in land-use planning and for emergency planning purposes.

The next group of chapters illustrates ideas related to the “voice of reason” concept. They offer prudent alternatives to regulatory and engineering approaches in solving environmental problems. Reid and Carpenter note the facility with which asbestos-monitoring requirements can be waived based on the results of bedrock mapping. Keaton and Lowe discuss how a geological approach could have assessed more accurately and cost effectively debris-flow hazards in contrast to the engineering methods that incorrectly defined 100-year flood plains along the Wasatch Front.

Ethical and philosophical questions confronting geoscientists under the “paradox of power” are addressed in the fourth group of chapters. Cronin and Sverdrup set the stage for a discussion of ethics in the geosciences through their work to protect the public by proper fault identification in the Malibu Coast Fault Zone. Whether a fault is classed as active or is recognized as a “fossil fault” bears upon proper use of land and on property rights questions. Feld et al. note that in the Love Canal trial the search for truth varied in process and criteria, depending upon one’s professional background and perspectives. Bjerstedt wrestles with the question of How much information is enough? in contemplating work at Yucca Mountain for a high-level radioactive waste disposal site. Boak and Dockery emphasize the need to access the validity of conflicting descriptions of reality when making long-term projections of geologic systems.

Although all the chapters discuss important issues in and by themselves, taken as a whole they provide a perspective of the relationship among geology, environmental questions about how humans use Earth’s resources, and ethical questions about how best to integrate geologic knowledge into systems of human welfare and safety.

Acknowledgments

The editors acknowledge the assistance of a number of people who made this volume possible. First are those who encouraged the development of the GSA theme sessions between 1992 and 1995 in which the papers were first presented orally: Fred Donath and David Gross. Theme session co-chairs who guided the oral discussions included Calvin Alexander, William Berry, Scott Burns, Monica Gowan, Brett Leslie, Syed Hassan, Jeffrey Keaton, Mac Ross, and Charles Welby. Former chairs of the Engineering Geology Division, Jerome DeGraff, Rhea Graham, and Michael Hart, supported the development of the volume during their tenures.

Reviewers play an important role in the evaluation of papers for such a volume. Because of the variety of topics covered in the papers, the editors chose reviewers not only within the GSA family but among others who by reason of their professional responsibilities possessed knowledge and understanding that might make their review of particular value to the authors of the manuscripts. To these persons the editors and the authors are especially appreciative: Dyane Brown, Edward R. Burt III, John M. Dennison, Tom Drake, Dale Dusenbury, Duane A. Eversoll, David W. Folger, Richard M. Fry, G. David Garrett, Neil J. Gilbert, Charles H. Gardner, Monica E. Gowan, Bruce W. Hurley, Mark E. Landis, Matthew A. Mabey, Peter Malin, Christopher C. Mathewson, Malcolm Ross, William P. Scott, Henry M. Singletary, James E. Slosson, Edward F. Stoddard, and Gerald F. Wieczorek.

Finally, no volume can exist without the efforts and interest of the authors. To them the editors say, "Thank you" for the time and effort that each has spent on their respective manuscripts. The editors hope that we have set them in a context that makes them useful.

