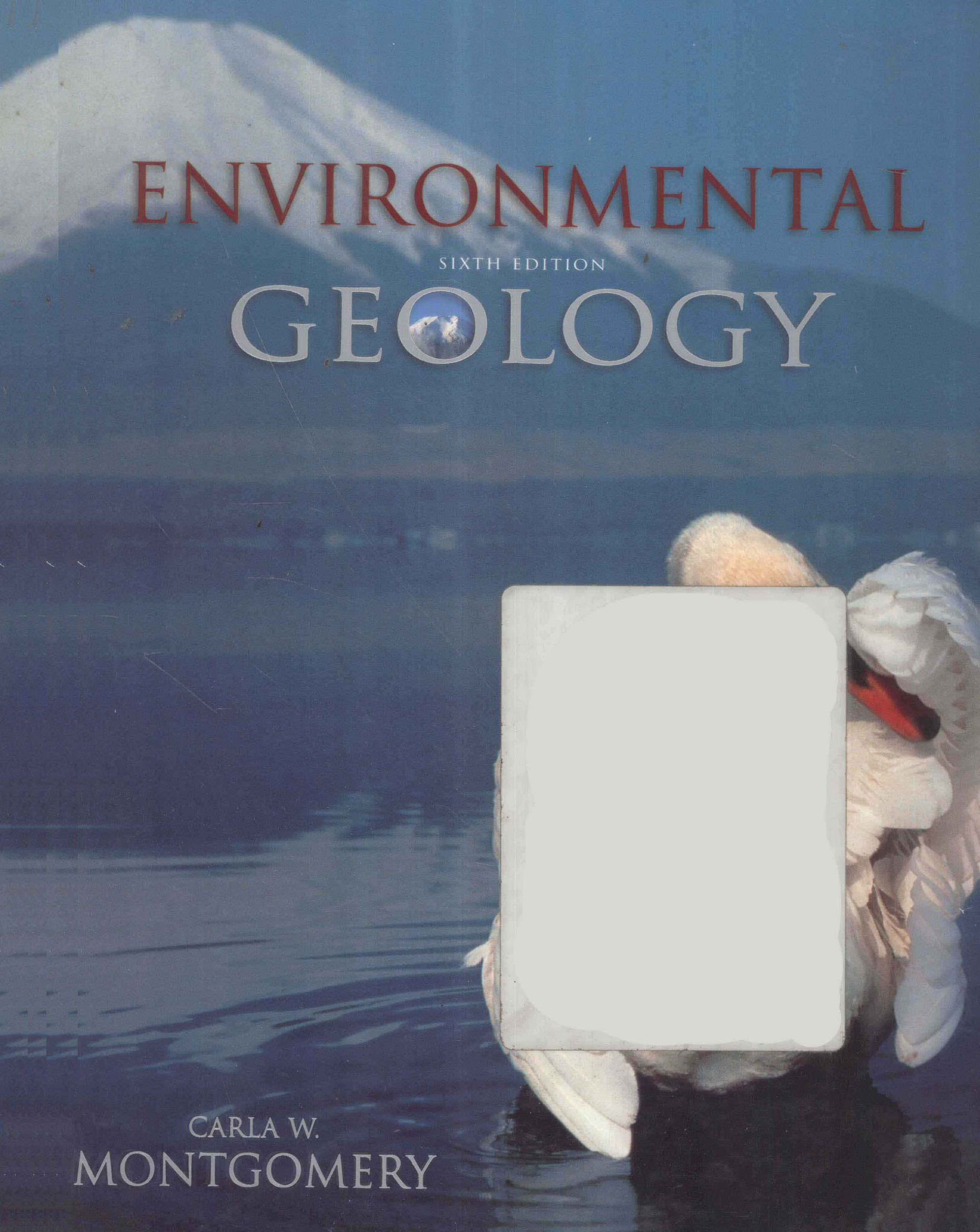
ENVIRONMENTAL GEOLOGY

SIXTH EDITION



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ENVIRONMENTAL GEOLOGY, SIXTH EDITION

Published by McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020.

This book is printed on recycled, acid-free paper containing 10% postconsumer waste.

International 2 3 4 5 6 7 8 9 0 QPD/QPD 0 9 8 7 6 5 4
Domestic 3 4 5 6 7 8 9 0 QPD/QPD 0 9 8 7 6 5 4

ISBN 0–07–366195–3
ISBN 0–07–119941–1 (ISE)

Publisher: *Margaret J. Kemp*
Developmental editor: *Lisa Leibold*
Executive marketing manager: *Lisa Gottschalk*
Project manager: *Richard H. Hecker*
Production supervisor: *Enboge Chong*
Design manager: *Stuart D. Paterson*
Cover/interior designer: *Jamie E. O'Neal*
Cover image: *Courtney Milne/Masterfile*
Spine and back cover image: *Brad Wrobleski/Masterfile*
Senior photo research coordinator: *John C. Leland*
Photo research: *Amy Bethea*
Senior supplement producer: *Tammy Juran*
Media technology producer: *Renee Russian*
Compositor: *Shepherd, Inc.*
Typeface: *10/12 Palatino*
Printer: *Quebecor World Dubuque, IA*

Photos not credited on page provided by author, Carla W. Montgomery. Interior design images provided by Adobe Image Library, Corbis, DigitalVision, and Letraset.

Library of Congress Cataloging-in-Publication Data

Montgomery, Carla W., 1951–
Environmental geology / Carla W. Montgomery. — 6th ed.
p. cm.
Includes bibliographical references and index.
ISBN 0–07–366195–3
1. Environmental geology. I. Title.

QE38 .M66 2003
550—dc21 2001041036
CIP

INTERNATIONAL EDITION ISBN 0–07–119941–1

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Environmental Geology is affectionately dedicated to the memory of Ed Jaffe, whose confidence in an unknown author made the first edition possible.

–CWM–

PREFACE

The *environment* is the sum of all the features and conditions surrounding an organism that may influence it. An individual's physical environment encompasses rocks and soil, air and water, such factors as light and temperature, and other organisms present. One's social environment might include a network of family and friends, a particular political system, and a set of social customs that affect one's behavior.

Geology is the study of the earth. Because the earth provides the basic physical environment in which we live, all of geology might in one sense be regarded as environmental geology. However, the term *environmental geology* is usually restricted to refer particularly to geology as it relates directly to human activities, and that is the focus of this book. Environmental geology is geology applied to living. We will examine how geologic processes and hazards influence human activities (and sometimes the reverse), the geologic aspects of pollution and waste-disposal problems, and several other topics.

Why environmental geology? One reason for studying environmental geology might simply be curiosity about the way the earth works, about the *how* and *why* of natural phenomena. Another reason is that we are increasingly faced with environmental problems to be solved and decisions to be made, and in many cases, an understanding of one or more geologic processes is essential to finding an appropriate solution.

Of course, many environmental problems cannot be fully assessed and solved using geologic data alone. The problems vary widely in size and in complexity. In a specific instance, data from other branches of science (such as biology, chemistry, or ecology), as well as economics, politics, social priorities, and so on may have to be taken into account. Because a variety of considerations may influence the choice of a solution, there is frequently disagreement about which solution is "best." Our personal choices will often depend strongly on our beliefs about which considerations are most important.

An introductory text cannot explore all aspects of environmental concerns. Here, the emphasis is on the physical constraints imposed on human activities by the geologic processes that have shaped and are still shaping our natural environment. In a real sense, these are the most basic, inescapable constraints; we cannot, for instance, use a resource that is not there, or build a secure home or a safe dam on land that is fundamentally unstable. Geology, then, is a logical place to start in developing an understanding of many environmental issues. The principal aim of this book is to present the reader with a broad overview of environmental geology. Because geology does not exist in a vacuum, however, the text, from time to time, introduces related considerations from outside geology to clarify other ramifications of the subjects discussed. Likewise, the present does not exist in isolation from the past and future; occasionally, the text looks both at how the earth developed into its present condition and where matters seem to be moving for the future. It is hoped that this knowledge will provide the reader with a useful foundation for discussing and evaluating specific environmental issues, as well as for developing ideas about how the problems should be solved.

ABOUT THE BOOK

This text is intended for an introductory-level college course. It does not assume any prior exposure to geology or college-level mathematics or science courses. The metric system is used throughout, except where other units are conventional within a discipline. (For the convenience of students not yet "fluent" in metric units, a conversion table is included in appendix D, and in some cases, metric equivalents in English units are included within the text.)

Each chapter opens with an introduction that sets the stage for the material to follow. In the course of the chapter, important terms and concepts are identified by boldface type, and these terms are collected as "Terms to Remember" at the end of the chapter for quick review. Many chapters include actual case histories or specific examples. To these, each reader could no doubt add others from personal experience. Each chapter concludes with review questions and exercises, which allow students to test their comprehension and to apply their knowledge, and also suggested readings and pertinent references. Additional references, including older and more technical ones, are found at the book's Web site.

A feature introduced with the fifth edition is the inclusion of "NetNotes" at the end of each chapter. These are modest collections of Internet sites that provide additional information and/or images. An effort has been made to concentrate on sites with material at an appropriate level for the book's intended audience and also on sites likely to be relatively stable in the very fluid world of the Internet (government, agency, educational-institution, or professional-association sites). Though limited by space, this selection should particularly help the novice user get started exploring, and it has been significantly updated in the latest edition.

With this edition, each chapter includes a boxed reading relating to chapter material that involves a situation, problem, or application that might be encountered in everyday life. The tone, in many cases, is light, but the underlying issues are nonetheless real. While some boxes were inspired by actual events, and some include specific factual information, all of the characters quoted, and their interactions, are wholly fictitious. (Users who may miss boxed readings from earlier editions will find some of their contents incorporated into the text in this edition, and the old boxes, intact, at the Online Learning Center.)

The book starts with some background information: a brief outline of earth's development to the present, and a look at one major reason why environmental problems today are so pressing—the large and rapidly growing human population. This is followed by a short discussion of the basic materials of geology—rocks and minerals—and some of their physical properties, which introduces a number of basic terms and concepts that are used in later chapters.

The next several chapters treat individual processes in detail. Some of these are large-scale processes, which may involve motions and forces in the earth hundreds of kilometers below the surface, and may lead to dramatic, often-catastrophic events like earthquakes and volcanic eruptions. Other processes—such as the flow of rivers and glaciers or the blowing of the wind—occur only near the earth's surface, altering the landscape and occasionally causing their own special problems. In some cases, geologic processes can be modified, deliberately or accidentally; in others, human activities must be adjusted to natural realities.

A subject of increasing current concern is the availability of resources. A series of five chapters deals with water resources, soil, minerals, and energy, the rates at which they are being consumed, probable amounts remaining, and projections of future prospects. In the case of energy resources, we consider both those sources extensively used in the past, and new sources that may or may not successfully replace them in the future.

Increasing population and increasing resource consumption seem to lead to an increasing volume of waste to be disposed of; thoughtless or inappropriate waste disposal commonly leads to increasing pollution. Three chapters examine the interrelated problems of air and water pollution and the strategies available for the disposal of various kinds of wastes.

The final two chapters deal with a more diverse assortment of subjects. Environmental problems spawn laws intended to solve them; the environmental-law chapter looks briefly at a sampling of laws and international agreements related to geologic matters discussed earlier in the book, as well as at some of the problems with such laws and accords. The land-use planning and engineering geology chapter examines geologic constraints on construction schemes and the broader issue of trying to determine the optimum use(s) for particular parcels of land, matters that become more pressing as population growth pushes more people to live in marginal places. While the "Geomedicine" chapter no longer appears, aspects of the subject are now integrated into several other chapters, and the emerging topic of health and climate change is recognized in chapter 9.

Relative to the length of time we have been on earth, humans have had a disproportionate impact on this planet. Appendix A explores the concept of geologic time and its measurement, and looks at the rates of geologic and other processes by way of putting human activities in temporal perspective. Appendix B gives an introduction to topographic and geologic maps and satellite and other kinds of imagery, highlighting some new techniques for examining the earth. Appendix C provides short reference keys to aid in rock and mineral identification, and Appendix D includes units of measurement and conversion factors. The Glossary collects definitions of boldface terms and select additional terms for quick reference.

Available with this text is an Instructor's Manual containing over 750 test questions. The test questions found in the Instructor's Manual are also available on McGraw-Hill classroom testing software, for use with the Macintosh® and IBM® PC computers. Also available are 170 acetate transparencies of key text illustrations and 120 color slides. These are designed to aid instructors in class presentations and to enhance student learning activities.

ACKNOWLEDGMENTS

A great many people have contributed to the development of one or another edition of this book. Portions of the manuscript of the first edition were read by Colin Booth, Lynn A. Brant, Arthur H. Brownlow, Ira A. Furlong, David Huntley, John F. Looney, Jr., Robert A. Matthews, and George H. Shaw, and the entire book was reviewed by Robert A. Marston and Donald J. Thompson. The second edition was enhanced through suggestions from William N. Mode, Laura L. Sanders, Jeffrey J. Gryta, Martin Reiter, Robert D. Hall, Robert B. Furlong, David Gust, and Stephen B. Harper; the third was further refined with the assistance of Susan M. Cashman, Robert B. Furlong, William N. Mode, Frank Hanna, Laura L. Sanders, Paul Nelson, and Michael A. Velbel; the fourth was strengthened through the input of reviewers Pascal de Caprariis, James Cotter, John Vitek, Paul Schroeder, Steven Lund, Barbara Ruff, Gordon Love, Herbert Adams, Michael McKinney, Thomas E. Hendrix, Clifford Thurber, Ali Tabidian, Dru Germanoski, and Randall

Scott Babcock; and the fifth edition from reviews by Barbara L. Ruff, University of Georgia; Michael Whitsett, University of Iowa; John F. Hildenbrand, Clover Park Technical College; Alvin S. Konigsberg, State University of New York at New Paltz; Vernon P. Scott, Oklahoma State University; Jim Stimson, Carroll College; Kevin Cole, Grand Valley State University; Gilbert N. Hanson, State University of New York at Stony Brook; Doreen Zaback, Vanderbilt University; and Ann E. Holmes, Columbia University. This sixth edition has benefited still further from careful reviews by Ray Beiersdorfer, Youngstown State University; Ellin Beltz, Northeastern Illinois University; William B. N. Berry, University of California, Berkeley; Paul Bierman, University of Vermont; W. B. Clapham, Jr. Cleveland State University; Ralph K. Davis, University of Arkansas; Brian E. Lock, University of Louisiana, Lafayette; Gregory Hancock, College of William and Mary; Syed E. Hasan, University of Missouri, Kansas City; Scott W. Keyes, Tarrant County College; Jason W. Kelsey, Marymount University; John F. Looney, Jr., University of Massachusetts, Boston; Christine Massey, University of Vermont; Steve Mattox, Grand Valley State University; William N. Mode, University of Wisconsin, Oshkosh; William A. Newman, Northeastern University; Clair R. Ossian, Tarrant County College; David L. Ozsvath, University of Wisconsin, Stevens Point; Alfred H. Pekarek, St. Cloud State University; Paul H. Reitan, University of Buffalo; and Don Rimstidt, Virginia Tech. The thoughtful suggestions of all of the foregoing individuals, and many other users who have informally offered additional advice, have substantially improved the text, and their help is most gratefully acknowledged. Any remaining shortcomings are, of course, my own responsibility.

M. Dalechek, C. Edwards, I. Hopkins, and J. McGregor, at the USGS Photo Library in Denver, have provided invaluable assistance with the photo research over the years. The encouragement of a number of my colleagues—particularly Colin Booth, R. C. Flemal, Donald M. Davidson, Jr., R. Kaufmann, and Eugene C. Perry, Jr.—was a special help during development of the first edition. The ongoing support and interest of fellow author, deanly colleague, and ecologist Jerrold H. Zar has, in turn, helped immensely to make the revision cycles survivable. Thanks are also due to the several thousand environmental-geology students I have taught, many of whom in the early years suggested that I write a text, and whose classes collectively have provided a testing ground for many aspects of the presentations herein.

My family has been supportive of this undertaking from the inception of the first edition. A very special vote of appreciation goes to my husband Warren—ever-patient sounding board, occasional photographer and field assistant—in whose life this book has so often loomed so large.

Last, but assuredly not least, I express my deep gratitude to the entire McGraw-Hill book team, and their predecessors at Wm. C. Brown Publishers, for their enthusiasm, professionalism, and just plain hard work, without which successful completion of each succeeding edition of this book would have been impossible.

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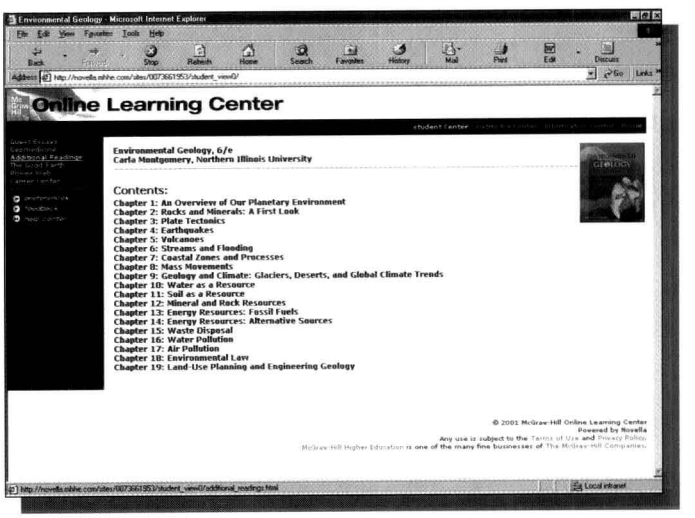

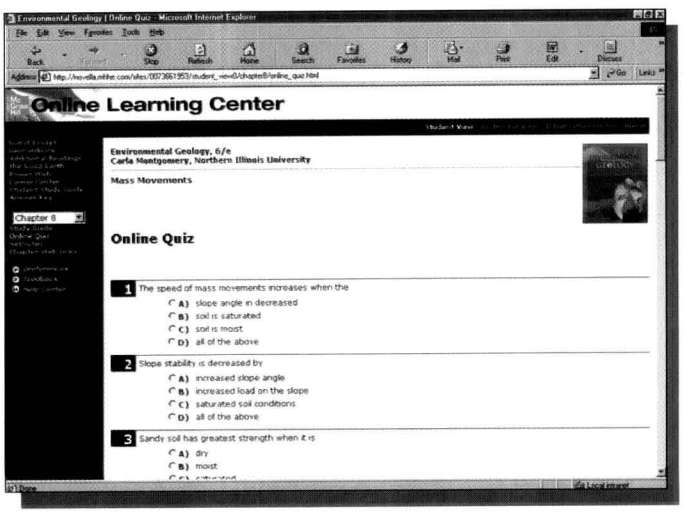

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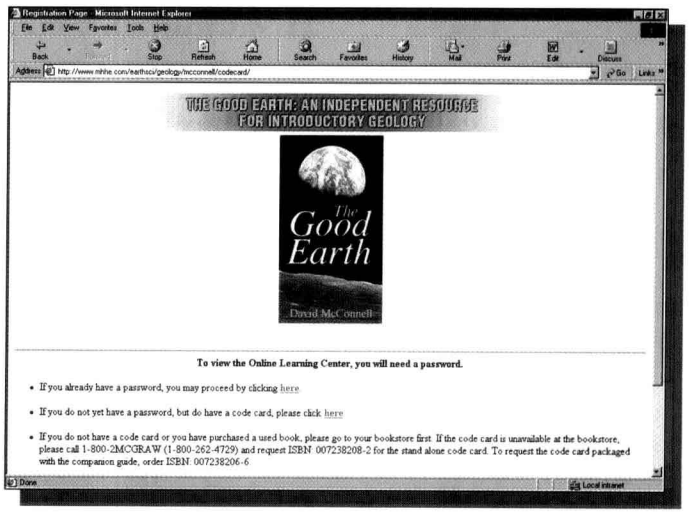

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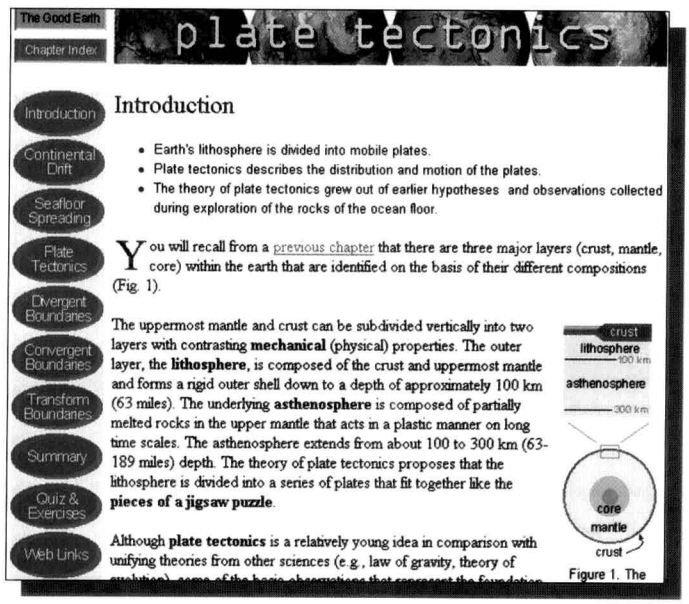

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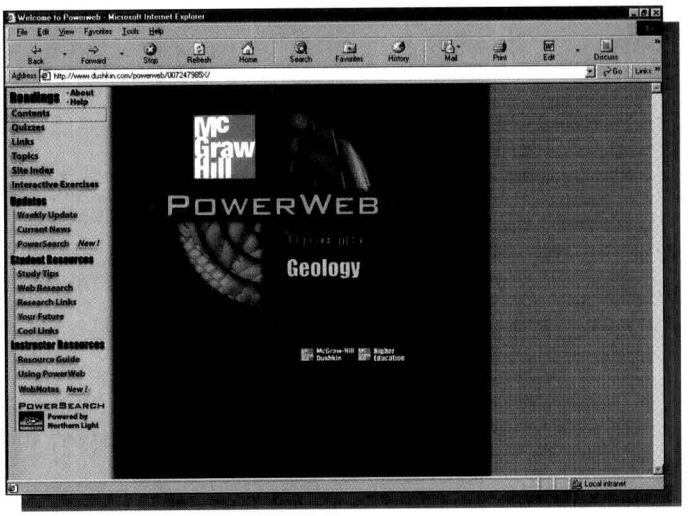

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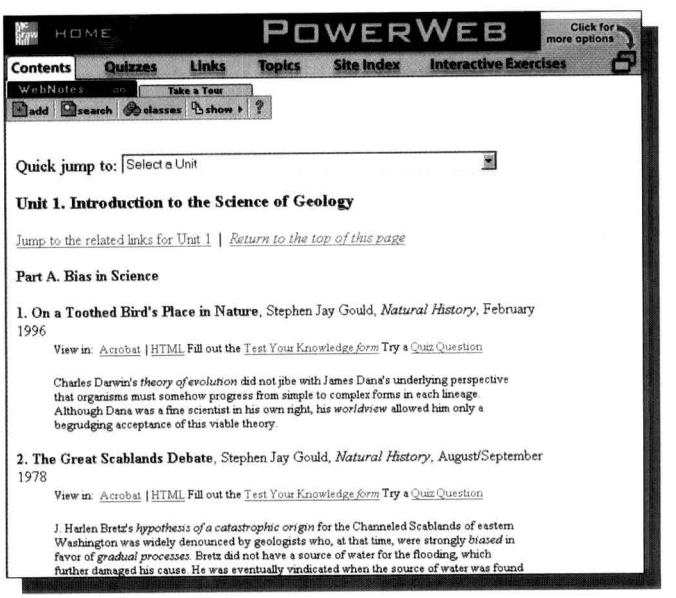

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