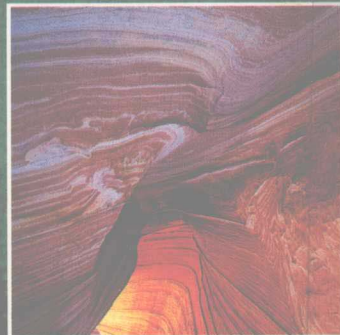
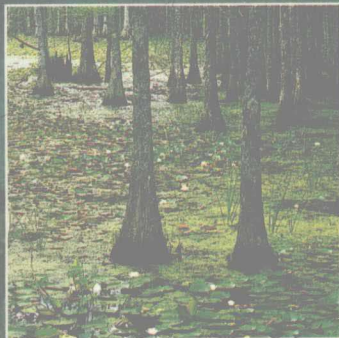


MURCK / SKINNER

GEOLOGY TODAY



UNDERSTANDING
OUR
PLANET



W/1 CD

GEOLOGY TODAY



UNDERSTANDING OUR PLANET

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We dedicate this book to Stella Kupferberg, an inspiration to all who knew her.

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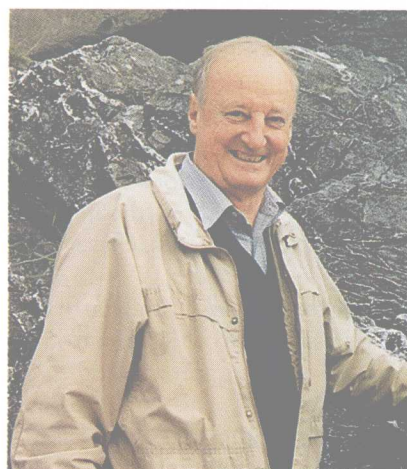
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• ABOUT THE AUTHORS •

The authors, Barbara W. Murck and Brian J. Skinner, have been privileged to have been involved in the development, study, and teaching of the emerging view of our home planet, called Earth system science. They bring to this project a love of geology and of teaching, a wealth of professional experience on all the continents of the world, and a relaxed but skillful writing style that makes even difficult concepts seem accessible to students.



As an undergraduate, *Barbara Murck* was a confirmed nonscientist, until an introductory geology course changed her plans. Since then her professional focus has ranged from igneous geochemistry and ore-deposit petrography to alternative energy sources and state-of-the-environment reporting. Her current work focuses primarily on environmental management training for decision makers in developing countries.



Brian Skinner was born and raised in Australia on the edge of what is now called degraded land—some call it desert. That is where he gained his earliest interest in the complex interactions that make up our environment. He has been privileged to work on every continent and to be involved in the beginnings of what we now call the Space Age. His interests are most centrally involved with mineral and energy resources, but because these materials are found in a great many geological environments, his professional interests are diverse.

• PREFACE •

What *Geology Today* Is About

This introductory geology book is about the fascinating interrelated processes that make the Earth the special place it is and about the wonderfully balanced ways by which it works and has worked over the vast geologic ages. *Geology Today* is also a book about continuing discoveries, because there is much about the Earth that we still know imperfectly or don't know at all. We continue to make discoveries about plate tectonics and how plate tectonic processes rearrange and renew the Earth's surface; about rainfall, winds, ice caps, and all the other processes that continually erode away the rocks that have been brought to the surface by volcanism and plate tectonics; about climate and the global interactions that drive climatic change; about the influence of life on geologic processes, and vice versa; and about how humans can survive and flourish on a geologically active planet. It is, in short, a book about the interactions among the many parts of the Earth system and about the new approaches now being used to study and assess these interactions.

It is our enthusiasm for the insights of the Earth system science approach that has led us to write an introductory geology text that builds on this approach and to do so at a level that is accessible to all. This is not a book about the tougher and more quantitative parts of Earth science. It is a book about understanding how planet Earth works. The most confident homeowner is the one who knows how the home and its various support systems operate. Similarly, we become more confident and effective proprietors of the Earth when we understand how its various systems function and interact with one another and how geologic processes affect our lives on a daily basis. It is our hope that this book will bring the workings of our larger home, the Earth, into clearer and more useful focus for our readers.

Organization

Geology Today is organized in five main parts.

In *Part One: The Third Planet*, students learn about the main characteristics of the Earth as a planet and its place in the solar system. They read about the origin of modern geology and find out how geologists use scientific observations to draw conclusions about the history of the Earth and geologic processes. They learn about atoms, elements, minerals, and rocks, the fundamental building blocks of the Earth, and about the age of the Earth system and its parts.

In *Part Two: The Dynamic Earth*, students learn about geophysical processes that originate deep within the Earth, including earthquakes, volcanism, and plate tectonics. Students are invited to evaluate the plate tectonic model for themselves, on the basis of observational evidence. The chapters of *Part Two* are concerned primarily with the parts of the geologic cycle that involve internal Earth processes.

Part Three: The Changing Earth focuses on the Earth's surface, a dynamic interface between the geophysical activity of plate motion, seismicity, rock deformation, and volcanism within the Earth and the constant activity of the atmosphere and hydrosphere outside the Earth. The surface of the Earth is constantly modified by the processes of weathering, erosion, sedimentation, and rock deformation. The chapters of *Part Three* focus on the external or crustal part of the geologic cycle. In the last chapter of *Part Three*, we summarize the common rocks and rock-forming processes in the context of the tectonic environments in which they occur.

Water in all its forms dominates the Earth system. It shapes the surface of the land, controls weather and climate, and sustains life. In *Part Four: Water World*, students learn about all aspects of the hydrologic cycle and the various roles of water in the Earth system.

Part Five: Living on Planet Earth offers a brief synopsis of the history of life on the Earth and the impacts of life on the chemical evolution of the atmosphere and hydrosphere. We also examine our current reliance on the material resources of this planet. As the human population grows, it becomes even more important that we understand how such resources form, how and where they occur, and how they can be managed to ensure their continued viability. We close the book with a look at the continuing and changing role of geoscientists in the twenty-first century.

Special Features

Many special features have been built into the book to make it a more useful and enjoyable educational companion for our readers.

An Accessible, Engaging Style

Many introductory geology textbooks have claimed to be “accessible” and “readable”; this is the book that finally achieves it. We believe that students will genuinely enjoy reading and learning from it. *Geology Today* introduces students to the basic concepts of physical geology, within a broader context of Earth system science. Through the book’s narrative style and historic perspective, students discover how scientists have used observation and deductive reasoning to arrive at some of the basic concepts that characterize our present-day understanding of the Earth system. See, for example, chapter 4 (“Plate Tectonics: A Unifying Theory”), where students follow the story of the theory of plate tectonics through conceptualization, controversy, observation, testing, refinement, and finally, general acceptance by the scientific community. Students learn that not all the answers have been found on the theory of plate tectonics, and so the final verdict remains out. Instead, they will find themselves in the middle of an ongoing process of scientific questioning, examination, and discovery.

Chapter Openers and Part Openers

At the beginning of each of the five main parts of the book are a brief synopsis of the contents of the part and a broad overview of the main concepts covered by those chapters. Each chapter opener presents a short vignette showing the relevance of the chapter material to life on planet Earth. Each chapter opener ends with a brief list of the most important things students will be learning in that chapter.

Strategic Questions

The inquisitive, problem-solving perspective of the text is reflected in the opening question and marginal puzzlers

(denoted by question marks). These puzzlers are intended to pique students’ interest by posing questions about geologic processes that they may previously have wondered about—questions that are addressed in the adjacent text.

Artwork and Photographs

Wiley’s Earth science textbooks are known for the quality of their artwork. In this book we have carefully designed the art program to complement the text and, in particular, to facilitate the learning process for introductory students. Line drawings are simple and clearly labeled. Caption “headlines” advertise the main content of each figure. Long, text-only tables are not used. Instead, the pedagogical effectiveness of both text and artwork has been enhanced by pairing what would formerly have been tabular material with line drawings and photos to illustrate concepts. And, of course, the Wiley tradition of spectacular instructional photographs is carried on in this book.

Key Terms

Students will find key terms boldfaced in the text and defined in a handy marginal glossary, adjacent to the first appearance of the term in the text. At the end of each chapter is a list of these terms, *The Language of Geology*, with page references for easy review. Full definitions and page references are provided for all key terms in the Glossary at the back of the book. A list of italicized terms is also provided in the Instructor’s Manual.

Geology Around Us

Each chapter contains a focus box, entitled *Geology Around Us*. The boxes highlight examples and case studies of geology at work in our daily lives (e.g., “Minerals in Everyday Life,” chapter 2). Some of the boxes provide an in-depth look at a geologic concept (e.g., “The Hawaiian Islands: A Record of Plate Motion,” chapter 4). Some of the boxes simply tell interesting stories related to the chapter topic (e.g., “Darwin’s Atlantis,” chapter 15).

Summary and Review: Text and Diagrams

Each chapter presents a summary of the chapter’s most important concepts, the *Chapter Highlights*. Questions for Review provide an opportunity for students to test what they have learned from their reading. Questions for Thought and Discussion are intended to be more open-ended and are appropriate for research projects, homework or laboratory assignments, or group discussions. In both types of questions, you will find references to figures that appear in the text. Many beginning sci-

ence students have trouble using and interpreting graphs and diagrams; we hope that by integrating the use and interpretation of diagrams into the end-of-chapter questions, we may help instructors to address this problem.

New Media

Our goal has been to bring the powers of interactive media to bear on the exploration of physical geology. At the end of appropriate chapters, references are made to two new-media components of the program: **GEOSCIENCES IN ACTION** CD-ROM, where students find themselves as “virtual interns” exploring certain problems as a geologist would, and **GEOSYSTEMS TODAY: An Interactive Casebook on the WWW**, where students can take virtual tours exploring cases in geoscience.

Geology in Art and Literature

Sandwiched between each of the main parts of the book is a two-page spread with artistic and literary references to geology. These “coffee breaks,” as we have come to refer to them, are intended to provide a visual and conceptual break for readers. To most geologists it will not come as a surprise that the Earth and its ways have served as inspiration for artists, poets, and writers throughout the ages and in all cultures. We hope the “coffee breaks” will hold special appeal for students with a background in nonscientific fields, many of whom now populate introductory-level university and college courses in geology and Earth science.

Appendixes

The Appendixes provided at the end of the book present useful information on elements and minerals, units and conversions, and geologic maps. In addition, we append a more detailed discussion of Bowen’s reaction series than the one that appears in the main text. Some teachers of geoscience consider this material to be too advanced for an introductory course; it is included here for use at the instructor’s discretion.

Supplements

Geosciences in Action. This CD-ROM accompanies each text and allows students to become “virtual interns” in geology, whether exploring the source of a certain pollutant or determining the volcanic hazard at an island resort. These “Virtual Internships” were authored by David DiBiase, Thomas Bell, and Hobart King, and developed by the Deasy Geographic Labs at Pennsylvania State University.

Geosystems Today. This casebook and interactive WWW site provides students with eight cases from around the world in which to see and explore the interaction of people and their environment. Authored and developed by Robert Ford, Westminster University, and James Hipple, University of Missouri.

Geology Today Media Resource Manager. This CD-ROM, free to adopters of the text, contain all of the line illustrations and many of the photos from the text for lecture projection, as well as several animations showing key geologic processes.

The Student Companion. This student study guide is authored by Barbara Murck and contains study hints, further explanations of key concepts, and self-tests.

Take Note! This free supplement for students contains all of the line illustrations from the text in a black-and-white format for students to use to take notes.

Instructors Manual and Test Bank. This resource is also authored by Barbara Murck and contains course material suggestions and test questions (also available in a computerized format).

Transparencies. The text figures are presented on transparency acetates for lecture enhancement.

Acknowledgments

As authors we could not ask for a more talented, patient, and caring team of professionals than those who came together to apply their expertise to this project. Our grateful thanks include our colleagues at John Wiley & Sons as well as those in the extended Wiley family who contributed to the book in many valuable ways.

The idea for a truly modern, readable, and accessible introductory physical geology text originally came from Wiley Geology Editor Cliff Mills, who has continued to be the creative force behind the project. The stamp of approval for the project came from Nedah Rose and Kaye Pace; we thank them warmly for their continuing support. From the beginning, the project has been nurtured with the greatest of care and skill by Senior Development Editor Nancy Perry. Nancy’s guidance, enthusiasm, and friendship led to an enjoyable project and a highly professional finished product. Sandra Russell, Senior Production Editor, saw the book through its production schedule with great competence and boundless good humor.

Special mention is due to Fred Schroyer, who put much effort into developing a particularly accessible and visually engaging art program. Fred’s creative input is responsible for much of the pedagogical effectiveness of the illustrations used in the book. Thanks also to Dan

Botkin, who helped the authors correct and clarify the difficult concepts presented in chapter 15.

As we strive to expand beyond the traditional boundaries of the printed page, new media are becoming more and more important as pedagogical tools. The “Virtual Internships” of the CD-ROM, *Geosciences in Action*, were developed by David DiBiase, Hobart King, and Thomas Bell. Robert Ford and James Hipple contributed the interactive case studies that are available through Wiley’s web page. Many thanks to these colleagues for developing these exciting new media explorations and to Fadia Stermasi who coordinated the development of new media for this project.

Others who contributed their considerable talents to the project include (in no particular order): Cathy Donovan, who provided ever-present helpfulness on all fronts; Kim Khatchatourian and Alexandra Truitt, who (as usual) managed to find the most remarkable photos; Jennifer Yee, who coordinated the supplements; Bridget O’Lavin, editorial assistant; Carl Spector, permissions editor; Carolyn Smith, whose familiar green pen once again tightened and improved the text; Ishaya Monokoff and Anna Melhorn, who coordinated the art program; Karin Kincheloe, who contributed an inspired design; and Catherine Beckham, who coordinated marketing for the book.

We also extend warm thanks to J. Marion Wampler. Many teachers of geoscience are familiar with Marion’s regular feature article in the *Journal of Geoscience Education*, entitled “Geomythology: A Column about Errors in Geoscience Textbooks.” Instead of waiting for *Geology Today* to show up in Marion’s column, we decided to take proactive measures by asking him to review each chapter for accuracy and clarity. Marion’s dedication to the task went beyond the call of duty; he combed each chapter in search of errors, omissions, inaccuracies, and other sources of confusion. The arrival of one of his reviews invariably elicited cries of anguish, irritation, and sometimes embarrassment (“How could I possibly have let *that* slip by . . . ?”). The book is both pedagogically and scientifically more sound—and certainly more readable—for Marion’s painstaking efforts. Of course, the authors take responsibility for any errors that still managed to slip through.

Finally, we recognize with gratitude the contributions of Steve Porter, co-author of *Environmental Geology*, *The Dynamic Earth*, and *The Blue Planet*, among others. Steve’s research and administrative responsibilities prevented him from participating in this project. However, his influence can be detected throughout the book, from his wonderful photographs

to the echo of his thoughts and words on the printed page. Thanks for your input, Steve.

Geology is an interdisciplinary science, encompassing many areas of expertise. For this reason, we sought the input of colleagues who collectively represent a wide range of experience in all aspects of geology research and teaching. The careful reading and extensive commentary by these colleagues improved the book immeasurably. Their thoughtful suggestions touched on every aspect of the book, from the overall organization to the tiniest details. Through their comments, our reviewers made available to us their many years of collective experience in conveying both the knowledge and the love of geology to beginning students. Thank you to those who assisted us by reviewing all or part of the manuscript. They are:

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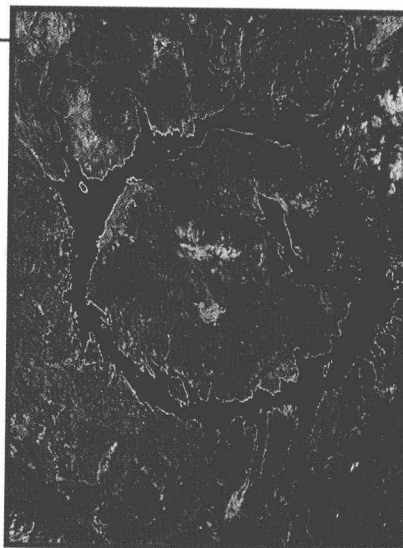
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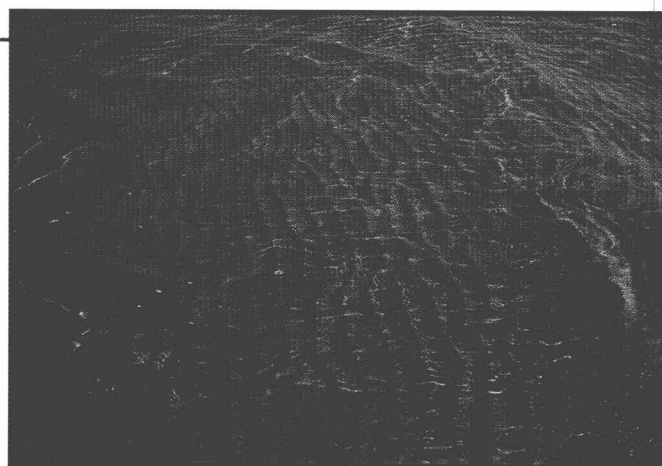
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