

CARLA W. MONTGOMERY

ENVIRONMENTAL
GEOLOGY



ENVIRONMENTAL GEOLOGY

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Preface

Why Environmental Geology?

The *environment* is the sum of all the factors and conditions surrounding an organism that may influence it. A person's physical environment encompasses rocks and soil, air and water, factors such as light and temperature, and other organisms present. It is possible to consider also a social environment, which 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. Since 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 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.

There are various reasons for studying a subject like environmental geology. One might simply be curiousity about the way the earth works, about the *how* and *why* of

natural phenomena. Another is that we are increasingly faced with environmental problems to solve 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 studied and solved using geologic data alone. The problems vary widely in size and in complexity. In a specific instance, we might also need to consider data from other branches of science, such as biology, chemistry, or ecology, and to take into account economics, politics, or social priorities, and so on. Because a variety of considerations may influence the choice of a solution, there is frequently disagreement about which solution is “best.” Our own personal choices will often depend strongly on our beliefs about which considerations are most important.

It is impossible in an introductory text to explore all aspects of environmental concerns. Here the emphasis will be on the physical constraints imposed on human activities by the geologic processes that 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, nor can we 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 will from time to time introduce peripheral related considerations from outside geology in order to help make clear other ramifications of the subjects discussed. Likewise, the present does not exist in isolation from the past and future; from time to time we will look 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 math 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 B, 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. To emphasize the present relevance of the material in the text, and to illustrate some of the variety of current environmental problems, many chapters include actual case histories or specific examples. To these each reader could no doubt add others from personal experience. Additional supplementary information is included in boxes set off from the main body of the text. Each chapter concludes with exercises that allow students to test their comprehension of text material and to apply that knowledge to real-world situations.

The book starts with some background material: a brief outline of the development of the earth 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 “nuts and bolts” of geology, rocks and minerals, which will introduce some basic terms and concepts that will be 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 which 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; 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 will 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 increasing pollution. Problems of air and water pollution and strategies for the disposal of various kinds of wastes are considered in the next section.

The last few chapters deal with a more diverse assortment of subjects. Medical geology, quite a new field, concerns the relationship between health and the geologic setting in which we live. Environmental problems spawn laws intended to solve them; the environmental law chapter looks briefly at a sampling of laws related to geologic matters discussed earlier in the book, as well as at some of the problems with such laws. The engineering geology/land-use planning chapter examines geologic constraints on construction schemes and the broader issue of trying to determine the optimum use(s) for parcels of land.

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 it looks at the rates of geologic and other processes by way of putting human activities in temporal perspective.

Available with this text are an Instructor's Manual containing 590 test questions and thirty-two acetate transparencies of key illustrations from the text. These are designed to aid instructors in class presentations and to enhance student learning activities.

Acknowledgments

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My family has been immensely supportive of this undertaking from the start. A very special vote of appreciation goes to my husband—patient sounding board, part-time photographer, and field assistant—in whose life this book at times came to loom as large as it did in my own. Last, but assuredly not least, I would like to express my deep gratitude to the entire WCB book team, for their enthusiasm, professionalism, and just plain hard work, without which successful completion of this project would have been impossible.

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