Physical and Chemical Hydrogeology

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Physical and Chemical Hydrogeology

To Diane and Cynthia
and
The Memory of Lucy and Phil

Preface

We view *Physical and Chemical Hydrogeology* as a textbook rather than a reference volume or collection of facts and formulas with little underlying organization. The approach taken is process-oriented, and one of the goals is to provide an intuitive feeling for the total science so that the subject can be seen as a whole rather than a collection of unconnected pieces. However, we have not overlooked the value of reference material, and original and other sources are included in a rather extensive bibliography. We recognize further that there is great interest in the practice of hydrogeology. To this end we include chapters or sections that deal exclusively with state-of-the-art applications, including a significant number of worked examples of computational procedures and a problem set for most of the chapters. We also recognize that in the absence of theory there can be no practice, only chaos. As some of the mathematical ideas in hydrogeology are among the most abstract that beginning students in the physical sciences will ever encounter, we have attempted a reader-friendly style of exposition so that the mathematics can at least be understood conceptually. The price one pays for this style of exposition is increased length and a fair amount of redundancy, some of which may hopefully reinforce the more difficult concepts.

Physical and Chemical Hydrogeology is divided into three sections. After presenting preliminary information on the hydrologic cycle and the porosity and permeability of porous material, the sections deal with fluid, energy, and mass transport in porous media. We believe these sections will serve a diversity of interests, including those of geologists, practicing hydrogeologists and engineers, geochemists, and geophysicists interested in fluid dynamics. We claim little originality in the basic content of the book, but we are pleased with the manner in which it is organized and treated. Whoever the reader, the book is intended as an introduction to hydrogeology, either at the advanced undergraduate or beginning graduate level. We have assumed the reader knows something about calculus, basic physics, chemistry, and geology.

The consideration of notation and units is always a central one in textbooks. Because of the integration of ideas from a variety of disciplines, it is difficult to employ a consistently familiar system of symbols. Whenever one symbol is generally accepted for two different quantities, choices have to be made. The question of units is equally perplexing. The SI system is used to some degree within the United States and more or less universally everywhere else. In the United States, some units are derived from the English system, some from the metric system, and some are best regarded as "field" units because their use is so common in field practice. In this text, we generally use SI metric units but will also provide an equivalent measure in field units where the use of such units is common practice.

For us the work was truly a collaborative effort with each of us contributing equally to the book. We would like to express our thanks to others who contributed directly and indirectly, in particular Alan Fryar, who prepared Section 15.4, and Vic Palciauskas, who commented on most of the theoretical developments through Chapter 9. Large parts of the manuscript were reviewed by Dick Jackson, Darrell Leap, Gary Robbins, and Don Siegel. Jim Hendry, Les Smith, Rob Schincariol, John Tinker, Jr., and Hans-Olaf Pfannkuch reviewed sections of the manuscript. Their helpful comments and suggestions helped us shape the final draft. We are also indebted to other colleagues and friends, and students who have influenced us through the years.

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