PETROLOGY OF SEDIMENTARY ROCKS

SECOND EDITION

Petrology of Sedimentary Rocks is an advanced textbook describing the physical, chemical, and biologic properties of the major types of sedimentary rocks, as revealed by petrographic microscopy, geochemical techniques, and field study. It covers the mineralogy, chemistry, textures, and sedimentary structures that characterise sedimentary rocks, and relates these features to the depositional origin of the rocks and their subsequent alteration by diagenetic processes during burial. In addition to detailed sections on siliciclastic rocks (sandstones, shales, conglomerates) and carbonate rocks (limestones and dolomites), it also discusses evaporites, cherts, iron-rich sedimentary rocks, phosphorites, and carbonaceous sedimentary rocks such as oil shales.

This Second Edition maintains the fundamental structure of the original book, and presents a comprehensive treatment of sedimentary petrography and petrology. It has been thoroughly updated to include new concepts and ideas, and cutting-edge techniques such as cathodoluminescence imaging of sedimentary rocks and backscattered electron microscopy. Numerous photographs and diagrams illustrate characteristic features while an extensive and up-to-date reference list provides a useful starting point for additional literature research.

This textbook is designed for advanced undergraduate and graduate courses in sedimentary petrology. It is also a key reference for researchers and professional petroleum geoscientists wanting to develop an understanding of the petrologic characteristics of sedimentary rocks and their geological significance.

SAM BOGGS, Jr. received his Ph.D. from the University of Colorado and worked in the petroleum industry for a number of years before joining the University of Oregon, where he taught sedimentology and related subjects for more than 30 years, and where he continues his research in sedimentary petrology as a Professor Emeritus. He has also worked part-time as a research geologist for the US Geological Survey. Professor Boggs is a member of the Society for Sedimentary Geology (SEPM), the American Association of Petroleum Geologists, and the Geological Society of America. He is the author of two other books for Cambridge University Press – *Backscattered Scanning Electron Microscopy and Image Analysis of Sediments and Sedimentary Rocks* (1998) and *Application of Cathodoluminescence Imaging to Study of Sedimentary Rocks* (2006), as well as the author of four other books.

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Dedicated to my father, Sam Boggs, Senior,
for all he gave.

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Preface

As indicated in the first edition, this book emphasizes the properties of sedimentary rocks rather than sedimentary processes. Thus, it focuses on description and discussion of mineralogic and chemical composition, as well as the textures and sedimentary structures that characterize sedimentary rocks. Further, it discusses application of insights derived from study of rock properties to interpretation of their origin, including provenance (sediment source), depositional environments, and diagenesis. Part I of the book deals with basic principles related to the origin, classification and occurrence of sedimentary rocks. Part II describes and discusses the siliciclastic sedimentary rocks such as sandstones. Part III describes the carbonate sedimentary rocks (e.g. limestones), and Part IV discusses other chemical sedimentary rocks and carbonaceous sedimentary rocks such as oil shales. The book is aimed at advanced undergraduate and graduate students; however, professional geologists may also find the book useful.

Sedimentary petrology is a broad scientific discipline that encompasses study of all kinds of sedimentary rocks, including those that constitute a relatively small volume of total sedimentary rocks. These volumetrically minor rock types nonetheless provide valuable insight into Earth history, and some are economically significant. Thus, the book gives significant coverage to minor rock types such as cherts, phosphorites and iron-rich sedimentary rocks, as well as to more abundant sedimentary rocks such as sandstones, shales and limestones, which make up the bulk of the sedimentary rock record.

Petrologic study requires application of suitable techniques for field and laboratory observation and analysis. Several kinds of studies, such as measuring and describing sedimentary structures, are carried out in the field before specimens are collected for further analysis. In the laboratory, petrographic microscopy is a venerable, basic tool for studying the composition and texture of sedimentary rocks; however, it is being supplemented increasingly by a variety of other tools and techniques (see Chapter 1). Electron microscopy, cathodoluminescence microscopy, X-radiography, electron probe microanalysis, Fourier analysis and various kinds of spectroscopic analyses are examples of techniques that allow further optical, geochemical and physical characterization of sedimentary rocks. This book discusses applications of many of these techniques and furnishes references to

numerous published monographs that provide further in-depth discussion of analytical methods.

During preparation of *Petrology of Sedimentary Rocks*, I drew heavily upon the published work of numerous researchers. I wish to acknowledge the value of their contributions and to thank other individuals, including reviewers and editors, who contributed to the book.