

SECOND EDITION

**ORIGIN OF
SEDIMENTARY ROCKS**

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ORIGIN OF SEDIMENTARY ROCKS

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PREFACE

This book was written for a first course about sedimentary rocks taught at the advanced undergraduate or beginning graduate level. In addition, we hope that it will have value for those professionals in geology and related fields who seek a modern treatment of the subject. The idea behind it began when we realized that there was no book available that brought together the many profound ideas and new data about sedimentary rocks that have appeared in the last ten years. We realized that a synthesis of this material was needed, both as a summary of what appears to be known and as a guide to the directions in which research on sedimentary rocks is now moving.

The three authors of this book differ in background, training, and research interest. We have tried to make this book the product of all of us and not simply a collection of single-authored chapters. We feel that this facet is important, because it should be possible for the reader to see the inherent similarities and differences between different types of sedimentary rocks and processes. Such rocks as limestones and sandstones should not be regarded as completely separate entities because of their differences in mineralogy.

We were faced with two main problems of selection: overall approach and particular rock types or phenomena. Our approach has been to emphasize the mechanisms and processes of sedimentation, both physical and chemical. We

assume only a standard undergraduate preparation in mineralogy and paleontology, combined with an elementary working knowledge of chemistry, physics, and calculus. Using this background knowledge, we have tried to show how an understanding of sedimentary processes can be developed that leads, in turn, to an understanding of the origin of sedimentary rocks.

In preparing this second edition, we have retained the basic approach of the first edition but have greatly expanded our treatment of facies and environments. We have done so for two reasons: it is clear to us from the comments of many instructors who use this book that they would like to see the topic of facies given more extensive treatment; and knowledge of modern sedimentary environments and examples of environmental interpretation of ancient sedimentary rocks have increased dramatically since the first edition was written.

Other major changes in this edition include: incorporation throughout the book (particularly in Chap. 2) of the concepts of plate tectonics; a systematic treatment of the geochemistry of natural waters (Chap. 6) before the discussion of weathering; and a new discussion of porosity and permeability of detrital rocks (Chap. 12). There are no longer separate chapters on zeolites or on major external controls of sedimentation. Some material from these earlier chapters has been incorporated into the revised chapters on cementation and deep diagenesis of sandstones (Chap. 9) and facies models (Chap. 19), respectively.

We retained our original policy of trying to restrict the number of references so as not to overwhelm the reader, but more citations are included than in the first edition. This practice, and the annotations of references, should lead those readers who are interested in a particular topic quickly into the larger literature of the field. We apologize to those of our colleagues whose ideas we may have used without specific reference; a recent book that covered a much narrower field of sedimentology but attempted a comprehensive bibliography found it necessary to include 60 pages of references!

All textbooks are largely compilations and syntheses with few, if any, new data. Certainly this book is no exception. Our object has been to collate the main results and insights of modern sedimentologic research and to present these in a way that will help interested readers to carry out their own investigations and prepare them for their future work.

We hope that some of our readers will send us their comments and suggestions for improving this book.

H. B., G.V.M., R.C.M.

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PART ONE

AIMS AND METHODS IN THE STUDY OF SEDIMENTARY ROCKS

Field work forms the basis for the study of sedimentary deposits, both modern and ancient. To make best use of the limited time and resources available for field studies, the geologist must first consider defining which properties he will observe and measure and how he will select his observations and specimens for further study in the laboratory. What are the fundamental properties of sediments? How do we measure them? How can we take a sample that will truly represent the unit being studied?