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Exercises in

SEDIMENTOLOGY

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PREFACE

This manual contains sedimentology exercises for students; it is not a sedimentology reference manual. In the following pages you will find ten exercises, some of which require more than one laboratory session to complete.

The study of sedimentology involves consideration of sedimentary materials, sedimentary processes, and the various products of these processes, with the ultimate end in view of interpreting the three-dimensional relationships of sedimentary strata. This manual contains exercises designed to introduce the student to the procedures used in sedimentological analysis.

Exercises One through Eight deal with the compositional and textural nature of sedimentary particles and the myriad combinations in which such particles may accumulate in nature, whether as modern sedimentary deposits or their ancient equivalents - sedimentary rocks. Exercise Nine deals with the analysis of three-dimensional arrangements in which sedimentary rocks are found, and Exercise Ten is designed to simulate the geological and economic conditions encountered in exploration for oil and gas. In general, Exercises One through Ten proceed progressively from very specific laboratory collection and analysis of data to more general, office treatment and interpretation of field and exploration information.

An instructor's supplement has been prepared to accompany Exercises in Sedimentology in order to assist instructors in fitting the exercises into particular course contexts. All of the exercises in this manual were generated by the authors, with the exception of Exercise Ten. This exercise is a modification of a "petroleum game" devised by Shepard W. Lowman, late Professor of Geology at Rensselaer Polytechnic Institute.

Numerous references are listed within individual exercises and a short list of other references is included following Exercise Ten. The last section of the manual is a glossary of sedimentological terms. All of these sections combine to make the manual a valuable information source for the student after completion of formal in-course study of sedimentology.

The authors wish to acknowledge the contributions of John E. Sanders of Barnard College, who wrote parts of the material taken directly from Principles of Sedimentology by Friedman and Sanders and used for this manual; Yitzhak Levy of Weizmann Institute of Science and the Geological Survey of Israel, who wrote early versions of several of the exercises while a visiting professor at Rensselaer Polytechnic Institute; and Richard

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Although this manual has been written to complement the text Principles of Sedimentology by Friedman and Sanders, it is designed to serve equally well for laboratory instruction in a course for which a text other than Principles of Sedimentology is being used.

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EXERCISE 1

The surface of the land is made
by nature to decay Our
fertile plains are formed from
the ruins of the mountains.

James Hutton, 1785

EXERCISE 1 SEDIMENTARY PARTICLES

Introduction

Sedimentary deposits are assemblages of individual grains, or particles. These particles compose the framework of a modern sand or mud deposit, such as a beach or a point bar, or of its lithified equivalent, a sedimentary rock. The purpose of this exercise is to introduce you to the various kinds of particles that are commonly found in sedimentary rocks. Depending on their kind, they may be excellent indicators of the nature of either (1) the source from which they were derived or (2) the environment in which they evolved and accumulated.

Kinds of Sedimentary Particles

Sedimentary particles may be divided into two broad groups (Friedman and Sanders, 1978): (1) solid breakdown products of older deposits and (2) materials that are not solid breakdown products of older deposits. The second group consists of (2a) materials violently ejected from volcanoes and (2b) materials transported in water solution and deposited at the site of accumulation by biologic secretion or chemical precipitation.

Group-One Particles: Solid breakdown products of older deposits. All particles which are eroded from the land constitute terrigenous particles. These are subdivided into two groups: (a) inorganic materials and (b) carbonaceous materials. Most terrigenous particles, if traced back to their original place of origin, come from bedrock. Examples of inorganic terrigenous particles are rock fragments, quartz, feldspar and heavy minerals. Heavy minerals, as the name implies, are more dense than most minerals. They were originally derived from igneous or metamorphic rocks. Carbonaceous terrigenous particles include: (1) solid carbonaceous materials reworked from older strata and (2) modern plant detritus.

Group-Two Particles: Materials that are not solid breakdown products of older deposits. These are subdivided into: (a) materials ejected

from volcanoes and (b) solids that grew biochemically or chemically in the depositional basin. Materials ejected from volcanoes are considered pyroclastic particles. They may be rock fragments (lithic), single crystals (crystal), or bits of volcanic glass (vitric). Accumulations of pyroclastic particles are sometimes referred to as tephra. Particles that grew as solids in the depositional basin include (1) skeletal debris, (2) nonskeletal calcium-carbonate materials, (3) evaporite minerals that were physically transported and (4) glauconites.

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