

The Nature of the Stratigraphic Record

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stratigraphic record is of particular interest. It deals with the study of the vertical and lateral movements of the surface of Earth, and the effects these movements have on the characters of the sediments and their rate of deposition.

It is unfortunate that the concept of geological time is not treated in a more exhaustive manner. Stratigraphy is the placing of *events* in their *sequence* in *time*. Matthews is biased toward the analysis of events, and assumes that students are familiar with, or can rapidly assimilate, the concept of time, and the methods to measure it. His lower sensitivity to these problems is also revealed in several minor details, such as (a) calling parts of the Devonian (e.g., Lower Devonian) sometimes an "era", sometimes a "period", or just "time"; (b) presenting geological time tables that may be confusing because of poor labelling of columns; and in one case (Table 9.2) the first column is not separated from the others, so that it appears that Triassic, Jurassic and Cretaceous belong to the Paleozoic. A more acute sensitivity to pedagogic principles could also be hoped for, e.g., by avoiding the use of terms and concepts before - sometimes several chapters before - a definition or brief explanation of them is given.

In the third part (5 chapters, 84 pages) of the book, which has a good review of recent and outstanding papers, an analysis is made of active processes and sediments formed in major environments of sedimentation, from braided streams to oceanic floors, and from restricted basins to open carbonate shelves. From the knowledge acquired from recent environments, sedimentary models are constructed that can be used in the interpretation of ancient stratigraphic units. Here, Matthews offers a superb selection of recent papers. This third part of the textbook justifies the subtitle given to this book, that is, "Dynamic Stratigraphy — Introduction to Sedimentation and Stratigraphy". This subtitle should be displayed in larger characters, and it should be written also in the jacket to make its titling less misleading.

The fourth section of the book is entitled "Cyclicity in the Stratigraphic Record". At the level of this book, this is stratigraphy at its best, and it may be

of interest also to the non-specialist, experienced geologist. Here, Matthews pulls together the knowledge gathered through the book, and guides the student through the analysis of Pleistocene marine sections, Paleozoic sequences of epeiric seas and the Kansas cyclothems. He shows how the various sedimentological and stratigraphic concepts and models are put to work.

The book reads well. The illustrations are well chosen, and enhance the understanding of the subject matter. With some reservation, the book can be considered a suitable textbook for institutions that offer only a one semester course covering both stratigraphy and sedimentology. Parts of the book can be used as a reading reference for students taking more specialized courses.

Matthews has shown effectively the close association that exists between sedimentology and stratigraphy, so much so that in future editions it would be helpful if formal definitions for both sciences could be given in the early pages. For the future, it is also hoped that larger emphasis will be given to the relation of stratigraphy to the "new global tectonics", to mineral accumulations, and to features of the sedimentary columns useful to man.

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The Nature of the Stratigraphic Record

by Derek V. Ager
John Wiley and Sons, Ltd., Toronto
 114 p., 1973.
 \$9.95.

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"This is not a textbook or a research treatise . . . It is a commentary on the general pattern of earth history . . . it is stratigraphy looked at by a non-stratigrapher." Thus the author in his preface; and he adds: "the one great hope I have for this book is that it will stimulate thought and argument, even rage."

Derek Ager is perhaps best known for his work on Mesozoic rhynchonellid brachiopods, and for his book on paleoecology (published in 1963). His research has carried him to many parts of Europe, and he has been an observant geological tourist in Canada and the United States. This book contains his personal reflections on the broader issues raised by his work, observations and reading. Its general thrust is summed up in one line summaries at the end of each chapter. Some examples: "at certain times . . . particular type of sedimentary environment were prevalent over vast areas of the earth's surface"; "the sedimentary pile at any one place . . . is . . . a tiny and fragmentary record of vast periods of earth history"; "the periodic catastrophic event may have more effect than vast periods of gradual evolution"; "most sedimentation in the continental areas is lateral rather than vertical . . .". The chapter heads are designed to drive the message home: "More Gaps than Record", "Catastrophic Stratigraphy", "Catastrophic Uniformitarianism".

I doubt that many geologists familiar with the results of modern sedimentology will find much that engages them in this book. There are, of course, matters with which we may disagree but the basic message seems valid, and it is well to be reminded of it. The sedimentary record is more incomplete than the pioneer

stratigraphers could possibly have guessed. The rate of sedimentation is so variable that most deposits should not be considered to form by "slow accumulation" but by rapid sedimentation alternating with long periods of reworking or non-deposition. Some sedimentation, probably more than was thought by Lyellian stratigraphers (though Lyell himself was remarkably flexible on the matter) was produced by "catastrophes" such as giant floods, hurricanes or turbidity currents. Other "depositional episodes" (Frazier, 1974) such as the growth of a single delta lobe, were probably completed in such a short period of geological time (a few hundreds or thousands of years) that, viewed across a hundred million years, they seem almost instantaneous. We know this, but is it in the text-books? Do we acknowledge it sufficiently in our current stratigraphic interpretations and terminology?

Ager is better at asking provocative questions than at providing a grand synthesis. The last chapter of his book ("The Nature of the Control") attempts to blend together American and European Phanerozoic stratigraphy with just a dash of plate tectonics. It still reads to me like the old story of "the seas swept in, the seas swept out". But the rest of the book can be recommended, the informal style makes easy reading and the ideas are worth pondering.

Reference

Frazier, D. E., 1974, Depositional-episodes: their relationship to the Quarternary stratigraphic framework in the northwestern portion of the Gulf Basin, Texas Bur. Econ. Geol., Geol. Circ. 74-1, 28 p.

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Shelf Sediment Transport: Process and Pattern

Edited by Donald J. P. Swift, David B. Duane and Orrin H. Pilkey
Dowden, Hutchinson and Ross, Inc., Stroudsburg, Pennsylvania, 656 p., 1972.
\$35.00

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The modern continental shelves of the world are peculiarly interesting and yet frustrating areas of study for geologists. The shelves comprise some six percent of the total surface area of the globe and in places are hundreds of kms wide. The shelves include most of the broad areas of shallow marine sedimentation that now exist. The stratigraphic record tells us that much of the exposed geological column was deposited in broad shallow seas, and uniformitarianism suggests that geologists should study the sediments on modern shelves in order to understand the distribution of facies in ancient continental seas. The near exhaustion of some mineral resources under parts of the continents, and the discovery of substantial resources under some continental shelves, have spurred development of the technology which has now made possible the active exploitation of these resources, even in relatively deep water and under hostile climatic conditions.

The frustrating aspects of shelf geology, however, have tended to prevail over the interesting aspects. Early studies soon showed that many characteristics of the modern shelves can be explained only by reference to the rapid post-glacial rise in sea level. K. O. Emery has argued convincingly that most modern shelves are not yet readjusted to the conditions that now exist and that have prevailed over them for only the last 6000 years. This suggests that "the present is the key to the Pleistocene" but is not much help with the rest of the geological record. Skepticism about the value of studying modern shelf sediments has been strengthened by the realization that many ancient shallow marine

sediments were deposited not on continental shelves but in vast, interior "epeiric" seas of which we have no modern examples.

Despite these frustrations, and others that arise from the difficulty and expense of operations, even in shallow water, that have to be carried out tens of miles from shore, some marine geologists have persisted with their studies of shelf sediments. This volume gives an excellent summary of work recently carried out at a number of U.S. institutions.

What has led to the most interesting results has been a change in the method of investigation. If modern shelves are largely relict, simply mapping the distribution of sediment types is of limited value: the patterns cannot be fully explained in terms of modern processes. Instead, it is necessary to obtain first an understanding of the actual processes operating on modern shelves. Armed with this understanding, it is then possible to see which aspects of modern shelves are, in fact, truly relict, which are better described as "palimpsest" (a term introduced by Swift, Stanley and Curray to describe sediments that are derived from one environment but that have been substantially reworked in another) and which are truly modern. Ultimately, a firm understanding of process may yet enable marine geologists to "retrodict" the characteristics of shelves which, in the past, were able to achieve a closer approach to equilibrium between process and response.

Most of the papers in the volume deal with physical aspects of sedimentation (there are no papers on carbonates or on specifically chemical or biological problems). Many papers explore the hydrodynamics of processes acting on the shelves: some are theoretically-based research papers, such as the paper by Sternberg on predicting bedload movement and transport rates, the paper by Southard and Cacchione on sediment movement by internal waves that form at the thermocline and break as the water shallows, the paper by Schubel and Okubo on diffusion of fine grained sediment across the shelves to the ocean basins, and by Komar and others on the characteristics and occurrence of deep water oscillatory ripple marks. A few papers briefly