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Aller au sommaire du numéro

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Book Reviews

Mechanics of Sediment Movement

(SEPM Short Course No. 3)

By G.V. Middleton and J.B. Southard
Society of Economic Paleontologists and Mineralogists Tulsa, Okla., 260 p., 1977 (Revised March 1978).
U.S. $7.

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This publication was initially designed to supplement and embellish a short course of lectures on sediment movement sponsored by the Eastern Section of the SEPM; its style is such that it cannot be accused of following the standard art of "textbookery". Prepared as a series of "lecture notes" (to use the authors' own terminology), it neatly packages in a refreshingly informal way a lot of basic to sophisticated information on fluid mechanics and sediment transport mechanics, and presents it in a form palatable for consumption by sedimentologists and related earth scientists. The reader is assumed to have an elementary knowledge of calculus and Newtonian physics, but a minimal knowledge of fluid mechanics. Discussion is confined to unidirectional flow (i.e., to the exclusion of wave effects), and no attempt is made to review the manifold theories pertaining to the prediction of bed-and-suspended load discharge. The emphasis is on the initiation of particle movement, the mechanics of bed-load and suspended-load transport, and the dynamics of bed configurations in cohesionless materials.

The first few chapters present an overview of basic fluid mechanics, emphasizing the physical properties and behaviour of fluids, fluid drag, Stokes' Law, flow patterns, flow separation, the Bernoulli equation and elementary boundary layer theory. These and other related topics are elaborated in later chapters. For example, Chapter 4 ("More on Drag and Settling") analyses the drag on spherical and non-spherical bodies with special reference to the interrelationships between size, shape, concentration and settling velocity; and the chapter closes with a discussion on the sedimentologic implications of liquefaction and fluidization.

Chapter 5 returns to the topic of turbulent flow in pipes and open channels, covering the mechanics of turbulent diffusion, the structure of turbulent boundary layers, velocity profiles, (rigid) boundary roughness and fluid resistance, friction coefficients and the equations of flow. The authors note the dearth of information on the turbulence structure of natural steams. Having regaled the reader with five chapters of meaningful background information, the focus is then shifted to the topic of sediment movement, beginning with the stability of single grains on a cohesionless stream bed (cohesive beds are not considered). Thereafter the discussion focuses on the nature of a mobile boundary at the threshold of particle movement, where the transport mechanism is characterized by sporadic "grain bursts" and by processes of sliding, rolling and hopping (saltation) of grains under the motivating influence of lift and drag forces. Saltation in an aerodynamic environment is also given a cursory treatment. H.A. Einstein's stochastic model of grain movement is reviewed in the light of recent data on dimensionless velocity parameters, and the Shields' classic competency relationship is updated for low boundary Reynolds numbers. Sediment sorting and channel armoring are shown to have an appreciable effect on the beginning of motion. The nature of sediment movement above the threshold is also explained in terms of the characteristics of the traction, suspension and intermittently suspended grain populations (with implications for cross-bedding), and the derivation of the suspended-load equation is outlined for the distribution of sediment concentration in the vertical. The enigmatic nature of the contact/transitional zone between bed and suspended load is briefly touched on.

Chapter 7 on "Bed Configurations" is prefaced by "More on Open-Channel Flow" (which could have come earlier) and by a capsule treatment of flume experimentation. Discussion ranges from the general succession of bed forms produced by increasing flow velocity/bed shear/stream power to the detailed patterns of flow, sediment and bed-form movement. The presentation is documented by depth-velocity diagrams and other plots showing the functional relationships between flow and sediment parameters. The chapter closes with a résumé of the controversial ideas pertaining to the genesis of bed forms. The final chapter (8) is devoted to the mechanics of sediment gravity flows, and specifically to the four geologically important categories designated as turbidity currents, liquefied sediment flows, grain flows and debris flows. Included here is a discussion on the role of the densiometric Froude number, the Bingham number (for plastic materials) and Bagnold's relatively untested concept of dispersive pressure.

In summary, the publication cites 178 references and presents an up-to-date coverage of many aspects of sediment transport mechanics within an earth

science and engineering context. It emphasizes the mathematical and theoretical aspects of the discipline, makes liberal use of dimensional analysis, and poses a number of unanswered questions. It tends to lack the polish, editorial finesse and perhaps the organization of a regular textbook (which it doesn't pretend to be), but it gets the message across with incisive clarity and achieves its goals admirably. It is a very worthwhile publication and no one could deny that the price is right!

MS received January 16, 1979.

Coastal Sedimentary Environments

Edited by Richard A. Davis, Jr.
Springer-Verlag, New York, 420 p., 1978
US $19.80

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The purpose of this book is to provide a comprehensive introduction to modern coastal environments and the processes operating within them. Because of the complexity of the coastal zone, a rather unusual, multi-authored approach has been adopted, with each chapter written by an individual (or individuals) who is a specialist in the particular field under discussion. Each chapter is intended to stand on its own, and contains a wealth of information concerning the morphology, sediment characteristics, and processes active within the various environments. Unfortunately, however, there is little cross-referencing between chapters, and the editorial pen apparently has not been wielded with consistent vigor. Consequently, the book is rather disjointed and uneven: a problem which is particularly serious in a text intended for advanced undergraduates and graduate students.

The selection of environments covered in the book is broad, but not entirely complete. Intertidal sand and mud flats, macrotidal or high-energy estuaries, rocky coasts, and back-barrier lagoons are not considered, and barrier islands as a whole receive only passing attention. Among the environments that are considered, coverage is for the most part neither comprehensive (in terms of tectonic or climatic variability), nor uniform. The two environments which have been most thoroughly studied and documented, namely deltas and beaches, receive relatively short (but adequate) treatment in this book, in chapters by L.D. Wright and R.A. Davis, Jr., respectively. Considerable literature is also available on low-energy (muddy) estuaries, but this environment is covered in the shortest and weakest of the environmental chapters (R.B. Biggs). In contrast, the less widely documented environments, salt marshes (R.W. Frey and P.B. Basan), coastal dunes (V. Goldsmith), and tidal inlets (J.C. Boothroyd), receive more extensive discussion. Indeed, the marsh and dune chapters may well be the best available summaries in the geological literature, and the chapter on marshes is the best in the book, in this reviewer's opinion.

The two final, short chapters do not add greatly to the book. Chapter 7 (J.C. Kraft), investigates transgressive and regressive coastal sequences, particularly for barrier islands, in a rather philosophical and generalized fashion, without reference to facies or to the preceeding environmental chapters. Chapter 8 (W.T. Fox) discusses several numerical modeling techniques that have been used to describe coastal zone morphology and processes. The coverage is non-mathematical and easily read, but is non-critical and seems out of place.

Throughout the book, there is a tendency for a multitude of observations from various sources to be listed without synthesis or comment. The result will undoubtedly be confusing to students without previous background. In addition, the detailed process descriptions are not linked sufficiently closely to the observed sediments. Thus, the book has limited direct applicability in the interpretation of ancient rocks.

On a more technical level, the book suffers badly from poor-quality figures. Many of the line and half-tone diagrams taken from other sources have not reproduced well, particularly in the chapter on tidal inlets, and some are almost impossible to decipher. Presumably this is the price we must pay for the low cost of the book. Typographical and other errors are also more abundant than one would wish, notably in the dune and tidal inlet chapters.

Despite its failings, this book does provide a worthwhile summary of coastal processes, and will be of some value of those actively working in either the marine or lacustrine coastal zone. However, most geoscientists can be forgiven for passing the book up.

MS received February 23, 1979.

Caledonian-Appalachian Orogen of the North Atlantic Region

Edited by E.T. Tozer and P.E. Schenk
Geological Survey of Canada, Paper 78-13, 1978, 242 p.
$5.00

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This volume is a collection of syntheses of parts of the Appalachian-Caledonian Orogen extending from the southern Appalachians of the USA to Svalbard. It includes syntheses of Morocco, West Africa, the Iberian Peninsula, France, Corsica and Sardinia as well as the main parts of the orogen that extend through eastern North America and northwestern Europe to eastern Greenland and Svalbard. The syntheses were presented in preliminary form at the Second International Working Group Meeting of IGCP Project 27 in late 1976 in Nova Scotia.

The styles of presentation are varied but the volume is intended to provide a brief overview of Caledonian geology in the Atlantic region. Whereas this aim is achieved in general, particular parts of the orogen are treated in a way that will confuse the general reader. A section comparing and interrelating the different segments would have been most useful to the non-specialist in this field of geology. Several articles lack structural cross-sections or tables of depositional and diastrophic development which would have helped the general reader.

The contributions on the Scandinavian Caledonides are particularly useful since they are preceded by a brief article by B.A. Sturt. The Caledonides of Britian are treated in a similar way but the