

BOOK REVIEW

Sediment Diagenesis, edited by A. Parker and B. W. Sellwood. D. Reidel Publishing Company, Dordrecht, Holland, 1983. 427 pages, Hardbound, \$53.50. ISBN 90-277-1677-3.

This relatively high-priced book is based on the keynote addresses of a 1981 NATO Advanced Study Institute conference on sediment diagenesis that was held in Reading, England. The first five chapters deal with siliclastic sediments and rocks; the last three with carbonate sediments and rocks. The chapters are of varied quality, and some are marred by diverse typographical and other errors that should have been ironed out by critical review, editing, and proof reading. The apparently offset printing of typescript or word-processor manuscript is adequate, but a simpler, bolder style of type would have made the book easier to read. The photographs are of poor quality and lack detail. Too much reduction makes many of the line drawings difficult to read. Most of the line drawings seemingly were taken directly from illustrations used in the preparation of slides for the conference without needed redrafting. The index is incomplete and locally inaccurate. Despite the editorial and reproduction problems, the book does pull together important ideas and information that are scattered widely in the geological and allied literature. The book would be more useful had it contained a summary of the major areas of agreement, controversy, problems, and research opportunities in a preface or in a set of concluding remarks.

T. Elliot's lead chapter (56 pp.) on clastic sediments is a good, synoptic review of their depositional environments and the interpretation of them in the rock record. Uninitiated readers who really desire to learn something about modern and ancient sedimentary environments, however, probably would find the little books by Selley (1978) and Walker (1979) more instructive. An opening theme for the chapter is the ways in which depositional environments influence the course of diagenesis. Further pursuit of the theme beyond the early stages of diagenesis would have been a difficult but worthwhile objective for other parts of the book. The second chapter (61 pp.), by G. V. Chilingsarian, is concerned chiefly with the role of compaction of clays and sands during diagenesis. The chapter draws freely from prior publications of the author. It touches on stresses in compacting sediments, on pressure solution in sandstone, on cementation by both quartz and calcite, and on some aspects of carbonate diagenesis. A brief discussion of overpressuring in reservoir rocks is useful, but an important paper by Barker (1972) is not

cited. Conversely, an oft-cited 1969 paper by Allen on the shapes and packing of sand grains is not listed in the references. The discussion of the relationships between compaction and variations in pore-water salinity is not everywhere clear, and it does not specifically mention the influence of electrical double layers on the composition of water entrained in and expelled from compacting shales. The list of references is extensive and includes a number of pertinent engineering and foreign publications.

Chapter 3 (45 pp.), by K. Bjørlykke, is on diagenetic reactions in sandstone. It is handicapped not only by the breadth and complexity of the subject, but also by matters of style and format. The author notes that early authigenic chlorite may form in marine sands whereas kaolinite is a common early diagenetic growth in continental deposits owing to differences in the composition of early pore waters. He points out, however, that initial pore waters can soon be replaced by waters of very different composition as burial proceeds, and, consequently, that kaolinite and K-feldspar tend to react to produce authigenic illite and quartz overgrowths. Using mass-balance calculations, however, Bjørlykke argues that pressure solution may be the chief source of silica cement in sandstone. Similarly, he also de-emphasizes the role of dissolved CO₂ in the production of secondary porosity, but the potential role of organic acids and chelating agents derived from maturing hydrocarbons is not discussed. A partly controversial segment of the chapter is devoted to brief generalizations about the course of diagenesis in sedimentary basins developed in different tectonic settings. The fourth chapter (54 pp.), "Diagenetic Reactions in Clays" by Bruce Velde, probably is the most stimulating part of the book even though the chapter draws heavily on Velde's 1977 book. Velde strongly advocates a ternary phase diagram approach to clay-mineral assemblages that is directly analogous to the approaches of metamorphic petrology. Problems of stability and metastability are discussed, and the geochemistry and associations of the major clay minerals are reviewed. Appreciable space is devoted to glauconite, but the discussion probably was written prior to Odin and Matter's (1981) excellent paper on the properties and origin of glauconite. Making use of what is known of time, temperature, and pressure constraints, of the partitioning of major elements among clay minerals during diagenesis, and of the evolution of clay-mineral assemblages and mixed-layer clays, Velde develops a working concept of diagenetic facies for clay-mineral assemblages. Even though his diagenetic facies doubt-

less will be modified by new information, the concept should find useful application in petrologic studies of both sandstone and clay rocks.

The English of chapter 5 (20 pp.), "Facies Control on Sandstone Diagenesis" by Hans Fuchtbauer, is a little cumbersome; figure captions commonly are unclear; and some labels and symbols are not explained well. Even so, the chapter is a good synthesis of the literature and of the author's own broad experience. The emphasis is on those early stages of diagenesis in which pore fluids still are similar to those of the depositional environment. The chapter also reviews selected petrographic criteria for distinguishing between early and late diagenetic events and for developing paragenetic sequences, including the useful "minuscement-porosity" and "contact-strength" concepts. Ultimately, Fuchtbauer instructively examines the early diagenetic responses of some dominantly quartzose sandstone units to original sedimentation in continental and marine to marginal-marine environments. Chapter 6 (60 pp.) deals chiefly with currently accepted depositional models for shoaling-upward sequences in carbonate rocks. Authored by Noel P. James, much of the chapter is drawn from James' articles in Walker's 1979 book, but the text is expanded, updated, and more informative. This reviewer has had only limited experience with carbonate rocks. Consequently, he thinks that the illustrations should have been augmented by good photographs of outcrops and hand samples in order to illustrate bedding and textural features. Nonetheless, he found the chapter readable and instructive.

R. G. C. Bathurst wrote the seventh chapter (29 pp.), entitled "Early Diagenesis of Carbonate Sediments." This readable chapter clearly is not derived simply from Bathurst's 1975 textbook. Rather, it is a worthwhile review of the products and processes of early diagenesis in marine and marginal-marine carbonate sediments. Inclusion of photomicrographs of thin sections showing various textural features, however, would have been helpful to readers lacking experience in carbonate petrology. The chapter is especially valuable because it points up processes that are poorly understood and treats them in a balanced way, such as kinetic factors controlling the precipitation of aragonite vs. Mg-rich calcite cements in similar settings where low-Mg calcite should be the thermodynamically stable compound. Similar balanced treatment is given to the

various processes by which early dolomitization takes place. Bathurst also points out that the processes responsible for pervasive early cementation of poorly compacted carbonate sediments remain partly unresolved. Chapter 8 (39 pp.), by H. R. Wanless, treats burial diagenesis in carbonate rocks. This provocative chapter, which is based largely on a 1979 paper by Wanless, is devoted mainly to pressure solution of limestone during burial. The author presents a number of photographs and photomicrographs illustrating the diverse kinds of pressure solution that he recognizes, and proposes that so-called nodular bedding and the associated clay films of some limestone units are products of pressure solution along microstylolites. Dolomitization is given uneven treatment in that only dolomitization induced by pressure solution of Mg-calcite and consequent precipitation of dolomite is considered in detail. Discussions of neomorphism, cementation, and secondary porosity are brief and poorly illustrated.

Even though the book organizes many aspects of diagenesis in a systematic way, the price prevents this reviewer from recommending it as a textbook for graduate courses. Despite the uneven coverage of topics, a less expensive paperback edition might form a useful base for courses in diagenesis. Because the book does represent a synthesis of important ideas, it will be a necessary addition to university and research libraries. The chapter by Velde is essential reading for students of clay petrology and for sedimentary petrologists concerned with authigenic clays in sandstone.

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