

# ***Sedimentary Basins: Evolution, Facies and Sediment Budget***

by **Gerhard Einsele**, 1992, ISBN 3-540-54743-6; Springer Verlag, Berlin, 1992; 628 p., 269 fig., price \$..

## **Review by Christopher G. Kendall**

This important text is destined to be a best seller for academic or economic geologists who need an understanding of sedimentary stratigraphy to interpret well logs, seismic and basin stratigraphy. Packed with many beautiful and detailed block diagrams illustrating sedimentary structures, sedimentary geometries and relationships conceived by Einsele and drawn by Herman Wolmer, the effect is overwhelming and is unmatched by any other book on sedimentary stratigraphy.

Einsele must have worked continuously for years to produce it and one can understand why in the introduction, he thanks his wife and family for their toleration of his incessant work on the weekends and the evenings.

The book is divided into five sections. The first section is short and classifies basins and depositional environments. It is here that the reader is first confronted with the block diagrams that dominate the text. Basins are classified on the basis of structural and depositional character. These include interior sag basins, margin sag basins, and oceanic sag basins which are sub-divided on the basis of their sedimentary fill ranging from continental to marine, clastic to carbonate or chemical sediments, sediments which lie in the deep marine to those of the shallow marine and so on.

Depositional systems and facies models are divided into seven sections. First continental material including glacial deposits, fluvial sediments, aeolian sediments, chemi-clastic sediments and lake sediments are described. Einsele's approach in this and other sections is to summarize the information on each depositional setting using block diagrams and numerous cross sections of sedimentary structures

Next coastal and shallow water sediments are described including beach and shoreface sediments, sediments of the tidal flats and barrier islands complexes, sediments of shallow seas including carbonates, and sediments of marine delta complexes, and so on, each topic being illustrated with numerous examples from the Recent and ancient. Then follows the sediments of adjacent seas and estuaries. Next is a section on oceanic sediments including hemipelagic and pelagic deep sea sediments, gravity mass flow deposits and turbidites with a discussion of erosion and the reworking of deep sea sediments. There is even a section on green marine clays, red beds, marine evaporites and Precambrian depositional settings. Finally there is a section on depositional rhythms and cyclic sequences which is accompanied by descriptions of the relationships of sedimentary sequences to sea level. I particularly liked seeing the revised block diagrams initially created by the Exxon school of seismic stratigraphers. The resulting diagrams are of somewhat better quality than those of Exxon and contain either more information or information that is more clearly expressed.

Part three of the book addresses subsidence, denudation, flux rates and sediment budget. Again Einsele falls back on the device of using cross sectional diagrams to illustrate his ideas and the ideas of others. The section on subsidence and rift modeling is more mathematical than other sections. The sections on denudation and mass transport use a series of histograms showing denudation rates, water chemistry, sediment load in rivers, responses to different terrains and so on. To describe sedimentation rates, cross-sections are used. These include those down river and across carbonate settings. They record average rates of

accumulation in each depositional setting. The section on organic matter production and carbonate flux deals with accumulation rates within the ocean today.

There is a very nice section entitled 'Basin Filling Models' in which Einsele illustrates the different schemes for interpreting the geometries seen in the different basin settings. Also illustrated is how tectonics, sedimentation and sea level are interwoven with one another producing the geometries seen in different basin settings.

Part four of the book concerns basin evolution and starts with rift basins, then moves to continental margins, slope basins, intercratonic basins, continental and intercratonic sag basins, deep sea trenches, forearc and backarc basins, remnant and foreland basins, Pannonian type basins, poly-history basins, etc.

Finally the book considers diagenesis and fluid flow. There is a chapter on mechanical and chemical diagenesis and then there is a section on hydrocarbons and coal. As with all the other chapters and sections in the book, these have much meat in them for all readers.

Einsele apologizes in the preliminary description of the book that the book bears his personal stamp. He needn't apologize! He claims that the book is influenced by his experience of the study of both modern marine sediments and ancient sedimentary rocks, that the volume is based on the courses he has taught over the years plus an intensive literature study. The courses must be good! He apologizes that he was unable to read all the important publications of sedimentary stratigraphy especially those written in Russian, Chinese, Japanese and others. Frankly he seems to have missed very little! In the areas that cover my experience, I found that he seems to have read most of the literature.

Because this book is by its very nature an overview of the various sedimentary stratigraphic and depositional settings and basin settings, it naturally cannot be all inclusive and Einsele has subjected the book to some editorial selectivity. However, I feel that the reader can gain a good understanding of a particular depositional setting or basin. Should they find that the information they need to really understand the rocks that they are examining isn't adequate, the text has enough references for the reader to search for the information elsewhere. However, in most cases, the reader will not need to go much further than this book to understand the mechanisms that produced the various sedimentary relationships that the reader may be examining. There is no doubt in my mind that the book should be of use to the practicing geophysicists even though the detailed description of sedimentary structures may not be of particular interest. However the gross sedimentary relationships that are described will help the average geophysicist to understand the processes that produce these relationships and the geometries which can be inferred from geophysical information and well data. I feel that as a reference text this book will not be misplaced on your shelves. Certainly it should be in your local library, be it in a company or the university.

It is a book written both for a beginner and the expert in the field of sedimentary stratigraphy. Gerhard Einsele should be congratulated for this beautiful review and summary of the state of the art interpretation of the sedimentary basins and I imagine that people will continue to read this book long into the future. This is a major contribution to sedimentary geology for which both Einsele and Springer Verlag should be proud. The type is clear and dark and the figures are beautifully reproduced and readable. The book is consistent in its quality throughout.