REVIEWS

Tracing Tectonic Deformation Using the Sedimentary Record

Edited by Tom McCann and Aline Saintot

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This volume reflects the outcome of a technical session titled "Tectonics and Sedimentation", which was held at the European Union of Geosciences meeting in Strasburg in April 2001. It consists of a collection of sixteen papers, including an overview on the broad topic of linked tectonics and sedimentation, followed by fifteen field-based case studies.

The topic approached in this Special Publication is relevant to the study of any type of sedimentary basin. Processes of sedimentation are dependent on the tectonic controls on the formation and evolution of basins and, as a result, subsidence histories may be interpreted based on the nature and stacking patterns of basin fills. The structural and sedimentological aspects of basin analysis are often approached separately in field studies. The message of this volume is that integration of the linked tectonic – sedimentological systems leads to far better results and to a more comprehensive understanding of the complex evolution of sedimentary basins. The related themes of tectonics and sedimentation require the application of many different theoretical, experimental and empirical resources provided by structural geology, sedimentology, geochemistry, geophysics, or numerical modeling. Following this philosophy, this volume provides a fine example of interdisciplinary research, which is proven once again as the modern scientific approach that has the edge over the individual application of conventional disciplines.

Because of the complex nature of its objective, a volume like this is bound to be both useful and limited. It is useful because of the theoretical discussions and practical examples of how the structural and sedimentological aspects of basin analysis can be integrated in field studies, but it is limited in the sense that relatively few basin types are exemplified with case studies. Out of the fifteen research papers, five deal with fold-thrust belts and associated intramontane or piggy-back basins, three papers focus on foreland basins, three on rift and/or graben/half-graben basins, two concentrate on intracratonic basins, one presents the case study of a divergent continental margin, and one other deals with a fore-arc basin. The case studies presented in the volume thus only cover about half of the range of basin types. This is in part due to space limitations imposed on a Special Publication such as this, but is also a consequence of the fact that the volume is the full-length extension of the papers presented in a conference technical session, where the selection of papers is partly a function of submissions rather than the conveners' own choice. Nevertheless, the research papers included in this volume exemplify most of the basic tectonic settings, including extensional, intraplate, and compressional.

Another consequence of this volume being the offspring of a European Union of Geosciences meeting is that the case studies are heavily based on European basins (twelve out of fifteen papers), with additional examples from Australia (one fore-arc basin), Chile (a divergent continental margin), and Asia (one intracratonic basin). This may hamper the interest of the North American readership, even though the presented material does have value in providing analogues and examples of practical methodologies "at work".

The opening paper by McCann and Saintot provides a useful overview of the process-response relationship between tectonic activity that may operate over a wide range of scales, and its effects on the sedimentary record. This review brings the purpose of the volume into focus, and represents a good introduction to the fifteen research papers that follow. After examining the basin-forming mechanisms in extensional and compressional settings, the paper provides useful summaries of the models of sedimentation that are currently available in various plate tectonic settings, from local to continental scales. These models account for the complex interplay of differential subsidence, sediment supply, basin physiography, climate, and sea-level changes, and emphasize the importance of three-dimensional models, which consider both along-dip and along-strike variations in structural style and deposition, over the two-dimensional ones. A good point is also made: that stratigraphic models of basin fill architecture are better constrained for certain types of basins, such as divergent continental margins, foreland basins, or rift basins, but are less developed for most other basin types as a result of the lack of studies and/or economic interest. The final section of

this review is also interesting, suggesting a series of possible new research directions, almost exclusively interdisciplinary, which would help to improve existing models of interlinked sediment–tectonics systems.

One third of the research papers in this volume focus on fold-thrust belts and the related areas of sediment accumulation. These papers deal with reconstructions of plate-tectonic configurations (Golonka et al.), palinspastic restorations (Lamarche et al.,), subsidence analysis (Carrapa et al.), provenance of piggy-back basin fills (Cibin et al.), and synkinematic sedimentation (Nalpas et al.). The sedimentation styles of graben to rift systems are exemplified by the work of Fernandez et al., Derer et al., and McCann et al. Three case studies of foreland systems focus on the sequence stratigraphy (Lazauskiene et al.), basin migration (Christophoul et al.), and thermal history of related orogens in such settings. Two intracratonic basins are examined in terms of facies distribution and paleogeography (Rieke et al.), and subsidence rates and mechanisms (Artyushkov and Chekhovich). Papers revealing the subsurface geometry and tectonic development of a fore-arc basin using geophysical data (Wartenberg et al.,), and the tectonic setting of a divergent margin based on a combination of provenance, geochemical and isotope studies (Augustsson and Bahlburg) complete the collection of case studies in this volume.

All papers are well illustrated with high-quality black-and-white diagrams, and the presentation of the volume in general is very good. I can conclude that in spite of unavoidable limitations, as argued above, this Special Publication is yet another fine product of the Geological Society of London, which captures the insight of one of the most significant topics in the modern research of sedimentary basins – the issue of linked tectonics and sedimentation. The volume should be of interest to a wide range of readership, from sedimentologists and structural geologists to geochemists, geophysicists and computer modelers.

The Sedimentary Record of Sea-Level Change

Edited by Angela L. Coe (Open University, UK)
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40 West 20th Street
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This colourfully illustrated book, edited by Angela L. Coe (Open University), with contributions by Dan W.J. Bosence (Royal Holloway, London), Kevin D. Church (Open University), Stephen S. Flint (Liverpool), John A. Howell (Bergen) and R. Chris L. Wilson (Open University), is based in part on a third-year level course in sequence stratigraphy developed at the Open University. In this textbook the authors use a highly rhetorical approach, with numerous posed questions and answers to reinforce their lessons. This may be effective in distance education courses delivered on DVD and videotape, but does not work well in print. Arguments are presented using well drafted, but over-simplified case models, with too few citations of the pertinent literature. Although short bibliographies are provided at the end of each section, they lack context. In keeping with the distance education model of the Open University, the text is supported by a website with downloadable examples of selected illustrations, worked examples and links to other resources.

The book is divided into four parts, each with numbered subsections. In the first part Coe presents a brief introduction to sedimentary rocks as a record of Earth processes, using an imaginary meandering river in flood as a metaphor for sedimentary processes. The angular unconformity at Jedburgh, UK, first described by James Hutton, is then used to introduce concepts of time within the sedimentary record. This is followed by a brief discussion of the methods for division of the stratigraphic record and geological time, with reviews of litho- and biostratigraphy, radiometric dating, magneto- and chemo-stratigraphy. She also examines astronomic influences on stratigraphy through climate change, and implies that Milankovich processes can only be extended with confidence to 35 Ma. To illustrate how sea-level change can be detected in the rock record, Coe and Church use Ryan and Pitman's observations on the catastrophic flooding of the Black Sea, which may have been the historic event that formed the basis for later accounts of Noah's Flood. They show how, at least during glacial intervals, oxygen isotopes can be used as a proxy for eustatic sea-level change, and how the stratigraphic record of sea-level change is also influenced by tectonics and sediment supply.

In part 2, Coe and Church provide a clear explanation of their version of sequence stratigraphy, which incorporates the use of the Falling Stage System Tract (FSST) to record sedimentation between the onset and end of base level fall. In their model the sequence boundaries are placed between the peak of the High Stand System Tract (HST) and the FSST, consistent with the nomenclature of Haq et al., rather than that of Hunt and Tucker, who established the FSST nomenclature and placed the sequence boundary between the FFST and Lowstand System Tract. The authors manage to avoid much of the inherent confusion in current scientific literature on sequence stratigraphy by not fully explaining the background and evolution of sequence stratigraphic nomenclature and models. This may make it easier to explain how the sedimentary record can be used as a proxy for sea-level change, but does not prepare students for the subtle differences in meaning of terms in the current spectrum of sequence stratigraphic models.

In part 3, Howell and Flint provide an extensive and well-illustrated discussion of the Cretaceous siliciclastic sequences at Book Cliff, Utah. This begins with a comprehensive description of the stratigraphy and sedimentary facies, using modern