BOOK REVIEWS

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POSAMENTIER, H. W. & ALLEN, G. P. (eds) 2000. *Siliciclastic Sequence Stratigraphy – Concepts and Applications*. SEPM Concepts in Sedimentology and Paleontology Series no. 7. vii + 210 pp. Tulsa: SEPM (Society for Sedimentary Geology). Price US $67.00 (member's price US $48.00; student price US $38.00), plus shipping and handling; hard covers. ISBN 1 56576 070 0.

Despite the huge proliferation of publications devoted to sequence stratigraphy over the past fifteen years or so, there is only a handful of real landmark books. This would include AAPG's Memoir 26 (1977), SEPM's Special Publication no. 42 (1988) and Exxon's (1990) sequence stratigraphy textbook (AAPG Methods in Exploration Series no. 7). We can now confidently add *Siliciclastic Sequence Stratigraphy – Concepts and Applications* as the single-most important publication on this subject during the past 10 years.

It is written by two well-known exponents of the subject who have been developing and practising the subject since its inception and from the invaluable perspective of two different oil company research centres (Arco and Total). Hence the title is particularly apt because the book balances both the conceptual framework and subsurface exploration and development applications. The book is an in-depth analysis and discussion of siliciclastic sequence stratigraphy in alluvial, coastal/deltaic and shelf environments, and deliberately excludes deepwater and aeolian depositional environments because of the conceptual limitations of the topic in these systems. It is divided into seven chapters, but the real 'meat' (and around 83% of the volume) is contained in Chapters 2, 3 and 4, which deal with concepts, stratal surfaces and facies/well log expression of systems tracts, respectively. The book is copiously illustrated with some 240 figures, almost half of which are in colour. Even more significant, many of these figures are new and original.

The book presents a rigorous scientific and conceptual analysis of the subject; it is deliberately not a 'cookbook', as some of the earlier publications tended to be treated. Hence, the topics covered go into considerable depth with relatively lengthy discussions on the pros and cons of the differing concepts and interpretations. It is deliberately aimed at the high-end of the subject, going far beyond any existing textbook on this subject and gives the reader a stimulating state-of-the-art review. However, many readers will also enjoy the pragmatic approach applied to practical subsurface exploration problems. I particularly enjoyed the minor chapters, including an overview (Chapter 1), practical methodology (Chapter 5) and misconceptions, confusion and pitfalls (Chapter 6).

This book is aimed at the research level and at those actively practising the subject of sequence stratigraphy. Hence, it will appeal enormously to clastic sedimentologists and sequence stratigraphers in universities (e.g. Ph.D. students and academic staff), research institutions and oil company research and technical centres. Professional petroleum geologists, particularly those working in mature data-rich areas, will find the practical aspects particularly helpful and stimulating. It is unlikely to be presented as a course textbook for most undergraduates, but will probably be essential reading, at least in part, for advanced-level students (e.g. fourth year/M.Sci. level undergraduates) and postgraduate students (M.Sc. level) taking a sequence stratigraphy module. Teachers of the subject will find the illustrations a treasure trove of information; they will need to get the book now and start revising course notes! The high quality printing, excellent illustrations and reasonable price will make this book a must for many personal libraries. It would be money well spent: it might be another 10 years before a comparable book appears! Finally, it is a fitting tribute to the deceased second author.

Howard D. Johnson

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PAYTON, C. E. (ed.) 1977. *Seismic Stratigraphy – Applications to Hydrocarbon Exploration.* AAPG Memoir no. 26, 516 pp.

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WILGUS, C. K., HASTINGS, B. S., KENDALL, C. G. ST. C., POSAMENTIER, H. W., ROSS, C. A. & VAN WAGONER, J. C. (eds) 1988. *Sea-Level Changes: An Integrated Approach*. Society of Economic Paleontologists and Mineralogists Special Publication no. 42, 407 pp.

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WELLS, J. 2000. *Icons of Evolution. Science or Myth*? xiv + 338 pp. Washington DC: Regnery Publishing Inc. Price US $27.95 (hard covers). ISBN 0 89526 276 2.

Here is a book certain to cause controversy as the author himself admits. Jonathan Wells, trained in both religious studies and molecular biology, addresses the status of evolutionary theory from 'scientific' and 'philosophical' viewpoints. He is a harsh critic of Darwinism as presented in many standard American textbooks, which he grades very poorly. Most of the book is devoted to picking holes in the explanations advanced to support favourite icons of evolution such as the origin of life, vertebrate homology, Haeckel's embryos, *Archaeopteryx*, peppered moths, Darwin's finches, fruit flies, horse and hominid evolution. His final conclusion is that Darwinism has been used to promote materialist philosophy, and that organizations like the American Academy of Science have adopted rigid Darwinist doctrine with such fervour that they effectively exclude alternative views, and promulgate Dawkins' philosophy that 'Darwin made it possible to be an intellectually fulfilled atheist' (p. 205). Serious philosophers of biology like Michael Ruse inevitably ask what it means if 'evolution is promoted … as more than mere science … as an ideology, a secular region' (p. 228). At least one palaeontological journal refused to review '*Icons*' on the grounds that Wells is a suspected creationist. Incidentally though, Darwin saw no need for a creator to guide the process of natural selection; he spoke of a creator or initial cause setting the evolutionary process in motion.

In my opinion Wells is right to draw attention to the philosophical pitfalls of blind 'scientific' faith in Darwinism. If science is a self-correcting process it should sort out Wells'

valid claims as well as his errors. Wells is also right to challenge scientific recycling of serious errors in many textbooks – notably the fake developmental series of embryos put together by Haeckel and the habit of pinning dead peppered moths on tree trunks where they are never normally found!

Wells has been branded a stealth creationist and chastized for his religious links and his stated opposition to Darwinian materialist philosophy (Coyne, 2001). But it is wrong to brand him a narrow-minded creationist or suppress his freedom of faith and expression, especially in America. A broader view reveals that Wells is allied with serious students of intelligent design (e.g. Dembski, 1999) and that much current criticism of Darwinism reflects ongoing paradigm shifts. There are at least two reasons for this. First, as Stephen J. Gould notes in 'Alas, poor Darwin' (Rose & Rose, 2000, p. 85), Darwin insisted that 'natural selection has been the main but not the exclusive means of modification' and that his conclusions had been 'much misrepresented'. Second, as our understanding of complex systems evolves, the paradigm of simple linear descent through time is inadequate to explain biological complexity. Evolutionary science needs to evolve to accommodate new philosophical perspectives or, as Wells puts it, Biology needs to clean house. Surely this, not rigid doctrine, is the essence of open-minded science.

Martin Lockley

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Rose, H. & Rose, N. 2000. *Alas, poor Darwin*. London: Jonathan Cape. 292 pp.

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Zalasiewicz, J. A., Rushton, A. W. A., Hutt, J. E. & Howe, M. P. A. (eds) 2000. *Atlas of Graptolite Type Specimens, Folio 1*. Contributors: Hughes, R. A., Lindholm, K., Loydell, D. K., Rigby, S., Rushton, A. W. A., Štorch, P., Strachan, I., Taylor, L., Williams, M. & Zalasiewicz, J. ii+100 pp. Maidenhead: the Palaeontographical Society and the British and Irish Graptolite Group (The Palaeontographical Society, c/o 27 The Crescent, Maidenhead, Berkshire SL6 6AA, UK). Price £10.00 incl. inland postage; spiral bound, soft covers. ISSN 1470-2096.

I think this is the only BIG G venture in which I have not been directly involved, and so do not feel too uneasy about reviewing it. And, as a systematic palaeontologist, it has to work for me, otherwise it fails. Well it does work: in fact it is prepared to a very high standard. I have had several occasions to test it during real-life research and it has proved invaluable. I have also tested it rather more artificially – spot checks if you like – and, again, it has proved faultless.

The *Atlas* consists of one side of A4 for each of 100 species, illustrating by line drawing the types, and with a minimal defining text and appropriate references. References are given in full at the citation, not at the end of the folio. For the most part the drawings are to a very high standard, clearly indicating the nature of the preservation (with brief text comment on this too), and the magnifications are sensible. There is a reassuring uniformity about the presentation, despite the involvement of a number of authors, so the editors can be congratulated on that.

Each entry has sufficient drawings of the holotype, lectotype, neotype, or whatever, and these are well labelled with measurements. The only thing I disagree with, and disapprove of quite strongly, is the slavish adherence to the 2TRD method of denoting thecal spacing. It would have been better if this method of measurement was given alongside earlier-developed methods. (In a few cases this does occur.) This would facilitate comparisons with the vast bulk of graptolite literature which gives thecal spacings in terms of the numbers of thecae per unit length. Of course, all competent graptolite workers have a conversion table pinned on their work bench. But then the question becomes: if a conversion table is necessary at all, is Howe's (1983) 2TRD method worth having? Many modern graptolite workers have been lured into using 2TRDs by its spurious claim to accuracy and measurement of detail. But that was achieved years ago by Packham (1962) and that modern workers have been sucked into 2TRD suggests to me that they failed to understand the earlier systems.

I have not yet submitted any *Atlas* entries of my own, but when I do so they'll receive 'traditional' thecal spacing measurements (and 2TRDs if they insist). All that said the *Atlas* is an admirable achievement and I look forward to seeing many more folios each with a hundred species contained therein.

R. B. Rickards

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Hart, M. B. (ed.) 2000. *Climates: Past and Present*. Geological Society Special Publication no. 181. vi+218 pp. London, Bath: Geological Society of London. Price £65.00, US $108,00; members' price £29.00, US $48.00; AAPG members' price £39.00, US $65.00; hard covers. ISBN 1 86239 075 4.

There are many different approaches to the study of past climates. This is well illustrated by the special publication of the Geological Society. The volume comprises seventeen papers which were presented at the Second European Palaeontological Congress held in Vienna in 1997. In this volume more than half the papers deal with the Quaternary. Despite the title I see no papers dealing with present climates.

In the first section on pre-Cenozoic climates there are only four papers: two modelling, one sedimentological and one palaeontological. Clausing & Boy examine lamination and primary production in fossil lakes, particularly concentrating on examples from the Carboniferous/Permian transition. The approach involves comparison with modern lake systems and phytoplankton productivity. The authors mention the problem of Permian lakes being difficult to decipher as the 'phytoplankton species are different or absent as a result of taphonomy'. It is also possible that many freshwater phytoplankton groups had yet to evolve. The authors offer ways to interpret annual laminites as opposed to non-annual laminites but it is clear much more work needs to be done. The paper by Beerling is on a different scale and uses a different approach to examine terrestrial vegetation in the Mesozoic. The model integrates the General Circulation Model (GCM) of Reading University with the University of Sheffield Dynamic Global Vegetation Model (SDGVM).

Two age intervals are examined in detail: Kimmeridgian and Cenomanian. Beerling shows that net primary productivity was high during both intervals compared with the present day and thus was influenced by the higher CO_2 values. Both vegetation and isotopic data are used to support the models which are presented in colour. Hart uses data from the distribution of planktonic foraminifera to model climates of the Cretaceous. This is not a numerical modelling approach such as undertaken by Beerling but one which uses a limited set of palaeontological data. These data, on a global scale, are used to identify five latitudinal zones (based upon diversity). The foraminiferal data are compared with other climatic maps and support the concept of a flatter pole–equator temperature gradient for the Cretaceous. The paper by Golovneva concerns terrestrial faunas and floras from the Maastrichtian in the northern hemisphere. Strangely data are plotted on a modern map which makes interpretation more difficult. New data concerns the floras and a CLAMP analysis was undertaken. These data are used to support the view of a warm temperate climate at high and mid latitudes and subtropical south of about 40°N during the Maastrichtian, with low seasonal variation in precipitation and moderate seasonality in temperature.

The second edition is concerned with mid-Cenozoic climates and also comprises four papers. Chira *et al*. look at the Miocene climates of Transylvania examining both marine and terrestrial records. They use the fossil data to identify warm and cool periods in this region. A more limited (palaeontologically) study is presented by Jurkschat *et al*. who consider late Miocene climate changes in the Spanish Lorca Basin based upon diatom data. Late Miocene climate cycles are also considered by Korpas-Hodi *et al*. and their effect upon sedimentation in west Hungary. Kvacec uses terrestrial plant assemblages to examine climate oscillations in the lower Miocene of North Bohemia. Kvacec emphasizes the importance in assessing taphonomic bias before plant assemblage lists can be used in palaeoclimatic interpretation. He further emphasizes the need to compare two assemblages originating from the same sedimentary and environmental setting where the resulting palaeoclimatic changes can be estimated more safely.

The third section comprising five papers considers responses to Quaternary climate change. These are all predominantly local studies using a range of approaches. Amore *et al*. integrate micropalaeontological data to examine Gaera Bay. Di Geronimo *et al*. examine macro-invertebrate assemblages to interpret cooling in Sicily. Nagy-Bador *et al*. use pollen records to infer climate change in the Great Hungarian Plain. Ermolli also uses pollen analysis to interpret climate change in southern Italy. A rather different approach is used by Rohling *et al*. who use palaeoceanographical and numerical modelling to look at sapropel formation in the Mediterranean. They compare palaeocirculation concepts based upon micropalaeontological records with results of a general circulation model (GCM). All the simulations show stagnant deep waters which would cause bottom water anoxia.

The fourth section comprises four papers examining vertebrate and hominid evolution as a response to climate change. Azanza *et al*. examine large mammal turnover pulses in the northwestern Mediterranean region. The 'pulses' are correlated with significant climatic events and also events such as the arrival of *Homo*. Bonfiglio *et al*. examine the contribution of Quaternary vertebrates to palaeoenvironmental and palaeoclimatological reconstructions in Sicily.

In broader debate Chaline *et al*. discuss the question 'Were climatic changes a driving force in hominid evolution?' The authors indicate that climate was important but debate more fully whether it was the driving force. They conclude that climate exerts a significant influence at crucial moments in that history. It would be interesting to know if the recent fossil hominid finds change their view. The volume has a four-page index.

Overall the volume is variable in quality and lacks a synthesis. In many respects it is a typical symposium volume. It certainly would have been more useful if several keynote summaries had been included. I was left wondering the value in having a hard-bound book to purchase rather than having the papers published separately in a relevant journal. After all there are so few plates that they could easily be downloaded from the web. With so many volumes for libraries to buy I am not sure whether this will top the list. I suspect that only those with a specialist interest in climate will want a copy for themselves.

Andrew C. Scott

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FAURE, G. 2000. *Origin of Igneous Rocks. The Isotopic Evidence*. xv + 496 pp. Berlin, Heidelberg, New York, London, Paris, Tokyo, Hong Kong: Springer-Verlag. Price DM 149.00, Ös 1088.00, SFr 129.00, £51.50, US $74.95 (hard covers). ISBN 3 540 67772 0.

Gunter Faure is a venerable figure in the field of radiogenic isotopes applied to geological investigation. He was part of a pioneering group at the Massachusetts Institute of Technology in the late 1950s, which did much to establish the groundwork for strontium isotope geology in particular (the book is dedicated to the group's founder members). He has devoted a significant part of his career to education and to the publication of general textbooks. This one sets out to summarize what has been learnt from isotope research (mainly Sr isotopes) about the origins of igneous rocks and the processes responsible for magmatism. It is aimed at graduate students and research workers. The first chapter is a potted version of the theoretical basis for Sr, Nd, Pb and O isotope variations in the Earth, taken largely from Faure's *Principles of Isotope Geology* (2nd edition, 1986, Wiley). This is claimed, perhaps rather optimistically, to obviate the need for prior knowledge of the field. This book is not a guide to analytical methodology and there is only a passing mention of the use of micro-sampling techniques and their increasing importance in investigating isotopic disequilibrium.

What makes the book notable is that the approach is based on a catalogue of individual case studies covering just about every known example of terrestrial volcanism where Sr isotope data are available. This sometimes includes additionally summarizing the volcanic stratigraphy, petrology and geochemistry of a single locality or group of localities. The scope of the survey, and the preparatory work that lies behind it, are astounding. All published data used (there are approximately 2500 bibliographical references!) have been adjusted to common standard results (where possible) to improve comparability, and many new diagrams have been drawn to illustrate them.

In each case the data and the interpretations given by the original authors are summarized. Since well over 200 such individual studies are detailed, this inevitably involves some repetition, particularly of alternative explanations for iso-

tope variation, and the result is not easily digested in continuous reading. The text is interspersed with short sections to introduce different groups of rocks and Faure gives a brief personal summary of conclusions at the end of each chapter.

The book is structured by subdivision into igneous activity characteristic of different tectonic environments. Chapter 2 (volcanic rocks in the ocean basins: mid-ocean ridges, oceanic islands and seamounts) is mainly used to establish the idea of different mantle reservoirs deduced from Sr–Nd–(Pb) compositions, and the now all-important notion of plumes of material rising from great depth. Isotopic variations in erupted lavas are mostly ascribed to mixing between asthenospheric and lithospheric sources or magmas. Chapter 3 develops the concept of mantle heterogeneity further to cover the products of intra-oceanic subduction (Pacific Ocean island arcs, the Caribbean, South Atlantic and Mediterranean arcs). The extra influence on variability identified here is minor incorporation of subducted oceanic sediments in the source regions. Sediment contamination is considered more important in the subcontinental subduction system of destructive margins (e.g. the western margin of the Americas, Chapter 4), but the fundamental process of magma production is acknowledged as fluid-triggered melting in the mantle wedge overlying the subduction zone. Chapter 5 deals with continental flood basalt provinces, an area in which Faure has been especially involved in his own research, with the conclusion that mixing processes involving both asthenosphere and subduction-modified lithosphere are responsible for the observed isotope compositions. The dominant causal effect of mantle plumes is again emphasized.

Chapter 6 concerns the production of alkali-rich igneous rocks in the continental interiors. The evidence, including that of xenoliths carried in the magmas, supports the idea of melting of old metasomatized lithospheric mantle, usually associated with rifting tectonics. Chapter 7 describes the major layered mafic intrusions of the continents which, unsurprisingly, are mostly identified as the products of mantle-derived magmas partially contaminated by crustal material. Finally, Chapter 8 considers the Archaean greenstone belts and granitic genisses of North America, and includes the isotope geology of some of the oldest known terrestrial rocks, in Greenland. Faure's final far-reaching conclusion is that all tectonic activity at the Earth's surface, and consequent magmatism, is caused by the driving force of hot plumes of solid rock rising from the deep mantle, ultimately as a result of the subduction of crustal material enriched in Rb, K and U. The extent to which the isotope data presented here provide proof or support for the details of this model, as opposed to just being consistent with them, is a philosophical point that is not addressed.

In concentrating on this mantle-centric approach, the book has some rather significant limitations that belie the title. The origin of granites has always been, and remains, one of the major issues in igneous petrology. But there is no mention of granite petrogenesis in this book beyond a brief note in the Preface and the very limited occurrences in Chapter 8. The role of crustal re-melting in orogenic magmatism is not dealt with systematically, and the concept of I-type and S-type granites is not even referred to. There is no treatment of Precambrian magmatism outside North America. Another limitation arises from the indexing system, which follows the format of the book's structure too closely. Thus, you can easily look up the available data for a given geographical locality, but not the processes that isotope data have been used to discuss, nor specific rock types (e.g. there are no entries such as water–rock interaction, slab-melting, He-isotopes, or rock names such as syenite or granite). A significant proportion of the data treated is from the earlier days of isotope research, and the field of hafnium isotopes, now very important in assessing mantle evolution, came too late for inclusion.

Presentation of the book is generally very good and the layout clear. With so much information packed into a relatively slim volume, the paper used is rather flimsy and the stout hard covers are essential for stability. A curious claim is that the use of acronyms is avoided, although MORB is used throughout.

I think the book will mainly prove useful as a source of reference information for particular geographical areas, and as a factual record of the first 30–35 years of conventional radiogenic isotope geology in the study of volcanic rocks.

R. J. Pankhurst

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ZHURAVLEV, A. YU. & RIDING, R. 2000. *The Ecology of the Cambrian Radiation*. Perspectives in Paleobiology & Earth History Series. ix + 525 pp. New York: Columbia University Press. Price US $80.00, £51.00 (hard covers), US $40.00, £25.50 (paperback). ISBN 0 231 10612 2; 0 231 10613 0 (pb).

Books focusing on life during the Cambrian are not a rarity: Simon Conway Morris's *The Crucible of Creation* and Stephen Jay Gould's *Wonderful Life* (and to a lesser degree, McMenanim & McMenamin's *The Emergence of Animals*) each deal with various aspects of what is now generally referred to as the 'Cambrian Explosion'. While each of these volumes is interesting and intriguing in its own right, none of them gets down to the 'nitty gritty' of what the Earth was like during the uprising of these Cambrian animal faunas, what it was like to be alive during the Cambrian. *The Ecology of the Cambrian Radiation* is a major new volume discussing exactly these themes, with 33 authors contributing to 21 chapters.

The book is divided into three main sections. The first contains seven contributions dealing with the environment during the Cambrian (plus some forays into the Vendian and the Ordovician). Chapter topics include climate change at the Neoproterozoic–Cambrian transition (Eerola), palaeomagnetically and tectonically derived Vendian to mid-Ordovician global maps (Smith), the diversification of sedimentary fabrics through the Cambrian (Droser & Li) and the possible effects of supercontinental amalgamation on the 'Cambrian explosion' (Brasier & Lindsay).

The second part of this book deals with community patterns and dynamics during the Cambrian and is made up of six contributions. Topics include biotic diversity and structure during the Neoproterozoic–Ordovician transition (Zhuravlev), ecology and evolution of plankton (Butterfield), the evolution of shallow-water level-bottom (Burzin, Debrenne & Zhuravlev) and deep-water benthic communities (Crimes), hardground communities (Rozhnov), and reefs (Pratt *et al.*).

Part III of this volume focuses on the ecologic radiation of major groups of organisms during the Cambrian. Most major groups are covered in this section, including sponges, cnidarians and ctenophores (Debrenne & Reitner), molluscs, hyolithids, stenothecoids and coeloscleritophorans (Kouchinsky), brachiopods (Ushatinskaya), Cambrian trilobites (Hughes) and non-trilobite arthropods and lobopods

(Budd), echinoderms (Guensburg & Sprinkle), algae and bacteria (Riding) and dinoflagellates (Moldowan *et al.*).

Most chapters are well-written (if occasionally rather brief), highly informative reviews that could easily stand on their own as independent publications. This strength also highlights, however, the two most obvious weaknesses of this volume: there is almost no attempt to unite common themes between chapters, resulting in general discussion being all too absent; and there is little new data or speculation presented (see Moldowan *et al.*'s chapter on molecular fossils and Budd's chapter on nontrilobite arthropods and lobopods, respectively, for interesting exceptions). Still, neither of these takes significantly from what is overall a good volume: the quality of writing and figures is almost always of a high standard (but see Figure 4.4 for an example of how it should *not* be done!), with extensive reference lists provided at the end of each chapter. This volume will serve as a good starting point for any research project, student or professional, dealing with life in the Cambrian.

The publication of *The Ecology of the Cambrian Radiation* goes a long way towards filling a major gap in the available palaeontological literature. While this volume will probably not suit many of the audience of those 'popular' Cambrian explosion books mentioned above, it will well serve those of a more academic inclination. Every library should have a copy, as should anyone seriously interested in life in the Cambrian.

Rod S. Taylor

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BURBANK, D. W. & ANDERSON, R. S. 2000. *Tectonic Geomorphology*. x+274 pp. Oxford: Blackwell Science. Price £52.50 (paperback). ISBN 0 632 04386 5.

Geomorphology, the study of the external form of the Earth, has undergone its own evolutionary transformation in the past 40 years, parallelling and interacting with profound changes effected in geology by plate tectonics. The overlap and cross-fertilization between the two disciplines is nowhere more obvious than in the realm of Quaternary Science and in the definition of the younger interdisciplinary field of Environmental Sciences or, to give a recent bandwagon term, Earth Systems Studies. Whilst many widely-used introductory geology and geomorphology textbooks now give adequate coverage to concepts of traditional geomorphology, they usually fail to capture the breadth of interdisciplinarity required for the successful study of tectonic geomorphology; Burbank & Anderson now provide us with the near-perfect alternative at a more advanced level. Doubtless this will filter down in future editions of introductory-level texts.

What's in this book? Eleven chapters that concisely inform and define the modern approaches to tectonic geomorphology. These cover geomorphic markers such as terraces and shorelines; time in the landscape; earth stresses and deformation; geodesy; rates of neotectonic (Holocene), Quaternary and Cenozoic deformation; erosion and landscape development; numerical modelling.

Standard of writing, illustration, production. All excellent. Clear prose, nice simple line diagrams and photos (some darkish though …).

Up-to-dateness? Excellent reference list and in-text citations. Usually very fair for scientific precedence.

Quantification of processes? Not bad, mostly empirical; useful introduction to numerical modelling ends the book.

What level? Given at a level that most professional academics should be able to digest and regurgitate in some appropriate form for their advanced undergraduate students. I expect the book to spawn a whole new generation of courses in the best universities as academics boldly submit their plans to Teaching Committees, begging to be allowed to teach this juicy 'new' subject approach to the waiting hordes. The book is well designed to teach and learn from.

Any crabs? Four only:

Firstly, the text has a rather cookbookish feel to it by the end, nerdish to some degree, perhaps engendered by the lack of general models and a global perspective relating the land surface to *large-scale* continental plate tectonic kinematics and forces. But perhaps this is an unkind view; other texts set out this stall in another part of the marketplace, Summerfield (*Global Geomorphology*, Longmans, 1991), for example, at a qualitative and less-advanced level.

Secondly, I found the treatment of quantitative processes in geomorphology inadequately developed with respect to the more detailed discussions of empirical tectonics and geology. Cutting-edge geomorphology rapidly became a highly developed physical science from the 1960s onwards, a process ignored at the time by many geomorphologists themselves and geologists and still under-recognized even in enlightened countries and institutions who should know better. Tectonic geomorphology process models build their fledgeling edifices on this mighty foundation.

Thirdly, I think it was a mistake to exclude magmatovolcanic landforms and processes and to restrict attention to land geomorphology – something on volcanoes and the oceans would have made a nice contrast.

Fourthly, the authors stress throughout their text the active tectonics engendered by displacement gradients caused by faulting and folding. The broad spectrum of regional deformation (formerly known as *epeirogenic* effects) due to deeper seated mantle and crustal processes (tectonic formation and erosional development of plateaux for example) is not given sufficient prominence in their case studies.

However, let me end by highly praising this important book, complimenting the authors and urging all geoscientists to have a copy on their shelves – no longer can geomorphology courses claim to ignore the vital dynamics provided to the landscape by tectonics, and *vice versa* for tectonic courses.

Mike Leeder

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FORTEY, R. A., HARPER, D. A. T., INGHAM, J. K., OWEN, A. W., PARKES, M. A., RUSHTON, A. W. A. & WOODCOCK, N. H. 2000. *A Revised Correlation of Ordovician Rocks in the British Isles*. Geological Society Special Report no. 24. iii+83 pp. London, Bath: Geological Society of London. Price £18.00, US $30.00; members' price £9.00, US $15.00; AAPG/SEPM/GSA price £11.00, US $18.00 (paperback). ISBN 1 86239 069 X.

This series is now well known, and several parts of the series have run to subsequent editions, this being the second edition (2000) of the Ordovician correlations. The format in the volumes is similar with each outcrop/structural region of the British Isles being afforded a separate chapter accompanied by location/outcrop maps and correlation charts of the main sequences in each region. So each lithostratigraphic column is given, together with rock unit thicknesses (usually

formational) and variations, and these columns abut a biostratigraphic column of graptolite biozones which in turn links to the chronostratigraphy.

Such volumes cannot be prepared without some discussion of the chronostratigraphic framework, and this particular volume has a chapter by R. A. Fortey on the definitions of chronostratigraphic subdivision. And it was especially important to deal with these matters in view of the international debate on the definitions and utility of the Ordovician series. In this work the lower part of the Llandeilo has been placed within a redefined Llanvirn Series; and the latest, preferred stage and substage array is summarized.

In one respect the Ordovician chart contrasts with the Silurian chart (Cocks, Holland & Rickards, 1992) in that it has a chapter by Woodcock on the terranes in the British and Irish Ordovician. This seems to me to lift the value and status of the whole volume and it is a feature that the Silurian chart should have included; a consequence is that subsequent chapters deal either with a geographical/outcrop region, or with the geology of a specific terrane. The chapter on international correlation is placed at the end and comprises a short text and a double-page correlation embracing the Baltic regions, Australia, North America, Bohemia and China. It includes differing chronostratigraphies, e.g. of North America, East Baltic, Bohemia and China. References and index complete the volume. To my mind, as someone who works on both Ordovician and Silurian strata, this is a much more impressive and useful volume than that on the Silurian which, in its next edition, must include some account of terrane geology and sequence stratigraphy.

R. B. Rickards

Reference

Cocks, L. R. M., Holland, C. H. & Rickards, R. B. 1992. *A Revised Correlation of Silurian Rocks in the British Isles.* Geological Society Special Report no. 21.

DOI: 10.1017/S0016756801296083

Okada, H. & Mateer, N. J. (eds) 2000. *Cretaceous Environments of Asia*. Developments in Palaeontology and Stratigraphy Series, Volume 17. vii + 255 pp. Amsterdam, Lausanne, New York, Oxford, Shannon, Singapore, Tokyo: Elsevier, Price Nlg 295.00, Euro 133.87, US $154.50 (hard covers). ISBN 0 444 50276 9.

From my rather limited perspective as a vertebrate palaeontologist (albeit one that is informed by some of my current work on the Cretaceous vertebrates of Asia), any prospect of being able to improve my understanding of the general regional geology and stratigraphy of 'Central Asia' (particularly Mongolia and northern China) is to be welcomed. This whole area has a distinctly 'will-o-the-wisp' quality particularly when it comes to stratigraphic correlation. Much (dare I say the majority?) of the published information appears to rely upon heavily circular argument. Therefore the prospect of learning a little more about the stratigraphy, general geology and palaeontology of this part of the world results in my approaching this new book with some considerable eagerness.

Cretaceous Environments of Asia represents a synthesis of the work of the UNESCO/IGCP project no. 350 that commenced in 1993. The aim at the outset of the project was to attempt to characterize the biological, climatological and physical environments of the Cretaceous of Asia. The intention was then to integrate this temporally and palaeogeographically, rather than by considering current geographical/national regions as entities. The articles in the current volume are still strongly 'nationalistic' in their coverage, so from that point of view at least the project has been less than successful.

This volume comprises 14 papers of quite strikingly variable type. Several deal with aspects of the stratigraphy, environment and geographic setting of Asian areas (East Russia, Mongolia, Eastern China, the Japanese Islands, Thailand and India); others are more concerned with the geophysical/ tectonic settings and temporal development of major portions of this area (with the primary focus being the Pacific Rim, and Japan).

As a whole the volume is, perhaps inevitably, disappointing for those who might be expecting a unified and synthetic analysis following a sustained period of focused research. Textually the volume has to be read carefully – there are a number of errors in text and figures that should have been picked up during copy-editing. Editorially, insisting on a greater uniformity of approach and more strenuous attempts at synthesis should, despite the inevitable difficulties, have considerably improved the content and quality of the papers. It is clear that progress in these fields and in this area of the world is fraught with difficulty. The concluding article in the volume, by Okada, strains to synthesize the achievements of the project by incorporating a great deal of extraneous work. This all rather tends to confirm what we already knew: that during the Cretaceous Period this part of the world is *still* relatively poorly understood, despite the fact that it clearly of outstanding scientific interest both tectonically, environmentally and biologically.

This volume is intended for a restricted, specialist readership. Because of its overall shortcomings it in a sense obviously highlights the need for greater intensity of work. What makes this particularly disappointing is the absolutely appalling price that Elsevier has chosen to set for this book. Despite the intrinsic interest of the topic, this book should have very few sales, and, I think, deservedly so.

David Norman

DOI: 10.1017/S0016756801306088

Christiansen, E. H. 2001. *PetroGlyph 1.0*. Interactive virtual microscope program for PC and Mac (minimum requirements: Windows 95 or higher; MacOS 7.5 or higher; QuickTime 4.0; 1000 colours; CD-ROM drive; 30 MB free RAM; 225 MB free disk). Oxford, Malden MA: Blackwell Science. Price £24.50. ISBN 0 632 04532 9.

PetroGlyph is an interactive virtual microscope with many of the capabilities of a petrographic microscope combined with those of an electron microscope. The software (presented on a single CD-ROM) works on both the Mac and Windows (95 or greater) operating systems, although for the purposes of this review only the Mac version was examined. No paper manual is provided, although help files are provided in the form of html pages. The software requires Quicktime 4.0 and will not work with more recent versions (according to the CD cover), but in the help file it states that Quicktime version 3 must be installed and that the program will not work with Quicktime 4.0 or higher.

The software requires a Setup file to be run as part of the initialization process and this should have placed an icon on the desktop that could be used to start the main program. With System 9.1 on a G4 PowerMac this did not occur,

although the main program could be run by double clicking on a file called 'PetroGlyph.pkg' on the CD.

Initially, *PetroGlyph* loads a grey marbled screen and requests that you select a new sample. A list is presented of 11 sedimentary, 13 metamorphic and 9 igneous rocks. Of these, 6 are limestones, and 6 are schists. There are no contact metamorphic rocks included in the package (unless marble and quartzite are considered to be of this origin), nor any of the following igneous rocks: dolerite, granodiorite, trachyte, rhyolite or any alkaline rock types such as syenite.

Once a rock has been selected then many of the tools and options become available. These include viewing the sample in plane polarized light and between cross polars, with a Bertrand Lens, and in reflected light. Each sample has also been imaged in an electron microscope, and cathodoluminescent (the authors call it Cathode Luminescence), backscatter(ed) electron and a number of single element maps are all available. There is also the option to click anywhere on the image and to bring up an energy dispersive X-ray spectrum of whatever mineral is present under the cursor. A background spectrum is presented if a hole in the thin section is encountered. All in all, an impressive achievement and worth the asking price of £24.50 for this interactivity alone.

But there is more – a series of tools allows you to measure the length of a mineral, measure angles, view a Michel–Levy birefringence chart, perform modal analysis (the software provides the equivalent of a point counter), look at rock classification charts and interact with the photomicrographs in two clever ways. Firstly, it is possible to display a list of all the minerals present in the image and to have the software highlight all occurrences of any one of them (by blacking out all the others). This works well, although is a little unclear when a 'black' mineral like magnetite is viewed against the black background. Secondly, it is possible to click anywhere on the image and have a list of possible minerals appear. If you guess wrongly, hints are provided to help you guess correctly.

On the down side this interactivity has limited the authors to one view for each rock sample (approx. 3.2×2.8 mm), and to simulate pleochroism and birefringence they have been forced into photographing the samples by rotating the polarizer rather than the sample stage. This is extremely confusing and totally unlike what a student would experience with a real microscope. In plane polarized light the polar can be rotated in 90 degree intervals and between cross polars in 15 degree intervals.

Perhaps the biggest criticism of the package is the quality of the images which are of variable quality. Some are fuzzy (out of focus), some are overexposed, some have peculiar colours and others have artifacts added to them as a result of image compression. The reflected light images do not always show a good polish or a consistent colour temperature and the backscattered electron images are presented in an odd yellowish-orange colour.

Other problems include missing data either in the form of minerals missing from the chosen field of view (e.g. there is no pyroxene in the gabbro view) or missing elements (there are no phosphorus maps despite apatite occurring in many samples). In one case (talc schist), apatite has the wrong X-ray spectrum. A few software bugs such as an inability to quit first time from the program and occasional problems with the measure complete the review.

In summary, *PetroGlyph 1.0* is an excellent training package for would-be mineralogists and geochemists. The concept is excellent, but is marred by significant problems in the implementation. The package really is worth the asking price, but wait for version 2 if you can.

Andy Tindle

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MARTIN, T. & KREBS, B. (eds) 2000. *Guimarota. A Jurassic Ecosystem*. 155 pp. München: Verlag Dr. Friedrich Pfeil. Price DM 120.00 (hard covers). ISBN 3 931516 80 6.

The disused Portuguese coal mine of Guimarota, near Leiria, is arguably the most important locality in the world for providing an insight into the evolution of Late Jurassic (Kimmeridgian) mammals and associated small vertebrates over 150 million years ago. The mine was worked for a decade, from 1973 to 1982, purely for its fossils. Tens of thousands of fragmentary bones and teeth plus some skulls and jaws (including some 800 identifiable mammal jaws and 7000 teeth and 750 dinosaur teeth), shells and plant fragments have been recovered thanks to the efforts of Bernard Krebs, the late Siegfried Henkel and local Portuguese helpers in what be must one of the largest palaeontological undertakings of its kind. Over 20 specialists have altogether spent more than 30 years investigating the remarkable Guimarota biota, and their findings are brought together in this splendidly produced volume. Quite a bit of the information has not previously been published, and what has can be hard to obtain and then in German. The man illustrations range from SEMs to new artwork.

Fossil mammals were first discovered here in 1959 and the mine was first worked for these fossils by Walter Kühne in the 1960s, but the main fossil workings followed the subsequent draining and repairing of the mine workings. The field work at the Guimarota locality was carried out exclusively by the staff of the Institute of Palaeontology of the Free University in Berlin. For the book, colleagues from the Free University and the Humboldt Museum in what used to be East Berlin contributed articles, but this was a long time after the wall had come down. *Guimarota* describes and interprets this extraordinary fauna which ranges from pteridophyte plants such as horsetails through representatives of several gymnosperms such as ginkgos and cycads to charophytes, ostracodes, bivalves, gastropods, fish, albanerpetontids, turtles, lizards, crocodiles, dinosaurs, pterosaurs, docodonts, multituberculates, dryolestids or henkelotheriids. There is something here for everyone interested in the life and times of the Late Jurassic.

As Thomas Martin summarizes 'the coals of Guimarota … were deposited in a coastal swamp within a Lusitanian basin. Extensive coastal plains existed on the eastern rim of the opening of the North Atlantic ocean, on which abundant vegetation flourished'. The plants indicate a subtropical forest-swamp with conifers, seed ferns and palm ferns as undergrowth and ginkgos and conifers on higher and drier ground. There were open bodies of water lined by dense groves of horsetails.

The aquatic invertebrates reflect limnic and brackish waters with suggestions of nearby marine influences. Euryhaline sharks and bony fish reinforce this interpretation. The amphibians are dominated by albanerpetonids, small salamander-like burrowers which probably hunted for insects in the soft and moist forest litter. The diverse lizards include three genera of skinks and two anguimorphs which range in habit from a small worm-like, probably burrowing, skink to a large predatory monitor. Fragmentary turtle remains belong to amphibious forms as are most of the

much more abundant crocodiles apart from a single representative of the large marine genus *Machimosaurus*.

The dinosaur remains are peculiar in that they mostly consist of the teeth of predatory theropods less than a metre in length but it is not clear whether they are juveniles or small forms. Pterosaur teeth and, for the first time outside Solnhofen, some *Archaeopteryx* teeth have also been found. But the most famous element of Guimarota is the mammal fauna.

Multituberculates are common mammals here and are thought to have been ecologically equivalent to rodents. Another extinct group is that of the docodonts, especially *Haldanodon*, known from a partial skeleton which provides an interpretation of its life habit. It was probably a semi-aquatic burrower, searching for worms and insect larvae in the litter of the forest floor. According to Martin & Nowotny, its teeth are 'worn down to small stumps by the abrasive action of the sediment particles it took in together with its prey'.

The most abundant mammals are the dryolestids: small, shrew- to hedgehog-sized insectivores with 8–9 molars compared with the 3–4 of modern mammals. The closest relatives of the Guimarota dryolestids lived in western North America, suggesting a close faunal connection at this time. Close relatives are the paurodontids which here include the most complete skeleton of *Henkelotherium*. Its skeletal anatomy suggests to Krebs that it possibly 'lived in brushwood, where it hunted insects and other invertebrates'.

Unfortunately a detailed taphonomy of the fossils is difficult because the mine is no longer accessible. The fossils are found associated with the coals but separation of the coals and their particular fossils was not possible so the total sample represents a mixture of faunas from a coal swamp environment which must have persisted over some time. There were repeated marine incursions which brought the occasional marine animals into the fossil assemblages. Disarticulation of the skeletal remains suggests that the cadavers were generally floating for some time before burial. The best modern analogue is probably the Florida Everglades.

As Thomas Martin concludes in his survey of this remarkable biota, there are a number of remaining questions. For instance, why is there such a lack of large terrestrial animals, especially sauropod dinosaurs? As he points out, an interesting parallel can be drawn with Messel which is also dominated by smaller animals. The argument for Messel is that the swampy conditions prevented larger animals from inhabiting the lake margins and the same may be true for Guimarota. Even so, there is also the interesting question of why the Guimarota vertebrate fauna is dominated by mammal remains.

Douglas Palmer

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HOLMER, L. E., POPOV, L. E., KONEVA, S. P. & BASSETT, M. G. 2001. *Cambrian–early Ordovician brachiopods from Malyi Karatau, the western Balkhash region, and Tien Shan, Central Asia*. Special Papers in Palaeontology no. 65. 180 pp. London: The Palaeontological Association. Price £60.00 (paperback). ISBN 0 901702 71 4.

This substantial monograph by a Swedish–Russian–Welsh team describes and revises 88 species of brachiopods within 55 genera, ranging in age from early Cambrian to early Ordovician (Arenig), and also their stratigraphical context within south-central Kazakhstan and north Kyrgyzstan. Do not be misled by that straightforward sentence and by the seemingly specialist title of the book. This work not only presents and revises hitherto inaccessible faunas from a remote area and collates them in an accessible format (not least in English), but also uses them to unlock key relationships within the complex of once-separate terranes that today make up the central part of Asia. The authors conclude that most of the Malyi Karatau was a seamount forming part of the South China plate in the early Cambrian, separating from it in the mid-Cambrian, and drifting westwards within temperate southern latitudes to become progressively closer to the Uralian margin of Baltica. In contrast (and somewhat counter-intuitively), the Atasu–Zhamsy Terrane (today lying to the north of Malyi Karatau) formed part of the vast east Gondwanan collage throughout Cambrian times, although that terrane appears to have drifted further away from the core Gondwana in the second half of the Cambrian. The paper also confirms that benthic rhynchonelliform brachiopods (previously termed articulates) are more reliable indicators of terrane affinity than the more numerous linguliforms (previously inarticulates), presumably because their larvae lived for shorter periods and were thus more provincial. This monograph is a notable piece of work, enhancing the substantial series which Special Papers in Palaeontology have now become, with contents and conclusions often of relevance far beyond the mysterious world of palaeontological systematics.

Robin Cocks

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CULVER, S. J. & RAWSON, P. F. (eds) 2000. *Biotic Response to Global Change. The Last 145 Million Years.* xiii+501 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £60.00, US $95.00 (hard covers). ISBN 0 521 66304 0.

At a time when positions are disappearing and research dollars are drying up, geologists and palaeontologists around the world have begun to realize that there is a market for their skills and expertise under the rubric of 'global climatic change'. Oil companies and universities no longer hire many palaeontologists, or fund their studies under conventional research programs, but some have been quick to realize that the fossil record provides a unique perspective on the past history of global climatic change, and that this bandwagon may help keep the profession alive. Several major NSF-sponsored programs on global change are now planned or in existence. In 1994, the Palaeontology Department of the Natural History Museum of London and the Department of Geological Sciences at University College London sponsored a joint research programme, 'Global Change and the Biosphere'. The organizers and editors were foraminifer specialist Steve Culver (then at the Natural History Museum, but now back home in the US at East Carolina University) and ammonite palaeontologist Peter Rawson (of University College London). They realized that the best opportunity for palaeontology to shed light on global climate change is the time interval of the last 145 million years, or of the Cretaceous (with its 'greenhouse' climate) and Cenozoic (when the 'greenhouse' developed into the present 'ice-house'). Not only is the geologic record of this interval much better known with much higher resolution and better dating

than older intervals, but in addition most of the organisms belong to modern groups, allowing a greater degree of confidence in palaeoecological reconstructions based on living analogues.

This volume is the product of that 1994 conference. After a brief introduction by the editors, there are two chapters giving a synoptic overview of the climatic and biotic events of the Cretaceous (by Andrew Gale) and the Cenozoic (by Kevin Pickering). Although these chapters are well written and clear, they suffer from a problem that is endemic to the book: they became outdated by the long publication delay. The conference was held in 1994, and it appears that the authors were last given a chance to update their work in 1996 (judging from the most recent dates in the bibliography) – yet the volume took four more years to publish. In the meanwhile, a lot of new research has been conducted on palaeoclimatic changes during the Cretaceous and Cenozoic. This is especially true of the explosion of information about the late Paleocene thermal event (barely mentioned here), our newer and much better understanding of the Eocene–Oligocene transition, and important recent insights, such as the impact of the closure of the Panamanian isthmus on global oceanic circulation and ultimately on the growth of the Arctic ice sheet. As the editor of several such symposium volumes, I'm fully aware of the difficulties of working with multiple authors, and then shepherding the process through often unwieldy publishing hurdles. However, a four-year delay from final revisions to bound copy is fatal for a volume that attempts to summarize such a rapidly changing research field. Authors and editors cannot do much about books that go out of date once they've appeared in print, but it is worse when a book is out of date *before* it appears in print!

The remainder of the book is mostly a taxon-by-taxon coverage of the biotic response of major groups to Cretaceous and Cenozoic climatic events. Here, the difficulties of having different authors covering widely diverse groups of plants and animals become apparent. Some chapters are highly detailed reviews of taxa that are very climatically sensitive, and can be sampled at very high resolution (such as many microfossil groups). Such databases allow the authors to talk with a great deal of confidence and detail about climatic changes and biotic responses. Other chapters deal with less climatically-sensitive groups, or groups with much lower sampling resolution, so one wonders what was the point of the inclusion of these topics in the volume. In other cases, the authors neglected data that would have been useful for understanding the response of their taxon to climatic change. For example, the chapter by Milner, Milner & Evans reviews the record of amphibians and reptiles through the last 145 million years, but fails to make much of Hutchison's (1982, 1992) work showing how sensitive they were to climatic change in North America. The chapter by Crame on the Bivalvia focuses on only the broadest phylogenetic and biogeographic trends, but work by Dockery (1986) and Hansen (1987, 1992) has shown that in some regions (such as the US Gulf Coast) the species-level changes in bivalves are highly reflective of climatic changes. The chapter by Hooker on mammals reflects the deterministic viewpoint that mammals faithfully track climatic changes (a view that I also held in 1994, as my work was also cited by Hooker). However, more recent higher-resolution dating of key climatic events, and closer study of the mammalian faunas in North America, have shown that North American mammals are relatively insensitive to major climatic changes, either in their palaeoecological responses, or as measured by proxies such as turnover rates, changes in dominance of certain groups, or changes in biogeographic ranges (Alroy, 1995, 1997, 1998; Prothero, 1999).

At a very general level, this volume is a useful overview of a wide variety of taxa, and contains a lot of useful information. For those conducting cutting-edge research on Cretaceous–Cenozoic organisms and climates, however, its factual base is so dated that it provides very little insight into the present or future direction of such research (which changed dramatically during the long publication delay). As such, it is a useful general reference for the scientist's shelf, but should not be counted on to provide the current thinking on many crucial topics. Today, scientists are no longer at the mercy of cumbersome publishing procedures. With a relatively inexpensive computer, a scanner, and printers' software such as QuarkXpress (and a slight investment in time), they can produce technical volumes entirely by themselves and ship them to the publisher ready for the printer. Perhaps with the advent of rapid publication of camera-ready manuscripts, it will be possible to circumvent some publication delays in the future, and turn out a more timely (and less costly, since this volume has only a few simple line illustrations) volume.

Donald R. Prothero

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MANDL, G. 2000. *Faulting in Brittle Rocks. An Introduction to the Mechanics of Tectonic Faults*. x+434 pp. Berlin, Heidelberg, New York, London, Paris, Tokyo, Hong Kong: Springer-Verlag. Price DM 179.00, Ös 1307,00, SFr 162.00, £61.50, US $105.00 (hard covers). ISBN 3 540 66436 X.

Many structural geologists will be familiar with Georg Mandl's excellent book *Mechanics of Tectonic Faulting* published in 1988 by Elsevier. This represented a summary of many of the concepts and ideas relating to the mechanics of shear failure in the crust, developed during his time as head of a large industrial research group. Since his retirement

from industry in 1985, he has been a professor at the Institute of Engineering Geology and Applied Mineralogy of the Technical University of Graz. This new book, *Faulting in Brittle Rocks: An Introduction to the Mechanics of Tectonic Faults*, benefits enormously from this experience.

In it the author has focused on the Coulomb–Mohr theory of brittle shear failure and his deep understanding of this topic has enabled him to exploit, more than other authors working in this field, the graphical representation of shear-related problems that this approach allows. This provides an accessible route into the subject for students and engineers lacking a strong mathematical background, without compromising on rigour.

The book is made up of nine sections. Sections 1 and 2 give an introduction to stress and strain, paying particular attention to the graphical representation of the stress equations and introducing the idea of representing tensor quantities in this way. Section 3 on the 'brittle regime' gives a brief introduction to rheology and discusses the concepts of brittle and ductile behaviour. Sections 4 and 5 on the Coulomb–Mohr theory of faulting and poro-thermo-elasticity of rocks respectively are both particularly fine expositions on these and other related topics such as hydraulic fracturing, residual stresses, the effects of change in fluid pressure and the influence of anisotropy on fault orientation. The remaining sections are on different aspects of faulting and are entitled 'Fault structure', 'Slip, reactivation and termination of faults', 'Parallel faults' and 'Modelling of faults and scale problems'.

The book is based on the author's postgraduate lecture course and is therefore well suited to be used as an advanced textbook. Because many of the chapters are self-contained and can be read independently, the work also represents an important reference text. My only regret in this context is that the references have been kept to a minimum.

The text is clearly written and the principles and concepts discussed illustrated with geologically pertinent examples. Although, understandably, the author draws extensively on research and examples directly relevant to petroleum geologists, the geomechanical principles addressed in the book are also of relevance to a large number of other Earth Scientists including structural geologists, engineering geologists, rock mechanics engineers and mining geologists.

In *Faulting in Brittle Rocks*, the author has drawn on his theoretical studies into brittle failure, his geological expertise and his insight into analogue modelling to produce an accessible and much welcomed contribution to the subject. For anyone seriously interested in problems of fracturing in the crust this book is a must.

John Cosgrove

DOI: 10.1017/S001675680135608X

Li, Y.-H. 2000. *A Compendium of Geochemistry. From Solar Nebula to the Human Brain.* xiii + 475 pp. Princeton, Oxford: Princeton University Press. Price US $70 (domestic), £44.00 (international); hard covers. ISBN 0 691 00938 4.

To say that this book covers a wide range of topics is certainly an understatement. It intriguing title is, however, somewhat misleading since the human brain is only discussed very briefly. The book will be a valuable source of reference for data ranging from elemental abundances in carbonaceous chondrites, through mineral distribution coefficients to the average concentrations of elements in the Earth's oceans and the elemental compositions of various biological reference materials.

Chapter 1 starts off with a comprehensive summary of basic chemical principles, such as atomic structure, ionic radii, electronegativity and solubility products. Having set the scene and laid the groundwork, Li in Chapter 2 takes us back to the beginning of time and discusses in some detail the Big Bang and nucleosynthesis. This is a chapter which if read in detail is quite heavy going, but is useful as a source of references. A short Chapter 3 focuses on the chemistry and structure of the Solar System, while Chapter 4 is an exceedingly useful review of the range of compositions displayed by meteorites. Chapter 5, entitled 'Igneous Rocks and the Composition of the Earth', brings us onto territory which will be much more familiar to readers of the *Geological Magazine*, and consequently it is possible that many will find the treatment of this topic somewhat basic. This said, however, the treatment is a good summary for the non-specialist, and indeed I would be extremely pleased if my undergraduate students knew all of the material contained in this chapter!

The next chapter is a highly informative and useful review of the geochemistry of weathering processes and sedimentary rocks, and igneous petrologists who deal with altered rocks would find this chapter of considerable use. Chapter 7 is a summary of the distribution of elements in the oceans, and since this and the succeeding chapter, on the biosphere and *Homo sapiens*, represent Li's main research field they are up-to-date and lucidly written. These two chapters will be useful sources of reference for those working in environmental and palaeoenvironmental research fields.

At £44.00 this book is reasonably priced, given the wealth of reference material that it contains. I would not go so far as to advise every geochemist to purchase a copy, since it is a book that I would envisage using only occasionally. I would, however, encourage people to order a copy for their library, and to alert colleagues to the existence of this book. It could save you and them some considerable time in searching the library for that obscure piece of geochemical information.

Andrew C. Kerr

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McGuire, W. J., Griffiths, D. R., Hancock, P. L. & Stewart, I. S. (eds) 2000. *The Archaeology of Geological Catastrophes*. Geological Society Special Publication no. 171. ix + 417 pp. London, Bath: Geological Society of London. Price £79.00, US $132.00; members' price £35.00, US $58.00; AAPG/SEPM/GSA price £47.00, US $78.00 (hard covers). ISBN 1 86239 062 2.

This Geological Society of London Special Publication arose from a meeting titled 'Volcanoes, earthquakes and archaeology' convened at Burlington House in London in 1997. The main theme running through the book is the integration of geology and archaeology in order to understand the impacts of earthquakes and volcanic eruptions on past societies, and to consider, in some cases, the lessons for understanding hazard and risk today. Of the 28 papers, most deal with aspects of volcanism, and most of the remainder with earthquakes. It is a rather eclectic collection, however, with a mixture of case study and review, historical asides and

technical reports. This may explain why little attempt has been made to provide an overall structure to the volume, for example along chronological, geographical or phenomenological lines.

A number of papers integrate archaeological data, literary sources, and geological information to reconstruct the kinematics of ancient earthquakes in the Mediterranean world, their impacts on the societies they disturbed and, in some cases, the implications for assessment of future seismic hazard. Buck & Stewart analyse ambiguities in the texts of Strabo, Thucydides and others to discriminate between reports of earthquakes in central Greece. In a similar vein, Jones & Stithos argue for caution in ascribing the sociopolitical outcomes of major earthquakes on ancient cities, urging for individual cases to be considered always within the historical context.

Hancock *et al*. focus on the Roman city of Heirapolis, Turkey, and discuss interrelationships between earthquake faulting, travertine deposition, and seismicity. They consider the exploitation of the travertine for building stone in the city, and how fault kinematics can be reconstructed from seismic displacements of built structures. De Boer & Hale consider another well-known site of the ancient world, the Delphic Oracle. They suggest that ethylene leaking up faults and fractures, following pulses of seismic activity, might explain the priestess's inspiration as the result of narcotic and 'not disagreeable mental clouding'.

Waelkens *et al*. review various strands of evidence for a 7th century AD earthquake in southwest Turkey, while Stithos interprets fault patterns on the volcanic island of Nisyros in the Cyclades. Guidoboni *et al*. aim at the heart of the methodology and complexities of archaeoseismology in an investigation of the archaeological evidence for a late Roman earthquake in the Messina region of Italy. They suggest this event may have been the previous major earthquake on the fault that broke in the devastating 1908 Messina earthquake, pointing to a recurrence interval in the region of 1–2 millennia.

On to volcanology. James *et al*. explore the importance of volcanic soils in archaeological contexts, while Griffiths provides an overview of the exploitation of volcanic rocks as tools and building stone. The latter paper is aimed, in part, at encouraging a more positive awareness of the beneficial aspects of living in a volcanic environment. Why did the Incas build their temples at Cuzco from andesite? Because they appreciated the 'aesthetic appeal of phenocrysts glinting in the sunlight against the matt blackness of the fine-grained groundmass of the rock' we are told. The idea that metaphysics as well as pragmatic concerns guided the choice of building materials by past societies is pursued by Hurst who considers the use of basalt by the Olmecs for monumental sculpture.

Several papers provide fact and speculation on the Minoan eruption of Santorini. This occurred in the late Bronze Age and has been implicated in the downfall of the Palace society on Crete. Friedrich *et al*. use geological and palaeontological observations to reconstruct the pre-eruption geography of Santorini, and to postulate the existence of an intracaldera island prior to the climactic eruption, while Russell & Stasiuk show how ground-penetrating radar can help to map the thickness of Minoan tephra, and to discriminate between fall and flow facies. By reinterpreting archaeological data, Driessen & Macdonald argue that the volcanic eruption followed a major regional earthquake, and that it was this double disaster that weakened the Palace society sufficiently for it to fall under the invading forces of Mycenaean Greeks. More imaginatively, Bicknell finds evidence for social upheaval following the Minoan eruption, in the decoration of ceramics from the cultural period known as Late Minoan 1B. The motifs include various marine creatures, and Bicknell argues that these were expressions of religious cults inspired by toxic red tides, the result of pumice fallout across the sea, that worked their way up the food chain.

Cioni *et al*. examine archaeological evidence for eruption precursors. Building damage in the excavated city of Akrotiri suggests that destructive earthquakes occurred in the months prior to the Minoan eruption, initiating a timely evacuation of the population. They also find that similar evidence for seismic precursors to the AD 79 eruption of Vesuvio is lacking, which may have implications for the seismic build-up to the next awakening of the Neapolitan volcano. One of Vesuvio's earlier outbursts occurred around the same time as the Minoan eruption, and in another paper, Cioni and colleagues provide a detailed picture of the eruption dynamics of this event, known as the Avellino eruption, and highlight the incorporation of Avellino tephra into ceramics of the period.

Two papers address different aspects of the preservation and management of cultural heritage in volcanically and seismically active areas. Pareschi *et al*. present an immensely rich Geographical Information System dataset on Pompeii and its environs, while Hughes & Collings review seismic and volcanic risk in Yemen, with particular reference to the world heritage status city of Sana'a.

Chester *et al*. integrate literary references to eruptions of Mount Etna with the geological record, and Day *et al*. and Grattan *et al*. look at the reliability of more recent historical records for reconstructing volcanic activity, and conclude on the dangers of taking too much at face value. Dodghson *et al*. consider the impacts of historic Icelandic volcanic eruptions on agriculture in the Scottish Highlands.

Two papers relate to volcanism in Mexico. Plunket & Uruñela read the social and cultural impacts of a 2000 year old eruption of Popocatépetl, which entombed rural settlements on the lower flanks of the volcano. They suggest that migrations of the displaced population influenced ideological developments in the temple city of Cholula. They also document some extraordinary volcano shrines – a fantastic example of art imitating nature since these sculptures were even connected to working ovens! Gonzalez *et al*. look at the age and impacts of a somewhat younger eruption of another Mexican volcano, called Xitle. It destroyed a lesser-known temple site, Cuiciulco, and resulted in abandonment of nearby sites. Looking at other segments of the Pacific Ring of Fire, Torrence *et al*. literally unearth the cultural response to repeated volcanic eruptions in western New Britain, and Riehle *et al*. highlight the human resilience to frequent volcanism in the Alaskan peninsula over the latter half of the Holocene.

Despite its lack of structure, this is a very worthwhile collection for those interested in the geoarchaeology of volcanic and seismic hazards in the ancient world, and the interrelationships between natural disasters and cultural change. There is nothing really to compare with it, except the Geological Society of America's Special Paper titled *Volcanic Hazards and Disasters in Human Antiquity*, which was also published in 2000. However, the latter is a compilation of only seven papers. Bill McGuire and the other editors deserve much credit for putting together such a varied and interesting set of contributions.

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SELLEY, R. C. 2000. *Applied Sedimentology*, 2nd ed. x + 523 pp. San Diego, San Francisco, New York, Boston, London, Sydney, Tokyo: Academic Press. Price US $82.50 (hard covers). ISBN 0 12 636375 7.

There used to be a TV advert for a brand of varnish that does 'exactly what it says on the can'; by the same token, this book is exactly what it says on the cover. It is a text for those who wish to apply sedimentology to areas such as engineering or petroleum exploration where an understanding of the subject is required, but a detailed knowledge is not necessary. It is best not to see this as a general introductory text for first year undergraduates in geology, who have a number of other suitable books to choose from, but it will be a useful reference text for geotechnicians and engineers. The writing style is very accessible, if a little idiosyncratic in some ways, and there are some nice humorous touches (such as the assertion that orgasmoglyphs can be recognised as trace fossils produced by rutting dinosaurs). The book has a clear format, with good use of diagrams and relevant photographs, and there are a number of useful summary tables.

The book is divided into four sections, of which the first provides a simple introduction to weathering and sedimentary particles, the second a brief but adequate resume of transport, sedimentary structures and depositional systems, and the third is the most satisfactory with a good coverage of the subsurface environment and a discussion of sedimentary rock types. Within these sections there are strengths and weaknesses in terms of coverage of subject matter. On the plus side, for example, there are comprehensive reviews of clastic and carbonate diagenesis, with useful sections on the controls on porosity and permeability. However, there are some omissions in the section on depositional environments (estuaries do not get a mention) and some sedimentologists might question the balance of emphasis given that 50% more coverage is given to evaporites than to mudrocks, although the latter are much more widespread. There is also some uncommon usage of terminology e.g. 'allodapic' as a term for redoposited limestones, and many sedimentologists now use the term 'sand' as a purely textural term without the implication that the grains are made of silica, as indicated on one of the diagrams in this book. The treatment of stratigraphy in general, and sequence stratigraphy in particular, is somewhat perfunctory, and although it could be argued that they lie beyond the scope of the text, sequence stratigraphic concepts and terminology are now widely used by geologists in the oil industry and deserve more than a passing mention. The final section is the most disappointing aspect of this book: dealing with sedimentary basins, it uses 'geosyncline' terminology throughout (despite noting that the term is obsolete), and provides a patchy and uneven coverage of basins formed in different tectonic settings.

Nevertheless, there is much to recommend in this book for the non-specialist who needs to know the rudiments of sedimentology and its application in a wide variety of fields.

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