BOOK REVIEW

BARBER, A. J., CROW, M. J. & MILSOM, J. S. 2005. *Sumatra. Geology, Resources and Tectonic Evolution*. Geological Society Memoir no. 31. ix + 290 pp. London, Bath: Geological Society of London. Price £85.00, US $153.00; GSL members' price £42.50, US $77.00; AAPG/SEPM/GSA/RAS/EFG/PESGB members' price £51.00, US $92.00 (hard covers). ISBN 1 86239 180 7. doi:10.1017/S0016756806212974

The 2004 Boxing Day earthquake and the terrible effects of the subsequent tsunami placed Sumatra firmly in every geologist's mind and graphically demonstrated the power of SE Asian tectonics to the wider public. It might therefore seem prescient to have planned the publication of a memoir describing the geology of Sumatra for 2005. For the authors however, the timing was unfortunate – from the Preface it would appear that this substantial volume went to press in November 2004. However, the chapter dealing with Seismology and Neotectonics contains some late additions which provide a comprehensive summary of the information that became available immediately after the earthquake and has a note added in proof to include data from other aftershocks up to the end of April 2005, including the second major earthquake (magnitude 8.6) to affect the region, on the island of Nias in March 2005.

In comparison to other publications that have followed the earthquake, this volume can fairly claim to provide a comprehensive context in which to place these momentous geological events. Comprehensive, as there is much more to the geology of Sumatra than its present-day position above an active subduction zone. It also contains one of the world's most prominent strike-slip faults (the Sumatra Fault), an active volcanic arc, a partially emergent forearc, and an extensive back-arc region. It contains a globally significant petroleum province, some coal reserves and more limited mineral resources. The geological evolution of the island can be traced back to the Carboniferous.

Much of the geological research conducted in Sumatra in the latter part of the twentieth century has been carried out by the British Geological Survey and the University of London SE Asia Research Group. The editors and most of the contributors are associated with these organizations and are thus able to draw on considerable personal experience. In addition they have incorporated references to pretty much every single paper or book to have dealt with the geology of the island. It thus follows in the tradition of Van Bemmelen, the Dutch geologist who published a 'comprehensive and masterly summary' of the Geology of Indonesia, initially in 1949, and in many ways is a worthy successor.

One gap in the current treatment is the limited coverage of the basins containing hydrocarbon reserves. Oil company data is always subject to the constraints of confidentiality, particularly in Indonesia given the involvement of Pertamina in all licences, but it would have been interesting to see some of the comprehensive datasets that must exist in these areas and would help to address the thorny question of the extent to which strike-slip deformation is associated with the formation and subsequent inversion of the Sumatra basins. In addition, the BGS and University of London projects were models of constructive collaboration with Indonesian organizations and it is perhaps a pity that none of their Indonesian counterparts are represented amongst the authors.

There is no doubt that this volume will replace Van Bemmelen as the standard reference for anyone working in Sumatra. At the time it was planned the potential readership might have seemed quite small but the events of 26 December 2004 show what a very significant area this is, and will no doubt be the focus of much more work in the years to come.

Chris Elders

References

VAN BEMMELEN, R. W. 1949. *The Geology of Indonesia*, The Hague: Martinus Nijhoff.

VAN BEMMELEN, R. W. 1970. *The Geology of Indonesia*, 2nd ed. The Hague: Government Printing Office.

NEMČOK, M., SCHAMEL, S. & GAYER, R. 2005. *Thrustbelts. Structural Architecture, Thermal Regimes, and Petroleum Systems*. xii + 541 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £110.00, US $190.00 (hard covers). ISBN 0 521 88294 7. doi:10.1017/S0016756806222970

Thrustbelts account for around one-fifth of all giant oil fields identified on Earth, and are likely to provide substantial hydrocarbon reserves well into the future. Early oil and gas discoveries were relatively 'easy' and made on the basis of prominent structural geometries. Modern exploration and production necessarily incorporate a much broader and more complex array of information. It is now essential to have a detailed understanding of a wide spectrum of factors affecting the evolution of thrustbelts and their constituent resources. Nemčok, Schamel & Gayer aim to provide this by synthesizing information from an incredibly diverse literature base. Compressing the enormous diversity of subject matter that contributes towards thrustbelt research must provide a daunting challenge to say the least, but the authors have successfully managed to combine topics that are usually treated individually into a valuable and comprehensive volume.

The opening part of this book presents a concise introduction to the topic of thrustbelts, incorporating background information and examples that are common to well-established structural geology textbooks. Chapters on thin- and thick-skinned structural styles are elegantly and extensively illustrated using regional cross-sections and interpreted seismic profiles. Examples are backed up by thorough referencing, and although at times this can make the text feel slightly like a glorified list of case studies, it is always possible to pursue a specific point. Sections on the mechanics of thrust wedges and thrust sheets are easy to read and would serve as a fine introduction for graduate courses. Although given a separate chapter, the mechanics governing thrustbelt deformation is a theme which is woven throughout the book.

Part II focuses on a series of parameters which control the evolution of structural geometries and the nature of fluid flow, including the role of pre-existing structures, the influence of layered stratigraphy, and the effects of

syntectonic erosion and deposition. More emphasis is placed on numerical and experimental data, which are presented with clarity and backed up using fundamental mathematics. Throughout, the book successfully strikes a balance between discursive and quantitative treatment of data. Thermal regimes within thrustbelts are the subject of Part III, which includes discussion on the role of pre-orogenic heat flow, the importance of deformation, and the role of fluid movement in governing thermal regimes. Data concerning a gamut of thermal parameters are presented using extensive tables, which makes this chapter a useful reference, not only relating to thrustbelts, but also on crustal heat flow in general. The book finishes by examining the development of hydrocarbons in thrustbelts, and the future petroleum potential. This chapter is purposefully concise; by keeping detailed discussion of petroleum plays, maturation and migration in thrustbelts to a minimum, the authors successfully avoid treading on the heels of other books which specifically deal with these topics, yet provide a sufficiently well-rounded account as to leave the reader feeling satisfied they have grasped the importance of the topic.

A minor quibble is that the quality of some of the photographs is poor, and the book would certainly have profited from the addition of colour diagrams. The price seems very high (£110, US$190), particularly given that it has the potential to become a relatively 'mainstream' publication, and one whose target audience includes students. Nevertheless, it should certainly be on the shelves of university libraries, where it will occupy a much needed niche. As a reference text it will be invaluable, particularly as a convenient starting point for the aspiring thrustbelt researcher. It is to be recommended for industry professionals and academics alike who are interested in teaching the subject or developing an up-to-date understanding of the complexity and global significance of thrustbelts.

Steven Smith

HUBBARD, B. & GLASSER, N. 2005. *Field Techniques in Glaciology and Glacial Geomorphology*. xi + 400 pp. Chichester: J. Wiley & Son. Price £19.99 (paperback). ISBN 0 470 84427 2.
doi:10.1017/S0016756806232977

In recent years, the growing interest in the response of glaciers to climate change seems to have resulted in an ever-increasing number of undergraduate and postgraduate students who wish to study the subject. The aesthetic appeal and often remote location of glaciated environments further attracts many of these students to undertake fieldwork. This book aims to provide such students, and less-experienced researchers, with a practical guide to a range of techniques in glaciology and glacial geomorphology. Given that most books and academic papers rarely dwell on the intricacies of field methods, it is a genuinely innovative contribution to the literature for which the authors deserve much credit.

The book begins with an introduction and discussion of planning and conducting fieldwork. Chapter 1 provides a crucial introduction to the role of fieldwork and its relationship to theory and modelling. Unfortunately, this chapter is rather brief and is somewhat dominated by detailed case studies demonstrating various ways in which data are collected and used to inform theory. This material may have been better incorporated within the 'text boxes' of later chapters. An extended introduction to scientific methodology and the role of fieldwork in Chapter 1 would have also provided a stronger foundation for Chapter 2, which provides an overview of planning and conducting fieldwork for the uninitiated. Given the inherent dangers associated with working on and around glaciers, many of which are highlighted in Chapter 2, some readers may be surprised that the concept of formulating a 'Risk Assessment' is neglected.

The remainder of the book is divided into superbly comprehensive chapters on a variety of techniques in glaciology and those used to investigate and map glacial geomorphology. The chapters on glaciological techniques cover the sampling and analysis of glacier ice (Chapter 3) and meltwater (Chapter 4); hot water-borehole drilling and instrumentation (Chapter 5); ice radar (Chapter 6); and techniques used in the analysis of glacier mass balance and motion (Chapter 7). The final three chapters focus on glacial geomorphology and encompass the investigation of glacigenic sediments (Chapter 8); the mapping of glaciers and glacial landforms (Chapter 9); and the reconstruction and monitoring of glacier fluctuations (Chapter 10).

The book is predominantly targeted at undergraduate students of Physical Geography and Environmental/Earth Science and one of its key strengths is that each chapter concludes with a list of possible suggestions for student projects. These suggestions provide a framework within which students can explore and develop site-specific ideas. A further strength of the book is that the techniques covered are deliberately restricted to those that are available at a reasonable budget and which undergraduate students are most likely to have access to in Higher Education. Another positive feature of the book is that many of the techniques are illustrated through reference to specific case studies in the literature. These are found in text boxes that provide an accessible synopsis of important work and also cite a handful of key papers that have utilized the technique with great success. This will help students grasp the important theoretical advances that have been made using the described techniques and will also guide them to the key literature.

Overall, this is an excellent book and certainly represents compulsory reading for undergraduate and postgraduate students who wish to carry out fieldwork in glaciology and glacial geomorphology. With over 400 pages, and packed with illustrations and photographs (all black-and-white), it represents excellent value for money. Its compact size (slightly larger than A5) also makes it conducive to taking into the field. It also serves its intended purpose as an excellent reference guide for more experienced researchers who may need reminding of the basics of the various methods alongside more specialized reading.

Chris R. Stokes

PATERSON, M. S. & WONG, T.-F. 2005. *Experimental Rock Deformation – The Brittle Field*, 2nd ed. x + 348 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 89.95 (+ VAT at local rate), SFr 152.50, £69, US $119 (hard covers). ISBN 3 540 24023 3.
doi:10.1017/S0016756806242973

This book occupies a largely unfilled niche within the structural geology/rock mechanics literature. The novel approach that the authors have taken, that of presenting our current knowledge of brittle deformation as determined from laboratory experiments, has led to an informative, readable reference volume that will benefit many scientists. Its range will not solely be restricted to those who work in the field of experimental rock deformation, although many in this

field will certainly benefit from the comprehensive review of the techniques involved and considerations of data quality. It should also appeal to those in the fields of structural geology, tectonics and geophysics that could benefit from the quantitative data emanating from rock mechanics laboratories, but may require a bit of background information fully to utilize and appreciate the data they may use.

Research into 'geological materials science' has drawn largely from classical materials science and consequently has often been two steps behind. This in part results from the complexity of natural rock deformation that involves multiphase polycrystalline aggregates of low symmetry minerals under various, often poorly characterized, environmental conditions within the Earth's crust. The timespan of geological processes is an added complication. The experience of both the authors, with their wealth of experience in experimentation and connections with the materials community, puts them in an ideal position to successfully write a text such as this. The book admirably draws on a materials science approach and provides much useful materials background on various areas of brittle rock deformation. It captures the motivation driving many experimental studies, that of attempting to simplify complex natural conditions in controlled experiments. With this in mind, the book summarizes the current understanding we have regarding brittle rock mechanics and provides an excellent reference for those dealing with experimental data.

More specifically, the book covers aspects of brittle deformation that are not traditionally covered in other texts, such as the chapter on brittle micromechanics. It covers a complete range of topics including theories of brittle failure, the evolution of physical properties during failure, frictional phenomena and the brittle–ductile transition. Some coverage of the basic concepts is sparse; for brevity the book necessarily has to refer the reader to other literature rather than expand the text further.

Although the book is a second edition of Paterson's original 1978 work, many revisions have taken place, the book has a contemporary feel and is up to date. Many of the original references have been kept, but these are classic works and are often overlooked. It is good to see the roots of such topics as rate and state friction covered to include the materials literature that provided the foundations for our current understanding.

In summary, the book is a comprehensive and unique text that will appeal to a broad range of people with an interest in brittle rock deformation. It is particularly well suited to graduate students and researchers in a wide range of disciplines regardless of whether or not they conduct laboratory experiments.

D. R. Faulkner

VAUGHAN, A. P. M., LEAT, P. T. & PANKHURST, R. J. 2005. *Terrane Processes at the Margins of Gondwana*. Geological Society Special Publication no. 246. vii + 446 pp. London, Bath: Geological Society of London. Price £95.00, US $171.00; GSL members' price £47.50, US $86.00; AAPG/SEPM/GSA/RAS/EFG/PESGB members' price £57.00, US $103.00 (hard covers). ISBN 1 86239 179 3.
doi:10.1017/S001675680625297X

This is a big volume. The title is a little misleading as most of papers are concerned with the Australides, defined by the editors as an orogenic belt, extending from western South America via Antarctica to eastern Australia, that formed the southern margin of Pangaea in the Palaeozoic. The volume is thus concerned primarily with orogenic activity at the southern edge of Gondwana during the Palaeozoic and Mesozoic. It is divided into two sections preceded by an introduction: a first section concerned with Regional Syntheses and a second section entitled Topics and Methodologies.

The volume begins with an introduction by the editors to terrane principles and terminology, an excellent review with references to many of the original terrane concept papers, and an overview of the subsequent contributions. The introduction is followed by nine papers dealing mainly with specific regions which take up the first two-thirds of the book. There is a very long review of the Tasmanides of eastern Australia which will be a good resource for those starting out or working in that region, but is quite hard work for the reader who is less interested or less familiar with it. As with some other papers in the volume more diagrams (especially illustrating palaeogeography, reconstructions, and tectonic evolution) would have helped comprehend the geological history. A review of Cretaceous and older terranes of New Zealand gives a valuable history of the development of New Zealand's tectonostratigraphic terrane system, which played an important role in establishing the concept, and provides a clear introduction to the geology of the Western and Eastern Provinces. There are four papers on South America concerned with Mesozoic magmatism of Patagonia, Palaeozoic island arc development on the Pacific margin of Argentina, and Palaeozoic orogeny in the Central Andes which consider the subduction history of the Gondwana margin and its similarities to the present-day Andean active margin.

There is one Antarctic paper in this section of the book which discusses the remote or local origin of terranes of the Early Palaeozoic Ross Orogen. A paper on the Appalachians seemed out of place in this volume although it is concerned with part of the Gondwana margin: an Early Cambrian reconstruction suggests Appalachian exotic terranes may have an origin on a continuation of the Australide active margin. A paper on Nd and Sr isotopes in metasediments from Australia, New Zealand, Antarctica and South America provides new data, discusses their provenance, and presents an interesting approach to reconstructing terranes and Gondwana by matching Nd and Sr isotopic fingerprints, and U–Pb zircon age data. This work will be of particular value to those concerned with the early history of New Zealand. A paper on the episodicity of terrane accretion links deformation and accretion episodes to Triassic and Cretaceous plume events and discusses a huge area of the Pangaea margins.

The second section of the book has a number of mainly shorter papers, some concerned with specific areas, some with terrane-related topics. The deep structure of terranes and their boundaries using earthquake seismic data is illustrated by very old Precambrian crust. Although described as terranes it is not clear that these old regions are comparable to terranes discussed in other papers in the volume and it would have been interesting to have seen some comparison to some much younger terranes. Are they bounded by deep structures or are they relatively shallow features of the crust? A contribution on southern South America presents the only palaeomagnetic data in the volume, which is somewhat surprising since this was one of key methodologies used in developing the terrane concept. It illustrates how palaeomagnetism supports the assembly of cratonic blocks

in West Gondwana by the end of the Precambrian and also highlights the resolution of the method since it concludes that Patagonia was part of Gondwana by the Devonian but cannot rule out collision after separation of up to 1000 km between the Early and Late Palaeozoic. A paper on the Colombian Andes reports new zircon U–Pb ages, Ar–Ar, and Sm–Nd data relevant to Rodinia reconstruction and describes events that led to formation of fragments when Iapetus formed, separating Gondwana and Laurentia, that were later added to the South American margin. Beautifully preserved and illustrated Archaeocyaths in Gondwana tillites from the Falklands are thought to be a type of sponge which diversified and then became extinct in the Cambrian. These are probably derived from the Transantarctic Mountains, and suggest rotation of a Falklands microplate in Gondwana reconstructions and evidence for ice movement and ice sheet extent. The volume is completed by papers on lithospheric mantle domains below Antarctica, provenance studies of metasedimentary rocks in NW Argentina, and new Ar–Ar dating and field observations of mafic dykes from Marie Byrd Land, West Antarctica which are related to transcurrent faulting on the Gondwana margin in the mid Cretaceous.

Many terrane workers seek analogues in other old orogens and it would have been interesting to read more of comparisons to young orogens such as those of the present Pacific margins. It is often difficult to understand exactly with what old terranes are comparable in modern orogens. None the less, this will be a very useful volume for Gondwana workers, and those interested in terranes. Some papers would have benefited from more illustrations, especially reconstructions, which would help the reader understand the development of the vast areas covered in the book. Although a few papers are rather long, the very comprehensive bibliographies will be especially valuable, and several provide excellent introductory reviews to specific areas for new workers.

Robert Hall

CLOUDSLEY-THOMPSON, J. L. 2005. *Ecology and Behaviour of Mesozoic Reptiles*. xii + 219 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 149.95 (+ VAT at local rate), SFr 254, £115.50, US $149 (hard covers). ISBN 3 540 22421 1.
doi:10.1017/S0016756806262976

Ever since the earliest scientific descriptions of plesiosaurs, ichthyosaurs and dinosaurs, the biology of Mesozoic reptiles has been the subject of intense interest. This fascination has been fuelled by the often-bizarre morphology of these animals, their gigantic sizes and, in many cases, the lack of informative extant analogue taxa. Many early studies were little more than informed guesswork, but recent years have witnessed the emergence of a wide range of quantitative techniques, driven by the development of new technologies and methods, which are now permitting the testing of palaeobiological hypotheses with unprecedented analytical rigour. An enormous literature has been generated by palaeontologists working on the diverse array of Mesozoic reptiles, but relatively few attempts have been made to provide overviews of this work, whether it be on locomotion, feeding, social behaviour or some other aspect of palaeobiology. In this volume, John Cloudsley-Thompson attempts the almost Sisyphean task of collating information on all groups of Mesozoic reptiles in order to provide a synthetic account of their behaviour and evolution. However, although this aim is admirable, the resulting volume cannot be regarded as a definitive, or even particularly accurate, guide. Instead, it provides an idiosyncratic (and somewhat old-fashioned) account, which is likely to become regarded as a curiosity, rather than a benchmark for future work.

The volume lacks a cohesive modern phylogenetic structure and presents an outdated classification scheme. Consequently, the relationships of the groups covered are unclear and there is no framework in which to explore the possible ways in which various features might have evolved. In particular, nowhere does Cloudsley-Thompson actually define the group of animals he is writing on: what exactly is a reptile? Most systematists now regard reptiles as a monophyletic group of organisms encompassing all extant members of the group, their ancestors and descendants. Interesting, this group includes birds and excludes basal synapsids ('mammal-like reptiles', to use their former, inaccurate name). However, this distinction is ignored in this volume: birds receive almost no coverage at all and basal synapsids are counted as reptiles (though, admittedly, the author does not provide much information on the latter). This is unfortunate, as an interesting discussion could have ensued regarding the biology of basal synapsids – were they mammal-like or reptilian in terms of their biology? In addition, coverage of the groups included is patchy: dinosaurs, pterosaurs, sauropterygians and ichthyosaurs are discussed at length, while other groups (lizards, turtles, crocodilians, sphenodontians and many more wholly extinct clades) receive only a paragraph or two. Although this does reflect research effort to some extent, much more could have been included.

Errors constantly creep into the text. For example, rhamphorhynchoid pterosaurs were stated to have become extinct at the end of the Jurassic, whereas we know that they persisted into the Cretaceous. Also, choristoderes, a group of crocodile-like taxa from the Mesozoic and Tertiary, are placed in Lepidosauria, rather than Archosauromorpha, as all specialists now agree. We are frequently told about Permian and Triassic lizards, but none are known (the earliest are currently from the Middle Jurassic). These mistakes, and many others (too numerous to mention here) seriously undermine the usefulness of this volume. In addition, the author occasionally contradicts his own statements, sometimes in the space of a few sentences. At one point we are introduced to the mesosaurs, a group of Permian marine reptiles, but told later that reptiles did not return to the sea until the Triassic. This leaves the reader confused and no better informed than when they started reading. Other annoying typographical mistakes are also potentially serious: the wingspan of *Quetzalcoatlus*, one of the largest aerial vertebrates, is given as 1.2 m (not 12 m) and the weight of the largest Mesozoic turtle, *Archelon*, is given as only 4.5 kg (wrong by an order of magnitude). Many of these examples are schoolboy errors that should have been picked up by either the author or his editors. A few isolated mistakes in such a wide-ranging compilation could be forgiven, but the large number included simply appears slapdash.

Although the author draws many detailed conclusions regarding the biology of the groups covered, the actual evidence used to support these inferences is not discussed in any depth whatsoever. There is almost no mention of the anatomy or reconstructed musculature of these animals, or of other indirect sources of relevant information (e.g. taphonomy, footprints, gut contents, etc.) that have a bearing on behaviour. There is also little criticism of any of the

hypotheses presented. As a result, many of these conclusions appear to be no more than either anecdote, the author's unsupported assertion, or idle speculation. The author cites his own earlier works frequently, though these are also compilations of the same ilk and present no primary data on these taxa. The bibliography appears extensive, at first sight, but most of the cited works are either semi-popular review articles (rather than research papers) or were written prior to 1997 – the few articles cited after that date appear to have been thrown in as an afterthought. Finally, the book is illustrated with numerous figures but, without exception, these are awful – poorly drafted and often wildly inaccurate. Most of them are derived from representations found in the older literature and some lack any sense of realism.

This book was a major disappointment; given the current dynamism in the field there is potential to write a really engaging account of these animals. Unfortunately, Cloudsley-Thompson fails to deliver, producing instead a staggeringly overpriced extended essay that will not satisfy specialist academic, undergraduate or informed popular audiences.

Paul M. Barrett

GAFT, M., REISFELD, R. & PANCZER, G. 2005. *Luminescence Spectroscopy of Minerals and Materials*. xviii + 356 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 99.95 (+ VAT at local rate), SFr 169, £77, US $129 (hard covers). ISBN 3 540 21918 8.
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This is a well-presented volume concerning the luminescence of a wide variety of minerals and synthetic mineral analogues. Whereas many earlier volumes about luminescence in geomaterials have largely focused on cathodoluminescence excitation and petrographic methods (i.e. luminescence imaging), the present volume is predominantly about spectroscopy and draws particularly upon UV excitation methods (photoluminescence, PL). The book begins with a chapter dedicated to basic physical principles behind luminescence which many students of luminescence in the Earth Sciences will value. It includes a discussion of the benefits of time-resolved luminescence as against continuous excitation – an important and expanding field. A chapter briefly discusses the equipment used for photoluminescence studies but there is little about the other forms of excitation that probably constitute the majority of publications in the Earth Sciences.

The central chapters contain information about luminescence centres, categorized according to centre type. This is in contrast to the majority of earlier works in which each mineral is studied in turn. The approach used by the book allows the reader to see the similarities between the luminescence behaviour of different mineral systems, but it does have the drawback that any one mineral can have several entries in the book and the index becomes an essential tool. The final chapters are short discussions that include allied analytical methods (including LIBS, Raman spectroscopy and second harmonic generation) and applications in automated mineral prospecting, gemmology, waste storage and biominerals. Each of these sections is relatively short and serves as a brief overview of a much larger topic.

The particular strength of the book is its review of photoluminescence in minerals, including time-resolved PL. Some of the authors are fluent Russian speakers, and therefore have access to the significant volume of literature about mineral PL published in Russian by some of the greats of mineral luminescence. This book provides an overview of important sections of that literature, currently inaccessible outside the Russian-speaking world. The section on rare earths (lanthanides) is also notably strong. The broad title of the book may lead some readers to expect it to contain more about other forms of excitation, particularly cathodoluminescence, and to provide a rather more comprehensive review of the behaviour of individual mineral systems than it does. Nevertheless, this is an important volume that students of luminescence in mineralogy will value. It will also be of interest to other solid state scientists such as chemists and physicists. Its price tag of £77 indicates that it is directed at libraries and specialists, rather than a general audience. It is a book I have recommended for my University library, and, as someone with a particular interest, it is something I will need on my own shelf.

Adrian Finch

WHITE, J. D. L., SMELLIE, J. L. & CLAGUE, D. A. (eds) 2005. *Explosive Subaqueous Volcanism*. Geophysical Monograph Series Vol. 140. x + 379 pp. Washington DC: American Geophysical Union. Price US $90.00 (hard covers); AGU members' price US $63.00. ISBN 0 87590 999 X.
doi:10.1017/S0016756806282979

Over the past few years, substantial progress has been made in our understanding of explosive subaqueous volcanism. Direct observation of explosive subaqueous eruptions and field studies of deposits related to explosive submarine, sublacustrine, and subglacial eruptive activity have provided insights into those processes operating in active magmatic systems, into volcanic phenomena, and into the links between explosive subaqueous volcanism and ore deposits. Theoretical studies and experimental data have shown that explosive eruptions can occur at substantial water depths; studies of rocks from the modern and ancient seafloor have provided clear evidence for explosive activity, such as basaltic lava fountaining, Surtseyan-type eruptions, and pumice-producing silicic eruptive activity in shallow to moderately deep water. Even so, the significance of explosive subaqueous volcanism remains one of the most controversial subjects in the field of volcanology and is often only a 'side issue' in the volcanological and petrological literature.

Geophysical Monograph 140 attempts to address this issue by providing a compilation of 24 papers, derived from an AGU Chapman Conference in Dunedin (New Zealand) in January 2002 on explosive subaqueous volcanism, which cover a broad range of topics, including the dynamics of subaqueous eruptive activity, explosive shallow- and deep-sea basaltic eruptions, explosive submarine silicic eruptions, subaqueous pumiceous deposits, and the economic significance of explosive submarine eruptions. Following an introductory review by the editors, the first section of the book (Subaqueous eruption dynamics) opens with two papers on the theoretical and experimental constraints on water–magma interaction and phreatomagmatic explosions in subaqueous volcanism. These are followed by case studies of subglacial eruptions in Iceland, volcaniclastic deposits from Loihi Seamount, Hawaii, and the interaction of lake water and rhyolitic magma at Taupo Volcano, New Zealand. Section 2 (Explosive eruptions in the modern deep sea) presents studies of recent explosive submarine eruptions and their products

in mid-oceanic ridge settings in the Atlantic Ocean, and from Miocene seamounts offshore to central California. Section 3 (Explosive shallow-marine (Surtseyan) eruptions and their kin) covers shallow-marine volcanic activity and detailed studies of volcaniclastic deposits associated with such activity in the geological record, as well as eruptive phenomena directly observed during the recent Serreta submarine ridge eruption in the Azores.

In the following two sections (Pumiceous subsea silicic eruptions from the modern seafloor; Subaqueous pumiceous deposits and their interpretation), the emphasis shifts to submarine explosive activity of silicic magmas and the interpretation of submarine pumiceous deposits both from the modern seafloor and the geological record. The last section (Economic significance of explosive submarine eruptions) focuses on the links between submarine calderas and products of explosive submarine silicic eruptions with economically significant volcanic-hosted massive sulphide deposits.

On the whole, *Explosive Subaqueous Volcanism* is well presented, and, as with all Geophysical Monographs, of high scientific standard. The editors have succeeded in bringing together a volume that illustrates the enormous progress that has been made in the study of explosive subaqueous volcanism. The collected papers provide a snapshot of this progress and encompass many of the exciting topics in this field. Perhaps the most important aspect of this monograph is that its contributions provide compelling evidence for significant explosive subaqueous volcanism even at considerable water depths. In this respect, this volume fills an important gap in highlighting a topic that has received (perhaps) too little attention from volcanologists and the broader Earth Science community. For volcanologists, professional geologists, and advanced geology students working on any aspect of explosive subaqueous volcanism, this book will undoubtedly stimulate ideas and so should prove to be a valuable resource for many years to come.

Ralf Gertisser

KOEBERL, C. & HENKEL, H. (eds) 2005. *Impact Tectonics*. Impact Studies Series. xix + 552 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 129.95 (+ VAT at local rate), SFr 220, £100, US $169 (hard covers). ISBN 3 540 24181 7.
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Impact Tectonics is the latest in a series resulting from the European Science Foundation's programme 'The Response of the Earth System to Impact Processes' and, like its predecessors, the result of papers presented at an international workshop. This book presents a wide-ranging view of some of the latest research into impacts and some useful reviews. The coverage of many of the various topics represents progress on a variety of individual research projects, rather than an attempt to produce a comprehensive guide to impact-related tectonics. The international author list includes most of the current key players in impact-related studies and the quality of the individual contributions is correspondingly high. These are grouped into four major areas: general aspects, structural and tectonic aspects, numerical and experimental methods and finally one paper on economic aspects.

The first section, General Aspects, deals with three of the characteristic products of impacts: pseudotachylites, shatter cones and impact-induced dykes. An in-depth discussion (Reimold & Gibson) of the correct definition and terminology for rocks formed by frictional melting ('pseudotachyllites') provides a welcome contribution to the clarification of the characterization of these materials. It also illustrates the problems of definition and of realizing a generally applicable consensus when the evidence is so heavily dependent upon research on a single impact structure – Vredefort in South Africa. The formation mechanisms of pseudotachylites and associated parameters are considered at length in the second chapter (Melosh), with special emphasis given to the problems peculiar to larger volume pseudotachylite formation associated with larger impact structures. The macroscopic, microscopic and petrographic characteristics and formation mechanism of impact-related shatter cones are compared with the same features of cone-in-cone structures – weathering-related features that may be misidentified as shatter cones (Ligli *et al.*). Madaitis presents a review of impact-related breccia dykes, their various mechanisms of formation and how they can contribute to the interpretation of the sequences of events during individual impacts and the reconstruction of some characteristics of the impact and target. In the only paper in this volume that deals with extraterrestrial impacts, Öhman *et al*. present a preliminary analysis of some Martian polygonal impact craters. Mapping of these structures is applied to the understanding of large-scale crustal structural properties of Mars' Greater Hellas Region. Wider application of the methods used in this paper is suggested by the presence of polygonal structures on other Earth-like planets, icy moons and meteorites within the Solar System.

In the second section, Structural and Tectonic Aspects, which constitutes approximately 40% of the book, research is presented on eight confirmed and two possible impact structures from locations mostly in Scandinavia and the Baltic region and also in Northern Russia and Libya. Each of these studies applies a range of tools, including satellite imagery (optical and radar), geophysics (e.g. gravity, magnetism, resistivity and seismics), chemical and isotopic composition, petrology and field observation. Most of the papers deal at length with the interaction between the impact and the local and/or regional geology of the target area at various stages between the actual impact and late stage modification events, including the type and distribution of different impact-related deposits, crater morphology, post-impact tectonic, depositional and erosional events. In this regard, the regional study of the Svecofennian Crustal Domain (Puura & Plado) nicely illustrates the possibilities of large numbers of impact structures, the apparent rates of cratering and the effects of a long and complex geological history on structures of different ages in different target rocks. The effects of oblique impacts, from transient cavity through post-impact structural uplift to directional evidence of ejecta distribution and the effects of tsunamis, are considered in detail in a re-evaluation of the Mjølnir Crater, Barents Sea (Tsikalas). Compelling topographic, petrological and geophysical evidence for the interpretation of two features as impact structures is presented in papers by Lilljequist & Preeden, and Henkel *et al.* These ten papers collectively cover the spectrum of issues relevant to the investigation of impact structures. They provide a clear and concise coverage of the key features of impact structures of a range of ages and sizes and in many different types of target lithologies and syn- and post-impact geological settings. In addition, this section brings once more to the forefront the number of identified terrestrial impact structures and, by implication, the number yet to be discovered.

A range of numerical and experimental methods is applied in the four papers that comprise the third section of the book. Preliminary results of a series of simulations using Hydrocode are applied to explain the observed features of the Lochne shallow marine impact (Shuvalov *et al.*) and to investigate the problems peculiar to impacts into water-covered targets. The effects of shock propagation in non-uniform targets are modelled by Hertzsch *et al.*, using a combination of Hydrocode simulation and data from shock experiments on dunite and quartzite. The results of this contribution have wide-ranging applicability in the study of large impacts. An unsuccessful attempt at fission-track dating of the Kentland impact crater is made by Webber *et al.* A paper by Sephton *et al.* investigates the molecular constituents of land plant-derived kerogen and palaeoenvironmental implications of its occurrence against the context of the end-Permian mass extenction.

Occurrences of economic mineralization associated with impact structures worldwide and the general potential for mineralization in these structures are reviewed in the last paper (Reimold *et al.*). Mineralizations present prior to and modified by impacts, and those caused during impact and during hydrothermal circulation caused by post-impact metamorphism, are considered. The principal examples discussed are the rich mineral deposits adjacent to the Vredefort impact structure (Au, U) and the Sudbury impact structure (base metal sulphides and PGEs). Other examples covered are Carswell (U), Ternovka (Fe, U), Siljan (Pb-Zn sulphides, hydrocarbons), among others. The economic potential of many other impact structures is briefly explored. Geophysical exploration for gas associated with the Siljan impact (Sweden) is reviewed in more detail in a review by Henkel & Aaro.

The book is richly illustrated throughout with pertinent photographs, maps, diagrams and graphs (187 in total, some in colour). The quality of these is generally high, although some have apparently suffered slightly during reproduction. All of the articles are clearly written, contain good overviews of the related research literature and extensive and useful bibliographies. They will be of great value to research workers and graduate students.

Impact Tectonics provides a wide-ranging and authoritative view of current research in terrestrial impacts. It should attract a wide readership from among impact researchers worldwide, and have relevance both in studies of known impact structures and the search for as yet undiscovered structures.

Chris Hayward

EDWARDS, R. A. & GALLOIS, R. W. 2004. *Geology of the Sidmouth district – a brief explanation of the geological map. Sheet Explanation of the British Geological Survey. 1:50 000 Sheets 326 and 340 Sidmouth (England and Wales)*. 30 pp. Keyworth: British Geological Survey. Price £9.00 (paperback). ISBN 0 85272 477 2.
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The Sidmouth region lies in the western part of the Dorset and East Devon Coast World Heritage Site at the western edge of the Wessex Basin. Although the map extends inland, interest is concentrated on the spectacular coast, whose cliffs form a readily accessible E–W cross-section. The booklet commences with Permian rocks which underlie the whole area and are possibly exposed at outcrop, but the dating at the Permo-Trias boundary is difficult. The cliffs in the west show the non-marine red beds of the Triassic Sherwood Sandstone and Mercia Mudstone groups. They are followed by grey mudstones of the Penarth Group of latest Triassic age, which are succeeded eastwards by the classic Early Jurassic Lias Group towards Lyme Regis. The easterly dipping Triassic and Jurassic rocks are truncated and overlain unconformably by the Early Cretaceous Gault and Upper Greensand formations. A lesser unconformity forms the base of the Late Cretaceous Chalk Group, which forms the white cliff tops. The less striking, but nevertheless important, Cainozoic deposits include the clay-with-flints, mass movement deposits (including head and colluvium), fluvial, alluvial, salt marsh, tidal creek, beach, submerged forest and calcareous tufa, reflecting largely post-Cretaceous denudation and Pleistocene periglacial conditions. Landslip areas, artificial deposits and worked ground are also covered. The structure is described briefly. A short chapter on applied geology includes mineral, energy and water resources, geotechnical considerations (= engineering geology) and natural radon emissions.

The map explanation forms a compact introduction and background to the geological map of Sidmouth. It is concisely written and well presented with colour illustrations and tables for clarity. Headings, naturally, reflect mappable units. The booklet is well referenced. Additionally, it guides the reader through further information sources such as other geological, geophysical, geochemical, hydrogeological and mineral maps covering the area, as well as other BGS technical reports on mapping, engineering geology, biostratigraphy and boreholes. It also points the reader towards the nationally important archive of rock, borehole, photographic and other BGS records at Keyworth. Strangely there is no mention of an absolute time scale, which could have been slipped into a stratigraphic table without adding extra text.

This is one of the new series of brief descriptions of the BGS 1:50 000 series geological maps. The map itself, also published in 2005, is not included, but is available separately. The booklet, in conjunction with the map, is an ideal introduction to the geology of the Sidmouth area, and is in a handy A5 size. It is suitable for anyone with a geological interest in this region, including students at all levels, and will appeal to focused visitors to the World Heritage site including professional and amateur geologists. The price at under £10 makes it much more attractive than the more expanded memoir series. This new series of BGS publications should appeal to a wide readership.

Simon R. A. Kelly

FREIWALD, A. & ROBERTS, J. M. (eds) 2005. *Cold-Water Corals and Ecosystems*. Erlangen Earth Conference Series. xxxii + 1243 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 229.00 (+ VAT at local rate), SFr 387.50, £176.00, US $299.00 (hard covers). ISBN 3 540 24136 1.
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Although cold-water reefs have been known for many decades, they remain overshadowed by their more glamorous tropical counterparts. Yet with the rise to prominence of cold-water carbonate systems, and an understanding that these extraordinary ecosystems are equally threatened by global change and destructive fishing techniques, cold-water corals are now being studied in the detail they deserve.

Cold-water reefs are far larger and more varied than previously appreciated: acoustic surveys have revealed numerous mounds, pinnacles, and linear structures stretching for kilometres on continental slopes and shelves worldwide, from a depth of 40 m to over 3000 m. These communities are dominated by low diversity non-photosymbiotic branching scleractinian and fan gorgonian corals, whose framework supports a rich associated biota of bivalves, foraminifera, annelids, together with abundant fish and bioeroders. They form a remote, deep, cold-water carbonate production system that is entirely separate from shallow tropical platforms whose productivity is based on the ability of biota to harvest sunlight to form calcium carbonate.

This thick volume results from the Second International Symposium on Deep-Sea Corals, held in Erlangen in September 2003, and is a fine summary of our current state of knowledge. The 62 papers are divided into eight themes: Palaeoenvionmental context (which explores insights from the fossil record); Distribution; Mapping; Exogenic and Endogenic Controls; Coral Biology; Diversity; Environmental Archive, and Conservation.

The inaccessibility of these communities presents many logistical challenges, and has necessitated the development of novel survey and surveillance techniques. Side-scan sonar and seismic methods have been used widely to map these topographic structures. Even so, there is still a great need for a full and reliable inventory of the distribution and abundance of these reefs. Many researchers also use video footage from remotely operated submersibles to assess the health of populations, and 'benthic landers' are being promoted to study seasonal ecological and reproductive phenomena.

Our scientific interest in these deep-water ecosystems is two-fold. First, while these communities are true reefs, their ecology is profoundly different from that of shallow tropical systems. Their distribution appears to be governed by hard substrate made available by current scour and sediment erosion, and these dominantly suspension-feeding communities are maintained by nutrient-laden currents in contrast to the nutrient-impoverished settings of tropical coral reefs. There is also some suggestion that the distribution of these reefs may sometimes be related to the supply of nutrients via light hydrocarbon seepage. We know little, however, as to the reproductive biology, population structure, and dispersal capabilities of the unusual corals that dominate the communities, but it is clear that their ecology, and that of the whole ecosystem, is driven closely by seasonal changes that in part may control the hydrodynamic regime. An accurate taxonomy of these slow-growing, deep-water corals is also still lacking, and so we still have little understanding of the way in which these otherwise disjunct reef communities might be connected by larval dispersal via deep ocean currents.

Second, these communities offer palaeoenvironmental data of great worth. The skeletons of non-photosymbiotic corals appear to show no isotopic fractionation, and so faithfully record sea-water temperature changes. Likewise, studies show that both Mg/Ca ratios, and trace and minor elements, offer invaluable high resolution data for the reconstruction of intermediate and deep sea nutrient chemistry, climatic variability, and oceanic circulation that neatly compliments that of the shallow marine record.

In summary, this volume presents a rich archive of data for these fascinating and important ecosystems. The collation of this volume was a substantial undertaking, and for the most part is well edited, and produced to high standards with the inclusion of many colour photos that bring to life these unfamiliar communities. The price prohibits widespread purchase, but the volume should certainly be placed on every reef enthusiast's bookshelf.

Rachel Wood

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