and organic uptake. Twelve chapters examine environmental deficiency and toxicity, and cover: volcanic emissions; radon; arsenic; fluoride; water hardness; selenium; iodine, aerosols and soil-borne pathogens, with more general reviews. The chapter on arsenic, though fairly comprehensive, fails to acknowledge or reference the outstanding contributions by John McArthur of UCL, London and Peter Ravenscroft to understanding the science behind the plight of Bengali and Bangladeshi villagers.

Section III includes five chapters on environmental toxicology, pathology and medical geology. One explains the role of epidemiology – statistics of disease occurrences – in assessing the outcomes of exposure to environmental hazards, an essential yet quite difficult part of medical geology. The chapter on environmental medicine overlaps to some extent with others, but includes material on risk assessment, such as establishing safe levels for ingestion of elements. Pathology and toxicology (Chapters 23 and 24) play important roles by establishing causes of ill-health and death, when causes have to be linked to effects – many geochemically induced ailments present symptoms that can be mistaken for those with other causes. This is of particular importance in recognizing respiratory cancers linked to inhaled dusts. Potentially toxic elements often occur in several ionic forms or species (Chapter 25), so that elemental arsenic, for example, although widely feared is a great deal less toxic than arsenite ions (AsO_3^{3-}) or the gas arsine (AsH_3). So the form in which an element enters and resides in an environment is crucial to its effects: often that is determined by the oxidation potential.

The final section covers investigative methods that are appropriate to discovering and assessing the risk from environmental hazards, both on the lab bench and using information and communications technology. The latter is now a powerful tool for analysing spatial information, whether it is the relationship of environmental chemistry to rock types, or modelling how hazardous materials move through environmental systems.

Though a monumental tome, *Medical Geology* is not a reference book, but one from which final-year geoscience undergraduates can learn a great deal, in the manner of equally huge first-year textbooks on physical geology. Traditional geology is rapidly being supplanted by that with a more applied emphasis, so-called 'environmental geology'. That is so for two reasons: traditional skills are becoming less valued in the market place than those demanded by legislation for protection of and from human environments; and increasingly it becomes clear that quality of life, and its length, are conditioned by a great many more factors than were once recognized. The clarity and high quality of the book, despite quite a lot of overlap between the chapters, is witness to the serious concern of all of its authors.

S. A. Drury

CHADWICK, R. A. & EVANS, D. J. 2005. *A Seismic Atlas of Southern Britain – Images of Subsurface Structure*. viii + 196 pp. + CD. Keyworth: British Geological Survey. Price £30.00 (paperback). ISBN 0 85272 512 4. doi:10.1017/S0016756806002871

Our detailed knowledge of the surface geology of Britain is perhaps unique as a result of centuries of study but the subsurface geology and structure are less well known. In contrast, since the late 1960s the subsurface geology of the offshore areas of the UK has been extensively surveyed using seismic techniques to the point at which detailed 3D images of large areas are available. The amount of seismic data acquired onshore is very small. Most of it is 2D and covers the Permian and Carboniferous basins either side of the Pennines and the Weald and Portland areas of southern England. Principally these data were acquired for hydrocarbon and coal exploration and much of it is publicly available as part of the UK Onshore Geophysical Library. While some of the data in the library are only a few years old, some date back to the 1960s and consequently the quality varies considerably.

The British Geological Survey has recently undertaken a review of these data and this book is the result. It is not really an atlas in the true sense of the word, more a gazetteer of images of some of the more important fault structures of England and Wales which are well imaged in seismic data. These structures are also used to illustrate patterns of faulting or specific events in the development of the basement rocks of southern Britain. There are no stratigraphic horizon maps or isopach diagrams, which perhaps reflects the predominance of 2D data available. The maps included show the surface and subsurface traces of the faults and the locations of the seismic lines illustrating them. In some cases these are supported by additional maps of geological and potential field data.

There is a short introduction describing the evolution in quality of the seismic data and the structure of the *Atlas*. I felt that an opportunity to review how that evolution was linked with developments in our understanding of the geology was missed at this point. Our knowledge of many of the structures of southern Britain is still relatively poor despite the availability of the data and it would have been useful to provide some examples of how our knowledge has been gained, if only to illustrate the limitations of the interpretations shown later. Chapter 2 provides a concise description of the major tectonic cycles that formed the present bedrock geology. This will be familiar to most readers of this book. What is more useful is that the structures illustrated by seismic data in the remainder of the book are indicated in bold text and heavy lines on maps. This is an invaluable quick reference for finding whether the features you may be interested in are included in the volume; most of the major features are, but this *Atlas* is by no means comprehensive.

The main part of the book is divided into three sections: basement and igneous features, sedimentary cover affected by the Variscan and sedimentary cover affected by the Cimmerian tectonic events. This is a logical structure since it automatically places most of the fault zones in their correct tectono-stratigraphic context. Each structure is very well illustrated, usually with more than one seismic profile as well as a map and occasionally potential field data. The profiles themselves are well chosen to illustrate a particular aspect of the structure or alternatively a particular faulting process, e.g. development of relay ramps or inversion, that the fault displays and that is relevant to the larger tectonic setting. Key stratigraphic horizons are picked on the seismic data, usually to display directions and amounts of throw or the positions of null points on inverted structures. While these are useful, they are keyed to a table at the end of Chapter 2 and not the figure captions, requiring frequent back referencing. Although many readers may be content with the illustrations presented here anyone using this book as a potential starting point for researching a particular structure and obtaining the relevant seismic data may be disappointed to note that the individual seismic lines shown are not referenced nor listed by their survey designations. I do not know if this was deliberate or an omission but it would have been useful to have them listed. In contrast, all the relevant BGS maps are included in the short reference list.

At the back of the book there is a CD-ROM containing a pdf version of the book which runs on a PC and a Mac. I found no mention of this in the contents list or elsewhere in the book. Its contents are identical to the actual book. All the figures are embedded in the text and there are no hyperlinks between maps and seismic data; consequently this appears to have little added value other than to provide a more portable electronic version of the volume.

I was left with mixed feelings after reading this. It provides some good illustrations of some of the major structures that played a role in the development of British geology and places them in their proper context. This will I'm sure prove useful for both teaching and research. On the other hand, the seismic data and the information have been available for some time and I was left wondering why this book was produced and particularly in this format. I cannot help thinking that a more useful and accessible publication could have resulted by using the resources spent on the book to make the CD-ROM fully interactive with links between seismic data, maps and text and to present the work in the form of the second BIRPS Atlas, which also included sub-sampled seismic data and a desktop interpretation package. At £30 it is relatively expensive and not as good value as the excellent revised Regional Guides the Survey is currently producing.

R. W. England

Reference

SNYDER, D. & HOBBS, R. 1999. *The BIRPS Atlas II. A Second Decade of Deep Seismic Reflection Profiling* (3 CD-ROM pack). London, Bath: Geological Society of London.

SEARS, D. 2004. *The Origin of Chondrules and Chondrites*. Cambridge Planetary Science Series. xii + 209 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £65.00, US $110.00 (hard covers). ISBN 0 521 83603 4.
doi:10.1017/S0016756807003123

Chondrites account for more than 65% of all known meteorites and about 86% of those actually seen to fall, and generally contain near-spherical, millimetre-sized beads of silicate called chondrules (Greek *chondros* = grain) after which they are named. Commonly, chondrules can make up 75% of the volume of the meteorites in which they occur. Many chondrites have remained essentially unaltered since their formation around 4.56 Ga ago, and carry a record of a wide variety of events that took place very early in the history of the Solar System. However, for more than a century, scientists have argued passionately over exactly how, and from what, these enigmatic objects formed. Today, there is general agreement that chondrules formed by rapid cooling of once molten, or partially molten, droplets. What caused the melting, where the melting occurred, and the nature of the starting materials are still subjects of intense debate. Because of their abundance in meteorites, however, deciphering the origin of chondrules is fundamental to our understanding of how the chondrites formed in the infant Solar System.

This book by Derek Sears in the Cambridge Planetary Science series focuses on these central problems in the study of the chondritic meteorites. The first chapter provides an historical backdrop to research on the chondrites, and the long process of study by which we have come to their modern classification. Chapter 2 takes a close look at asteroids as the potential sources of most meteorites, and compares them with what has been deduced about the structure of meteorite parent bodies from the study of meteorites. The chapter concludes with what we have learned about the surface processing (cratering and regolith) of asteroids from recent close encounters by spacecraft. Chapter 3 reviews the chemical and isotopic composition of chondrites, their compositional trends, textural differences, the effects of prograde and retrograde metamorphism, and their ages. At the end of chapters 1 and 3, Sears notes two questions that are important to understanding the origin of chondrites: what was the origin of the chondrules; and, what caused the metal–silicate fractionation? Concerning the latter, the behaviour of iron and oxygen in chondritic meteorites, the author notes, is of such fundamental importance that it determines the chondrite classes.

In Chapter 4, Sears covers in detail the main properties of the chondrules themselves: their composition and petrology, comparison with experimental analogues, the rate at which they cooled, their subsequent alteration, stable isotopic composition, and their ages. Chapter 5 is devoted to cataloguing the many and various theories of the origin of chondrules, which are then discussed in more detail in Chapter 6.

An extensive discussion of theories for the mechanism of metal–silicate fractionation in chondrites is presented in Chapter 7, and how chondrules and metal, together with the host matrix, may have been assembled to produce chondrites. In the last chapter, Sears presents his favoured model for the origin of chondrules and chondrites, and not all planetary scientists will agree with it. Essentially, Sears contends that chondritic meteorites are the result of major impacts on a volatile-rich, carbonaceous parent body similar in composition to the primitive, chondrule-free CI chondrites. Chondrules and Ca–Al-rich refractory inclusions, then, according to the author, represent objects resulting from impact melting that have fallen back to the asteroid surface together with matrix, metal, sulphide and other components. Aerodynamic sorting in the temporary, impact-generated gas and dust cloud effected metal–silicate fractionation, with the scale of the impact being the major determinant of the resultant deposit and, therefore, chondrite class.

In regard to his preferred model, unless I missed it, the author does not seem to provide an explanation for the resolvable difference (at least 2–3 Ma) between the ages of Ca–Al-rich inclusions and most chondrules in the CV chondrites. Moreover, I am not sure about his suggestion that a philosophical divide might exist between scientists in America (generally favouring a nebula origin for chondrules) and those in Europe/Japan (generally favouring an impact origin). As far as I remember, since the 1950s and 60s, a good number of proponents of a planetary origin for chondrules were Americans, and there have been champions of both nebula and impact theories on either side of the 'Big Pond' for a long time. In reality, the complex story of the chondrites, which includes both nebula signatures and processing on parent bodies, has made it very difficult to decipher their origin. However, I agree wholeheartedly with the author's suggestion that the key lies in visiting comets and asteroids to view the materials in the context in which they were made. With space probes on their way to deliver such materials to Earth in the next few years we are moving into exciting times, and this may indeed trigger a sea-change in planetary science.