BOOK REVIEWS

BOWEN, R., 1988. *Geothermal resources*, 1989, 2nd. Ed. Elsevier Applied Science, Linton Road, Barking, Essex IG11 8JU, England £60.00, hardback, 485pp. ISBN 1 85266 287 1.

In his Preface, Robert Bowen has stated his aim as being "both to interest and to stimulate the reader in addition to offering a compact, but comprehensive, source of geothermal information for office and field use by earth scientists, engineers and isotope geologists, environmentalists, sociologists and land planners". To what extent has the author succeeded?

Indeed, for its size, the book is packed with information, tables and with references, although many of the latter are from the late seventies with some up to 1986. There are seven chapters that lead the reader logically through from the origins of geothermal resources to their use and environmental impact. Chapter 1 outlines the origins of earth heat right from the first condensation of dust and gases to the differentiation of core, mantle and crust and their associated thermal characteristics. Chapter 2 defines the different geothermal systems, conductive and convective, the nature of heat flow through factured media and fluid systems, and then both idealised models and selected case-study models of hydrothermal systems.

Chapters 3, 4, and 5 cover geothermal exploration, resource assessment and exploitation respectively. These deal with each topic with a very practical "how-to-do-it" methods approach, including both the types of pre-production modelling employed as well as specific items of equipment necessary for exploitation. They have clearly been compiled with care by someone who knows the practicals from firsthand experience. Specific projects are used to some extent, including the Los Alamos and Cornish Hot Dry Rock projects, although considering the number of geothermal operations in the world today, perhaps a greater number and variety of case studies could have been presented.

Chapter 6 discusses some of the environmental impacts of geothermal resource development. Chapter 7 outlines the different uses of geothermal energy including both electrical and non-electrical schemes (eg. process heating, space heating, horticulture and fish farming). Some information is presented here on the experiences in selected countries around the world, although space precludes a thorough treatment of each.

The Glossary, four Appendixes and comprehensive author and subject Indexes are a very helpful addition to the book. Appendix 1 is, in fact, mainly a bibliography of more recent work arranged by country, which to some extent addresses the relative lack of recent case studies and references in the main part of the book. The other appendixes give names of companies and organisations of geothermal interest and a world list of geothermal localities.

Certainly the author has succeeded in producing a useful and informative book that goes much beyond his 1979 edition. Clearly it is not the last nor the only word on a subject that must surely become increasingly important for all of us in the near future. For those involved in the field and who can afford the price, buy it; otherwise recommend it to your library. It is not, however, a book to stimulate those not already working in the area.

Dorrik A V Stow

BARKER, A. J., 1990. *Introduction to metamorphic textures and microstructures*. Blackie and Son Ltd. Glasgow and London. 153 pages, 88 figures, 8 pages of colour plates. £13.95 paperback, £30 hardback. ISBN 0 216 92684 X and 0 216 92685 8 pbk.

Most textbooks on metamorphic rocks deal largely with mineral assemblages and more recently with estimates of their conditions of formation. There are many good books of this type available. In isolation, the mineral assemblages tell only a part of the history of a rock; much more is locked up in its structures and textures. Few books covering metamorphic textures have appeared since the classic work by Spry in 1969. Andrew Barker attempts to improve the knowledge and awareness of this latterly neglected aspect of metamorphic petrology, with a text that fills the obvious gap that has arisen in the last twenty years.

The book is divided into three sections. The first short one (20 pages), called "An introduction to metamorphism and metamorphic rocks", deals briefly with a general outline of metamorphic petrology. This is essentially the ground covered in great detail by most other books on metamorphism.

The second section, "Introduction to metamorphic textures and microstructures" (45 pages) begins with a discussion of the two terms. Many geologists may believe that they are synonymous; in metamorphic petrology and indeed geology in general the term texture is commonly used for any microscopic arrangements of crystals or grains. However, the author points out that in the fields of metallurgy and materials science, from where much of the theory for this type of work is derived, the term texture is only used for a fabric with preferred orientation, whereas microstructure is a more general term for all microscopic arrangements. He makes a plea for geology to come in line with the other physical sciences and use microstructure. There is good sense in this but as "texture" is so entrenched in both the literature and minds of most geologists it is perhaps optimistic to believe it will be widely adopted. This section mainly deals with the development of fabrics, crystal shapes and sizes, inclusions, intergrowths and overgrowths. They are discussed in terms of fundamental processes and are clearly explained and well illustrated. In only one or two places, such as the use of the strain ellipsoid that is referred to in several places, did I think a little more explanation might have helped the reader with a limited background.

The third section, comprising nearly half the book, covers "Interrelationships between deformation and metamorphism". This is to a great extent the main theme of the book and the one that makes it stand out from most others. The vast bulk of metamorphic rocks are deformed but this aspect is skimmed over by most other texts. The section covers firstly deformation mechanisms, classifications of deformed rocks and the influence of deformation on metamorphic processes. The latter is particularly important as reaction rates are speeded up by several orders of magnitude. Further sections cover porphyroblasts and their relations to foliations and a shear sense deduced from pressure shadows. Vein formation, a phenomenon widespread in many lower grade terranes is described and related to various modes of formation. Such information is only usually found in texts on structural geology but is clearly an integral part of the metamorphic process. Fluid inclusions are also briefly discussed.

The final section deals with "deciphering polydeformed and polymetamorphosed rocks". A brief outline is given of some of the features these complex processes produce.

The book clearly fulfils the author's aim—to fill a gap left by most modern texts on metamorphism. It is something of a border zone between mineralogy, structural geology and materials science and all the better for that because surely that is what a study of metamorphic terranes entails. There is enough information to give most students an idea of what the subject entails and adequate references to point the more serious researcher in the appropriate direction in the more specialised disciplines. At a cost of £14 in paperback it represents good value for money and it can be highly recommended as an adjunct to the standard texts on metamorphic petrology.

M.T. Styles

MOSELEY, F. (Editor), *The Lake District*. Geologists' Association Guide, London, 1990. 213pp., no plates, 58 figs., £9.50, softback. ISBN 0 7073 0591 8.

The Lake District has provided geologists with a host of geological puzzles and complexities in great variety and has, as a consequence, received countless individuals and parties during the last hundred years or so who have come to enjoy the wonderful scenery and explore the fascinating geology.

The geological pilgrimages to the Lake District have added to the ever increasing pressures brought about by the droves of visitors each year and one of the first and very pleasing reactions to this excellent new guide is the care that Dr Frank Moseley has taken to educate we geologists in the conservation of the magnificent terrains we have inherited. Moreover, many of the well known classical excursions in the Lake District have been over-used and it is most refreshing to see many relatively unknown excursions described in this guide. It is to be hoped that this will 'spread the load' of many of those easily distinguishable visitors sporting their hand lenses draped round necks, and sketch maps and note books in hand!—dare we hope for less prominence of those destructive hammers?

The guide follows on rapidly from the publication of the excellent 'Geology of the Dorset Coast' which we hope has set the standard for future Geologist Association publications. The new format is so much more attractive than the old mustard or buff coloured, dated guides, which we hope will all receive the overhaul they so badly need.

The Lake District guide has an attractive, coloured, typical Lake District panorama for a cover and the layout of the book is clear. The quality of the sketch maps, however, is very variable, some may well be difficult to follow. Another small worry would be wondering how well a bulky text of this type will stand up to the rigours of living in an anorak pocket in typical Lake District conditions.

As Dr Frank Moseley so rightly states, we can now look at the complexities and puzzles of Lake District geology with reference to the evolution of the Iapetus Ocean and the geological history in this context is dealt with in a clear and concise way in Dr Moseley's introductory chapter.

It is pleasing to have a guide of this type which has used the expertise of a number of specialists who have recently worked in the areas of the itineraries they describe and the detail and preciseness of these itineraries reflects this excellent knowledge of those areas. The object of the guide was to cover equally all the main divisions of Lake District geology and while accepting there have been omissions because of difficulties of access or lack of authors for some areas, there has been a strong bias towards the Borrowdale Volcanic Group which form, in full, or in part, the contents of 16 of the 25 excursions. If the guide was designed to cover equally all aspects of the Lake District geology it is a pity that room could not be found for some of the well known but, nevertheless, classic excursions such as the Shap area, the Skiddaw Granite aureole and the Silurian sequences in the Skelgill area to the east of Windermere. Admittedly reference has been made to some of these areas in itinerary 1, but they deserve more. It could also be said that these excursions have been well covered in other guides; the same however could be said for the Carrock Fell excursion which has been included.

Despite my minor criticisms I warmly recommend what is an excellent guide. It has something for everyone, from the keen amateur to the professional geologist, and it also caters admirably for those who love to combine fell walking with geology. Itinerary 1, which is a road route itinerary, has many advantages. The locations on this itinerary can give a broad overview to the geology of the area for a visitor whose time is limited, the localities can be used when bad weather prevents using many of the other itineraries and it can also be very useful for those who find that the passing of time is beginning to take its toll on physical fitness. This itinerary is most commendable.

The guide provides excellent references to maps and the bibliography is extensive and up to date. This paper-back, at a price of £9.95, is well worth every penny and is thoroughly recommended.

Dr. I.D. Sutton

COOPER, M.P. & STANLEY, C.J., *Minerals of the Lake District: Caldbeck Fells*. 1990. Natural History Museum Publications, London. 160pp., 90 plates of which 72 are in colour, 21 figs., A4 format, £14.95, softback. ISBN 0565 01102 2.

At first sight this guide might appear to be something very much for the specialist and of possible limited appeal to the 'general' geologist. It is, however, very much an authoritative guide to the mining history and minerals of the Caldbeck Fells, possibly the most famous and interesting of all the Lake District mining areas. It is from this area of the Lake District that some of the most beautiful and finest specimens of minerals, such as hemimorphite, linarite, mimetite (campylite) and pyromorphite have been collected. Some of the minerals which have been found are extremely rare and although there are no minerals unique to this area, quite a number have been found only in a very few other locations in the world. An area which boasts some 175 mineral species, many of which have produced museum quality specimens and others noted for their rarity, deserves special treatment. This guide by Mick Cooper and Chris Stanley does just that.

The way the book has been prepared is excellent. It has a first class introduction and is followed by chapters which have a sensible, logical sequence and plenty to stimulate the interest. There is an excellent short chapter dealing with the geology of the Caldbeck Fells, very well illustrated by maps, including an 1824 map prepared by William Smith. The chapter on the Mineral Deposits sets out very clearly a classification of the mineralisation based largely on the main types of mineral veins and this is followed by discussion on the conditions of origin and formation of the mineral bodies.

An added virtue of the book is the way the authors have used historical documents in a very attractive, illustrative way. This is particularly so in the detailed, but interestingly stimulating chapter on the mines and mining. The details of mining history and the geology of mines have always produced a compatible combination and although the evidence of the early history of mining in the Caldbeck Fells is very much fragmentary the detail described in this chapter for the last two centuries or so gives us some insight into the social history of the area during that period, as well as precise information about the history and the development of the individual mines.

Both authors have an obvious affinity with fine mineral specimens and this has the effect of stimulating the reader to appreciate the aesthetic beauty as well as the scientific interest of the minerals. For each of the minerals the chemical composition, occurrence, form, relative abundance and locations are described and many are superbly illustrated with marvellous photographs. The details of the physical properties are not within the scope of this guide.

The guide is completed with two useful appendices and an excellent bibliography. All in all, a first class publication, one that I strongly recommend and, other than a little nit picking over the lack of scale for one or two of the mineral photographs I have nothing other than praise for a beautifully produced and magnificently illustrated guide.

Dr. I.D. Sutton