

due to the whole range of metamorphic processes. This atlas follows the scheme of organisation of Yardley's textbook *An introduction to metamorphic petrology* (1989, Longman), being divided into two sections, Part 1 following sedimentary and igneous rocks of listed compositional types through a range of metamorphic conditions (Plates 1 to 78), and Part 2 illustrating metamorphic textures (Plates 79 to 113). Each section is prefaced by a short introduction, Part 1 presenting a pressure-temperature map of the broad metamorphic facies classification which is used to indicate the conditions of metamorphism of the rocks shown in the individual plates, the captions providing cross-references. For students, this use of metamorphic facies as a guide, instead of assignment to a facies being treated as an end in itself, gives an example of good practice. The organisation of Part 2 is less satisfactory, perhaps inevitably given the wide variety of rocks and processes which have to be summarised. I did not get the sense of enthusiasm which comes through in Part 1, and which is found in *Atlas of deformational and metamorphic textures* by Borradaile, G. J., Bayley, M. B. and Powell, C. M. (1982), Berlin, Springer) which I was sorry not to see mentioned in the reference list.

The actual rocks illustrated include familiar classics such as the pelitic hornfelses of the Skiddaw aureole (Plate 28), the regional metamorphic pelites of western Ireland (many examples), impactite from the Ries Crater of Germany (Plate 8), blueschist facies metabasites from California (Plates 66 and 67), eclogites from western Norway (Plates 68-70) and charnockite from St Thomas's Mount, Madras, India (Plate 76). There are also illustrations of significant discoveries of more recent times, for example the coesite-bearing schist of the Dora Maira massif of the Alps (Plate 37), and the high-temperature granulites of Antarctica (Plate 26). There is only one illustration (Plate 58) where a better example could have surely have been found from the collections available. The authors have missed an opportunity for topicality in the year of German re-unification, by not including a granulite from the type area in Saxony.

Unfortunately, although the captions do convey the authors' enthusiasm, there are lapses from the high standard of accuracy and authority which characterised the first *Atlas of the rock-forming minerals*. There is no such thing as 'cross polarised light' (p. 4), although I have seen it mentioned in undergraduate and postgraduate theses. The abbreviation XPL refers to *Crossed Polars*, if a mnemonic is needed (and has changed to CPL in the caption to Plate 31). The

rock in Plate 5, the introductory example of a dynamic metamorphic rock, is correctly described as a peridotite mylonite in the heading, and incorrectly as a protomylonite in the caption. The authors say in their preface 'We have tended to ignore . . . minerals or textures which cannot be clearly seen on our original photographs because . . . there is nothing more frustrating than a photograph which does not show what it purports to show.' Yet the caption to Plate 42 opens with the words 'This is an extremely fine-grained rock and mineral identification is not easy. The bulk of the rock is composed of fine-grained quartz with chlorite and minor epidote.' The minerals named are not identifiable in the PPL and XPL photographs, and the opening sentence is the kind of thing students should be encouraged *not* to put into their own rock descriptions. G. W. Barrow published his discovery of the regional metamorphic zones in the Grampian Highlands 90 years earlier than the date given in the reference list. Regrettably, these are not isolated examples and I hope that the publishers will consider a re-draft of the text, while retaining the excellent photographs. In a work of this authority, petrologists should practise what they preach.

In spite of this reservation, I must end by repeating that this is a vital reference book for all who use the petrological microscope to study rocks.

R. MASON

Barker, A. J. *Introduction to Metamorphic Textures and Microstructures*. Glasgow and London (Blackie) and New York (Chapman and Hall), 1989. vi + 162 pp. Price £30.00 hardback, £13.95 paperback.

The author's stated aim in writing this book is to produce a text 'which deals comprehensively and exclusively with the interpretation of metamorphic rocks in thin section'. It is also 'written primarily for the undergraduate' but should 'provide a useful first source of reference' for metamorphic geologists in general. The book is short, comprising 170 pages of text, 89 diagrams (including black and white photographs) and 44 colour photomicrographs. It is divided into sections which include: introductions to processes and environments of metamorphism, the facies concept, and the compositional range of metamorphic rocks; discussions of rock textures and

fabrics; controls on crystal morphology, inclusions, intergrowths, coronas and replacements; accounts of deformation mechanisms and the influence of strain (including the use of shear-sense indicators); explanations of porphyroblast inclusion patterns and relationships with the matrix; development of vein infills and fluid inclusions; and finally interpretation of poly-deformed and metamorphosed rocks.

Thus the book attempts to view metamorphic rocks in their true context: as rocks very strongly influenced by deformation processes and disequilibria not just those relating to temperature and pressure variations and idealised equilibrium conditions. The aim is admirable but because the author has tried to compress accounts of all the phenomena involved into a 'concise and inexpensive' text he has had to leave many explanations aside or state them too briefly, and he has been selective, in some sections, of the phenomena that should have been discussed. This problem is however common to many geological texts that try to save the student money by being brief; emphasis is placed on description rather than explanation, and reference to the literature is minimised—surely a sad situation but inevitable in view of the spread of the free-market disease.

The author's summaries of types of metamorphism, facies, grade, crystal growth and the characteristics of the main compositional groups of metamorphic rocks though brief, are clear and will be useful to the undergraduate. However discussions of the variety and origins of rock fabrics are too brief and incomplete. The emphasis placed on the role of simple-shear is misleading and could give undergraduates the impression that this is the only type of deformation that metamorphic rocks suffer. Reference to the strain ellipsoid in this section, and elsewhere, is made without an adequate discussion of its geometry and significance. Also, diagrams and photographs are sometimes not adequately labelled. Undergraduates will I think struggle to understand deformation mechanisms particularly in the absence of clear illustrations. Whilst possibly not the author's fault it is a pity that some of the black and white photographs have not reproduced too clearly and many are rather small, even though there is ample space on the page to enlarge them.

Despite these criticisms the book is a welcome addition and will undoubtedly be useful to all students of metamorphic geology—there is no alternative to my knowledge and on most counts it is preferable to Spry's earlier text. Hopefully if revision becomes possible the author and publisher would consider considerable expansion.

D. POWELL

Lipin, B. R. and McKay, G. A., Eds. *Geochemistry and Mineralogy of Rare Earth Elements*. Washington, D.C. (Mineralogical Society of America: Reviews in Mineralogy, Vol. 21), 1990. x + 348 pp. Price \$20.00.

The *Reviews in Mineralogy* started in 1974 as Short Course Notes and since then have rightly earned a good reputation. This volume, the 21st, is a worthy addition to the series, with eleven chapters covering the geochemistry of the rare earth elements in mineralogical, igneous, sedimentary and metamorphic systems [M.A.90M/4247–4257]. There is also an appendix on cathodoluminescence emission spectra of rare earth element activators in minerals.

The approach of the book is mostly along traditional lines—dividing the subject into cosmic and lunar systems, the principal rock groups, minerals, and isotopic studies. This has led to some repetition—we are quite often told about ionic radius and how this affects the distribution of the rare earth elements (*REE*), and basalts are discussed in five of the chapters. The book starts with a well-written chapter by W. V. Boynton on cosmochemistry. He spells out clearly the differences between nebular and planetary processes and gives the basis for the quantitative calculation of *REE* condensation. A final section summarises the information that *REE* studies have given us—especially about the solar nebula. P. J. Patchett has a short chapter on isotope geochemistry, with frank statements on the applicability and limitations of the methods. The emphasis is on studies of crustal evolution, in which Nd isotopes have had a significant impact. There is little on the use of combined Sr–Nd isotope studies and the important work of some research groups (e.g. Hawkesworth's) receives no mention.

A well-structured chapter on *REE* partitioning between minerals and basaltic melts, by G. A. McKay, discusses first principles as well as some current problems. G. N. Hanson gives a short account of trace element modelling, a lot of which is to be found in other standard texts on geochemistry or petrology. He shows how *REE* data trends can be used to differentiate between batch melting and fractional crystallisation in magmatic processes. This is followed by an extensive survey of *REE* in upper-mantle rocks by W. F. McDonough and F. A. Frey. It builds on an earlier (1984) review by Frey and deals with massive peridotites, ultramafic xenoliths, megacrysts and inclusions. Its purpose is to demonstrate how *REE* data can be used to understand and constrain upper-mantle processes. This is well achieved and although the chapter is one of