A wider view through the microscope

Shelley, D. 1992. *Igneous and Metamorphic Rocks Under the Microscope.* Chapman & Hall, London. 445 pp. Price £24.95.

An understanding of what the petrographic microscope shows us in rocks is pivotal to the appreciation of geology. Observations that can be made in the field are fundamentally limited when it comes to investigating grain-scale processes, whilst the use of large expensive machines to examine atomic-scale patterns can sometimes lead to 'not seeing the wood for the trees'. Moreover, textures viewed down the microscope are often a pleasure to behold—it is a pity that undergraduates might not always agree. In this book, David Shelley takes a detailed look at all aspects of texture development in igneous and metamorphic rocks, both deformed and undeformed, concentrating on what can be seen through the petrographic microscope but without neglecting the added insight from other investigative techniques. It is aimed at both undergraduates and researchers. For me, this description of the processes of texture development is the core of the book and is both interesting and thorough. It brings together ideas from different branches of 'hard rock' petrology which are not often covered in a single text—too often textbooks are specifically targetted at igneous *or* metamorphic processes—and yields a quite distinctive view of rock forming processes.

In contrast to this the first section of the book concerns *classification* of igneous and metamorphic rocks. Inevitably, this is both informative and dull. The conflict between the description of phenomena and their interpretation is highlighted here. Classification, particularly of igneous rocks, is ultimately driven by some feeling for the process which formed those rocks, yet at the same time must be objective. The discussion does, therefore, involve mention of igneous and other processes, but not in a completely coherent fashion, because this section *precedes* the part of the book concerned with interpretation. Igneous rocks are dealt with according to the recommendations of the IUGS subcommission. Metamorphic rocks are, as the author points out, more complex, yet nomenclature is rather more flexible and fuzzy, with the result that there are fewer rock names to become familiar with. For this we should be thankful. There is no doubt that classification systems should be documented and used, but it is debatable to what extent any undergraduate would need the detail presented here. In the Introduction, the author encourages beginners to refer to Part One on classification before moving on—but teachers using this book might well consider other strategies.

In Parts Two and Three, Shelley moves on to the processes controlling development. Part Two considers a wide variety of igneous and metamorphic processes, whilst Part Three is specifically concerned with mineral preferred orientations and thus perhaps of particular interest to readers of *Journal of Structural Geology*. I enjoyed all of it. Yes, I found errors—name a textbook which has none—but I also found much of interest. The discussion of metamorphic processes has something of the flavour of the books of Spry and Vernon, but is of course more up to date: in fact very up to date, with the author incorporating work from several 1990 and 1991 papers. I am not myself familiar with any book which would cover the igneous processes in the way in which this text does. Part Two begins with the fundamental concepts of crystal nucleation and growth, and of how growth is controlled by diffusion and by the attachment of atoms at crystal edges: many igneous and metamorphic textures are mentioned here, including 'standard' ones such as zoning and also other less well-known phenomena. I found the discussion of the variety of processes which can lead to twinning particularly remarkable and informative. Discussion then focuses on specifically igneous and metamorphic textures in separate sections. Crystal size distributions, sector zoning and textural modification in cumulates are just some of the igneous topics which struck me as being both well explained and very much of current interest. The section on metamorphic rocks includes stalwart topics such as the inference of deformation histories from poikiloblast–matrix relationships and 'cutting-edge' ideas like those of crystal size distributions and their link to metamorphic histories. My main unease is at a rather fundamental level, and concerns the discussion of the ultimate controls on crystal shape. Sometimes, it is implied that euhedral crystal shapes develop because they minimize the surface energy of the grain (e.g. p. 119). Elsewhere, we find that facetted shapes develop as a result of different growth rates of different faces (p. 251). These two causes of facetting are fundamentally different: confusing them could lead to major misinterpretations. Although these have, I think, been largely avoided in this book, any reader should be cautious of expanding these particular ideas on crystal shape development. My own view is that facetting is always the result of competing growth rates: the surface energy argument expounded in many texts is a large red herring.

Part Three concerns crystal preferred orientations, both of crystal shapes and lattices. There is a strong overlap with processes introduced in Part Two, and by this stage the reader is already familiar with a host of links between deformation and metamorphism. The discussion begins with how to measure preferred orientations (including X-ray as well as optical techniques). Processes giving rise to them are split into those related to rotation, growth and crystal plasticity. Later, rocks dominated by specific minerals are selected to illustrate these ideas—quartz, carbonates and olivine are all given a thorough treatment, and, as a refreshing change, the metamorphic discussion finishes with a mention of hornblende. In the final section of Part Three, Shelley returns to igneous rocks to round off the analysis, textures here being dominated by rotation and growth.

The book finishes with a combined glossary and index, and an extensive set of references. Altogether, it contains a very substantial set of information and ideas, backed up by many good quality photographs and line drawings. Any research-level reader should welcome the comprehensive nature of the book, but the first year undergraduate could well be daunted by the volume of material. It isn't really arranged on a learning curve: this is epitomized by the classification section where, faithful to the IUGS scheme, the reader is introduced to the delights of uncompahgrite before much more than a whiff of gabbro. The material cuts across levels of skill and across subjects often, for good of ill, taught separately. So it might not be used as a standard text, but as source for teaching ideas and as a reference it would serve well at the undergraduate level. At the research level many workers would benefit from the plethora of ideas covered. In the Introduction, Shelley expresses his hope that the reader will be persuaded that "... petrology with the microscope involves a lot more than purely descriptive petrography, and is a subject well worth pursuing for its own sake". In this task, he has succeeded.

John Wheeler

Liverpool, U.K.

Rock behaviour

Goodman, R. E. 1993. *Engineering Geology—Rock in Engineering Construction.* Wiley, Chichester, U.K. Price £62 (clothback); £16.95 (paperback).

Textbooks on Engineering Geology which attempt to cover this extensive subject in a few hundred pages are necessarily selective. Larger volumes are often very expensive and therefore beyond the means of most undergraduates.

Richard Goodman and Wiley have produced an excellent 412 page text at a remarkably low price, following closely on the *Principles of Engineering Geology* by Johnson & De Graff, which Wiley produced at a similar low price.

Wiley's International Editions are printed in Singapore and therefore suffer slightly from poor photo reproduction and reduced paper quality. However, at just 4 pence per page this is quite acceptable.

Goodman's approach has been unashamedly lithological: with five out of nine chapters concentrating on the engineering behaviour of various rock types. This is a refreshing approach which makes the volume a particularly useful addition to the many books on engineering geology which have recently come on to the market. It is a very useful site reference text and would be applicable to any courses teaching civil engineers from a lithological base.

Unfortunately, civil engineers need to know about other aspects of geology not tackled by the book. Goodman acknowledges the shortcoming in the Preface "to the student". He concludes "If after learning this subject you wish to explore it further, you will probably want to follow it up with a course in at least one of the following: general geology, geomorphology, structural geology or geophysics and tectonics". This is a strange comment since general geology is really a prerequisite for this text. It is also surprising that Goodman does not recommend the student to study rock mechanics since his other textbooks are on that subject.

What about content? After an introduction about the role of geology in engineering, Chapter 2 covers some aspects of general geology in just 35 pages. Brief definitions of minerals, rock and