This book presents a wide range of crystallographic data on the major minerals. After a short introduction, the reader is presented with over 300 pages of data tables and figures of major oxides, hydroxides, silicates (subdivided into orthosilicates, chain silicates, framework silicates, etc.), carbonates, nitrates, sulfates (*sic*), phosphates and halides.

The crystallographic data presented includes formula, density, space group, cell parameter, cation coordination number, Wyckoff position, fractional coordinates, bond lengths, polyhedral volume and electrostatic site energy. In addition, a source reference for each structure is given. The full page figures are largely polyhedral drawings of the structures, and are generally very clear.

The book is intended for petrologists and geochemists interested in understanding the geochemical behaviour of minerals in terms of their atomistic structure. From this point of view the work may well prove a useful source of data. I cannot help feeling, however, that by omitting the fractional coordinates of the anionic species, this book has fallen short of being an invaluable data source, and is likely to have only limited appeal. Admittedly, including anionic coordinates would have considerably increased the amount of data, but I believe it would have been well worth doing. As it stands this book is interesting, but not an essential addition to the library of every mineralogist.

G. D. PRICE

Frey, M. (ed.). *Low Temperature Metamorphism.* Glasgow (Blackie), 1987. x+351 pp. Price £45·00.

The study of 'low-temperature metamorphism' or low- to very low-grade metamorphism is an area that has been largely neglected by British geologists. This partly reflects the long-standing debate as to whose realm the subject falls into, generally being considered too high a temperature for those involved with diagenetic investigations, and too low a temperature for metamorphic petrologists. The truth of the matter of course is that there is a continuum.

The study of low-temperature metamorphism is itself a very young branch of the Earth Sciences, dating from the pioneer work of Coombs and others in the mid to late 1950s. While there has been a limited attempt in recent years to redress the balance by some British geologists, still the majority of work in this field is undertaken by investigators in other countries; this is clearly reflected by the contributors to this volume.

This book provides an authoritative review of the subject in question, with the relevant chapters all being written by recognized authorities in their field. The very nature of the subject demands input from many different disciplines within the Earth Sciences, which is demonstrated by the diverse topics covered in the book.

The first chapter (by Frey and Kisch) describes the realm of the book, highlights problems of definition in low-temperature metamorphism, and discusses aspects of terminology. Chapter 2, by Frey, describes how metamorphic grade at these low temperatures may be determined utilizing clastic, principally pelitic, rocks. Textural developments, the various crystallinity indices utilized, aspects of polytypism and polymorphism, clay mineral assemblages, and geothermometry and geobarometry are detailed. Mineral assemblages and mineral facies in low-grade volcanic and volcaniclastic are described in Chapter 3 by Liou, Maruyama and Cho. Their discussion largely relates to the model NCMASH system as developed by the authors, which must represent one of the most significant developments in low-grade metamorphic studies in recent years. Chapter 4, by Teichmüller, gives an account of low-grade metamorphic effects on organic materials. Details of the types of organic matter in sedimentary rocks are followed by a description of the processes of coalification, anthratization and graphitization, and the rank and stage parameters. Fluid inclusion investigations in low-grade metamorphic studies are reviewed by Mullis in Chapter 5. An introductory description of methodology is provided, followed by accounts of estimation of fluid composition and density, and aspects of geothermometry and geobarometry. In addition various case studies are reported. Chapter 6, by Hunziker, is an appraisal of radiogenic isotopes in low-grade metamorphic studies. A review of the problems of isotope studies in low-grade metamorphic terrains is followed by a description of the principal techniques utilised (K–Ar, ^{40}Ar–^{39}Ar, Rb–Sr, fission track dating, U–Th–Pb and Pb–Pb). The final chapter is an extensive review by Kisch on correlation in low-grade metamorphism, a chapter of enormous value given the diverse courses of low grade metamorphic investigations. In particular Kisch correlates illite crystallinity, metabasite mineral assemblages, and coal rank. As in other reviews by this author he provides invaluable exhaustive reference to other published works. Finally a most comprehensive and up-to-date reference list is provided.

In conclusion this book is to be recommended to anyone who has a research interest in low-grade metamorphic investigations. The various contributions are authoritative and well written

and the editor has quite obviously exerted considerable and appropriate control. The final point in its favour is the lack of any alternative!

R. E. BEVINS

Helgeson, H. C., ed. *Chemical Transport in Metasomatic Processes*. Proceedings of NATO Advanced Studies Institute, Dordrecht, Holland. (D. Reidel) 1987. xxv+782 pp. Price £94·25.

A resort near Corinth and a seaborne geological excursion to the Cycladic Islands in the Aegean might seem unlikely venues for the advancement of geochemistry, but this formidable volume of the proceedings of a NATO Advanced Studies Institute in Greece in 1985 attests otherwise. It is in the nature of NATO-ASI proceedings that a significant proportion of the published material is of a review character. In this instance, two and a half years have elapsed between the ASI and the publication of this volume of proceedings, with the result that some of the material in the proceedings will be familiar, in a different guise, to specialists in the field who are abreast of the current journal literature. Nonetheless, there is much material, both new and old, to challenge and stimulate the specialist and student alike in this diverse volume [M.A. 88M/3788-3815].

The diversity of material is considerable, spanning mantle metasomatism, the theory of fluid transport and metasomatism, the thermodynamics of mineral-grain interfaces, speciation in metamorphic and hydrothermal fluids, modelling of fluid movement and circulation from the scale of the mineral grain to that of the whole crust, and a comprehensive overview of the petrology, geochemistry, tectonics and field geology of the Cycladic Islands of the Aegean. The authors are in the main the leading authorities in these fields. The scarcity of experimental studies in such a large volume on fluid geochemistry and metasomatism is disappointing, given the manifest inadequacy of the experimental basis for thermodynamic data sets for minerals and fluids, but the volume probably truly reflects recent trends away from experimentation towards theory and modelling.

A few papers in this volume do successfully attempt to marry theory or modelling to real geological examples, but the gap between theory and practice is nonetheless apparent in many contributions, and the clearly increasing complexity of metasomatic and fluid-transport theory demonstrated in several papers serves to underline the need for theoreticians, modellers and practical geochemists and geologists to collaborate in bridging this gap.

At £94·25, this volume is only likely to find its way onto the shelves of the specialists in the field of chemical and fluid transport, but it should become a widely-referenced university library text, giving as it does a fair reflection of the state of the art in this field as seen by some of its foremost practitioners. Given the quantity and diversity of its contents, the book is better value for money than might at first be suggested by its high cost.

C. M. GRAHAM

Carmichael, I. S. E. and Eugster, H. P. (eds.). *Thermodynamic Modelling of Geological Materials: Minerals, Fluids and Melts* (Volume 17 in Reviews in Mineralogy), Washington, D.C. (Mineralogical Society of America), 1987. xiii+499 pp. Price $18.00.

Volume 17 of Reviews in Mineralogy continues the high standards of its predecessors and constitutes a remarkably broad ranging review of the application of thermodynamics to geological and geochemical problems. The main emphasis is on thermodynamics involving fluids, and the volume will do a great service in bringing this rapidly evolving field to a wider audience. However the range of geological applications that the volume encompasses is particularly large, spanning sedimentary, igneous and metamorphic rocks, and ore deposits; truly there is something for everyone.

In the first part of the volume the basic principles of the thermodynamics of phase equilibria are developed by Newton, and applied to crystalline solutions by Navrotsky, while Wood describes the approach to more complex systems with multiple solid solutions. All this is good stuff, well written and up to date, but it must be said that this is largely material that has been well reviewed in recent years, by these and other authors. Indeed, while there are some new developments, notably the work on Fe-minerals described by Newton, the examples are mostly drawn from the same groups of minerals as in earlier reviews.

A second group of 7 chapters concerns crustal fluids and mineral-fluid equilibria, from the points of view of both the solvent and its dissolved load.

Two chapters, by Holloway and by Ferry and Baumgartner, are concerned primarily with supercritical fluids in the C-O-H system. Holloway discusses the nature of forces between molecules in the fluid and develops equation of state models before giving examples of equilibrium calculations. Ferry and Baumgartner concentrate on various versions of the Redlich-Kwong equation of state in current use, which they contrast. If you like reading equations, this is the chapter for you.

Five chapters are concerned primarily with