

basic principles of geology. It will appeal to all those wishing to study West African geology, especially undergraduates in the countries of the region. It covers the area, south of the Sahara, from about 15° N. (Senegal to Niger) to about 5° N. (Sierra Leone to Nigeria).

The first chapter introduces the geological setting of West Africa, whilst the remainder of the text treats the subject in four parts: the Precambrian; sedimentary basins; Mesozoic to Cenozoic igneous activity; and the Quaternary. Each chapter has a useful summary, and each of the four parts begins with an introductory chapter setting out the general geological principles and the arrangement of the ensuing chapters. Thus the Precambrian is introduced by an informative chapter describing crustal reactivation, regional patterns in West Africa, basement rocks, and supracrustal and granitic rocks. This is followed by chapters on the Archaean, the Proterozoic, the Pan-African of the western and eastern parts of the area, and a synthesis. The Pan-African is dealt with in this part because it represents the final stage in the formation of the African shield although it is largely younger than the Precambrian.

The sedimentary basins described in Part 2 comprise the Late Precambrian (Infracambrian) to Lower Palaeozoic sequences, Mesozoic to Tertiary inland basins, and coastal basins. A description of the general occurrence of sedimentary basins within and around continental masses introduces these subjects, which are followed by a chapter on the economic potential of the younger basins referring especially to oil, coal, uranium, and phosphates. A short chapter on the generality of orogenic magmatism in the area introduces Part 3, which consists of brief chapters on Permo-Triassic dolerites and carbonatites, the Younger Granites (especially the Nigerian tin granites), Cretaceous to Cenozoic magmatism and volcanism including kimberlites and the diamond fields. In the final part, the Quaternary is introduced by a chapter on earthquakes, volcanoes and meteoric impact; it also deals with geomorphology, Quaternary deposits including laterites, and water resources.

The authors have set out to provide a thorough treatment of fundamental principles and their application to West African geology in 162 pages of text, with the result that a great deal of information is condensed into a slim volume, giving a rather staccato style. For this task they have appreciated that many standard references are often unavailable to their intended readers and that there is a necessity to emphasize the role of geological provinces without offending nationalistic sensibilities. They have brought together a mass of information on the area despite local differences in placing

boundaries or interpreting the mechanisms of formation. Above all this book is intended to be helpful and constructive in these matters. There are useful and informative maps and diagrams, although some of the diagrams showing plate tectonic reconstructions are occasionally so stylized as to seem almost inapplicable to West Africa in the Precambrian. The reader is helped by the full contents list and index and the glossary of terms from *Abakaliki Basin to Zungeru mylonites* which also includes general items such as *cauldron subsidence* and terms like *thermotectonic event* developed specifically in the context of African geology.

JOHN F. W. BOWLES

Shepherd, T. J., Rankin, A. H., and Alderton, D. H. M. *A Practical Guide to Fluid Inclusion Studies*. Glasgow and London (Blackie), 1985. xi + 239 pp. Price £26.

The enormous growth of the use of fluid inclusions in all branches of geology has led to the publication of a large number of books, short course notes and special issues on the subject. One item that has been missing is an extensive work on the practical aspects of fluid inclusion analysis. However, this book exactly fills the gap in the literature, being a text dedicated to aiding researchers in obtaining meaningful data from fluid inclusions.

Chapter 1 provides a background to fluid inclusion analysis including information on the types of fluid inclusion, their formation and post formation changes. Chapter 2 is concerned with the preparation of material for analysis and Chapter 3 with the information obtainable from optical examination. Thermometric analysis is dealt with in Chapters 4–7, covering everything from equipment and standards to the presentation of data. There are detailed step-by-step accounts of how to handle fluid inclusions of all chemistries (from simple H₂O–salt inclusions to CO₂–CH₄–N₂-bearing inclusions) during heating and freezing. Chapters 8 and 9 are devoted to chemical analysis and all methods are described, and their respective merits discussed. The methods dealt with vary from crush-leach analysis to more specialized spectroscopic techniques of ICP-decrepitation analysis, SEM analysis of daughter minerals and Laser Raman analysis of single inclusions. Chapter 10 speculates on the areas in which new advances will be made and this is followed by appendices providing addresses and manufacturers of the materials and equipment needed for preparation and analysis (nearly all UK).

The book is sympathetic to the reader and assumes no previous knowledge on the subject. It

has the clarity essential in a laboratory manual and the possible pitfalls and possible misconceptions are exposed at each stage. It is well produced and well illustrated throughout. The sections on optical and thermometric analysis contains photographs of the full range of fluid inclusions likely to be encountered and the changes that occur during heating and freezing. The use of relevant diagrams (P - T , phase, etc.) to explain the observed changes during thermometric analysis prove very useful in the understanding of the data acquired.

There is some theoretical discussions of the data but this is used to provide an understanding of the data *senso stricto* rather than provide petrogenetic interpretations.

This book admirably achieves its aim of providing a usable laboratory manual for those involved in the study of fluid inclusions. It is highly recommended by the reviewer, especially to those entering this field. Users of the book will benefit greatly from the authors' practical experience and improve their chances of producing well qualified data efficiently.

R. A. D. PATRICK

Berry, F., and Vaughan, D. J., *Chemical Bonding and Spectroscopy in Mineral Chemistry*. London and New York (Chapman and Hall), 1985. x + 325 pp., 129 figs. Price £35.

The editors of this book on spectroscopy and bonding present a welcome and most timely contribution to the mineralogical literature. In recent years there has been a rapid increase in the number of spectroscopic techniques used in the study of minerals, but because of the lack of suitable texts it has often proved difficult for the non-specialist to learn and appreciate the significance of the results obtained by these investigations. This book goes a long way towards solving the problems faced by non-spectroscopists in their attempt to incorporate the findings of spectroscopy into their larger understanding of mineral behaviour.

Almost inevitably a book attempting to cover the wide range that spectroscopy now encompasses must be a multi-author affair, and indeed this is both the strength and the weakness of this volume. The strength naturally derives from the expert knowledge that each author can bring to his chapter, while the weakness, although not strongly pronounced, must derive from the differences in styles, approach and thoroughness of each chapter. The uniting theme in all of the chapters, however, is how various spectroscopic observations shed light upon the nature of bonding in minerals. To this end, the introductory chapter by J. A. Tossell on the applications of quantum mechanics to bonding in

minerals is both lucid and an essential part of the volume.

The three subsequent chapters by D. S. Urch, R. G. Burns and G. Walker deal with various aspects of the interaction of electromagnetic radiation with electrons in minerals. Although the three techniques discussed, X-ray spectroscopy, electronic spectra and luminescence techniques all provide insights into the distribution of electrons in minerals and their relative energetics, I feel that a chapter on infra-red and Raman spectroscopy would have strengthened this part of the text. Nevertheless, these three chapters all provide an excellent guide and introduction to the spectroscopic techniques to which they are dedicated.

The next two chapters are concerned with the interaction of radiation with atomic nuclei. A. G. Maddocks' chapter on Mössbauer spectroscopy is a fine review of a more familiar but underused mineralogical technique, while W. R. McWhinnie's chapter on resonance spectroscopy outlines the theory of an approach to mineralogical study which I am convinced is going to grow in importance in the next decade. Finally the editors each contribute more specialist, but equally informative, chapters on the nature of bonding in opaque minerals and on mineral surfaces. The study of opaque minerals is neglected in the main by mineralogists and petrologists, but as D. J. Vaughan's chapter reveals, much can be gained from investigation of these phases. F. J. Berry's chapter on surfaces addresses the least well known aspect of mineral behaviour, but one which is potentially the most important and challenging area of mineral physics. Despite our relatively extensive knowledge of the behaviour of single-crystal minerals, we are as yet unable to use that knowledge to predict the nature and properties of polycrystalline aggregates such as rock. Until we understand mineral surfaces and grain boundaries, we will be unable to apply our knowledge of the physics of minerals to describe the physics of the Earth, and as such the chapter by Berry may point the way to much future mineralogical research. This whole text is most worthwhile and thoroughly recommended.

G. D. PRICE

Maaløe, S. *Principles of Igneous Petrology*. Berlin, Heidelberg, New York and Tokyo (Springer Verlag), 1985, xiv + 374 pp., 291 figs. Price DM 138.00.

Petrology is both descriptive and interpretative. In the interpretative part the various observations made are synthesized into a plausible physical and chemical scheme of petrogenesis. Extending the