

BOOK REVIEWS

Hochella, M. F. and White, A. F., eds *Mineral-Water Interface Geochemistry*. Washington, D.C. (Mineralogical Society of America: Reviews in Mineralogy, Vol. 23), 1990. xvi + 603pp. Price \$20.00.

The latest addition of the excellent 'Review in Mineralogy' series, published by the Mineralogical Society of America, focuses on the mechanisms of sorption and desorption occurring on mineral surfaces. The reactivity of minerals in aqueous systems is of fundamental importance in understanding geochemical cycles and has become a major new research direction through advances in surface analysis and theoretical modelling techniques.

The collection of papers put together by Hochella and White review the various mechanisms of attachment and detachment of aqueous species on mineral surfaces and provide an up-to-date account of recent work in this field. Following an overview of the subject the volume is broadly divided into four sections. The first section (Chapters 2 and 3) reviews microscopic and atomistic observations of mineral surfaces and the fundamental atomic processes that occur at the mineral-water interface. The second section (Chapters 4-8) covers sorption processes and discusses thermodynamic properties of surfaces, surface complexation and molecular adsorption models as well as the new *in-situ* methods for characterising sorbed species. Processes controlling precipitation and dissolution are discussed in the third section (Chapters 9 and 10) which includes the classical theories of precipitation and crystal growth, near-surface diffusion mechanisms and leaching processes. Finally, surficial oxidation-reduction and photo-redox reactions are reviewed in Chapters 11-14.

The 'Reviews in Mineralogy' series represents outstanding value for money and credit is due to the editors and contributors to this volume for bringing together new concepts in geochemistry and surface science. This book will be a valuable reference text for all those interested in water-rock interactions, especially those interested in weathering processes, ore formation and environmental geochemistry.

D. MATTEY

Ragland, P. C. *Basic Analytical Petrology*. New York and Oxford (Pergamon Press), 1990. xii + 369pp. Price £32.00 (hardback), £15.00 (paperback).

This is a small/medium-sized book (370 pages) but is amazing for the amount of information that is packed into it. The topics covered include phase diagrams (including Shreinemaker's construction), thermodynamics, variation diagrams, trace elements, experimental petrology, a very useful first chapter on 'basic tools' and a short (10 pages) section on igneous rocks and plate tectonics. Also the inclusion of a description of programming in BASIC underlines the wide scope of this book.

It is not surprising therefore that in most cases the reader is presented with facts and no discussion of options and therein lies the all too obvious weakness of this book. As the geological sciences are a mixture of fact and theory it would explain why the production of this type of book is barely attempted in the Geological Sciences. The author is often describing the top of the iceberg without giving any hint of the mass of material under the surface which is somewhat dangerous for inexperienced students. With a reasonable restriction on time and space it is not possible to comment on all the many and varied sections in this book so I have focused my attention on a few familiar (to me) sections, especially those on phase equilibria and volatile solubility. For instance, in chapter 5 (p. 270), we are told about the effects of H₂O and CO₂ dissolving in silicate melts; the former depresses the melting temperature greatly while the latter has only a little effect on the melting temperatures. The explanations given for this contrasting effect are that more H₂O dissolves than CO₂ and that the silicate melt is depolymerised by the H₂O but polymerised by the CO₂. A chemical reaction is presented which supports this latter. This explanation is vastly oversimplified which leads to it being misleading on the following grounds: (i) forsterite, a completely depolymerised phase melts at a *higher* temperature than albite which is a very polymerised phase therefore polymerisation and melting temperature are not necessarily linked; (ii) a consensus of whether H₂O is predominantly dissolved as H₂O or (OH) and thus its effect on the melt structure has not been reached; (iii) likewise the relative import-

ance of CO₂ or CO₃ in silicate melts has not yet been reached; (iii) likewise the relative importance of CO₂ or CO₃ in silicate melts has not yet been fathomed; (iv) the solubility of CO₂ in peralkaline melts is considerable and has a significant effect on their melting temperature.

Even the discussion of the SiO₂ phase diagram (p. 137) I find confusing, for example, the stishovite, keatite, β -cristobalite phases are mentioned in the text but not shown on the diagram. Displacive and reconstructive phase changes are discussed but no explanation of why the α - β quartz phase boundary is shown and the α - β cristobalite one is not; what happened to α - β tridymite etc. anyway? In this case the author is again in 'a half-way house' situation having given more than the minimum information but has not then explained it fully enough. Also in the phase equilibrium section I could not see the advantage in using terms such as 'forbidden zone' and 'Claperyon diagram' for 2-phase region and *PT* diagram respectively; the latter two might be old fashioned but are at least self-descriptive.

Relatively speaking a lot of space is devoted to variation diagrams (pp. 286-313) but yet no mention is made of the Pearce diagram, which is generally agreed to be an advance in this subject. This seems to be quite a surprising omission.

So this book is far from perfect. Most, but certainly not all, of these imperfections stem from the ambitious nature and scope of the book. It has many good points. I particularly liked the worked examples which are done in detail and to completion so that the reader has no doubt of the result. Many commonly used but often unexplained terms such as LOI in rock analyses, Mg number of basalts and olivine, accuracy and precision, are explained, and this service should be appreciated by students and non-specialists alike.

I would estimate that a wide range of Earth scientists would benefit from reading this book as I certainly did. I suppose that in the British University system our second year students would find the examination of the top of the icebergs very useful before going on to see what is below the water in their third year. Also, non-specialist geologists switching into the subject at the graduate level might find this book very helpful. Therefore, despite some objections to the content and method of treating some subjects I can highly recommend this book—it really is packed full of useful information and well worth a place on your shelf.

D. L. HAMILTON

Foster, R. P., Ed. *Gold metallogeny and exploration*. Glasgow (Blackie Publishing Group), 1990. xvi + 432pp. Price £85.00

It is rather surprising that the intense exploration activity for gold during the last decade has not prompted the appearance of any books reviewing the geology of gold deposits. Several useful conference proceedings or special society publications on aspects of gold mineralization have been published, but there has been no up-to-date, standard reference since the classic text by Boyle was published more than ten years ago. Considering the major advances in our understanding of the characteristics of gold deposits this new text is therefore most timely.

The book includes chapters on a wide range of topics, each written by well-known experts in the respective fields, and its stated aims are to provide 'succinct syntheses of all major aspects of gold metallogeny and exploration' (M.A. 92M/2665-2677).

Chapter 1 by Crocket summarises the distribution of gold in the Earth's crust and includes modern analytical data for gold content of a large number of igneous, metamorphic and sedimentary rocks, from a variety of geological settings. The overall higher contents in mafic compared to felsic igneous rocks are highlighted and ascribed to differences in magma source regions, but it is surprising that no reference is made to the recent high gold contents found in some lamprophyres.

Chapter 2 by Seward summarises the hydrothermal geochemistry of gold and in particular the mode of transport of gold in hydrothermal fluids. Bisulphide and to a lesser extent chloride ligands are favoured for transporting gold but also highlighted are the many areas where experimentally-based thermodynamic data at elevated temperatures are lacking, or a matter for debate. Seward illustrates how boiling of a gold-bearing hydrothermal fluid can affect its chemistry and thus influence gold deposition. He also introduces the possibility that mineral surfaces and sulphide gels may be important for adsorbing or scavenging gold from solution.

Chapter 3 by Groves and Foster covers the Archaean lode gold deposits. The authors highlight the worldwide association with banded iron formations, mafic volcanics, and felsic intrusives in greenstone belts. Models of genesis seem now to be generally accepted but the source of the fluids is still uncertain (metamorphic, igneous, or mantle degassing).

In contrast to the rather uniform characteristics of the Archaean lode gold deposits, those of the Phanerozoic are more diverse in nature. In