

of the processes involved in steady state double-diffusive convection in magma chambers by Clark *et al.*, constraints on crystal sizes in intrusions imposed by the cooling regime and crystallization kinetics (by Brandeis and Jaupart), application of Legendre transforms to construct thermodynamic potentials which are minimal at thermodynamic equilibrium, and the testing of the equations by simulations of isothermal and isenthalpic assimilation (by Ghiorsio and Kelemen). Lastly, Taylor discusses differences in the style of hydrothermal alteration between layered gabbros and granites on the basis of stable oxygen isotope studies.

The last section deals with crustal felsic magma properties and processes. Initially, Pichavant *et al.* provide evidence for fractionation in peraluminous magmas using chemical evidence from the Macusani glasses contained in ash-flow tuffs. Mysen uses the RKNFSYS rock file data of Chayes to gain insights into relationships between bulk, elemental compositions, structures and properties of magmatic silicate melts. In the third paper of the section, Fraser and Rammensee indicate the use of the Knudsen Cell mass spectrometer to determine the mixing properties of granitic and other aluminosilicate melts, by mass spectral analyses of the vapour phase coexisting with melts. Navrotsky then discusses calorimetric techniques to obtain thermodynamic data for hydrous minerals, melts, and glasses. The effect of fluorine species on melt viscosities is discussed by Don Dingwell. The following paper, by Nekvasil and Burnham, is an application of a revised quasi-crystalline model to the calculation of pressure and water content effects on granitic phase equilibria.

As can be seen from the brief indications of the paper contents, the volume is truly interdisciplinary, with contributions from leaders in the various fields. Apart from the scientific standards, the editor and the Geochemical Society deserve commendation for the introduction preceding the main topic of the paper. In every case, care has obviously been taken to lead the interested non-specialist into the main topic. The volume is recommended not only for specialists, and interested non-specialists, but also for final year undergraduates for excellent examples of scientific argument and approach. The reviewer would give the paper by Taylor and Green, on the petrogenetic role of methane as an example. Following a lucid discussion and evaluation of the roles of volatiles and f_{O_2} in petrogenesis, the authors discuss the theory and techniques involved with the use of Fourier transform infrared spectroscopy as an analytical tool to study the behaviour of methane in silicate melts. The spectral data are presented, models evaluated, and conclusions drawn. Together with most of the papers in

the volume, communication has been emphasized. With only a couple of exceptions, all the diagrams are clear and sufficiently labelled.

A major trend in the volume is the discussion and evaluation of the roles of volatile species, both in interaction with the silicate melt, but also as controlling f_{O_2} during melt differentiation. The physics of melt fluidity was another major trend. However, as P. J. Wyllie ended in his paper, 'there is as yet no consensus about the rheology of mantle-fluid systems'. Although it is not in any way a derogatory opinion of the reviewer, notable absences in the volume lie in stable isotope contributions (apart from that of Hugh Taylor), and in contributions from the sister laboratory of the Department of Terrestrial Magnetism. In spite of the pioneering work in ^{10}Be , the exciting data from these studies were not mentioned in the volume. The net result however, is a very high quality volume from the Geochemical Society, remarkable both for the scientific quality and the effort expended in communicating to the non-specialist.

A. P. GIZÉ

Levinson, A. A., Bradshaw, P. M. D. and Thomson, I. *Practical Problems in Exploration Geochemistry*. Wilmette, Illinois (Applied Publishing Ltd), 1987. xii + 269 pp. Price \$80.00.

The publication of textbooks on the principles and practice of exploration geochemistry spans the last 25 years, but this, the latest of the genre, breaks new ground with its highly innovative approach. The authors, one a senior academic with a pedigree which already includes an invaluable textbook on exploration geochemistry, the other two top mineral exploration managers in Canada, have assembled a compendium of exploration geochemistry case histories. But in their book each case history is divided into two parts: the first part comprises a thought-provoking problem to stimulate the mind of the inquisitive student of exploration geochemistry; later the solution to the problem is presented and its wider implications for the routine application of exploration geochemistry are discussed.

The first 160 pages are devoted to the 40 problems that the book contains. Each has been contributed by a geologist and is drawn from his or her practical experience of exploration geochemistry. The problem is positioned with details of geographical location, climate, physiography, local geology, sampling patterns, analytical methods and whatever further information may be appropriate to leading the reader into attempting a reasoned interpretation of geochemical data that are then

given. The authors pose several direct questions with each problem, such as the likely source of geochemical anomalies, factors which have influenced anomaly development and recommendations for further work in the area. In the next 100 pages of the book, each of the problems receives clear and extended answers to the questions, and a full discussion of the nature of the problem, why it arises, what precautions should be routinely taken to deal with it, and so on.

For the most part the problems are not esoteric or bizarre, but are examples of the slight but ultimately predictable departures from idealized or simplified models of geochemical dispersion patterns. They are the problems that the practitioner of exploration geochemistry is bound to face in the real world.

The book is organised into groups of problems in the categories of reconnaissance, follow-up, detailed and integrated surveys. Relevant maps, diagrams and tables of data are plentiful. Useful references to pertinent papers in the scientific literature accompany each of the problems. The book also sports an excellent index, an asset that some might have omitted in a book of this type, but which would be sorely missed.

Some prior knowledge of exploration geochemistry is required in order to enjoy and appreciate the value of this book, so it is not for the beginner. It is, however, essential to all those who truly need to have a working knowledge of exploration geochemistry, and it is versatile in its applications. College and university lecturers may opt to use it as a means of formulating instructive exercises and as a source of case histories. Students will undoubtedly find it an excellent self-teaching aid. Exploration professionals will find it illuminating and a useful work of reference.

Handsomely presented throughout and bound in hard cover, 'Practical Problems in Exploration Geochemistry' deserves wide readership in its specialist field.

M. HALE

Hall, A. *Igneous Petrology*. London (Longman), 1987. viii + 573 pp., 366 figs. Price £17.95 (soft cover).

This undergraduate textbook is divided into fifteen chapters. The first seven treat the occurrence, petrological phase equilibria, trace-element distribution, isotopic composition and evolution of igneous rocks and magmas. Of the remainder, six chapters cover the field and tectonic occurrences, chemistry and petrogenesis of magmas that erupt at the present day, and the final two concern anortho-

sites and Alpine peridotites. Much of the material appears in a textbook for the first time.

Major element, microscopic and hand-specimen petrography are not covered, so a second book will be required for these topics. To my mind, even brief remarks on the mineralogical and textural characteristics of the rocks would have been beneficial in making the petrogenetic discussions more tangible, and in demonstrating that these are useful sources of petrogenetic information.

Nonetheless, the author skilfully balances information on field relations, tectonic relations, phase relations, chemistry and isotopes to produce rounded and thoroughly modern discussions of magma genesis, that should prove compelling to keen students. It is a welcome feature that Hall indicates the importance of field relations by the inclusion of numerous simple, but effective maps. It is also welcome to find an appropriate proportion of British field examples in this text. The reference list is extensive (c. 1400 entries) and, though up-to-date and covering predominantly the last 25 years, does not ignore the older literature in which the foundations of modern study were established.

While a reviewer can almost always find that a book lacks some marginal topic (e.g. this one barely mentions extra-terrestrial igneous rocks), it seems to me a serious omission that the new ideas emerging in physical petrology, and particularly in fluid processes in magma chambers, are not dealt with. Perhaps the author feels these matters are still too controversial for undergraduates, but this is to exclude them from the most exciting, topical and rapidly developing aspects of igneous petrology in the 1980s. The next edition must remedy this shortcoming.

Amongst the many textbooks on igneous petrology published in the last decade, the distinction of this one is its price. Congratulations to the author for choosing a publisher who appreciates that undergraduates have limited funds, and accordingly has produced a modestly priced paperback book. I expect buoyant sales and no little competition for Cox, Bell and Pankhurst's *The interpretation of the Igneous Rocks*.

C. H. DONALDSON

Salkield, L. U. *A Technical History of the Rio Tinto Mines: some notes on exploitation from pre-Phoenician times to the 1950s*. London (Institute of Mining and Metallurgy) 1987, x + 114 pp., 4 maps. Price £15.99.

Many of the important technical developments associated with mining and metallurgy in Europe and the Spanish Colonial domains have originated