BOOK REVIEWS

Albarède, F. *Introduction to Geochemical Modelling.* Cambridge (Cambridge University Press), 1995. 563 pp. Price £60.00. ISBN 0 521 4545 4.

In its publicity, this book is described as being for "the motivated reader", to help "overcome the formal difficulties of geochemical modelling". The publicity is accurate, as Francis Albarède's book is not an easy read for undergraduates, or others, who lack a firm foundation in mathematics. Indeed, it seems to be essential that readers should have experience of mathematics at university level, and this will frighten off many who use geochemical modelling, and for whom an introductory book would be valuable.

The book is long, and about equally split between equations and prose. There are abundant worked solutions within the text, most of which were solved by the author using the software package MatLab on Macintosh desk computers or Sun workstations. The book has been, 'tested' on masters students at Lyon, and it is as well to remember that these students will be amongst the élite in France.

The first part of the book is devoted to general principles, starting with how to tackle raw data (mass balance, working with ratios and why they are important, fractionation). There then follows a chapter on linear algebra (to bring the reader back up to speed with matrices, vectors and orthogonal functions) which leads on to a chapter on numerical analysis, and methods of solving partial differential equations (finite differences). The fourth chapter on techniques is devoted to probability and statistics, including sections on errors and their propagation, Monte-Carlo simulations and principal component analysis. This is followed by a chapter on inverse methods of data analysis, emphasizing least squares methods.

Once the techniques are covered (about 60% of the book), it moves onto their application. The first is to modelling chemical equilibrium, dealing with reactions in solution (taking as an example the calcium carbonate system, and mercury-chloride complexing), and speciation in gaseous mixtures, before moving on to rock systems. After equilibrium, dynamic systems are covered, with residence times, radioactive decay and reactor behaviour (for a single magmatic reservoir, moving on to interacting, multielement, reservoirs). A whole chapter is devoted to transport, advection and diffusion; in diffusion, one section covers variation in diffusion coefficient with time (an interesting concept in itself). This chapter uniquely has appendices, describing the error function, the theta function and Duhamel's principle. The final chapter focuses on magmatic processes, dealing with batch melting and crystallization, incremental processes, open magmatic systems, disequilibrium processes, and a critical appraisal of compatible versus incompatible elements. There are some 13 pages of references, and a four-page index.

The author quite rightly makes no apology for his rigorous mathematical approach. It does mean that this book is hard work, but it should certainly be considered by any who use geochemical data, be they for fluids or rocks (sedimentary, metamorphic or igneous), major or trace elements, or isotopes. It is destined to become a library book, for which it is recommended, but postgraduate courses which require a sound theoretical basis (to which they devote appropriate time) should consider this as a course text, and doctoral students who use geochemical data should work with this book, particularly if they want their work to stand above the crowd of data gatherers.

D. A. C. MANNING

Dunn, P. J. *Franklin and Sterling Hill. New Jersey: the World's Most Magnificent Mineral Deposits.* Franklin, New Jersey (Franklin-Ogdensburg Mineralogical Society, P.O. Box 146, Franklin, NJ 07416, USA.), 1995. xxiv + 755 pp., 420 photos., 300 maps, sections and line-drawings. Published in five parts at $30.00 per part or $150.00 for the entire work (plus surface shipping and handling of $5.00/part or $15.00 for the entire work).

This five-part *tour de force* attempts to outline the history, geology, mining development and above all the mineralogy of these famous deposits, now worked out, but which were particularly rich in zinc, manganese and iron. They have been known for some 300 years and yielded over 33 million tons of ore. Approximately 10% of all known mineral species were to be found here; more valid new mineral species (69) have been described from here than from any other locality and some 10 % of the minerals are unique to Franklin and Sterling Hill.