

BOOK REVIEWS

Prendergast, M. D. and Jones, M. J., Eds. *Magmatic Sulphides—the Zimbabwe Volume*. London (Institution of Mining and Metallurgy) 1989. 254 pages. Price £55.00.

This volume contains 18 papers out of a total of 27 that were presented at the Fifth Magmatic Sulphide Field Conference held in Zimbabwe in August, 1987, as the last event to be organized by the International Geological Correlation Programme Project 161.

The first three papers (involving contributions by Prendergast, Wilson and Keays) are devoted to the Great Dyke which not surprisingly, was a major theme of the Conference. These cover the tectonic setting, stratigraphy, petrology, structure and emplacement; mineralization and mineral deposits; and controls of platinum group element mineralization, respectively. Ten papers cover aspects of the sulphide and platinum group element mineralization in the Madziwa intrusion, Zimbabwe (Birch and Buchanan), the Bushveld complex, South Africa (papers by Merkle and by Hatton), the Molopo Farms complex, Botswana (von Gruenewaldt *et al.*), the Rana Layered Intrusion, Norway (S.-J. Barnes), the Duluth complex, USA (Martineau), the Lac des Iles and the Montcalm complexes, Canada (Macdonald *et al.*; Barrie and Naldrett), and certain mafic and ultramafic intrusions in Finland (Papunen; Alapieti *et al.*). There are three papers which deal with the volcanism of the Archaean komatiite—associated nickel deposits and their host rocks in the Yilgarn Block, Western Australia (by Hill *et al.*, Frost and Groves, and Evans *et al.*). In one very interesting theoretical paper by Naldrett, Lehmann and Augé, the possible effects of non-stoichiometry in spinels on compositions of the sulphides in the chromitites of ophiolite complexes is discussed. The last paper in the volume (by Sander and Cawthorn) discusses the results of a gravity and magnetic survey of the Insizwa intrusion, South Africa, and discuss the implications for exploration.

As might be expected from the origins of this volume, the final contribution of a fairly long term (IGCP Project 161 members first met in 1978) international collaborative programme involving experts in the study of magmatic sulphides, the

science is of high quality. It is also a volume that has been well produced, with clear figures and tables, and in an identical format to that used in the IMM Transactions (A4 page size, double column). There is a very brief (1 page) subject index, and a name index which gives the pages of their articles next to the names of contributors; it also lists the names of all those authors whose work is cited in the text, but referenced to the appearance of that name in a bibliography rather than the actual article.

There is no doubt that the 'Zimbabwe Volume' is an important contribution and essential reading for those with any significant interest in magmatic sulphides, whether as research worker, teacher or exploration geologist. However, it is in effect a special (thematic) issue of the Transactions of the IMM (Earth Sciences Section) and its circulation will be limited largely to libraries by its high price. Competing journals, notably *Economic Geology*, have taken to publishing thematic issues on particular classes of ore deposit and on mineralization in particular geographical areas as part of their normal run. This policy has proved very successful, and whilst not wishing in any way to detract from the clear scientific merits of the 'Zimbabwe Volume', one feels its authors interests (and those of IMM Fellows and Members) might have been better served by the IMM issuing this material as part of the Transactions.

D. J. VAUGHAN

Wellmer, F.-W. *Economic Evaluations in Exploration*. Berlin, Heidelberg and New York (Springer-Verlag), 1989. xiv + 163 pp. Price DM 38.00.

One of the original aims of this book was to provide the exploration geologist with an understanding of the range of evaluation techniques available for the assessment of the potential economic viability of mineral deposits. In this respect, it is highly successful. It is generally very well written and the translation is excellent. Only rarely have continental conventions managed to escape the re-drafting into English, e.g. the use of commas instead of decimal points. The overall approach to mineral economics is very practical and pragmatic and most geologists will, as a result, find

the concepts and techniques described easy to understand and assimilate. At each stage, worked examples are provided which further facilitate the understanding of the subject matter of the book.

The book commences with a review of imperial or 'Anglo-American' units and their metric equivalents, including many archaic units long discarded. This helps clarify misunderstandings that may exist in the literature. It will be particularly useful to those who wish to re-evaluate old databases, maps and mine or exploration records. This is followed by a discussion of metal prices, including inflation indexing and trends. The two short chapters (totalling 12 pages) which deal with reserve evaluation are rather disappointing in that only two methods are discussed in any detail, viz, sectional methods, using rectangular ore blocks centred on individual boreholes, and polygon methods. In the latter case, no indication is given as to the thickness component that should be applied for use on different plan and sectional projections. The whole subject has, unfortunately, been dealt with in a very superficial way and anyone seeking a better understanding of the principles of reserve evaluation will be forced to look elsewhere. This is a pity, for reliable economic evaluation can only be achieved if the mineral inventory has been determined as accurately as possible, given the data constraints at this stage of the exploration programme. The reader is left with the impression that the reserve calculation is a relatively unimportant aspect of mineral evaluation. The section on grade weighting is adequate but no reference is made as to how abnormally high (or low) assay values in an intersection should be treated. The discussion of the specific problem of polymetallic deposits could have been expanded to discuss alternative methods to metal equivalents. Similarly, expansion of the section on the role of mining and processing constraints on reserve evaluation would have been worthwhile.

The book really comes into its own from Chapter 7 onwards when the author clearly shows his expertise in the subject of financial evaluation. A series of short, but well written, chapters on Net Smelter Return; mine life; capital, operating and freight costs for underground and open-pit mines; and finally, operating cut-off grades, then form the basis for the chapters on economic evaluation by Net Present Value and internal Rate of Return methods. Also considered are those aspects of taxation, mine financing and sensitivity analysis that are of particular relevance to the exploration geologist. A set of useful appendices are provided which include metric-imperial conversion tables, typical ore densities, core and sieve

sizes, inflation indices and discounting factors.

Though the title of the book, and the unsophisticated nature of the ore-reserve techniques described, both suggest that the purpose of the book is to describe economic methods applicable during the exploration phase of a deposit, there is considerable doubt whether a geologist would be involved in such an analysis at this early stage. The techniques described are really more applicable to a preliminary feasibility study of a deposit at an advanced stage of exploration when a more rigorous assessment of the in-situ and mineable reserve would have been undertaken using considerably more reliable ore-reserve methods. This book is thus seen as a means of making geologists more aware of the economic significance of his/her work and giving him/her sufficient background knowledge to be able to play a more valuable role in the later mine design and feasibility studies.

A. E. ANNELS

Lowenstam, H. A. and Weiner, S. *On Biomineralization*. New York and London (Oxford Univ. Press), 1989. 336 pp. Price £40.00.

'On Biomineralization' is an individualistic review by the authors of the minerals and mineralization processes in biological systems. The topic is one of overlapping interest to several disciplines, including mineralogy, biology, chemistry, biochemistry, medical sciences, and geology. The authors have generally chosen to approach the topic from a biological aspect.

After the first brief introductory chapter, the following chapter presents a general discussion on biomineralization, a listing of the minerals reported to date (almost 60) with their taxonomic distributions, and a brief consideration of the biochemical macromolecules involved. In Chapter 3, the authors consider in some detail the nucleation and growth processes, with an emphasis on whether the mineralization is biologically induced or controlled. Chapters 4-9 review biomineralization within selected Kingdoms and Phyla: Protocista (Diatoms, Foraminifera, and the coccolith-forming Haptophyta), Cnidaria (including sea anemones and corals), Mollusca, Arthropoda, Echinodermata, and finally, the Chordata. The chapter on the Chordata is the largest, reflecting the intensity of vertebrate research. In the last three chapters, the authors explore areas of personal interest in non-skeletal functions in biomineralization, environmental influences in biomineralization, and finally, the evolution of biomineralization.

It is clear that biomineralization is a research