

Just what benefits may ensue from the discovery and exploitation of resources is largely unknown and Cronan's book is one of a number which have attempted to make preliminary assessments. The author directs his attention to the non-living resources, though chose not to address hydrocarbons or alternative energy resources. The structure of the book is to take the broad groups of potential resources, namely aggregates, placers, precious coral, phosphorites, manganese nodules, cobalt-rich crusts and hydrothermal mineral deposits, and deal with each of them separately addressing modes of occurrence, composition and resource potential with selected and appropriate case histories. He avoids the serious economic, political and environmental issues which have yet to be addressed and sticks to telling his readers about what is known to be there.

The book is up-to-date with a great deal of evidence from the very latest reports of exploratory scientific cruises by research vessels of many nations being quoted. While globally we are only at the earliest stage of assessing the quality and quantity of resources, Cronan's book reveals that we have acquired a considerable amount of detail concerning the nature and possible origins of the minerals involved. Readers of the *Magazine* may or may not be interested in the EEZ issue, but they will be attracted to the concise accounts of ore genesis in a range of marine settings presented by Cronan.

This book is not an over-optimistic prospectus for future ocean wealth as was Mero's *The Mineral Resources of the Sea* (1965); rather here is a distinguished authority on ocean minerals giving us a readable and scientific report on the state of our knowledge. There are many line diagrams; some maps, however, require a modicum of nautical knowledge since scales are only obvious from reading off the minutes of latitude. Further, it is not always immediately apparent which areas of sea-floor might be taken to belong to which state. The book is backed by a long list of references to mainly recent works on the subject and readers should be able to add further to their knowledge. The text has been well proof-read, sadly the figures have received less attention, particularly when kilometre scales are added: clearly occasionally the draughtsman just did not take enough care.

*Marine Minerals in Exclusive Economic Zones* adds significantly to our knowledge yet shows how much more exploration is required. It can certainly be recommended.

A. J. SMITH

Salje, K. K. H. *Phase Transitions in Ferroelastic and Co-elastic Crystals*—Volume 1 Cambridge topics in mineral physics and chemistry (Cambridge University Press), 1990. xiii + 366 + xlvii. Price £50.00.

Research into ferroelasticity is entering an exciting stage, where significant insights into the underlying physical principles which generate elastic instabilities are beginning to emerge. This book by Salje aims to introduce the reader to the theory behind ferroelasticity and related behaviour, while illustrating these ideas with a wide range of examples. The book is in two parts. The first, by Salje himself, is essentially a textbook on the subject, while the second part is composed of research papers, by various authors, on more advanced topics.

Chapters 1 and 2 provide a basic introduction to the nomenclature and definitions used in this subject, and present a discussion of the meaning of the terms ferroelastic, co-elastic, etc. Two chapters outlining the ideas behind the Landau potential and spontaneous strain, are followed by a more detailed discussion of the coupling between spontaneous strain and the order parameter. The nature of ferroelastic and co-elastic twins, and the mobilities of domains are analysed in Chapters 7 and 8. The final chapters in this first part of the book, go on to discuss the specific heat and excess entropy of ferroelastics, gradient coupling and strain modulation, and aspects of the kinetic behaviour of ferroelastic and co-elastic crystals.

The second part of the book consists of nine chapters, by different authors, covering such topics as elastic transitions and hard mode infrared spectroscopy, trigger mechanisms in improper ferroelastics, neutron scattering studies, and symmetry analysis of specific transformations. Finally in a considerable appendix, a group-subgroup relationship table, and an extensively referenced list of several hundred ferroelastic and co-elastic phases are presented.

The book is well written and clearly printed. It is a pleasure to see that the many excellent transmission electron micrographs, illustrating important microstructural features, are all well reproduced. The author is to be congratulated on producing such a useful book, however his hope that this book could act as a second year undergraduate text may be a little optimistic. The Part IB Natural Sciences Tripos in Cambridge, invoked as an example of such a second year course, is somewhat atypical, and I feel that most users of this book will be final year undergraduates or even research students. This book

should be on the shelves of all workers in the field, and in all Materials Science and Mineralogy libraries.

G. D. PRICE

Annels, A. E. *Mineral Deposit Evaluation: a Practical Approach*. London (Chapman and Hall), 1991. 451 pp. Price £49.95.

This is going to be very useful book for geologists and other professionals in the mining and mineral extractive industries and a good text for students in those (regrettably few) educational establishments which teach mineral evaluation. As the sub-title says, the book deals in a very practical way with the process of quantifying resources and reserves of minerals including some very welcome material about the evaluation of coal, gravel, sand and other non-metalliferous deposits. It is very much written from a geologist's point of view (none the worse for that) but does include a great deal of the engineering and economic aspects that are vital to understanding this multi-disciplinary subject.

The book is organized into eight chapters dealing with the representation of data (maps, plans, sections, projections etc.), sampling, 'classical' and 'geostatistical' reserve estimation, grade control. There is a long chapter devoted to design and evaluation of open-pit operations recognising the importance of low-cost mining in the present economic climate. There is a whole chapter devoted to case histories, ten of them covering several metal mines, two limestone quarries, a gravel pit, opencast coal, a potash mine, chosen from five different countries.

In addition to this chapter, the whole of the rest of the book contains case history material and illustrative examples from a wide variety of contrasting deposits. The chapter on financial evaluation was written by a different author, E. G. Hellewell. Although the chapter covers adequately the subject it is not well integrated into the rest of the book. As a consequence, the book does not deal with the use of econometric techniques (internal rate of return etc.) in sensitivity analysis, risk analysis, grade optimization, in which mine geologists inevitably become involved as part of the planning process.

At every point in the book, computer-based methods are discussed and many of the illustrations are taken from computer output. There are a lot of references to proprietary software packages which are perhaps essential but are liable to become dated fairly quickly.

It is very easy for a reviewer to say that this or that subject deserves more coverage, which begs the question of what should be left out in order to prevent the book becoming too long; everything in this book is relevant. What I do feel is lacking in some ways is discussion of the mineralogical nature of deposits in relationship to the processing and marketing of the products; a bed of gravel containing one per cent alkali-reactive clasts has a very different value to one that does not.

The book is very well illustrated with numerous clear line drawings and photographs. The design is a little annoying in places and the index could have been longer with advantage. But none the less, this is a good book, and very welcome. Every mine should have a copy and one can only say to the geology graduate who has never heard of a mineral deposit but can only find a job as a trainee mine geologist in an Australian gold mine; read it on the plane, you won't regret it.

C. DIXON

Van Loon, J. C. and Barefoot, R. R. *Determination of Precious Metals: Selected Instrumental Methods*. Chichester and New York (John Wiley and Sons), 1991. x + 276 pp. Price £45.00.

The precious metals (Pt, Pd, Rh, Ru, Ir, Os, together with Au) are strategic elements that continue to command importance in industrial processes, medicine as well as the jewelry trade, investment and bullion markets. In consequence, much of the expertise in the determination of these elements has resided traditionally in industrial and commercial service laboratories. A book that covers methods for the determination of these elements, mainly in range of geological applications is to be welcomed in filling a gap in the current market.

The strengths and weaknesses of this book are set in the introduction. The authors consider that the determination of these elements remains the ultimate challenge to the inorganic analytical chemist, but propose that despite well documented advances in instrumentation for traces element analysis, there have been few real breakthroughs in the determination of the precious elements. They also endorse a statement by Beamish that fire assay is the preferred method for the determination of gold in complex rocks and that the classical lead method never failed to find a paying ore. Thus, although the book encompasses a range of 'recommended' methods, these can largely be classified as 'established', rather than innovative with a preference to methods based on the 'classical' lead fire assay