BOOK REVIEWS

Henderson, P., ed. *Rare Earth Element Geochemistry*. Amsterdam and New York (Elsevier Science Publishers), 1983. xii + 510 pp., 139 figs. Price Dfl 220.00 ($85).

With developments in analytical techniques over the last fifteen years, the rare earth elements (*REE*) have become an integral weapon in the geochemist's armoury. This book brings together reviews of the major applications of *REE* geochemistry written by experts in each field, together with discussions of *REE* mineralogy, economic importance, and analytical techniques.

Whilst there is undoubtedly a need for textbooks dealing with *REE* geochemistry, I feel that this book suffers from attempting to be too comprehensive about the *REE*, yet insufficiently comprehensive about the way that, in practice, *REE* data are almost always considered in relation to other chemical data. Most students or researchers are topic-oriented rather than analytical technique or element-group oriented, so that only a small number of chapters are likely to be relevant to any given reader. This results in topics which are not treated in sufficient detail to be of more than introductory value to researchers. A typical example of this problem is the nature of chapters 7 and 8: these consist of descriptions of chondrite-normalised *REE* patterns for the full gamut of continental igneous rocks arranged in no obvious order, followed by rather simplistic discussions of the way in which such patterns may have arisen, with little reference to the other data, petrographic, chemical, and isotopic, which can readily eliminate several of the hypotheses in specific areas. For example, these chapters readily allow the reader to find out the range of *REE* concentrations in Eu-anomalous kimberlites, but do not easily permit an understanding of the significance of *REE* in understanding the petrogenesis of complete calc-alkaline suites. Incidentally, I found rather curious the use of Eu/Sm rather than Eu/Eu* to express Eu anomalies.

I found that the chapters on petrogenetic modelling (4), ocean basin igneous rocks (6), *REE* mobility (9), aqueous *REE* geochemistry (10), radiogenic isotopes (11), and *REE* analytical techniques (13) provided very helpful and readable discussions of their field and I would not hesitate to recommend these to students. It is noteworthy that, with the exception of the isotope chapter, these are some of the shorter chapters in the book. The chapter on isotopes is a special case because there is at present no textbook available which gives more than cursory mention to the vital role that Nd isotopes play in modern geochemistry, and extension of this chapter could be usefully considered. The chapters on mineralogy (2), cosmochemistry (3), upper mantle rocks (5), and economic importance (12) I found somewhat impenetrable because of their length and extreme detail, but I would suggest they would form a useful reference source.

In summary, I feel that while much of the book is very valuable and should therefore be in geology libraries, it suffers from lack of clarity in target audience and sometimes manages to be over-comprehensive in a way that would not endear it to undergraduate users, while lack of reference to other aspects of chemistry makes it only of introductory or reference value to research workers.

M. F. THIRLWALL

Atherton, M. P., and Gribble, C. D., eds. *Migmatites, Melting and Metamorphism*. Nantwich (Shiva Publications Ltd.), 1983. x + 326 pp., 152 figs. Price £25.00 (hard), £12.50 (paper).

The eighteen papers (and seven extended abstracts) here presented are the proceedings of a meeting held in 1982 at the University of Glasgow and sponsored by the Geochemistry Group of the Mineralogical Society and the Geochemical Society. The contributions are organized into sections on experimental studies, isotopic studies, fluid studies, field and related studies of migmatites, and field and related studies on other rock types. (Abstracts of each paper are given in MA **35**, no. 2.)

In an introductory chapter, B. E. Leake stresses the importance of structural control in relation to these rock types; the association of granite emplacement with episodes of plate movement is fundamentally a structural correlation. Wyllie argues that regional metamorphism, migmatites, and granites are produced by massive influxes of heat carried largely by fluids, but partly by magmas, rising from the mantle, especially above subduction zones where wet crustal wedges are dehydrated and partially melted. Halliday relates the zoned granitic plutons of the Scottish Southern Uplands to intermediate magmas crystallizing from the margin inwards, the magma partially melting the country rock sediments which then mix with felsic differentiates to form a buoyant mass which could intrude the hot plastic core of the pluton.

Several papers stress the importance of fluids. The dominance of H_2O, with some CO_2, in fluid inclusions in high-grade amphibolite-facies rocks in western Ireland is described by Yardley *et al.* and

Friend discusses the link between charnockite formation and granite production in southern India, where both these rock types may be attributable to the dilution of a CO_2-rich volatile phase by H_2O (released during hydration), which initiated partial melting. Weaver and Tarney argue that although the Lewisian granulites of NW Scotland are strongly depleted in heat-producing elements (K, Rb, Th, U), the Indian charnockites are enriched in these elements, which removal of a partial melt cannot explain, though the concept of a chemically evolving fluid flux in the deep crust is consistent with available chemical data.

Partial melting is favoured by Olsen to explain the Front Range migmatites of Colorado, a process also invoked by Johannes for Scandinavian migmatites. For the migmatites of southern Brittany, Brown emphasizes the importance of isothermal melting at 700–800 °C while the pressure diminished from 10 to 5 kbar.

The papers are each commendably brief and with the references collated at the end of the volume. Most of the contributions offer reviews of published work and give an up-to-date summary of research on migmatites and the genesis of granites and granulites. This book will provide a useful source of reference for both teachers and students.

R. A. HOWIE

Mangone, G. J., ed. *American Strategic Minerals.* New York (Crane Russak Inc.), 1984. xvi + 153 pp., 15 figs. Price $19.50.

This latest addition to the growing literature of Western strategic minerals* may interest the mineralogist concerned about future supplies of minerals, but it is primarily intended for the United States citizen who needs to appreciate more fully the essential role of mineral supplies from abroad in maintaining at once the most advanced consumer economy and one of the two largest arsenals in the world. The volume contains the texts of six papers presented at a national conference held at the University of Delaware, Wilmington, in December 1982, organized by Professor Mangone who, besides occupying the Chair of International Law and Organization and directing the Center for the Study of Marine Policy, is also a Fellow of the Geological Society of America. In his brief foreword he claims that 'without access to minerals under secure conditions and at reasonable prices, the strength of the United States could be quickly dissipated' and he adds the view that the two world wars of the present century were started, by Germany and Japan, to gain access to minerals. No doubt many will regard this last view as an oversimplification, but no one should doubt that access could have serious implications for future international relations.

Professor J. C. Kraft of the University of Delaware ('Strategic Minerals and World Stability') illustrates the world distribution of major deposits of the ores of Fe, Cr, Ni, Mn, Au, Ag, Pt, Pb, Zn, Cu, Al, Ti, Li, and Be by means of maps that bring out its marked non-uniformity. He shows very frankly why it is desirable for the USA to maintain good relations with South Africa as its major supplier of chromite, diamonds, platinum group metals and gold; and he makes the new suggestion that gold may, after all, prove to be the most significant strategic mineral. He stresses the gravity of the coming resource crisis and wishes to communicate the realities of a finite world to the lay public.

V. A. Cammarota ('American Dependence on Strategic Minerals') and J. D. Morgan ('Future Demands of the United States for Strategic Minerals'), both of the US Bureau of Mines, contribute authoritative data which show that although the United States is, and will remain for another century, a major producer of many minerals required by its industry and commerce, it is becoming increasingly dependent on imports of about twenty minerals, some of which are not found in quantity with its borders. There is little likelihood of a reversal of this trend. A tabular comparison covering 36 mineral commodities shows that the position of the European Community and of Japan is markedly worse as regards import dependence than that of the USA, while the USSR is very nearly self-sufficient.

Professor J. R. Moore of the University of Texas ('Alternative Sources of Strategic Minerals from the Seabed') is not content merely to discuss the potential for Ni, Co, and Zn in deep-sea ferromanganese nodules, the recovery of which remains hamstrung by international discord, but proceeds to advocate the continental shelf and coastal placers within the United States' territorial limits as an alternative source of strategic minerals including those of Cr, Pt, Au, Ti, Zr, P, and even of Pb, Zn, and Cu. The restriction of this zone to 32 km wide means that the total area is small compared with the American landmass, and it is difficult to envisage substantial contributions even if the expensive work of prospecting can be undertaken.

A. L. Mendelowitz and J. E. Watson, both of the International Division of the US Accounting Office contribute a concise account of United States overseas mining investment between 1966 and 1979, showing that investment in Developing Countries ranged from 17 to 36% of the total. Finally, J. W. Curlin, editor of the journal *Strategic Materials*

* See also *Mineral. Mag.* (1984), **48**, 305.