and can be described by statistical models; that is, observed mineral deposits, which are only samples, and undiscovered deposits belong to the same parent population". Suffice it to say that an external (to the USGS) review validated the science and methodology of the assessment methods used by the USGS group but it was subsequently recommended that a 'standard of care' code for the preparation of future such assessments be actioned.

This is an unusual and thought-provoking book. Surprisingly, the many parallels between the oil and gas forecasting and the mineral-resource assessment methodologies are not highlighted and one is left with a subconscious feeling that the two main sections of the book (chapters 1–4 and 5–7) were written independently; even the final chapters do not integrate completely. In places, the manner of writing is whimsical, almost journalistic, which sometimes appeals and other times irritates. The final chapter is highly personalized in its account of individuals' contributions to the fierce internal debates that surrounded the publication of the assessment models and results, all set against the funding and re-direction soul-searching that was wracking the USGS at that time. All in all an intellectually stimulating book describing different but overlapping techniques for assessing our natural resources; a book that will be of real value to senior resource company personnel, environmentalists, and senior exploration managers who are often guided by the same kinds of stochastic considerations, both financial and geological. In fact anyone at the exploration-exploitation interface will find much to reflect on, be they representing the corporate face or the general public, and it is precisely at this interface that we, as geoscientists, are reminded emphatically of the growing need for us to be able to communicate clearly and unequivocally with an increasingly concerned and involved public sector. R.P. FOSTER

Mitchell, R.H., Eby, G.N. and Martin, R.F. (Eds.). *Alkaline Rocks: Petrology and Mineralogy*. The Canadian Mineralogist Vol. 34, part 2, 173–484, 1996. Paperback, 311 pp. Price $38.00. ISSN 0008-4476.

This volume (a thematic number of the Canadian Mineralogist) is a collection of papers presented at a symposium on the petrology, mineralogy and geochemistry of alkaline rocks held in Waterloo, Ontario in May 1994, ten years after a similar symposium held in Edinburgh to mark, in turn, the tenth anniversary of the publication of Henning Sørensen's book *The Alkaline Rocks* in 1974. Like Sørensen's work, this volume starts with a contribution on the utterly insoluble problem of classification and nomenclature. Seven well-known experts, headed by Alan Woolley, bravely enter the nomenclatural minefield of lamprophyres, lamproites, kimberlites and the kalsilitic, melilitic, and leucitic rocks. If you have a wolgidite in your favourite field area you can now call it a diopside-leucite-richterite madupitic lamproite, which is pretty explicit provided you know that madupitic lamproites have, by definition, groundmass poikilitic phlogopite, whereas to qualify as an ordinary lamproite phlogopite can be present as a phenocryst phase. We can safely expect this paper to become a standard work of reference.

The second paper (O'Connor *et al.*) looks at the fascinating subject of glasses in mantle xenoliths, from the west Eifel. Whether these are pristine examples of deep mantle liquids, liquids formed on ascent, or samples of the host lava, or something between is the question, and in this case the authors plump for the first, and most interesting solution. Readers who like me are dismayed by the undefined use of 'enrichment' and 'metasomatism' will not find their day enriched by reading this paper, however. The next paper, by Pearson and Taylor, is concerned with metasomatism at high levels, covering the fenitization of a suite of alkaline ultrabasic sills in Western Australia. Mysteriously, the source of the metasomatising fluids is not known.

The next eight papers deal with intrusive complexes or provinces of alkaline silicate rocks. Wittke and Holm describe nephelinitic to syenitic dykes associated with the House Mountain volcano in Arizona and Potter describes the chemical homogeneity of feldspathoidal rocks over the 400 km Trans-Pecos magmatic province, which crosses unperturbed two distinct basement tectonic fronts. Bell and others take us to the type locality of turjaites and turjites in the Kola (there is a challenge to your knowledge of nomenclature!) and Moreau *et al.* introduce us to much younger agpaitic rocks in the Los archipelago, off Guinea. Landoll and Foland revisit one of the old problems of alkaline rocks, the apparent ability of magmas in some complexes (in this case Mont Shefford in Quebec) to evolve across the alkali feldspar join in petrogeny's residua system. They conclude that the nepheline syenite magma reacted with quartz-bearing country rocks and through a process of simultaneous assimilation and fractional crystallization (AFC) was able to cross the thermal barrier. They do not convincingly address the problem that adding silica to a liquid of nepheline

syenite composition will merely cause it to freeze by crystallizing alkali feldspar. Whatever AFC modelling may suggest, phase equilibria cannot be ignored. McHone introduces plumes to the volume, concluding that the Mesozoic alkaline intrusions on land in N.E. North America are not a straightforward extension of the chain of New England seamounts in the Atlantic basin and cannot be explained by the straightforward over-riding of a stationary mantle plume. McLemore *et al.* introduce economic aspects of alkaline rocks, in the context of the Wind Mountain laccolith, New Mexico, and Miller continues the economic interest, describing rare-element peralkaline granite pegmatites from Strange Lake, Labrador.

The next three papers are about carbonatites, the first, by Barker, discussing the premise that carbonatites may not necessarily represent 'juvenile' mantle carbon but carbon recycled deep into the mantle by subduction. This enjoyable and clearly written review deals with the now widely accepted role of deep carbonate liquids as the main carrier of the elements in which mantle rocks need to be metasomatically 'enriched' prior to extraction of alkaline magmas, and can be recommended for student use. It is followed by an account of extrusive carbonatite from the Eifel (Riley *et al.*) and then by an account of carbonatites from Kola by Bulatch and Ivanikov.

The final group of six papers has a mineralogical emphasis. Simonetti *et al.* describe beautifully zoned diopside phenocrysts in nephelinites from Napak, Uganda, and Woolley *et al.* describe unusually aluminous alkali pyroxenes from Malawi, produced by metamorphism of agpaitic rocks. Currie and Van Breemen discuss the origin of rare minerals in the Kipawa syenitic complex, Quebec, Zaitsev describes carbonate minerals from carbonatites in the Khibina Massif, and McCormick and Le Bas describe phlogopite in carbonates from Uganda. The final paper, by Chakhmouradian, describes niobium and rare-earth minerals in carbonatite from Oka, Quebec.

This is a useful volume with a number of high quality papers. The standard of editing is high, without errors, but I would have found a table of contents useful. However, in contrast with its predecessors of ten and twenty years ago most contributions do not have a review character. It would have enhanced the collection had the authors provided an overview of what the big ideas of the present are, and where they are taking us. A reader ten years in the future will not find it easy to single out the important advances of the last ten years from this volume, however useful the individual papers to *aficionados* of alkaline rocks. I. PARSONS

Grew, E.S. and Anovitz, L.M. (Eds). *Boron Mineralogy, Petrology and Geochemistry*. Reviews in Mineralogy 33, Mineralogical Society of America. xx + 862pp. Price $32.00 ($24.00 to MSA members). ISBN 0-939950-41-3.

When dealing with boron, one's thoughts automatically turn to tourmaline and a short chapter in the DHZ student volume, little suspecting that it is possible to come across a book with 862 pages devoted to this element and its mineral hosts. This book is encyclopaedic in its coverage, with nineteen contributions from thirty one authors. It is all the more remarkable that the book contains over 140 pages of references, although many overlap as they are given chapter by chapter.

After an explanation of why its cover is graced with a particular shade of green, the book starts with what amounts to an apology: Anovitz and Grew introduce the topic of boron mineralogy, petrology and geochemistry and emphasise how little is known. They list boron minerals in a table which occupies over 20 pages, summarizing details of each occurrence and giving key references. Hawthorne and Burns get to grips with the crystal chemistry of boron, and introduce the nomenclature used to describe the multitude of possible structures. It is reassuring to discover that there is a hierarchical approach to dealing with what at first appears to be a chaotic problem.

Werding and Schreyer devote a chapter to the synthesis of boron minerals, focusing on the high pressure borosilicates, followed by Navrotsky's very succinct summary of the thermochemistry of borosilicate melts and glasses (including discussion of commercial glasses such as Pyrex). Both chapters identify questions which need to be addressed in future work. A detailed and critical review of the available thermodynamic data is provided by Anovitz and Hemingway, who give data where available for the essential thermodynamic quantities.

Moving on to occurrences of boron, a geological framework is adopted. First, continental borates are considered (Smith and Medrano), looking at borate deposits largely from the point of view of the economic geologist. This chapter focuses on those associated with evaporites, and associated diagenetic reactions (addressing borate mineral stabilities as a function of pore fluid composition and temperature). A useful table of literature sources is provided. London, Morgan and Wolf move to the other extreme of crustal environments, looking at boron in granitic rocks and its behaviour within natural magmatic systems. How boron enters a melt, and what controls