isotopic studies of xenoliths from localities covering one million square kilometres to the compositional heterogeneity within a single nodule 18 cm in diameter. Herein lies the difference between our present state of knowledge and that of 1967. We now know that the mantle is heterogeneous on centimetre, kilometre, and thousand kilometre scales. With its apt and well produced colour plates, lucid figures and wealth of information, this book is value for money and an excellent review of the state of the art.

ROBERT HUTCHISON

Menzies, M. A. and Hawkesworth, C. J., eds. *Mantle Metasomatism.* London and New York (Academic Press), 1987. xx + 472 pp. Price £46.00.

There is a growing appreciation amongst geoscientists that much of the upper mantle may have been metasomatised, but there is less consensus as to what that involves. This book provides a timely review of recent research in mantle metasomatism, and resolves some previous confusion in the terminology.

The book contains 11 chapters written by 22 authors which have been well organised into three Parts, with titles which are largely self explanatory. Part 1 (Theoretical and Experimental Foundation; 2 chapters) provides the necessary background for the expected behaviour of metasomatising fluids and melts, with important new data for solute capacities. Part 2 (Metasomatism and Enrichment in Lithospheric Peridotites; 6 chapters) examines the xenoliths themselves, combining mineral chemistry, whole-rock and isotope chemistry with petrographic studies. This Part is particularly well illustrated, with abundant photomicrographs (including 4 full page colour) and line drawings. Huge variations in incompatible element (especially *REE*) levels and isotopic histories occur on a mineral grain scale, with obvious implications for mantle heterogeneity. Part 3 (Enrichment Processes and Basaltic Volcanism; 3 chapters) uses the inverse approach of characterising mantle metasomatic processes by deduction from the trace element and isotope geochemistries of oceanic and continental volcanic magmas.

The book is fully referenced at the end of each chapter, and has a comprehensive 7 page index. It is well written and contains numerous annotated diagrams and data tables that should encourage reading by any active researcher with an interest in the upper mantle, including final year undergraduates. It is valuable both as a first-source text and for secondary references on mantle metasomatism that should be available to every geoscientist.

A. P. JONES

Morris, E. M. and Pasteris, J. D., eds. *Mantle Metasomatism and Alkaline Magmatism.* Colorado (Geological Society of America; Special Publication **215**), 1987. x + 383 pp. Price $45.00 (postpaid).

The volume opens with an excellent review of intrinsic oxygen fugacity data (IOF). Ulmer *et al.* consider the problems inherent in such determinations but conclude that redox heterogeneity *does* exist in the mantle. The redox state may have much to do with a complex pre-history that involves polybaric crystallisation of alkaline (Wilshire, Nielson and Noller) and kimberlitic (Eggler *et al.*) magmas producing dykes (enrichment process) and altered wall-rock (metasomatic process) that contain distinguishable sulphides (Dromgoole and Pasteris). The origin of such metasomatic melts is apparently caused when melts intersect the two cusps on the peridotite-H_2O-CO_2 solidus (Meen). The ensuing reactions apparently produces mantle similar to the Leucite Hills (USA) volcanics, the Westland (New Zealand) lamprophyres (Barreiro and Cooper) and the Nunivak-St. Paul's rocks. Roden 'ages' the Nunivak and St. Paul's peridotites in an elegant demonstration that only recently metasomatised mantle can produce Na-rich alkaline magmas whilst old metasomatised mantle is a more likely source for K-rich magmas. The picture is further complicated (Shervais *et al.*) by the need for hybridisation of melts to produce certain kimberlitic magmas. Diamond occurrences (Bergman *et al.*, Janse and Sheahan, Mansker *et al.*, Waldman *et al.*) are not all kimberlitic, being related to either sedimentary conglomerates of ophiolitic? derivation or kimberlites that may be olivine lamproites. Off the stable cratons, subduction-related continental volcanic rocks evolve to rhyolites whilst extensional volcanics remain essentially undifferentiated (Price *et al.*) Closer examination reveals *early* differentiated volcanics on rift margins and *later* undifferentiated volcanics on rift valley floors (Kempton *et al.*) due to priming of conduits for mantle-derived melts (Barker *et al.*). Involvement of depleted mantle and crust is invoked where one has syenites, carbonatites and other alkaline rocks (Hill and Barnes, Morris, Tilton *et al.*, Zartman and Howard). Comparative data from alkaline volcanics erupted on the continents and in the oceans (Nelson and Nelson) reveal that crustal thickness produces different derivatives. Oceanic alkaline volcanic rocks

(Bloomer, Evans, Shervais and Kimbrough) require either addition of a *LREE*, Ba, Sr, Zr-rich and Ti, Y *HREE*-poor component to the MORB lithosphere or variable degrees of melting of the same source *without* the need for metasomatism.

The book contains some very good data-based review papers, but the prologue is misleading as it includes discussion of all the meeting abstracts and not the volume. Also some organisation under thematic headings would have made reading more enjoyable.

M. Menzies

McBirney, A. R. *Igneous Petrology*. San Francisco (Freeman, Cooper & Company) and Oxford (Oxford Univ. Press), 1984. 509 pp., 275 figs. Price £40.00.

Alex McBirney has for some long time been one of the most engaging and iconoclastic of igneous petrologists and an intermediate-level text book by him will be approached with a greater sense of expectation than most new arrivals in the field. In content the book does not disappoint; it is pre-eminently an extremely *interesting* book, full of thought-provoking points, very much concerned with processes in igneous petrogenesis, and providing a very good framework for Honours-level teaching. Almost all aspects of the subject which a well-rounded petrologist should have covered are treated, at least in outline, and the book is particularly effective at getting to the heart of the problems of igneous petrogenesis. Phase diagrams and quantitative modelling of processes are used to understand igneous rocks on the scale between different plate-tectonic settings, and the individual intrusion or volcano. It does not dwell greatly on nomenclature, and trace element and isotopic modelling are properly used only where they provide supporting evidence for models which are feasible in terms of major elements and mineral equilibria.

Chapter one introduces meteorites and the nature of the mantle. We immediately meet the first of many drawings of thin sections, in the time honoured (but rather unsatisfactory) format of overlapping circles. The drawings are reasonably good, but in most cases no scales are given, and the minerals are never labelled. Both features will cause problems (and bad habits) for students. Throughout the book all drawings are done with a free-hand style of lettering. They are generally clear and of high quality, but occasional mis-spelling of labels and a lack of rigour in certain lines in phase diagrams suggest that author and artist might have paid slightly more attention to detail. For example, an old hobby-horse of mine rears up on Fig. 4-6b—the line joining two feldspars to liquid in the alkali feldspar phase diagram at high water pressure is an isotherm and should be exactly horizontal and straight, not curved as shown. Features like this are non-trivial and will mislead students. Chapter two very briefly develops nomenclature, presenting the IUGS scheme, and then discusses water content and physical properties of magmas; as the preface says, the student is expected to have an elementary background in petrography and petrology, basic mineralogy and adequate chemistry, physics and maths, and I would judge the book well-pitched for British second-year students and onwards. Basic thermodynamics introduces Chapter 3. Although I found the text reasonably clear, there are some unfortunate signs of inadequate checking of manuscript and proofs (for example equation 3-26 contains 3 errors, and Fig. 3-7b has a caption but no figure; capitals and lower case are used inconsistently for symbols). There are also a few examples of less-than-rigorous use of terminology, such as the reference to the chemical potential of a liquid (rather than a component in the liquid phase) on p. 85. It is alarming, in Chapter 4, to find arfvedsonite consistently rendered without the 'v'. Phase diagrams, and their relationship to G–X diagrams are introduced in a general way at length, and then used more specifically in the following chapter which deals with the nomenclature and phase relationships of the main rock-forming minerals, and the textures of igneous rocks. Mechanisms of differentiation, and the use of trace elements to model magmatic evolution constitute Chapter 5.

From the half-way point on, the book is devoted to exploring the natural occurrence of igneous rocks, at a variety of scales, in the light of the principles and mechanisms established earlier. These remaining six chapters are excellent. I liked very much the way that field relations, petrography, phase relations, and processes are interwoven. Few existing textbooks have so successfully made the connection between field observations and theory, and the whole atmosphere is one of open-minded enquiry. The first topic is magmatic differentiation in basic intrusions; some photographs of layering are presented and various mechanisms of layer formation are discussed, but considering McBirney's controversial contributions in this field the treatment is surprisingly muted. Basalts and magma series form Chapter 7, and this leads in 8 to discussion of the origin of basalts and the nature of the mantle. Orogenic magmatism follows, then granitic plutons and siliceous ignimbrites. Starting from the relevant phase diagrams the chapter deals