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BOOK REVIEWS

Until very recently, one problem for igneous petrologists was to find a satisfactory book on the subject of petrogenesis of igneous rocks. However, with no book available, at least there was no choice to make and, as a consequence, the reviewer has taught advanced igneous petrology for more than 20 years without a textbook. Now, with the publication of two excellent books in 1989, the problem is that the reviewer cannot decide which is best. Head-to-head competition between the two books on a chapter-by-chapter basis works out to a draw. If the reviewer had had the wit, energy, and ability to write a book for his students, these are the ones he would have tried to write. (Incidentally, anyone else contemplating writing a book on the petrogenesis of igneous rocks should immediately put down her pen, or shut off his word processor.) So, now with two excellent books available, there is still no real choice. The only satisfactory solution is to dig deep and buy both.

Igneous Petrogenesis. By M. Wilson. Unwin Hyman, London and Boston, 1989, 466 + xvii pages. US$39 (paper), US$100 (cloth), (ISBN 0-04-552025-9, 0-04-552025-0).

Psst...want to buy a really good book on the *origin* of a wide variety of *volcanic rocks* according to *geochemical evidence*? If so, then Marjorie Wilson's excellent book, subtitled *A Global Tectonic Approach*, deserves special consideration. It is divided into four parts: Part One (approx. 100 pages) is a review of the principles of igneous petrogenesis; Part Two (approx. 50 pages) deals with magmatism at constructive plate margins; Part Three (approx. 100 pages) with magmatism at destructive plate margins; and Part Four (approx. 150 pages) with magmatism within plates.

Part One begins with the relationship between magmatism and plate tectonics, moves through an extremely lucid treatment of the geochemistry (majors, traces, *REE*s, isotopes) of igneous rocks (it is difficult to recall a better account written anywhere), a treatment of partial melting processes, and finally an elaboration of the processes of magmatic differentiation. With this excellent initial groundwork, the reader is well prepared to appreciate the rest of the book.

Each chapter in the remaining three parts is organized in the same manner: an introduction, then a simplified petrogenetic model, then a presentation of the necessary regional geology, petrology, and geochemistry, and finally a detailed petrogenetic model.

Part Two is all about MORBs, and the role of basaltic magmas in the construction of oceanic crust. If, long ago, you lost the oceanic crustal forest among the individual and innumerable DSDP-ODP trees, this is the place to re-assemble the big picture from the igneous perspective.

Part Three treats magmatism at destructive plate margins in three chapters: island arcs, continental margins, and back-arc basins. Clarity is a hallmark of this book, and nowhere is this trait more in evidence than in this section dealing with this petrogenetically complex tectonic environment.

Part Four requires four chapters to deal with the cases of oceanic islands, continental tholeiitic flood basalts, continental alkaline rift-zone magmatism, and potassic magmatism within continental plates. If the going gets tough anywhere in the book, it is in the chapter on continental rift-zone magmatism where the individual, weird, and confusing igneous products make simplification difficult.

The strengths of this book are many. Marjorie Wilson has no apparent petrogenetic axe to grind, so the book has balance and credibility. Also, she writes in an extremely reader-friendly style...nothing stuffy or pedantic here. If she has to violate a grammatical rule or two to make a point clear, she does it, and without sacrificing scientific credibility. Also, she richly bestows her volume with figures consisting of maps, cross-sections, photomicrographs, phase diagrams, and chemical variation diagrams. The majority of these figures originate with prominent examples in the recent literature. In addition, over 50 tables provide the reader with the essential geophysical, chronological, petrological, and chemical data necessary to support the arguments in the text. The Table of Contents, substantial reference list, and informative Index also are extremely useful.

The great weakness of this book, not at all obvious from the title, is the virtual exclusion of the special problems of plutonic rocks. Otherwise, weaknesses are minor, such as a perpetuation of some non-Streckeisen terms, *e.g.*, "oceanic" and "hawaiite".

The appropriate student audience for this book would already have had one course in igneous petrology. However, the appeal of the book is much wider, and its audience should include all those who want to be brought up-to-date in the matter of volcanic activity and its relation to plate tectonics. Wilson's *Igneous Petrogenesis* represents very good value for

money and is a "must" for all libraries, igneous petrologists, and well-read earth scientists.

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Origins of Igneous Rocks. By Paul C. Hess. Harvard University Press, Cambridge, Mass., 1989, 336 pages. US$65 (cloth), (ISBN 0-674-64481-6).

Psst...want to buy a really good book on the *origin* of a wide variety of *volcanic and plutonic* rocks according to both *phase equilibrium and geochemical evidence*? If so, then Paul Hess's excellent new book deserves special consideration. The material is organized into 19 chapters, the first 7 dealing with essential background information and the principles of igneous petrology, and the remaining 12 with the petrogenetic problems of specific igneous associations.

The first 7 chapters deal with reading and interpreting petrogenetically important phase diagrams, explanation of the processes of magmatic differentiation, elementary principles of geochemistry, properties of silicate metals, structure and composition of the Earth's mantle, and an important chapter on the concept of primary magmas. With this thorough grounding the reader is well prepared to understand the approaches to petrogenetic problem-solving in the rest of the book.

The remaining 12 chapters dissect the petrogenetic problems of ocean-floor volcanism, within-plate oceanic volcanism, island-arc volcanism, continental magmatic arcs, continental flood basalts, layered mafic intrusions, anorthosites, granites and rhyolites, kimberlites, continental rift magmatism, komatiites, and lunar petrology. In each case, the relevant geological, geophysical, geochemical, and phase-equilibrium evidence is considered, with a view to constraining the number of possible interpretations. Many good examples support each case.

Hess's integration of geochemistry and phase-equilibrium studies, the two most powerful petrogenetic tools, is one of the great strengths of this book. Another strength is the readable style of his writing...it is open, direct, clear, and even occasionally, unexpectedly, and intentionally, humorous. The frequent use of questions promotes a dialogue with the reader, and the occasional use of exclamation marks conveys the author's obvious enthusiasm for his subject. These stylistic devices go a long way to make the subject enjoyable for even the most hard-pressed student. The book is liberally provided with illustrations, including maps, cross-sections, chemical variation diagrams, and phase diagrams relevant to the petrogenetic problem under discussion. Finally, and most importantly, it is the rigor of his petrogenetic interpretations that brings most credit to Hess's book.

Weaknesses concern mainly errors of omission. For example, given the generally accepted importance of geochemical modeling, the book could have been expanded in this area. Also, although the last 12 chapters cover most of the important petrogenetic problems, they underplay several (*e.g.*, the special problems of carbonatites, syenites, lamprophyres, and my own favorite rocks, peraluminous granites). Perhaps future editions will grow to do them justice.

This book is more for igneous specialists than a general audience, although its style makes the subject accessible even to the general geological reader. Unfortunately, its price may create some consumer resistance among impoverished students; otherwise, this book must be in the hands of every respectable igneous petrologist, and on the shelf of every library. Even in these days of rapidly changing ideas in igneous petrology, I predict that Hess's *Origins of Igneous Rocks* will stand for many years as a petrogenetically authoritative work, and as a scientific and stylistic model for others.

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X-Ray Diffraction and the Identification and Analysis of Clay Minerals. By Duane M. Moore and Robert C. Reynolds, Jr. Oxford University Press, 1989, 332 pages. Soft cover, spiral bound. $34.95.

I like this book and hope that it may find its way into classrooms and laboratories everywhere. This refreshingly readable, well-illustrated volume is first and foremost a teaching resource; therefore, the primary audience is students and educators. Professionals will find this book a useful addition to their laboratory literature, however, because it contains observations and useful hints for analysis of clay minerals from experienced researchers in this field.

Conceptually, this volume is really three books. The first part, Chapters 1 through 3, includes a historical perspective on the discovery of X rays and the importance of clay minerals (Chapter 1), the nature and production of X rays (Chapter 2), and a relatively detailed discussion of diffraction effects by sample material (Chapter 3). The second part deals with the classification and structure of clay minerals (Chapter 4) and sample preparation (Chapter 5). The third part covers the identification (Chapters 6 and 7) and quantitative analysis (Chapter 8) of clay minerals.

The appeal of this book is the logical development of the concepts of both X-ray diffraction and clay

mineralogy, and the rigorous treatment of those concepts that provides the basis for a good theoretical understanding of this analytical method. The theory is supplemented with practical information that is presented in a "cookbook" manner. All of this is presented with a style, to quote the authors, that "communicate(s) our delight and enthusiasm for the subject matter... (without) taking ourselves too seriously". As a teaching resource, this volume provides the necessary information for a course in the principles of X-ray diffraction. It may also be used as a lab manual for sample preparation and analysis of clay minerals. The price is reasonable for course-related materials.

This book is a useful addition to laboratory libraries because it provides a ready source of practical information. For example, there is a good description of the filtration technique for making oriented mounts; the book specifically addresses the problem of peeling off the filter after applying the sample to a glass slide. As many technicians know, this step can ruin an otherwise good day. For the less-experienced clay analyst, this book provides equipment manufacturers and, in some cases, model numbers of specific items used in preparation of clay minerals. It has very readable tables of *d* values, degrees and intensities for most clay species and mixed-layered clays that facilitates rapid comparisons, and thoroughly discusses different methods for specific mineral identification.

An additional asset of this volume is a detailed discussion of calculated diffraction-patterns. The use of calculated diffraction-patterns in the analysis of clay minerals is becoming more widespread, with the development of more powerful personal computers, and this approach has broad application in both educational and analytical methods.

To summarize, *X-Ray Diffraction and the Identification and Analysis of Clay Minerals* is a welcome addition to the existing literature and fulfills the need for a single volume that provides information on theory of X-ray diffraction, sample preparation, and the nature and identification of clay minerals. This volume is particularly good for students and educators, but is useful for professionals as well. There are even tetrahedra and octahedra templates for making models of clay minerals, something anyone can do when the equipment is down or you're tired of reading about clay minerals.

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Australian Mineralogist. Edited by C. Kovac. Gemcraft Pty. Ltd., 293 Wattletree Road, Glen Iris, Victoria 3146, Australia, 1989, 316 + iv pages. $49.95 + $8.60 (Aust.) postage (approx. $44 US).

This volume, which is available only in soft cover, is a reprint in one volume of the first 51 numbers of *Australian Mineralogist*, which appeared first as a separately paginated supplement to a popular magazine. There is no national mineralogical society in Australia, although there are four State societies, largely composed of amateur collectors, who are assisted by a number of professionals. Mr. C. Kovac offered to insert a supplement in his monthly magazine in 1981 for papers on mineralogy. This resulted in the publication, over the next several years, of a substantial number of papers, both by professional mineralogists and competent non-professionals, mainly on topographical mineralogy. Most of the papers were, naturally, on Australian minerals and mineral occurrences.

Publication of the magazine changed hands in 1986, but in 1987, Mr. Kovac undertook the publication of *Australian Mineralogist* as a separate journal. The issues reprinted in the volume under review were, in their original format, given numbers, 1–51; the compilation is called Volume 1. The new independent publication started as Volume 2, Number 1 in July 1987, and is now published four times a year ($28 Aust. *per annum*).

Volume 1 is a unique and valuable document for anybody interested in Australian geology and mineralogy. Before this, papers describing Australian minerals and mineral localities were not common. The more sophisticated papers were published mainly in overseas journals; a sprinkling of mineralogical papers have appeared in Australian journals of a broader geological or other scientific nature from time to time. This volume contains some 120 articles, recording details (commonly including chemical analyses, optical and SEM data) of nearly 300 minerals from some 120 localities. Many of the minerals are rare species, and have not been described or reported before from Australia. There is also much interesting historical information on old mining areas. The publication does not contain papers on theoretical or experimental mineralogy.

The volume, which is of A4 size, is well printed on good-quality paper, and contains nine pages of color plates of mineral specimens, as well as a comprehensive index.

E.R. Segnit

Microcomputer Graphics for Geoscientists. By Malcolm Reeves. Short Course Notes, Volume 5. Geological Association of Canada, 1989, loose-leaf bound, 149 pages, nine 5 ¼ in. diskettes. $50 CDN (member's price $40 CDN) ISBN 0-919216-37-4.

An understanding of quantitative methods has become essential for every practitioner of earth science, regardless of subdiscipline. This has resulted

in the widespread use of microcomputers in academic research and industry, making a familiarity with the data-base management, computation, and graphics capabilities of microcomputers an important part of undergraduate training. In recognition of this, the Department of Geological Sciences at the University of Saskatchewan in 1984 established a microcomputer laboratory for teaching and research. This laboratory, GEMLAB, is now widely admired in the earth science community as an example of an economical and effective microcomputer teaching environment.

"Microcomputer Graphics for Geoscientists" was a 1987 Geological Association of Canada Short Course designed to use the capabilities of GEMLAB to provide an introduction to the techniques of microcomputer (IBM–PC) graphics and to suggest applications in the earth sciences. The resulting notes and diskettes are bimodal in content, addressing the broader questions of acquisition of hardware and software as well as providing many of the technical details required for programming graphics applications on IBM–PC and compatible computers. The reference lists for each chapter are useful guides for further reading.

The more general chapters provide a valuable source of advice, obviously based on considerable experience. They are as follows:

1. "GEMLAB: The microcomputer laboratory" is a discussion of the design considerations and an evaluation of the local-area network of microcomputers in the laboratory. This is essential reading for educators considering the establishment of their own teaching microcomputer laboratory. In the systems engineering world, it is well known that the completeness and accuracy of the "User Requirements Analysis" determine the success or failure of a hardware–software system. This chapter demonstrates why GEMLAB is a success.

2. "Review of microcomputer graphics applications" serves as an extended introduction to the graphics applications discussed in the remainder of the notes. It includes the noteworthy advice "Never write what you can buy ... Never buy what you already have or can get for nothing..."

4. "General-purpose graphics packages" outlines the capabilities of commercially available graph, contour and wireframe surface-plotting packages, and provides example output from general packages in specific applications.

5. "CAD packages in the geological sciences" is a brief review of the capabilities of computer-aided drafting and design packages. Along with evaluation hints, the important questions of file formats and data interchange are discussed.

10. "Real time graphics" introduces the use of the IBM–PC for the acquisition and display of real-time data, including acting as virtual oscilloscopes or chart recorders. The diskettes contain both the FORTRAN source and an executable program that simulate the acquisition of 8 channels of data. The program could be easily modified to work with a real-data-capture system.

11. "Interactive graphical input" is a review of the extensive range of input devices for transferring graphic information to microcomputers. Example PASCAL programs are provided to illustrate data capture from a standard 2-button mouse and a digitizing tablet. A number of other programs demonstrate programming techniques for cursor selection of x–y coordinates or text menu choices.

12. "Hardcopy output devices" emphasizes low-cost graphics output devices, in particular dot matrix printers and pen plotters. Among the demonstration programs is one that demystifies Hewlett Packard's ubiquitous HPGL for controlling vector devices.

The technical chapters are written for programmers. The accompanying diskettes have PASCAL, FORTRAN, or BASIC source code and compiled programs and libraries that illustrate material discussed in the notes. They provide examples of good coding practice, programming techniques, and algorithms useful to any programmer tackling the sometimes arcane world of microcomputer graphics. Although they include several fully functional application programs, the Preface emphasizes that they are distributed primarily for illustrative purposes. The author apparently (and justifiably) does not wish to be burdened with the ongoing maintenance that would be implied if this was considered a supported software collection.

3. "Spreadsheet models and graphics" is a brief review of the use of spreadsheets for a selection of geological problems including graphics. A copy of LOTUS 1–2–3 or SUPERCALC4 is required to run the examples of graphics and numerical modeling applications. Readers should append to the references a citation to a book that appeared since the short course was prepared: Orvis, W.J. (1987): 1–2–3 for scientists and engineers. Sybex, San Francisco, 341 pp.

6. "Character mapped graphics" describes the use of character mode for video graphics on the IBM–PC. Discussion includes use of the extended character set as well as user-defined characters and screen paging. A BASIC system for producing lithological logs using character graphics is provided on the diskettes.

7. "Bit-mapped graphics" is a technical discussion of graphics-mode video for the IBM–PC on CGA, IBM monochrome, and Hercules displays. Graphics primitives, the GKS standard, and graphics subroutine packages are described. The techniques are illustrated by several programs, including an executable version of USA, a boundary-element stress-analysis package, SHELLGEN, a BASIC pro-

gram for generating and displaying growth stages of mollusca, and STEREO, a PASCAL program for displaying structural and rock-mechanics data. Readers should note that the recent release of Microsoft FORTRAN 5.0 includes a library with a complete set of graphics functions, thus simplifying the utilization of microcomputer video graphics with existing FORTRAN programs.

8. "Graphics windows and viewports" discusses the terminology and concepts involved in mapping from a user coordinate system (window) to device coordinates (viewport). An executable version of BLOKRIG, a teaching program for geostatistics, is included to illustrate a variety of text and graphics windows.

9. "Animation" is a review of the graphic animation capabilities and programming techniques for the IBM-PC. No example programs are included.

Cross-referencing between the notes and programs on the diskettes is minimal, but the diskettes contain extensive documentation and "readme.bat" files that guide one through various demonstrations. I encountered only two trivial bugs in the software received for this review, both restricted to batch files and easily fixed or worked around. The question "Which adapter cga or ega (c/e)?" in several demos required the response "a" in order to use my EGA; and the query/prompt "AT&T VDC present (y/n)?" in USA.BAT required an <ESC>, not "n", in order to continue the demonstration with a non AT&T video adapter.

These reasonably priced notes are appropriate for anyone contemplating the acquisition of hardware and software for graphics-based applications in the earth sciences as well as moderately experienced programmers who wish to expand their graphics skills. It should not be considered as a text for an undergraduate or graduate course, but rather as important resource material for a) any earth sciences department determined to increase the computer literacy of students and b) any earth scientist who wishes an overview of the potential of microcomputer graphics in his or her field.

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Carbonatites: Genesis and Evolution. Edited by Keith Bell. Unwin Hyman, 8 Winchester Place, Winchester, MA 01890 USA. 1989. 618 pages. Price: $125 US (hardbound). ISBN 0-04-445068-0.

From traces of melt in the asthenosphere, to lavas and welded spatter on the surface, carbonatites make up a minute but petrologically intriguing fraction of the Earth. As a group they are the most mineralogically diverse of all rocks, and they have a long history as the subject of speculative petrogenetic models. The rapid pace of petrology's understanding of carbonatites in recent years is well captured in this book, which contains 23 papers by 31 authors touching authoritatively on nearly every aspect of carbonatite genesis and evolution. The book was originally intended to be the record of a special session on carbonatites at the 1986 GAC–MAC meeting in Ottawa, Canada. As such, it contains some of the latest results of research into the phase equilibria, geochemistry, mineralogy, and geology of carbonatites, but it is much more. Review chapters give a historical perspective and supply most of the background a nonspecialist would need to appreciate what carbonatites are and in what forms they occur. The chapters are arranged so that the nomenclature, distribution, mineralogy, and field relationships of carbonatites are discussed first, followed by geochemistry, phase equilibria, and petrogenetic models.

A. Woolley and D. Kempe propose a nomenclature for carbonatites based on mineral assemblages, rather than exotic and arbitrary names (*e.g.*, calcite carbonatite instead of sövite). A. Woolley notes that most carbonatites are associated with continental swells and rifts, but that they may also erupt within extensional zones produced during continental collision. Carbonatites show the full range of intrusive and extrusive igneous forms and features, excepting large plutons (D. Barker). Their association with alkaline silicated rocks, and relatively late time of emplacement in alkaline complexes, imply that most are derivatives of silicate magmas. A brief chapter by A. Treiman summarizes some physicochemical properties of carbonatite melts and their consequences for the behavior of carbonatite magmas.

Most intrusive carbonatites are Ca-rich sövites, but until recently Na-rich natrocarbonatite lavas were the only known freshly erupted carbonate magmas. The identification of juvenile Ca-rich extrusive carbonatites containing phenocrysts of calcite (J. Keller) shows that sövitic magmas do exist, and can be erupted.

Carbonatites are mineralogical cornucopia with significant economic potential. D. Hogarth gives a detailed and scholarly view of pyrochlore, apatite, and amphibole in carbonatites, bolstered by abundant references to Russian and other non-English literature. A. Mariano gives a brief but comprehensive overview of economic mineralogy and the formation of ore deposits in carbonatites.

Interesting examples of carbonatite provinces and centers are discussed in this book. P. van Straaten notes that carbonatites are less common in the Archean Tanzania craton than in the surrounding Proterozoic belts, which contain extensional domains periodically reactivated from the late Proterozoic to

the present. Carbonatites of the Canadian Cordillera (J. Pell and T. Höy) record mid-Paleozoic rifting on the western edge of Laurentia, with different levels of emplacement exposed within the forelands and crystalline belts of Mesozoic orogenies. S. Eriksson provides a detailed account of the geology and petrology of Phalaborwa, a well-studied copper- and phosphate-rich carbonatite in South Africa. J.B. Dawson brings us up to date on the world's only active carbonatite volcano, Oldoinyo Lengai in northern Tanzania.

The radiogenic isotope geochemistry of carbonatites (K. Bell and J. Blenkinsop: Sr–Nd; S. Kwon *et al.*: Pb) provides valuable information on the history and dynamics of the subcontinental upper mantle. Most carbonatites have depleted isotopic compositions that are similar to oceanic island belts. In the Superior and Grenville provinces of the Canadian Shield, Sr–Nd–Pb studies indicate that depletion in the source region occurred about 3 billion years ago, although it is uncertain whether the source was locked into the subcontinental upper mantle, or was in convecting, asthenospheric mantle. A mixture of depleted and enriched sources is indicated for the Cenozoic carbonatites of East Africa. An interesting aspect of the stable isotope geochemistry of carbonatites (P. Deines) is their very small spread in δC^{13} compared to diamonds and basalts. Deines suggests that this indicates that magmas parental to carbonatites sample relatively large volumes of mantle, homogenizing all but large-scale variations in C isotope composition.

Nine chapters on mantle metasomatism and dynamics, and carbonatite generation and evolution, provide varying and sometimes conflicting views. The issues are: what role does mantle metasomatism play in the source regions of magmas parental to carbonatites? And do carbonatites come directly from the mantle, or are they exsolved as immiscible liquids from CO_2-rich nephelinites and related magmas? There is complete agreement that there is a "solidus ledge" for peridotite–CO_2–H_2O at 17–25 kbar (estimates of the exact pressure vary). At the ledge, with increasing pressure the solubility of CO_2 in melts increases and the solidus temperature decreases dramatically. Melts rich in CO_2 rising through the ledge are liable to react with solid peridotite, freeze, and release metasomatizing fluids.

A. Jones supports a strong link between metasomatism and the genesis of kimberlites and carbonatites. P. Wyllie emphasizes the possible role of concentration and transport of volatiles from the deep upper mantle by kimberlitic melts, with the parental magmas for carbonatites being derived from asthenospheric mantle spiked by previous invasions of kimberlites. J. Meen *et al.* model the formation and partial melting of mantle containing metasomatic veins of amphibole lherzolite ± carbonate. They suggest that the spread in East African carbonatite Nd and Sr isotope compositions is due to the interaction of melts of isotopically enriched veins with depleted mantle. S. Haggerty, also drawing lamproites into the kimberlite–carbonatite circle, argues that carbonatites originate directly from mantle metasomatic bodies, or 'metasomes'.

In contrast, D. Eggler considers that carbonatites, carbonated nephelinites, and kimberlites can all be generated from mildly depleted OIB-source mantle with no necessary pre-enrichment by volatiles. Therefore, these magmas must sample relatively large volumes of mantle, and their segregation is highly dependent upon compaction mechanics and the solidus ledge. According to Eggler, carbonatites that satisfy the criteria for primary mantle melts (high Mg number and Ni content) are very rare, and the primary magmas for carbonatite-bearing complexes are, with few exceptions, carbonated silicate magmas (nephelinite to melilitite), which segregate at depths of 65–80 km.

Most authors in this book agree that the consistent association of carbonatites with alkaline silicate rocks requires that most carbonatites are generated by liquid immiscibility from CO_2-rich silicate melts. B. Kjarsgaard and D. Hamilton present new experimental data showing that sövite magma can be generated by immiscibility. Trace-element fractionation between silicate and carbonate melts (D. Hamilton *et al.*) is not capable of producing the extreme enrichment in *REE*, Nb, *etc.* so often observed in carbonatites, such that secondary processes, such as crystal fractionation, must be involved. The last word is given to J. Gittins, who is outspoken in support of a model for primary carbonatite magma. He argues that the diversity of carbonatites is best explained by fractionation of phenocrysts and alkaline fluids from dolomite carbonatite, obtained by partial melting of the mantle with no intervening immiscibility.

The diversity of acceptable hypotheses on the petrogenesis of carbonatites means that no consensus on their origin is possible at this time. A comprehensive overview of the current wisdom on carbonatites, as an introductory or summary chapter, would therefore have been interesting and is notable for its absence. More importantly, there is disagreement on the meaning or significance of some data, which is occasionally presented and interpreted in one chapter and disputed in another. For example, J. Gittins, arguing against liquid immiscibility, states that "There is no reason to suppose that a nephelinite magma can dissolve much CO_2...". But other chapters in the book report the compositions of silicate liquids with up to 10% dissolved CO_2, and describe a continuum between carbonatite and nephelinite liquids at the peridotite–C–O–H solidus. Several of the authors conclude that natrocarbonatite can form

by crystal fractionation of sövite, but only M. Le Bas notes that this is prevented by a thermal divide in the binary Na_2CO_3–$CaCO_3$. When A. Woolley uses the intrusions of the Canadian Cordillera as possible examples of carbonatites emplaced in orogenic zones, he contradicts Pell and Höy, who interpret them 168 pages later as rift-related. P. van Straaten's conclusion that carbonatite magmatism was closely associated with the initiation of the Pan-African event is puzzling, since they are separated in his Figure 13 by 100–400 million years. Readers will want to apprise themselves of all points of view, and recognize that certain important aspects of carbonatite petrogenesis remain speculative and even partisan. This reviewer found the chapter by P. Wyllie to be particularly informative and well-informed.

Despite its minor shortcomings, this book is a highly valuable source of information on carbonatites, in this regard only needing, perhaps, one or two more descriptions of major intrusions. The figures were carefully drafted and reproduced, the paper is acid-free (though not glossy), and the book is solidly bound and provided with an extremely attractive dust jacket featuring spectacular photographs, front and back, of Oldoinyo Lengai. The text has been painstakingly edited, and 19 pages of subject and location indexes enhance its value. Full titles and journal names are given in the references to each chapter. The list price is reasonable for a book of its size and quality. *Carbonatites: Genesis and Evolution* will find a place on the shelf of any igneous petrologist, from advanced undergraduate to professional, and will also be of interest to economic geologists and mineralogists.

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