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BOOK REVIEWS

Minerals of the Kovdor Massif. By Gregory Ivanyuk and Victor Yakovenchuck. Russian Academy of Science, Kola Science Centre Publishing, Apatity, Russia, 1997, 116 pages, hardcover, US$30.

Here is your chance to see what kovdorskite, manasseite, bobierrite and juonniite, the latter a new addition to the mineral kingdom as of 1997, look like. In this bilingual (Russian and English), abundantly illustrated coffee-table book, the authors introduce us to the minerals of the Kovdor Massif through short but informative text and photographs. They point out that the unique mineral diversity of the Massif has incited many of the world's mineralogical museums to mount special exhibitions devoted to the Massif. A nice touch for all of us who just dream of visiting Russia, the author has included many beautiful photographs of the wintery northern landscape. One senses the artist behind the geologist. Indeed, G.Yu. Ivanyuk recently provided a set of wonderful drawings to illustrate *Glossary of Mineral Synonyms*, just published by MAC.

The first chapter (pages 11-18) gives a brief introduction to the Kovdor alkaline-ultrabasic igneous complex, with a colored geological map, and describes briefly each rock type. This composite, multiphase intrusion composed of alkaline ultrabasic and carbonate rocks was discovered in 1933. (The English translation says 1993. This is one of a few typos I stumbled across and it is in the first sentence of the book!) Located in the southwestern part of the Kola Peninsula above the Arctic Circle, the massif covers 41 square kilometers. Over 150 different minerals have been identified so far in the Kovdor Massif. Color maps of two ore deposits (magnetite and phlogopite) also are included. Unfortunately, there is no regional geological map showing the location and setting of the Massif. On the other hand, latitudes and longitudes are given.

The second chapter (p. 19-24) describes briefly the five mineral deposits of the Kovdor Massif. The baddeleyite – apatite – magnetite deposit, discovered in 1933 and mined for its iron since 1962, is the most important to the economic life of the area. Since 1975, apatite and baddeleyite are also recovered from this deposit. Moreover, six minerals asssociated with this iron deposit are not found anywhere else in the world: kovdorskite, girvasite, rimkorolgite, krasnovite, strontiowhitlockite and juonniite.

The largest part of the book (p. 25-113) consists of a listing of most of the minerals found in the Kovdor Massif. They are organized into seven groups: sulfides, oxides and hydroxides, carbonates, sulfates, phosphates, halides, and silicates and aluminosilicates. For each mineral species, the authors provide its chemical formulae and a short paragraph describing how it occurs in the Massif, in what rock type it can be found, and a few distinguishing features. This part is abundantly illustrated, with 100 colored plates. There has, however, been no attempt to have a photograph for every mineral. Rather, the photographs have been chosen on an aesthetic basis. For example, of the 16 sulfides present in the Massif, only two are illustrated: pyrite (six photographs) and chalcopyrite. The quality of the photographs varies from average to very good. A few SEM photographs have also been included. Many unusual minerals are illustrated, the highly photogenic kovsdorskite (colorless to blue to dark pink), juonniite, bobierrite, for example.

Given its very reasonable cost, $US30 plus postage, this book will be a worthwhile acquisition for anyone interested in minerals and specially minerals from Russia. It can be ordered from Mr. Klaus Hielscher, Feldbergstraß 223 e 63, D-61449 Steinbach, Germany. Tel/Fax. (49 6171)73796.

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Minerals First Discovered on the Territory of the Former Soviet Union. By Igor V. Pekov. Ocean Pictures Ltd., Box 368, Moscow, 103009 Russia, 1998, 369 pages, US$52 plus $3 postage and handling. Available from Carol Finnie, 448 East Mulberry Street, Lebanon, Ohio 45036, U.S.A. Hardbound (ISBN 5-900395-16-2).

The detailed localities of mineral-discovery sites and the nature of the original specimens are of great interest to mineralogists, both professional and amateur, museum curators, mineral dealers and mineral enclyclopedists. Some minerals, known from antiquity as gem or industrial materials, have discovery localities that can only be speculative. Other species described from the 16th through the 19th Centuries have missing or incomplete discovery data. In the 20th Century, the problem has persisted for minerals discovered in the Soviet Union and China. Otherwise complete descriptions of new species often left the reader with localities such as "Central Kazakhstan", "Southern Urals" or "Hunan Province". Happily, the publication of the book reviewed here solves the problem for at least minerals of the former Soviet Union.

Minerals First Discovered on the Territory of the Former Soviet Union (hereafter *Minerals First Discovered*) is attractively hardbound in a handy size (13.5 × 22 cm). It is printed on good matte paper in a clear 10 point font. I had no problem reading any portion of the book. The layout and organization are good. The translation to English is excellent, and I found very few spelling, grammatical or typographic errors.

Minerals First Discovered opens with a short message of support for the project and a confirmation of the author's credentials by Professor Andrei Bulakh. This is followed by a 12-page Introduction in which the author gives a brief history of mineralogical and geological study in the Russian Empire, the Union of Soviet Socialist Republics and the present Russian state. The author clearly states that he does not intend the work to be an exhaustive compendium of mineral data. Rather, he pointedly emphasizes the geographic aspect and historical context of mineral discovery.

The vague references to mineral localities in the USSR came about for several reasons. First, the original publications were nearly always in Russian with only abstracts of the work given in principal European languages. These abstracts rarely gave details of discovery localities, even when they were present in the original paper. Further, many discoveries were published in regional periodicals, which were not readily available to readers beyond the borders of the USSR. More important, however, was the imposition of a secrecy system for geographic information from geological surveys. Publication of geographic localities for minerals of "strategic" constituents was not allowed. The principal goal of *Minerals First Discovered* is to reveal the discovery localities exactly, or at least in greater detail than was hitherto allowable. The author gathered information from original publications, government reports, dissertations, personal communications with mineralogists participating in the discovery, and museum curatorial data. He also visited many of the discovery sites.

The remainder of the Introduction gives the author's criteria for inclusion of species, designation of type localities and type specimens, and notes on mineral names. There are many abbreviations used throughout the book, but these are clearly explained in listings at the end of the Introduction. Almost all of the 582 species listed are in the *Glossary of Mineral Species*, 7th edition (1995), by Fleischer and Mandarino. Sixteen minerals, either not listed in the *Glossary* or defined as less than full status, are in the author's opinion worthy of species status and are thus included.

The heart of the book is given in Part 1, Minerals First Discovered on the Territory of the Former Soviet Union. Each of the species described has an individual entry with the name in upper case, followed by the chemical formula and, in some cases, an indication of the group to which the species belongs. A symbol indicating the inclusion of a color specimen or SEM photograph is given with the mineral name. A short paragraph describing the discovery locality follows, often along with brief notes regarding the history of the discovery. If more than one discovery site is known, one locality is clearly designated as the type locality. Locality placements are wonderfully detailed, sometimes right to the outcrop or depth within a borehole. Would that all site descriptions were this detailed! Where known, a brief description of the discovery specimen is given, including color, crystal sizes, habit and the associated assemblage.

The explanation of the mineral name is given in a separate paragraph. There are no new essential data, but better translations of place names often make the names more understandable. The biographic information given for eponyms are better than those available in *The Great Encyclopedia of the Soviet Union*, heretofore the best (and in some cases the only) source of biographic information. At the end of each entry, the storage locality and collection number are given for the type specimen. Generally, only one reference is given for each mineral, that of the original description. In a few cases, additional references of historical interest are given.

The book is well illustrated. Twenty-eight SEM photographs are included in Part 1. A further forty SEM photographs are given following the last entry, zvyagintsevite. The SEM photos are good quality, and all have a caption giving magnification, specimen source and a collection reference number. Color photographs of 146 specimens are bound in a separate section in the middle of the book. These, although small, are generally of very good quality. A caption gives size information, geographic locality and association, if relevant.

Following the specimen photographs, 38 color photographs of famous discovery localities are given. These are of good quality and of general interest. It is difficult to photograph something like the Khibina alkaline massif and have the picture meaningful from a mineralogical or geological perspective. The scenery illustrated is, however, often spectacular, and it is fun to see Mt. Kukisvumchorr, the Tolbachik volcano and the mountains of Kyrgyzstan and Tajikistan.

Crystal drawings are scattered throughout the descriptions of Part 1. These are generally taken from the original published study of the mineral. In a few cases, however, the diagrams are new, as prepared by the author.

Part 2 of *Minerals First Discovered* presents the geographic distribution of the minerals in several different ways. The classification scheme first presents data for the whole of the former USSR. These data are then followed by classifications based on less inclusive geographic regions, *e.g.*, Russia, Urals, or Irkutsk. This section includes photographs of mineralogists associated with studies in particular geographic areas. The tables are accompanied by 17 pages of maps. The first map shows the geographic regions used in the classification scheme. Each of the other maps concentrates on a particular geographic region and shows discovery localities. The maps are gathered together at the end of Part 2, necessitating much page turning to and from the classification tables. I would have preferred to have the corresponding table and map on facing tables, but this is probably not efficient or economical from a publishing perspective.

Part 3, entitled Chronology of Discoveries, first lists mineral discoveries by year. The list begins with crocoite in 1766 and ends with 1997, the last year for which data are included. It is interesting to note that, from 1766 to 1951, there were only one or two minerals discovered each year in the regions covered in this book. Beginning in 1953, however, an average of 11 minerals were discovered each year, the high point of 23 discoveries coming in 1983. The surge in the years after World War II certainly was aided by the invention and improvement of modern analytical instrumentation. It was also inspired, however, by the intense geological study of mineral deposits for material necessary for the production of thermonuclear weapons and their delivery systems.

The book concludes with a list of references, and index of place names, a list of people after whom minerals have been named, and an Appendix which gives compounds discovered in the burnt coal dumps of the Chelyabinsk brown-coal basin, southern Urals. The author points out that it is unclear whether the compounds are natural or artificial. The Committee on New Minerals and Mineral Names of the International Mineralogical Association does not consider proposals for new minerals from burnt coal dumps. Of the 45 names listed, however, nine are accepted as mineral species.

The book contains 15 pages of advertisements, 14 of which follow the color photograph section. The advertisements are non-intrusive; this reviewer did not even notice them on his first reading, testimony to his ability to shut out commercials.

I found *Minerals First Discovered* to be well researched, written and produced. It is full of interesting data that have not been generally unavailable. This is especially true for the discovery localities. The main part of the book, Part 1, is easy to use, the illustrations are good, and the various sections dealing with the geography and chronology of discoveries are interesting and useful. I recommend the book without hesitation.

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Das grosse Lapis Mineralienverzeichnis (third edition). By S. Weiss. Christian Weiss Verlag, Orleansstrasse 69, D–81667 München, Germany, 1998, 304 pages. DM29.80 (ISBN 3–921656–17–6).

The first edition (1990) was reviewed in *The Canadian Mineralogist* **29**, 599-600 (1991). The second edition appeared in 1994. The price and number of pages has remained the same for all three editions; however, the number of entries per page has been increased (less white space). About 3850 mineral species and the equivalence of 2000 other mineral names are given. A spiral binding allows the book to be open on the desk. Many additions and corrections to the earlier editions have been made.

Tabulated data in alphabetical order are given for mineral name, chemical formula, crystal system, colour, hardness, streak, cleavage, size, rarity, and chemical crystallographic classification. Some original diacritical marks have been added. Rounded and square brackets for chemical groups as recommended by the International Union of Crystallography are correctly used.

The original spelling is given for many mineral names (*e.g.*, Adamin, Akanthit, Brasilianit, Hämatophanit, Linneit, Seladonit, and Tetraedrit). Rather than the English prefixes of potassic and sodic used in the amphibole nomenclature, the Latin prefixes of kalium and natrium are substituted. One more reason that the amphibole nomenclature will need to be revised.

Not all polymorphs, which are mineral species, are given (*e.g.*, Gersdorffite-$Pa3$, Gersdorffite-$P2_1$, and Gersdorffite-$Pca2_1$). Some named polytypes, which are not mineral species but structural variants, are given (*e.g.*, dickite, orthochamosite, orthochrysotile). Under the heading crystal system, it would have been more useful to list the polytype symbols.

A unique chemical-crystallographic classification is given, which is similar to that of Strunz, Nickel & Nichols and Dana. Fifty years ago, this classification was helpful; however, it now has outlived its usefulness. Instead of this entry, density would make better use of the space.

All recent new minerals and recent International Mineralogical Association papers (*e.g.*, amphiboles, zeolite) have been taken into account. Very few errors were noted. The book is clearly printed on high-quality paper. Although written in German, an English-only reader will be able to understand the tabulated data. It is a good buy.

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Ultra-High Pressure Mineralogy: Physics and Chemistry of the Earth's Deep Interior. Edited by Russell J. Hemley. Mineralogical Society of America, Reviews in Mineralogy, volume 37 (1998). xvi+671 p., US$32.00, softbound (ISBN 0–939950–48–0).

For 25 years, cost-conscious earth scientists in search of succinct, authoritative, current reviews of mineralogical topics have turned to the *Mineralogical Society of America* series, Reviews in Mineralogy. Originally notes for short courses, they have long since evolved to a more complete format distinguished by careful (if sometimes pedantic) presentation and excellent bibliographies. The early volumes treated a single mineral, or group of minerals, but more recent volumes have tackled much larger topics, such as thermodynamic modelling, and trends in igneous petrology. This evolution has been accompanied by a rapid expansion in size of the volumes and number of authors, with consequent problems of gaps and overlap in coverage, and maintaining unity of style and aim of presentation. The current volume illustrates both the strengths and weaknesses of this approach.

Weighing in at over a kilogram, it must be approaching the maximum size for a soft-cover book intended to have a significant useful life. In 19 chapters, by 34 authors, the volume treats virtually every aspect of ultrahigh-pressure mineralogy, many of which would be considered geophysical or tectonic rather than mineralogical topics by most earth scientists. The first eight chapters treat what might broadly be called the experimental and observational framework. An introductory chapter by Mao and Hemley briefly covers the technology that has made ultrahigh pressures and temperatures achievable, and the methods by which physical properties can be measured *in situ*. These authors suggest that the rapid advance in achievement of high pressures and temperatures and the exotic methods of measurement (synchrotron radiation, acoustic coupling) sparked the current interest in high-pressure mineralogy. Most earth scientists would feel that this is the tail wagging the dog. Interest grew when high-pressure minerals, particularly coesite, were found at the Earth's surface in significant amount, as noted by Liou, Zhang, Ernst, Rumble and Maruyama in the following chapter on high-pressure minerals in deeply subducted rocks. This is a good summary, concentrating on the mineralogy and metamorphism, although the same material has been recently reviewed elsewhere, in some cases by the same authors (for example Ultrahigh Pressure Metamorphism, Cambridge University Press, 1995). The next two chapters (by Mysen, Ulmer, Konzett and Schmidt and by McDonough and Rudnick) treat the same occurrences of mantle material (orogenic ultramafic rocks, mantle inclusions in mafic rocks). However, the treatment is up-to-date, concise, and accompanied by an excellent bibliography. An interesting point that emerges from these two chapters is the significant K content in pyroxene and amphibole, suggesting that K content in the upper mantle may be higher than previously estimated. Chapters 5 and 6 (by Agee and Bina, respectively) consider the match between laboratory and seismic data for the deeper mantle. Laboratory experiments tend to suggest that the simplest models proposed for discontinuities (for example olivine to wadsleyite) are insufficient. Significant lateral and radial heterogeneities probably exist. The core–mantle boundary is discussed by Jeanloz and Williams, with emphasis on the recently discovered ultralow-velocity areas on this boundary, whereas the core is discussed by Stixrude and Brown, with a helpful listing of current topics of interest. Prewitt and Brown round out the first part of the book with a thorough discussion of high-pressure crystal chemistry.

The second part of the book deals with more theoretical matters. Navrotsky casts a critical eye on the precision of thermodynamic data for ultrahigh pressures, and generally finds it to be rather low. Fei examines solid solutions and element partitioning, Shen and Heinz examine high-pressure melting, and Dingwell considers viscosity and diffusion. All of these subjects depend on availability of appropriate and accurate experimental techniques, many of which are still subject to serious uncertainties. Duffy and Wang summarize recent advances in PVT equations of state, whereas Liebermann and Li discuss elasticity at high pressure and temperature, and Weidner surveys rheological studies. All of these chapters include thorough discussions of the experimental techniques and results. After chapters on vibrational and electronic and magnetic properties, the book ends with a chapter on the theory of minerals at high pressure, which concludes that first-principle methods can now make realistic predictions of mineralogy in the deep mantle and core. In view of the many surprises chronicled earlier, this claim must be treated with some skepticism.

The strength of this book is the breadth and authority of coverage, together with superb bibliographies (current to late 1996, with some 1997 coverage). Weaknesses include a considerable amount of overlap and duplication, an emphasis on techniques unlikely to be of interest to anyone except specialists, and utilitarian, rather than elegant, illustrations. As can be expected with so many authors, there are marked variations in style, outlook and polish. Still, at a price of only $24 (for MSA members), this is superb value. I rate it a "must buy" for anyone with the slightest interest in high-pressure mineralogy and the interior of the earth.

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The Physics of Explosive Volcanic Eruptions. Edited by J.S. Gilbert and R.S.J. Sparks, Special Publication 145, The Geological Society of London, Burlington House, Piccadilly, London, W1V 0JU, U.K., 1998, 186 pages. US$98 hardbound (ISBN 1–86239–020–7). North American orders through the AAPG Bookstore, PO Box 979, Tulsa, Oklahoma 74101–0979, U.S.A., tel: (918) 584-2555.

This collection of seven chapters, preceded by an introductory overview by the editors, arose from an Arthur Holmes European Research Conference, organized through the Geological Society of London, which was held in Santorini, Greece in September 1996. As the title indicates, the book discusses the physics behind explosive volcanic eruptions. It reveals how we are starting to understand the underlying mechanisms that cause this type of spectacular and environmentally damaging activity. The work is also an illustration of how many earth scientists are becoming increasingly multidisciplinary and versatile: for example, in order to plumb the depths of volcano mechanics, a thorough knowledge of physics, mathematics (especially fluid dynamics) and chemistry is a prerequisite. There's a lesson for undergraduates and undergraduate degree programs here too – a strong background in the basic sciences and mathematics is important. This polymath approach may have other implications. Perhaps the concept of separate scientific disciplines, so favored in the 20th century, with each subject isolated within its own empires and institutions, is becoming steadily supplanted by the cross-disciplinary approach demanded by Nature in order to fully understand its workings. Are we returning, albeit better equipped, to the days of the natural scientists of the 19th century, like Darwin, who was trained as a geologist as much as he was a biologist? Certainly, real progress is typically made when researchers look beyond their own discipline and try to meld ideas from allied subjects. This collection of works is an illustration of how knowledge from other disciplines has been adapted to understand a very complicated geological process.

The contributors are all experts in their own right, and the reader is introduced to the current state of thinking in many of the key areas relating to explosive volcano dynamics. Following the introduction by Gilbert and Sparks, which provides a succinct and useful guide to recent developments and future research directions, there are four chapters devoted to magma behavior inside explosive volcanoes and three to external effects. The chapter by Dingwell summarizes recent experimental work. Over the last decade, Dingwell's group has made major contributions to our understanding of the densities, surface tensions, viscosities and thermal conductivities of silicic melts, and much of this work and that of allied groups is summarized here. In particular, the roles of viscosity and the glass transition temperature, and their influence on magma rheology, are discussed (*e.g.*, brittle *versus* ductile response to stress). It is now well appreciated that magmas are polymeric suspensions that exhibit non-Newtonian behavior, a behavior that is constantly evolving with depressurization and vesiculation during unloading and ascent. Navon and Lyakovsky in the next chapter discuss the kinetics of bubble formation and crystal growth. The modeling of complex systems undergoing vesiculation (either through pressure reduction, or an increase in magma vapor content, or both) is attempted from the mathematical standpoint. There are a lot of variables and unknowns here, and a number of simplifying assumptions have to be made. Homogeneous bubble nucleation is difficult to achieve in anything but ultrapure liquids, let alone magmas, so heterogeneous nucleation will clearly be the norm. This means that the supersaturation required for bubble nucleation is effectively lowered. Vesiculation results in rapid expansion of the magma – the driving force for eruption. Understanding how bubbles form, which may lead to the development of foams, is one of the keys to understanding the explosive process. Conversely, loss of bubbles from a magma can affect a transition from explosive to effusive behavior.

Mader discusses the nature of conduit flow and fragmentation, which depends on magma vesicularity. There is a critical transition from bubbly flow, where the liquid (melt) phase is continuous, to fragmented flow, when the gas phase is continuous. Fragmentation occurs when voids occupy more than about 70–75% of the total volume, beyond which true foams develop. The transition to fragmentation can take place by brittle or ductile processes. Mader then goes on to describe various laboratory experiments that attempt to simulate fragmentation, and evaluates the inherent scaling problems. How bubbles are transported in magma is a function of magma permeability, and Jaupart discusses how conduit wall fracturing can lead to periodic degassing of the magma and chamber depressurization. Magmas can lose gas *via* fractured conduit walls during their ascent, so that magma fragmentation ceases and effusive flow rather than explosive activity ensues. Indeed, documented alternations between explosive and passive effusive activity (*e.g.*, as recorded at Mount St. Helens) appear to favor degassing *via* fractures, rather than requiring a chamber stratified in volatile content.

The last three chapters deal predominantly with the products and consequences of explosive volcanism, shifting emphasis from theoretical and physical models to the field. Woods reviews volcanic plumes, citing examples from several recent eruptions, and goes on to evaluate source conditions for plume formation and ascent, the initial stages of which are analogous to the decompression of an overpressured jet from a nozzle. The role of surface water can also have a major effect on eruption column structure: small amounts of water can mix with the hot ejecta and increase the gas content, thus promoting plume buoyancy; larger amounts of water (40–50% mass) can cool the ejecta, and prevent column buoyancy. Bursik considers how the eruption column is dispersed, a case of understanding differences between plume- and atmosphere-dominated transport of tephra, with wind systems eventually controlling plume motion. Here we get into implications of volcanically induced change in global climate, and considerations of meteorology as much as volcanology. Proximal and distal transport and fallout processes are also appraised. Last, but certainly not least, Druitt, in the longest chapter of the book, concludes with a comprehensive review of pyroclastic density currents. These are high-speed (over 100 meters per second), gravity-driven flows of hot particles and gas. Because of their ground-hugging nature, these can pose a significant threat to life and property. Both pyroclastic surges and flows and their respective deposits are reviewed. The second half of Druitt's chapter focusses on an appraisal of physical models of density currents, and pyroclastic flows as concentrated granular avalanches.

The quality of production is good, with clear figures and generally well-reproduced photographs. There is a detailed index, and the references (given at the end of each chapter) are comprehensive and up-to-date. Resetting of text has occasionally left in end-of-line hyphens where they should have been removed (*e.g.*, col-lapse, page 145). Overall, there are few typographic errors, though "raptured [as opposed to ruptured] melt film" (pages 45 and 47) does leave something to the imagination with regards unusual magma states.

Another text that covers similar ground has recently been published as part of Elsevier's Developments in Volcanology Series. It is entitled *From Magma to Tephra*, edited by Armin Freundt and Mauro Rosi (Elsevier, 1998, US$135, 334 pages). Two authors (Dingwall and Bursik) contribute to both these texts, and there is clearly some overlap in the material covered. Notwithstanding Freundt's and Rosi's volume, which is probably worth a look if you are into explosive volcanology, *The Physics of Explosive Volcanic Eruptions* should ideally be in every earth sciences library. Whilst it is unlikely to be used as an undergraduate course book, undergraduates could well benefit from reading certain chapters as part of a more advanced igneous petrology course. It could be used as a graduate-level course book for volcanologists, and it is likely to be most helpful to senior researchers entering the field.

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The Earth's Mantle, Composition, Structure and Evolution. Edited by Ian Jackson, 1998, Cambridge University Press, Cambridge, U.K., 566 pages. US$130.00 (hardbound). (ISBN 0–521–56344–5).

Our understanding of the Earth's mantle has increased dramatically over the past 40 years. For the many scientists who take an interest in this endeavour, there is the daunting task of appreciating the origin of ideas, and staying current, in a multidisciplinary area of study. This book can be a great help, for it provides an authoritative, up-to-date and reasonably readable overview of the mantle from the perspectives of cosmochemistry, isotope geochemistry, experimental mineralogy and petrology, fluid dynamics, seismology and rock and mineral physics. Graduate students will appreciate the overviews and references to key papers that shaped the way we look on the mantle.

Overall organization of the book into three equal-length parts reflects the multidisciplinary nature of the subject: Part I. Accretion and Differentiation of the Earth; Part II. Dynamics and Evolution of the Earth's Mantle, and Part III. Structure and Mechanical Behaviour of the Modern Mantle. Each of the eleven review articles, arranged as chapters, has different authors, with editor Ian Jackson, and the editorial advisory board (D.H. Green, B.L.N. Kennett, K. Lambeck and I. McDougall) are first authors on five of these. Fifteen of the 20 internationally respected authors work at the Australian National University's Research School of Earth Sciences, established by the late Professor A.E. Ringwood. The book is dedicated to him. One might argue that it provides an "incestuous" perspective; unlike many multi-authored books, however, this is not a collection of vaguely related research papers, but a coherent overview reflecting the research group's interests and initiatives. Here is a brief look at each chapter.

Chapter 1, Composition of the Silicate Earth: Implications for Accretion and Core Formation by O'Neill and Palme sets the stage for the rest of the book. After a brief introduction to the solar nebula and planetesimal formation, there is a marvelously succinct review of the bewildering world of meteorite jargon. This leads to a cosmochemical classification of the elements, constraints on the composition of the bulk Earth, and an accretionary model involving: 1) formation of the protoearth (~85% of the Earth) from refractory (non-volatile) material condensed at the Earth's present distance from the sun, 2) a period of core formation lasting at least 50 Ma, 3) addition of an oxidized component rich in the moderately volatile and highly volatile elements that perhaps condensed farther from the sun, 4) a second stage of segregation into the core, and 5) addition of a late veneer supplying the mantle's complement of highly siderophile elements. The thirty or more acronyms do not improve readability, but overall this is an excellent overview of the Earth's early formation.

Chapter 2, Early Differentiation of the Earth: An Isotopic Perspective (McCulloch and Bennett) expands on some of the topics from Chapter 1. The authors discuss the ^{238}U–^{206}Pb, ^{235}U–^{207}Pb and ^{87}Rb–^{87}Sr evidence for accretion and ^{182}Hf–^{182}W information on core formation supporting an interval of up to 100 million years for these processes to occur. The evidence from ^{146}Sm–^{142}Nd for thorough mantle mixing up to 4.3 billion years ago and ^{147}Sm–^{143}Nd information bearing on the evolution of the crust–mantle system complete the chapter.

Chapter 3, Primordial Solar Noble-Gas Component in the Earth Consequences for the Origin and Evolution of the Earth and its Atmosphere (McDougall and Honda) represents an excellent overview of information inferred from noble gas data. After pointing out the Ar and Xe evidence for profound early (first 100 million years) degassing of the Earth, the authors discuss Ne and He isotopic data in support of primordial solar noble gas in the mantle. They attempt to reconcile this conclusion with the non-solar noble gas composition of the atmosphere.

Chapter 4, Understanding Mantle Dynamics through Mathematical Models and Laboratory Experiment, by Griffiths and Turner, begins the second part of the book. The authors isolate the key processes likely to govern mantle convection and then present the mathematical fundamentals and focal modelling results that form the basis for the present view of mantle convection. By simply referring to the important papers on modelling details, the authors keep the text readable. A noteworthy aspect of the chapter is the simple and convincing argument for the inevitability of mantle convection due to the strong dependence of mantle viscosity on temperature and the inability of conduction to remove heat from radioactive decay.

In Chapter 5, Plates, Plumes, Mantle Convection and Mantle Evolution, Davies expounds on the modelling results presented in the previous chapter. The topographic evidence (oceanic ridges and swell associated with hotspots) is presented for two convective regimes, one induced by cool, dense plates and the other related to rising mantle plumes. The last third of the chapter shows that despite significant progress in understanding convective processes today, attempts to extrapolate back to predict thermal, convective and tectonic styles over the Earth's history have been far from unequivocal.

Many of the arguments in The Mantle's Chemical Structure: Insights from the Melting Products of Mantle Plumes (Chapter 6, by Campbell) begin by assuming models for thermal and fluid dynamic characteristics of mantle plumes discussed in previous chapters. The geochemical characteristics of high-temperature magmas (picrites and komatiites) are used to speculate on the chemical structure of the mantle (depleted upper mantle, slightly depleted lower mantle and an "enriched" source for oceanic island basalts (OIB) at the core–mantle boundary) and how it has changed over time. Although the chapter is interesting, the discussion about the importance of eclogite in OIB genesis underscores that despite 30 years of intense research, there are still fundamental differences of opinion about the composition and melting behaviour of the mantle.

Much of what we think we know about magma formation in the mantle (*i.e.*, the consensus) comes from decades of work on "pyrolite" (synthesized hypothetical equivalent of upper mantle material) at The Australian National University and the University of Tasmania. Chapter 7 by Green and Falloon recounts this legacy of accomplishment. It reviews the high pressure and temperature melting experiments, indicating which materials yield magmas (plagioclase, spinel and garnet lherzolites) and then recounts the importance of C, H and O in the formation of incipient melts. The melting experiment results are used to explain and interpret chemical variability in MORB, plume, intra-plate and subduction-zone magmas through the existence of a major melting regime, an incipient melting regime and a carbonatite melting interval superimposed on other variables such as oxygen fugacity. This chapter helps put in perspective much of the research on basalt petrogenesis today (*e.g.*, trace element and isotope studies) by supplying an overview of the phase-equilibria background.

Kennett and Van der Hilst (Chapter 8) introduce Part Three of the book with the article on Seismic Structure of the Mantle: from Subduction Zone to Craton. To begin, the major breakthroughs in seismic research over the past century are briefly reviewed. Then the authors outline information on seismic wave velocities in the upper mantle, transition zone, and lower mantle, and look at the three-dimensional modelling suggesting penetration and deflection of subducted oceanic lithosphere at the 660 km discontinuity. Efforts to unravel the shallow structure below the continents are also reviewed, but more work must be done before the mantle expression of major lithotectonic (orogenic) boundaries can be studied.

Chapter 9 (Composition and Temperature of the Earth's Mantle: Seismological Models Interpreted through Experimental Studies of Earth Materials) by Jackson and Rigden has one major conclusion: calculated estimates of the seismological characteristics of the Earth's mantle match those inferred from seismic waves, providing evidence that the mantle has relatively uniform chemical composition throughout. The analysis of available thermoelastic properties of the mantle provides assurance that observed changes in seismic velocities through, for example, the transition zone (410–660 km depth), are more likely related to phase changes than bulk chemical compositional changes. Uncertainties and prospective avenues for further research are outlined.

In Chapter 10, Lambeck and Johnston show how glacial-rebound phenomena have been used to estimate the viscosity of the mantle. The sophisticated models that have been developed predict the observed history of sea-level change at various sites around the world with impressive accuracy. These models also place constraints on the viscosity of the lower and upper mantle. Modifications of the models use satellite orbital geometry to confirm viscosity estimates from long-term glacial rebound observations and infer that sea levels have been rising over recent decades, in accordance with tide gauge records.

Mantle Rheology: Insights from Laboratory Studies of Deformation and Phase Transition, by Drury and Fitz Gerald, is the last and one of the most clearly written chapters in the book. An 8-page introductory section on deformation of crystalline solids provides a lucid description of fundamental concepts and controls on rheology and a useful briefing on the jargon. Subsequent sections examine experimental evidence for controls on deformation in the upper mantle, the deep mantle, and the possible effects of phase transformations in the transition zone. The last few pages attempt to see where research is going and where significant advances may be made in understanding mantle deformation mechanisms and rheology.

The above paragraphs illustrate that the book covers many research directions. However, certain topics are not given due emphasis. For example, the extensive research on trace elements and radiogenic isotopes, important for monitoring the history of subduction recycling and extraction of mantle melts, is conspicuously lacking. Thus, the book is not a comprehensive review but an overview reflecting the research directions, findings and perspective of the group that wrote it. A strong point, perhaps reflecting this group relationship, is that chapter cross-referencing gives one a view of the impact of one field of study (*e.g.*, seismology) on the direction of research and interpretation of data from other fields (*e.g.*, geochemistry).

The number of 1997 references suggests that most of the volume was completed in late 1996 for release in 1998. Thus, for a book, it reaches the objective stated in the Preface of being up-to-date. Other goals were to be "thoroughly readable" and useful for beginning graduate students through to experienced researchers. Overall, it achieves these goals, although some chapters are more useful for researchers (*e.g.*, Chapter 9) and others better suited for advanced undergraduates (Chapter 8). Faculty at undergraduate institutions will find it a valuable resource. However, owing to the multidisciplinary scope of the book, no one should expect to readily appreciate all the information imbedded in every chapter. There are few typographical errors, and the printing, layout, drafting and photograph reproduction are all of very high quality. To my astonishment, the binding remained intact following months of abuse as my travelling companion. At $130.00 (U.S.), this reasonably comprehensive, 566-page multidisciplinary book is fairly priced. Although unabashedly biased in perspective, it represents perhaps the best, and most readable overview of the state of the mantle available.

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N. L. Bowen and Crystallization–Differentiation – The Evolution of a Theory. By Davis A. Young. The Mineralogical Society of America, 1015 Eighteenth Street, N.W., Suite 601, Washington, D.C. 20036, U.S.A. 1998, 276 pages. US$16.00 (MSA members: US$12.00) softbound (ISBN 0–939950–47–2).

N.L. Bowen and Crystallization – Differentiation takes the reader through the history of the factors, scientific and personal, that led to Bowen's remarkable theory on the evolution of igneous rocks. When Bowen published the theory of crystallization–differentiation in 1915, only four years after receiving his Ph.D., he had experimental data from only a handful of chemical systems, no information on the effect of pressure and volatile contents, and no data on the role of important constituents such as potassium and iron. These limitations were overcome in the ensuing years, but the basic principles put forth back in 1915 have not changed.

The book is divided into six sections with a total of 24 chapters. The author begins, in chapters 1 and 2, by summarizing the petrologic thinking prior and up to the time when Bowen arrived on the scene. In chapter 1, early thoughts on the possible sources of basalt and granite are reviewed. The general line of thinking was polygenetic. In other words, basalt and granite were not related genetically, but were the results of separate processes, perhaps with the interior of the earth layered with basaltic and granitic strata. In chapter 2, the author focuses on monogenetic models of magmatic evolution. Contamination and differentiation of parental magma to yield derivative liquids gained credence. At this time, at or slightly before the turn of the century, it was clear to the leading igneous petrologists that the principles used to describe the physical chemistry of solutions apply equally well to magmatic liquids. That line of thinking was also central to Bowen's theory and discussions.

Chapter 2 emphasizes that immediately prior to Bowen's first experimental endeavors, two very important experimental advances had been made. Both were developed at the Geophysical Laboratory during its early years. One was the design of the quenching technique, whereby the experimenter could examine the experimental charges in the microscope after an experiment. The second was the development of thermocouple techniques, calibrated to temperatures near 1500°C. The stage was then set, both intellectually and experimentally, for Bowen to begin his experimental endeavors.

The second section, "Genesis of a Theory", contains four chapters beginning with a brief background of Bowen's early years, his Ph.D., and employment at the Geophysical Laboratory. In Chapter 3, the author notes that Bowen, following his undergraduate study at Queen's University in Canada, was dutifully impressed by the application of the principles of solution chemistry to igneous rocks by the Norwegian school of igneous petrology, led at the time by J.H.L. Vogt and W.C. Brøgger. Bowen contacted Brøgger, but the answer from Norway indicated to Bowen that Brøgger did not want him as a graduate student. Instead, Bowen pursued a Ph.D. at M.I.T. He contacted the director of the Geophysical Laboratory, A.L. Day, after a year at M.I.T inquiring as to whether he might pursue experimental studies at the Geophysical Laboratory as a part of his Ph.D. program. On the suggestion of Day, Bowen embarked on an experimental examination of the system anorthite–nepheline.

Chapter 4 illustrates how Bowen concluded that igneous rocks could not be explained in terms of eutectic melting and crystallization. The chapter discusses the experimental work on the albite–anorthite join, with its continuous solid-solution loop. The 1913 paper reporting these results held the first germs of the theory. The thinking was greatly substantiated by Bowen's immediate attention to the melting behavior of olivine and pyroxene where, for the first time, incongruent melting behavior of pyroxene, $MgSiO_3$, to olivine, Mg_2SiO_4, and liquid opened the venue for differentiation of basaltic liquids further. With an expansion into the more complex system Mg_2SiO_4–$CaMgSi_2O_6$–SiO_2 in 1914, the essential ingredients for the principles underlying crystallization–differentiation theory were in place.

Bowen realized, however, that experimentally derived liquidus phase diagrams alone would be insufficient. In order for fractionation to be effective, the crystallizing minerals must be separated from the melt. In chapter 5, the first experiments on crystal settling are reviewed. The experiments revealed that crystal settling in magma chambers, with attendant chemical evolution of the residual silicate melt, is indeed feasible. Bowen then put forth his theory for the evolution of igneous rocks. He also launched his first of numerous attacks on alternative models for igneous differentiation, including Soret diffusion, and liquid immiscibility.

Bowen's theory of Crystallization–Differentiation, published in the *Journal of Geology* in 1915, is discussed in chapter 6. The experimental database available to Bowen at that time was limited to only several experimental studies in simple three- and four-component systems, and foreshadows the areas that would remain in the debate over the theory during the following decades. This discussion would involve not only the application of liquidus phase-relations in experimental systems, but also Bowen's analysis of competing models. For example, Bowen used thermal arguments to conclude that assimilation of solid rock in a magma was unlikely. Soret diffusion was cast aside as a viable mechanism because in his view those components supposedly enriched in the cooler portions of a magma chamber would be those about to separate out as crystals. Liquid immiscibility was dismissed because, Bowen argued, there was not one example of liquid immiscibility demonstrated either in nature or in the laboratory.

The third section, also consisting of four chapters, describes the reaction of the scientific community to the theory. Chapter 8 addresses the first of many objections to the theory. These include challenges by, in particular, Daly and Grout. Daly did not discount the laboratory demonstration of fractionation and settling of crystals, but he remained skeptical of their application to nature, in part because he found no evidence of the supposedly large masses of crystallized materials. The objections listed by Grout, first espoused in an article in the *Journal of Geology* in 1918, resembled those of Daly. Grout commented that layered intrusions such as the Duluth Gabbro do not show the gradual evolution from basalt to granite. Instead, there is a sudden transition between the two. Both Daly and Grout resorted to liquid immiscibility and assimilation as alternatives. Chapter 9 contains Bowen's response to this criticism. He concluded that assimilation is an endothermic process. In the absence of a heat source, Bowen found assimilation to be an unlikely mechanism. Bowen objected to liquid immiscibility model on two grounds. First, he felt that there was no natural evidence. Second, he argued from the topology of relevant liquidus phase diagrams that liquid immiscibility would be extremely unlikely for compositions relevant to igneous rocks. Chapter 9 also includes a summary of Bowen's considerably less convincing argument for why one might not find in nature the intermediate-composition rocks expected from the crystallization–differentiation theory.

The last chapter (chapter 10) in section three first describes the circumstances of Bowen's return to the Geophysical Laboratory from Queen's University in 1920 (where he had spent the previous 1½ years; see chapter 7), followed by a detailed discussion of the reaction principle in igneous petrology. The reaction principle followed naturally from the realization that eutectic crystallization was not a viable mechanism with which to describe magmatic evolution. Bowen argued that the principles that govern magmatic evolution were those of continuous reaction series, as illustrated by the plagioclase melting loop, and discontinuous reaction series, as illustrated with the incongruent melting behavior of $MgSiO_3$ (pyroxene) to olivine + liquid.

Chapter 10 also describes Bowen's return to experiments after a hiatus of several years. Working with G.W. Morey, Bowen published the melting phase relations of K-feldspar to leucite + liquid. The phase diagram, used to deduce the genetic links between subalkaline and alkaline magmas, contained a total of two (2) data points!

Section four, again with four chapters, is entitled "Consolidation of the Theory", and begins in chapter 11 with the circumstances that led to the book, *The Evolution of the Igneous Rocks*, published in 1928. This book, perhaps the most famous of all treatises on igneous petrology, was the result of a series of lectures given by Bowen at Princeton University in 1927. Chapter 11 comments on the many new ideas in this book and on the fact that it contained no new experimental data. Much of the new material, the author concludes, came in response to criticism by one of Bowen's colleagues, C.N. Fenner, at the Geophysical Laboratory.

Chapters 12 and 13 are devoted entirely to the dispute between Fenner and Bowen. Fenner argued, for example, that linear trends in variation diagrams from igneous rock series would be inconsistent with Bowen's theory. Bowen countered by pointing out that when plotting the chemical data appropriately, the trends were not linear, but followed those expected by liquids evolving through crystal fractionation. Fenner argued for gaseous transfer of heat and material. Bowen found that there was little evidence in nature for volatile enrichment until the very latest stages of magmatic evolution. Fenner's argument over iron enrichment during fractionation received little response from Bowen at this stage but that would soon change. In 1928 Bowen essentially stated that iron in differentiated igneous rocks is well purged, as is the case for lime and magnesia. The last chapter (chapter 14) in section four summarizes some of the impacts of "Evolution of the Igneous Rocks" on the science of igneous petrology and is essentially a summary of how the luminaries of the day viewed the book. It was generally favorably received.

One of the greatest limitations of the original theory was that it did not take into account iron. The fifth section of Crystallization–Differentiation (another four chapters) describes how Bowen began experimentation with Fe-bearing systems around 1930. Such experiments had been difficult (they still are) in part because of the experimental need to control the redox state of iron. Many of these problems were overcome through the collaboration between Bowen and Frank Schairer, which began shortly after Schairer arrived at the Geophysical Laboratory in 1927. The two of them embarked on their first joint venture in 1929 with a melting study of aegirine ($NaFe^{3+}Si_2O_6$) in air and found that aegirine melts incongruently to hematite and liquid. This liquid was obviously enriched in silica, with no evidence of iron enrichment. Chapter 15 continues with a summary of Fenner's repeated calls for a more conservative approach to understanding igneous processes, followed by a summary of the phase relations in the system Na_2SiO_3–Fe_2O_3–SiO_2, which Bowen published with H.M.V. Willems and J.F. Schairer in 1930. Here, for perhaps the first time, Bowen recognized that there could be two fractionation trends, one of silica enrichment, and one of iron enrichment. However, Bowen did not give credit to Fenner, but merely stated that this conclusion was consistent with that proposed by Vogt long ago. The relationship between Fenner and Bowen had become quite strained.

Chapter 16 reviews the first phase-equilibrium studies of iron-bearing systems under reducing conditions. The first system was $FeO–SiO_2$, followed almost immediately by the more complex system, $FeO–MgO–SiO_2$. Owing to the much lower melting point of Fe_2SiO_4 than Mg_2SiO_4, liquids in equilibrium with olivine would always be enriched in iron relative to the olivine itself. In this system, Bowen had another example of a continuous reaction series.

In Chapters 17 and 18, we find Bowen in the thirties working with Frank Schairer and focusing on the residual liquids. Chapter 17 deals with granitic and rhyolitic liquids and Petrogeny's Residua System. Bowen and Schairer compared experimental results in the system $NaAlSiO_4–KAlSiO_4–SiO_2$ with compositions of natural igneous rocks. Of a total of 40 rhyolite, trachyte, and phonolite compositions from the East African Rift Valley system, all but three fell in the low-temperature trough of the experimental system. The remaining three were quite close. Bowen took this as further proof that the ultimate end in igneous evolution is represented by these rocks.

In chapter 18, the author addresses the first real obstacle to Bowen's original theory. This came in the form of a detailed study of the Skaergaard intrusion published in 1939 by Wager and Deer. Wager and Deer demonstrated that in Skaergaard, there was ample evidence that the ultimate end of igneous differentiation could be iron enrichment. In other words, Wager and Deer agreed with Fenner's postulates that there exists a fractionation trend that ends with iron enrichment. Bowen was not ready with a rebuttal this time.

The sixth and last section of the book contains six chapters under the heading of "Later Stages of the Theory". Chapter 19 describes the circumstances surrounding Bowen's second departure from the Geophysical Laboratory, to the University of Chicago for a decade-long stay. It was Bowen's hope that by teaching and conducting research at the University of Chicago, he might be able to introduce experimental petrology to the university setting. Although this stint as professor lasted longer than the one at Queen's just after World War I, Bowen came to conclude now, as he did then, that he missed the Geophysical Laboratory, and he returned to Washington on January 1, 1947.

Chapter 20 is a summary of Bowen's view on ultrabasic rocks, whether these can be the results of crystallization from a melt, or whether these rocks are cumulates. The discussion was primarily between Bowen and Harry H. Hess of Princeton University. Hess contended that by dissolving significant amounts of H_2O in ultramafic liquids, their melting temperatures might be sufficiently lowered so as to be consistent with field evidence. Bowen did not bite and added further experimental evidence in support of his position through his first experimental study, this time with O.F. Tuttle, at pressures above ambient. The system was $MgO–SiO_2–H_2O$ to 4000 atmospheres. Bowen and Tuttle concluded that even several percent H_2O did not lower the liquidus temperatures sufficiently to make Hess's hypothesis of H_2O-rich ultramafic liquids viable.

In Chapter 21, we return to the granite problem. While Bowen and others in North America had been busy discussing the role of granite in igneous evolution, European investigators such as H.H. Read were vigorously advancing the concept of granitization. In other words, granite was not an igneous rock at all! Bowen obviously did not think much of those concepts, and got a first-hand chance to express his views during the special symposium on the origin of granite, sponsored by the Geological Society of America, and held in Ottawa in December 1947. This conference is covered in chapter 22. H.H. Read gave the first presentation and Bowen gave the last. Read espoused the view that any inference as to the origin of granite should be governed by geological observations. The principal issue was the room problem, which Read assured the audience could be dealt with only by careful field work. Bowen pointed out, however, that it was "less a question of sight than insight". He reminded the audience that while examining the rocks, one does not see the rocks in the process of formation. The chapter offers a detailed description of Bowen's response to and argument with the granitization concept. He took issue with diffusive transport, heat sources, and the room problem.

Chapter 23 is devoted to the last few years of Bowen's life and career. After finishing the work on the system $MgO–SiO_2–H_2O$, Bowen and Tuttle started a massive project on the system $NaAlSi_3O_8–KAlSi_3O_8–SiO_2–H_2O$, which is described in this chapter. Bowen retired, however, from the Geophysical Laboratory while the project was in its early stages, and was completed by Tuttle after Bowen's death in 1956. The chapter also describes the circumstances surrounding Bowen's retirement in 1952. One gets the impression that Bowen was tiring at this point.

The last chapter (chapter 24) is entitled "Concluding Observations". This is a brief summary of the various aspects of Bowen's life and career discussed in the previous 23 chapters. The impact of the theory on current petrological thinking also is discussed, although not in great length or exhaustively.

Crystallization–Differentiation is a detailed and well-written narrative of the development of a theory unrivaled in igneous petrology. The book offers the reader a sense of the environment in which Bowen was working and how he arrived at the various elements of the theory. The text is sprinkled with detailed presentation of discussion between Bowen and his colleagues, and leaves the reader with a good sense of Bowen's personal and professional style.

Crystallization–Differentiation is recommended reading for any student of igneous petrology, both at undergraduate and graduate levels. The professional will find it enjoyable. It is well written and easy to read, with a good balance between scientific subjects and personal observations.

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Les Minéraux. Par Jiří Kouřimský (adaptation française et compléments de Daniel Pajaud), Librairie Gründ, 60, rue Mazarine, F–75006 Paris, France, 1996, 256 pages. CDN $32.95 (ISBN 2–7000–1843–5).

Ce livre rejoint une demi-douzaine de livres semblables déjà publiés en langue française qui visent les amateurs et les collectionneurs débutants. La plupart de ces livres sont des traductions. Il s'agit ici d'une traduction du tchèque. *Les Minéraux*, livre sous-titré « *Encyclopédie illustrée* », fait partie d'une collection de six ouvrages sur l'histoire naturelle publiés par Gründ.

Le livre commence par une vingtaine de pages d'introduction qui traitent de façon superficielle du rôle des minéraux dans l'histoire de l'homme, de leurs propriétés et de leurs modes de gisement. Suivent dix chapitres traitant des minéraux proprement dits. Ils sont: les éléments (14 pages, 8 minéraux), sulfures et composés de même type (26, 23), halogénures (6, 2), oxydes (52, 16, dont 32 pages traitent du quartz et de ses variétés), carbonates (14, 10), sulfates et composés de même type (12, 9), phosphates et composés de même type (14, 14), silicates (70, 50, dont des résumés très brefs pour les amphiboles, les micas, *etc.*), composés organiques (8, 3), et météorites et tectites (six pages). Voilà: 135 minéraux et peut-être une cinquantaine de plus mentionnés en passant dans le texte. Tout celà est suivi d'un glossaire de 46 termes et d'un index des minéraux traités (trois pages). Une bibliographie de sept ouvrages de vulgarisation et de six ouvrages spécialisés se trouvent à la fin du livre.

Les aspects intéressants de *Les Minéraux* sont nombreux. D'abord, le livre présente toute une série d'excellentes photos en couleur (environ 250), dont la moitié met en évidence des exemples provenant de la République Tchèque et des pays voisins, localités relativement peu connues des minéralogistes, tant amateurs que professionnels. En outre, le fond historique des minéraux est souvent bien développé, autant que leur étymologie (sauf pour le disthène, p. 177). La présentation générale du livre est attrayante, et la reliure cousue est costaude.

D'autre part, les défauts de ce livre sont nombreux, D'une liste personnelle de 204 minéraux « de base » que j'utilise dans mes cours, une vingtaine sont absents, dont alunite, axinite, covellite, enargite, ilménite, scapolite... Il y a des informations périmées. Par exemple, l'Australie, qui aujourd'hui fournit environ 40% de la production de diamants, n'est pas même mentionnée comme pays producteur. La discussion géologique est anté-diluvienne: « La planète Terre est une boule de magma en fusion dont l'enveloppe externe (l'écorce terrestre ou lithosphère) s'est solidifiée en refroidissant » (p. 23). Il y a plusieurs erreurs dans les citations de dureté (p. 5, 32, 110, 111, 171), de formules chimiques (p. 155, 180, 204, et des indices un peu partout), et une lamentable sous-utilisation du clivage comme propriété-clé dans l'identification des minéraux. C'est Goshen (non pas Goschen, p. 19), Grenville (non pas Greenville, p. 202), Wolfsburg (non pas Wolfberg, p. 57), et Broken Hill se trouve en Australie (non pas au Colorado, p. 138). Traitant des minéraux, l'uraninite n'est pas un isotope de thorianite (p. 122), c'est hédenbergite (pas haidinbergite, p. 78), le minéral « sylvinite » ($NaKCl_2$) n'existe pas (p. 70), et les cristaux d'or sont octaédriques (non pas rhomboédriques, p. 28). Enfin, je doute que chacun de nous consomme annuellement comme sel de cuisine 7.5 kg de halite (p. 69).

Malgré tous ces défauts, *Les Minéraux* offre des renseignements généraux, de la beauté visuelle et des nouvelles localités à un prix abordable pour les amateurs. Cependant, ceci n'est certainement pas un ouvrage pour les professionnels.

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