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BOOK REVIEWS

Petrogenesis of Metamorphic Rocks (7th edition). By Kurt Bucher and Martin Frey (†). Springer–Verlag, Berlin, 2002. 341 + xv pages. ISBN 3–540–43130–6.

This is the seventh edition of "Winkler", a book that revolutionized the teaching and general understanding of metamorphic petrology. Prior to the first edition, authored by Prof. H.G.F. Winkler, and published in 1965, the subject was treated qualitatively by Alfred Harker in his lucidly written and beautifully illustrated text, *Metamorphism*, published in 1932, and thermodynamically by Hans Ramberg in the 1950s in an opaque text that few ever were able to understand.

Petrogenesis of Metamorphic Rocks opens with prefaces to the sixth and seventh editions, and the usual acknowledgments. The preface to the seventh edition is heavy with sadness, for it recounts the tragic death of Prof. Frey in a mountaineering accident in September, 2000. He was only 60.

The text of this book is in two nearly equal parts: the first four chapters (168 pages) deal with general principles and fundamental background material, whereas the final six chapters (162 pages) cover the metamorphism of specific groups of rocks. This approach is logical and opens a clear road for the teacher. The book concludes with a two-page list of mineral abbreviations, and a five-page general index. References are given at the conclusion of each chapter. Not all references are cited in the text, however, and many are offered as suggestions for additional reading.

The first chapter treats the conditions and types of metamorphism, whereas the second deals with the rocks themselves: their protoliths, classification and nomenclature, and an introduction to mineral assemblages and their graphic representation. Structures and textures of metamorphic rocks are touched upon, but nowhere treated in detail in this book. Metamorphic processes, *i.e.*, heat flow and geotherms, pressure, time and chemical reactions (solid, dehydration, mixed volatiles, and so on), the phase rule and the construction and use of Schreinemakers's diagrams, constitute the bulk of chapter three. Chapter four, the book's longest, covers metamorphic grade, index minerals, and facies, and delves into many facets of quantitative geothermobarometry and its associated pitfalls.

The final six chapters, respectively, describe and interpret the metamorphism of the major groups of rocks: ultramafic, carbonate, pelitic, marly, mafic, and granitoid rocks. Although the chapter on ultramafic rocks traces serpentinization and steatization in considerable detail and expounds on the applicability of the CMASH system, surprisingly it omits rodinitization. The chapters on pelitic and mafic rocks are particularly complete, occupying together nearly 100 pages. Each thoroughly treats all degrees of metamorphism, from subgreenschist to granulite, and from shallow contact to eclogite.

Many outstanding tables listing metamorphic reactions (5.1, 6.1, 7.1, 7.2...) and diagrams (facies, Fig. 4.2; a sequence of 14 AFM projections, Fig. 7.6; mafic rocks on ACF diagrams, Fig. 9.3; *etc.*) that are sprinkled through the text will be highly useful to students. Also, the authors are to be commended for their consistent use of the kilobar as the unit of pressure. It is far easier for newcomers to visualize a bar than a pascal.

In general the text is clear and reads fluidly. Given that the authors' native tongue is that of Goethe, the absence of Germanic sentence structure is especially appreciated. I came across a few errors, only two of which merit mention. Although the authors state (p. 128) that the aluminosilicate triple point currently accepted by the community of petrologists is at 4.5 kbar and 550%C, all their diagrams (except Fig. 7.8, where reactions are particularly crowded) show the point at considerably less extreme conditions, typically around 4 kbar and 500%C. Then, "chrysotile and antigorite are extremely magnesium-pure minerals" (not iron-pure, p. 184).

Finally, I was pleased to see the authors' use of two mineral names that never should have been banned by the IMA: "salite" (p. 27) and "crossite" (throughout the text). In fact, Prof. Bucher goes farther, in saying on page 311 that "crossite" is an "amphibole name recently disapproved by IMA, however, I like it!" (Bucher's own emphasis, heartily endorsed by this reviewer!).

Petrogenesis of Metamorphic Rocks is, like the preceding six editions, a fine and important book. By and large, it is precise and accurate, clearly written, logically organized and well focused. It is suitable as a text

for a serious, no-nonsense, one-semester undergraduate course in metamorphic petrology, though the instructor may have to do a bit of pruning. With a background in thermodynamics (not really necessary here for the baccalaureate student) and support from current journal articles, "Winkler's 7th" is a suitable text for the graduate level.

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Calcite. Edited by T. Huizing, M. Jarnot, G. Neumeier, R.P. Richards, and G. Schneider. ExtraLapis English No. 4. Lapis International; LLC, P.O. Box 263, East Hampton, Connecticut 06424, U.S.A., 2003, 114 p. US$25.00 plus US$3.50 for shipping to non-U.S.A. addresses. Soft cover (ISBN 0–971–5371–3–5).

Calcite, with its subtitle "*The mineral with the most forms*" is an exemplary initiative by Lapis International to present the wonders of natural history to the population at large and to popularize the science of mineralogy in general. It presents a splendid succession of insights into the nature and occurrence of calcite that is bound to surprise and delight all mineral lovers. The twenty-three chapters of this tidy 114-page volume are here grouped for convenience by this reviewer into three main topics and sections: 1) *mineralogy–crystallography* (p. 1-47); 2) *important localities* (p. 48-90), and 3) *photogallery* (p. 91-103). Included is a short note on cleaning calcite and aragonite, and one on biomineralization in echinoderms (p. 104-108).

The section on *mineralogy–crystallography* comprises essential notes on: polymorphs of $CaCO_3$, and calcite and its relations, summarized by R. Hochleitner and T. Huizing; crystal shapes, in which R.P. Richards, developer of the Mac version of SHAPE, presents an elegant primer; calcite pseudomorphs, unmasked by R. Hochleitner; cleavage and the birth of modern mineralogy, a fascinating account in which L. Touret acknowledges our collective debt to René Just Haüy; cleavage, a succinct summary of the phenomenon, by R.P. Richards; fluorescence and phosphorescence, in which W. Lieber presents an excellent overview of the phenomena applicable to the polymorphs; polarization and optical properties of calcite, an elegant synthesis by M. Gunter; reflection, refraction and twinning, where M. Gray expounds on developing kaleidoscope colors in cut calcite.

The section on selected *important localities* of calcite specimens deals in succession with: China, where, according to G. Liu, mining and trading of specimens began in the late 1980s only; India, where the masterly precis of B. Ottens highlights the three distinct generations of calcite crystals hosted in the Deccan flood basalts (a comprehensive article on this subject is scheduled to appear in *Rocks and Minerals* in 2004); Dal'negorsk, Russia, about which T. Huizing provides a delightful tour of some mineral deposits, which evidently have produced some of the world's finest samples of calcite; Cumbria, U.K., for which M.P. Cooper provides a magnificent feast for the eyes, with text to match, and a focus on fabulous twins; Saint Andreasberg, Germany, to which ancient mining region in the Harz Mountains, G. Grundman offers a flashback; Romania, whose mines, according to M.L. Wilson, continue to produce beautiful specimens; mid-continent U.S.A., where T. Huizing shows why Mississippi-Valley-type deposits are such an important source of fine crystals of calcite, then goes on to explore the diversity and quality of calcite crystals from limestone quarries in the American Midwest; Michigan, U.S.A., according to S. Dyl and T. Huizing, source of many of the world's best calcite specimens; Irai, Rio Grande do Sul, Brazil, where L. Balzer reveals a few of the 350 distinct habits of calcite present in amethyst geodes in the Parana basalts, and an all-too-brief expose on "skunk calcite". Does anyone out there really understand how or why these curiosities develop?

The section on *photogallery* features several magnificent photographs of calcite specimens from Tsumeb and Mexico, and, in the editor's words "...a smattering of photographs of calcite from other localities around the world". Then comes a beautiful photo essay on the truly bizzare world of limestone cave formations by Sarah Bronko, a student of Westover School in Middlebury, Connecticut. Ms. Bronko introduces such exotic features as helictites, cave pearls, soda straw forests, and calcite cups. Following this extravaganza, the technical note by R. Duthaler on cleaning calcite and aragonite comes as a distinct anticlimax, but this is succeeded by the intriguing insights on biomineralization by R. Hochleiter and R.P. Richards, specifically, the crystalline framework of echinoderms. Two pages of key references nicely round off this beautifully balanced collector's issue.

Who would have thought it likely? Here is an extremely commonplace mineral (over 600 forms, and thousands of habits), crucially important in industry, agriculture, and, according to a note on the back cover, a mineral that has been "... instrumental in shaping the worlds of microscopy, architecture, mineralogy, technology, physics and even the science of war". *Calcite* conveys this message vividly, and having succeeded to such a degree must be recommended as a first-rate in-

vestment for mineral afficionados young and old, amateur and professional.

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Les Minéraux de Belgique (second edition, 2002). By Frédéric Hatert, Michel Deliens, André-Mathieu Fransolet and Eddy Van Der Meersche. Published by the Institut Royal des Sciences naturelles de Belgique, 29, rue Vautier, B–1000 Bruxelles, Belgique. 304 pages, soft cover. No ISBN number. Price: 35 euros.

Belgium is a country whose mineralogical inventory is relatively well known. This is the second edition of a book published in 1976 by J. Mélon, P. Bourguignon and A.-M. Fransolet. In the intervening years, there has been a flurry of activity, largely by assiduous and patient amateurs who have scoured the countryside. In addition, the availability of sophiticated analytical equipment has led to many new discoveries, many involving rather small samples. In all, 260 mineral species now are known to occur in Belgium, and of these, sixty or so are new to this edition.

The mineral species are presented under the following ten headings: 1) Elements (6), 2) Sulfides, sulfosalts, tellurides and selenides (39), 3) Oxides and hydroxides (19), 4) Halogenides (3), 5) Carbonates and nitrates (21), 6) Sulfates and tellurites (37), 7) Phosphates and arsenates (52), 8) Tungstates and molybdates (3), 9) Silicates (66), and 10) Organic compounds (3). Each section is introduced by a shaded title page, the reverse side of which contains a listing of the species in that section. The color of the shading (light grey, light green, beige, *etc.*) is then carried through as a background for the text and figures throughout a given section. Note that some common rock-forming minerals have been left out or down-played. The compilation is preceded by a brief account of the geological context of the country, and is followed by a set of references, a geographic index, a mineralogical index, an appendix listing the principal forms of calcite, and another listing those of quartz. The book is amply illustrated with 129 sketches of crystals with faces clearly indexed (figure number indicated in red in the text), and 70 photographs (photo number indicated in blue in the text), many of them in color, largely the contribution of the fourth author.

In bringing the inventory up to date, the authors have done a great job of underscoring the essential contributions of dedicated amateur mineralogists. The volume (23 × 17.5 cm) is attractive, and the typography, original, with running titles and section numbers running vertically at the outer edge of pages. The sans-sérif type appeals to me and is very easy to read. A relatively heavy matte paper is used, and many photographs lack the crispness that they could otherwise have had.

Like many others, I consider Belgians custodians of the French language; in this respect, the text is impeccable. I particularly value the authors' contribution on the proper way to write mineral names *en français*. Thus as I edit, I should insist on *chloritoïde* as a masculine noun, *ottrélite* as a feminine noun, and I should continue using the names of mineral species as collective nouns, and thus never in the plural. In the latter respect, the text generally conforms, but there are lapses. Is *siegenite* written with or without accents *en français*? I am perhaps not the only editor who worries about details like this. The answer (no) is to be found in this handy book.

Which are the minerals first discovered in Belgium? I would have appreciated a chronological or alphabetical listing in the Introduction. The information is there, under the heading of individual entries. I compiled such a table, reproduced here as Table 1. I am struck by the number of phosphates and arsenates among the 17 minerals whose type locality is in Belgium. Also, ten of those minerals were discovered in the nineteenth century. The formulae reported by the authors correspond in all respects to those reported in *Fleischer's Glossary of Mineral Species* (Mandarino 1999), but in the case of drugmanite, I would have chosen to follow the version of the formula used in the official IMA listing, $Pb_2(Fe^{3+},Al)(PO_4)(PO_3OH)(OH)_2$. Viséite, named after the discovery locality at Visé, is written with the accent in Mandarino's *Glossary*, as it should. It would have

TABLE 1. LIST OF MINERALS FIRST DISCOVERED IN BELGIUM, ARRANGED CHRONOLOGICALLY

Ottrélite	$(Mn^{2+},Fe^{2+},Mg)_2Al_4Si_2O_{10}(OH)_4$	von Leonhardt (1821)
Hopeite	$Zn_3(PO_4)_2{\bullet}4H_2O$	Brewster (1822)
Halloysite	$Al_2Si_2O_5(OH)_4$	Berthier (1826)
Willemite	Zn_2SiO_4	Lévy (1829)
Delvauxite	$CaFe^{3+}_4(PO_4,SO_4)_2(OH)_8{\bullet}4–6H_2O$	Dumont (1838)
Ardennite	$Mn^{2+}(Al,Mg)_6(SiO_4)_2(Si_2O_{10})$ $[(As,V)O_4](OH)_6$	von Lasaulx (1872)
Davreuxite	$Mn^{2+}Al_6Si_4O_{17}(OH)_2$	de Koninck (1878)
Richellite	$Ca_3Fe^{3+}_{10}(PO_4)_8(OH,F)_{12}{\bullet}nH_2O$ (?)	Cesàro & Despret (1883)
Koninckite	$Fe^{3+}PO_4{\bullet}3H_2O$ (?)	Cesàro (1884)
Destinezite	$Fe^{3+}_2(PO_4)(SO_4)(OH){\bullet}6H_2O$	Cesàro (1885)*
Fraipontite	$(Zn,Al)_3(Si,Al)_2O_5(OH)_4$	Cesàro (1927)
Viséite	$Ca_{10}Al_{24}(SiO_4)_6(PO_4)_7O_{22}F_3{\bullet}72H_2O$ (?)	Mélon (1942)
Drugmanite	$Pb_2(Fe^{3+},Al)H(PO_4)_2(OH)_2$	Van Tassel *et al.* (1979)
Ferristrunzite	$Fe^{3+}Fe^{3+}_2(PO_4)_2(OH)_3{\bullet}5H_2O$	Peacor *et al.* (1987)
Vantasselite	$Al_4(PO_4)_3(OH)_3{\bullet}9H_2O$	Fransolet (1987)
Viaeneite	$(Fe,Pb)_4S_8O$	Kucha *et al.* (1996)
Graulichite-(Ce)	$(Ce,La,Nd,Ba)(Fe^{3+},Al)_3$ $[(As,Al)O_4]_2(OH)_6$	Hatert *et al.* (2002)

* long considered synonymous with diadochite, destinezite was accepted as a distinct species by the CNMMN in 2000, as a result of the structure refinement of Peacor *et al.* (1999).

been nice to have the authors point out to one and all that by the same token, the manganese-dominant analogue of chloritoid is *ottrélite*, named after the discovery locality at Ottré, not ottrelite, as it is spelled in the *Glossary*, or Mn-chloritoid, as it is called by most metamorphic petrologists. And which of these minerals is known only from the type locality?

In editing, I value books of this type. I am forever chasing down references. Here is a document that should provide "one-stop shopping" when it comes to accurate and complete references to the literature, in particular those references pertaining to species whose type locality is in Belgium.

I must report that I am at the same time impressed and disappointed with the list of references. It is impressive because it is encyclopedic. It is disappointing because in each case, the number of the last page is left out. Thus each entry is incomplete insofar as my requirements are concerned. And it would have been so easy for the authors to satisfy my needs and my dependence on this book for "one-stop shopping" in this respect.

Les minéraux de Belgique is an authoritative treatment of the subject, and as such should be a very useful reference for years to come, of direct appeal to amateurs and professionals alike.

Robert F. Martin
chief compiler of references