sum 100.64%. These results indicate that Fe_2O_3 is not essential in mpororoite, that the ideal formulae of mpororoite and anthoinite, respectively, should be $WAlO_3(OH)_3 \cdot 2H_2O$ and $WAlO_3(OH)_3$, and that the unit cells must be at least doubled to meet their unit cell contents.

Discussion

The reported formulae differ from the originally proposed compositions, $(W,Al)(O,OH)_3 \cdot H_2O$ and $(W,Al)(O,OH)_3$, of mpororoite and anthoinite. Although new, augmented cell dimensions are not given, the original parameters proposed were $a = 8.27$, $b = 9.32$, $c = 16.40$Å, $\beta = 92°29'$. [Min. Record 12, 83; Am. Min. 58, 1112]. **J.A.Z.**

Richetite

P. Piret and M. Deliens (1984) New data for richetite $PbO \cdot 4UO_3 \cdot 4H_2O$. Bull. Minéral., 107, 581–585 (in French).

Richetite occurs at the Shinkolobwe uranium deposit in Shaba, Zaire. Analysis by microprobe gave PbO 16.38, UO_3 78.28 and H_2O 5.34 (by difference).

X-ray study gave triclinic $P1$ or $P\bar{1}$, $a = 20.81$, $b = 12.06$ $c = 16.30$Å, $\alpha = 103.8$, $\beta = 115.1$, $\gamma = 90.4°$, $V = 3570$Å^3 and $Z = 9$. A new X-ray powder pattern is given.

The mineral occurs as black, hexagonal plates with forms {001}, {110}, {$\bar{1}$10} and {010}. It is biaxial negative with $\alpha \sim 1.9$, β and $\gamma \sim 2.0$, $2V$ large, $X \parallel c^*$, $Y\Lambda[110] = 85°$, $Z\Lambda[110] = 5°$. **J.D.G.**

BOOK REVIEWS

BASALTS. A Hutchinson Ross Benchmark Book. Edited by P. C. Ragland and J. J. W. Rogers. Van Nostrand Reinhold Company Inc., New York. 430 pages. U.S. $55.00.

The editors of this 430 page basalt volume guide the readers through nearly 60 "benchmark" papers claimed to be either "widely recognized to have had a profound effect on our thinking" or expected "to be the wave of the future." The collection is grouped under seven headings covering aspects of classification, experimental work, mantle evolution, major basalt types, and tectonic environment. Mineralogy and isotope studies are lightly covered by the volume. Introductions to the various parts place the selected papers into their historical and scientific contexts. The introductions are carefully referenced and the volume contains a detailed author index.

It is a pleasure to renew old acquaintances with significant papers highlighting the development of modern classification schemes for basalts and basaltic series (Kennedy, Tilley, Macdonald, Katsura, and Kuno). The editors have also made a wise selection of experimental work related to basalt petrogenesis, many of which my generation of igneous petrologist probably have never read. Here is an opportunity to read classical papers by Bowen, Fenner, Osborn, Yoder, Tilley, Green, Ringwood, O'Hara, and Kushiro together with more recent papers by Presnall, Walker, and Stolper. These papers are commonly cited in petrological literature and an imprint seems useful. The first two sections on classification and petrogenesis occupy well over half of the entire book; the remaining are devoted to chemical mantle evolution and major basalt types.

Some readers may be search in vain for papers which they believe to have shaped our present understanding. However, the editors, taking the limited space in this volume into considerations, should not be blamed for such omissions. More serious is that the editors may be attempting to shape "the wave of the future" by including very recent papers whose content and data is still debated in the open literature (e.g., the Presnall, Walker and Stolper papers). Many papers throughout the volume are of local geological, volcanological and geochemical interest and could have been deleted without great loss (this goes in particular for three papers authored or co-authored by the second editor). It is also not clear to the reviewer why five papers on komatiite and shoshonite are included in the classification chapter when other high-magnesian and/or potasic basaltic types are totally ignored. Furthermore none of these "unusual" rocks are covered by the subsequent sections.

If this Benchmark volume on Basalts really contained all that it promised, this reviewer would have had no reservation in recommending it. However, the problem is that it does not. At the best, the editors have included excerpts and more typically only single figures and abstracts. Only 13 papers are presented in their full length. Thus, the reader is frequently referred to missing introductions, data, discussions and figures, and is unable to evaluate the conclusions. Such an evaluation is crucial for all scientific work. Interested readers would therefore have to, and hopefully will, consult their own libraries for the full text. This Benchmark volume does not fulfill its intention to be a reference for the petrologist and geochemist without access to a good library. If the editors want to present a textbook, they should be encouraged to do the full work and write an advanced textbook on basalt chemistry and genesis. They clearly demonstrate that they are capable of doing so.

The philosophy behind the editorial work on this book seems to assume that major scientific knowledge should be made easily accessible and carefully "condensed" before being offered to the researcher and advanced student. If this philosophy should be embraced in editorial work on future Benchmark volumes and in geology classrooms, we might expect that coming generations of geologists will lose their basic training in reading original scientific communications. There seem to be good reasons to discontinue that editorial practice and the publisher should be held responsible for bringing out the book. This despite the fact that reprint collections of some of the included papers certainly could be used by the petrological community (e.g., the Yoder and Tilley, Green and Ringwood, and O'Hara papers on experimental petrology). And if the publishers are searching for old papers to reprint, why not a fully annotated edition of, for example, Bowens early experimental papers? The present book cannot be recommended and in this reviewer's opinion copyright holders are urged to exercise better control over their rights.

PETER THY
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CLAY MINERALS, A Physico-chemical Explanation of their Occurrence. By V. Velde. Published by Elsevier Science Publishing Company, Inc., New York, 1985, 427 p.

The author has drawn from a voluminous literature and his own wide-ranging research in developing this petrologic interpretation of clay mineral assemblages. The 697 cited references date mostly from the 1960's and 70's, but they well cover the period from 1938 to 1983. Data and conclusions from the literature are well blended with the author's own critical observations and interpretations. Considerable emphasis is given to chemiographic analysis, perhaps too much in this reviewer's opinion, but a wealth of other information is thoughtfully presented. This book is particularly welcome because it is petrologic in approach and it complements other leading clay references that are primarily mineralogical.

The first part of the *Introduction* identifies the types of information selected from the literature and gives the selection criteria. The second part discusses clay mineral names and structures. Notwithstanding the statement that "no new definitions will be proposed", several clay mineral names are redefined, and in several instances the redefinitions accord with neither the original definition nor prevailing usage. Smectite, for example, generally accepted as the group name for 2:1 di- and tri-octahedral layer silicates with layer charge between 0.2 and 0.6 per formula unit, is redefined as "a nonspecific term for di-octahedral expanding phases". Allevardite, generally regarded as equivalent to rectorite, which takes priority, a regular 1:1 interstratification of paragonite-smectite, is redefined as regularly interlayered illite-smectite. Rectorite is redefined as regularly interlayered paragonite-beidellite. A careful reading of this part is necessary before proceeding to the main part of the text.

The other introductory sections briefly treat Chemical Systems, Stability and Metastability, Stability and Reaction Rate, Geologic Environments, and the choice of Chemical Coordinates for representing Phyllosilicate Assemblages.

The main text is a good review of the chemistry of minerals in clays, their variability and mineralogical peculiarities, their typical occurrence, laboratory synthesis, and stability. The different forms of silica and zeolites are reviewed in the same manner as the phyllosilicates. Chemiographic diagrams are used extensively. Much interesting information is presented about clay minerals in all of the principal natural environments, including the environments of deepsea clays and soils.

Typography is not one of the strengths of the book. Ackward or unnecessary extra spaces and incorrect hyphenation are frequent. Figure captions are not clearly set apart from the text. More careful editing could have eliminated these typographic irregularities along with ambiguous phrases and unnecessary parenthetic comments, and in so doing could have smoothened the text and considerably increased the rate of assimilation by the reader.

This book contains a comprehensive and up-to-date review of pertinent publications and a stimulating summary of what reasonably might be concluded from published information about the stability and environmental significance of prevalent clay mineral assemblages. The publisher's style is hardly an asset, and the special meanings given to some clay mineral names by redefinition may trip the unwary reader. Nevertheless, this new book on CLAY MINERALS represents much painstaking effort to collate, organize, and interpret available information. It complements other leading references that deal mainly with the mineralogy of clays, and it is a welcome second attempt by the author to expand clay petrology.

VERNON J. HURST
University of Georgia

CRYSTAL STRUCTURES OF CLAY MINERALS AND THEIR X-RAY IDENTIFICATION. Edited by G. W. Brindley and G. Brown. Mineralogical Society, Monograph No. 5, London, 1980, 495 p. Reprinted with amendments in 1984.

This third edition of Monograph No. 5 is a complete revision of earlier editions, with a new format, but the same aims: to provide an authoritative account of the fundamentals of clay mineral structures and to serve as laboratory handbook for the X-ray identification of clays. Great advances made in clay mineralogy since the second edition appeared in 1961 have been thoroughly covered in the new text, through about 1979. Before reprinting in 1984, very limited new material was added, including a few newer references.

The first half of the monograph offers a comprehensive treatment of the crystal structures of most layer silicates, and the types of structural disorder that are prevalent in clay minerals. The second half presents X-ray diffraction procedures for the identification of clay minerals and associated minerals, and for quantitative X-ray mineral analysis. There are 7 chapters and one appendix, all by recognized authorities.

Chapter 1 by S. W. Bailey, 124 pages, reviews the fundamentals of two-dimensional sheets, layers, and different ordered stacking sequences. The morphology, crystal structure, and polytypism of most phyllosilicate species are discussed. The account is precise and well illustrated. It is not clear, however, why pages of Debye-Scherrer photos were included, despite the predominance of diffractometry, nor why two important phyllosilicate species, halloysite and imogolite, were omitted from the classification of phyllosilicates and not described in the text.

Chapter 2 by G. W. Brindley, 71 pages, discusses types of disorder in clay minerals and how diffraction patterns are influenced by disorder, layer curvature, and crystallite size. These often complicate the interpretation of diffraction patterns of clays. This review better defines the complications, without showing clearly how to resolve them. The interpretation of powder X-ray diffraction data alone without distinguishing the effects of fineness, distortion, and disorder can lead to error, as exemplified by the long-held view of 7Å halloysite as simply a disordered stacking of kaolinite layers, a view disproved by single-crystal electron diffraction. Order-disorder is discussed for most clay mineral species except imogolite and allophane.

Chapter 3 by D. M. C. MacEwan and M. J. Wilson, 51 pages, treats aqueous complexes, organic complexes, dehydration, and rehydration from the viewpoint of how they may be used to characterize clay minerals.

Chapter 4 by R. C. Reynolds, 54 pages, deals with interstratified clay minerals, the common types, how to recognize them, and a theoretical account of X-ray diffraction by interstratified structures. Calculated and experimental diffraction profiles are compared.

Chapter 5 by G. Brown and G. W. Brindley, 55 pages, describes sample preparation methods and instrumental conditions for X-ray diffraction analysis of clays. This is a very useful section on established procedures. It would have been improved by more explicitly integrating into the procedures what was presented in earlier chapters about the diffraction effects of crystallite shape, fineness, and disorder. A section on automated X-ray diffractometry and associated data processing might have been added.

Chapter 6 by G. Brown, 49 pages, gives well organized information on detrital and authigenic minerals found in clays.

Chapter 7 by G. W. Brindley, 27 pages, is a review and evaluation of available methods for quantitative X-ray mineral analysis.

The Appendix, a 36-page table for converting $^\circ 2\theta$ values to d-spacings for Cu, Co, and Fe radiation is dispensable, consider-

ing the ready availability of pocket and other computers, which are at least as easy to use.

This monograph is, by far, the best single reference available on the crystal structures of most clay minerals and their X-ray identification. It is an indispensable book where clays are mineralogically analyzed.

VERNON J. HURST
University of Georgia

'MINERALOGIYA' (Mineralogy) by A. A. Godovikov. 648 pp., 1983, Moscow, Mineral Resources Press (Izdatelstvo Nedra), 2nd edition, price—3 Roubles 50 Kopecks (In USSR) = $4.50 (U.S.A.). In Russian.

This revised and supplemented second edition of a mineralogy text, first published in 1975, is intended for professional mineralogists, petrologists, geochemists, and other specialists with an interest in mineralogy and mineral resources. It is, however, also useful to students at the university or graduate level. The printing is large (11,300 copies) compared with that of most other mineralogy and geology texts available in the U.S.S.R. This book has become a standard and widely used text in the Soviet Union.

A knowledge of mineralogy, crystallography, and taxonomy of minerals as well as a good working knowledge of the Russian language is essential to fully utilize this book. The book consists of the following sections in order of presentation: introduction, different popular concepts, accepted abbreviations and contractions, concepts and aspects of minerals, fundamentals of mineralogical classification, mineralogical data beginning with native elements and ending with halogen salts, selected literature, alphabetical index of minerals (in Russian only), and table of contents. A total of 607 out of 648 pages is devoted to the presentation of mineral data.

Data for each mineral group and many individual species are presented in the following order: name (origin and facts); chemistry (including substitutions of other elements and known solid solution series); structure; appearance and forms; mode of occurrence; physical properties; diagnostic properties (for identification); conditions of formation and associated minerals, notable localities, experimental data; alteration and transformations; and economic importance (if any). Not all groups or individual species have all these categories discussed.

The book is reasonably up to date (about 1978) and contains descriptions of major and well characterized mineral groups and species. Partial information is given for some relatively rare species such as jeremejevite and volkonskoite, but other rare mineral groups or species such as jeremejevite and volkonskoite, but other rare mineral groups or species are not covered (e.g., crichtonite group, durangite, iranite). Temperatures are given in degrees Kelvin. Experimental data of various sorts (e.g., temperature of transition of gypsum to anhydrite as a function of NaCl concentration) are given throughout, as well as summary tables and figures of data such as polyhedral cations in sulfates versus coordination number, and principal mineral associations of the halogenides.

This book does not give any X-ray diffraction or unit cell data, but space groups are given for a few minerals. General cell dimension data are given for a few minerals such as ixiolite and columbite-tantalite. Optical data are not included. These omissions may tend to limit the use of the book. Some minerals are given in the alphabetical index along with their formulas but are not treated in the text; e.g., varlamoffite, neptunite, and synchysite. Discussion of some chemical groups is of necessity curtailed; e.g., Nb-Ta multiple oxides: only tapiolite, and the columbite-tantalite, samarskite, euxenite, aeschynite and pyrochlore groups are discussed. Errors of fact and typographical errors are few.

However, this book is a storehouse of information on mineral localities within the U.S.S.R. and the Communist-block countries. This information is not readily available elsewhere except in individual journal articles in the Slavic languages. The amount of mineralogical, chemical, structural, and classification data presented in this small volume is to be commended.

In all, this book is well worth having by those who are interested in systematic mineralogical problems and who read scientific Russian with some facility.

This book may be ordered through bookstores specializing in Russian or Slavic language books. Two such bookstores in the United States are Victor Kamkin Bookstore, Inc., 12224 Parklawn Drive, Rockville, Maryland 20852, and Szwede Slavic Books, 2233 El Camino Real, Palo Alto, California 94302-1214.

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NOTICES

M.A.C. Short Course on Silicate Melts

May 17–18, 1986

The Mineralogical Society of America is sponsoring a short course, May 17–18, 1986 in Ottawa, Canada. Silicate Melts: Their properties and structure applied to problems in Geochemistry, Petrology, Economic Geology, and Planetary Geology will be preceding the GAC-MAC Annual Meeting. For details contact: C. M. Scarfe, Department of Geology, University of Alberta, Edmonton, Alberta, Canada T6G 2E3; telephone (403)432-2740.

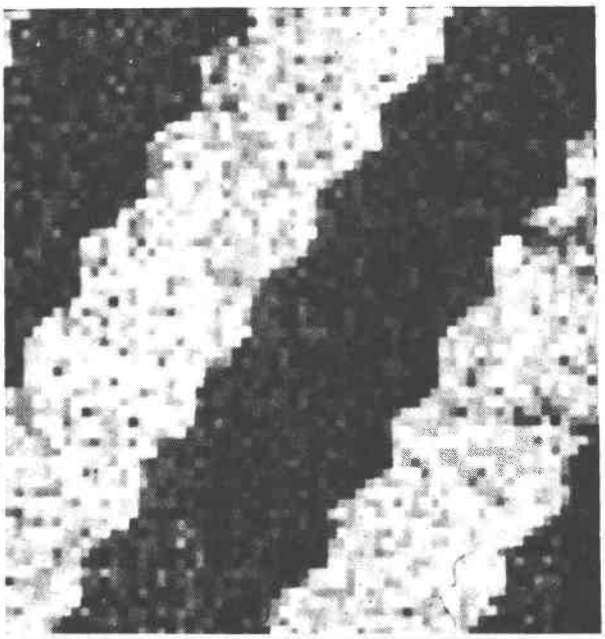
New instrument allows observation of surface magnetic microstructure

Researchers at the National Bureau of Standards (NBS) have developed a technique for observing—simultaneously—the magnetic character of a surface and its physical structure over dimensions as small as 100 angstroms (10 nanometers).

The new research tool is expected to have important applications in a number of fields, including the development of high-density magnetic recording media and small, high-efficiency electric motors.

The technique weds an ultra-high-vacuum, high-resolution scanning electron microscope (SEM) with a new, compact electron spin-polarization detector developed at NBS. By measuring the secondary electron spin polarization, the resulting instrument images directly the magnitude and orientation of the magnetic structure of materials with a resolution far better than the best current instruments, while simultaneously producing a conventional topographic SEM image of the surface.

The magnetism of an object is essentially a measure of the net electron spin density in the material. Electron spins in nonmagne-



SPIN-POLARIZED ELECTRON MICROSCOPY—Magnetic domains imaged using an SEM fitted with the NBS electron spin polarization analyzers. The light and dark regions correspond to areas of opposite magnetization. The material is an Fe-Si 3% single crystal test sample and the picture dimensions are about 50 μm × 50 μm.

tic materials have random orientations; in materials with some degree of magnetism, more spins are oriented in one direction than in the opposite direction yeilding an "electron spin polarization."

Not all of the electrons in a magnetic material are oriented in the same direction, however. Typically, the material contains regions or "domains" in which there is a preferred direction along which the electron spins are oriented; the preferred directions may vary from one domain to another. An important feature of this new technique is that since the SEM beam probes regions smaller than the domain size, it is possible to view the magnetic domains with very high spatial resolution.

Exactly how the domains are magnetized and what relationship the surface topographic and chemical features bear towards the arrangement and distribution of the surface magnetic domains are key factors in a number of commercially important magnetic materials.

Examples include high-density magnetic recording media for computers; new, strongly magnetic alloys for use in small, high-efficiency electric motors; communications devices; and other applications.

A key element in the new NBS instrument is a low-voltage electron spin detector. Previous spin detectors (Mott detectors) operate at about 100,000 volts and require at least a cubic meter of space and special high-voltage precautions. The new detectors, which operate at about 150 volts, will fit in a cube about 6 cm on a side and are at least as efficient as an optimized Mott detector. The detector relies on the spin-dependent scattering of the electrons from an evaporated polycrystalline gold film.

The polarized SEM is based on research results reported by NBS in 1982 which demonstrated that the secondary electrons which are emitted by targets struck by an electron beam (as in scanning electron microscopy) retain the spin polarization of the region of the surface from which they originate.

A paper describing the initial results with the new instrument will appear in the September issue of the *Journal of Microscopy*. The authors are John Unguris, Daniel Pierce, and Robert Celotta of the NBS Center for Radiation Research, and Gary Hembree of the Center for Manufacturing Engineering.

ERRATA

List of Officers and Committees (Vol. 70, 869–870). The following corrections should be noted: Appointive Posts for 1985:

Nominating Committee for Officers—J. Laird; Committee on Committees—delete S. E. Haggerty and replace with S. A. Morse; Committee on Management—H. C. W. Skinner; Financial Advisory Committee—J. F. Hays; and Committee on External Medals and Awards—delete A. W. Rose and M. J. Buerger and replace with R. A. Bailey.