The Canadian Mineralogist
Vol. 35, p. 797-803 (1997)

BOOK REVIEWS

Early Precambrian Processes. Edited by M.P. Coward and A.C. Ries. Geological Society, London, Special Publication **95**. Available in North America from: AAPG Bookstore, P.O. Box 979, Tulsa, Oklahoma 74101, U.S.A., 1995, 295 p., US$112 (half-price to members of the Geological Society), ISBN 1-897799-36-5.

Early Precambrian rocks constitute but a tiny portion of Earth's total outcrop. Rocks dating from the dimmest past have been blasted by meteor impact, reduced by erosion, covered by younger deposits, and transformed by metamorphic, igneous or hydrothermal processes. Worse, the bit that has been spared may not be all that representative of the original panoply. Yet, intriguing is the fact that the currently recognized oldest rocks, the 5.0 Ga Acasta Gneisses of Canada's north, chemically are no different from rocks of volcanic arcs fed by modern subduction zones. So, the Archean geologist must be a sort of super sleuth, a Sherlock of the Earth with Mycroft's brilliance, to conjure the most plausible scenario for the remotest past.

Early Precambrian Processes is a slim, expensive book dedicated to Professor John Sutton, FRS. It carries 16 papers, ranging from 9 to 25 pages each. A two-page preface by coeditor Mike Coward outlines briefly the thrust of the contributions. References are listed independently with each paper, but a seven-page comprehensive index is given at the conclusion of the volume.

The textbook-like title of the volume is misleading; only a few of the papers deal directly with processes, most offer descriptive examples with speculation, and three don't even deal with the Early Precambrian.

The book opens with an interesting paper in which Maarten De Wit and Andrew Hynes propose that the absence of continental crust older than 4.0 Ga may be the result of mid-ocean ridges having stood above the level of an ocean with 30% less water than today. With the release of water from the early mantle, sea level rose and the Hadean–Archean transition was reached when the Earth's heat loss was first taken up by a World Ocean.

The succeeding paper by K.A. Eriksson traces the evolution of the atmosphere from 3.9 to about 2.0 Ga. Its evolution is tied to the growth of continents, for which of course, there is contradictory evidence. Eriksson divides the timespan into four epochs: 3.9 Ga, asteroid bombardment; 3.9–3.2 Ga, small continents and large oceans; 3.2–2.6 Ga, continental growth, and 2.6–2.0 Ga, vast epicontinental seas. Oxygen could escape to the atmosphere only after oceanic sinks were exhausted, beginning perhaps as early as 2.3 Ga.

E.G. Nisbet follows with a highly speculative paper on the origins of life and the biosphere. He suggests that the carbon cycle, which began more than 3.5 Ga ago, led with time to the establishment of a Gaian biosphere.

In a succeeding paper on greenstone belts, R.M. Shackleton points out that the Archean represents more than one third of geological time and that because production of radiogenic heat dropped by more than half during the eon, one may expect "... more differences in tectonic processes between the Early and Late Archean than between the Archean and today." Using examples from Africa, Canada, Australia, and Saudi Arabia, Shackleton attempts, not wholly successfully in this reviewer's eyes, to sustain this notion.

Pierre Choukroune and colleagues from Rennes highlight four characteristics unique to Archean cratons (lack of high-P metamorphism, vast volumes of magmatic rocks, absence of oceanic crust and sutures, and lack of linear trends) and, using examples from their experience in India, China, and West Africa, propose a unique Archean scenario that began with dome-and-basin structures and, by progressive horizontal deformation, led to prevalent upright structures. The authors belittle thrusting, and reject shallowly dipping layers in the Archean crust. The authors' discussion of periodic crustal softening lies between speculative and improbable.

Peter Treloar and Tom Blenkinsop, in the following paper, conclude that the Tibetan-style crustal extension model is not adequate to explain deformation patterns in the Zimbabwe craton. The tectonic history of the craton is multiphase, and was drawn out over a timespan (from 2.68 to 2.0 Ga) longer than the entire Phanerozoic.

Based on 13 U-Pb SHRIMP dates on zircon, Jim Wilson and colleagues present a revised stratigraphic column for the Zimbabwe craton. They propose three or four cycles of magmatism, each progressing from ultramafic to granitic. Populations of xenocrystic zircon reveal contamination from underlying units and indicate that the greenstone belts were laid down on continental crust.

Alec Trendall, in a philosophic discussion (and, to this reviewer, the most useful paper in the volume), succinctly summarizes our knowledge of the Pilbara craton, pointing out five specific points to be resolved. Trendall concludes that the answers will come only from careful and intensive study "rather than by the facile application of fashionable paradigms" (of which nine are offered).

John Myers accounts for the Yilgarn craton as a remnant of a supercontinent (Canada's Superior Province may be another remnant) formed in Late Archean time by plate-tectonic processes not unlike those operating today. His view certainly clashes with that of his French colleague four chapters earlier!

A dozen authors, headed by D.I. Groves, then propose that gold deposits of the Yilgarn craton are epigenetic, synchronous (*ca.* 2.635 ± 0.01 Ga), and occurred at depths between <5 and 20 km. They derived from weakly saline, deeply sourced, overpressured ore fluids that were focussed by low mean rock-stress at a variety of structures or rock types. The model may be valid in other Archean cratons.

R.J. Herrington then presents a highly detailed account of Late Archean (<2.7 Ga) gold mineralization in the Midlands greenstone belt in the Zimbabwe craton. How well this account agrees with those of Treloar and Blenkinsop, or Groves *et al.* (respectively five and one chapter earlier in the same volume), I leave to the reader to judge.

The ensuing three papers really have little to do with "Early Precambrian Processes." They deal with Proterozoic mafic dykes (2.5 to 1.83 Ga), Laurentia-Baltica relationships (2.6–1.5 Ga), and Proterozoic shear zones (1.8–1.7 Ga).

The next-to-final paper, by Mike Coward and the Spencers, covers the evolution of the Witwatersrand, the best-preserved and most thoroughly studied Archean sedimentary basin on Earth. The Witwatersrand was deposited between 3.0 and 2.8 Ga, and underwent lower-greenschist-facies metamorphism, probably in Early Proterozoic time. A variety of plate-tectonic models have been proposed for the Witwatersrand. Following detailed analysis of sedimentological, stratigraphic, structural and geophysical data, the authors conclude that an analogue is to be found in the sub-Andean basins of South America.

The volume concludes with a paper by R. Graham that emphasizes similarities between the geologically young accretionary collage of central Asia and Precambrian tectonic patterns. Arguments are bolstered by geophysical evidence and computer models. His conclusions run counter to some reached in earlier chapters of the same volume.

Let me close with a question: Was his volume necessary? Your reviewer would say no. *Early Precambrian Processes* is a loosely knit collection of articles with a thin and torn common thread running through them. Continuity is absent and, in fact, many of the articles reach contradictory conclusions.

Perhaps the New World Order has entrenched marketing in the Earth Sciences. The Geological Society is not alone in flogging loosely focussed, thematic "Special Publications" which, to the dismay of librarians, command premium prices. (An exception, by the way, is offered by MSA's well-structured and modestly priced *Reviews in Mineralogy*.) Let's face it, the 16 papers in *Early Precambrian Processes* are journal articles, not unlike those that you and I read monthly in CJES, GSA, JGR, *etc.* Many mineralogists and geologists have personal subscriptions to these journals. Is it worth shelling out three years' worth of *The Canadian Mineralogist* or CJES to possess this volume? No, certainly not. For the neophyte who wants a quick rundown on Early Precambrian processes, I recommend a short article entitled "The Earth's early evolution" by Sam Bowring and Todd Housh (*Science* **269**, 1535-1540, 1995).

Tomas Feininger
20, rue St. Flavien
Vieux-Québec, Québec G1R 4J9

Precambrian Crustal Evolution in the North Atlantic Region. Edited by T.S. Brewer. Geological Society, London, Special Publication 112, 386 pages. US$115 or £69 (available to members of the Geological Society for US$56 or £34; see above). ISBN 1-897799-62-4.

This volume contains a collection of papers presented at the inaugural meeting of International Geological Correlation Program (IGCP) project 371 on "Structure and Correlation of the Precambrian in Northeast Europe and the North Atlantic Realm" (COPENA), which was held in Nottingham in 1994. From the preface, the reader learns that the project aims to bring together earth scientists from each side of the Atlantic to focus attention on the evolution of the Precambrian crust. Judging by the contributions published in this text, this is an admirable goal; at the start of the project, clearly there is a great disparity in the state of our knowledge of the four main regions represented (Canada, U.K., Scandinavia and Greenland, Russia).

Being the proceedings of an IGCP conference, this publication is very much at the forefront in our understanding of Precambrian tectonic development in the North Atlantic region. In the areas with which I am better acquainted, I found it to provide a very useful overview that draws together the work of many people. In some of the areas where my experience is more limited, I found that it offers a good entry point to the current discoveries and debates.

IGCP project 371 claims to cover Precambrian time, but in this set of papers, there is a heavy bias to the Paleoproterozoic and Mesoproterozoic. Of the twenty papers included, only three make reference to Archean tectonics, and two to Neoproterozoic events. Of course, through much of the area under consideration, the culmination of tectonism occurred in the Paleoproterozoic or Mesoproterozoic, but there are significant Archean components that are not addressed (for example, Nain–Preketilidian and Saamian tectonics). Papers are grouped in the book first by location, then by age of event.

The volume begins with a concise and very useful overview of several seismic reflection profiles that have been obtained in the past decade from central Scandinavia (BABEL), the British Isles, Canada (LITHOPROBE), and southern Greenland. There follows a set of four papers that switch abruptly to much more local studies of geochemistry, isotopic geochemistry, and age relationships in the Lewisian (one paper) and Russian Karelia (three papers). The geology of Eastern Canada and southern Greenland is covered in a series of six overview papers, in my opinion the strongest part of the volume; these provide an excellent up-to-date compendium of work carried out in the Burwell domain, the Torngat Orogen, the southeastern Churchill Province, the Makkovik Province, the Ketilidian orogen, and the Grenville Province. A key paper, on a model for the plate tectonic evolution of the North Atlantic region through the Mesoproterozoic, nicely switches the emphasis to Scandinavia, and provides a useful set of maps into which the reader can place the events of the following seven papers on Baltic geology. These papers are more local in their scope than the equivalent section on the North American and Greenland Proterozoic orogens earlier in the book; this fact largely reflects the more extensive history of work in the latter areas. Taken together, however, they provide a synopsis of our knowledge of the geology of southern Norway and Sweden, including Proterozoic components of the Caledonide belt. One paper in this set deals (in great detail) with the paleomagnetism and age of dykes in northern Finland. The final paper suggests a Baltic provenance for Neoproterozoic clasts in a Dalradian tillite in Scotland. Although this topic fits the overall theme of the text, it seems a poor choice for the final contribution, as the reader is left wanting a concluding paper, that perhaps would have summed up the significant findings of the conference, or contemplated the direction of the IGCP project as it runs its course.

This volume belongs on the shelves of anyone working or teaching in the area of Precambrian geology. It represents the most useful up-to-date summary of the recent developments in our understanding of the eastern Canadian Shield and, with a little more work, provides a working knowledge of current understanding in the southern Baltic Shield. Being an edited compendium, it displays a variety of writing styles and abilities, compounded by a few translation-related problems. The over-riding principle of presentation seems to be that the smaller the area under investigation, the more detailed and lengthy the presentation. It is frustrating to be confined to only 18 pages for the southeastern Churchill Province, when 28 pages are given to paleomagnetism and Sm–Nd ages of two dyke suites. I also found it perplexing to go from the three papers on local studies in Russian Karelia to the regional approach for the Canadian Shield. The set of seven papers on Baltic Proterozoic geology falls somewhere between, but in general, benefit from a working knowledge of the area. However, the introductions are written in sufficient detail (albeit one zone at a time) that a person not familiar with the area can acquire that knowledge from this book.

The quality of presentation is variable; although it is presented with the usual standards of paper and binding of the Special Publications of the Geological Society, some papers (notably those probably not originally written in English) suffer from an excess of typographic errors. These are annoying, but do not detract from the science. The use of a color map for the eastern Grenville is a very welcome addition, an asset that also would have been welcome with some of the other maps. At US$115, it is an expensive book, not likely to be acquired by many students, but certainly well worth being included in every Earth Science library that shelves items dealing with regional geology.

Robert Raeside
Department of Geology
Acadia University
Wolfville, Nova Scotia B0P 1X0

Volcano Instability on the Earth and Other Planets. Edited by W.J. McGuire, A.P. Jones and J. Neuberg. Geological Society Special Publication 110, 1996, The Geological Society, London, U.K., 388 pages. £75 or US$125 (hardbound) (ISBN 1-897799-60-8).

Humans seem keenly interested in the most destructive hurricanes, the biggest volcanic eruptions and the most horrific earthquakes. With the eruption of Mount St. Helens and the recognition of giant debris avalanches around Hawaii, it was only a matter of time before the popular scientific press published on the biggest, most catastrophic landslides (see *Earth*, February 1997); they occur on volcanoes. The book *Volcano Instability on the Earth and Other Planets* is the only available text on this theme. Although most portions of the book have obviously not been written for first-year university earth science students, this is a must-have text for both undergraduate and graduate institutions. Given that it deals with the grand, the catastrophic and, for good measure, the extraterrestrial, it is likely to be a popular book in the library. Considering that this is a serious, professional, one-of-a-kind publication dealing with hazards having ominous ramifications, it is an important contribution.

The book contains a variety of papers representing contemporary themes and approaches to the study of volcano instability on Earth and other planets. It stems from a conference on volcano instability. The authors' addresses show multinational representation as follows: Italy (23 authors), United Kingdom (19), United States (10), Spain (3), Japan (1), and France (1). The "Contents" does not have subject headings, but the 26 papers are organized as follows: comprehensive reviews (two papers), destabilization and failure processes (next five), monitoring and hazard assessment (four), studies of specific continental or subduction-related volcanoes (10), oceanic islands (two), Mars and Venus volcanoes (two), and a seismic study of Stromboli. The eleven paragraphs below provide a glimpse at the topics addressed, study methods and volcanoes discussed in each of the articles.

The first paper (McGuire) is an up-to-date (>60% of the references are from 1990s) review of volcano instability. Topics addressed include scales, frequencies and modes of failure, the role of water, rift formation and dyke emplacement in failure, transport and emplacement mechanisms, hazard implications, monitoring and mitigation. Collapse-caldera problems are not addressed in the article, because the instabilities are generated by magma buoyancy. This is a good place for the professional or advanced undergraduate to garner an introduction to the topic.

The second review article (Head) discusses factors (density of the crust, frequency of magma rise, atmospheric pressure and density, lithospheric thickness, lithospheric plate movement, and volatile composition of the upper crust) that have probably influenced edifice size, geometry and, ultimately, instability on the Moon, Venus and Mars. Some of the diagrams elegantly illustrate the immensity of volcanoes on Venus and especially Mars. The analysis yields new insight into the causes of instability in Earth's volcanoes.

In the next section, Elsworth and Voight quantitatively model mechanical and thermal pore-fluid pressures caused by dyke intrusion along rift zones. The modeling suggests that the pressures could trigger the large-scale debris avalanches that occur around oceanic islands. Tibaldi shows that most dykes intruded in Stromboli over the last 100,000 years entered a NE–SW zone of weakness. This suggests that dyke intrusion exerted a geometric control and provided a trigger for lateral collapse of Stromboli. In the next paper, Russo *et al.* model the influence of regional stress on the mechanical stability of volcanoes using Stromboli as an example. Day, using a simpler, more general model than Elsworth and Voight, also concludes that hydrothermal pore- fluid pressures can instigate instability. The author examines mechanisms whereby the high pressures can be generated and proposes ways to predict impending failure on individual slopes. van Wyk de Vries and Borgia compare the physical features, styles of deformation and processes on four Nicaraguan volcanoes built on different types of basement. They conclude that the viscosity of the basement helps explain many of the deformational features shown by the volcanoes.

In the section on monitoring and hazard assessment, Murray and Voight show that ground-deformation data can be used to predict eruptions at Mount Etna. Smith and Shepherd assess the tsunami hazard associated with slope failure on the submarine Lesser Antilles volcano, Kick'em Jenny. They conclude that even a small landslide could have devastating effects in the Grenadines. Carrycot reviews the development and orientation of rift zones in the Canary Islands, and then discusses their implications in the assessment of volcanic hazards. The final article in this section (Garvin) describes new airborne laser altimetry methods of characterizing the topography of volcanoes. The methods should be extremely useful for monitoring changes in the shape of volcanoes that can signal impending eruption or collapse.

There are four articles on Mount Etna, possibly because many people live in the shadow of this potentially dangerous volcano. The papers illustrate the variety of approaches that can be used to study volcano instability. They also show that despite intense study, the jury is still out as to the underlying mechanisms causing continued movement on the volcano. Firth and others use changes in coastal elevation to evaluate three models (deep-seated spreading, shallow sliding and movement of tectonic blocks) for the on-going flank collapse on Mount Etna. They conclude that the flank movements are superficial and superimposed on a regionally uplifting subvolcanic basement. Montalto and others report that recent "superficial" seismicity on Mount Etna supports seaward sliding of a complicated ensemble of blocks resting on shallow independent *décollements* largely within the volcanic pile. In contrast, Rasa and others use measurements of aseismic creep to argue that the eastern flank of Mount Etna, including the upper levels of the sedimentary basement, are sliding owing to a main, deep-seated detachment surface. Rust and Neri use field and subsurface data to argue that the area of instability on Mount Etna is much larger than previously recognized. They suggest that the newly recognized system of bounding faults in the south requires deep detachment.

The stratigraphy and fault structures bounding Roccamonfina volcano are examined by De Rita and Giordano. They conclude that a major failure in slope 400 Ka BP was caused by a high rate of extension in a graben bounding the volcano. De Rita and others discuss the structural evolution of Bracciano volcano, which appears to be another volcano whose development has been strongly controlled by regional extension. Duncan and others describe the mechanisms of transport and emplacement for a variety of different mass-flow deposits on Monte Vulture, Italy. Buchner and others integrate new ^{14}C dates with previous paleontological and K/Ar studies of rates of uplift on the volcanic island of Ischia (Italy). The rapid uplift (0.9 to 2.4 cm/a), although slowing, has produced steep topography prone to slope failure.

Deception Island (Antarctica) is commonly considered a classic example of a ring-fault-bounded collapse caldera. Martí and others use seismic and fault-mapping techniques to show that the caldera formed through subsidence of central blocks bounded by regional faults, without any ring fault system. Yamagishi reviews large collapse-related structures, hydrologic mass-flows and slides associated with caldera formation on 12 Quaternary, intermediate-composition volcanoes related to subduction below Hokkaido, Japan.

Garcia documents the textures, stratigraphy, and composition of glass and mineral grains comprising sand beds recovered during Ocean Drilling Program, Leg 136, 320 km west of Hawaii. Integration of these data with paleontological and paleomagnetic data leads to the remarkable conclusion that the sand beds represent turbidite deposits associated with three debris avalanches on Kauai, Lanai and Hawaii. The turbidity currents can travel vast distances (1000+km), which provides a new explanation for mixed fossil assemblages in deep-sea sediments. Hawaii has become the type example for oceanic island landslides. This article also provides useful references to other works on Hawaiian slope collapse and associated debris flows. The next paper by Labazuy examines another oceanic island, Réunion. He assembles several types of bathymetric data to create digitized topographic maps of the seafloor around Réunion Island. The mapping reveals 550 km^3 of slump and debris avalanche deposits produced by cyclic failure of the Piton de la Fournaise volcano. Such deposits apparently typify ocean-island volcanoes.

Crumpler and others comprehensively review the physical features of all Martian volcanoes and their calderas. This paper, the longest in the book, contains numerous excellent photographs, sketch maps and diagrams. After a detailed description of each volcano, the calderas are classified (steep-walled *versus* sag-walled), and models are proposed for their development. Flank structural patterns and rift-zone orientation are used to infer the effect of regional stresses (caused by loading an inclined surface) on development of the volcano. Ultimately, all these factors are used to explain formation of various large features involving slump, slide and deformation.

Venus has approximately 250 volcanic domes displaying evidence of slope collapse, as discussed by Bulmer and Guest. On the basis of morphological similarities with deposits on Earth, they identified debris avalanche deposits (most common), small-scale pyroclastic flow deposits and deep-seated slides. The article is rich with representative photographs of different types of dome and their deposits.

Carniel *et al.* suggest that seismic data may be useful in predicting eruption at Stromboli.

Considering the number of references in most articles to papers written in the 1990s, and the speed (for a book) with which the volume was printed, the book seems very up to date. There is considerable variation in the length and scope of the papers, but this is to be expected, given that these are in fact the proceedings of a conference. To be fair, some of the less comprehensive articles give insight into the direction of ongoing or developing research programs. At least some of the articles will be useful at an undergraduate level. Others could have been useful at this level, but are burdened by long sentences loaded with jargon, as is all too common in the literature. Some papers are specialized enough that they will mainly be of interest to a very limited audience. This should not be surprising given that an objective of the book was to give a "cross-section of contemporary research into volcano instability". The printing, layout, drafting, paper, binding and photograph reproduction are all of high or very high quality. Compared to the cost of many foreign professional books the price (US$125) is not extreme, but MAC and GAC publications come out looking like bargains.

Given that there are no other professional texts on this increasingly popular subject, the editors did not have to aim for a niche market. I think that they came up with a very useful book that will be of interest to many people for a number of years to come. Our library has been asked to order one.

John D. Greenough
Department of Earth and Ocean Sciences
University of British Columbia
Okanagan University College
3333 College Way
Kelowna, British Columbia V1V 1V7

Rare Earth Minerals: Chemistry, Origin and Ore Deposits. Edited by A.P. Jones, F. Wall and C.T. Williams. Mineralogical Society Series, Volume 7. Chapman & Hall, London, U.K., 1996, 372 pages. CDN$58.95 (softbound) (ISBN 0-412-61030-2).

Rare Earth Minerals is a valuable addition to the Mineralogical Society Series produced by the Mineralogical Society of Great Britain and Ireland. The series provides descriptions of leading-edge research aimed at a wide audience, ranging from senior undergraduates to research-oriented geoscientists. This book stems from an international conference held at the Natural History Museum, London, in April 1993. The editors selected contributions that provide an introduction to the subject of rare-earth minerals, review examples of current research, and describe some prominent deposits of the rare-earth elements (*REE*).

The book is organized into thirteen chapters encompassing the contribution of twenty-three authors. Each chapter is self-contained, and chapters are arranged in a logical order. The introductory chapter, by P. Henderson, reviews *REE* geochemistry. The second chapter, by R. Miyawaki and I. Nakai, introduces the crystal chemistry of rare-earth minerals and their structure-types. Chapter 3, by R.H. Mitchell, discusses perovskite-group minerals, one of the most important hosts for *REE* in alkaline rocks, and outlines a revised classification of these minerals. Chapter 4, by P.J. Wyllie *et al.*, gives an overview of experimental studies that can explain how high concentrations of the *REE* in carbonatite deposits can be derived from the Earth's mantle. In the following chapter, R. Gieré discusses the formation of rare-earth minerals in hydrothermal systems, and focuses attention on the zonation of *REE* minerals in veins probably formed from Alpine-type metasomatic fluids. *REE* minerals in felsic alkaline rocks are the common theme in the next two chapters. Chapter 6, by A.O. Larsen, describes *REE* minerals from syenite pegmatites in the Oslo region, Norway.

These famous pegmatite localities were among the first to be investigated, and were the focus of a classic monograph by W.C. Brögger in the last century. R.P. Taylor and P.J. Pollard in Chapter 7 study the origin of ore-forming fluids that formed *REE* mineralization in the Thor Lake deposit, Northwest Territories. In Chapter 8, F. Wall and A.N. Mariano focus on *REE* minerals and deposits in carbonatites, and describe an example from Malawi. Chapters 9 and 10 deal with low-temperature *REE* mineralization; in Chapter 9, G. Morteani and C. Preinfalk examine the distribution of the *REE* in laterites formed on top of the alkaline complexes at Araxa and Catalao, in Brazil. Chapter 10, by Z. J. Maksimovic and G. Panto, deals with rare-earth minerals in karst-bauxites and karstic nickel deposits. China possesses about 40% of the world reserves of *REE*, but there is little information available in the English literature. Chapter 11, by Wu *et al.*, helps to fill this gap by describing the major Chinese deposits. Another famous *REE* deposit occurs in the Kola Peninsula of northern Russia, poorly documented outside of the Russian literature, is the subject of Chapter 12, by A.P. Belolipetskii and A.V. Voloshin. The last chapter, by C.T. Williams, focuses on analytical techniques used in studies of *REE* minerals. The contributions in the text are well supported by a glossary of the relevant minerals and their formulae.

In the tradition of other Mineralogical Society publications, this volume is well edited and presented with ample, high-quality illustrations and graphs. There is a slight variation in the quality of editing, however, including the omission of N symbols in two geological maps (Chapter 11). These are minor errors in an otherwise well-produced publication. The book will be particularly useful as a reference text for students at an advanced level or for researchers in geochemistry, mineralogy and economic geology. The price of the book is consistent with other volumes in The Mineralogical Society Series and provides very good value for the quality of information and presentation. It is well worth the investment.

Jarda Dostal
Department of Geology
Saint Mary's University
Halifax, Nova Scotia B3H 3C3

Crystal Structures. I. Patterns and Symmetry. By M. O'Keeffe (Arizona State University) and B.G. Hyde (The Australian National University). Mineralogical Society of America, Washington, 1996. 453 pages, US$36, Hardcover (ISBN 0-939950-40-5).

This book represents volume I of a two-book series dealing with the crystal chemistry of minerals and inorganic materials. The publication of volume II entitled "Crystal Structures. II. Inorganic Materials" is anticipated in the near future. This first volume introduces the concepts of two- and three-dimensional symmetry and their application to the description of non-molecular crystal structures in terms of lattice geometry, polyhedra, sphere packings and nets. Approximately one third of the book is used for an introduction to point-group and space-group symmetry, whereas the rest is devoted to the topics of polyhedra and sphere packings and three-dimensional nets.

In chapters 1–3 (98 p.), the concepts of point-group and space-group symmetries are introduced at a level suitable for senior undergraduate students in a mineralogy or crystallography course. The approach is essentially geometrical and the reader is regularly referred to the *International Tables of Crystallography* for a more in-depth treatment. Chapter 3 also contains a useful practical section on how to use the space-group tables in the *International Tables for Crystallography*, and detailed examples of application are presented using crystallographic data for common inorganic and mineral compounds (*e.g.*, rutile, spinel, quartz). In chapter 4 (32 p.), more examples are introduced as part of the description of geometrical properties of crystal lattices and unit-cell transformations, and useful advice is given for drawing crystal structures. Indeed, the importance of good structural drawings is emphasized throughout the book, which contains dozens of them illustrating the various ways of representing structures in projection.

Chapters 5, 6 and 7 (75, 80 and 90 pages, respectively) form the core of the book; they contain very detailed descriptions and discussions of 3-dimensional geometrical patterns in periodic crystal structures. More complex structures and their geometrical building principles are described and, as noted by the authors in their "Note to the Reader", several careful readings of these chapters "with pencil and paper at hand" may be required in order to fully appreciate and understand the material presented. In particular, the serious reader will need to familiarize himself or herself with a variety of symbols and notations, such as those used for the nomenclature of nets. Chapter 5 deals with the geometrical description of polyhedra, clusters and tilings (2-dimensional nets), with structural examples including, in particular, intermetallic compounds, metal borides and sheet silicates. Chapter 6 describes the familiar packings of spheres (*e.g.*, close packings), as well as some less familiar ones (*e.g.*, involving 10-, 11- and 8-coordination), in terms of their symmetries and their geometrical interrelationships. This chapter also introduces the novel descriptions of some crystal structures (*e.g.*, garnet) in terms of packings of one-dimensional rods or cylinders. Like all chapters in the book, chapter 6 ends with a series of useful exercises which, in most cases, require the reader to draw crystal structures. Chapter 7 deals with the more complex topic of 3-dimensional nets and their topologies. The reader unfamiliar with the symbols and notations might find the first reading difficult. This chapter also contains the descriptions of numerous crystal structures with, as expected, an emphasis on zeolite-like framework compounds.

The book ends with a series of appendices that can serve as brief introductions to more difficult mathematical subjects, such as higher dimensions or topological properties of polyhedra and nets. Appendix 5 presents short descriptions of some major binary and ternary structure-types, as well as structural data for about 90 structures discussed in the text. A list of books also is given; it includes all the well-known reference books on crystal chemistry, plus some books on mathematical crystallography and geometry. Some titles, dating back 25 years or more, may not be accessible to everyone, but other references to more recent articles in specialized journals are given throughout the text.

Overall, this book will be very useful to students, instructors and researchers alike, not only in the fields of mineralogy and crystallography, but also in solid-state chemistry and materials science. Its very affordable price should enable the interested readers to obtain their own copy and use it as a working reference, which, I believe, is what the authors intended.

Jacques Barbier
Department of Chemistry
McMaster University
Hamilton, Ontario L8S 4M1

CHANGE IN POLICY CONCERNING PAGE CHARGES FOR THE USE OF COLOR

As a matter of general policy, no page charges are assessed to contributors to this journal. However, there is an exception, for those authors choosing to use figures in color. The extra cost of printing certain signatures in color in an issue was formerly passed on to the author(s), as stated in the Guidelines for the Preparation of a Manuscript (inside back cover, volume **34**, part 3, June 1996 issue). This extra cost consists of two components, the cost of color separation, which is roughly CDN $75 per figure, and the added cost of printing the signature containing the article on a four-color press, which is roughly $750 per signature. The executive committee of the Mineralogical Association of Canada (MAC), anxious to see an increase in the utilization of color, has decided to absorb the second of these costs, effective immediately. This is a period of hard decisions by authors concerned the rising costs of publishing the results of their scientific investigations, commonly in journals that do little to enhance the impact of the product. In its subsidy of the bulk of the expense of publishing in color, the executive of the MAC sends the message that it wishes to ensure of maximum impact of the scientific articles that it chooses to publish.