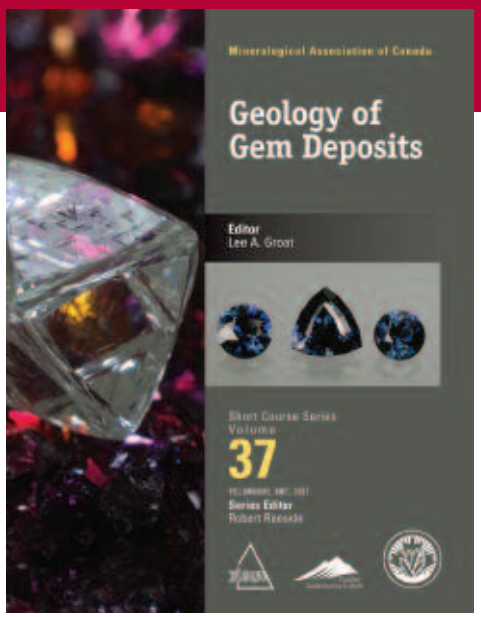
GEOLOGY OF GEM DEPOSITS[1]



Everybody knows what gems are, but very few can tell how they form. There are several reasons for this, some concisely explained by Lee Groat in the preface of this book. In particular, large mining companies have recently started to pay attention to gemstones. However, unlike other minerals or ores, there are no well-established prospecting guidelines or strategies for gems (except diamond). This book is a significant contribution towards that aim. It presents a much-needed overview of rapidly evolving research in the field, particularly on corundum and emerald.

The book is divided into 10 chapters. The first is on diamond, by Thomas Stachel. After generalities on diamond, in particular morphology and optical centers, the accent is put on inclusions, their origin, and age. Gem corundum deposits are reviewed by Gaston Giuliani and five coauthors. They present a historical perspective on corundum formation, followed by a detailed classification of deposits articulated around magmatic, metamorphic, and placer categories. The discussion is centered on major deposits, and several maps are provided. Emerald is explored by Lee Groat and three coauthors, who give details about the various economically or academically important deposits. Several classifications are presented, none of which fully satisfies the authors. The usefulness of stable isotopes is discussed, and exploration guidelines are offered. The following chapter is on non-emerald beryl, by David Turner and Lee Groat. After discussing the crystal chemistry of beryl and the geochemistry of beryllium, the authors offer a methodology to study beryl occurrences, as well as prospecting guidelines.

Daniel Marshall and Lori Walton author a short chapter on the formation of chrysoberyl, a rarity in the literature. They propose three general types of deposits: pegmatite-hosted, metamorphic/metasomatic, and placer. They conclude with brief exploration guidelines. Lori Walton and Daniel Marshall discuss tanzanite and tsavorite together, as these gems are very closely related. They outline field identification criteria (often forgotten by more academic geologists) and the very specific geology of tanzanite and tsavorite, which are associated with graphitic gneisses. Another short chapter, by Daniel Marshall, is dedicated to topaz. This gem occurs in six different types of deposits, not only pegmatites. Field recognition and prospecting criteria are offered.

Skip Simmons authors a detailed chapter on gem-bearing pegmatites. After defining the term and the various classes of pegmatites, the author explains their internal and regional zonations. Pegmatitic melts and volatiles are presented. Of particular interest is the discussion on gem pockets and the long list of pocket indicators. The description of pegmatite mineralogy (limited to tourmaline, beryl, and topaz) is very useful because it integrates the geological, chemical, and gemological approaches. The chapter concludes by explaining the limited success of geophysical and geochemical exploration for pockets. The chapter on jade by George Harlow, Sorena Sorensen, and Virginia Sisson is as compact as jade itself. After discussing the etymology and cultural significance of jade, the authors embark on a detailed overview of jadeite and nephrite jade deposits and their formation. If a hydrothermal origin for jadeite jade is still to some extent controversial, nephrite is considered to form as a result of dolomite replacement or in association with serpentine formation. Most jade deposits record events at convergent margins. The book concludes with a short chapter on Canadian colored gemstones by Bradley Wilson. The chapter presents information on a dozen species and varieties, as well as on Canada's budding gem production.

This book is aimed at members of the geological and mining community who are interested in gems, and will be helpful to gemologists fluent in geological language. The text is supported by a number of color plates. Some readers would have liked to see an even larger number of gems discussed, but obviously a choice had to be made. The book contains a small number of mistakes; for example, a specialist in the origin of color will regret that Li and Cs are presented as causing the pink color in beryl.

One impressive aspect of this book is its tremendous, well-selected bibliography, even if, in some sections, non-English literature is inadequately covered, which is all the more surprising for a document published in bilingual Canada. Many of the authors provide synoptic illustrations representing the various modes of formation of a particular gem. Even if this necessarily entails some degree of simplification, it is very pedagogical and most appreciated by those of us involved in teaching. Many of the contributors must be commended for presenting conflicting hypotheses in a very objective way.

Many chapters offer insight into exploration, which is paramount to the gem industry. Efficient exploration paves the way to larger or renewed production, which will in turn promote research on gems and their deposits. Overall, *Geology of Gem Deposits* is definitely a step forward in the development of gemology as a science in its own right.

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[1] Groat LA, editor (2007) Geology of Gem Deposits. Mineralogical Association of Canada Short Course Volume 37, 288 pp plus 24 color plates, ISBN 978-0-921294-37-5; $50 (in US$ outside Canada; in CDN$ in Canada); $40 for MAC members

SULFIDE MINERALOGY AND GEOCHEMISTRY[2]

This volume is a follow-up to *Sulfide Mineralogy*, published in 1974 as volume 1 in the excellent series Reviews in Mineralogy. Professor Vaughan has collated papers from a series of renowned researchers, and the volume provides a comprehensive review of research into sulfide mineralogy and crystal chemistry. This field has changed greatly in the last 33 years as a result of advances in microanalytical and spectroscopic techniques. The volume comprises 13 chapters written by 17 contributors and includes several chapters by Professor Vaughan. The papers have been well edited, and the minimal errors that remain do not detract from the overall quality of the volume.

Chapter 1 by Vaughan provides an overview to the volume and a review of the chapter contents. Makovicky, in chapter 2, presents a comprehensive review of the crystal structure of sulfides and related natural and synthetic compounds involving elements such as tellurium, selenium, arsenic, and antimony. Pearce and others summarize the complex electrical and magnetic properties of metal sulfides in chapter 3. The constraints acting on chemical bonding in metal sulfides are explained in terms of these properties. The theory and measurement of electrical and magnetic properties are described, along with spectroscopic and diffraction studies. In chapter 4, Wincott and

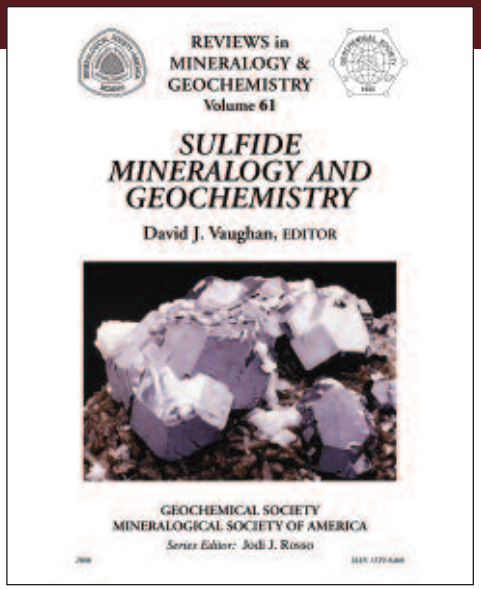
Cont'd on page 362

[2] Vaughan DJ, editor (2006) Sulfide Mineralogy and Geochemistry. Reviews in Mineralogy & Geochemistry 61, Mineralogical Society of America, 714 pp, ISBN 0-939950-73-1, US$40, 25% discount for MSA and GS members

BOOK REVIEWS *(cont'd from page 361)*

Vaughan discuss spectroscopic studies in terms of X-ray emission, absorption, and Mössbauer spectroscopy, and they review methods for studying metal sulfide surfaces, including the use of high-intensity photon sources associated with synchrotron radiation such as EXAFS and XANES. They also provide examples of the application of these techniques to the determination of the electronic structure of sulfide compounds. Coauthored by Vaughan and Rosso, chapter 5 treats chemical bonding in metal sulfide minerals and how it relates to crystal structures, stabilities, and physical properties.

One of the more applied chapters in the volume is chapter 6, in which Sack and Ebel review the thermochemistry of sulfides in solution. The application of metal sulfide phase relations to ore deposits is demonstrated through a review of the literature and is illustrated with case studies. In chapter 7, Fleet presents the phase equilibria of metal sulfides at high temperatures. A feature common to this chapter and several others is the demonstration of the interrelationship of the themes treated in different chapters. In this case the importance of understanding phase equilibria in the context of electronic and magnetic properties is emphasized. Rickard and Luther review the nature of metal sulfide complexes and clusters in chapter 8. They show the importance of clusters for understanding natural aqueous systems



and the interaction of sulfide chemistry with biological agents. Chapter 9 is a comprehensive summary by Rosso and Vaughan of the nature of sulfide mineral surfaces determined with experimental and theoretical tools developed during the last 20 years. The atomic and electronic structure of sulfides is described, with examples of several common sulfide minerals. The same authors carry on the same theme in chapter 10, where they consider the nature of chemical reactions at sulfide mineral surfaces. A minor criticism of the volume is that these two chapters should have followed chapter 5.

Chapter 11, by Reed and Palandri, returns to an applied theme by examining the nature of sulfide mineral precipitates from hydrothermal fluids. The chapter presents a description of the chemical and physical processes that drive sulfide mineral dissolution and precipitation. In chapter 12, Seal reviews the application of sulfur isotopes to the study of sulfide minerals. Volume 61 is worth purchasing for this review alone, written by one of the foremost researchers in this field. The review is comprehensive and uses case studies to illustrate the application of sulfur isotopes in various geochemical environments. The final chapter of the book, by Pósfai and Dunin-Borkowski, narrates the role of sulfides in biosystems. This comprehensive review demonstrates the importance of organisms in the dissolution and precipitation of sulfide minerals, particularly iron sulfides.

In summary, the volume is an excellent addition to this series and, like previous volumes, is set to become a benchmark in its field. It will appeal to those who conduct research on sulfide minerals and those studying natural and synthetic systems involving sulfides.

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FRONTIERS IN MINERAL SCIENCES
CAMBRIDGE, 26–28 JUNE 2007

Meetings such as the one described here are often conceived many years before they actually happen. When "Frontiers" was first discussed, Michael Carpenter was president of the Mineralogical Society of America (MSA) and David Price was president of the Mineralogical Society of Great Britain and Ireland (MSGBI) and the summer weather was fine in Cambridge. The Mineralogical Association of Canada (MAC) and the Société Française de Minéralogie et de Cristallographie (SFMC) agreed to join our merry band and we had a meeting to organize. This was to be a unique coming together of the societies mentioned. When Michael offered to chair the organizing committee, we had visions of a select gathering of about 150 delegates. So we were hugely surprised and delighted when the meeting proved so popular. We had to squeeze the door shut at 402 delegates from 26 countries. As mineralogy meetings go, nothing other than IMA meetings can rival it in terms of numerical success.

All learned societies talk about what it is that makes a good meeting. The venue? The convenor? The wine? The time of year/weather? The programme? Cambridge in June, with Michael Carpenter in the hot seat, a superb line-up of plenary lecturers, and the bonus of some outstanding sessions with excellent talks thrown in for good measure was the heady mix which moistened our tastebuds as the mid-summer gathering drew near. The event did not disappoint, even if the weather did! In the wonderful surroundings of Fitzwilliam College, 18 symposia in up to six parallel sessions played out over three days. Interspersed were an ice-breaker reception, a welcome from the Department of Earth Sciences at

Frank Spear, MSA's Dana Medalist, receiving his award from Barb Dutrow, MSA president, at the conference dinner, and Matt Kohn, citationist.

Sedgwick Museum, the conference dinner, some wonderful musical entertainment (by the talented cellist Kim Cook, amongst others) and punting on the river Cam, all well oiled with delightful college wines and sustained by food provided by the college and local hostelries.

Key, of course, was the science. Below is a list of the scientific sessions. All were well attended, and because of the pressure of time, one had to be sharp to keep on top of the wide choice of pickings that were available.