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BOOK REVIEWS

Porphyry Deposits of the Northwestern Cordillera of North America. Edited by T.G. Schroeter. Special Volume **45** (1995), Canadian Institute of Mining, Metallurgy, and Petroleum, Xerox Tower, 1210-3400 de Maisonneuve Boulevard West, Montreal, Quebec H3Z 3B8. 904 p. CDN $75 (members), $95 (non-members), $55 (students). ISBN 0-919086-56-X.

Porphyry deposits have been a major part of the mining industry in western Canada for much of the last five decades. Millions of dollars have been invested in exploration in the northwestern Cordillera, and this investment, on an industry-wide basis, has been well rewarded. Since the dawn of the modern era of copper–molybdenum mining in the Highland Valley in the early 1950s, 15 mines have been brought into production, and numerous other prospects and deposits have been identified. With the resurgence of interest in porphyry exploration, driven in part by new discoveries in the western Pacific and South America, and the recognition that this environment has a substantial potential for Au, the production of this magnificent new volume by the CIM is certain to attract much attention.

The volume was conceived in 1992 with the intent of providing a comprehensive update to the popular CIM Special Volume 15 (Porphyry Deposits of the Canadian Cordillera, 1976). The editors set out to assemble the collective knowledge of explorationists, miners and researchers "to document the huge amount of new information on porphyry and porphyry-related deposits in the northwestern Cordillera that has been gathered since publication of the earlier volume in 1976". Updates based on recent work were sought for deposits first described in the earlier volume, and new descriptions were written for virtually every other significant deposit in the northwest. The resulting book is huge, with 69 papers contributed by a total of about 175 authors and coauthors. Formatted in the 8½ by 11" double-column page style that will be familiar to CIM Bulletin readers, the hard-cover text still runs to almost 900 pages. It includes a map pocket with a 1:2,000,000 map on the base of the Tectonic Assemblage Map of the Canadian Cordillera (GSC Map 1712A), showing the location of all porphyry deposits and a descriptive table of more than 500 occurrences drawn from the British Columbia and Yukon minfiles.

The text is organized in six sections. Part A consists of seven review papers that discuss the northwestern Cordilleran deposits in various contexts. Parts B, C, D, and E are the descriptive meat of the volume, each section devoted to a particular subtype of deposit. Part B describes porphyry Cu (±Au, Mo) deposits of the calc-alkaline suite and is by far the largest section (32 papers and more than 370 pages). Part C is on porphyry Cu (±Au) deposits of the alkaline suite; Part D is on porphyry Mo (±WO_3) deposits, and Part E pertains to porphyry Au (±Ag, WO_3, Cu) deposits. Part F constitutes a wrap-up and review paper by John Thompson on the models and methods of exploration, and recent avenues of research on porphyry deposits.

Part A contains the history, descriptive background and the geological and tectonic context for the book. Newell, Carter and Sutherland-Brown provide a colloquial thumbnail sketch of the history of exploration and development of porphyry deposits in the Cordillera; the people and anecdotes will be familiar to many readers, and mountain-top shots of Bell G3 and Hiller 12E helicopters evoke memories of the pre-turbine days of helicopter-supported exploration. Taylor presents a summary and analysis of the economic perspectives of porphyry-style mineralization, a brief summary of the economic performances of 13 individual deposits, and an assessment of economic necessities for future mines. McMillan *et al.* provide a review of the regional geological and tectonic settings of deposits. They emphasize that these deposits represent two distinct periods of mineralization, a pre-accretion Triassic–Jurassic event, and a post-accretion Late Cretaceous to Eocene event. Sinclair presents an overview of granite-related mineralization of the Cordillera as a context for porphyry deposits, and two papers (Lasmanis and Nockelberg *et al.*) describe porphyry mineralization in Washington and Alaska, respectively (the latter in the context of a detailed metallogenic analysis). Mortensen *et al.* describe new U–Pb geochronology on intrusions related to porphyry Cu–Au deposits, and demonstrate that porphyry-related intrusions in Quesnellia and Stikinia were intruded within a very narrow time-interval in the Late Triassic.

The descriptive part of the volume (Parts B to E) is clearly focussed, and the information is generally well-presented. With 61 papers representing virtually all of the major deposits from northern Washington, British Columbia, Yukon and Alaska, there is a huge amount of data to assimilate. The potential for the reader to become hopelessly overwhelmed by the sheer volume of information must have been of concern to the editors. To address this problem, they adopted the

strategy of having the papers written in standard format around a more or less standard template. This tactic has worked well, and helps to focus the volume in the direction intended by the editors. As the Foreword indicates, this book is primarily intended as a hands-on publication for the mining industry. The emphasis is on description, especially field description, of features that are significant in the exploration for and mining of these deposits. Clear descriptions of exploration history, applied methods of exploration, an up-to-date estimate of grade and tonnage, and descriptions of regional and deposit geology, mineralization and alteration are features of virtually all papers. Many contain descriptions of mining and processing methods, and economic analyses that will provide an interesting insight into the decision-making related to mine development (these should be required reading in undergraduate courses in economic geology). The practical approach also is evident in the types of information that are generally not present. There are few academic studies here, and sparse reference to fluid inclusions, stable or radiogenic isotopes, mineral chemistry, or other topics that are of great interest to academic researchers and their funding agencies, but may be of less interest to their industry counterparts. Although there is some discussion of tectonic settings and discussions of genetic models, these are not prominent through the book, and are seldom a major focus of individual papers (except those review papers devoted to the topics). This book does not present state-of-the-art research into porphyry deposits; rather, it focuses on state-of-the-art practical information, and therein lies its great strength.

The quality of papers is not always uniform; a very few are so abbreviated as to be unsatisfying. The editorial work has been done thoroughly and well, and there are few obtrusive typos or other errors. The quality of the writing is generally high, again, I suspect, a testament to the hard work and dedication of the editors. My main criticism relates to the quality of reproduction of some figures and many photographs. This comment relates mainly to the choice of paper. Many figures, particularly those with relatively heavy line work or bold text, did not reproduce clearly. Particularly heavy figures (*i.e.*, bar graphs) often show through from the back, creating a displeasing effect. Black and white photos reproduced very poorly; in many cases, the reproduction does not clearly portray the feature it is meant to illustrate. Color photos have generally fared better, although there are some examples of poor reproduction of color and image. No doubt, the paper quality was chosen with an eye to the cost and the eventual price of the volume; the reader will have to decide whether the cost in print quality is worth the benefit in price.

Minor criticism notwithstanding, this book is a magnificent achievement. It belongs on the bookshelf of all economic geologists, right beside Special Volume 15. Together, these certainly constitute the standard reference for porphyry deposits in the northwestern Cordillera and will continue to do so for the foreseeable future. However, the value of this book extends well beyond the industry community. For students, it provides a wealth of descriptive information that is necessary to develop an appreciation of these deposits, but is so often omitted in scientific journal presentations. For researchers, it provides the essential descriptive geological base upon which new research ideas and directions must be founded. For non-geologists, it provides many examples of readable, understandable descriptions of the economic analysis that is the foundation of mine decision-making.

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Geology of Canada. **8.** *Geology of Canadian Mineral Deposit Types.* Edited by O.R. Eckstrand, W.D. Sinclair, and R.I. Thorpe (1995). Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario, Canada K1A 0E8. CDN $91, US $70. (ISBN 0-660-13136-6).

This volume represents part of the Decade of North American Geology (DNAG) project, the results of which summarize various aspects of the geology, tectonics, geophysics and mineral resources of North America and its surroundings. It is one of nine volumes comprising the latest *Geology of Canada*, the seventh such overview by the Geological Survey of Canada since its founding in 1842.

The book admirably defines and summarizes systematically the features of economically significant types of Canadian mineral deposits. Recognition of mineral deposit types is fundamental to the method of economic geologists. As defined in the introduction, "a mineral deposit type is a collective term for mineral deposits that (a) share a set of geological attributes, and (b) contain a particular mineral commodity or combination of commodities such that (a) and (b) together distinguish them from other types of mineral deposits." Doubtless it will surprise some readers to learn that (according to 1987 data), two thirds of the total value of the 18 mineral commodities produced in significant quantity was derived from four of them (Au, Zn, Cu and Ni). Likewise, although obtained from more than 25 mineral deposit types [the 21 most significant of which unfortunately are not (as stated) shown in bold in the Table of Contents], almost two thirds

of the value of this production was obtained from only five. They are: volcanic-associated massive sulfide base metals, nickel–copper sulfide, porphyry Cu–Mo–Au–W–Sn–Ag, Lake-Superior-type iron formation, and evaporites.

The synthesis of Canadian milneral deposit types is first class. Many of the summaries of deposit type are written by internationally renowned investigators having extensive experience with a given mineral deposit type. These contributions provide wonderful focal points for anyone seeking an overview and appreciation of the latest developments on studies of a given mineral deposit type. Meticulously prepared and edited, each summary provides a consistent and user-friendly guide to information, namely: introduction, relevance to Canadian and world mineral supply, size and grade of deposits, geological features, definitive characteristics, current genetic model(s), exploration guides, acknowledgements and selected bibliography. Accompanying illustrations are clear and well labeled. There is an excellent selection of illustrative photographs, although several have suffered somewhat in reproduction. Nit-picking aside, the 28 mineral deposit specialists at the Geological Survey of Canada and the three from outside have rendered invaluable service in thus documenting the state of knowledge on mineral deposit types. This volume also serves as a pointer toward work that needs to be done in the years ahead. As such, it is therefore of special interest to researchers, exploration geologists, and other students of mineral deposits outside as well as in Canada.

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Chemical Fundamentals of Geology (second edition, 1996). By Robin Gill. Chapman and Hall, 115 Fifth Avenue, New York, N.Y. 10003, U.S.A. 298 p., US$31 (paperback), (ISBN 0-412-54930-1).

The diversity and fundamental importance of geochemistry are nicely summarized by Robin Gill when he writes (p. 144): "Few scientists are expected to deal with as wide a range of materials and properties as the geologist. Consider the contrast between red-hot silicate lava and grey Atlantic sea water, between the engineering properties of crystalline granite and those of soft clay or mud, between the electrical and optical properties of quartz and those of gold." A tangible and direct contact that the author feels for his subject is constantly transmitted in this fine book. It is a well-organized, lucid, clearly written, and eminently user-friendly text. The reader is repeatedly reassured, being led from topic to topic in logical fashion. Where the going gets tough, the reader finds extra help (p. 125). "Of all the chapters in this book, understanding Chapter 5 requires the most physical insight. The reader is strongly encouraged to persevere . . . Nevertheless, for the reader to whom the concept of electron 'waveforms' is unacceptably remote from everyday experience, the main conclusions of Chapter 5 are presented below in non-wave terms". This statement is in the introduction to one of the 51 "boxes" in the text that lucidly set aside selected topics of particular significance. These boxes will greatly aid the student. Clearly reproduced line-drawings enhance the text, and many are outstanding. One (Fig. 10.4), in only 100 cm^2, renders clear to this reviewer a concept that for 40 years had been murky and contradictory!

Chemical Fundamentals of Geology covers to varying degrees most subdisciplines in the broad domain of geochemistry at a solid, no-nonsense undergraduate level. As such, it is suitable text, although the teacher may wish to add more organic geochemistry and geochronology from other sources. In addition, this book offers an excellent brush-up for the rusting mineralogist–geologist, as well as a refresher for students embarking on graduate studies involving geochemical problems.

Ten chapters, ranging from 15 to 35 pages in length, make up the book. The first four, dealing with energy, equilibrium, kinetics, and aqueous solutions, cover much of the ground of general geological chemistry. Chapters 5 through 8, atoms, the periodic table, bonding and crystals and melts, home in on atoms, their properties and arrangements. Of these, chapter 7 and 8 should be required reading for students of optical mineralogy. The final two chapters deal with the chemical elements, particularly those of geological consequence, and their origin. Each chapter closes with a few exercises, the answers to which are given in appreciable detail on the nine pages that follow the last chapter. The book concludes with four appendices: a glossary (about 150 terms), a bit of basic math, notes about pH, and a list of the elements (a periodic table follows the index on p. 298, not on p. 299 as cited at several places in the text).

Errors of fact or typography are rare. "X site" in Table 8.4 should be "B site". Here also, it should be emphasized that the calculation of the mineral formula and site occupancies for the amphibole chosen [a glaucophane lifted from Deer, Howie & Zussman (1963, v. **3**, p. 336) with 0.10% MnO added] are clearly developed. However, most compositions of amphiboles today are reported as incomplete (anhydrous) results of electron-microprobe analyses. The recalculation of anhydrous analytical results and a few words on the final report of the IMA

Subcommittee on Amphiboles seem in order. Then, the statement (p. 200) that Rb and Cs "are too scarce to form their own minerals" ignores pollucite, a reasonably common mineral in granitic pegmatite, and rhodizite, an admittedly rare borate. Finally, I am sure that it is 1% by weight, and not 1% of them (*i.e.*, solar-system debris) that are "large enough to survive as recoverable meteorites" (p. 238).

In summary, this is an excellent, thoughtful, and useful book that is reasonably priced. It is suitable as a basic text for an undergraduate course in geochemistry, as well as being an excellent reference work for elucidating fundamental geochemical concepts and processes.

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Igneous Petrology (second edition, 1996). By Anthony Hall. Longman Group Ltd., Harlow, Essex CM20 2JE, England, 551 pages. CDN $64.95 (softbound), (ISBN 0-582-23080-2).

The second edition of *Igneous Petrology* by A. Hall is a revised and updated version of his 1987 book. Like the first edition, the book aims to provide an introduction to modern igneous petrology. The book contains 14 chapters that flow in logical sequence. The first seven chapters deal with general topics including the occurrence, composition and evolution of igneous rocks; the last seven chapters systematically consider the main magma-types. Chapter 1 discusses present-day igneous (volcanic) activity and is followed by two chapters on volcanism and plutonism, that include a discussion of the factors controlling eruptions, the products of volcanic eruptions (lavas and pyroclastic deposits) and the types of volcanoes and intrusions. The chemical composition of igneous rocks, including both major and trace elements, is treated in chapter 4. Most of the chapter is devoted to the distribution of trace elements; major elements are considered rather briefly. Considering the importance of the major elements to an understanding of magma evolution, they deserve a more extensive treatment. Chapter 5 discusses melting and crystallization, and introduces phase diagrams with various examples of binary and ternary silicate systems. The effects of oxidation and reduction on magma evolution are also briefly described. Chapter 6 deals with stable and radiogenic isotopes in magmas and igneous rocks. Magmatic evolution is discussed in Chapter 7; topics such as crystal fractionation, liquid immiscibility, liquid fractionation, contamination, zone melting and the mixing of magmas are highlighted. The crystal fractionation section also covers igneous layering in some detail. The remaining chapters examine the major groups of igneous rocks: basalts, granites, andesites, alkaline igneous rocks (nephelinite–carbonatite association, trachytes and phonolites and their plutonic equivalents), kimberlites and ultrapotassic rocks, peridotites and anorthosites. These chapters provide a large amount of information on the compositions and the theories of the origin of these rocks and give examples of their various occurrences.

Compared to the first edition, the book has been slightly reorganized and significantly updated to include recent developments in the field. Some notable changes include dropping the section on spilites in the basalt chapter, and dividing the section dealing with intra-plate basalts into oceanic island basalt and continental flood basalt sections. The chapter on the distribution of trace elements is enlarged by the incorporation of a section on major elements that was mainly in the Appendix in the previous edition. The chapter dealing with alkaline igneous rocks combines two chapters, "Trachytes and phonolites", and "Nephelinites and carbonatites" from the first edition.

The book is well-referenced and illustrated. The editing of figures, however, is far from perfect. For example, the map in Figure 345 does not have a scale, whereas other figures do not have consistent labeling. Notwithstanding these shortcomings, the writing style is smooth and readable.

The book provides a modern view of igneous petrology and would be suitable as a textbook for an undergraduate course in igneous petrology or as a reference book for non-specialists. It presents the material at a level that is accessible to those who have only rudimentary background in mineralogy and petrography. The treatment of the topic is essentially descriptive, and the absence of detailed thermodynamic and mathematical modeling makes it less suitable for graduate courses. Within its specific niche as an introductory undergraduate textbook, this book represents good value for the money.

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