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# Book Reviews

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## Western and Arctic Canadian Biostratigraphy

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Edited by C. R. Stelck and  
B. D. E. Chatterton  
*Geological Association of Canada Special  
Paper Number 18*  
(*Percival Sydney Warren Memorial  
Volume*), 1978, 602p.  
\$18.50 (GAC members); \$22.00  
(Non-members)

Reviewed by David Skevington  
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It was Ulrich, I believe, who once proclaimed paleontology without stratigraphy to be an absurdity. Whatever provoked such an outburst, it could not have been a publication in the same league as G.A.C. Special Paper 18 which presents a generally excellent account of the current state of stratigraphic paleontology in western and arctic Canada. Inevitably, the coverage - spatially, temporally and biologically - is incomplete and uneven: the area is immense, the environment largely hostile and the remoteness such that the sheer cost of mounting field expeditions is all but prohibitive and, indeed, would be so but for the generous support of industry and commerce.

The 17 technical papers included in this volume resulted from the Biostratigraphy Symposium held in honour of the late P. S. Warren, the pioneer western Canadian biostratigrapher, at the 1976 GAC Annual Meeting in Edmonton. The fact that over two years elapsed between presentation and publication was no doubt a source of frustration to editors and authors alike, but it has in no way detracted from the value of the final product; indeed, it is evident from the references that some authors compensated for the delay by up-dating their manuscripts to the year in which the volume was issued.

Twelve papers, comprising three-quarters of the text, deal with Paleozoic faunas and biostratigraphy; emphasis is placed on conodonts and brachiopods and their utilization, while trilobites, ostracodes, graptolites, cephalopods and foraminiferans also receive substantial treatment. This Paleozoic concentration is paralleled by a preponderance of articles based on faunas from the District of Mackenzie and neighbouring parts of Yukon Territory and British Columbia. One reason for this must be the superb quality of the fossil material as exemplified by the plates accompanying the papers authored by, for example, Ludvigsen (trilobites), Tipnis *et al.* (conodonts) and Copeland (ostracodes). With material like this and the workers to describe it, what further justification need be sought for the establishment of a Canadian paleontological monograph series!

Of the remaining five papers, four are concerned with Mesozoic and one with Cenozoic stratigraphy while, from the fossil standpoint, attention is focussed on Jurassic ammonites, Cretaceous microfloras, foraminiferans and terrestrial vertebrates, and Tertiary mammals. The most significant of the post-Paleozoic contributions, both in size and content, is that of Caldwell *et al.* which presents a foraminiferal zonal scheme for the Cretaceous which, though preliminary, is applicable throughout the western interior of Canada and southwards into the western United States.

In overview, some authors clearly had more to say than others; some have documented detailed stratigraphies based on carefully collected sequences and previously monographed faunas, others have been obliged to include substantial systematic content in their contributions, while yet others, at a less advanced stage in their investigations, have had to contend with tentative identifications and their stratigraphic interpretations are necessarily that much less refined. This is one aspect of the unevenness to which I alluded earlier; having in mind the scope of the volume, however, its existence is inevitable and not a target for criticism.

Indeed, with such a wealth of information at such a reasonable price it is somewhat invidious to highlight weaknesses. Nonetheless, it is a matter for personal regret that the one article devoted to graptolites did not elaborate upon the unique sequence of faunas, ranging from the early Ordovician to the early Devonian, which is preserved in the Richardson Mountains. It is also fair comment that a number of the papers would have benefited greatly from the inclusion of illustrations of representative fossils and the two dealing with ammonoids come particularly to mind in this regard. The technical quality of the publication is generally so high that such few sub-standard features as do occur have an impact far beyond their true effect; the inverted table in the paper by Armstrong and Mamet and the lack of contrast in the plates accompanying Braun's article may be cited in this regard.

It would be wrong to conclude this review on a downward turn. Special Paper 18 stands as a worthy memorial to P. S. Warren. The factual content, the editorial and technical standards achieved and the GAC's pricing policy, which brings the book within everyone's reach, are all deserving of the highest praise.

MS received November 2, 1979

## Fossils of Ontario, Part 1: The Trilobites

By Rolf Ludvigsen  
Royal Ontario Museum Life Science  
Miscellaneous Publications, 1979  
\$7.50

Reviewed by Alfred C. Lenz  
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Royal Ontario Museum has undertaken a long range task of updating the more-than-100 year-old studies of H. A. Nicholson on the Paleontology of the Province of Ontario. The strategy is to publish an updated series of syntheses of each major taxonomic group. The present publication "The Trilobites" is the first in the series and as such will be the pace-setter for subsequent volumes. According to the foreword, the level of the publication is "directed to the student, the collector, the professional paleontologist, as well as to the interested person who wishes to be informed."

The book begins with a generalized geological column of formations of southern Ontario and Hudson's Bay lowlands, and a series of easily usable geological maps of both regions, a separate one being devoted to each System and to Manitoulin Island.

The succeeding chapter is devoted to an introduction to the trilobites. This section includes a general discussion of what comprises a trilobite, a summary of the geologic range and generic diversity of the group through time, several good sketches of trilobites showing all major skeletal components, a brief discussion of trilobite eyes, and a short discussion supported by illustrations, on trilobite ontogeny and moulting. The chapter concludes with a chart showing the formational distribution of all genera known in Ontario.

A brief chapter is devoted to early workers who included trilobites in their studies, among them Bigsby, Billings, Raymond and Wilson. Thoughtfully, photographs of these four workers are included.

The main section of the book follows, including a very brief comment on trilobite families highlighted by a sketch of a typical representative of each family. Discussion of the trilobites is at the generic level, and is stratigraphically arranged. Ordovician genera constitute by far the greatest number, comprising 34 genera. Silurian trilobites and Devonian

trilobites each comprise 14 genera. Descriptions of the genera are brief, but include the salient features, as well as the names of the species known in Ontario and their formational distribution.

The last section of the book comprises a glossary of morphologic terms followed by an extensive bibliography of 127 references ranging in time from 1824 to 1978.

The book is well written and is easy and interesting reading, the quality of the paper and the photographs is first-rate, and typographical errors are virtually nonexistent. The hard cover of the book is attractive with a handsome drawing of the Silurian trilobite *Arctinurus boltoni* (Bigsby).

The book will undoubtedly be of great interest and use to the student and amateur, but it is doubtful that it will fulfill its goal of being of great use or challenge to the professional trilobite worker. This however is to be expected. I have only one major criticism; that is I was disappointed that no mention was made of trilobite paleoecology, nor (especially) of trilobite community studies which have made such strides in recent years. This is especially puzzling considering the considerable contributions of the author in this field. I think both students and amateurs would find such a section a welcome, interesting and useful addition.

All in all I was most impressed with the quality of this work, and both ROM and Rolf Ludvigsen are to be congratulated for a fine publication, which at \$7.50 is a very good buy.

MS received October 5, 1979

## Aspects of Diagenesis

Edited by Peter A. Scholle  
and Paul R. Schluger  
*Society of Economic Paleontologists and Mineralogists, Special Publication No. 26,*  
443 pages, 1979.  
\$15.00 U.S.

Reviewed by M. A. Carrigy  
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The subject matter of this book is very important for the petroleum geologist but I doubt that many will have enough fortitude to read this book from cover to cover. The volume is well edited and will be appreciated most by those with a fairly intimate knowledge and interest in methods of estimating paleotemperatures and the processes of diagenesis.

The Editors have combined the papers presented at two SEPM symposia sponsored by the Eastern and Rocky Mountain Sections in 1976 and 1977 respectively. Part I deals with the methods of determining paleotemperatures and Part II with diagenesis as it affects clastic oil reservoirs.

Part I comprises eight papers on indicators of paleotemperature in sedimentary rocks such as conodont colour, reflectance of vitrinite grains, graphitization of kerogen, dehydration of clay minerals, formation of zeolites, fluid inclusions in quartz overgrowths, fission tracks, and oxygen isotopes.

Part II has 16 papers on diagenesis which deal with such diverse topics as, porosity reduction, lithification, origin and importance of secondary porosity, diagenesis in volcanic sandstones, lithic sandstones, pure quartz sandstones, vitric and arkosic sandstones, and sediments deposited in deepwater off-shore bars, fluvial, deltaic and shallow marine environments and coastal dunes.

The writers of these papers discuss in great detail the effects of temperature, pressure, mineral composition and the chemistry and movement of the pore fluids on the diagenetic histories of the rocks. Most of the authors seem to agree that the first step in the lithification process takes place near the surface where authigenic minerals are deposited on or between the framework grains. This results in the reduction of primary porosity and permeability with temperature and time and then, as the rock is buried more deeply, the minerals may start to dissolve creating secondary porosity and thus new space to trap migrating hydrocarbons.

The exploration geologist thus can no longer write off strata that have been deeply buried as potential reservoirs but must try to decipher the diagenetic history to see if secondary porosity has been created. Because the porosity being created by these processes is not necessarily related to structure or bedding, petroleum reservoirs could be formed which are difficult to detect by current geophysical methods.

In general, the papers in Part I are a cohesive group and provide a good survey of the state of the art. The papers in Part II are not as cohesive and this is probably a reflection of the complexity of the lithification processes and our poor understanding of them. It is obvious from reading this volume that the processes resulting in the authigenic deposition and solution of minerals in clastic rocks cannot be explained by simple PVT analysis. It is clear from reading this book that the diagenetic history of clastic rocks is a fascinating subject, and that much careful petrography needs to be done before the physico-chemical parameters controlling the origin of porosity in sedimentary rocks can be identified.

To summarize, this is a tough book to read but it should be on the shelves of all petroleum geologists who want to be successful in finding the oil which could be reservoired in obscure stratigraphic traps at great depths.

MS received November 20, 1979

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## Kimberlites, Diatremes, and Diamonds: Their Geology, Petrology, and Geochemistry (Volume 1).

## The Mantle Samples: Inclusions in Kimberlites and Other Volcanics (Volume 2)

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Edited by F. R. Boyd and H. O. A. Meyer  
*Proceedings of the Second International Kimberlite Conference (Volume 1 and 2).*  
American Geophysical Union,  
Washington, D. C. 20008, 1979

\$19.00 U.S. each volume;  
20% discount for AGU members

Reviewed by N. T. Arndt  
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The first International Kimberlite Conference was held in Cape Town, South Africa, in September, 1973. The conference, and the resultant *Proceedings Volume* (Phys. Chem. Earth., v. 9, 1975) stimulated a greater interest in kimberlites, diamonds and associated rocks, and it provided, during field trips, a chance for participants to sample various South African kimberlite localities.

The impressive results of the research that followed were presented at the Second International Kimberlite Conference, which was held in Sante Fe, New Mexico, in October 1977, and now are more widely available with the publication of the conference proceedings that consist of 66 papers in two large volumes (822 p.). With few exceptions, these papers describe comprehensive investigations of various aspects of kimberlites and related rocks. They contain abundant new analytical data (including some 250 garnet analyses and 350 clinopyroxene analyses) and innovative interpretations or approaches to petrological or geophysical problems, some directly applicable to kimberlites or nodules, and others with wider application.

The first volume deals with the geology, petrology and geochemistry of diatremes and diamonds. It is divided into three sections: (I) diamonds; (II) kimberlites - their field relations, mineralogy and petrology, geochemistry, and experimental studies; and (III) diatremes and carbonatites. In each section, although there are some papers of general interest to petrologists, there are also many that will be of

interest only to those working in the specific field. In the first paper in the section on diamonds (Gurney *et al.*), the mineral compositions of ultramafic inclusions in diamonds are used as the basis of a model for diamond formation: progressive capture of calcium by  $\text{CO}_3^{2-}$  in an initial  $\text{CO}_2$ -rich kimberlitic melt results in the formation of diamond as a phase cognate with kimberlite. Rarer diamonds within eclogitic inclusions are interpreted to have formed independently and are thought to be xenocrysts in the kimberlite. Other papers in this section deal in an exhaustive manner with the morphological and physical characteristics of diamonds and are not very illuminating to the non-specialist.

In the section devoted to kimberlites there are some papers that amount only to descriptions of newly discovered or previously undescribed occurrences. Many other papers, however, should prove interesting to any petrologist. Hawthorne *et al.* describe the geology and discovery of the Dokolwayo Kimberlite and associated paleoalluvial diamond deposits, and use chemical and mineralogical evidence to relate the alluvial diamonds to the kimberlite. Skinner and Clements developed a mineralogical classification of South African kimberlites, in which they characterize a kimberlite on the basis of the groundmass minerals: diopside, monticellite, phlogopite, calcite and serpentine. In C. B. Smith *et al.*'s comprehensive description of kimberlites in Colorado and Wyoming, they relate structure and lithology to the depth within a kimberlite intrusion exposed by erosion. J. V. Smith *et al.* analyzed the K, Rb, and Ba composition of micas in kimberlites to test the role played by phlogopite in the formation of basaltic magmas. They concluded that phlogopite could be important in the formation of continental basalts, but that in the formation of other basalts, more complex processes involving alkalis from other sources must have operated.

Papers in the geochemistry section provided useful analytical data on, for example, Pb, Ir and Au abundances (Paul *et al.*) or U abundances (Brookins *et al.*) in kimberlites, but yielded no startling conclusions. Good summaries, and new experimental data, on the melting behaviour of  $\text{H}_2\text{O}$ - and  $\text{CO}_2$ -bearing peridotite and the formation of kimberlitic magmas are provided by Wyllie, and Egglar and Wendlandt.

The final section, on diatremes and carbonatites, contains interesting papers on emplacement mechanisms (Anderson, Lorenz) as well as papers on the geology and chemistry of individual occurrences.

The second volume deals with "the mantle sample": inclusions in kimberlites

and other volcanics. It contains the following sections: (I) Geophysics, (II) Eclogites and peridotites from kimberlites, (III) Megacrysts, (IV) Xenoliths from the Colorado Plateau, (V) Xenoliths from Basalts and other Volcanics. Its papers fall into two groups: (a) those containing descriptive material and analytical data on xenoliths and megacrysts, which although useful and perhaps interesting to specialists, are of little value to the general reader: (e.g., "first reported occurrence of nodule-bearing rocks in southeastern New England") and (b) other papers that deal with issues and problems of more general interest. These include the geothermal gradients deduced from the compositions of minerals in nodules or xenocrysts, the ascent velocities of kimberlites, and evidence of mantle metasomatism and the role it plays in the formation of alkalic magmas.

The first two papers, which comprise the geophysics section, fall into the second group. In the first, Jordan has developed a simple algorithm for estimating the mineral compositions, density and seismic velocities of garnet lherzolites from their chemical compositions. He uses estimates of mantle densities to support his earlier-presented theories on the existence of compositionally anomalous sub-continental mantle stabilized by temperature gradients. A. B. Thompson considers net-transfer reactions and exchange equilibria in the  $\text{CaO-Al}_2\text{O}_3\text{-MgO-SiO}_2$  system in his discussion of metamorphism in a model mantle. The latter paper is rather heavy going but provides a technique of determining whether coexisting nodule assemblages are related by compositional differences (and thus could be in equilibrium) or by P and T differences (and thus out of equilibrium).

The following section contains a number of interesting papers. Hatton and Gurney, and Robinson interpret the co-existence of graphite and diamond in eclogite nodules to indicate melting or crystallization at conditions straddling the graphite-diamond reaction curve. Robinson, recognizing from morphological evidence two generations of diamond separated by a period of graphite crystallization, advocates a crystallization path involving temperature increase at constant pressure. He does not explain how these conditions might be achieved.

Evidence of mantle metasomatism is presented by Boettcher *et al.*, and Clarke. The former authors propose that the development of titaniferous phlogopites and amphiboles in nodules reflects an introduction of aqueous fluids rich in Ti, K, Fe and other elements, which preceded or played an active role in the formation of alkali basalts and kimberlites. The quaint

style characteristic of many of Boettcher's contributions detracts from the paper: even a facile examination discloses a plethora of unusual phrases that are neither in chorus with, nor consonant with clear scientific writing. Clarke's paper describes unusual K-bearing sulphides that provide further evidence for mantle metasomatism.

The dynamics of kimberlite intrusion are discussed by McCallister *et al.* on the basis of the thickness of exsolution lamellae in pyroxenes, and by Mercier on the basis of the sizes of olivine tablets in annealed porphyroblastic peridotite nodules. Both predict rapid ascent velocities (70 km/hr in Mercier's estimate). Mercier also uses experimentally-derived strain rates to show that deformation in nodules took place during the melting event that produced the host kimberlites.

Other notable papers include the accounts of nodule sulphides by Tsai *et al.*; high-pressure spinels, by Haggerty; hydrous minerals in nodules, by D. Smith and Helmstaedt and Schulze; and the comprehensive description by Danchin of nodules in the Precambrian Premier Mine, which is typical of the better papers of this type in the volume.

The book is printed using a camera-ready process which may account for not only the relatively low price (\$19.00 per volume), but also for the relatively large number of typographical errors, and the poor reproduction of some figures. It may also relate to some incorrect table references (e.g., Table III rather than Table IV, p. 69), or uncorrected drafting errors (Fig. 1, p. 93). There are, however, a number of grammatical errors that should have been picked up by the editors or reviewers. We read, for example, the statement that "This criteria . . . may not be entirely equivocal" when the authors almost certainly mean "The criterion . . . may not be entirely unequivocal", and we put up with the persistent use of "intrusive" rather than the noun "intrusion" in some papers - why must we see the phrase "one or more intrusives in each area . . ." in one paper? But these are quibbles. In general the editors have done an excellent job in producing these volumes, and I have little hesitation in recommending their purchase by anyone interested in kimberlites, nodules and mantle processes.

MS received November 29, 1979

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## Metamorphic Map of the Canadian Shield

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Compiled by J. A. Fraser, W. W. Heywood and M. A. Mazurski  
Map 1475A, Geological Survey of Canada  
\$2.00

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## Metamorphism in the Canadian Shield

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Edited by J. A. Fraser and W. W. Heywood  
Geological Survey of Canada,  
Paper 78-10, 367 p.  
\$8.00 (Canada), \$9.60 (Others)

Reviewed by Walter E. Trzcinski, Jr.  
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"Metamorphism in the Canadian Shield" is a collection of 29 papers presented at a symposium in Ottawa, Canada, May 5-6, 1977 to mark the publication of the first metamorphic map of the Canadian Shield.

The map, sold separately from Paper 78-10, is compiled at a scale of 1:3.5 million and represents the work of many people over a long period of time. The compilation is rather general and subdivides the metamorphism into the classical subgreenschist, greenschist, lower amphibolite, amphibolite, upper amphibolite and granulite facies. Neither diagnostic mineral assemblages nor metamorphic reactions are given for distinguishing the metamorphic facies. Where available, isograds, areas of polymetamorphism, radiometrically determined ages and indicator minerals are shown.

The symposium papers are published according to geological province. There are seven articles about the Superior Province, two about the Slave Province, one about the Bear Province, twelve about the Churchill Province, two about the Southern Province and four about the Grenville Province. An introductory article by W. S. Fyfe outlines some of the goals and questions that metamorphic petrology should address itself to today. Unfortunately too few of the articles arrive at the address. Many of the articles agree with Fyfe that the early crust was thinner than today, and that the metamorphism was of low to medium pressure. Only the anorthosite-related rocks indicate higher pressures of metamorphism. As to be expected for such a gigantic area the articles coverage is uneven. For example,

in the southwest part of the Superior Province there are five detailed articles and by comparison, for an equivalent area in Nouveau Québec there is one short article (62 versus 5 Pages). All the articles give petrographic descriptions of metamorphic rocks and many relate the metamorphism to tectonic events through radiometric data and/or field data.

Of special note is the article by P. H. Thompson on the Slave Province in which the author presents an interesting analysis of erosion events and the resulting distribution of metamorphic intensities. Also of note for their detailed and copious petrographic data and analyses are the articles by Bailes and McRitchie on the Kiseynew Gneiss Belt, Manitoba, Jackson and Morgan on Baffin and Bylot Islands and Morey on the Lake Superior Region, U.S.A.

As W. F. Fahrig points out in the Foreword "The symposium volume and complimentary metamorphic map are expected to focus the attention of petrologists on the metamorphic problems of the Canadian Shield and to result in many years of fruitful research". To the researcher looking for problems this symposium volume will certainly act as an introductory guide.

MS received November 23, 1979

## **Canadian National Committee for the Scientific Committee on Oceanic Research (SCOR)**

It is proposed to move the International Non-Governmental Scientific Committee on Oceanic Research (SCOR) Secretariat, currently housed with the Royal Society in London, England, to Dalhousie University, in late 1980.

An Executive Secretary will be appointed to attend to all aspects of the day-to-day administration of SCOR affairs. The Executive Secretary is directly responsible to the elected officers of SCOR, particularly the President and Secretary. The position of Executive Secretary is a part-time one (probably less than 50%), and will involve some international travel.

Scientists who may be interested or require further information regarding terms of reference, tenure, salary, etc. should contact me, not later than 30 April 1980.

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