

# Paleozoic Evolution and Metallogeny of Pericratonic Terranes at the Ancient Pacific Margin of North America, Canadian and Alaskan Cordillera

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Volume 35, Number 3-4, December 2008

URI: [https://id.erudit.org/iderudit/geocan35\\_3\\_4rv03](https://id.erudit.org/iderudit/geocan35_3_4rv03)

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Publisher(s)

The Geological Association of Canada

ISSN

0315-0941 (print)

1911-4850 (digital)

[Explore this journal](#)

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Cite this document

Waldron, J. W. (2008). Paleozoic Evolution and Metallogeny of Pericratonic Terranes at the Ancient Pacific Margin of North America, Canadian and Alaskan Cordillera. *Geoscience Canada*, 35(3-4), 150–152.

another very readable chapter that deals with Théodore Monod and the on and off, three-quarters of a century-long search for the lost *Fer de Dieu* meteorite of Mauritania.

Two related chapters cover the travels and geological observations of Charles Lyell on the Canary Islands and Madeira and Georg Hartnung on Madeira and the Azores. Continuing with an island theme, the following chapter covers Charles Darwin's visit to the Cape Verde Islands and more specifically examines his (then) catastrophist views and his "conversion" to the more gradualist views of landscape modification expressed by Charles Lyell.

Work in the Americas is highlighted by several chapters including "Naturalists from Neuchâtel", which refers to the Swiss scientists that accompanied Louis Agassiz to America. Also discussed are Clarence Dutton's work on western North American volcanic activity, isostasy, and the geology of the Utah Plateau, and the journeys of J.B. Tyrrell (of Royal Tyrrell Museum of Palaeontology fame) and J.W. Tyrrell across the "Barren Lands" of Canada in 1893 and 1894. This chapter describes the Tyrrells' observations on an epic journey from Edmonton to Lake Athabasca, Baker Lake, Chesterfield Inlet, Churchill and, eventually, Winnipeg, and would be of interest to many Canadian geologists.

A tour of several continents takes the readers first to South America, with two chapters that describe, respectively, native geological travellers in the Portuguese Empire of the late 1700 and early 1800s, and the travels of Charles Darwin (and others) in Patagonia. In Australasia, a chapter is devoted to the search for limestone in colonial New South Wales; another to the works of Thomas Mitchell, a soldier and a geologist who compiled perhaps the first geological maps of southeastern Australia in 1834; and lastly to nineteenth century observations of the Mt. Dun (of Dunite fame) Ophiolite belt of South Island, New Zealand. One other chapter describes the work of Franz Hilgendorf who introduced evolutionary theory to Japan around 1873.

Anyone interested in additional information on any of these topics

would be well-served by the comprehensive bibliographic references that accompany each chapter.

Is the book of general interest? Certainly some sections are, and different readers will find items that will attract and keep their attention. The editor is to be congratulated in pulling together a very diverse set of contributions in a logical pattern. However, some topics will appear more "academic" and of less general interest — albeit still providing material that should broaden knowledge of some areas geographically far removed from North America and Europe. The book is not easy to read, as it contains a large amount of information in a visually condensed format; although the text is clear (no problem with the chosen fonts) there is a problem with the point size and especially with the quotations of abstracted text that appear to be in 5 or 6 point. All illustrations are clear, within the limitations of the original diagrams, maps and photographs.

In summary, this rather expensive book (US\$180.00) book is likely of more interest to the academic reader than to a casual reader of geological information.

## **Paleozoic Evolution and Metallogeny of Pericratonic Terranes at the Ancient Pacific Margin of North America, Canadian and Alaskan Cordillera**

**Edited by M. Colpron and J. Nelson**

*Geological Association of Canada  
Special Paper 45, 2006  
ISBN 1-897095-22-8  
Price \$74.00; Member Price \$55.50*

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This volume represents the culmination of several years of systematic mapping of large areas of the Canadian Cordillera and adjacent Alaska, with a focus on those regions that have traditionally been assigned to the Yukon–Tanana and other pericratonic terranes. Most of the papers represent contributions under the umbrella of the 1999–2003 Pacific Margin NATMAP program, in which provincial and territorial surveys combined with the Geological Survey of Canada to focus mapping efforts on terranes related to the Paleozoic and Mesozoic margins of the Laurentian plate. Additional contributions on Alaska were supported by the United States Geological Survey. The volume represents the culmination of that five-year effort, and provides documentation of the major conclusions of those programs.

This volume contains a huge amount of information, which partly accounts for the length of time it has taken to complete this review. In addition to 18 papers, and two fold-out maps and charts, a CD-Rom (provided in a pocket inside the back cover) contains, in its 345 Mb of data, a prodigious amount of additional information.

The volume can be divided into two somewhat unequal parts. The first twelve papers deal mainly with

areas that have, at one time or another, been associated with the Yukon–Tanana terrane in Alaska, Yukon, and northern British Columbia. These papers present a tightly integrated view of tectonic relationships in the newly mapped areas. An introduction by Colpron et al. attempts to clarify the rather convoluted history of nomenclature in the Yukon–Tanana terrane, and introduces the two fold-out plates contained in the back pocket: a synthesis map of the pericratonic domain of the northern Cordillera, and a stratigraphic chart displaying and correlating numerous successions documented by the research program. The succeeding papers with first authors Dusel-Bacon, Murphy, Devine, Colpron, Roots, and Mihalynuk deal with specific regions. The editors are to be congratulated in achieving some uniformity of legend and colour schemes in the stratigraphic columns, throughout these more localized studies. As a result, it is possible to use the stratigraphic diagrams in all these papers, in conjunction with Plate 2, making it easier for the reader to digest the huge amount of information presented. Efforts have also clearly been made to coordinate colour schemes and legends in the maps, although these are, perhaps, less successful; yellow, for example, is consistently used for clastic units, but it is used for clastic units of many different ages and affinities. Also, many units are filled with black-and-white shadings without colour. More use might have been made of shadings superimposed on colour to provide a scheme in which each major unit had its own pattern. The addition of more cross-sections and field photographs would have helped readers to visualize the structures being described. Nonetheless, these are nit-picking complaints that result from an effort to read these papers in succession. There is far more uniformity in the presentation than would have been possible if, for example, the papers had been presented as diverse journal publications.

Through this sequence of papers, a convincing case is built for a view of the Yukon–Tanana terrane as a portion of Laurentia that became separated in the mid-late Paleozoic but never drifted far from its place of origin. Also clarified is the relationship

between the ‘real’ Yukon–Tanana terrane and regions of Alaska formerly classified as ‘Yukon–Tanana’ but which are now clearly demonstrated never to have left Laurentia. There are still some cracks in the façade of agreement, however. A careful look at the map in Plate 1 reveals a perfectly straight, N–S boundary, coinciding with the Alaska–Yukon border, between the Lake George assemblage, part of the Laurentian margin, and the Klondike assemblage, interpreted to be part of the more travelled Yukon–Tanana block. Clearly there is more work to be done in achieving a synthesis that extends seamlessly across the international boundary.

Both, the introduction by Colpron et al. and a paper by Gunning et al., attempt to extend the analysis southward into parts of British Columbia included in the Stikine terrane. Although useful new data are presented, a link between Yukon–Tanana and Stikinia seems to be assumed by the authors, without strong justification, and without discussion of the supposedly intervening Cache Creek oceanic terrane. One gets the impression from the limited data in the paper that the history of Stikinia is perhaps being shoe-horned into the framework established for Yukon–Tanana. This link comes over as more tenuous than the others established in the first section of the book, and reveals that much more work remains to be done to determine where Stikinia fits in the Cordilleran collage.

Also included in the first section of the book are ‘topical’ syntheses, by subject area. Papers by Orchard and Mortensen et al. deal, respectively, with conodont paleontology and with lead-isotope geochemistry. While the conodont paper is necessarily a data-intensive systematic compilation, and therefore not intended as an easy read, I found the lead-isotope paper a useful and informative introduction to a subject about which I was previously quite unfamiliar. I came out of the paper feeling I had learned a lot. The same was true of the compilation of results from igneous rocks by Piercey et al. The various techniques and isotopic arguments for the sources of magmas are well explained and the conclusions are convincing. The last paper in the

section is a synthesis of the tectonic and metallogenic evolution of the pericratonic domain by Nelson et al., which rounds off the first part of the book well. There is a significant overlap between the material covered in the Piercey and Nelson papers, which probably reflects the fact that five of the six authors on each paper are the same. Both are excellent syntheses, but is it necessary to repeat the same series of maps with only very minor changes? If these papers had been published in separate journals then both would clearly have had to contain overlapping introductory material and regional analysis. Reading them back-to-back, one is left with the feeling that some condensation could have been achieved.

The last part of the book deals with a series of six studies extending into the southern Cordillera. These papers contrast with the first part of the book in that they are much less integrated. Papers by Logan and Colpron, and Ferri and Schiarizza deal with stratigraphic and structural relationships in the Kootenay terrane. Interestingly, cross-sections are much more in evidence here than in the first part of the book, and they help the reader significantly in grasping the map relationships. A substantial paper by Paradis et al. examines magmatism and massive sulphide deposits in the Eagle Bay assemblage of the Kootenay terrane. While providing excellent data and interpretations on these topics, the stratigraphic framework of these units is particularly convoluted; the reader’s grasp of the stratigraphy is not helped by the fact that many units are referred to only by their map acronyms (e.g. unit EBAF), which are never spelled out in full. While this language may be common to participants in the Pacific Margin NATMAP program, it is not particularly accessible for outsiders who wish to learn their way around Cordilleran geology. The largest longest and probably most controversial paper in the second part of the volume, is by Thompson et al., and presents a discussion of a large swath of southern British Columbia, much of which has been included in the Quesnel terrane. The authors present a strong critique of previous syntheses, including an unusual number of quotations from

previous literature, which they use both to underscore the contradictions of previous interpretations and to support their thesis that stratigraphic units can be traced from the Laurentian margin well out into the area mapped as Quesnellia. Interestingly, many of their section headings and interpretations are stated as questions; they raise the possibility that, at the latitude of their study, there was never a Slide Mountain oceanic domain separating Quesnellia from the continental margin, and that previous cross-sections and palinspastic reconstructions showing the Kootenay terrane originating outboard of the Monashee complex are incorrect. The final two papers in the volume present additional data that have a bearing on the status of Quesnellia, from stratigraphic and isotopic perspectives, respectively. The short paper on the Trail Gneiss by Simony et al. shows that at least some basement rocks in Quesnellia appear to be juvenile, and do not represent fragments of North America as would be suggested by the Thompson et al. hypothesis.

It is clear from the overall structure of the volume that these topics are controversial, and that the broad consensus achieved in the northern Cordillera does not extend to southern British Columbia. The cover picture, for example, shows a reconstruction from the Nelson et al. synthesis in which Quesnellia is located well away from Laurentia, in contrast to the Thompson et al. model for a Quesnellia which remains attached to the continent. These controversies will undoubtedly be thrashed out in the coming years; unfortunately, the GAC special volume format means that there is no opportunity for 'discussion and reply' debates as would be possible in a journal.

The volume also raises a broader question in Cordilleran tectonics. When the terrane concept was originally proposed in the Cordillera in the 1970s and 80s, terranes were defined as fault-bounded regions between which there were no known stratigraphic links. A division into terranes became standard in presenting the geology of the Cordillera. The work stimulated by the terrane concept, including that presented in the current volume, has led to the discov-

ery of stratigraphic links between some of these regions. For example, in the present volume, mafic rocks described as 'oceanic' and labelled 'Slide Mountain Terrane' are shown in stratigraphic contact with the authors and editors of this volume have chosen (perhaps wisely) not to open this Pandora's box just yet, preferring instead to use the traditional terrane terminology. In the meantime, those learning Cordilleran geology have to be prepared to deal with some contradictions.

Physically this is a well-produced volume. There are occasional grammatical errors that the editors missed, as well as some instances where east and west are mixed up in locations, but these are minor irritations. The CD contains complete copies of all 18 papers in pdf formats at both low and high resolution, together with supplementary information in the form of data tables and no less than 30 complete open file maps at 50 000 and 100 000 scales. Although most of these maps are available on the BC and Yukon government websites, it takes time to search out and download them; having all 30 maps in the same place is a tremendous benefit. It is unfortunate that it was not possible to include pdf maps in the contributions on Alaska, which would have made this a truly international resource. Nonetheless, the data that are provided represent significant added value for researchers.

Despite the minor misgivings expressed above, this volume is a major achievement and is a tremendously useful resource for Cordilleran geology. The editors are to be congratulated in bringing together a huge number of authors in a volume that has a much more integrated feel than a typical conference-derived special publication. The degree of coordination is impressive, particularly over the first twelve papers. This volume should stand for many years as a milestone, and as a basis for discussion and further work, in the understanding of the Canadian Cordillera.