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Cambrian Strata of the WCSB (South Area): An integrated Chapter with a Multidisciplinary Perspective

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Summary

We present a Southern Area synthesis of the Cambrian to Lower Ordovician that enables margin-to-interior correlations by integrating outcrop-anchored time-equivalent markers, outcrop and subsurface biostratigraphy and U–Pb geochronology, and a sequence-stratigraphic reading of the Sauk megasequence. This work is framed within an approach that (i) revises parts of the stratigraphy, (ii) reconciles formation-scale lithological shifts with age-equivalent surfaces, and (iii) delivers the map and cross-section products needed for Atlas 2027.

Introduction

This Cambrian chapter summarizes the stratigraphic framework developed for the Geological Atlas of the Western Canada Sedimentary Basin—Atlas 2027 project. It highlights the collaborative efforts of co-authors and contributors across surveys, universities, and industry. This work stands explicitly on the collective foundation built by decades of Cambrian field geologists, subsurface mappers, paleontologists, and stratigraphers who advanced our understanding long before the Atlas 2027 effort began.

The chapter integrates lithostratigraphy, sedimentology, biostratigraphy, geochronology, and sequence stratigraphy to refine regional correlations, chronostratigraphic ties, and depositional models across the basin. We created regional maps and basin-scale cross-sections that document the distribution, thickness, and lithological variability of Cambrian successions, and we systematically embed biostratigraphic and radiometric age control to tighten timelines and highlight the diachronous nature of some units. Framed within a sequence-stratigraphic approach, these data illuminate the evolution of depositional systems, accommodation trends, and basin-infill history, providing a robust framework for regional correlation and basin analysis.

Organization and Extent of the Chapter

The Cambrian strata of the WCSB are organized into two geographically defined parts—South Area and North Area—that together deliver a basin-wide Cambrian stratigraphic framework consistent with the Atlas 2027 mandate.

Part 1 (South Area) spans the southern WCSB, linking the Rocky Mountain Front and Main Ranges to the Alberta–Saskatchewan–Manitoba plains. Its primary aim is to establish time-equivalent correlations between the mountain-belt outcrop and the subsurface (Figure 1). A dedicated northeast British Columbia subsection extends these ties laterally from the Cordilleran exposures into the basin interior. Part 1 also includes a brief subsection on the milestones in the history of Cambrian study, summarizing foundational developments that shaped the evolution of regional understanding.

Part 2 (North Area) focuses on the northern WCSB—Yukon and the Northwest Territories—synthesizing the Sahtu Basin and the roles of the Mackenzie and Ogilvie arches, the Misty Creek

Embayment, and linkages into the Richardson/Ogilvie/Wernecke–Mackenzie–Selwyn belts. The northern component follows the Atlas 2027 extension up the Mackenzie corridor toward the Arctic coast, using harmonized cross-sections and formation edges/isopachs to bridge the south–north gap where Cambrian strata are absent or truncated beneath younger unconformities.

Stratigraphic Approach and Rationale for Formation Descriptions

We organize the Cambrian–lower Ordovician description into three genetic units that match the Sauk subdivisions of Palmer (1981)—(I) latest Ediacaran–lower Cambrian, (II) middle Cambrian, and (III) upper Cambrian–lower Ordovician—and present each unit separately, covering the stratigraphy of the Cordilleran margin and the subsurface of the Interior Plains. Within each unit, we further sort formations by facies belt—Inner Detrital (craton), middle Carbonate Shoal (platform), and Outer Detrital (outboard/basin)—so that age-equivalent, genetically related packages remain the organizing principle while lateral lithologic change is expressed naturally along the same time surface.

We employ a basin-wide set of stratigraphic markers, constrained by biostratigraphy, to trace lateral, age-equivalent units from the southern Canadian Rockies into the subsurface of Alberta, Saskatchewan, and Manitoba. Markers are named where they are best exposed and defined (outcrops in the southern Rockies) and then projected into the Interior with biostratigraphic control. Because formal formations (e.g., Deadwood) are lithologically diverse and exhibit strong lateral facies changes, we do not force every pick to coincide with a lithologic break; the time surface is the primary datum, and lithology is allowed to vary laterally along that surface.

Basal Cambrian Sandstone (BCS) explicit exception: The BCS is intentionally portrayed with a time-transgressive top because it onlaps and drapes Precambrian basement and becomes younger eastward. We retain it as a lithostratigraphic reference as a Cambrian unit to communicate its regional footprint and thickness (including current carbon capture and storage and Helium exploration and production relevance), which follows its lack of formal formation status due to its highly diachronous nature. In cross-sections, the BCS top is flagged with an asterisk and not linked between wells, so the time-equivalent framework remains intact.

Results

This trans-provincial collaboration delivered the Cambrian Chapter (Part 1 – South Area) for Atlas 2027, including 10 new regional maps and 12 basin-scale cross-sections (e.g. Figure 2) that document the distribution, thickness, and lithological variability of Cambrian successions. A key advance over prior syntheses is the systematic integration of biostratigraphy and U–Pb geochronology into a sequence-stratigraphic framework, which tightens stratigraphic correlations and chronostratigraphic ties across the basin. Taken together, these data clarify depositional systems, accommodation trends, and the basin-infill history, providing a portable foundation for regional correlation, basin analysis, and future geological studies.

Acknowledgements

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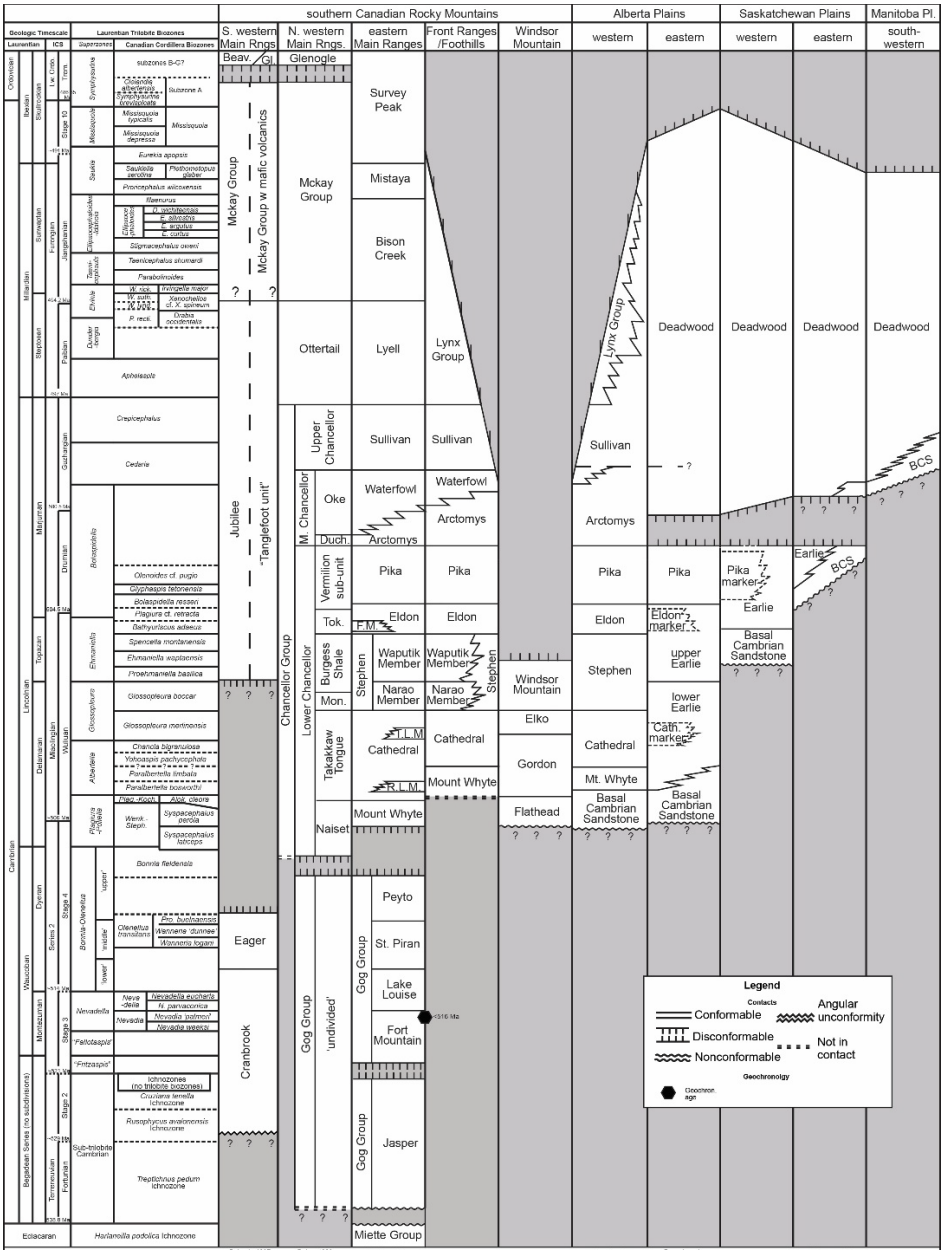


Figure 1. Correlation chart of lower and middle Cambrian formations from the plains of southwestern Manitoba to as far west as the southern portion of the western ranges of the southern Canadian Rocky Mountains in southeastern British Columbia. Chronostratigraphic abbreviations: Lr. Ordo. = Lower Ordovician Series; Trem. = Tremadocian. Biostratigraphic abbreviations: *N. parvaconica* = *Nevadella parvaconica*; *Pro. buelnaensis* = *Proliostracus buelnaensis*; *Wenk. – Steph.* = *Wenkchemnia–Stephenaspis*; *Plag. – Koch.* = *Plagiura–Kochaspis*; *Alok. cleora* = *Alokistocare cleora* (originally called the *Amecephalus cleora*); *P. recti.* = *Proceratopyge rectispinata*; *W. lynd.* = *Wujiajiania lyndasmithae*; *W. suth.* = *Wujiajiania sutherlandi*; *W. rick* = *Wujiajiania ricksmithi*; *E. curtus* = *Ellipsocephaloides curtus*; *E. argutus* = *Ellipsocephaloides argutus*; *E. silvestris* = *Ellipsocephaloides silvestris*; *D. wichitaensis* = *Dartonaspis wichitaensis*. Lithostratigraphic abbreviations: B.C.S. = Basal Cambrian Sandstone; R.L.M. = Ross Lake Member; T.L.M. = Trinity Lakes Member; F.M. = Field Member; Cath. Marker = Cathedral marker; Mon. = Monarch Formation; Duch. = Duchesney unit; Oke = Oke unit; M. Chancellor = Middle Chancellor Group; Gl. = Glenogle Formation; Beav. = Beaverfoot Formation.

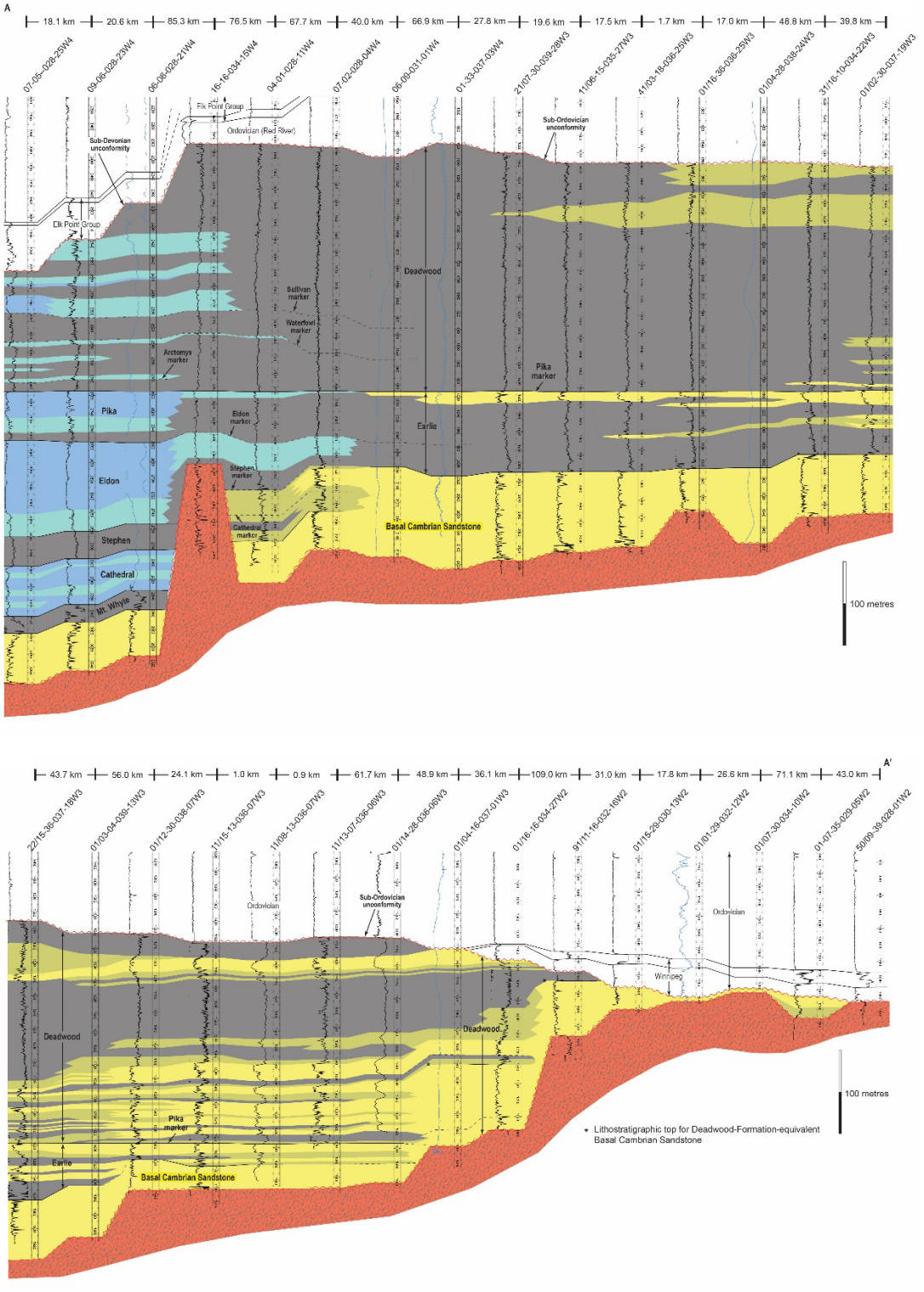


Figure 2. West–east cross-section example from the Cambrian Chapter of Atlas 2027. In the Atlas, the cross-section is presented in two panels, with the left panel above and the right panel below.