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Getting the Wind(ermere) at our Back(bone): Clarifying Fifty Years of Ediacaran-Cambrian Confusion in NW Canada

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Summary

The Mackenzie Mountains of northwestern Canada preserve a thick Neoproterozoic to Paleozoic succession that records the extended early evolution of the northwest Laurentian margin. Lithostratigraphic correlations in the trilobite-bearing Cambrian (Cambrian Series 2 and above) and younger strata are reasonably robust, as are those in the Tonian and Cryogenian. By contrast, correlations in the Ediacaran and sub-trilobite Cambrian (i.e., Terreneuvian) are a source of puzzlement dating back to bedrock mapping projects of the 1960s. In part, this reflects strongly developed onshore-to-offshore (northeast to southwest) trends, which caused dramatic changes in the stratigraphic packaging of this interval across the region. The resulting confusion hampers modelling of Ediacaran-Cambrian basin evolution and tectonics.

In proximal successions, a “cap carbonate” marks the base of the Ediacaran. Above this, the Sheepbed Formation consists mainly of dark-weathering shale, capped by a locally preserved carbonate member. The interval between the Sheepbed Formation and the Cambrian (Series 2) Sekwi Formation is represented by the Backbone Ranges Formation, which contains a lower siliciclastic member, a middle carbonate member, and a quartzite-dominated upper member. In distal successions there are up to seven formations in the same interval, and age constraints from Ediacaran macrofossils and Cambrian ichnofossils place the sub-Cambrian unconformity at a karst surface atop the carbonate-dominated Risky Formation, partway between the Sheepbed and Sekwi formations. The Risky Formation is the uppermost Windermere Supergroup unit in the Mackenzie and Wernecke Mountains. The proximal Backbone Ranges Formation has lacked biostratigraphic data, and the sub-Cambrian unconformity has been placed variously at the formation’s erosional base or at a karst surface atop the middle member.

Recent studies of the proximal succession in the northern and eastern Mackenzie Mountains suggest that the upper member of the Backbone Ranges Formation is divisible into at least four regionally mappable units. New collections of Ediacaran macrofossils and Terreneuvian trace fossils from the northern Mackenzie Mountains place the Ediacaran-Cambrian boundary within the upper member, at the top of a regionally extensive carbonate tongue correlated with the Risky Formation. Thus, the sub-Cambrian unconformity and the top of the Windermere Supergroup lie within the upper member of the Backbone Ranges Formation. This presents a challenge to lithostratigraphic bookkeeping that likely will require abandonment of the Backbone Ranges Formation. However, the finer divisions and new age constraints for these strata provide a clearer understanding of regional lithostratigraphic and allostratigraphic correlations—a necessary precondition for accurate tectonostratigraphic understanding of the early evolution of the NW Laurentian margin.