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Newly proposed regional correlations of Neoproterozoic Windermere Supergroup stratigraphy in the southern Canadian Cordillera

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Rocks of the Neoproterozoic Windermere Supergroup (WSG) in the southern Canadian Cordillera (SCC) were deposited during a pivotal time in Earth history that included the break-up of the supercontinent Rodinia, multiple major marine isotopic excursions, and the advent of multicellular life to name but a few. Nevertheless, despite its geological significance many fundamental questions remain unresolved, which in part can be attributed to the challenges in regional stratigraphic correlation caused by the general absence of biostratigraphic and absolute geochronological control in these mostly siliciclastic rocks. However, recent advances in various geochemical tools and techniques and the study of a number of key outcrops have begun to provide important insight into better constraining the regional lithological and temporal relationships of Windermere Supergroup (WSG) stratigraphy in the SCC.

Based on recent detrital zircon data Hadlari et al. (2021) showed that the WSG in the SCC can be subdivided into two parts based on detrital zircon (DZ) data. The basal part comprises a rift succession dominated by a Grenville-dominated DZ assemblage (1.0-1.5 Ga), in addition to volcanic rocks dated at 669.6 + 6.7Ma (Hadlari et al. 2024), which provides a maximum depositional age for the younger overlying part. This upper part comprises a distinctively bimodal Paleoproterozoic (1.75-1.95 Ga) and Archean (> 2.5 Ga) DZ assemblage and represents an areally expansive (> 35,000 km2) deep-marine turbidite system composed largely of siliciclastic rocks with few regional lithological markers and almost no absolute geochronological control. These strata are very well exposed in the Cariboo Mountains of east-central B.C. Here, a number of km-scale outcrops composed of steeply dipping strata have provided not only detailed insight into the sedimentological aspects of these strata but also their lithological make up and stratal architecture and arrangement. Combined with the recent geochronological control, these new stratigraphic data provide a better comparison with earlier attempts to correlate WSG strata in the southern Canadian Cordillera, most significantly the compilation of McMechan (2015) (Fig. 2). Revisions to the work of McMechan are confined mostly to the upper part of the Windermere succession, which is particularly relevant to the positioning of the sub-Cambrian unconformity, and accordingly, the initiation of events leading to development of the Western Canada Sedimentary Basin. In particular, strata included previously in the WSG may in fact be part of a thick succession of mass transport deposits with common decameter-scale blocks of carbonate possibly associated with the earliest stages of the sub-Cambrian unconformity, which then is overlain by a thick succession of carbonates overlain by siliciclastic slate overlain by a succession of mixed and/or interlayered carbonate and siliciclastic strata, and ultimately quartz arenites of the well-known Gog/McNaughton groups. This suggests that the sub-Cambrian unconformity may in fact be older and improperly positioned in many existing correlation schemes, but more profoundly, much more complicated

than previously thought, and in fact may represent a single composite surface of discontinuities locally but elsewhere multiple separated disconformable surfaces bounding post Windermere strata (Fig. 3).

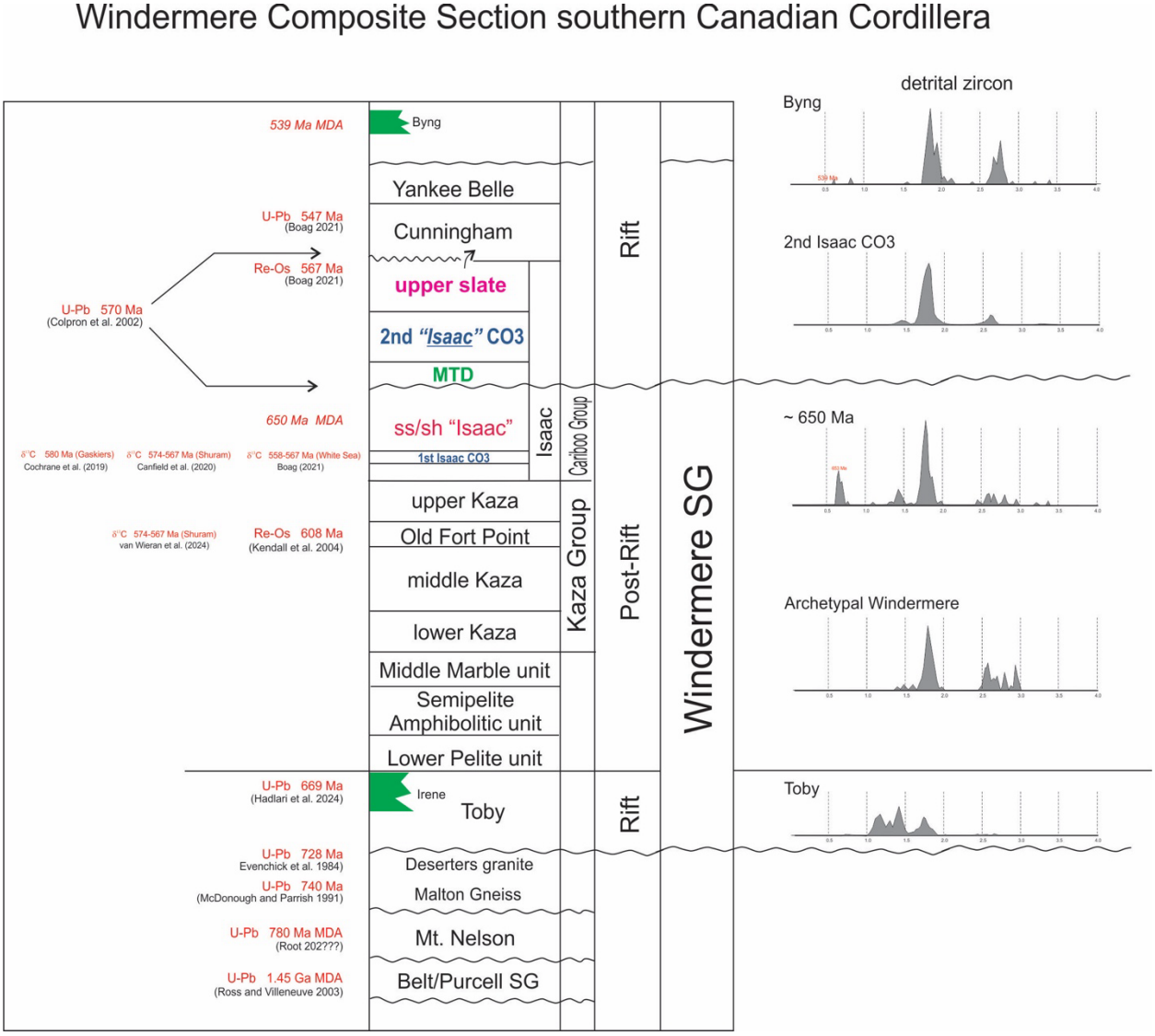

Fig. 1 Proposed composite stratigraphic section of Neoproterozoic stratigraphy in the Southern Canadian Cordillera. Geochronological control shown in red font on the left. Detrital zircon assemblages shown on right. Note the subdivision of the stratigraphy into an unconformity-bounded basal rift/post-rift assemblage, which coincides with the Windermere Supergroup, and an upper rift succession bounded at its base an unconformity overlain locally by a mass transport deposit (MTD) containing carbonate blocks, some measuring hundreds of meters in length and several tens of meters in thickness. This unconformity is possibly the first of several unconformities formed during the Late Precambrian to Early Paleozoic along the continental margin of Laurentia and be coincident with the onset of tectonism leading to the development of the Western Canada Sedimentary Basin.

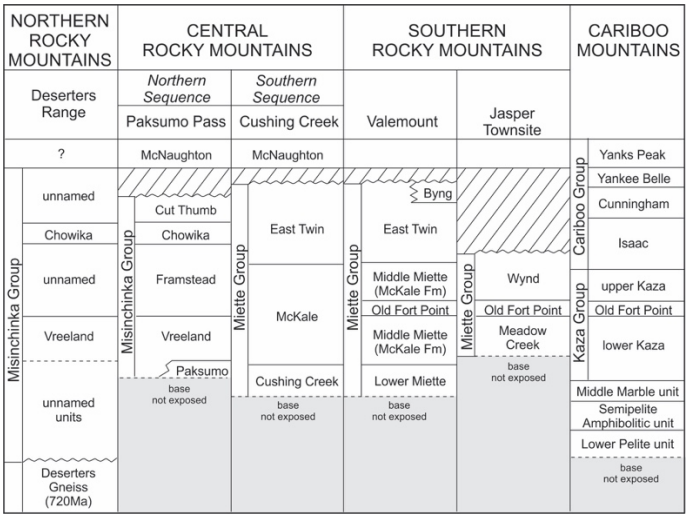

Fig. 2. Correlation chart of Windermere stratigraphy in the Southern Canadian Cordillera by McMechan (2015).

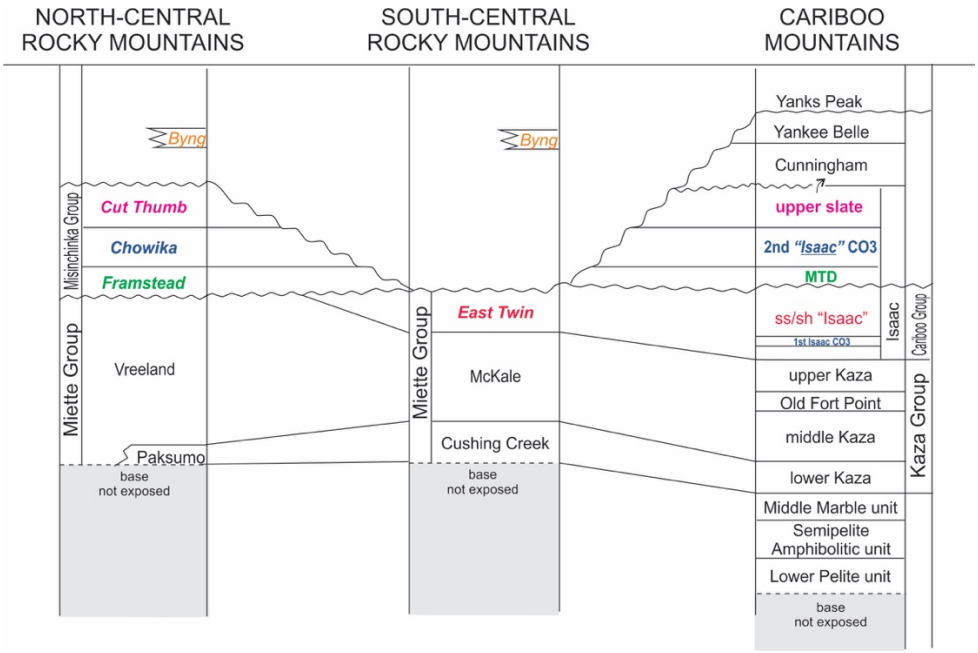

Fig. 3. Proposed correlation of Neoproterozoic strata in the Cariboo Mountains with those in the central Rocky Mountains. Nomenclature of strata in the central Rocky Mountains follows that of McMechan (2015).

References

McMechan, M.E., 2015. The Neoproterozoic succession of the central Rocky Mountains, Canada. Bulletin of Canadian Petroleum Geology, v. 63, p. 243-273.