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Stratigraphic continuity across the southern Canadian Cordilleran Foreland Thrust and Fold Belt: Implications for tectonic models

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Introduction

Several hypotheses have been proposed in recent decades that there is a major Cretaceous aged suture or subduction zone within the southern Canadian Rockies and elsewhere along strike in the Canadian and American Cordillera that separates exotic, non-North American 'ribbon continent' rocks from North American rocks. These include the Cordilleria model (Chamberlain and Lambert, 1985, Lambert and Chamberlain, 1988), SAYBIA model (Johnston, 2008; Chen et al., 2019) and the Rubia ribbon continent model (Hildebrand, 2009, 2013). The surface location of the suture in the SAYBIA and Rubia ribbon continent models is interpreted to be at or adjacent to the Lower Paleozoic carbonate to shale basin facies change that is located at the boundary between the Eastern and Western Main Ranges of the southern Canadian Rockies (Fig. 1, Johnston, 2008; Hildebrand, 2013; Chen et al., 2019). Proterozoic Purcell Supergroup and Windermere Supergroup strata are considered to be part of the exotic ribbon continent in both the SAYBIA and Rubia models, and it logically follows that all pre-Cretaceous strata deposited above the Windermere or Purcell successions would necessarily be exotic according to the models.

In this abstract we briefly describe stratigraphic information accumulated during more than 100 years of geological investigations within the southeastern Canadian Cordillera that strongly indicate that there is little chance that a major ribbon continent suture is present within the Rockies, the Rocky Mountain Trench, or the adjacent Purcell, Selkirk or Cariboo Mountains. This conclusion is based mainly on the observation that many details of Mesoproterozoic, Neoproterozoic and Paleozoic stratigraphic successions can be confidently correlated throughout the region across, and around the ends of, thrust faults and other structures. It is noteworthy that all of the major sequences except the Neoproterozoic Windermere Supergroup extend into the undeformed Plains of southern Canada or Montana. This clearly demonstrates that these successions are part of the North American geological province.

Purcell Supergroup

Widespread stratigraphic subdivisions of the Mesoproterozoic (ca. 1500 Ma to 1320 Ma) Purcell Supergroup (Belt Supergroup in the USA) can be correlated from central Montana, where the succession overlies Paleoproterozoic basement (Schieber, 1989), through the northern American Cordilleran thrust belt and the Southern Canadian Rocky and Purcell Mountains, and the Selkirk Mountains adjacent to the US border. An additional tie to the North American craton

is provided by Lower Paleozoic, Upper Paleozoic and Mesozoic strata that overlie the Purcell Supergroup in the Lewis Thrust Sheet and are correlative in detail with strata in the Plains.

Recognition and correlation of laminated stratigraphic 'markers' in the Aldridge Formation (Hamilton et al., 2000) provide remarkably compelling stratigraphic ties between outcrops in the western Rockies, across the Rocky Mountain Trench and the Purcell Mountains, and into the Selkirk Mountains in southernmost Canada (Brown et al., 2011 and other maps in the same series; Paul Ransom, written communication, 2019).

Windermere Supergroup

Correlation of stratigraphic subdivisions of the Neoproterozoic Windermere Supergroup (ca. 720 Ma to 570 Ma) establishes linkages between the central and western portions of the Rockies and the Purcell, Selkirk, and Cariboo Mountains. The widespread distribution of the Old Fort Point Formation and correlatives (Smith et al., 2014) reinforces the reliability of the stratigraphic correlations between the various regions of outcrop.

Latest Neoproterozoic and Lower Paleozoic Strata

The uppermost Neoproterozoic to Silurian tectonostratigraphic sequence is widely distributed throughout the Rocky, Purcell, Selkirk and Cariboo mountains in southern Canada as well as in the subsurface in the Foothills and the Plains as shown in Fig. 1. The basal, uppermost Neoproterozoic and Lower Cambrian portion of the sequence (Hamill Group, Gog Group and correlatives, along with overlying Lower Cambrian strata) can be correlated between the central and western regions of the Rockies and across the Purcell, Selkirk and Cariboo Mountains. In particular, a triplet succession of Lower Cambrian quartzite with overlying shale and Archaocyathid limestone can be traced south and west from the Jasper Alberta area to the Kootenay Arc. There can be no Kootenay Terrane – Lower Paleozoic strata in the Kootenay Arc must be of North American affinity.

Middle Cambrian to Silurian strata can be confidently correlated from the Plains into the Rockies, and across the carbonate to shale facies change at the Kicking Horse Rim, at the boundary between the Eastern and Western Main Ranges (Aitken, 1971; Cook, 1975; Stewart et al., 1993; Collom et al., 2009). Lower Paleozoic strata overlie autochthonous North American Paleoproterozoic basement, Mesoproterozoic Purcell Supergroup and Windermere Supergroup strata at different locations throughout the region, and thus the Lower Paleozoic succession ties all of these older rocks together.

Devonian to Triassic Strata

This succession can be correlated from the undeformed Plains into the Front and Eastern Main Ranges of the Rockies. Devonian and also locally Mississippian strata are present in the western portions of the Rockies and in scattered locations in the eastern Purcell Mountains. Devonian strata overlie Lower Paleozoic strata in the Plains and at many locations in the Rockies; locally they overlie Mesoproterozoic Purcell Supergroup and Neoproterozoic Windermere Supergroup strata.

Crowsnest Pass Cross-Strike Discontinuity

This discontinuity is a NE-trending zone in the southernmost Canadian Cordillera (Fig. 1; Price, 1994) across which significant syndepositional changes in thickness and facies occur within Mesoproterozoic and Paleozoic strata in the Cordillera (Benvenuto and Price, 1979; McMechan and Price, 1982). Cretaceous deposition in the Plains was also influenced by this zone (Zaitlin et al., 2002). The zone is interpreted to have been controlled by by reactivation of structures within the basement. The continuation of the zone from the Plains, across the Rockies and the Rocky Mountain Trench and into the Purcell Mountains ties the strata in the thrust belt to autochthonous North America, and indicates that there is no significant strike-slip in the region.

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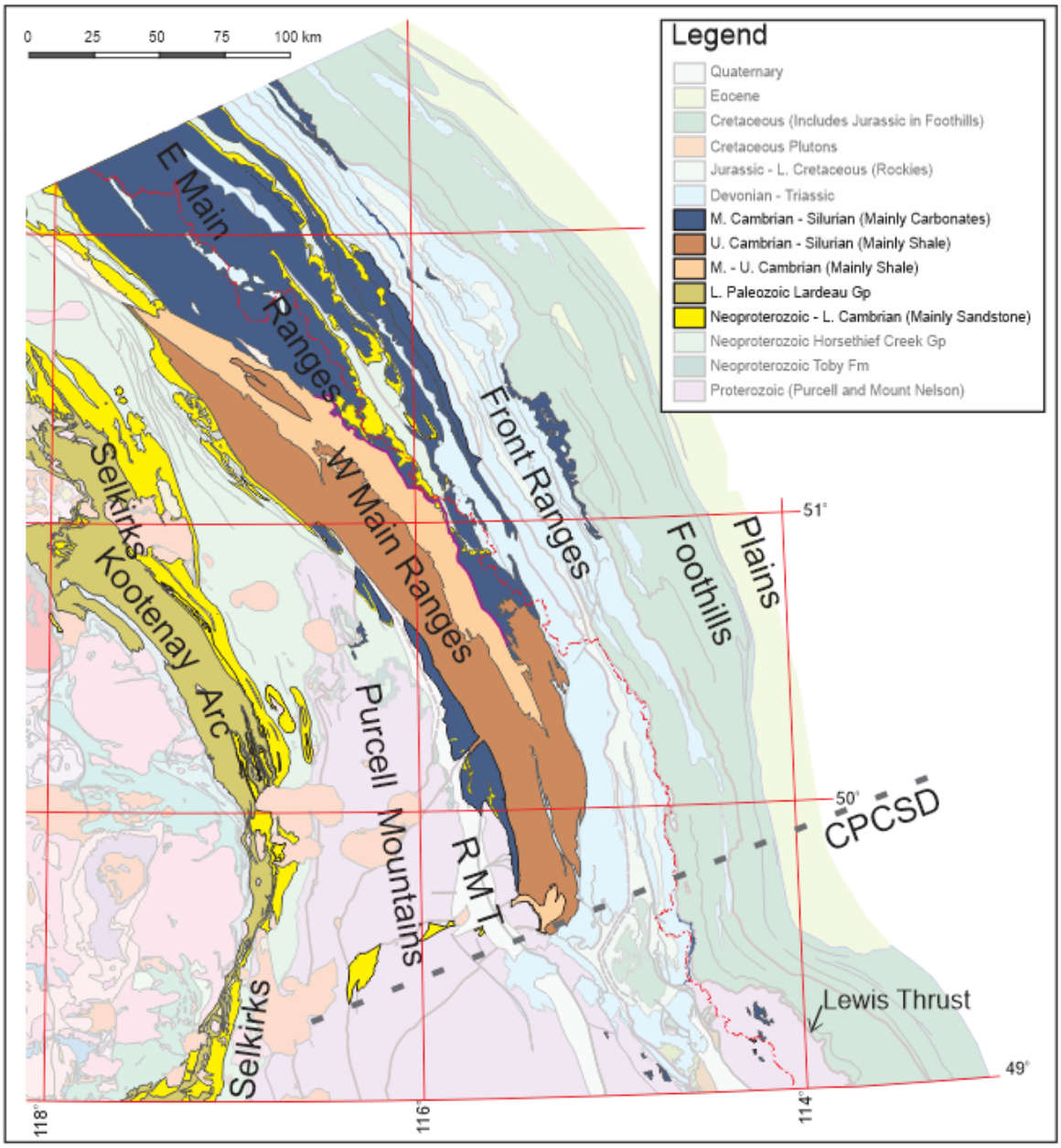

Fig. 1. Geological map of the southern Canadian Cordilleran Foreland Thrust and Fold Belt, with outcrops of Lower Paleozoic strata emphasized. Lower Paleozoic strata are also widely distributed in the subsurface in the Foothills and Plains. The map is compiled from maps by the Geological Survey of Canada, the British Columbia Geological Survey, and Alberta Geological Survey. CPCSD: approximate location of the Crowsnest Pass Cross-Strike-Discontinuity. R M T: Rocky Mountain Trench.