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Geology of the southern Kicking Horse Rim Cambrian carbonate platform edge, southern Canadian Rocky Mountains – structural and tectonic implications

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Summary

The Kicking Horse Rim (KHR; Aitken, 1971) is an 80 km long paleotopographic feature developed at the edge of the Cambrian carbonate platform west of Calgary, Alberta. Episodic uplift occurred along this NNW trending zone during the Miaolingian and Furongian (Middle and Upper Cambrian) and controlled the position of the facies change between the carbonate platform and deep-water slope environments to the west (Aitken, 1971; Stewart, 1991).

In the southern KHR study area (Figure 1), extensive hydrothermal alteration, with local magnesite and/ or Pb-Zn mineralization occurred along the west margin of the Rim. The earliest evidence of Rim uplift in the study area occurred during deposition of the Cathedral Formation with the westward disappearance of northeasterly sourced shale tongues (early to medial Miaolingian; Aitken, 1997). The main carbonate units: Cathedral, Eldon-Pika, Waterfowl, Lyell change into basinal facies in slightly different places in the KHR with the Cathedral escarpment occurring west of the change for the Eldon-Pika unit consistent with observations for the northern KHR area (Stewart, 1991; Stewart et al., 1993). Spectacular slump scars and mega-conglomerates mark the edge of the platform at the upper Eldon-Pika level in the northern half of the study area. These locally-sourced megaconglomerates form an undisputable stratigraphic tie between the platform and basin. Together with the unfaulted or discontinuously faulted nature of the change from platformal to basinal strata, they clearly show this a stratigraphic feature and not a suture between an exotic 'ribbon continent' (SAYBIA - Johnston, 2008; Chen et al., 2019; Rubia - Hildebrand, 2009, 2013) and North America. Southward facies changes into basinal strata of the McKay Group suggest the KHR did not extend as far south during deposition of the youngest units of the Cambrian platformal succession (Bison Creek, Mistaya).

Cambrian platformal strata of the KHR form a broad area of exposure near Mount Assiniboine with younger units progressively exposed to the SSE until the platformal strata of the Lyell Formation disappear near the Palliser River. In contrast to the tight folds and penetrative fabrics developed in adjacent basinal Cambrian and Ordovician strata (Chancellor and lower McKay groups) to the southwest and northeast, platformal strata are mainly deformed by kilometre scale open folds and flexures. In the Mount Assiniboine area these form the hanging wall of the Simpson Pass thrust (SP), further south they form the broad upright limb of a large, southward-

plunging, east-facing monocline. Near Mount Assiniboine the SP abruptly truncates structures in its footwall.

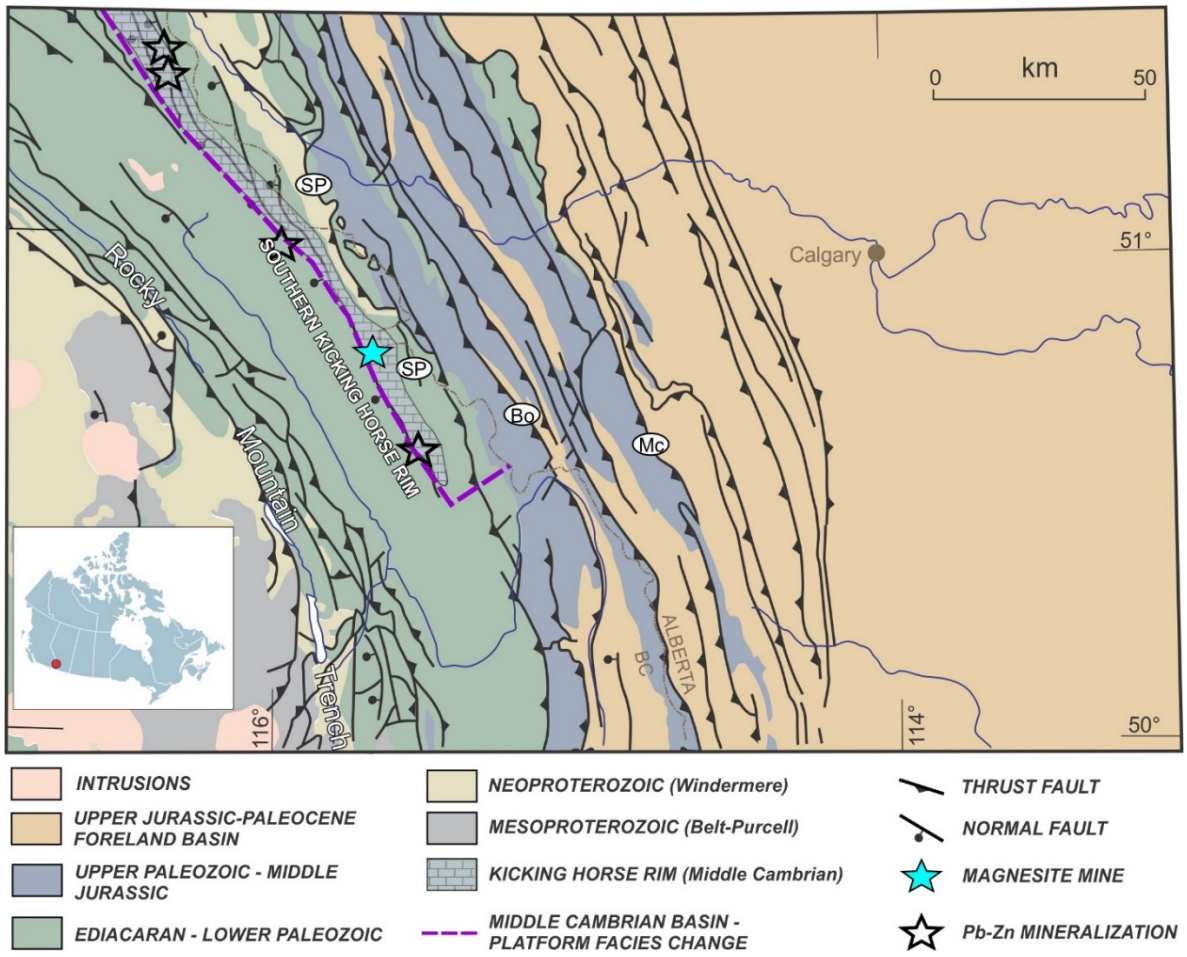

Figure 1. Geological map of the southern Canadian Rocky Mountains showing the location of the Kicking Horse Rim and associated mineral deposits. Mc –McConnell Thrust, Bo – Bourgeau Thrust, SP- Simpson Pass Thrust. Geology after (Wheeler and McFeely, 1991).

Ten detailed and two regional cross sections across the southern KHR strongly suggest that: 1. the southward disappearance of the Cambrian platform at surface is due to underlying structure and not the result of stratigraphic thinning; 2. a single thrust fault with a prominent hangingwall ramp through the entire Cambrian platformal succession initially carried the KHR strata northeastward to form an east-facing monocline; 3) in the north this fault continued to climb up section through Ordovician to Permian and probably to Jurassic strata as the Fatique thrust; 4) in the south much of the displacement on this fault went into a detachment in argillites of the basal McKay and formed faulted detachment folds at Upper Ordovician to Devonian stratigraphic levels. Thus the northern edge of the thick McKay basin appears to have had a

significant effect on the subsequent structural style; 5) the Simpson Pass thrust is an out-of-sequence thrust fault at its south end that truncated in its footwall the monocline of Cambrian strata formed above the Fatique thrust.

From the above structural relationships it appears that motion on the Fatique thrust and deformation of the western Main Ranges including the part carried on the Bourgeau thrust sheet occurred prior to motion on the southernmost Simpson Pass thrust. Although there are no direct constraints on the timing of deformation, intrusive relationships from the western Main Ranges southwest of the study area show deformation occurred prior to 109 Ma (Larsen and Price, 2006; Larson et al., 2006) during a regional Late Jurassic – Early Cretaceous deformation event (Price, 1981; Evenchick et al., 2007; Simony and Carr, 2011). Using dates from fault gouges Pana and van der Pluijm (2015) suggested movement on the SP occurred in the Late Jurassic.

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