

# STRATIGRAPHY AND STRUCTURE OF THE WILD HORSE RIVER AREA, SOUTHEASTERN BRITISH COLUMBIA

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**KEYWORDS:** Regional geology, Fernie map-area, Southern Canadian Cordillera thrust and fold belt, Paleozoic sediments and volcanics, mid-Cretaceous plutons.

## INTRODUCTION

The Wild Horse River area is situated in an anomalous part of the western Main Ranges of the Rocky Mountains near Cranbrook, B.C. (Figure 1). It lies immediately north of the transverse NE-trending Boulder Creek fault which is part of the Crowsnest Pass Cross Strike Discontinuity (CPCSD; Price, 1994, 2000), a major structural and stratigraphic discontinuity

in the Southern Cordillera that coincides with a 220 km right hand offset in the margin of the Cordilleran miogeocline. The anomalous features of the Wild Horse River area include: conspicuous variations in Cambrian stratigraphy, the occurrence of anomalous mafic volcanics within Cambrian and Ordovician miogeoclinal strata, several small mid Cretaceous (?) plutons, and the enigmatic steep northeast-trending Boulder Creek transverse fault. This critical segment of the western Main Ranges has the potential to provide important new insights on the tectonic evolution of the Cordilleran miogeocline and the Cordilleran foreland thrust and fold belt in the vicinity of the CPCSD.

The stratigraphic succession in the Wild

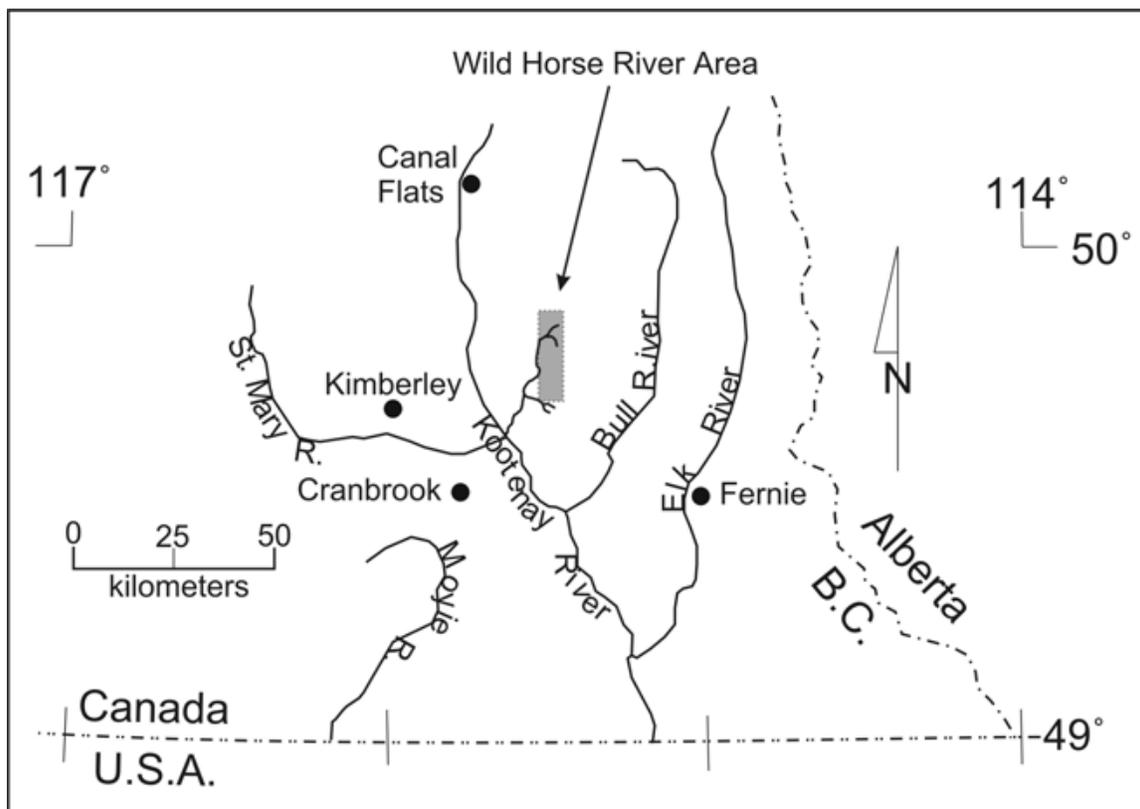


Figure 1. Location map of the Wild Horse River area (outlined in grey).

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Horse River area comprises Cambrian and Ordovician miogeoclinal carbonate rocks, shales and sandstones that unconformably overlie Mesoproterozoic sedimentary rocks of the Purcell Supergroup (Schofield 1922; Rice, 1937; Leech, 1958; Welbon and Price, 1992a, 1992b, 1993). The geological structure of the Wild Horse River area is complex, comprising, west-verging back thrusting and folding along the western flank of the Porcupine Creek fans structure, and superposed east-verging structures associated with the Lussier River thrust fault, which underlies the eastern limb of the Purcell anticlinorium. At least part of the displacement on the anomalous transverse, northeast trending Boulder Creek fault, may be related to the much younger (Tertiary) normal faulting that produced the Southern Rocky Mountain Trench. Detailed structural mapping in the Wild Horse River area has outlined the relationships between east and west verging structures, and has elucidated the enigmatic stratigraphy, and timing relationships between thrusting and folding and the mid-Cretaceous plutons.

## PREVIOUS WORK

The initial systematic outline of the regional geology of the Cranbrook region was based on reconnaissance geological mapping by J.S. Schofield (1922). Subsequently H.M.A. Rice (1937) published a more detailed map (1 inch = 1 mile) and description of the regional bedrock geology of the Cranbrook map area, which includes the southwest corner of the Wild Horse River area. In the late 1950's G.B. Leech (1958, 1960) produced a 1 inch = 2 miles map of the Fernie map area, west half, that encompassed all of the Wild Horse River area and he also defined the regional geological setting upon which later more detailed studies have been based. More recently, Höy (1982, 1985) and McMechan (1979) have produced more detailed maps (1:50,000) of the Mesoproterozoic rocks; Welbon and Price (1992a, 1992b, 1993) produced more detailed maps of the relationships between the Mesoproterozoic and Cambrian rocks of the Hughes Range; Norford and Cecile (1994a, 1994b) have described the complex stratigraphic and structural relationships of Ordovician and Upper Cambrian sedimentary and volcanic rocks in the Wild Horse River area, and Stretch (1997) has outlined detailed structure and anomalous stratigraphy in the area adjacent to and southeast of the Wild Horse River area.

## STRATIGRAPHY

The Wild Horse River area includes parts of two distinct fault-separated tectonostratigraphic domains (Figure 2) each characterized by a distinctive Lower Paleozoic stratigraphy and structural style. In the Hughes Range a relatively thin Lower Cambrian platformal shallow-water succession unconformably overlies Mesoproterozoic sedimentary rocks of the Purcell Supergroup. In the Tanglefoot domain the Purcell Supergroup is overlain by a thick succession of Cambrian and Ordovician shale and shaley carbonate miogeoclinal rocks, including deep water and slope deposits.

### *The Cranbrook Formation*

The Lower Cambrian Cranbrook Formation (Schofield, 1922), which unconformably overlies Mesoproterozoic Purcell Supergroup sediments in the Cranbrook area, typically consists of massive coarse-grained, white, pale red and grayish purple quartz arenites (locally conglomeratic) in beds up to 1 m thick; crossbedding is common (Rice, 1937; Leech, 1958; Stretch, 1997).

In the Wild Horse River area (Figure 3) the Cranbrook Formation comprises up to 100 m of coarse to medium grained, white to grayish purple, blocky weathering quartz arenite. Conglomeratic sandstones, which are common locally, contain pebbles of quartz and quartzite. The Cranbrook Formation varies locally throughout the map area. In the Boulder Creek area, in the hanging-wall of the Lussier River Thrust it occurs as a fine grained dark brown to black weathering sandy siltstone interbedded with thin (<0.5m) lenses of buff to light brown weathering quartz arenite. The variability of the Cranbrook Formation may be due in part to stratigraphic on-lap of local structures produced by Cambrian block faulting (Welbon and Price, 1993).

### *The Eager Formation*

The Lower Cambrian Eager Formation (Schofield, 1922) consists of a thick succession of dark grey, commonly rusty weathering argillite (Rice, 1937) with minor interbedded dark brown shales, siltstone and limestone (Leech, 1958). The contact with the underlying

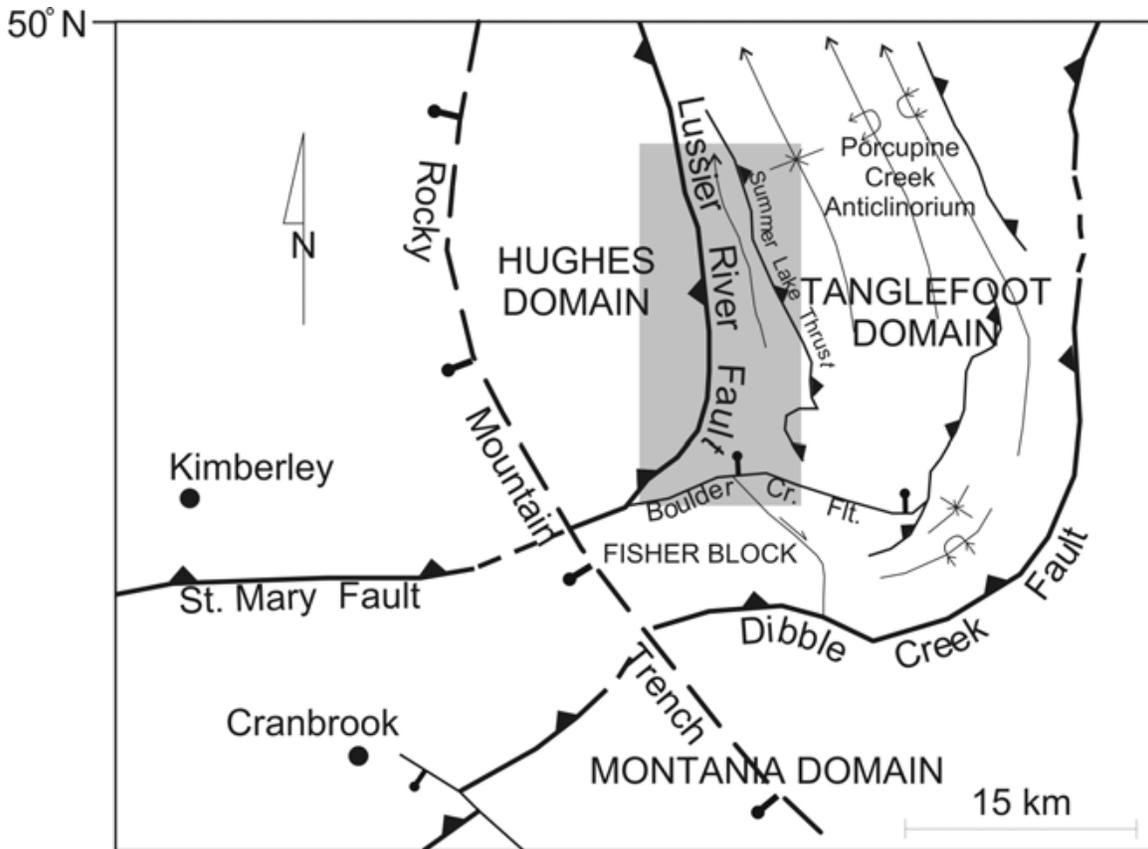


Figure 2. Tectonostratigraphic domains of the Wild Horse River area (shown in grey) and the surrounding region. The Fisher block within the Tanglefoot domain comprises an east-northeast facing panel of Mesoproterozoic rocks beneath a décollement in the Eager Formation. Modified from Stretch (1997).

Cranbrook Formation is conformable (Leech, 1958; Stretch, 1997), characterized by transitional interbedded fine sands and argillite (Schofield, 1922), however, some studies have suggested local disconformity at the base of the Eager Formation (Rice, 1937).

The Eager Formation in the Wild Horse River area occurs as two separate and distinct successions: 1) “thin” Eager within the Hughes Range domain and 2) the “thick” Eager in the Tanglefoot domain. The “thin” Eager, which is missing locally because of erosion beneath the unconformably overlying Jubilee Formation, is a thin veneer of shale and/or shallow-water limestone on top of the Cranbrook Formation (Leech, 1958). The “thick” Eager of the Tanglefoot domain comprises up to 2000 m (Rice, 1937) of dark grey, brown to black weathering, structurally incompetent argillite with minor dark to medium grey weathering argillite and minor shale (Leech, 1958; Stretch, 1997). Beds (where discernable) are about 1 cm thick commonly with micaceous partings. In the Wild Horse River area, Middle Cambrian deep-

water, resedimented carbonate deposits of the “Tanglefoot Unit” overlie the “thick” Eager Formation with apparent conformity.

### *Jubilee Formation*

The Middle (?) to Upper Cambrian Jubilee Formation (Evans, 1933; Henderson, 1954; Leech, 1954, 1958, 1960) occurs in the Hughes Range domain. It is a cliff-forming succession of platformal dolostone that is about 1200 m thick (Leech, 1954). A lower division consists of finely laminated, medium bedded, light grey and white, cream to dark grey weathering dolostone (Leech, 1954); an upper division comprises poorly bedded, dominantly massive, locally coarsely crystalline medium grey dolostone (Leech, 1954). The Jubilee Formation overlies the “thin” Eager and Cranbrook Formations and locally the Mesoproterozoic strata of the Purcell Supergroup unconformably (Leech, 1954, 1958, 1960; Welbon and Price 1992a, 1992b, 1993), however, Leech (1958)

noted the contact between the Jubilee Formation and underlying Lower Cambrian rocks may

locally be transitional. Upper Cambrian rocks of the basal unit of the McKay Group

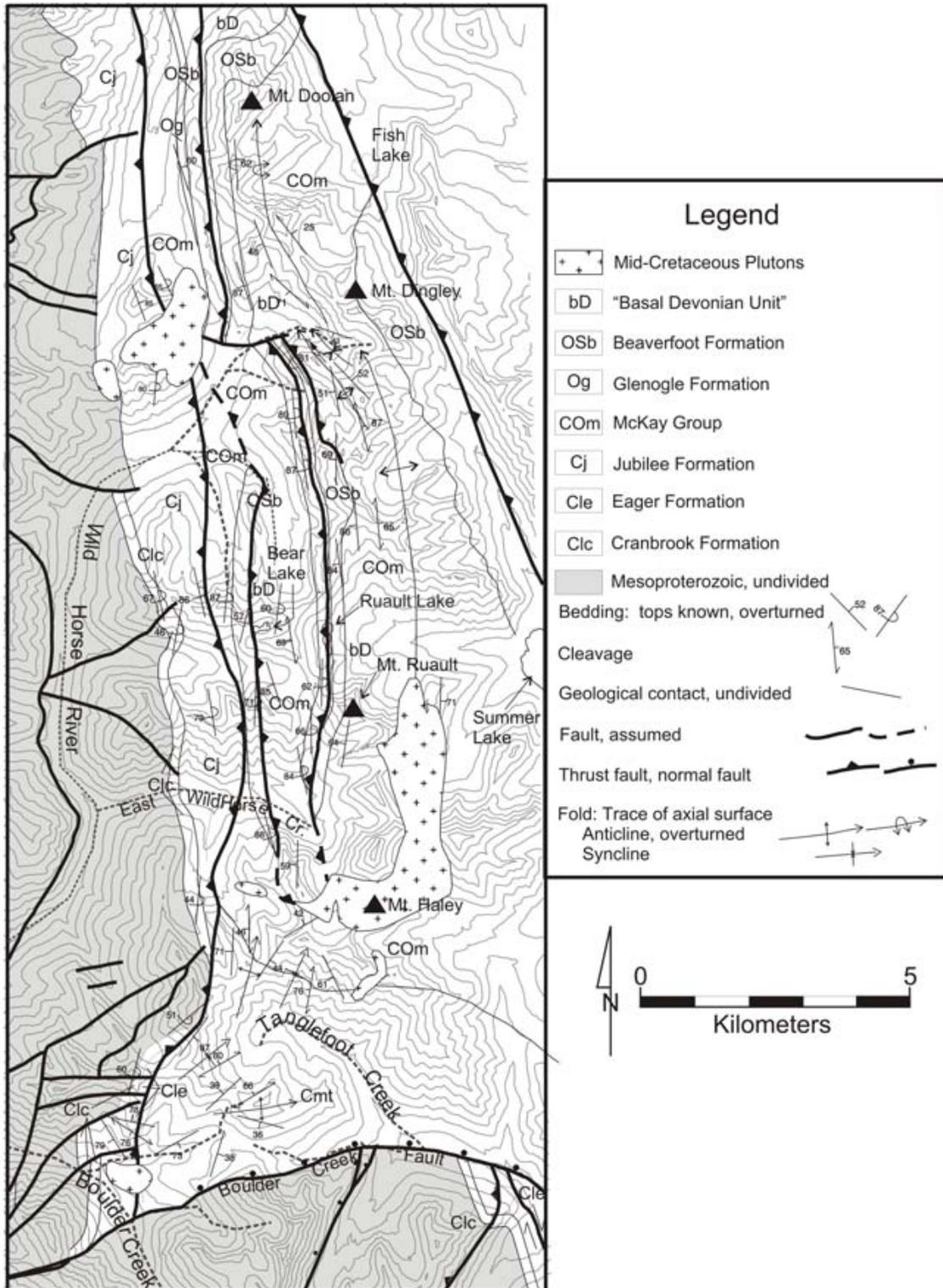


Figure 3. Geological map of the Wild Horse River area. See text for unit descriptions. The data are from 2003 field work plus Leach (1958, 1960), Welbon and Price (1993), and Stretch (1997).

conformably overlies the Jubilee Formation.

### ***“Tanglefoot Unit”***

The Middle Cambrian “Tanglefoot unit” (Leech, 1958, 1960; Thompson, 1962; Stretch, 1997) occurs in the Tanglefoot domain, where it conformably overlies the Eager Formation. It consists of banded, medium to dark grey and brown weathering, medium to dark grey argillaceous allodapic limestone, mudstone, wackestone and packstone, carbonate breccia, with minor dolostone and shale (Stretch, 1997). In the Boulder Creek area the “Tanglefoot unit” locally contains intercalated andesitic extrusive volcanics. The “Tanglefoot unit” which is unique to the southern end of the western Main Ranges of the Canadian Rocky Mountains, resembles parts of the Chancellor Formation of the Kickinghorse Pass area. In the Wild Horse River area it appears to be conformably gradational into the overlying McKay Group, which is underlain by the Ottertail Limestone in the Kickinghorse Pass area. The upper part of the “Tanglefoot unit”, at least, occupies the same stratigraphic position as the Jubilee Formation and thus the two units may be lateral equivalents. The Jubilee Formation and the “Tanglefoot unit” have not been observed in stratigraphic contact.

### ***McKay Group***

The Upper Cambrian and Lower Ordovician McKay Group (Evans, 1933; Leech 1958; Aitken and Norford, 1967) is a widespread 1-1.5 kilometer thick succession of thin-bedded light coloured shales and limestones. The McKay Group is separable into two main lithologic divisions: a lower recessive shale dominated division with minor nodular shaley limestones, and a more resistant cliff-forming upper division comprising thinly bedded grey limestones with minor intercalated shale (Leech, 1958).

In the Wild Horse River Area the McKay Group is characterized by an upper division dominated by light to medium grey weathering, medium grey fresh, thin to medium bedded limestone, argillaceous limestone and minor dolomite, and a lower succession of dark grey to rusty brown weathering, medium grey fresh limey shales, nodular limestone and minor thinly bedded limestone. McKay Group rocks

conformably overlie the Jubilee Formation in the Hughes Range domain and the “Tanglefoot unit” in the Tanglefoot domain. They are locally conformably overlain by the Glenogle Formation, but most commonly are found unconformably below the Beaverfoot Formation. The sub-Beaverfoot unconformity cuts down section to the south, removing most, if not all of the Ordovician McKay Group strata (Norford and Cecile, 1994a).

The McKay Group in the Wild Horse River area is enigmatic because it contains abundant intercalated volcanic rocks (Norford and Cecile 1994a, 1994b). These are mainly volcanic agglomerates consisting of coarse sand to cobble sized clasts of orange weathering dolostone and dark green-grey volcanic clasts, but amygdular, intermediate to mafic volcanic flows are also common. The volcanic rocks within the McKay Group are not widespread; they occur mainly within one thin (<1km) north-south trending thrust-fault sheet.

### ***Glenogle Formation***

The Middle Ordovician Glenogle Formation (Burling, 1922; Henderson, 1954; Leech 1954, 1958) typically comprises < 300 meters of black, locally calcareous graphitic shale and dark grey laminated silty shale. It conformably and gradationally overlies Cambro-Ordovician limestones and shales of the McKay Group, and is unconformably overlain by either the Ordovician Mount Wilson Formation (Norford, 1964) or the Ordovician and Silurian Beaverfoot Formation.

The Glenogle Formation is only present at the extreme northern edge of the Wild Horse River Area, where it forms a thin (<100 m) south-tapering wedge beneath the sub-Beaverfoot unconformity. It comprises dark brown to black, laminated mudstone and quartz wackestone overlain by black limestone containing 2-3 mm euhedral pyrite crystals.

### ***Beaverfoot Formation***

The Upper Ordovician and Lower Silurian Beaverfoot Formation (McConnell, 1887; Burling, 1922; Evans, 1933; Leech, 1958; Norford, 1962) consists of thickly bedded, medium to buff grey mottled weathering, cliff forming dolostone with minor intercalated

limestone and cherty limestone. The Beaverfoot Formation, which is widespread in the Southern Canadian Rocky Mountains, records a transgressive carbonate shelf that developed above a regional unconformity.

In the Wild Horse River Area, the Beaverfoot Formation consists of ~ 250 m of mottled medium to very light grey weathering, thickly bedded (up to 1 m) medium grey, finely to medium crystalline dolostone. The Beaverfoot Formation is locally fossiliferous (corals, cephalopods, gastropods, and crinoids) and sporadically interbedded with thin (up to 20 cm), rusty red to brown weathering quartz arenite. The base of the Beaverfoot Formation in the Wild Horse River area commonly contains a 5-10 meter thick volcanoclastic unit possibly related to volcanics in the underlying McKay Group or to the Mt. Dingley diatreme, which formed after deposition of the McKay Group, but before the deposition of the Beaverfoot Formation (Norford and Cecile, 1994a).

### ***“Basal Devonian Unit”***

The “Basal Devonian unit” of the Wild Horse River area is a midden of rubbly weathering, variably bedded pale yellowish orange, grayish yellow, red, grayish purple and medium gray weathering dolostone, sandy dolostone, dolostone breccia with a limestone matrix, limestone and local mixed lithology cobble conglomerates. The “Basal Devonian unit” unconformably overlies the Beaverfoot Formation and at one locality contains clasts of the underlying Beaverfoot Formation. In the Wild Horse River area the “Basal Devonian Unit” is found between two opposing panels of the Beaverfoot Formation, where it is structurally complicated, and difficult to characterize, however, it is thought to represent parts of the Cedared (Belyea and Norford, 1967) and/or Burnais Formations (Shepard, 1926; Evans, 1933; Henderson, 1954; Leech, 1954,1958)

### ***Mid-Cretaceous Plutons***

The Wild Horse River differs from other parts of the southern Canadian Rocky Mountains in that it contains several small leucocratic mid-Cretaceous “granitic” plutons (Leech, 1958; Welbon and Price, 1992a, 1992b). These vary

somewhat in composition, but commonly comprise coarse, to very coarse grained monzonite or quartz monzonite, with up to 15% hornblende. The largest pluton in the area, the Mt. Haley stock, has been dated ( $^{40}\text{Ar}/^{39}\text{Ar}$  on hornblende) at ~108 Ma (Stretch, 1997). The age of these plutons is highly significant because it provides a minimum age for the faulting and folding within the Wild Horse River area

## **STRUCTURE**

The Wild Horse River area straddles two distinctive structural subprovinces within the Southern Canadian Rocky Mountains: The Western Ranges and the Western Main Ranges subprovinces of North and Henderson (1954). The Western Ranges subprovince coincides with the Hughes Range tectonostratigraphic domain; the Western Main Ranges subprovince coincides with the Tanglefoot domain (Figure 2). There are conspicuous changes in structural style and in physiographic expression between the two subprovinces. Each structural subprovince/tectonostratigraphic domain will be discussed separately.

### ***Hughes Range domain (Western Ranges subprovince)***

The Hughes Range domain comprises a steeply dipping to overturned east-facing panel of Mesoproterozoic Purcell Supergroup sedimentary rocks and unconformably overlying Lower Paleozoic strata that are separated from the main Purcell anticlinorium by a west-dipping Tertiary listric normal fault that follows the east side of the Rocky Mountain Trench (Figure 2). The eastern boundary of the Hughes Range domain is marked by the Lussier River Fault, a listric, west-dipping, east-verging, out-of-sequence thrust that separates east-verging structures associated with the Purcell anticlinorium from the west-verging structures in the western flank of the Porcupine Creek fan structure (Leech, 1958, 1960; Welbon and Price, 1992a, 1992b, 1993). Deformation within the Hughes Range domain is dominated by faults. Many of these are steeply dipping northeast-trending transverse faults, some with normal separation, and others with reverse separation. Variations in preservation of underlying formations along unconformities beneath the Cranbrook Formation and the Jubilee Formation

indicate that these faults were active as normal faults during the Proterozoic and the Cambrian and were reactivated during Mesozoic thrusting and folding (Welbon and Price, 1992a, 1992b, 1993).

### ***Tanglefoot domain (Western Main Ranges subprovince)***

The Tanglefoot domain is underlain by the Porcupine Creek anticlinorium (Balkwill, 1972), a broad, north-trending fan structure with east-verging folds and thrusts in the east flank, west-verging folds and thrust in the west flank, and in the Wild Horse River area, an intervening broad, open syncline (the Top of the World syncline) that extends across the fan axis (Figure 2). The west-verging “Mt. Doolan anticline”, which dominates the western flank of the fan structure, plunges gently northward, and locally is overturned. It changes along strike from a broad, open fold, in the south, near Tanglefoot Creek to a close fold northeast of Ruault Lake, and to a moderately inclined tight fold, overturned to the west at Mt. Doolan (Figure 3).

A west-verging, east-dipping thrust fault (“Summer Lake thrust”) imbricates the upper part of the McKay Group and the lower part of the Beaverfoot Formation in the east limb of the “Mt. Doolan anticline”. Strata in the hanging wall of the “Summer Lake thrust”, dip gently to the east beneath the broad, shallowly north-plunging Top of the World syncline.

A principal focus of this thesis/study has been the elucidation of the enigmatic structure that occurs between the western limb of the “Mt. Doolan anticline” and the Lussier River fault. This structure comprises steeply dipping inward-facing panels of McKay and Beaverfoot strata and an intervening thick succession of shaley strata with abundant intercalated dark green volcanic rocks. This structure initially was mapped by Leech (1958, 1960) and by Welbon and Price (1992a, 1993) as a syncline with volcanogenic Silurian(?) or Middle Devonian(?) strata in the core and Ordovician and Cambrian Beaverfoot and McKay strata in the limbs. The eastern limb of this supposed syncline is the west limb of the Mount Doolan anticline; the western limb is a steeply dipping, east-facing panel of Beaverfoot and McKay strata that is truncated southward against the footwall of the Lussier River fault. New biostratigraphic data and mapping by by Norford and Cecile (1994a) have

shown that the volcanic rocks in the core of the supposed syncline belong to the Cambrian and Lower Ordovician McKay Group, that these McKay strata are in fault above the top of the east-facing McKay and Beaverfoot Formations in the west limb of the supposed syncline, and that the Beaverfoot Formation in the east limb of the supposed “syncline” actually comprises two separate inward-facing panels of Beaverfoot Formation, one forming the west-facing west limb of the Mount Doolan anticline, and the other forming the top of an east-facing structural panel that extends downward into the McKay succession within which the volcanogenic rocks are interbedded. Both of the inward-facing panels of Beaverfoot Formation are capped by a thin (~50 m) interval of basal Devonian Cedared Formation. Overlying gypsum of the Middle Devonian Burnais Formation is not exposed; and if present, is very thin. Norford and Cecile (1994a) concluded that the two inward-facing panels of McKay, Beaverfoot, and Cedared strata at Ruault lake (Figure 3) form the limbs of a “very tight” (essentially isoclinal) syncline. Noting that the fault that juxtaposes the volcanic-rich succession of McKay strata with the Beaverfoot Formation at Bear Lake (Figure 3) is more or less parallel with the strata on either side of it, and that the Cedared Formation is preserved locally beneath the McKay Group along this fault (Figure 3), they concluded that this fault is an east-verging thrust fault that was rotated into a near vertical to overturned orientation during subsequent folding the formations in which it is embedded.

In the present study we have attempted to trace these structures along strike to the north and to the south, and to determine where the vertical to overturned east-verging thrust fault might emerge eastward and, in particular, whether the two inward-facing panels of Beaverfoot Formation and overlying Cedared Formation are connected by a fold hinge, or separated by this east-verging thrust fault.

The contact between the two inward-facing panels of Beaverfoot Formation and overlying Cedared Formation is exposed at several localities between Mount Ruault and the upper headwaters of Wildhorse River (Figure 3). Locally, as on the east-west ridge north of Ruault Lake, near vertical and subparallel, inward-facing panels of Cedared Formation are separated by a bedding-parallel thrust or detachment fault that may follow the gypsum of the Burnais Formation. Elsewhere to the south

and to the north, various stratigraphic levels within the Beaverfoot Formation, on the west, are in fault contact with Cedared Formation, on the east. This relationship is indicative of an east-verging thrust fault that juxtaposes a hanging wall ramp, along which the fault cuts up-section in the direction of fault displacement, over a footwall “flat”, along which the fault follows a bedding-parallel detachment. Southward from Ruault Lake to Mount Ruault, this thrust fault, which we will refer to as the “Ruault Lake fault” is parallel with the Cedared Formation in the over-ridden (“footwall”) panel but cuts down-section in the over-riding (“hanging wall”) panel cutting out the Beaverfoot Formation completely south of Mount Ruault. Southward from Mount Ruault, the Ruault Lake thrust also cuts down-section in the over-ridden (“footwall”) panel toward the valley of the headwaters of East Wild Horse Creek. There bedrock is concealed by extensive glacial overburden and the location of the fault is uncertain. Farther south, in the vicinity of the Mount Hayley stock, where the Beaverfoot Formation appears to have been cut out on both sides of the Ruault Lake fault and McKay Group strata apparently occur on both sides, the location of the fault has been inferred by extrapolation (Figure 3). Between Mount Ruault and the upper headwaters of the Wild Horse River, the Ruault Lake fault follows an extensive bedding detachment above the Cedared Formation (probably in the gypsum of the Burnais Formation) along the footwall of the Ruault Lake fault. We have interpreted the extensive bedding detachment beneath the Ruault Lake fault as the emergent eastern equivalent of the east-verging thrust in the western part of the Wild Horse River area that separates the McKay Group strata with intercalated volcanics rocks from the Beaverfoot Formation (Figure 4). This fault also is sub parallel with Cedared-Beaverfoot contact along its footwall. This suggests that it probably also follows a footwall detachment in Middle Devonian gypsum here. South of East Wild Horse Creek the fault cuts down-section in its footwall toward the Mount Haley stock (Figure 3). In the vicinity of the stock the location of this east-dipping fault has been inferred by interpolation to connect with the west-dipping part of the Ruault Lake fault around the hinge of a north-plunging synform. The implication is that the Ruault Lake fault has been folded, along with the beds above and below it, to form a tight, north-trending synform. This overall structure,

will be referred to below at the “Upper Wild Horse River (UWHR) structure”.

Along the east branch of upper Wild Horse River, the Beaverfoot Formation is cut out northward along a footwall ramp on the Ruault Lake fault; farther north the fault has McKay Group on both sides and it is difficult to locate.

There is an abrupt 1.5 km left-hand offset of the entire UWHR structure along a concealed east-west fault beneath the glacial drift of the upper Wild Horse River west of Mount Dingley (Figure 3). This fault offset coincides with an equivalent left-hand deflection of the hinge zone of the Mount Doolan anticline; but there is no deflection of the east limb of the Mount Doolan anticline or of the Summer Lake thrust, which imbricates the McKay and Beaverfoot strata within the east limb of the anticline. Further work is planned for the elucidation of the nature and significance of this left-hand transverse structure.

### ***Boulder Creek Fault***

The Boulder Creek Fault is an enigmatic east-west trending transverse structure with a left-hand strike separation and apparent downthrow to the north (Leech, 1958). It forms part of the Crowsnest Pass cross-strike discontinuity (Price, 1994, 2000); and is aligned with the St Mary fault, which follows the locus of an older structure that was active during the deposition of the Neoproterozoic Windermere Supergroup of the western Purcell Mountains (Lis and Price, 1976). The Boulder Creek fault also is aligned with a conspicuous deflection of the Porcupine Creek anticlinorium, which changes from north-trending north of the Boulder Creek fault to east-northeast-trending south of it. The Boulder Creek fault either truncates or has reactivated the regional décollement in the Lower Cambrian Eager Formation that forms the base of the Porcupine Creek anticlinorium in the Tanglefoot area (Stretch, 1997). The present left-hand separation with apparent downthrow to the north may be associated with reactivation of the Boulder Creek fault as a normal fault during the Tertiary crustal extension that produced the southern Rocky Mountain trench.

The Boulder Creek fault evidently has had a complex displacement history. with stratigraphic

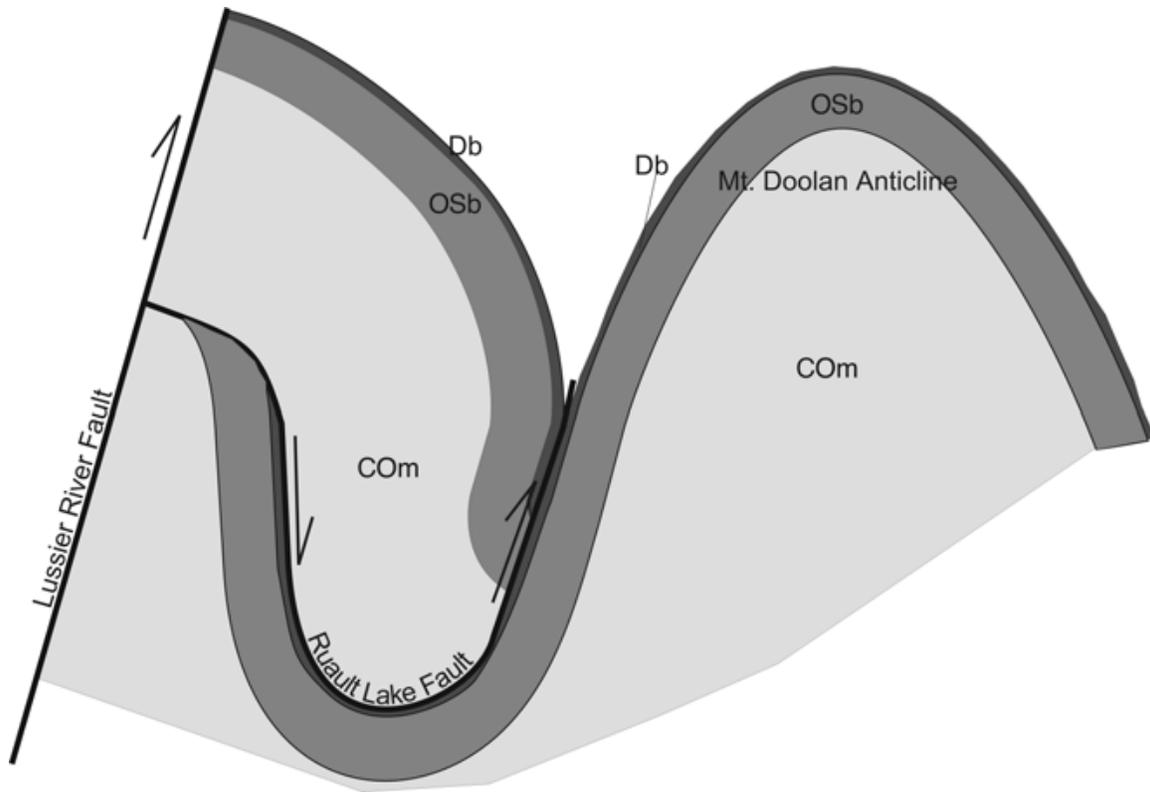


Figure 4. A schematic cross-section through the Upper Wild Horse River structure showing fault juxtaposed, inward facing panels of Beaverfoot Formation and a folded Ruault Lake fault. The Upper Wild Horse River structure is cut out to the west by the out-of-sequence Lussier River Fault.

evidence suggesting it was a Stratigraphic evidence indicates down-to-the-south displacement during deposition of Mesoproterozoic rocks of the Aldridge Formation (Höy, 1993) and during deposition of the Lower Cambrian Eager and Tanglefoot Formations. Structural evidence suggests the fault was reactivated as a right-handed reverse fault in the Cretaceous related to deflection in the axis of the Porcupine Creek anticlinorium, and the Lussier River fault. As indicated above, it may also have been reactivated during Tertiary extensional deformation.

Three distinct sets of minor faults can be distinguished in fabric data collected along the north side of the Boulder Creek fault, however, they do not provide an unequivocal indication of the kinematics of the fault. The first set, observed ~1.5 km north of the Boulder Creek fault, consists of small faults that tend to dip steeply to the north with tectonic lineations plunging shallowly (20-30°) to the east. A second set, observed less than 500 meters north of the fault consists of moderately steeply (60-70°) south-dipping faults with lineations

plunging shallowly (~30°) to the west. The third set of minor faults, observed at both localities, consists of shallowly south- and north-dipping (30°) faults with down dip lineations.

### ***Timing of Thrust and Fold Deformation***

The timing of thrusting and folding in the Wild Horse River area is constrained by small crosscutting plutons one of which has been dated at ~108 Ma (Stretch, 1997). An unnamed monzonite pluton near the headwaters of the Wild Horse River postdates motion on the Lussier River Fault; the 108 Ma Mt. Haley stock intrudes the core of the Mt. Doolan anticline near Mt. Ruault truncating the structures in the folded rocks. These crosscutting relationships show that deformation related to the development of the Porcupine Creek Anticlinorium and displacement along the Lussier River Fault occurred prior to ~108 Ma.

## CONCLUSIONS

The Wild Horse River area is a geologically complex segment of the Southern Cordilleran Thrust and Fold Belt. Enigmatic abrupt contrasts in Cambrian stratigraphy are due to juxtaposition of different stratigraphic domains by thrust faulting. Volcanic rocks intercalated within the Cambro-Ordovician strata are local phenomena that probably due to diatremes. Cross-cutting Mid-Cretaceous granitic plutons show that thrust and fold deformation in the Wild Horse River area occurred prior to ~108 Ma. The Boulder Creek fault has a complex displacement history

## ACKNOWLEDGMENTS

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