OTHER INVESTIGATIONS

GEOLOGY OF THE PRECAMBRIAN PURCELL SUPERGROUP CRANBROOK–FORT STEELE AREA (82G/11, 12)

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INTRODUCTION

During the summer of 1977, approximately 120 square kilometres of Purcell strata in a northwest-trending strip along the eastern edge of the Rocky Mountain Trench between the Bull and Wild Horse Rivers (Fig. 15) was mapped at a scale of 1:25 000. The main objects of the study were to examine the stratigraphy of the Helikian Purcell succession; determine lateral and vertical sedimentary environment associations; outline major structures; and investigate the relationship of faulting to sedimentation, with particular emphasis on evidence for or against syn-depositional faulting. This study forms part of a Ph.D. thesis being completed at Queen's University and has been supported, in part, by the British Columbia Ministry of Mines and Petroleum Resources.

STRATIGRAPHY

The formation names used in this report are those proposed by Leech (1958), and the subdivision of the Aldridge Formation follows the criteria outlined by Edmunds (1973). The stratigraphy of the Aldridge through Gateway Formations was studied north of the Dibble Creek fault, whereas south of the fault only the Creston and Kitchener-Siyeh Formations were examined during the 1977 field season. Estimates of formation thicknesses, their spatial variability, and a comprehensive interpretation of sedimentary environments will not be made until mapping of Purcell strata between the Boulder Creek fault and Sand Creek and section measurement has been completed. The following discussion summarizes the stratigraphic characteristics of the field mapping units chosen.

Aldridge Formation: The oldest rocks (Paleo-Helikian) exposed in the map-area belong to the Middle Aldridge Formation. Three distinct sedimentary packages characterized by abundant thin to thick-bedded laterally continuous, pyritic, fine to medium-grained quartzite are recognized. Each quartzite bed generally displays graded bedding in the top few centimetres, may contain black argillaceous rip-up clasts, and usually has flute or load casts along its base. Thus, the quartzites resemble the A unit of the Bouma turbidite sequence (*see* Walker, 1976). A preliminary study of flute cast orientations indicates a south to southwest source direction for these quartzites. Between successive thin to thick quartzite beds, pyritic, crossbedded, or laminated, very fine-grained quartzite or siltite, up to a few metres thick, may occur.

Separating these quartzite units are thick sequences of grey pyritic slate with rare darker laminae and occasional abundant limestone nodules, laminated very thin-bedded, light and dark grey, pyritic slate, minor brown-weathering, light grey siltite very thinly interbedded with grey-weathering, dark grey siltite, and rare very thin-bedded, crossbedded siltites or quartzites.

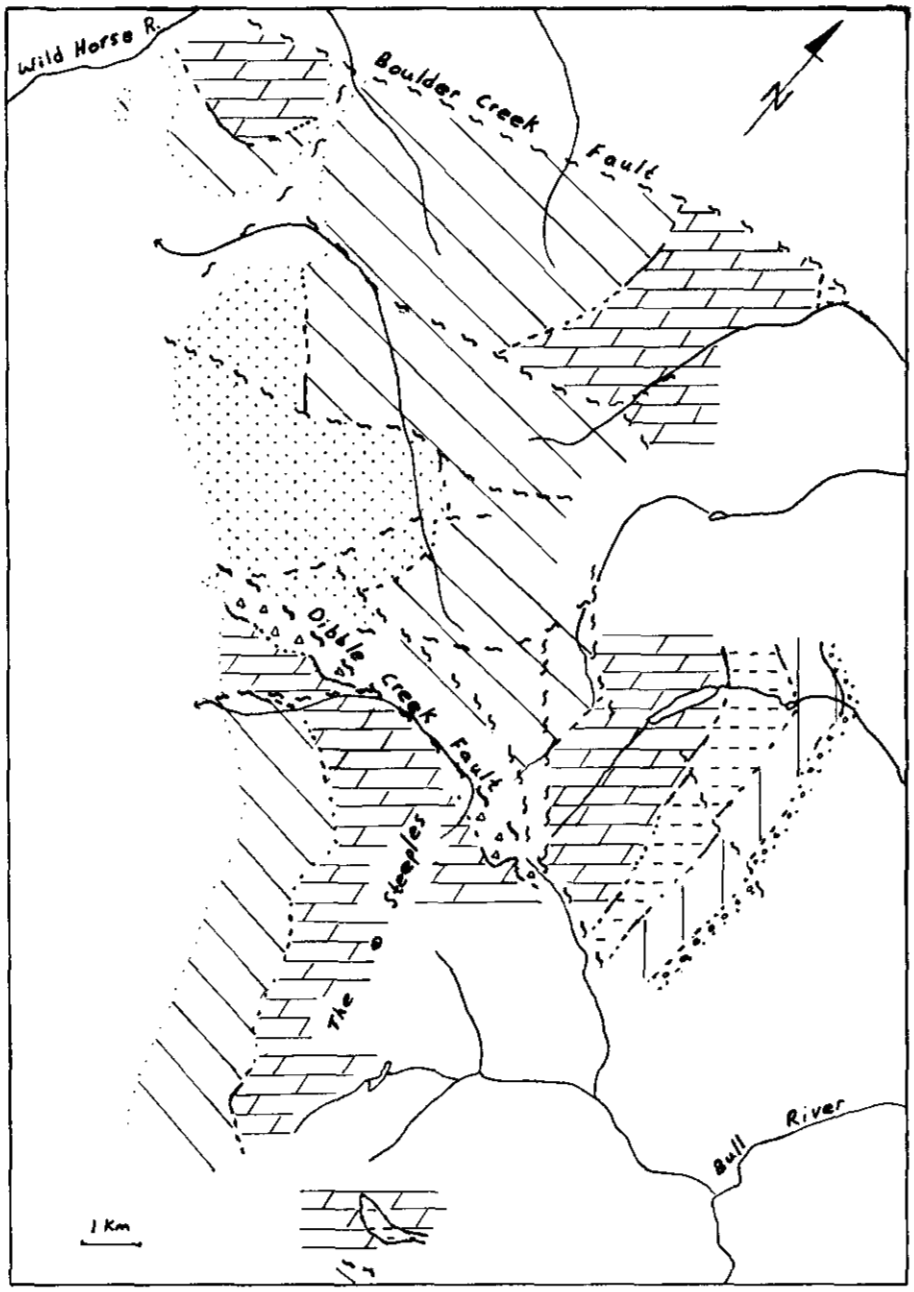

Figure 15. Generalized geology of the Purcell Supergroup between the Bull and Wild Horse Rivers, Cranbrook-Fort Steele area.

LEGEND

DEVONIAN


BASAL UNIT: DOLOMITE BRECCIA, SANDY DOLOMITE, QUARTZITE; OVERLAIN BY LIMESTONE, SHALY LIMESTONE, AND SHALE

CAMBRIAN


CRANBROOK FORMATION: QUARTZITE, CONGLOMERATE, AND SANDSTONE

PRECAMBRIAN

PURCELL SUPERGROUP


GATEWAY FORMATION: MICACEOUS SILTITE, DOLOMITE, WITH MINOR SANDSTONE


KITCHENER-SIYEH FORMATION – UPPER PART: SILTITE, PURCELL LAVA AT TOP


KITCHENER-SIYEH FORMATION – LOWER PART: DOLOMITE, SILTY DOLOMITE, ARGILLACEOUS DOLOMITE, AND DOLOMITIC ARGILLITE


CRESTON FORMATION: SILTITE, WITH LENTICULAR QUARTZITE LENSES


ALDRIDGE FORMATION: QUARTZITE, SILTITE, AND PHYLLITIC ARGILLITE

SYMBOLS

GEOLOGIC CONTACT: KNOWN, APPROXIMATE, ASSUMED . . . . . 

FAULT . . . . .

Above the uppermost quartzite sequence are the rusty weathering, pyritic, medium and dark grey, interlaminated phyllitic argillites of the Upper Aldridge Formation. Abundant crossbedded or laminated, light grey siltite occurs in zones at both the base and top of the unit.

Creston Formation: Rocks of the Upper Aldridge Formation grade into those of the Creston Formation over a distance of a few hundred metres. A distinctive irregularly interlaminated to very thinly interbedded, light green or grey and black siltite forms the basal Creston Formation throughout the map-area. Mud cracks, cut and fill, load-casting, and rusty weathering blotches are common. This unit always grades upward into discontinuously interlaminated to very thinly interbedded, light and darker green siltites with occasional thin-bedded, lenticular, fine-grained quartzites that are frequently crossbedded and often contain rip-up clasts. Mud cracks, ripple marks, cut and fill, and load casts are common sedimentary structures. A number of mappable units of variable thicknesses, order of succession, and lateral continuity occur above this. These include:

(1) Rocks with similar sedimentary structures and lithologies, but with green-purple, green-green, or less commonly purple-purple-coloured siltite couplets. This unit has not yet been recognized south of the Dibble Creek fault.

(2) Rocks with similar sedimentary structures and lithologies, but with quartzites comprising 15 to 35 per cent of the section, and occurring as tabular lenses up to 20 metres thick. The siltites are green or purple in colour and dolomitic interbeds are common in both lithologies, especially near the top of the unit. This unit occurs only near the top of the Creston Formation and is found on both sides of the Dibble Creek fault.

(3) Very thin-bedded purple siltite, with minor discontinuously laminated green siltite couplets and thin-bedded, lenticular, fine-grained quartzite that is often crossbedded and contains rip-up clasts. Mud cracks and load casts are locally abundant. Although this lithologic unit is recognized on both sides of the Dibble Creek fault, its stratigraphic position is different on either side of the fault.

(4) A unit characterized by abundant thin-bedded grey-purple or purple-mottled grey, coarse siltite, with minor green or purple discontinuously laminated siltite couplets and thin-bedded, lenticular, fine-grained quartzite that often contains rip-up clasts, mud cracks, load casts, and cut and fill structures that are associated with the laminated siltites and quartzite beds. This unit has not yet been recognized south of the Boulder Creek fault.

(5) Parallel-bedded, thin-bedded, very fine-grained quartzites, with some very thin siltite interbeds. This unit is only recognized near Lone Peak.

Kitchener-Siyeh Formation: Almost everywhere rocks of the Kitchener-Siyeh Formation transitionally overlie those of the Creston Formation. The change to dolomitic argillites from green siltites usually occurs over a distance in the order of a hundred metres, while the transition from Creston map unit 2 occurs over a much shorter interval.

The lower (dolomitic or Kitchener) part of the Kitchener-Siyeh Formation shows pronounced changes in general stratigraphy and thickness across the Dibble Creek fault. To the south of Sunken Creek, a few tens of metres of dolomitic siltite and argillite, locally containing white crossbedded quartzite lenses, occur above the contact with the Creston Formation. The remainder of the Lower Kitchener-Siyeh Formation is

interbedded thin to thick-bedded dolomite or silty dolomite with well-developed molar-tooth structures or limestone pods, very thin-bedded grey or green siltite, lesser dolomite with discontinuous thin black argillite laminae with or without molar-tooth structures, minor very thin lenses of dolomitic, fine-grained sandstone; and occasional thin algal stromatolite beds. A zone of well-developed algal head stromatolites, approximately 20 metres thick, occurs near the top of the unit, and is only found to the south of the Dibble Creek fault. This zone is in a similar stratigraphic position to an algal stromatolite zone found in the eastern Rocky Mountains. The latter stromatolite zone extends from Marias Pass, Montana to North Kootenay Pass, British Columbia (*see* Price, 1964), and the zone found on the steeples may be a continuation of it.

To the north of the Dibble Creek fault a relatively thick sequence of dolomitic argillites, argillites, argillaceous dolomite, minor dolomite, and rare dolomitic quartzite lenses occurs at the base of the Kitchener-Siyeh Formation. Mud cracks and pyrite are locally abundant in the argillaceous rocks. Above this is a unit of interbedded thin to thick-bedded dolomite, containing discontinuous chaotic black argillite partings, with or without molar-tooth structures, dolomite or silty dolomite with molar-tooth structures or limestone pods, very thin-bedded grey siltite, and minor very thin lenticular dolomitic or calcareous quartzites.

In most areas, the transition to siltites of the upper (non-dolomitic or Siyeh) part of the Kitchener-Siyeh Formation occurs over a very short interval. However, near Cliff Lake the transition takes place over a thickness of a few hundred metres and is a mappable unit. Green, or locally purple, very thin-bedded to discontinuously laminated siltites, and minor thin-bedded fine to medium-grained dolomitic sandstone lenses comprise the siltite unit. Sedimentary structures such as mud cracks, ripples, crossbedding, cut and fill, and rip-up breccias are extremely abundant throughout. South of the Dibble Creek fault this unit has the same characteristics. Its top was not observed in the area mapped since sandy dolomitic breccias, sandy dolomites, and granule to fine sand-sized quartz arenites of the basal Devonian unconformably overlie the Kitchener-Siyeh Formation in this region.

Purcell Lava: North of the Dibble Creek fault, the lowermost flow or associated crystal tuff of the Purcell lava overlies the upper siltite unit with a sharp contact. These green or purple-weathering flows are chloritized or sericitized plagioclase porphyries and most contain quartz, calcite, or specularite-filled amygdules. Sedimentary sequences up to 25 metres thick, consisting of laminated green or purple siltite, with thin lenses of dolomitic sandstone and minor very thin-bedded dolomite or bedded crystal tuff, occur between some of the flows. Immediately east of Cliff Lake, the sedimentary interbeds are thickest and most numerous. The number of interbeds and their thicknesses decrease markedly along strike to the north and south from there. The uppermost lava flow has at least 2 metres of local relief on its upper surface. Parallel laminated siltites and dolomitic sandstones of the Gateway Formation overlap this surface.

Gateway Formation: The Gateway Formation is divisible into three general units. The Lower Gateway Formation consists of tan-weathering, light-coloured dolomite, stromatolitic dolomite, and dolomitic siltite, green or purple discontinuously laminated siltites, thin-bedded red micaceous fine-grained sandstone, and locally, purple thin-bedded fine to coarse-grained quartz arenites in tabular lenses 3 to 4 metres thick. Mud cracks and ripples are locally abundant. Purple or green thin-bedded to discontinuously laminated, micaceous siltites and minor lenticular very fine-grained quartzite comprise the middle part of the Gateway Formation. Mud chip breccias, mud cracks, and salt casts occur locally. The presence of dolomitic siltites and thin dolomitic lenses and layers interbedded with the green or purple siltites characterizes the Upper Gateway Formation. Mud cracks, salt casts, and ripple marks are present in siltite layers. In most areas, this

formation is truncated with slight angularity by the white, pink, or grey quartzites and quartz-rich grits and conglomerates of the Lower Cambrian Cranbrook Formation. A transition to micaceous, maroon, fine-grained sandstones, that may belong to the Phillips Formation, was observed below this unconformity on the ridge immediately north of Dibble Creek.

Intrusive Rocks: Although numerous hornblende-plagioclase sills and dykes were observed in the Lower Purcell formations, none were seen in the Upper Purcell formations. Narrow contact metamorphic zones border the larger 'sills' in the Aldridge and Creston Formations, while wide zones of 'bleached' dolomitic rock occur around the 'sills' in the Kitchener-Siyeh Formation.

STRUCTURE

The Dibble Creek fault is the dominant structural feature, dividing the map-area into two stratigraphic and structural regions. South of the fault Devonian rocks unconformably overlie the Kitchener-Siyeh Formation, while the Upper Purcell formations have been removed. Strata are in open folds that plunge gently to the northeast and significant faults are apparently rare. Between the Boulder Creek and Dibble Creek faults, a more complete section of Purcell stratigraphy from the Aldridge to the Gateway Formation is found beneath the Cambrian unconformity. Numerous faults cut the area. In the region around Maus Creek, the strata are deformed into mesoscopic to megascopic asymmetric folds, with one limb striking northwest and dipping northeast and the other limb striking north and dipping steeply east or overturned to the west. To the east of this area, around Cliff Lake, strata are dominantly north striking, steep easterly dipping, or slightly overturned to the west; to the northeast toward the Boulder Creek fault, strata strike northwesterly and dip steeply to moderately northeast. Locally strata are overturned to the west by northwesterly plunging folds.

MINERALIZATION

Chalcopyrite and pyrite, and less commonly galena, are found associated with quartz veins. These occurrences are restricted to the Aldridge, Creston, and Lower Kitchener-Siyeh Formations, and most of those observed have already been mined or explored by adits.

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