TECTONIC SIGNIFICANCE OF STRATIGRAPHIC AND STRUCTURAL CONTRASTS BETWEEN THE PURCELL ANTICLINORIUM AND THE KOOTENAY ARC, EAST OF DUNCAN LAKE (82K): PRELIMINARY RESULTS

By Marian J. Warren and Raymond A. Price
Queen's University

KEYWORDS: Regional geology, Purcell anticlinorium, Kootenay Arc, stratigraphy, deformation, Horsethief Creek Group, Hamill Goup, Mohican Formation, Badshot Formation, intrusions.

INTRODUCTION

The main goal of this study is to elucidate the nature and tectonic significance of the profound stratigraphic and structural changes that occur between the crest of the Purcell anticlinorium and the Kootenay Arc.

Reconnaissance (1:250 000) mapping by Reesor (1973) outlined conspicuous contrasts between the thick basal Paleozoic (Hamill-Badshot) succession that overlies the Windermere Supergroup in this area and the thin, condensed early Paleozoic succession with overlapping Upper Devonian strata that occurs immediately to the east in the Purcell Mountains. Reesor also described the abrupt contrast between the tight upright fold structures in this area and the refolded, west-verging, recumbent isoclinal folds that occur immediately to the west in the Kootenay Arc. He also showed that several small granitic plutons in the area were probably emplaced while folding was still underway.

The rocks exposed in this area (Figure 1-3-1) record both the Late Proterozoic to early Paleozoic birth and development of the Cordilleran miogeoclinal passive margin of North America (Bond and Kominz, 1984; Bond *et al.*, 1985), and the Late Mesozoic to Early Cenozoic deformation, regional metamorphism and granitic plutonism resulting from collisions between North America and a series of allochthonous terranes that have been accreted to it (Monger *et al.*, 1982).

Systematic detailed geological mapping (1:50 000 and greater) was begun during July and August of 1991 within an area of about 900 square kilometres in the western Purcell Mountains, between Duncan Lake and the headwaters of Toby and Jumbo creeks (Figure 1-3-2). This will link the detailed mapping along the Kootenay Arc by Fyles (1964) to the detailed mapping by Root (1987) and Pope (1990) in the central and eastern Purcell Mountains.

The main objectives of this study are:

- To establish the nature and tectonic significance of the stratigraphic relationships between the thick sequence of Windermere. Hamill and Badshot strata in the study area and the condensed onlapping early Paleozoic succession that occurs on "the Windermere high" in the adjacent area, below the Mount Forster thrust fault, in the central and eastern Purcell Mountains (Root, 1985);
- To establish the nature, evolution and regional tectonic significance of the change in structural style between the study area and the adjacent areas in the Kootenay Arc and the central Purcell Mountains;
- To establish the relative time relationship between the intrusion of granitic plutons and the deformation and metamorphism;
- To determine the pressure and temperature conditions under which the plutons were emplaced and the surrounding rocks were deformed;
- To date the plutons, the metamorphism and the deformation.

STRATIGRAPHY

HORSETHIEF CREEK GROUP

Mapping during the 1991 field season was concentrated primarily in the upper part of the Horsethief Creek Group; mapping will be extended east of the Purcell divide in 1992 to include the base of the Horsethief Creek Group and the Toby Formation, which unconformably overlies the Purcell Supergroup. Five mappable units were identified within the middle to upper part of the Horsethief Creek Group (Figure 1-3-3). In ascending order, these units are: (Ht1) a dark limestone and calcareous argillite; (Ht2) a light green-grey argillite and muscovite-quartz schist: (Ht3) a coarser grained, dark grey-green, micaceous quartzite and quartzose schist, capped by (Ht4) a sequence of interbedded light grey or white grits, quartzites and thin carbonates to the east, and by (Ht5) interbedded grits and dolostone-clast conglomerate to the west. The lower units are laterally continuous, but the upper units are not. The total thickness of these units is estimated at 2.0 to 2.5 kilometres.

Ht1: DARK LIMESTONE AND ARGILLITE

This unit is well exposed in the western part of Howser Creek and in Tea Creek. It consists of dark grey, thinly to thickly bedded limestone or marble, locally argillaceous, and commonly pyritiferous. The carbonate is interbedded with dark argillite. The base of the unit was not observed. The upper contact with overlying argillite was not directly observed, but appears to be abrupt. Minimum thickness of this unit is estimated at 200 to 300 metres.

Ht2: LIGHT GREY-GREEN ARGILLITE

This unit is a largely homogeneous sequence of light grey or grey-green argillite. It lies stratigraphically above the dark limestone and marble (Ht1). Where not too severely deformed, bedding is visible as subtle lighter and darker

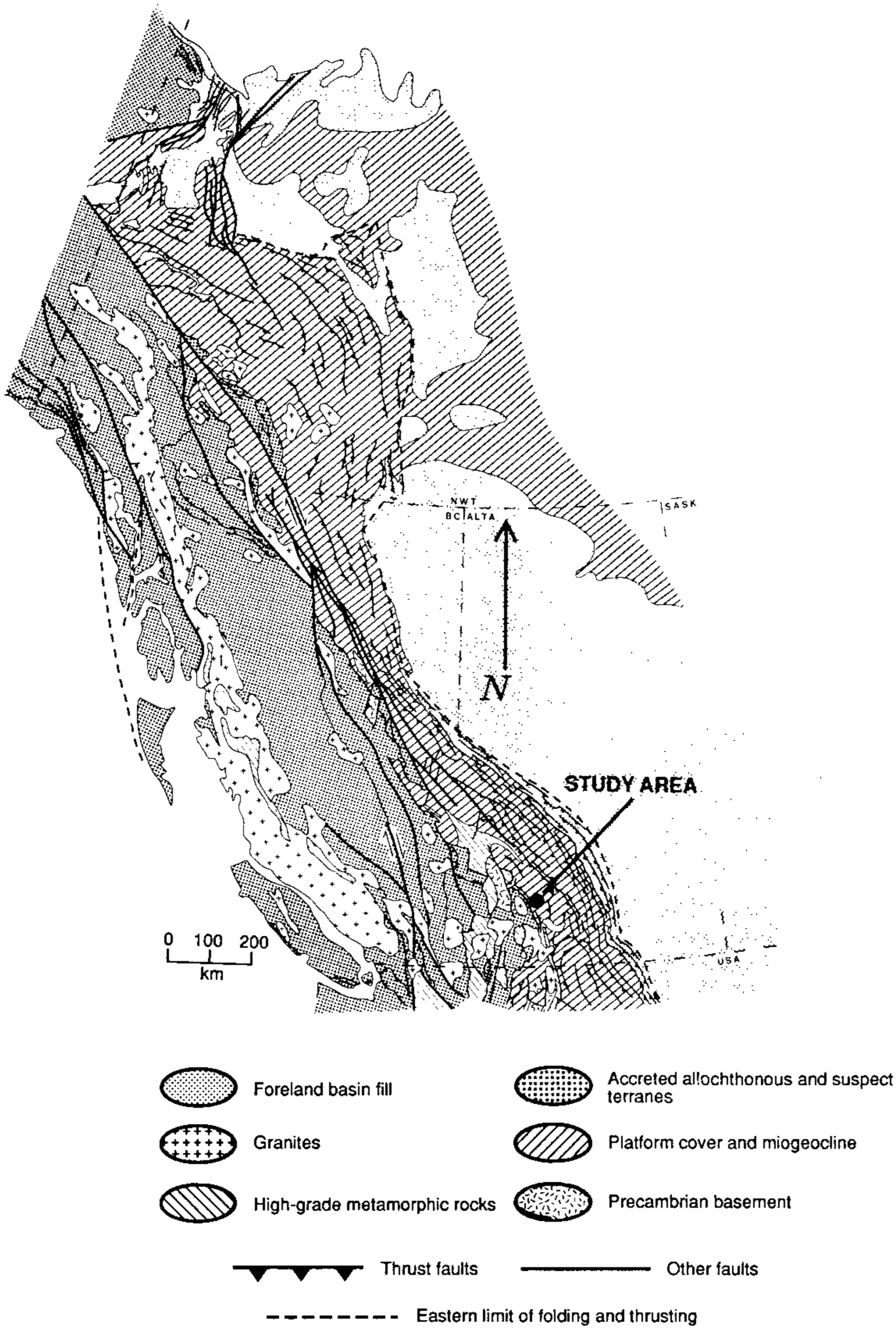


Figure 1-3-1. Tectonic map of the Canadian Cordillera showing location of the study area. Modified after Douglas (1968) and Price (1986).

grey bands, 1 to 10 centimetres thick. No changes in grain size or composition between beds are discernible in hand specimens. Pyrite is abundant and rusty orange weathering is characteristic. Toward the west, or locally within high-strain zones, this unit is a silvery quartz-muscovite schist, locally containing biotite porphyroblasts. The argillite is recessive and forms valleys, such as those cut by the north and south forks of Glacier Creek. This unit is generally poorly exposed. It is more strongly deformed than the overlying grits and quartzites, and an estimated thickness of about 1000 metres may be in error due to significant tectonic thickening or thinning, as strain is concentrated in the less competent argillites relative to the grits and overlying quartzites.

Ht3: DARK GREEN-GREY QUARTZITE AND QUARTZOSE SCHIST

The grey-green argillite grades upward into a coarser grained dark schist or quartzite. Colour and texture are variable from a grey, competent muscovite-rich quartzite, to a dark green, quartz-muscovite-(chlorite) schist or quartzite in which tectonic fabrics are well expressed. Laterally discontinuous grit horizons, several centimetres to several metres thick, contain white and blue quartz pebbles up to 4 millimetres in diameter. Feldspar clasts are very rarely observed with the naked eye. Other primary sedimentary structures were not observed. This unit is absent north of Jumbo Pass, on the east side of the Purcell divide. Estimated thickness ranges from 0 to 500 metres.

Ht4: INTERBEDDED WHITE GRITS AND QUARTZITES

Toward the top of Unit Ht3, dark quartzites are interbedded with increasingly abundant light-coloured quartzose grits. The transition to a sequence dominated by interbedded grits and quartzites occurs over an interval as thick as 100 metres. Contacts between light and dark horizons are sharp. Where Unit Ht3 is absent, the contact between the grits and the underlying Ht2 argillite is extremely sharp. The grits are composed dominantly of pebbles of white quartz, with less abundant pebbles of blue, grey, and rare, distinctive red quartz. Feldspar is rare, but locally comprises 2 to 3 per cent of the clasts. Toward the contact with the overlying Hamill Group, beds of coarse-grained white quartzite are increasingly abundant. In general, this sequence becomes finer grained and more mature upward. Sedimentary structures are more common toward the top, and include abundant trough crossbeds, planar-tabular crossbeds, pebbly channels up to 1 metre across, pebbly graded beds, and possible hummocky cross-stratification. A distinguishing feature of this sequence is the occurrence of two to three, metre-thick, tan and orange dolostone beds, about 100 metres below the base of the Hamill Group. Individual beds are laterally continuous over at least a few hundred metres.

Ht5: INTERBEDDED DOLOSTONE-CLAST CONGLOMERATE, ARGILLITE AND GRIT

This unit is well exposed west of Macbeth Icefield, where it overlies Unit Ht3, and underlies the Hamill Group. Structureless beds, up to 10 metres thick and laterally continuous only over tens of metres, contain abundant orange-tan-weathering dolostone cobbles and boulders, in a "matrix" of white, blue and grey quartz pebbles, rarer feldspar pebbles, muscovite and carbonate. Locally, thin conglomerate beds are rich in pelitic clasts. Within individual beds, clasts are poorly sorted. The conglomerates are interbedded with quartzose grits and minor grey argillites. Graded beds, 10 centimetres to 1 metre thick, are common in the grits. Trough crossbeds are observed more rarely. West of Macbeth Icefield, Unit Ht5 is approximately 200 metres thick, but the true thickness is difficult to estimate due to the effects of tight folds. Elsewhere, the unit is less than 50 metres thick, although it has not been traced along strike to the north of the icefield. Unit Ht5 may be a lateral equivalent of Unit Ht4.

CONTACT BETWEEN HORSETHIEF CREEK AND HAMILL GROUPS

The contact between the Horsethief Creek and Hamill groups varies significantly in the study area. It was studied at several localities, primarily within the Glacier Creek drainage. The Hamill Group quartzite was observed in contact with three Horsethief Creek Group map units, Ht5, Ht4 and Ht3. In all of these localities the contact is interpreted as sedimentary, but it may be tectonic in the lower part of Howser Creek, where it is not well exposed, and also west of Macbeth Icefield, where there is shearing parallel to the contact.

Where the Hamill Group overlies the white grits and quartzites of Unit Ht4, the contact is gradational and commonly difficult to map. The transition between the grit and massive orthoquartzite typically occurs over several tens of metres, and quartzose grit or quartz-cobble beds occur within the lower several tens of metres of the base of the Hamill Group.

Where the Hamill Group overlies Unit Ht3, the dark quartzite and schist, the contact is more abrupt, marked by a 1 to 10-metre transition to a light grey orthoquartzite. Crossbeds and grit horizons appear to be less common in the quartzite than when it overlies Horsethief Creek grits.

The contact is most abrupt above the dolostone-clast conglomerate and grit of Unit Ht5 west of Macbeth Icefield, where beds at the base of the Hamill Group appear to truncate bedding in the conglomerate at a low angle. The overlying Hamill contains grit units, as well as laterally continuous dark grey vitreous quartzites, several metres thick.

HAMILL GROUP

Stratigraphic subdivision of the Hamill Group is made difficult by lateral variations, faulting and lack of complete traversable sections in very rugged topography. Several distinct map units are recognized within the group, but correlation of units between different areas is tenuous (Figure 1-3-3). The sequence described in this study area, however, bears some marked similarities, as well as several differences, to those described by Höy (1974) to the south, in the Kootenay Arc, and by Devlin (1989) to the north, in the Dogtooth Range.

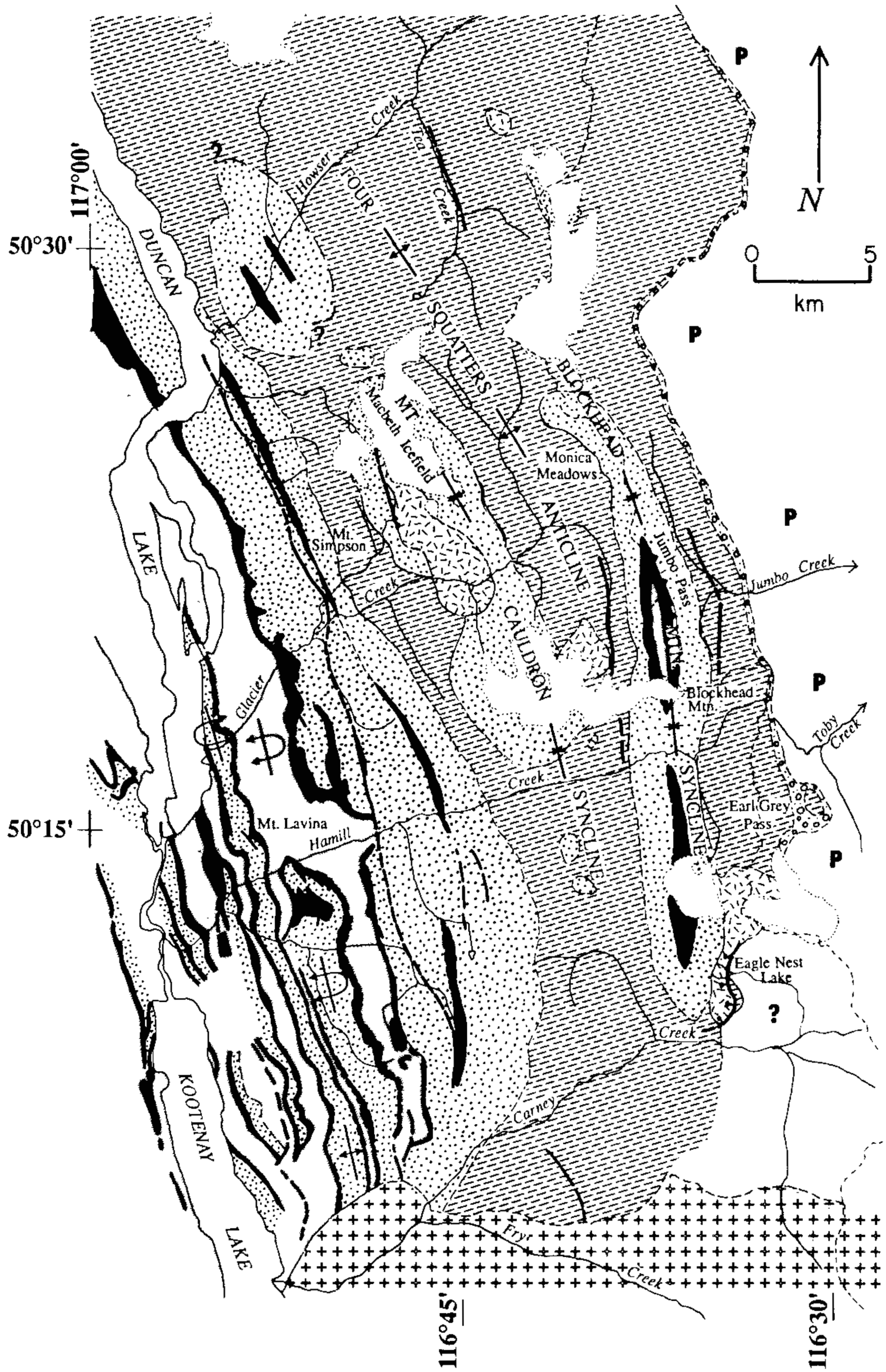
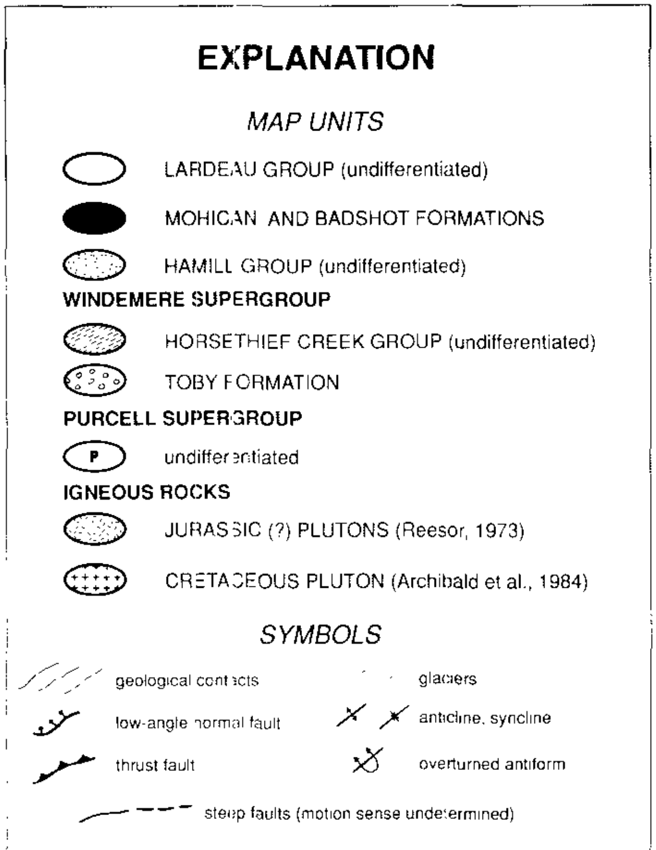


Figure 1-3-2. Geological map of the study area and adjacent segment of the Kootenay Arc. Modified after Reesor (1973). See facing page for legend.



The Hamill Group (Walker and Bancroft, 1929) lies stratigraphically above the Horsethief Creek Group, and below the Badshot Formation. It is characterized by thick, mature quartzites in the Glacier Creek drainage, but a section to the north and west near Howser Creek contains more variable and generally less mature rock types, and locally abundant mafic metavolcanic rocks. Reconnaissance suggests that there may be a similar, although less marked, change to the south into Hamill Creek. These variations may reflect abrupt changes across faults, rather than lateral gradations.

In the upper part of Glacier Creek, the total thickness of the Hamill Group is estimated to be from 900 to 1500 metres, including the Mohican Formation. The estimated thickness of 1500 metres may be due to stratigraphic repetition by thrust faults.

Hm1: LIGHT GREY CROSSBEDDED ORTHOQUARTZITE

The base of the Hamill Group is characterized by a thick sequence of light grey, clean quartzite, characterized by large trough crossbeds. Truncation surfaces are 5 to 50 centimetres apart, and planar. Flow directions are difficult or impossible to measure because three-dimensional exposures are rare, but crossbeds indicate a variety of flow directions. Estimated thickness of this unit is 300 to 500 metres.

Hm2: PELITIC SCHIST, SEMIPELITE AND METAVOLCANICS

A less mature sequence, Unit Hm2, overlies the crossbedded quartzite of Unit Hm1. It consists of interbedded quartz-muscovite-biotite-(chlorite)-(garnet) schist, local biotite-chlorite-(plagioclase)-(hornblende)-(garnet)-(calcite) mafic schist in layers 1 to 10 metres thick, some impure quartzite and carbonate, and minor pebble or cobble conglomerate. Contact relationships suggest that the mafic rocks were emplaced as both dikes and flows. Thin horizons of quartz-muscovite-hornblende-garnet schist may reflect a volcanic source, and rare mafic clasts are found in conglomerate lenses associated with the mafic schists. Quartzite and pelite are interbedded on a scale of 5 centimetres to 5 metres. Total thickness is very loosely estimated at 0 to 250 metres. The lower contact appears to be abrupt; the upper contact is gradational.

Hm3: MASSIVE WHITE ORTHOQUARTZITE

A distinctive, brilliant white, structureless, fine to medium-grained orthoquartzite occurs in a few localities in sharp contact above the amphibolite or biotite schist of Hm2. Parting surfaces thinly coated with fine-grained muscovite are 10 centimetres to 1 metre apart. East of Mount Lavina, on the ridge between the Glacier and Hamill creek drainages, this unit overlies Unit Hm2. In other localities, its stratigraphic position is not yet clear. Its maximum thickness is approximately 200 metres.

Hm4: INTERBEDDED DARK AND LIGHT QUARTZITE AND SEMIPELITE

Unit Hm4 consists of a heterogeneous sequence of dark grey quartzite, black quartzose muscovite-(biotite) schist, and less common white quartzite beds. Bed thicknesses range from a few centimetres to ten metres. Sedimentary structures are rare, but subtle graded bedding occurs in the quartzose schist, and crossbeds in the light quartzite. Both upper and lower contacts are gradational, although the lower contact with Unit Hm3 is more abrupt. Estimated maximum thickness is 1000 metres near Blockhead Mountain. A minimum thickness of about 100 metres, south of Mount Simpson, reflects significant tectonic attenuation, probably along an isoclinal fold limb.

Mohican Formation

The Mohican Formation (Fyles and Eastwood 1962) represents a transition between quartz-rich sediments of the Hamill Group and carbonate-rich rocks of the Badshot Formation. Much of the Mohican Formation is characterized by light to medium grey, brown-weathering quartz-muscovite schist and interbedded thin tan metasiltstones. The base contains quartzite beds which decrease in abundance and thickness upwards. Metre-thick dolostone beds become more abundant toward the top and the schist becomes more calcareous upwards.

The most striking feature of the Mohican Formation is the occurrence of three closely spaced orthoquartzite beds about 50 to 100 metres below the Badshot Formation, in the core of the Blockhead Mountain syncline. Each of the beds is

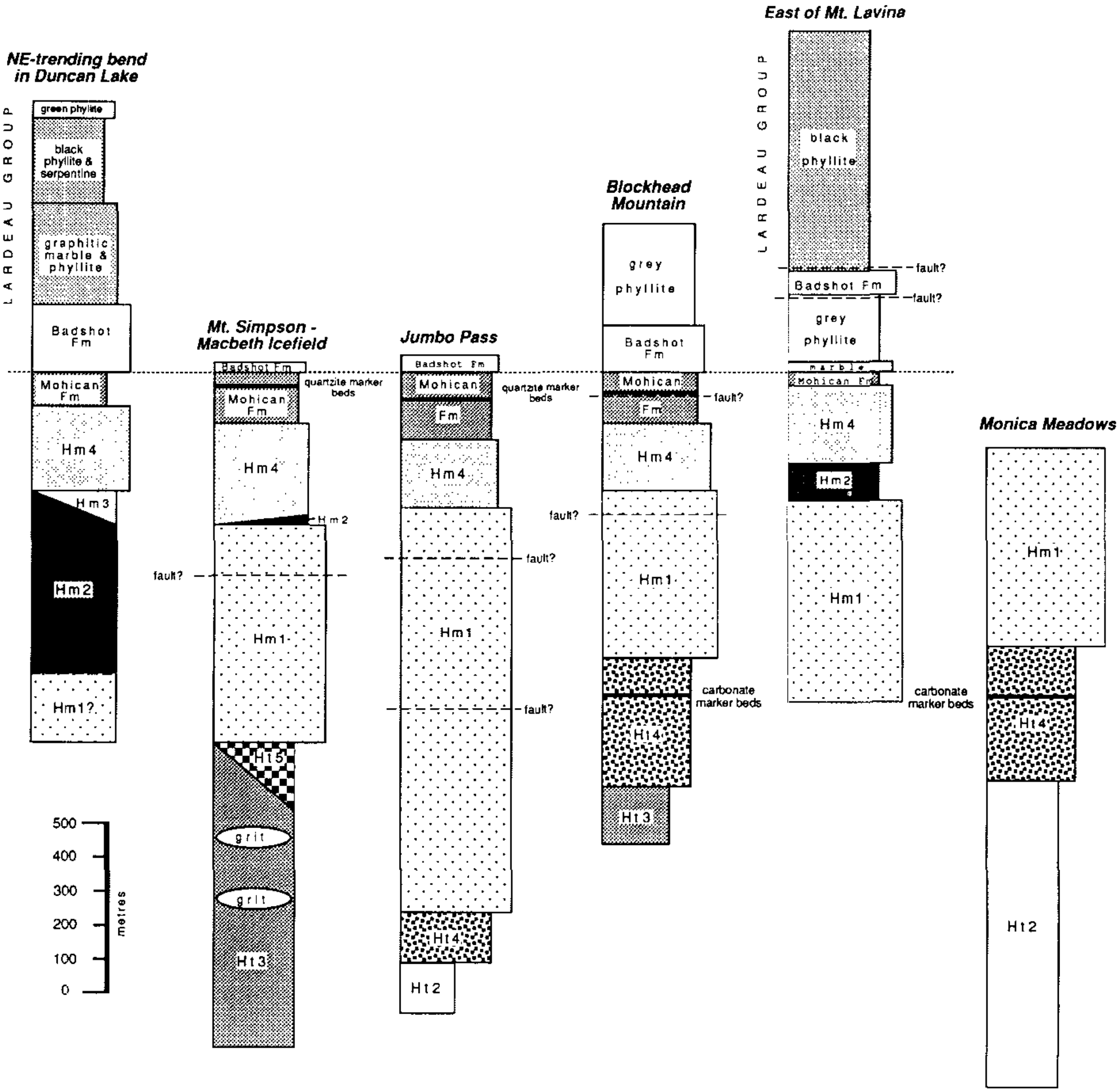


Figure 1-3-3. Stratigraphic columns from the study area showing approximate thicknesses of map units. Upper and lower limits of columns represent limit of exposure or truncation along a fault. Column locations are identified in Figure 1-3-2.

about 5 metres thick, and contains abundant trough crossbeds, very similar to those observed at the base of the Hamill Group. The three beds are a very prominent marker horizon in cliff faces, and can be traced along the entire exposure of Mohican Formation in the Blockhead Mountain syncline, a distance of 20 kilometres. A white quartzite, 5 metres thick, was also mapped in Mohican schist beneath the Badshot Formation near Mount Simpson, and may represent a tectonically thinned equivalent to the west.

The thickness of the Mohican Formation is difficult to estimate because of tectonic thickening and thinning. Within the highly strained rocks of the Kootenay Arc, Unit Hm4 and the Mohican Formation are commonly indistinguishable.

Badshot Formation

The Badshot Formation (Walker and Bancroft, 1929) stratigraphically overlies the Mohican Formation of the Hamill Group. It is characterized by two rock types in the study area, which are not separated into mappable units. Most abundant, and most characteristic, is a cliff-forming, white to medium grey, commonly laminated marble or dolomitic marble. At the eastern edge of the area mapped by Fyles (1964), marble horizons tens of metres thick may be separated by grey, locally calcareous schist. The schist varies in thickness from several metres to 100 metres. It is possible, however, that a single carbonate horizon has been duplicated by faulting or folding, and the schist belongs to either the underlying Mohican Formation or overlying Index Formation.

Phyllite in the Core of the Blockhead Mountain Syncline

A homogeneous, silvery grey phyllite overlies the dolomitic marble of the Badshot Formation in the core of the Blockhead Mountain syncline. Root (1987) tentatively mapped this unit as the lower Index Formation of the Lardeau Group. The grey phyllite, however, differs in appearance from the lower Index Formation exposed to the west along Duncan Lake. The lower Index phyllite or schist is characteristically black, commonly graphitic, and contains abundant black or graphitic marbles above the contact with the Badshot Formation.

Lardeau Group

The Index Formation of the Lardeau Group is well exposed in tight map-scale folds within the Kootenay Arc on the east side of Duncan and Kootenay lakes (Fyles, 1964). The formation as mapped by Fyles includes: black, commonly graphitic, phyllite or schist of the lower Index Formation, with interbedded black marble at the base; and green phyllite or quartz-muscovite-chlorite schist, with quartzose laminations, of the upper Index Formation. It is not a goal of this study to remap the Lardeau Group in this area, but two observations which differ from those of Fyles are worth noting.

Southeast of Mount Lavina, plagioclase-actinolite or hornblende-biotite-chlorite-(epidote) greenstone, 20 to 30 metres thick, is intercalated with green and beige, laminated muscovite-chlorite-quartz schist. This sequence is exposed in the core of a syncline and appears to stratigraphically overlie the upper Index Formation.

The lower Index Formation, between the mouths of Glacier and Howser creeks, contains at least one thin ultramafic to mafic unit, which varies in composition and texture from a green talc-chlorite-(antigorite)-(magnesite)-(calcite) schist to an equigranular to well-foliated plagioclase-hornblende-biotite-(chlorite) gneiss or schist with strongly sheared chloritic schistose margins. The unit is up to 30 metres thick, and has been traced south for approximately 3 kilometres from the bend in Duncan Lake (E. Lawrence, personal communication), parallel to the dominant schistosity. Repetitions of this unit may be the result of isoclinal folding which also deforms the dominant schistosity.

STRUCTURE

The overall map pattern outlined by Fyles (1964) and Reesor (1973) has not been changed significantly as a result of this study. However, several important new observations contribute to the understanding of the kinematics of deformation in this part of the Kootenay Arc and adjacent Purcell anticlinorium.

Sequence of Deformation

Three main phases of deformation are recognized in the study area: (1) early large-scale west-verging recumbent folds (Fyles, 1964); (2) a dominant phase of upright or east-verging folds, associated with steep ductile shear zones and a pervasive subhorizontal north-south stretching lineation; and (3) a late crenulation or spaced cleavage which is probably not correlative across the entire area.

Prograde metamorphism up to garnet grade accompanied Phase I or the early part of Phase II deformation. Retrograded garnet porphyroblasts show that the garnet isograd is considerably farther east than shown by Reesor (1973). Widespread retrograde metamorphism probably occurred late in Phase II deformation.

Minor folds related to Phase I, previously thought to be confined to the Kootenay Arc (Reesor, 1973), are preserved in competent rocks as far east as Jumbo Pass. These folds form Type 3 interference patterns with younger, upright Phase II folds, but do not affect the map pattern as they do in the Duncan Lake region.

Phase II fold axes are parallel to a distinctive subhorizontal lineation. It is expressed in quartzose rocks as mullions or quartz rods at a wide range of scales, as an intersection lineation or mica and quartz mineral lineation in schistose rocks, as boudinage in rocks of variable rheology, and as strongly stretched clasts in grits and conglomerates. Aspect ratios of stretched clasts are as high as 50:1. The plunge is most commonly shallow to 330° to 340°, although domains of southeasterly plunge are not uncommon. The lineation is pervasive within the strongly deformed, overturned sequence of Hamill Group, Badshot Formation and Lardeau Group to the west, but is very well developed in high-strain zones as far east as the Purcell divide.

The Phase II schistosity or cleavage also decreases in intensity from west to east, but is locally stronger in ductile shear zones, parallel to the axial surfaces of map-scale structures. A variety of complex folds and faults are clearly outlined in the Blockhead Mountain syncline by the three marker beds within the Mohican Formation, and indicate that the syncline is internally complex. These structures include megascopic boudinage, duplexes and large-amplitude, repeated isoclinal folds. The Phase II fabric varies in orientation from east-dipping to west-dipping. A pattern to variations in orientation of Phase II structures has not been recognized yet. The variation may be due to fanning of Phase II structures, changes in orientation with structural level, or disturbance by Phase III structures.

The Phase III deformation is coaxial with Phase II in the western part of the area (Fyles, 1964), but cuts obliquely across earlier structures in the eastern part of the area.

Transition From Purcell Anticlinorium to Kootenay Arc

Fyles' (1964) mapping provided thorough documentation of the complex fold style in the vicinity of Duncan and northern Kootenay lakes. A largely inverted sequence represents the lower, overturned limb of a large southwest-verging recumbent fold, which closes west of Duncan Lake. This structure is isoclinally refolded by younger, tight, upright folds (Fyles, 1964). Reesor (1973) reported a "sudden change of folding intensity" several kilometres east of Duncan Lake, within the westernmost exposed Horsethief Creek Group. This change separates rocks of the western Purcell anticlinorium from the more complexly deformed rocks of the Kootenay Arc to the west. To the east, Reesor (1973) documented an upright stratigraphic succession, deformed only by less tight, upright or steeply east-verging folds. It is important to note that the geometric relationships shown on Reesor's (1973) compilation map allow no place for the upright limb of the west-verging recumbent structure mapped by Fyles to "root" to the east.

A well-developed ribbon mylonite zone has been traced from the west flank of Mount Simpson, north of Glacier Creek, to south of Hamill Creek. To the north, the stratigraphy is disrupted at the edge of Duncan Lake, suggesting that the fault continues. The fault lies primarily within the Hamill stratigraphy, but juxtaposes different parts of the Hamill Group. The regional subhorizontal lineation, including stretched pebbles, is particularly well developed in this zone. Shear-sense indicators observed in outcrops within the fault zone include C-S fabrics and strongly asymmetric minor folds. The dominant shear sense is dextral, although in many places indicators are ambiguous or lacking. The amount of fault displacement cannot be estimated.

Along strike to the south, a similar change in fold style is also marked by a fault zone, the West Bernard fault of Höy (1977) or the Seeman Creek fault of Leclair (1988). East-verging reverse motion was inferred in the Riondel area, but conclusive evidence was lacking (Höy, 1974).

Relationships Between Intrusive Rocks and Deformation

Three types of intrusive rocks are found in the study area: small, elongate and locally deformed hornblende biotite granodiorite plutons (Jurassic?; Reesor, 1973), foliated felsite dikes which are common in the western part of the study area, and larger two-mica quartz monzonite plutons (Cretaceous Fry Creek batholith; Reesor, 1973; Archibald *et al.*, 1984). Field relationships indicate that the elongate plutons and the felsite dikes were intruded during the latter part of Phase II deformation. The dike margins, foliation and elongate xenoliths are parallel to the Phase II schistosity and axial surfaces. The dikes, however, are not themselves folded, and the dike foliation is not as strong as that within competent country rocks. The dikes are commonly boudinaged, with stretching subparallel to the regional subhorizontal lineation. Veins associated with the elongate plutons are folded by the Phase II deformation, but not nearly as tightly as are the host sediments. Some veins completely cut the Phase II fabric at low angles. The western margin of the Glacier Creek stock is very weakly foliated compared to the country rock, although the adjacent Hamill quartzite shows evidence of intense ductile deformation during Phase II deformation.

Minor folds in the country rock are parallel to the contact with the Fry Creek batholith within 0.5 metre of the contact, but the batholith completely crosscuts the map-scale structures. The north-south subhorizontal mineral lineation is evident in the country rock, but nowhere in the pluton. The western part of the pluton, however, near the mouth of Fry Creek canyon, displays a moderately southeast-dipping quartz-muscovite schistosity, and a west-dipping quartz lineation. Eocene Ar-Ar dates from the western part of the pluton suggest that it has been affected by Eocene extension (Archibald *et al.*, 1984).

A spectacular ductile fault zone separates the southern tail of the Toby stock from the upper part of the Horsethief Creek Group to the east of the stock. A strong west-plunging mineral lineation, including hornblende, is developed on a west-dipping mylonitic fabric and shear-sense indicators imply west-side down. Boudinage is dramatic on a variety of scales. This fault is also suspected to be Eocene, and it is hoped that Ar-Ar dating of oriented hornblendes will help to constrain the age of deformation.

SUMMARY AND PRELIMINARY CONCLUSIONS

- The middle to upper part of the Horsethief Creek Group is characterized by a sequence of five mappable units, which may represent a transition from deep to shallow water. The base of the Hamill Group appears to be gradational at some localities, but not at others; and to overlap the top three units of the Horsethief Creek Group.
- The internal stratigraphy of the Hamill Group can be correlated quite closely with that described by Höy (1974) in the Riondel area to the south, and less closely with that described by Devlin (1989) in the Dogtooth Range to the north; however, in the Glacier Creek area, immature clastic sediments and volcanic rocks are much less significant in the middle of the Hamill Group than in the regions to the north and south.
- A prominent subhorizontal stretching lineation associated with the development of Phase 2 structures is pervasive within the Kootenay Arc, and widespread at least as far east as the Purcell divide.
- A well-developed, steep ductile mylonite zone separates rocks of the Kootenay Arc from upright rocks of the Purcell anticlinorium. Evidence suggests that motion was dominantly strike-slip, although an earlier history may be masked.
- Low-angle ductile normal faulting has affected the southeastern part of the area and may be associated with regional Eocene extension.

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