GEOLOGY OF THE TRIASSIC BLACK PHYLLITE IN THE EUREKA PEAK AREA CENTRAL BRITISH COLUMBIA* (93A/7)

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INTRODUCTION

The Eureka Peak area lies approximately 100 kilometres east of Williams Lake, in central British Columbia (Figure 3-2-1). Fieldwork in 1986 concentrated on establishing a stratigraphic order within the Triassic sequence of black phyllites and mapping the structural features of the area. An area of 300 square kilometres was examined, extending from Crooked Lake on the south, to the southeastern shore of Horsefly Lake on the north.

Previous work by the author during 1984, and briefly during the 1985 field season, involved detailed geologic mapping of the Eureka Peak syncline as part of a Master's thesis project under the direction of Dr. J. V. Ross.

GEOLOGIC SETTING

The area studied lies within the Quesnel terrane of the Intermontane Belt (Monger *et al.*, 1982), and is adjacent to the Omineca Belt-Intermontane Belt boundary. The terrane boundary is defined by the Eureka thrust (Struik, 1986). Structural relations across this major tectonic boundary have been summarized by Ross *et al.* (1985) and Ross and Fillipone (in preparation).

The unnamed black phyllites occur in a linear belt adjacent to the Omineca Belt-Intermontane Belt boundary and are assigned to the Quesnel River Group (Tipper, 1978; Campbell, 1978). The phyllites structurally overlie metavolcanic rocks to the north (Campbell *et al.*, 1973) that range in age from Mississippian to early Permian

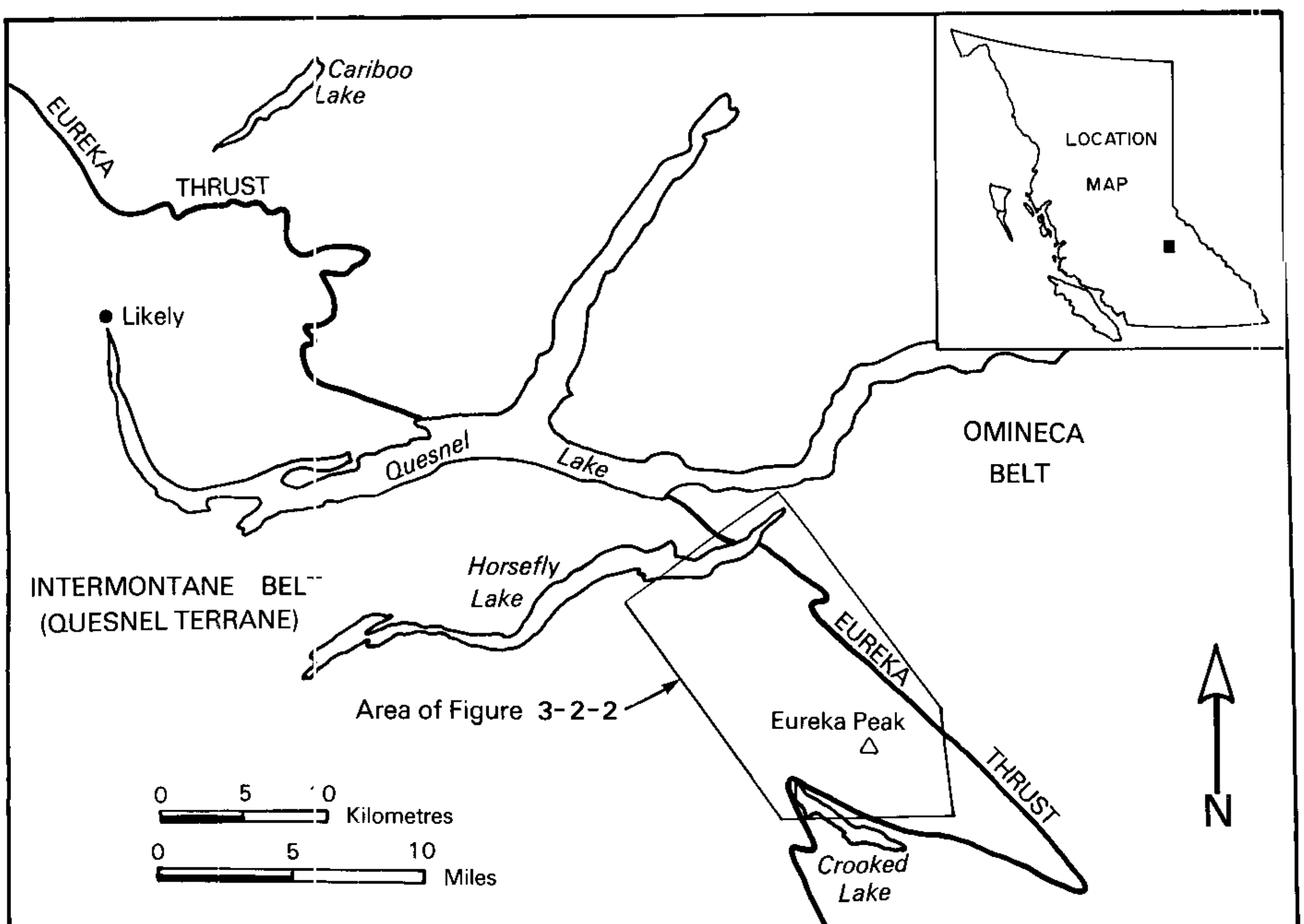

Figure 3-2-1: Major tectonic boundary between the Omineca Belt and Intermontane Belt outlined by the Eureka thrust. Location map inset.

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement.

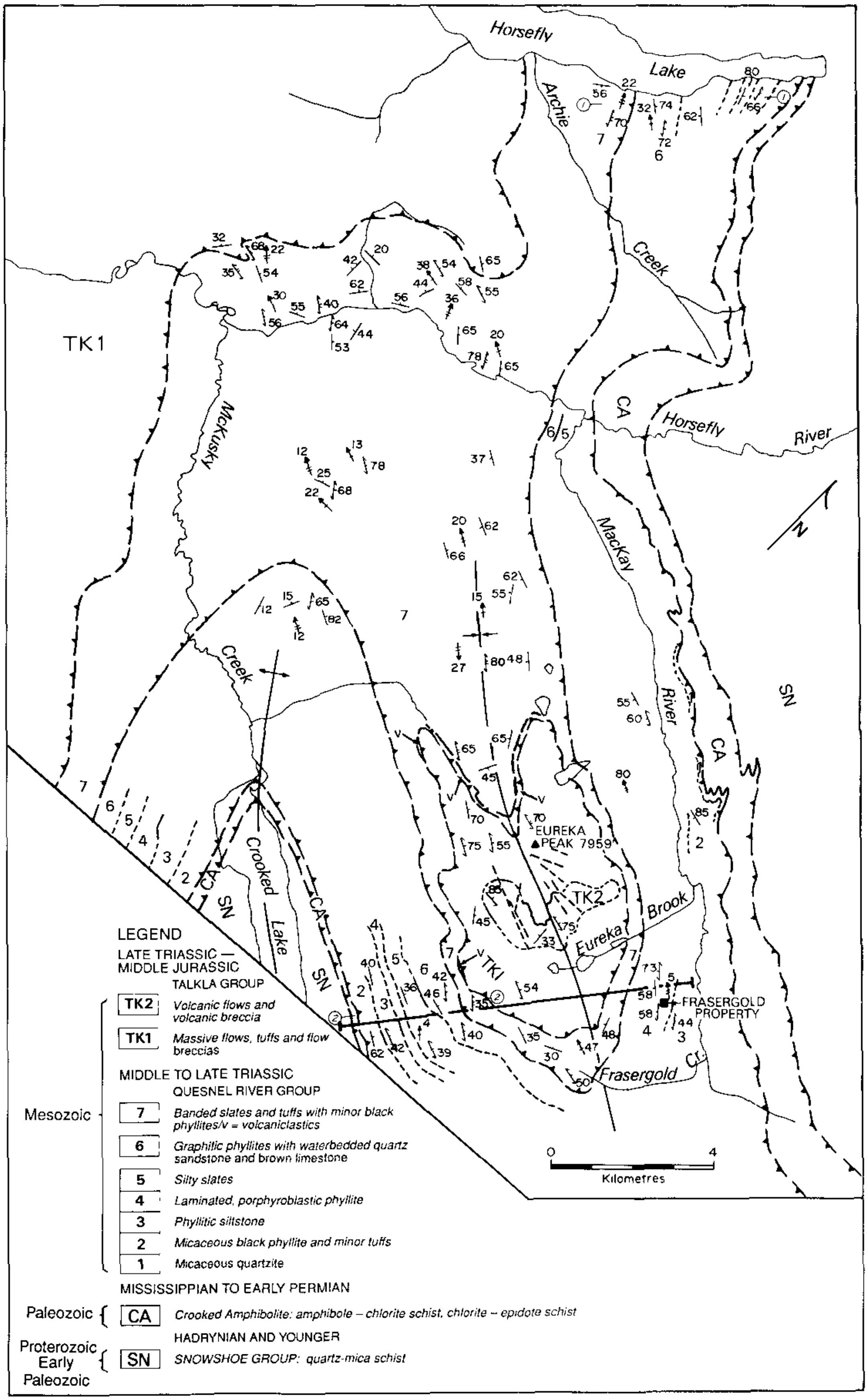

Figure 3-2-2: Generalized geology of the Eureka Peak area.

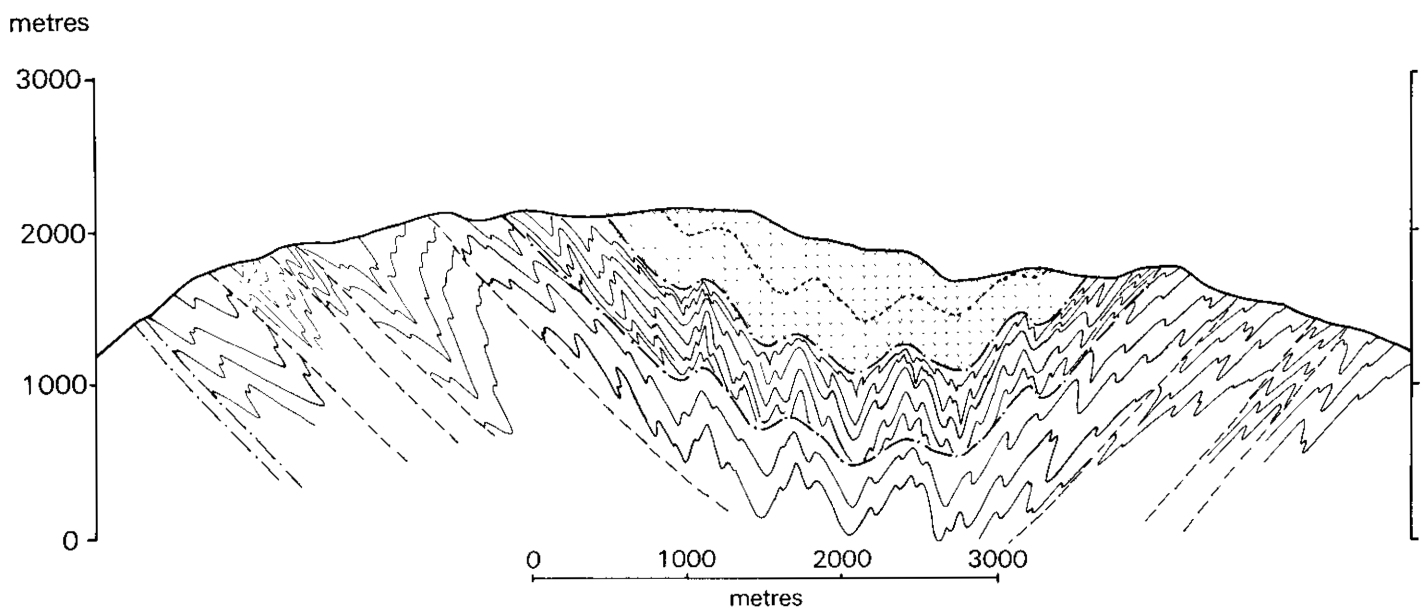

Figure 3-2-3: Schematic cross-section to accompany Figure 3-2-2.

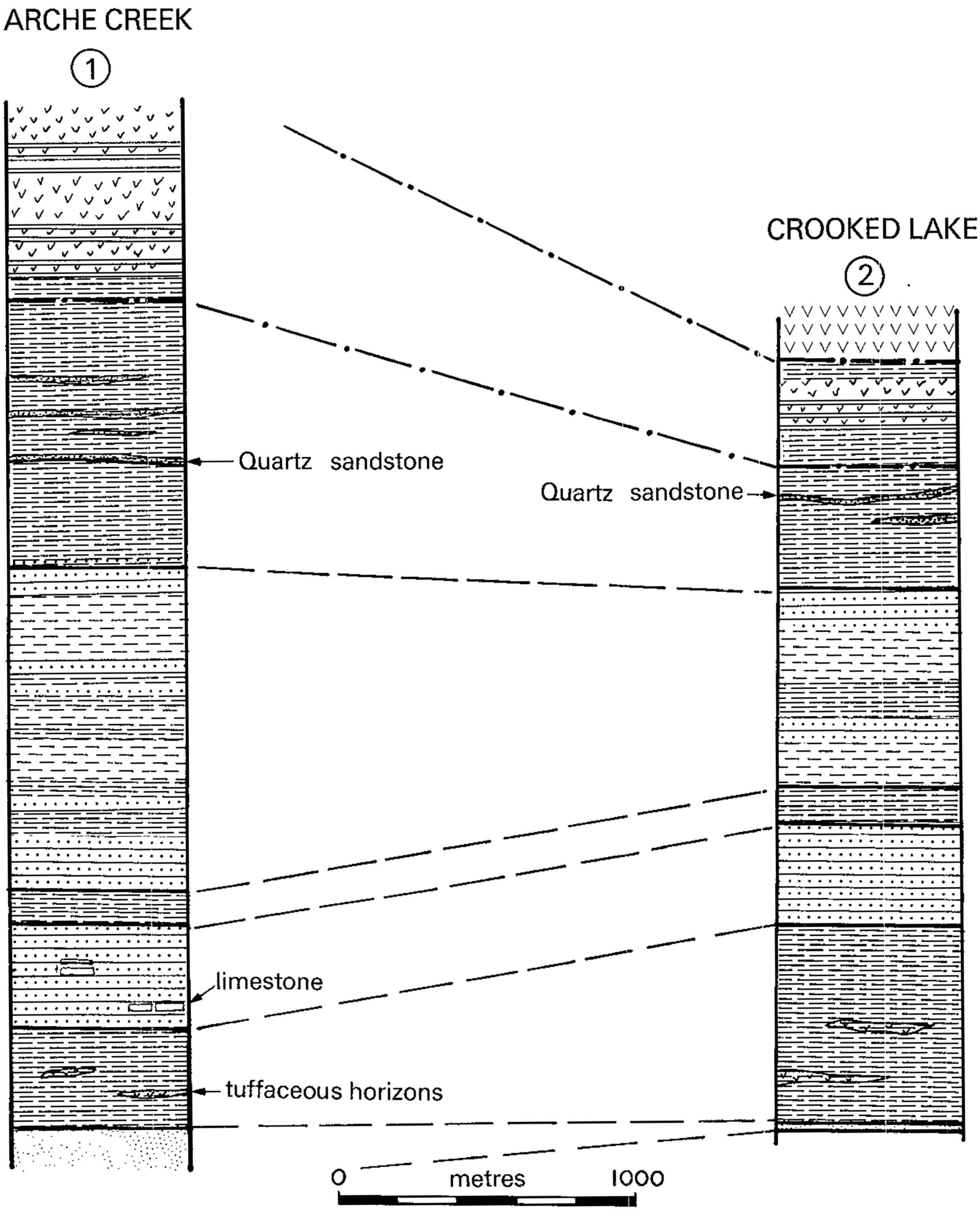

Figure 3-2-4: Schematic stratigraphic sections at two locations and correlations.

(Orchard and Struik, 1985). The metavolcanic unit in the Eureka Peak area is designated as the Crooked amphibolite and is believed to be correlative to the Antler Formation of the Slide Mountain Group exposed further to the north (Struik, 1986). The phyllites are in turn structurally overlain by metabasalts, tuffs and volcanic breccias of the Takla Group. Conodonts from limestone within the black phyllite north of Quesnel Lake range in age from early Middle Triassic (Anisian) to Late Triassic (Norian) (Struik, 1986). The age of the overlying Takla Group is unknown in the area studied, but may be Late Triassic to Early Jurassic and perhaps Middle Jurassic in age. These rock units have been deformed into a regional synformal structure referred to as the Eureka Peak syncline, and have been regionally metamorphosed to the lower greenschist facies.

STRATIGRAPHY

BLACK PHYLLITE (Lithologic Units 1-7)

Previous work in the Eureka Peak area during the 1985 field season established some details of the stratigraphy within the black phyllite package. Fieldwork in 1986 focused on establishing stratigraphic continuity throughout the map area. Areas of relatively continuous exposure were examined in detail and, where possible, measurements were made with reference to a known marker unit such as the lower contact with the Crooked amphibolite or the upper contact with the Takla Group rocks. Preservation of fine details of the original bedding features within the phyllites was essential to identifying stratigraphic variations. All contacts between defined lithologic units within the phyllites are gradational over a distance of several metres.

Two complete stratigraphic columns within the black phyllites were constructed and correlated (Figure 3-2-4). The location of each column is indicated on the accompanying geologic map (Figure 3-2-2).

UNIT 1

The basal unit of the black phyllite package is a micaceous quartzite of variable thickness (10 to 150 metres). The unit structurally overlies the metavolcanic rocks of the Crooked amphibolite. Buff to rust-weathering, pale recrystallized quartz sandstone dominates the unit. Locally the sandstones are dark grey to green in colour. Compositional layering is outlined by alternating quartz-rich and mica-rich bands. Planar alignment of muscovite defines the schistosity strongly developed parallel to bedding. The micaceous quartzite outcrops on both limbs of the Eureka Peak syncline. On the southern limb a maximum thickness of about 20 metres is observed; on the northern limb thickness varies from 20 to 150 metres (Elsby, 1985). Further to the northwest at Archie Creek a minimum thickness of 100 metres is exposed, however the contact with the underlying Crooked amphibolite is not observed.

Concordant and discordant relations have been observed along the contact between the quartzite and underlying metavolcanics. Imbrication of this contact has been documented on the southern limb of the syncline at the southeastern end of Crooked Lake (Campbell, 1971).

UNIT 2

An extremely siliceous, locally graphitic, dark grey to black phyllite overlies the micaceous quartzite. Bedding is difficult to discern and is locally defined by rust to dark grey-weathering thin quartz sandstone beds. minor dark grey siltstone beds up to 20 centimetres thick and discontinuous tuffaceous horizons and lenses. The phyllite observed at Archie Creek is more graphitic than its counterpart to the southeast at Crooked Lake. This unit is always characterized by a very shiny, phyllitic foliation.

UNIT 3

Unit 3 is comprised of a sequence of interbedded light and dark grey silty slates. Bedding is defined by well-developed fine banding and thin laminated quartz sandstone beds. The unit is nonfissile and has a well-developed slaty parting. Minor interbeds of dark grey siliceous limestone average 1 to 3 metres thick.

UNIT 4

A well-laminated grey phyllite, grading upwards into a porphyroblastic phyllite, overlies the silty slates of Unit 3. Bedding is defined by thin, finely laminated quartz sandstone beds. The strongly developed phyllitic foliation is locally outlined by fine graphitic material. Porphyroblasts of garnet, plagioclase and chloritoid occur within this unit on the southern limb of the Eureka Peak syncline. On the northern limb of the syncline, south of the MacKay River and also at Archie Creek, chloritoid occurs as porphyroblasts associated with a second porphyroblast phase which has been completely altered to an iron oxide.

UNIT 5

Graphitic phyllites interbedded with dark grey siltstones and silty slates overlie the porphyroblastic phyllite. Graphitic phyllite, blue-black in colour, comprises the majority of this unit at Archie Creek. To the southeast at Crooked Lake, silty slates are predominant and are only locally graphitic. Reddish brown weathering of laminated dark grey siltstone beds (10 to 15 centimetres), and pale green tuffs occurring as discontinuous lenses parallel to bedding are characteristic features of this unit. Very thin, laminated pale quartz sandstone beds occur locally throughout the unit.

UNIT 6

Unit 6 is a sequence of phyllites that grades upwards through graphitic black phyllites, grey silty phyllites and back into more graphitic black phyllites. Bedding is always well defined by pale. laminated siltstone beds. The prominently bedded siltstones rarely exceed 2 centimetres in thickness and are characteristic of this unit. In the uppermost portion of the unit, black silty limestones occur as lenses and discontinuous beds.

UNIT 7

Unit 7, the uppermost unit in the phyllite sequence, is readily distinguished by a significant volcanic component in the sediments On the southern limb of the syncline the base of the unit is marked by a sharp fault contact; bedding attitudes are locally discordant across the fault (Plate 3-2-1). Quartz veins are prominent near the contact This contact is not exposed at Archie Creek.

The volcanic component in the sediments increases progressively upwards. This stratigraphic progression is observed throughout the map area. Within the lowermost 50 metres of unit 7, dark grey to black phyllites are interbedded with grey to green tuffs. The tuffs become predominant upsection and are interbedded with grey to black banded slates, massive pale quartz sandstone and minor limestone. The uppermost 100 metres of the unit consists of fissile graphitic phyllites interbedded with tuffs and locally with dark brown to black limestones and minor quartz sandstone beds. In outcrop the phyllites are black and sooty, locally pyritiferous and recessive. The tuffaceous beds have a rusty, speckled appearance and are locally calcareous.

In the core of the Eureka Peak syncline and locally along the limbs, the top of the metasedimentary sequence is marked by a volcaniclastic unit of variable thickness. Where present the volcaniclastic unit is in fault contact with the overlying volcanic rocks of the Takla Group. The volcaniclastic unit and associated metasediments were earlier believed to stratigraphically and structurally overlie the volcanics (Campbell, 1971). These rocks are currently assigned to Unit 7 as the same stratigraphic gradation seen along the southern limb is also observed in the core of the Eureka Peak syncline, as the contact with the Takla Group is approached.

TAKLA GROUP

Basic volcanic rocks of the Takla Group occupy the core of the Eureka Peak syncline and are the youngest rocks exposed in the area. The volcanic succession consists of metabasalt, augite porphyry flows, tuffs and volcanic breccias. Low-grade metamorphism has affected the entire unit, resulting in the growth of chlorite, actinolite and rarely biotite. Throughout the area, the basal contact of the volcanics with the underlying metasediments is a fault.

STRUCTURE

Three major phases of deformation have been recognized. Overprinting relations observed in the field form the basis for differentiating each successive phase. Features associated with each phase are developed throughout the area, however the intensity and style of folding are influenced by lithology and position with respect to the regional structure.

PHASE 1

Phase 1 structures are primarily represented by folding of bedding (F_1). A well-developed penetrative slaty to phyllitic foliation (S_1) is axial planar to F_1 folds and moderately to steeply inclined to the northeast and southwest. A prominent mineral elongation lineation, parallel to the F_1 fold axes, plunges at shallow to moderate angles to the northwest and southeast.

The first phase structures show the greatest variation in style with respect to structural position. At lower structural levels the phase 1 folds are tight to isoclinal. The extreme tightness results in transposition of layering and local mesoscopic stratigraphic inversions. Transposition of Phase 1 structures is particularly pronounced within several tens of metres of the lower and upper contacts of the phyllite sequence with the Crooked amphibolite and Takla Group, respectively. At the contacts Phase 1 deformation has been largely accommodated by the phyllites, due to the contrast in competency between the units. The phyllite is less competent and the folding is controlled by the more rigid volcanic rocks. Without sedimentary "way-up" indicators it is impossible to determine the facing directions of individual transposed packages. Despite the local structural inversions there appear to be no overall stratigraphic inversions within the map area.

At higher structural levels the axial plane cleavage is more steeply inclined and the F_1 folds become more open and upright. In the Takla Group the first phase folds are open buckle folds.

PHASE 2

The second phase of deformation establishes the regional map pattern, folding the Omineca Belt-Intermontane Belt tectonic boundary. Phase 2 folds (F_2) refold all earlier structures throughout the area. A nonpenetrative spaced or crenulation cleavage (S_2), along which extensive pressure solution has occurred, is well-developed axial planar to F_2 folds. The second phase structures show a consistent southwesterly sense of vergence with their axial planes inclined steeply to the northeast. Phase 2 deformation is responsible for the tightening of first phase structures, locally overturning F_1 folds to the southwest. F_2 fold axes are oblique to nearly parallel fo F_1 axes and result in the curvilinear nature of F_1 linear structures. The similar orientation of the planar and linear elements

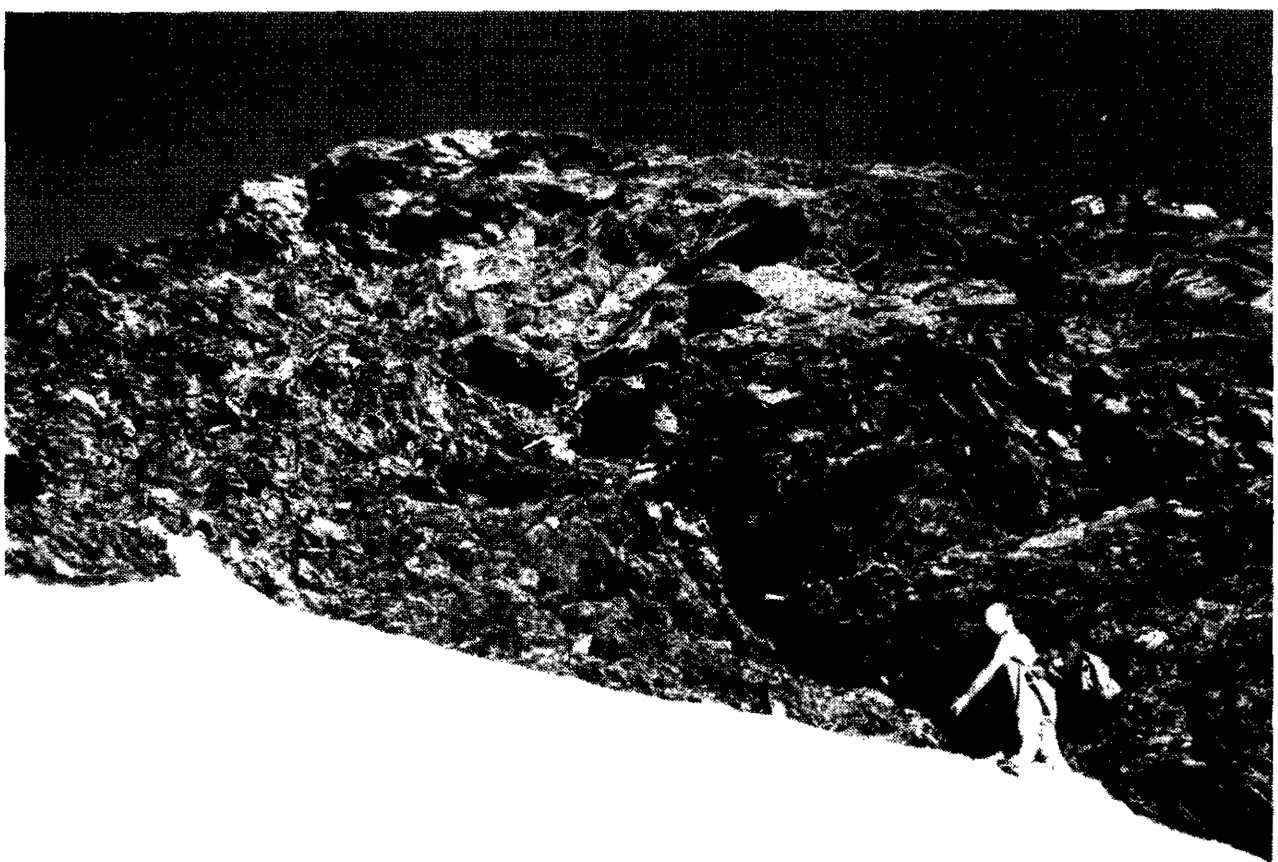

Plate 3-2-1: Sharp fault contact between Unit 6 and Unit 7. The light-weathering tuffs in the hangingwall distinguish Unit 7 from Unit 6.

within the two phases can be related to the general lack of intense refolding of F_1 structures, and instead has served to tighten F_1 folds that are then overprinted by the S_2 fabric.

PHASE 3

Phase 3 folds (F_3) occur as a warping of bedding and previously developed surfaces and locally as small-scale crenulations. The axial planar crenulation cleavage (S_3), where observed, dips to the southwest. F_3 folds are most evident at lower structural levels and display a consistent northeasterly sense of vergence. At higher structural levels, the effects of Phase 3 deformation are absent or only weakly developed.

PHASE 4

Phase 4 deformation is ubiquitous as a spaced cleavage and fracture set. Macroscopic folding is not associated with this latest structural episode. Spacing of fractures varies according to lithology, and ranges from about 1 centimetre to 0.5 metre; dips are steep to both the north and south.

FAULTING

Faulting associated with first phase deformation is particularly significant in the Eureka Peak area, where two major thrust faults have been identified:

(1) At the contact between Units 6 and 7,

(2) At the contact between Unit 7 and the overlying Takla Group.

The faults are nearly parallel to stratigraphic contacts, truncating bedding at low angles in some instances. They are overprinted by second phase structures, but are not intensely refolded. Brecciation, slickensides and quartz-filled fractures are common within the fault zones, which rarely exceed 3 metres in width (Plate 3-2-2). The amount of displacement along the thrusts is unknown.

Several higher angle faults cut the Takla Group rocks in the core of the Eureka Peak syncline. They are steeply inclined to the northeast and parallel the regional foliation; displacements are not significant.

Plate 3-2-2: Discordant bedding relations observed across the fault zone within which occurs quartz-filled lenses and fractures.

MINERAL OCCURRENCES

The Frasergold property is located on the northeastern limb of the Eureka Peak syncline, southwest of the MacKay River (Figure 3-2-2). Gold mineralization is associated with pyrite, pyrrhotite and chalcopyrite, and occurs as disseminations in the black phyllite and in quartz veins. The mineralized zone is apparently localized in a porphyroblastic phyllite equivalent to Unit 4. Extensive mineralization of this unit is not apparent at Archie Creek or on the southern limb of the Eureka Peak syncline. Mineralized quartz veins parallel the phyllitic foliation (S_1), and are parallel to subparallel to bedding (S_0). The veins have been deformed, locally taking up a sigmoidal geometry. Quartz veins formed early in the structural history of the area and represent metamorphic segregations associated with the dewatering of the sediments during the initial stages of Phase 1 deformation. These processes are interpreted to be the result of deformation associated with convergence between allochthonous terranes and the western margin of North America during the mid-Jurassic. The mineralization is interpreted to be of syngenetic origin with later remobilization during regional metamorphism.

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REFERENCES

Campbell, K.V. (1971): Metamorphic Petrology and Structural Geology of the Crooked Lake Area, Cariboo Mountains, British Columbia, Ph.D. Thesis, *University of Washington*.

Campbell, R.B. (1978): Quesnel Lake, *Geological Survey of Canada*, Open File 574.

Campbell, R.B., Mountjoy, E.W. and Young, F.G. (1973): Geology of the McBride Map Area, British Columbia, *Geological Survey of Canada*, Paper 72-35.

Elsby, D.C. (1985): Structure and Deformation Across the Quesnellia-Omineca Terrane Boundary, Mount Perseus Area, East-Central British Columbia, M.Sc. Thesis, *The University of British Columbia*.

Monger, J.W.H., Price, R.A. and Tempelman-Kluit, D.J. (1982): Tectonic Accretion and the Origin of the Two Major Metamorphic and Plutonic Belts in the Canadian Cordillera, *Geology*, Volume 10, pages 70-75.

Orchard, M.J. and Struik, L.C. (1985): Conodonts and Stratigraphy of Upper Paleozoic Limestone of Cariboo Gold Belt, Central British Columbia, *Canadian Journal of Earth Sciences*, Volume 22, pages 538-552.

Ross, J.V., Fillipone, J.A., Montgomery, J.R., Elsby, D.C. and Bloodgood, M.A. (1985): Geometry of a Convergent Zone, Central British Columbia, Canada, *Tectonophysics*, Volume 119, pages 285-297.

Ross, J.V. and Fillipone, J.A. (in preparation): Details of a Convergent Zone Associated with Accretion of Late Paleozoic to Early Mesozoic Allochthons to the Western Margin of North America, Central British Columbia, Canada, Submitted to *Geology*.

Struik, L.C. (1986): Imbricated Terranes of the Cariboo Gold Belt with Correlations and Implications for Tectonics in Southeastern British Columbia, *Canadian Journal of Earth Sciences*, Volume 23, Number 8, pages 1047-1061.

Tipper, H.W. (1978): Northeastern Part of Quesnel (93B) Map-area, British Columbia, Current Research, Part A, *Geological Survey of Canada*, Paper 78-1A, pages 67-68.