Ministry of Energy, Mines and
Petroleum Resources
Hon. Jack Davis, Minister

MINERAL RESOURCES DIVISION
Geological Survey Branch

GEOLOGY OF THE EUREKA PEAK AND SPANISH LAKE MAP AREAS, BRITISH COLUMBIA

By Mary Ann Bloodgood

ERRATA

1) Mary Ann Bloodgood on cover and title page should read: Mary Anne Bloodgood.

2) On page 13 caption should read:
Plate 8. South of Peak 7352' in the core of the Eureka Peak syncline, textural transitions within porphyritic flows are characterized by (A) coarse flow breccia at the base of the flow, and (B) massive, though still heterogeneous textures in the upper part of the flow.

PAPER 1990-3

Editors:
Brian Grant
John Newell
Formatting and Page Layout:
Janet Holland

Canadian Cataloguing in Publication Data
Bloodgood, Mary Anne, 1960-
Geology of the Eureka Peak and Spanish Lake map areas, British Columbia

(Paper, ISSN 0226-9430 ; 1990-3)

Includes bibliographical references.
ISBN 0-7718-8894-5

1. Geology - British Columbia - Eureka Peak Region. 2. Geology - British Columbia - Spanish Lake Region (Cariboo) 3. Geology, Economic - British Columbia - Eureka Peak Region. 4. Geology, Economic - British Columbia - Spanish Lake Region (Cariboo) I. British Columbia. Geological Survey Branch. II. Title. III. Series: Paper (British Columbia. Ministry of Energy, Mines and Petroleum Resources) ; 1990-3.

QE187.B58 1990 557.11'75 C89-092277-2

VICTORIA
BRITISH COLUMBIA
CANADA

October 1990

ABSTRACT

The Eureka Peak and Spanish Lake areas lay within the Quesnel Terrane of the Intermontane Belt, adjacent to the Omineca Belt - Intermontane Belt tectonic boundary. It represents a convergent zone between the arc related Quesnel Terrane and parautochthonous Barkerville Terrane. The boundary is defined by the Eureka thrust.

Underlying the area are Middle Triassic to Early Jurassic sedimentary and volcanic rocks, represented by the Quesnel River Group and the Nicola Group, respectively. Petrologic and geochemical studies suggest protoliths of island arc and marginal basin affinities (Bloodgood, 1987a). The Quesnel Terrane structurally overlies the Barkerville Terrane, represented by Hadrynian to early Paleozoic metasediments of the Snowshoe Group and the Late Devonian to Middle Mississippian Quesnel Lake gneiss. The base of the Quesnel Terrane is marked by mylonitized mafic and ultramafic rocks of the Crooked amphibolite.

Correlation of features across the boundary has established the structural continuity in the region and recognition of structural features common to both terranes which developed in response to plate convergence. The deformational history involves two phases of coaxial folding, accompanied by extensive pressure solution, and later overprinting by northeast trending fractures. Synchronous with first phase deformation, thrust faults and detachment surfaces developed, primarily along stratigraphic contacts due to contrasting rheologies of the adjacent lithologies. Second phase deformation established the regional map pattern, folding both the fault surfaces and the tectonic boundary.

Synchronous to the deformation, regional metamorphism is evidenced by the growth of minerals characteristic of amphibolite facies in the Barkerville Terrane and greenschist facies in the Quesnel Terrane. Cleavage surfaces have acted as a locus along which pressure solution occurred, providing a pathway for the migration of fluids generated during regional metamorphism.

Mineral exploration within the Triassic black phyllites has been ongoing since the Barkerville gold rush. Three mineral deposit types have been recognized within the area, all of which have important structural and stratigraphic controls. Remobilization of gold and sulphide minerals during regional metamorphism is characteristic of syngenetic lode gold mineralization. Porphyry copper mineralization occurs in association with alkalic stocks within the metavolcanic Nicola succession. And, vein mineralization associated with zones of intense listwanite and carbonate-silica alteration have also been recognized. In each case, fracture formation and cleavage development accompanying regional metamorphism and deformation have provided the pathway for the migration of hydrothermal and mineralizing fluids.

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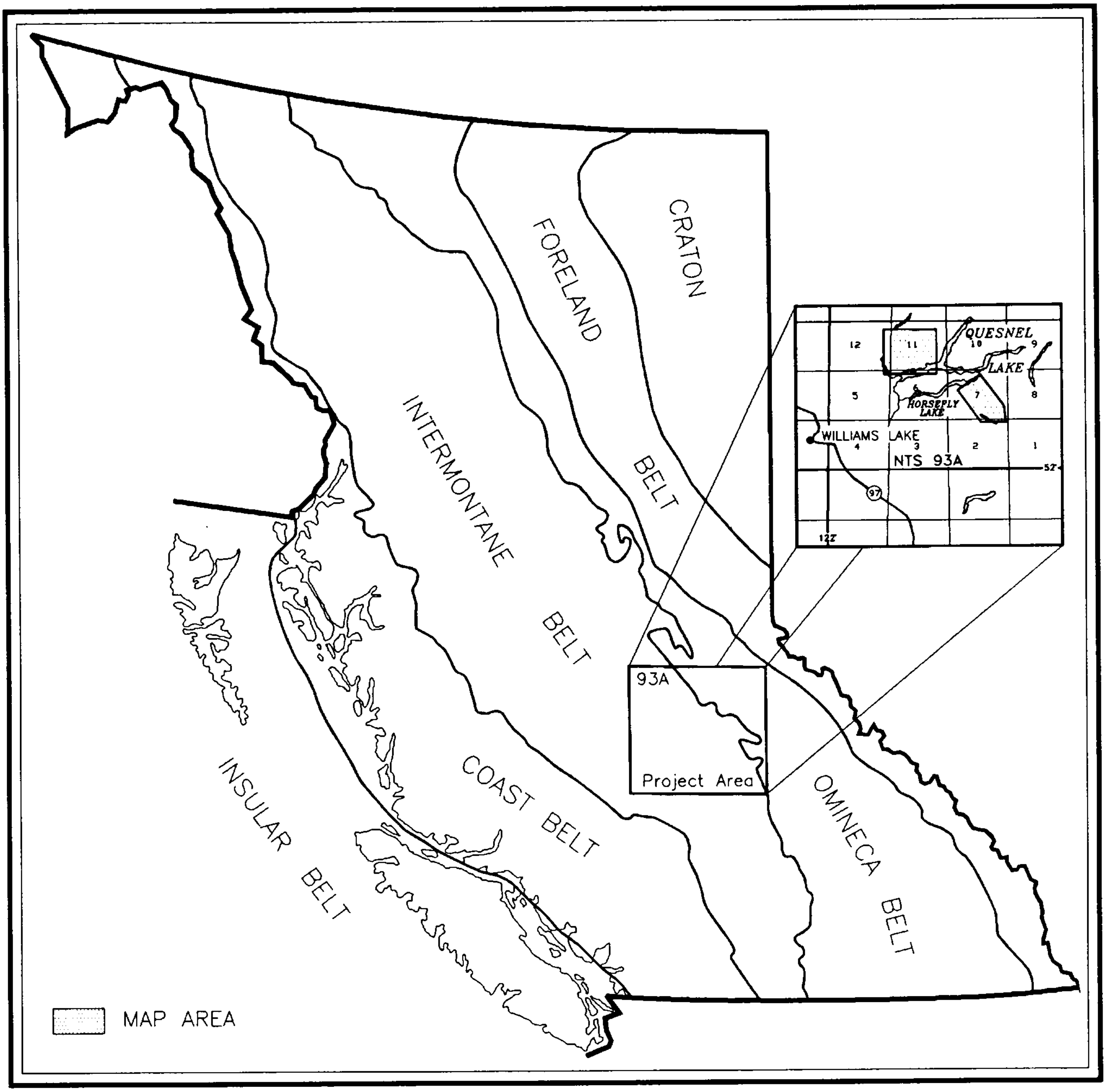


Figure 1. Generalized tectonic map of the Canadian Cordillera showing the major structural divisions (after Wheeler and Gabrielse, 1972) and the location of the study area.

INTRODUCTION

The Eureka Peak and Spanish Mountain areas lie within the Quesnel Terrane of the Intermontane Belt, and straddle the Omineca Belt - Intermontane Belt tectonic boundary. The limits of the mapped area are shown on Figure 1. The emphasis of the work has been to examine the stratigraphic and structural complexities of the metasedimentary rocks of the Quesnel Terrane. Fieldwork was begun during the summer of 1984, and involved detailed geologic mapping of the Eureka Peak syncline as part of the author's M.Sc. thesis research at The University of British Columbia between 1985 and 1987. An examination of both the sedimentary and volcanic sequences in the Quesnel Lake region was conducted under the direction of Dr. A. Panteleyev of the British Columbia Ministry of Energy, Mines and Petroleum Resources. The results of this work are summarized in Panteleyev (1986, 1987, 1988, 1989), Bailey (1988) and Bloodgood (1986, 1987).

LOCATION

The study covers approximately 1200 square kilometres east of Williams Lake, in central British Columbia. Two major routes provide easy access to the area via good all-season roads from both 100- Mile House and 150-Mile House on the Cariboo Highway (Figure 2).

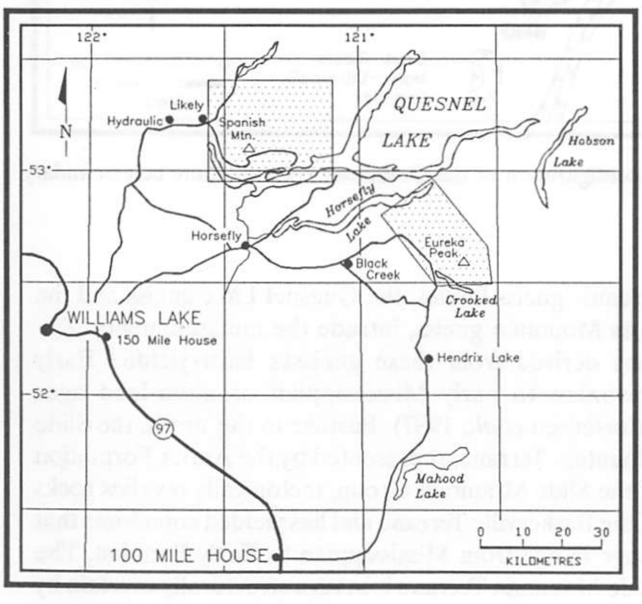


Figure 2. Routes of major road access, and limits of the mapped area.

A well-maintained gravel road extends from 100-Mile House, through Canim Lake and Hendrix Lake, and approaches Eureka Peak from the southwest. To the west, a paved road links 150-Mile House and the town of Horsefly. From Horsefly an all-season gravel road proceeds east via Black Creek to the Eureka Peak area. A northern fork, approximately 3 kilometres north of 150-Mile House, provides direct access to the Likely - Spanish Lake area about 80 kilometres to the north. A rough, but scenic route along logging roads connects Likely to the historic Wells - Barkerville area. These roads, however, are variably maintained and local inquiry regarding road conditions is advised before traveling this route.

PREVIOUS WORK

The original mapping in the region was done by the British Columbia Department of Mines, followed by the Geological Survey of Canada. Initial work attempted to correlate stratigraphy eastward from the Quesnel Highlands and Cariboo Mountains to the Rocky Mountains (Sutherland-Brown, 1963; Campbell *et al.*, 1973; Campbell, 1973, 1978); which at that time were interpreted to be a laterally continuous stratigraphic sequence. Campbell *et al.* (1973) considered the sequences east of the Intermontane Belt - Omineca Belt boundary to be the western, finer grained facies equivalents of the Kaza Group sediments to the east. These are now separated into the distinct Cariboo and Barkerville Terranes. Struik (1986) originally interpreted these two terranes as representing continental shelf sediments, and continental shelf sediments with intercalated volcanics, respectively, and has since suggested that the Barkerville Terrane may be related to a Paleozoic rifting event (Struik, 1987).

Economic interest in the area has focused upon gold mineralization. The wealth of the Barkerville placer deposits brought multitudes of gold seekers to the area, which flourished in the late nineteenth and early twentieth centuries. Placer exploration and production continues today and there are several productive placer operations in the Spanish Lake area. Vein-hosted gold deposits have also been recognized within the metasedimentary sequence. The most notable among these are the Frasergold property north of Eureka Peak and the CPW property on Spanish Mountain.

Within the metavolcanic belt to the west, alkalic stocks commonly host porphyry copper deposits which

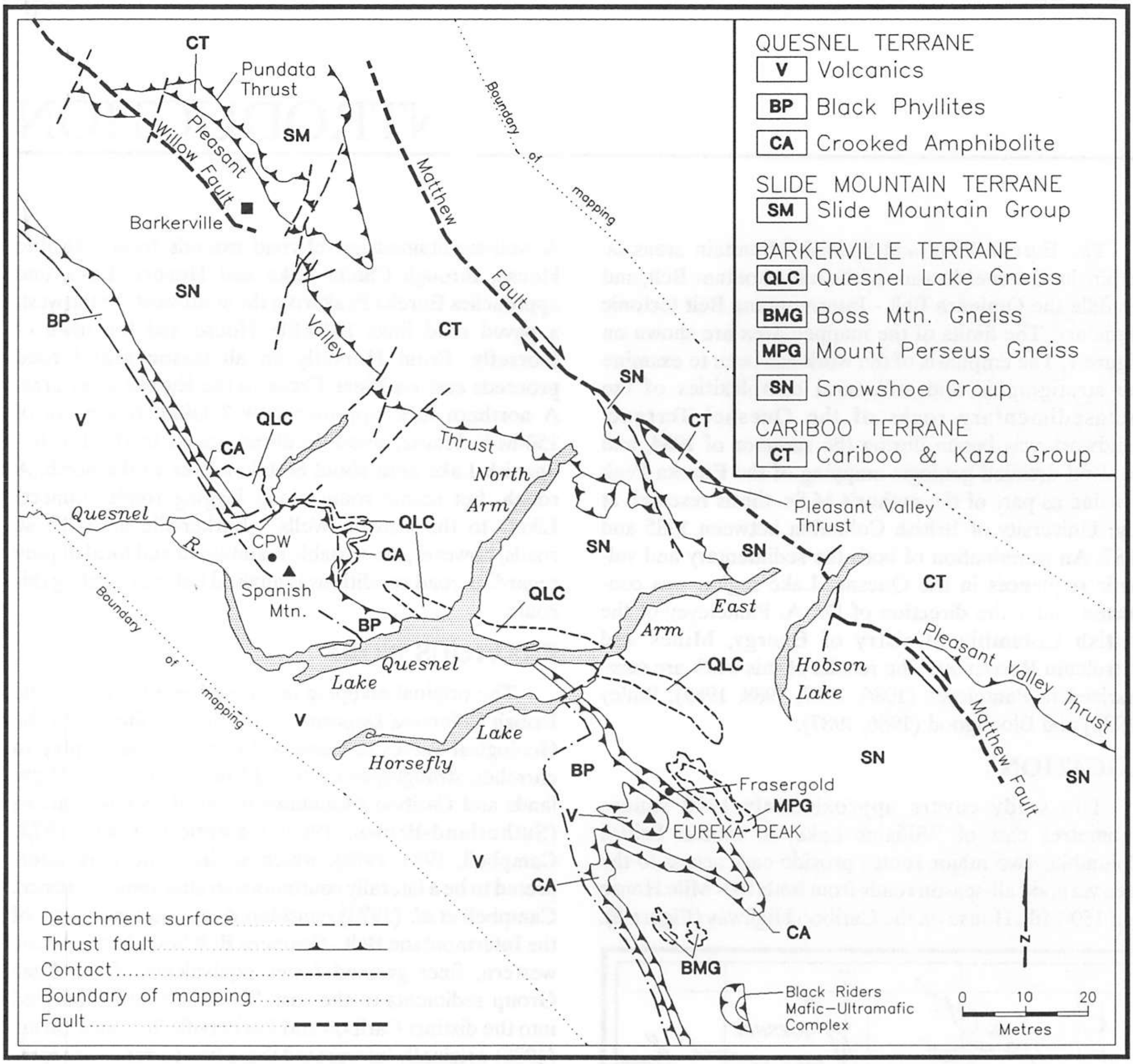


Figure 3. Regional geology of the Quesnel Lake area and the configuration of the Omineca - Intermontane belt boundary defined by the Eureka thrust.

have a strong gold association. Notable deposits of this type are Cariboo-Bell and QR located west and north of the area covered by this study and within the area examined by Bailey (1976; 1978; 1988).

REGIONAL SETTING

The Quesnel Terrane structurally overlies Hadrynian to early Paleozoic metasediments of the Snowshoe Group (Fillipone, 1985; Elsby, 1985; Carye, 1985), and locally is in direct contact with the Quesnel Lake gneiss. These two units comprise the Barkerville Terrane within the study area (Figure 3) and are believed to represent the deformed western margin of the North American craton. Granitic gneiss bodies, the Quesnel Lake gneiss and the Boss Mountain gneiss, intrude the metasediments. Zircons derived from these gneisses have yielded Early Devonian to early Mississippian uranium-lead ages (Mortensen *et al.*, 1987). Further to the north, the Slide Mountain Terrane, represented by the Antler Formation of the Slide Mountain Group, tectonically overlies rocks of the Barkerville Terrane and has yielded conodonts that range in age from Mississippian to Early Permian. The Slide Mountain Terrane is in turn structurally overlain by the Quesnel Terrane, composed of pelitic metasediments and intermediate to mafic metavolcanics of the Quesnel River Group (Tipper, 1978; Campbell, 1978).

A mafic metavolcanic unit, the Crooked amphibolite, is the basal unit of the Quesnel Terrane. It has previously been correlated with the Antler Formation of the Slide Mountain Group (Campbell, 1978; Ross *et al.*, 1985) based upon its lithologic similarities. Further to the north, the Antler Formation occupies the same structural position with respect to the Barkerville Terrane, and is designated as the Slide Mountain Terrane. However, as illustrated in Figure 3, no physical link has been established to prove that the Antler Formation and Crooked amphibolite are lateral equivalents, and the metavolcanic unit in the Quesnel Lake region is designated as crooked amphibolite included with the Quesnel Terrane (Struik, 1985). Detailed geologic mapping in this area has confirmed that the metavolcanics which discontinuously overlie the Barkerville Terrane from Dunford Lake to north of Quesnel Lake are allochthonous and much of the Paleozoic section is absent. The Crooked amphibolite may be the sheared metamorphic equivalent of the Antler Formation of the Slide Mountain Group, or could represent unrelated Mesozoic basement to the Quesnel Terrane.

Structurally overlying the Crooked amphibolite are Triassic metasediments and metavolcanics comprising the Quesnel Terrane. These rocks extend as a continuous belt from north and east of Kamloops, to north of Prince George (Tipper *et al.*, 1981). Historically the rocks have been correlated with the Quesnel River Group and Takla Group (Campbell, 1978; Tipper, 1978; Rees, 1981). Reconnaisance mapping in the Quesnel Lake mapsheet (NTS 93A) by the Geological Survey of Canada in the 1960s assigned both the metasediments and the metavolcanics to the Quesnel River Group (Campbell, 1978). As a result of subsequent mapping to the north (Tipper, 1978) and in the vicinity of Quesnel Lake (Rees, 1981) the volcanic units have been correlated to the Takla Group. The abundance of augite-bearing porphyritic breccias in the volcanic sequence suggests that these rocks in the Quesnel Lake region may correlate with the Nicola Group in southern British Columbia. Both the Takla and Nicola Group rocks are considered time-equivalent lithostratigraphic units. Informal correlations between the volcanic rocks in the Quesnel Lake map area with the Nicola Group rocks to the south are now made by Struik, (personal communication, 1988) where the rocks are of equivalent age and are lithologically similar. Herein, the author maintains this informed correlation and assigns the Mesozoic metasedimentary and volcanic sequences to the Nicola group.

The present geological configuration of the Quesnel Lake area is believed to be a result of a Jurassic convergent event during which the allochthonous assemblages of the Quesnel Terrane were thrust eastwards over the North American craton. Sedimentary and volcanic assemblages of Late Paleozoic and Mesozoic age were emplaced over Proterozoic to early Paleozoic rocks of North American affinity comprising the Barkerville Terrane. Obduction of the Quesnel terrane resulted in intense crustal deformation, involving folding and the development of extensive mylonite (high strain) zones within the crustal rocks, and regional metamorphism ranging from greenschist to amphibolite facies. Detachment surfaces developed during eastward transport of the allochthonous assemblages, resulting in imbrication at higher structural levels. Regional deformation following the final accretion of the Quesnel Terrane resulted in folding of the tectonic boundary, as illustrated in Figures 2 and 3.

STRATIGRAPHY

BARKERVILLE TERRANE

SNOWSHOE GROUP

Rocks of the Snowshoe Group are the oldest in the region and are believed to be Proterozoic (Hadrynian) to early Paleozoic in age. The Snowshoe Group consists of pelitic to semipelitic schist (Plate 1), micaceous quartzite, feldspathic schist, metasiltite and phyllite, with lesser grit, micritic limestone and amphibolite. Metamorphic grade ranges from greenschist to amphibolite facies. Detailed mapping has established a stratigraphic sequence within the Quesnel Lake area (Struik, 1983) and numerous graduate students at The University of British Columbia have concentrated their research within the Snowshoe Group rocks south and east of Quesnel Lake.

The group is dominated by pelitic to semi-pelitic schists which may be in part equivalent to the Paleozoic Eagle Bay assemblage of the Adams Plateau - Clearwater area (Schiarrizza and Preto, 1987). These rocks have also been correlated with the Lower Paleozoic Lardeau Group and the Carboniferous Milford Group of the Kootenay Arc (Okulitch, 1979).

QUESNEL LAKE GNEISS

The Quesnel Lake gneiss, a large intrusive body within the Snowshoe Group metasediments, is a megacrystic quartz-feldspar augen gneiss of granitic composition. It is well exposed in the Spanish Lake area north of the Cariboo River, where it occurs as a large body adjacent to the Barkerville - Quesnel terrane boundary.

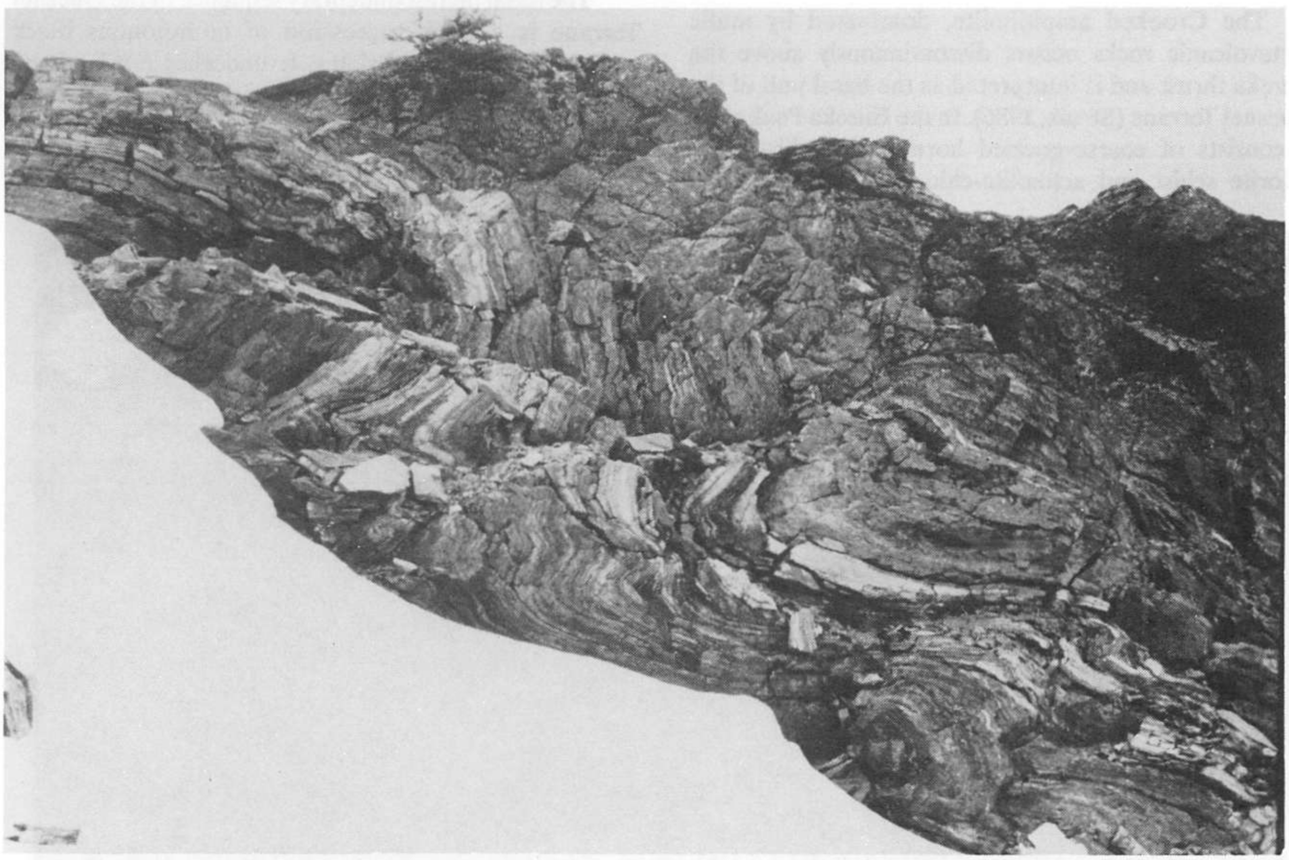


Plate 1. Outcrop of pelitic schists characterizing a portion of the Snowshoe Group on Boss Mountain.

Along this tectonic boundary the gneiss has a well-developed mylonitic fabric and is mechanically intercalated with rocks of the structurally overlying Crooked amphibolite. North of Seller Creek, the gneiss is overlain by Triassic metasediments of the Quesnel Terrane, but the contact is not exposed. The gneiss reappears to the east of the North Arm of Quesnel Lake, and is believed to be related to the Boss Mountain gneiss and the Mount Perseus orthogneiss exposed south of the lake (Mortensen, *et al.* 1987). In these areas (Figure 3) the gneiss occurs as a tabular body up to 2 kilometres thick that is generally conformable with compositional layering in the surrounding Snowshoe Group rocks. Structural relationships within the gneiss indicate that emplacement of the orthogneiss preceded or was contemporaneous with first phase deformation (Ross *et al.*, 1985). Uranium-lead dating of zircon and monazite obtained from the Quesnel Lake gneiss exposed south of Quesnel Lake and in the Boss Mountain area has constrained the age of emplacement as Late Devonian to middle Mississippian (Mortensen *et al.*, 1987).

QUESNEL TERRANE

CROOKED AMPHIBOLITE

The Crooked amphibolite, dominated by mafic metavolcanic rocks occurs discontinuously above the Eureka thrust and is interpreted as the basal unit of the Quesnel Terrane (Struik, 1986). In the Eureka Peak area, it consists of coarse-grained hornblende schist, talc-chlorite schist and actinolite-chlorite schist (Plate 2). Along strike, north of Quesnel Lake, it is characterized by mafic metavolcanics, amphibolite, chlorite schist, serpentinite and ultramafic rocks; pillow lavas are present locally. The contact between the Crooked amphibolite and the underlying sequences is sharp and highly strained, marked by the development of a mylonitic foliation, mechanical imbrication and tight infolding of adjacent units. Larger bodies of mafic to ultramafic rocks occurring along this contact are also observed south of Crooked Lake, in the Dunford Lake area. This sequence has been called the Black Riders mafic-ultramafic complex (Figure 3) and interpreted as a klippe, thrust inboard of the tectonic boundary (Montgomery, 1978; Radloff and Ross, 1988).

Correlation of the Crooked amphibolite with the Antler Formation of the Slide Mountain Group has been based primarily on lithologic similarities and structural position. Within the study area the Crooked amphibolite lacks the sedimentary component which has yielded fossil ages elsewhere in the Slide Mountain Group. However, localized ultramafic occurrences within it bear a definite Paleozoic mantle signature (Ross and Fillipone, 1986).

NICOLA GROUP METASEDIMENTS

The basal metasedimentary sequence of the Quesnel Terrane is a thick succession of monotonous black graphitic phyllites and slates. It underlies much of the region and is believed to correlate with the Triassic Nicola Group exposed further to the south within the Quesnel Terrane. A stratigraphic sequence has been defined within the metasediments, and consists of nine lithologic

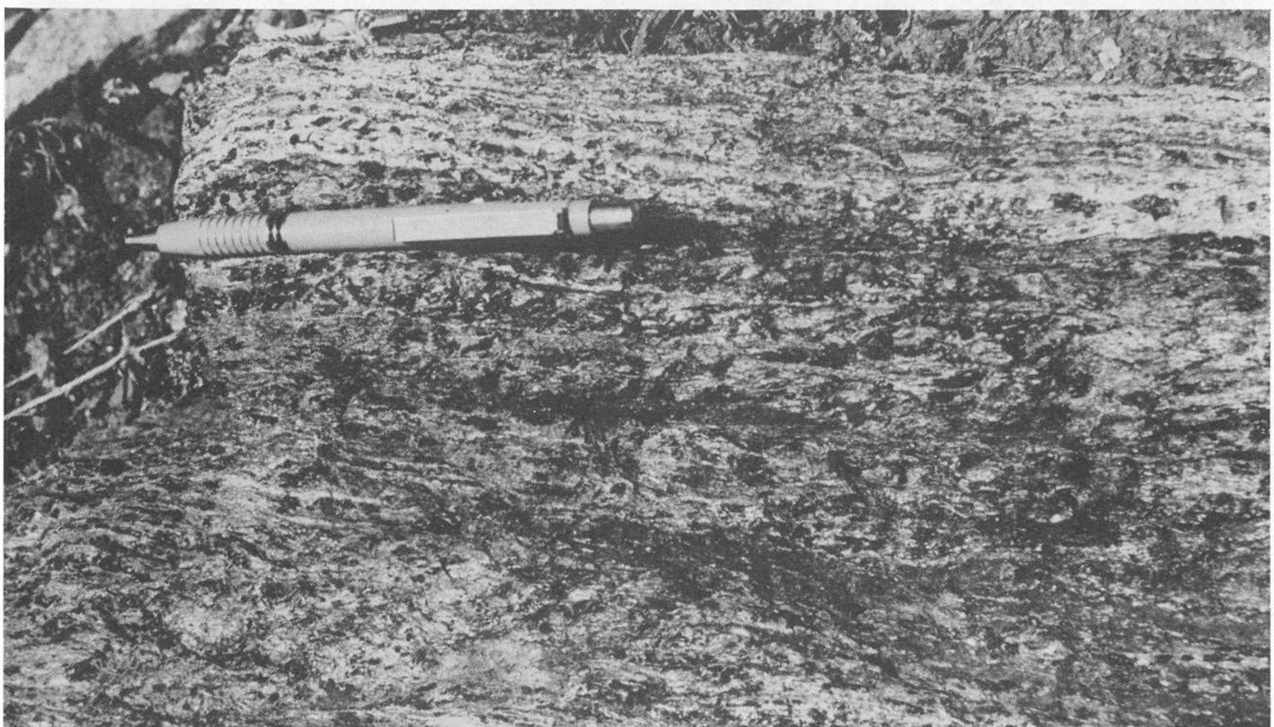


Plate 2. Coarse-grained amphibole schist on the southern flank of Eureka Peak. Alternation of quartz and feldspar-rich interbeds with amphibolitic horizons defines compositional layering.

divisions. All internal contacts within the phyllite succession are gradational over a distance of several metres, except where otherwise noted. Detailed geologic mapping along a strike length of approximately 80 kilometres indicates that the lithologic variations are of regional extent; they are believed to reflect regional changes in the patterns of sedimentation during the evolution of the Quesnel basin. Construction of schematic stratigraphic sections illustrates the relative thicknesses and correlations between individual lithologic units throughout the region (Figure 4).

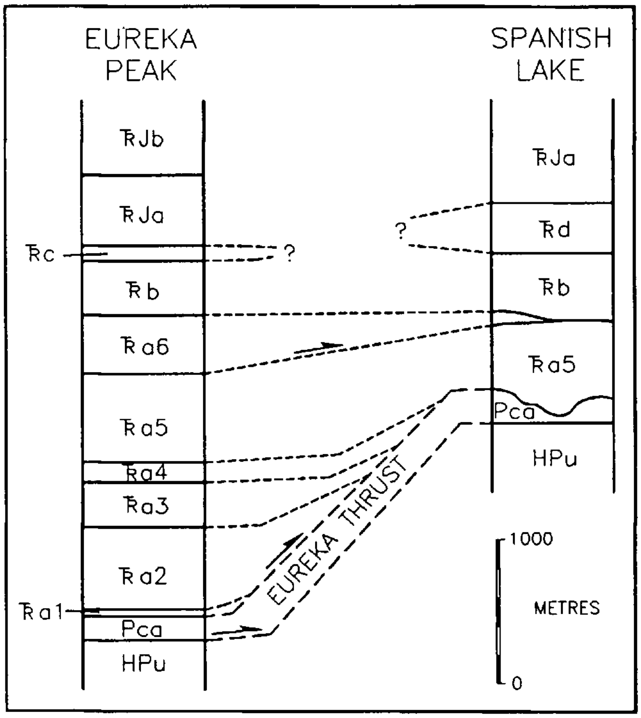


Figure 4. Schematic sections illustrate stratigraphic correlations between the Eureka Peak and Spanish Lake areas and show the positions of the major thrust faults.

The following discussion of the Quesnel Terrane stratigraphy draws heavily on observations in two relatively well-exposed type-localities, where the stratigraphy was originally defined (Bloodgood, 1987a, b, c). The metasedimentary succession comprises the basal section of the Quesnel Terrane, and is believed to represent a basinal assemblage upon which an island arc was built during the Mesozoic. Incorporation of volcanic detritus becomes common towards the top of the metasedimentary package. The volcanic debris is similar in composition to the overlying basaltic rocks, suggesting that late sedimentation and early arc-related volcanism were at least in part contemporaneous. Bailey (1988) has mapped equivalent sedimentary rocks west of the volcanic sequences of the Quesnel Terrane, suggesting that the basin geometry of the Quesnel trough has been preserved. Greenschist facies mineral assemblages have been documented throughout the region.

UNIT TRA1

The basal unit of the black phyllite succession is a micaceous quartzite. It crops out along both the southern and northern limbs of the Eureka Peak syncline and varies significantly in thickness from 10 metres to a maximum of 150 metres. Bedding is well defined by thin, pale grey to white, parallel-laminated quartzite beds (Plate 3); bed thickness varies from 0.5 to 6 centimetres. Strongly developed planar alignment of rusty weathering muscovite defines a bedding-parallel schistosity.

Where observed, the contact of the micaceous quartzite with the underlying Crooked amphibolite is sharp, although concordant and discordant relationships have been documented. The contact is imbricated at the southeastern end of Crooked Lake (Campbell, 1971; Carye, 1985), and in the Mount Perseus area (Elsby, 1985). Due to the sporadic nature of exposed contacts, it is difficult to determine whether the great variation in thickness of the unit is a reflection of primary sedimentation as suggested by Campbell (1971), or of structural thickening by the imbrication of a much thinner unit. No correlative unit has been observed in the Spanish Lake area.

UNIT TRA2

Siliceous, locally graphitic, dark grey to black phyllite overlies the micaceous quartzite. The strongly developed phyllitic foliation is marked by distinctive silvery fresh surfaces. Bedding features are rare, although locally defined by thin rusty to dark grey quartz-sandstone beds, minor dark grey siltstone beds up to 20 centimetres in thickness, and discontinuous tuffaceous lenses. On the south limb of the Eureka Peak syncline porphyroblasts of garnet are abundant within 10 metres of the base of the unit. They range up to 0.5 centimetres in size. Small, chalky weathering plagioclase porphyroblasts occur throughout the unit.

The contact with the underlying micaceous quartzite is not exposed. On the south limb of the Eureka Peak syncline, a noticeable break in slope indicates the approximate location of the contact, which may be faulted. On the north limb, highly discordant contact relationships are observed between the phyllite and the underlying quartzite. This is interpreted to be a result of faulting (Campbell, 1971). No lithologically equivalent units have been recognized in the Spanish Lake area.

UNIT TRA3

Unit Tra3 is a sequence of interbedded light and dark grey silty slates with minor phyllitic siltstones. Bedding is defined by well-developed fine banding, thin laminated quartz-sandstone beds, and minor interbeds of dark grey siliceous limestone. Cleavage is well developed and

Plate 3. Bedding within the micaceous quartzite exposed on the southern flank of Eureka Peak is defined by thinly interbedded dark and light grey parallel-laminated quartz-sandstone beds.

defined by a very planar, slaty parting. Small quartz-filled veins occur throughout the unit and are most commonly oriented parallel to bedding. No lithologically correlative units have been recognized in the Spanish Lake area.

UNIT TRA4

A finely laminated grey phyllite is in gradational contact with the silty slates of Unit Tra3. Bedding is defined by pale grey to rusty weathering quartz-sandstone beds, up to 1 centimetre in thickness, but commonly 1 to 3 millimetres thick. A strongly developed phyllitic foliation is outlined by fine graphitic material. Porphyroblasts of garnet, plagioclase and chloritoid occur within this unit on the south limb of the Eureka Peak syncline. On the north limb, porphyroblasts of chloritoid occur in association with ankerite. Bedding-parallel quartz lenses, up to 2 metres thick and several metres in length, have been observed within this unit, and are most abundant on the north limb of the Eureka Peak syncline, particularly on the Frasergold property. No stratigraphically equivalent units have been recognized within the Spanish Lake area.

UNIT TRA5

The porphyroblastic phyllite grades upward into coarser grained, dark grey to black-weathering silty slates with interbedded dark grey quartz sandstones. Bedding is defined by dark, dull grey quartz-sandstone beds ranging in thickness from 10 to 12 centimetres. Thinner layers of pale grey to white, parallel-laminated quartz sandstone are interbedded throughout the unit. Pale-weathering quartzite and pale grey to green-weathering tuffs occur as discontinuous lenses parallel to bedding. The silty slates have a well-developed planar slaty parting, and are locally speckled and rusty weathering. This unit is the lowest member of the black phyllite succession in the Spanish Lake area where it dominates the outcrop pattern (Figure 5, in pocket).

UNIT TRA6

A sequence of grey graphitic phyllites that grade upward through black phyllites, grey silty phyllites and back into more graphitic phyllites comprises Unit Tra6. Bedding is always defined by pale, laminated quartz-siltstone beds (Plate 4). These prominently bedded siltstones are characteristic of this unit but rarely exceed 2 centimetres in thickness.

Unit Tra6 is best exposed on the south limb of the Eureka Peak syncline and at Archie Creek. Outcrops in the Spanish Lake area are confined to small lozenge-shaped synformal zones to the north of Blackbear Creek (Figure 6, in pocket).

UNIT TRB

Unit Trb, the uppermost unit in the phyllitic portion of the metasedimentary succession, is readily distinguished by a significant volcanic component. The contact with the underlying black phyllites is always faulted. Quartz veins, brecciation and slickenside striae are ob-

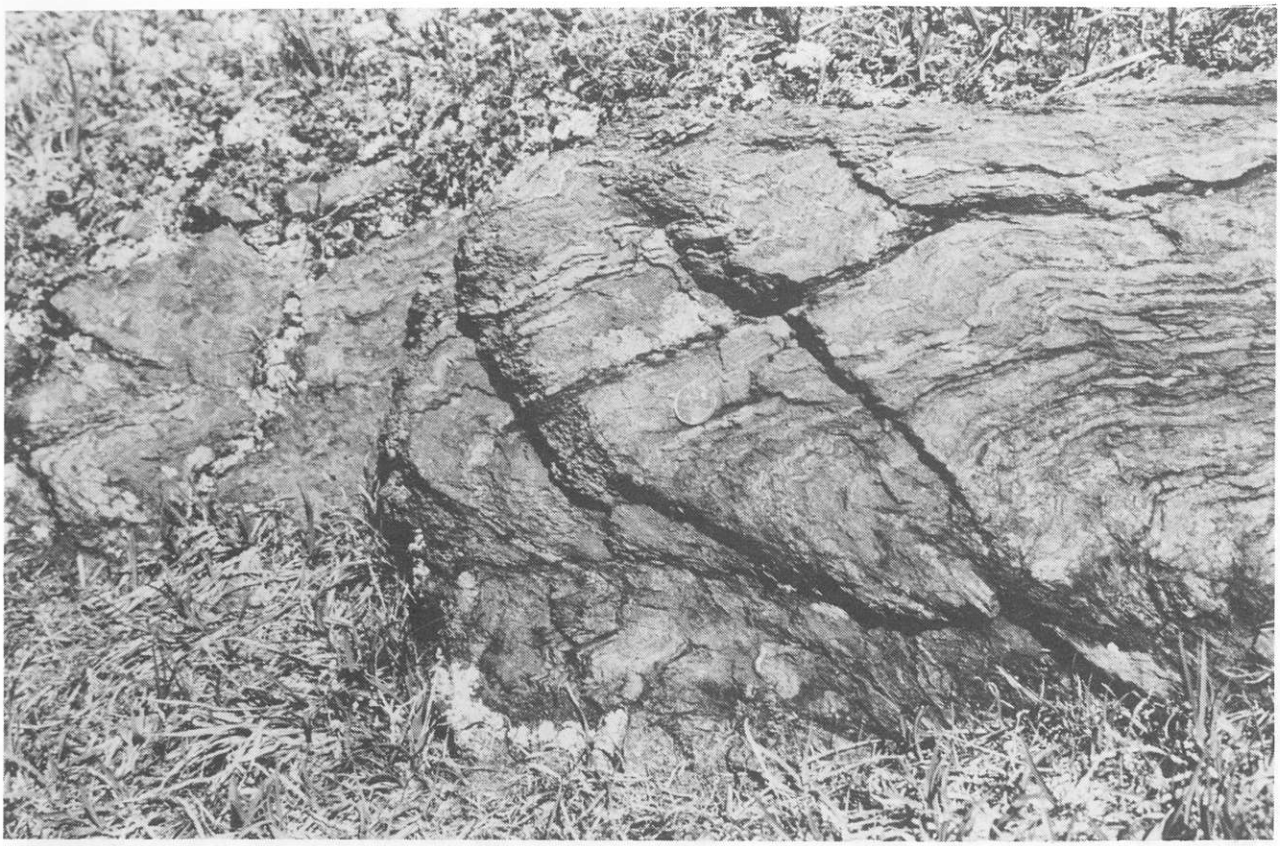


Plate 4. North of peak 6935′ parallel-laminated quartz siltstone defines bedding within unit Tra6. The thin siltstones are prominent throughout the unit.

served within the contact zone. Unit Trb crops out continuously along both the northern and southern limbs of the Eureka Peak syncline, and underlies much of the western part of the area. In the core of the syncline the sequence is capped by a discontinuous volcaniclastic unit. It extends west of the Horsefly River, and is in contact with the overlying volcanics near the summit of Big Slide Mountain. North of Quesnel Lake, the lower contact of the unit is disconformable along its entire strike length and is interpreted as a fault contact.

In the Eureka Peak area, relatively continuous exposure of this unit allows lithologic variations to be examined in detail. The stratigraphic progression, characterized by an increasing volcanic component in the sediments at higher stratigraphic levels, can be seen on a regional scale. Dark grey to black phyllites with interbedded grey to green tuffs comprise the lowermost 50 metres of the unit. Very siliceous, banded aquagene tuffs (Plate 5) become more abundant stratigraphically upsection and are interbedded with grey to black banded slates, massive pale quartz-sandstone and minor limestone. The uppermost part of the unit consists of fissile graphitic phyllites interbedded with tuffs, and locally with dark brown to black argillaceous limestones and minor quartz sandstone beds. The phyllites within this section are recessive, black and sooty in outcrop. Locally they are strongly silicified, but throughout the region they are characteristically rusty weathering and pyritiferous.

North of Quesnel Lake Unit Trb is moderately exposed south of Blackbear Creek and underlies the Spanish Lake and Spanish Mountain areas. Limited exposure has hindered detailed examination of lithologic variations within it, however, broad trends have been identified. Very black, rusty weathering, slaty to phyllitic metasediments interbedded with gritty, dark brown to black-weathering grey limestones comprise the sedimentary component. Conodonts obtained from these limestones range in age from Anisian to Ladinian (Middle Triassic) and indicate possible imbrication within this unit (L.C. Struik, personal communication, 1988). Two samples collected east of Spanish Mountain and along the Abbot Creek recreation road have yielded conodonts of Anisian and probable Anisian age, respectively (GSC Location numbers C-117649 and C-117645).

The volcanic component of the sequence increases progressively upsection, with the appearance of discontinuous lensoid exposures of banded tuff, volcanic conglomerate, flow breccia and locally, pillow lava. The banded tuffs in the Spanish Lake area are lithologically identical to the banded aquagene tuffs observed within

Plate 5. Colour-laminated, interbedded black silty slates and buff-weathering tuffs and siltstones within unit Trb west of the Ptarmigan Lakes.

the Eureka Peak area. However, in the Spanish Lake area a discontinuous volcanic conglomerate containing clasts of the underlying tuffs locally overlies the banded tuffs. Volcanic flow breccias and pillow lavas occur as discontinuous lenses up to several kilometres in strike length. The volcanic rocks are particularly well exposed where they cap several prominent knobs east of Spanish Mountain. The flow breccias appear identical in both composition and texture to the pyroxene-bearing porphyritic flows which occur at the base of the volcanic sequence farther to the west (Bailey, 1988), and to the south, in the Eureka Peak area (Bloodgood, 1987b). Dikes of the same composition locally crosscut bedding within the sediments. The dikes appear to be compositionally equivalent to the overlying volcanic rocks and are likely feeders to them.

VOLCANICLASTIC BRECCIA (UNIT TRC)

A volcaniclastic breccia locally overlies the tuff-phyllite sequence of Unit Trb. It crops out discontinuously within the Eureka Peak area and exposure is limited to the core of the syncline west of Eureka Peak. Small, discontinuous lensoid slivers of breccia have been observed on the southern limb (Figure 5, in pocket). Both the lower and upper contacts of the volcaniclastic breccia, with Unit Trb and the Nicola group volcanics respectively, are faults. The contact zone is marked by fault gouge and slickenside surfaces within a zone 1 to 3 metres wide. No correlative lithologic unit has been observed north of Quesnel Lake.

Recognizable clasts contained within the unit are angular and weather darker than the supporting pale to medium-grey matrix. Frayed and flamelike terminations of the clasts are characteristic of pumice fragments in welded tuffs and the unit is believed to be of pyroclastic origin (Bloodgood, 1987a, c). Cleavage is defined by a well-developed chloritic parting.

VOLCANIC WACKES (UNIT TRD)

North of Quesnel Lake, Unit Trb is immediately overlain by coarse-grained, green volcanic sandstones and wackes. This unit is well exposed along the main road north of Likely, and to the south of Spanish Mountain. Interbedding of volcanic siltstones, sandstones and minor argillaceous sediments defines bedding. The interbedding of dark grey to black argillaceous sediments varying from 3 millimetres to 2 centimetres thick within the dominant green sandstones and wackes establishes a compositionally defined, colour banded sequence, paral-

Plate 6. The fault contact metasediments of the Quesnel River Group and overlying Nicola Group volcanic rocks, looking east from peak 6935′. The volcanic rocks form a klippe in the core of the Eureka Peak syncline.

lel to bedding. No penetrative cleavage is recognized within this unit. A very rough fracture cleavage is locally developed as a preferred plane of parting parallel to bedding.

The nature of the basal contact of this unit with the underlying metasedimentary sequence is undetermined. A high-angle fault separates lithologic units at the one locality where the contact is exposed. However, concordant bedding relationships on either side of the fault zone may indicate that movement was confined to the bedding plane.

NICOLA GROUP METAVOLCANICS

A thick succession of Mesozoic volcanic rocks comprises the central and western parts of the Quesnel belt. These rocks range in age from Norian (Late Triassic) to Sinemurian (Early Jurassic) (Bailey, 1988). They structurally and stratigraphically overlie the basal metasedimentary succession. Bailey has identified sedimentary rocks of Early to Middle Jurassic (Pliensbachian to Bajocian) age overlying the volcanic sequence to the west. The contact of the Quesnel Terrane with the Cache Creek Group to the west is not exposed, but is inferred to be a fault located within the Beaver Creek valley (Campbell, 1978), that may be the southern extension of the Pinchi Fault.

In the Eureka Peak area, a klippe of mafic to intermediate volcanic rocks occupies the core of the Eureka Peak syncline (Plate 6). Mafic crystal tuffs and augite-bearing porphyritic flows with lesser metabasalt and volcanic breccia comprise the 300-metre-thick volcanic succession. These units are believed to correlate with Unit 2 of the volcanic package defined by Bailey (1988) and Panteleyev (1988) to the northwest.

CRYSTAL TUFF

Within the Eureka Peak area the basal member of the volcanic sequence is composed of finely crystalline, variably cleaved, competent tuff. This unit is well exposed along the southeastern limb of the syncline where the contact passes through the northernmost of two lakes (Ptarmigan Lakes), and the tuff outcrops along several prominent cliff faces. The tuff attains a maximum thickness of 50 metres. To the west, and further to the northeast, it thins and is locally absent. It crops out locally on the western limb of the syncline where it attains a thickness of 10 to 20 metres south of peak 7352′.

Plate 7. The pillow lavas in this photograph immediately overlie the fault contact illustrated in Plate 6; a massive outcrop appearance characterizes these lavas.

The tuff is massive in outcrop and is generally homogeneous in texture and composition, but is locally banded. It is characterized by buff-weathering pale green to grey fresh surfaces. Minor green mafic phenocrysts, 2 to 3 millimetres in size are commonly altered to epidote and chlorite. Pyrite cubes, up to 1 centimetre square, have been observed and millimetre-sized cubes are commonly found concentrated within narrow pyritic beds. Locally, a thin discontinuous breccia is observed at the base of the crystal tuff. Volcanic fragments of variable size, shape and composition are supported by a vesicular, fine-grained and weakly banded groundmass.

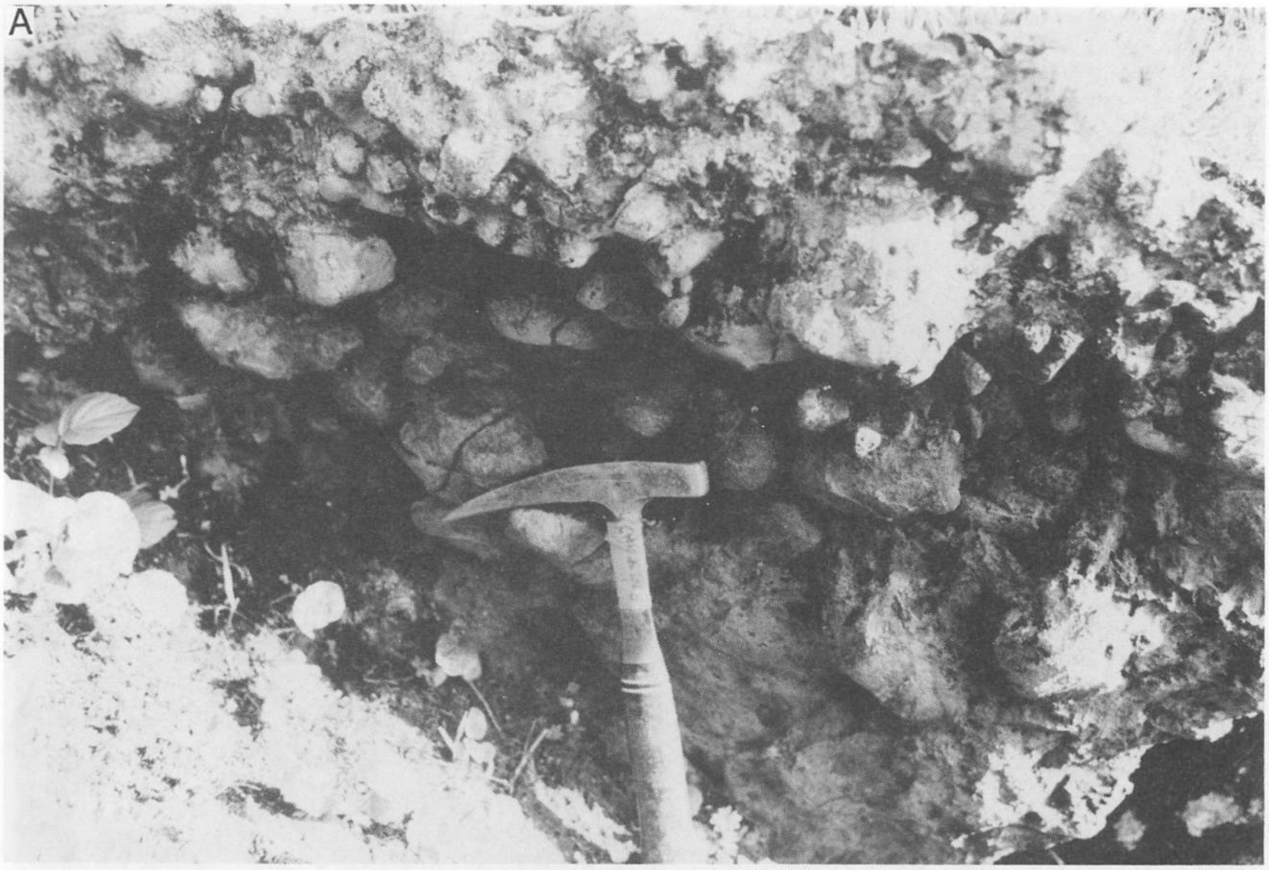
BASALT PILLOW LAVAS

A thin, discontinuous unit of basalt pillow lavas locally overlies the crystal tuffs (Plate 7). It is well exposed along the ridge immediately west of Ptarmigan Lakes, where the lavas are 5 to 10 metres thick. At this location they are underlain by approximately 5 metres of the crystal tuff which directly overlies Unit Trb. Isolated exposures of a massive, unpillowed mafic volcanic unit on the western col of Eureka Peak are believed to represent the same unit.

The pillow lavas are pale grey to green weathering and dark green to blue-black on fresh surfaces. The pillow structures are flattened, with dimensions of 60 by 30 by 60 centimetres.

FLOWS AND FLOW BRECCIA

A thick sequence of porphyritic basalt flows and flow breccias overlies the pillow lavas. These rocks are pale green to grey when freshly broken, and weather pale grey to green. Phenocrysts of green pyroxene and amphibole are acicular to stubby, show variable degrees of alteration and range in size from less than 1 millimetre to 1 centimetre. Individual flow cycles are marked by the gradation from a brecciated base, to a more massive, homogeneous and coarsely porphyritic top (Plate 8). Several of these transitions can be seen in outcrop; the thickness of each individual flow is estimated to be 15 to 30 metres. The basal part of each flow is characterized by a rubbly appearance in outcrop. It consists of distinct cobbles ranging from 10 to 15 centimetres in length, and with length-to-width ratios of 2 to 1. The cobbles appear compositionally equivalent to the matrix, but have a different texture. Typically, they are very porphyritic and the supporting matrix is aphanitic to fine grained, although in some cases this pattern is reversed. Compositionally, individual flows vary little from bottom to top. The flows and flow breccias dominate the volcanic se-



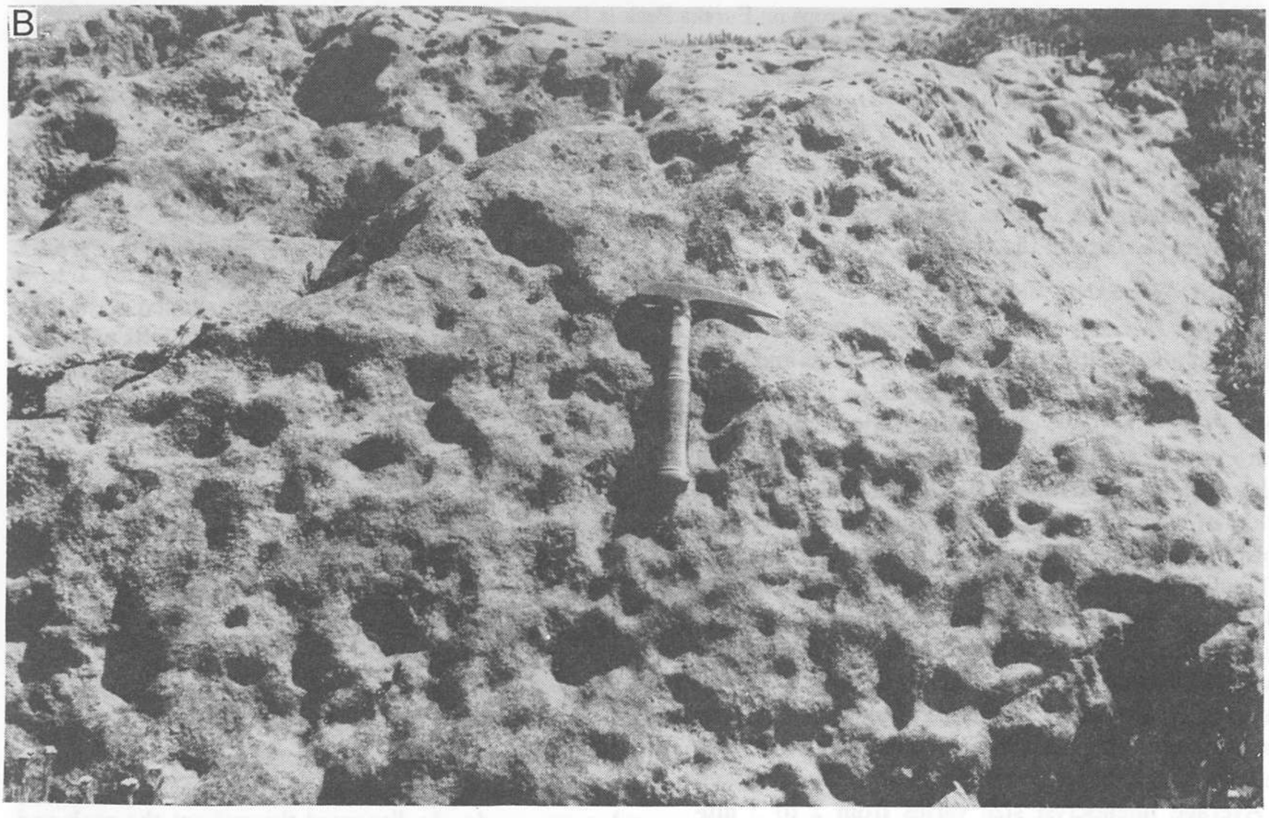


Figure 8. Equal-area projection of L_1 for the (A) Eureka Peak and (B) Spanish Lake areas. The distribution of lineations defines a great circle corresponding to S_2.

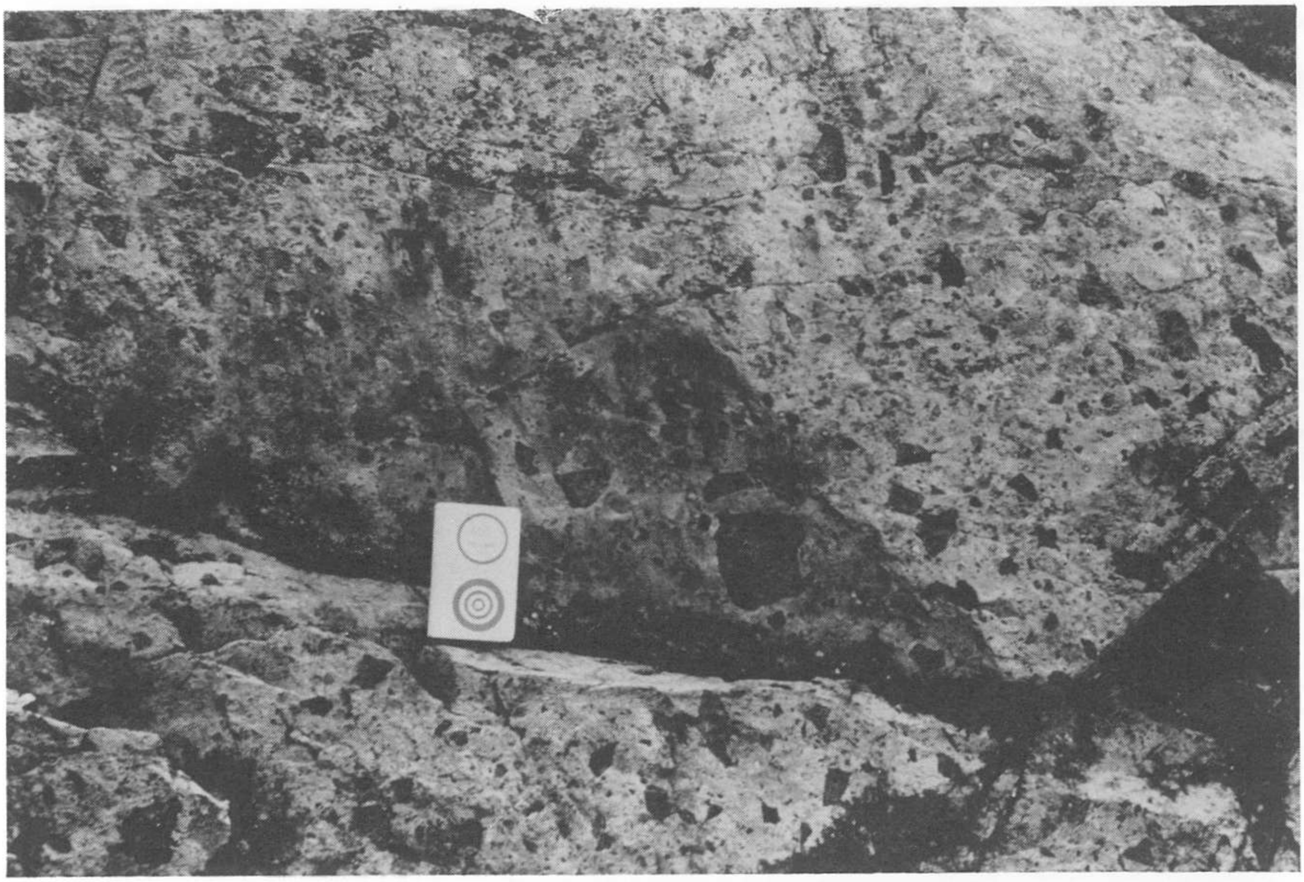


Plate 9. A distinctive volcanic breccia outcrops on Eureka Peak in the core of the syncline; it is characterized by large clasts of pyroxenite and hornblendite which may represent mantle xenoliths within a vent breccia. Maximum clast size is comparable to the 15 by 20 centimetre field notebook.

quence underlying the Eureka Peak area, and crop out extensively in the core of the syncline.

FLOWS AND VOLCANIC BRECCIA

The flow breccias are in gradational contact with a sequence of porphyritic flows, volcanic breccias and tuffs. The best exposure of this sequence is to the south of Eureka Peak. The flows characteristically weather rusty and are crumbly; within less altered outcrops, the unit weathers chalky grey to medium green or yellowish green in areas of extensive epidote alteration. Fresh surfaces are pale green to greenish grey.

The volcanic flows are coarsely porphyritic, with 20 to 50 per cent black and green mafic phenocrysts in a pale green aphanitic groundmass. Black hornblende phenocrysts are almost always euhedral, varying in habit from acicular crystals to stubbier prismatic forms. The green pyroxene phenocrysts are commonly subhedral, and show greater alteration to chlorite than the hornblendes. Average phenocryst size varies from 2 to 5 millimetres, but some phenocrysts exceed 2 centimetres in length.

Locally, the flows contain large angular xenoliths. In outcrop the clasts appear to be monomineralic and vary from glomeroporphyritic masses approximately 1 to 3 centimetres across to large irregularly shaped clasts tens of centimetres in diameter (Plate 9). The clasts are composed of both pyroxene and amphibole and may represent mantle xenoliths. These brecciated zones are limited in extent, grade into the surrounding flows and may represent vent facies. This interpretation is supported by the association with flow breccias which may have formed during the upwelling of a volcanic dome (Wright and Boyes, 1963).

The porphyritic flows interfinger with medium to dark green tuffs that weather a dark green or rusty colour. This unit is 1 to 10 metres thick and consistently well cleaved, usually schistose in character and moderately to strongly calcareous. Small euhedral pyrite crystals (1 - 2 millimetres or less) occur in planar concentrations; larger pyrite crystals, ranging in size from 0.2 to 1-centimetre cubes are randomly dispersed throughout the rock and often have well-developed fibrous calcite pressure shadows.

STRUCTURAL GEOLOGY

STRUCTURAL SETTING

The geology of the Quesnel Lake mapsheet (NTS 93A) reflects a complex deformational history, involving the folding and fracturing of a mechanically heterogeneous lithologic sequence. This study has involved structural observations at both the mesoscopic and microscopic scale. Field studies focused on establishing the nature, orientation and distribution of the major structural elements, the relative timing of structural events, their geometry, and significance in the structural history of the area. Microscopic studies were directed towards determining the nature of cleavage and fracture development in order to interpret the relative timing of deformation events. Careful examination of textural relationships seen in thin section allows inferences to be made regarding deformation mechanisms, and the partitioning of strain during deformation.

The following structural analysis of the Eureka Peak area is based upon the examination of the prominent planar and linear structural features observed in the field. Both the orientation and the intensity of development of each structural element is influenced by the relative competency of the lithology, and its position with respect to the major structures. Overprinting relationships of structural elements indicate that two phases of deformation involving folding have occurred in the Eureka Peak area. The development of two cleavage morphologies and lineations is fundamental to the recognition of two phases of deformation.

PHASE 1 STRUCTURES

Structures associated with the first phase of deformation (F_1) are a penetrative slaty cleavage (S_1), the lineation defined by the intersection of bedding on the slaty cleavage surface (L_1), and a mineral lineation.

The slaty to phyllitic cleavage within the black phyllite succession occurs as closely spaced planes defining a penetrative fabric. The spacing of individual cleavage planes varies from approximately 0.01 to 0.1 millimetre. They are defined by a fine micaceous or graphitic parting in the metasediments and a chloritic parting in the volcanic rocks. The cleavage is axial planar to mesoscopic and microscopic folds, strikes to the northwest, and dips variably to the northeast and southwest (Figure 7). Individual cleavage surfaces vary from planar to undulatory or anastomosing. A planar parting defines the cleavage in the more siliceous or slaty sediments; more closely spaced anastomosing surfaces outlined by a micaceous to graphitic parting characterize the penetrative foliation in the finer grained sediments. In outcrop exposures, a darker coloration along the cleavage plane outlines cleavage stripes; rootless isoclinal folds of bedding are truncated by these stripes. Examination of thin sections indicates that the stripes are due to the concentration of insoluble material along the cleavage plane. These features are interpreted to be the result of extensive dissolution along the cleavage surface. Small quartz veins occur parallel or subparallel to bedding and within the hinges of folds, and may represent material remobilized by pressure solution processes. The penetrative cleavage is most strongly developed in the argillaceous sediments of the black phyllite sequence, and is poorly developed or absent within the coarser rocks, particularly the overlying metavolcanic suite.

Mineral elongation lineations and intersection lineations plunge northwest or southeast at shallow to moderate angles, parallel to the axes of local mesoscopic folds (Figure 8). Mineral elongation lineations are defined primarily by elongate quartz grains that appear as fine, fibrous smears up to several centimetres in length. Intersection lineations, defined by the intersection of two planar structures, are prominent in the well-bedded sections of the metasedimentary succession; the most prominent is defined by the intersection of bedding with one of the cleavage surfaces.

East of peak 6397′ in the Eureka Peak area, quartz rods approximately 1 centimetre in diameter, and a minimum of 1 metre long, define the lineation. As illustrated in Plate 10, the mineral lineations are parallel to the bedding/cleavage intersection lineation. Both lineations vary in plunge along the length of the fold axis giving rise to the curvilinear form evident in the photograph.

EUREKA PEAK AREA

Mesoscopic F_1 structures are most evident within the metasedimentary succession where a strong penetrative slaty to phyllitic foliation, S_1, is present. In the Nicola Group volcanics mesoscopic folds are manifest as open warps, and axial planar cleavage is only weakly to moderately developed.

As illustrated by Plate 11, there is a consistent variation in the orientation of the first phase slaty cleavage, from the limb to the hinge region of the Eureka Peak syncline. At lower structural levels, within the black phyl-

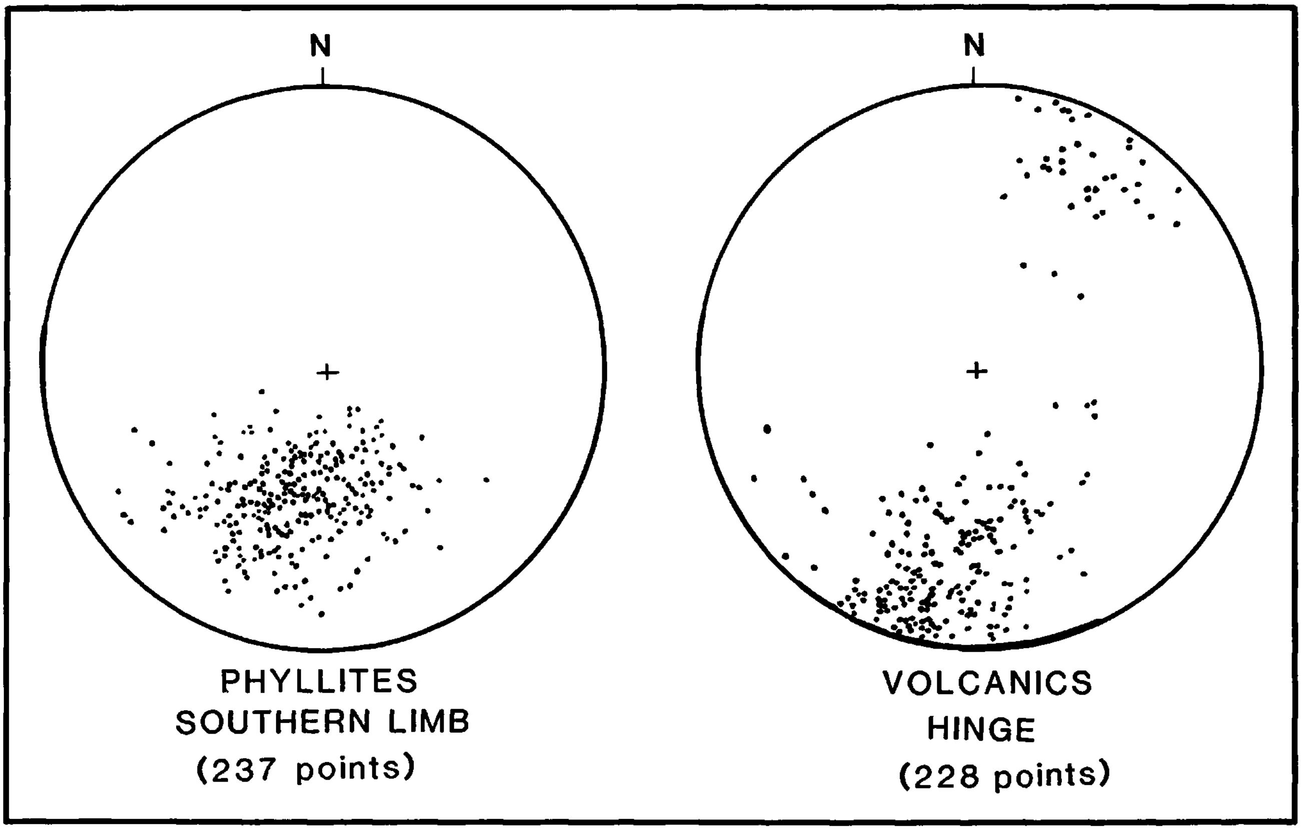


Figure 7. Equal-area projection of poles to S_1 in the Eureka Peak area. S_1 cleavages on the southern limb of the syncline dip shallowly to moderately to the northeast. In the hinge zone they are steeper and dip both northeast and southwest.

lites, and on the limb of the syncline, F_1 folds are tight to isoclinal (Plate 11a). The axial-plane cleavage is gently to moderately inclined to the northwest. In contrast, at higher structural levels within the volcanic succession, and in the hinge region of the syncline, S_1 is more steeply inclined and fold forms at this structural level are open and upright (Plates 11b,c). The change in orientation of the cleavage, and the transition in fold style is probably a result of greater flattening strains concentrated along the limb of the syncline, and close to the faulted lithologic contacts. This interpretation is supported by the greater intensity of deformation within the phyllites. The more competent volcanics show few effects of the deformation in contrast to the less competent phyllites, which accomodated a much greater proportion of the strain.

All structures associated with F_1 show the effects of subsequent deformation. The slaty cleavage is deformed and cut by a spaced or crenulation cleavage (S_2). Mineral lineations are often bent around the F_2 fold hinges and orientation analysis confirms the distorted nature of F_1 linear structures. As illustrated in Figure 8, the distribution of L_1 lineations plot along a great circle corresponding to the second phase axial plane.

No regional-scale structures are recognized associated with F_1 deformation in the Eureka Peak area. All F_1 folds are easterly verging outcrop-scale features and the maximum limb length is approximately 10 metres. The absence of any significant change in vergence within the area can be interpreted in two ways: either the area is on one limb of a very large F_1 fold, or F_1 structures developed only at the mesoscopic scale.

Spanish Lake Area

In the Spanish Lake area, structures associated with F_1 deformation are manifest as bedding folds and as a widespread, well-developed, penetrative slaty cleavage and an intersection lineation defined by the S_0/S_1 intersection.

Bedding features are discernible in most exposures as fine colour laminations and as thin grey to white quartz-siltstone interbeds. Within the metasedimentary succession, bed thickness ranges from a few millimetres to tens of centimetres. Most individual beds are 2 centimetres or less in thickness although coarser sandy beds frequently attain thicknesses of 10 to 12 centimetres.

F_1 folds are recognized on both the mesoscopic and microscopic scale and are tight to overturned. As illustrated in Figure 9, S_1 is gently to moderately inclined. As in the Eureka Peak area, vergence of F_1 structures is somewhat obscurred by F_2 overprinting, but is believed to have been represented by eastwardly verging structures. In the Spanish Lake area, the sense of asymmetry observed on mesoscopic folds indicate the presence of a macroscopic F_1 antiform; however the closure of the antiform is not seen, and it is postulated that the area may lay on the upper limb of a large F_1 nappe structure.

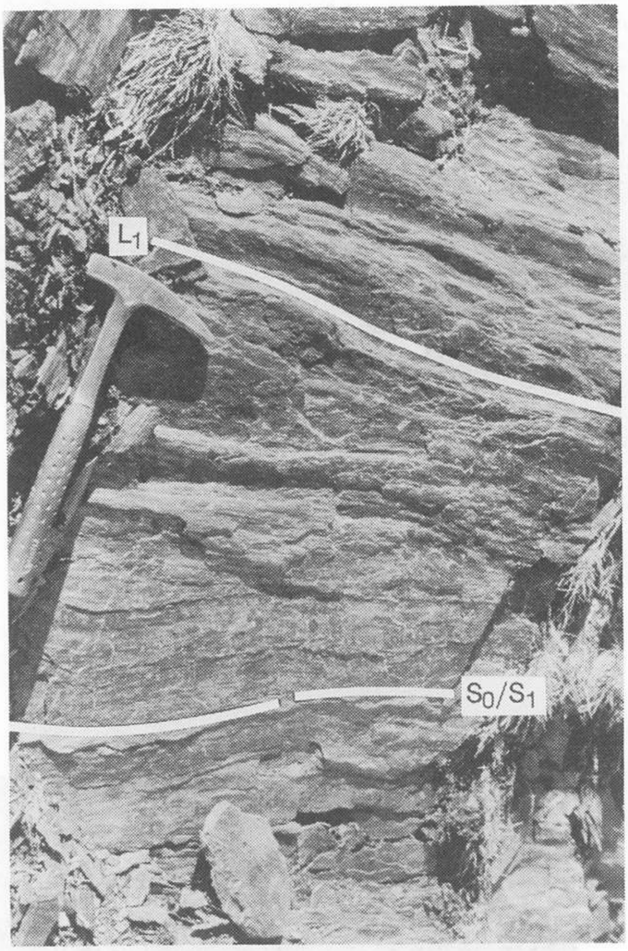
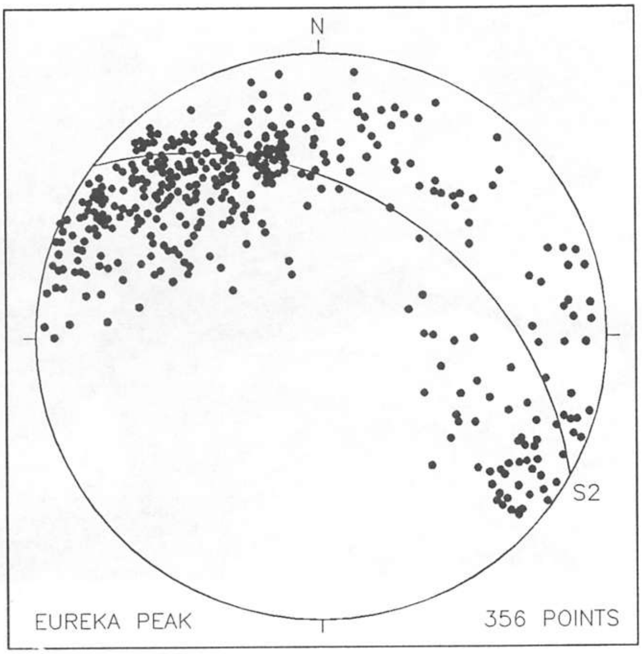


Plate 10. Mineral lineation defined by quartz rods. A S_0/S_1 intersection lineation is visible in the lower part of the photo.



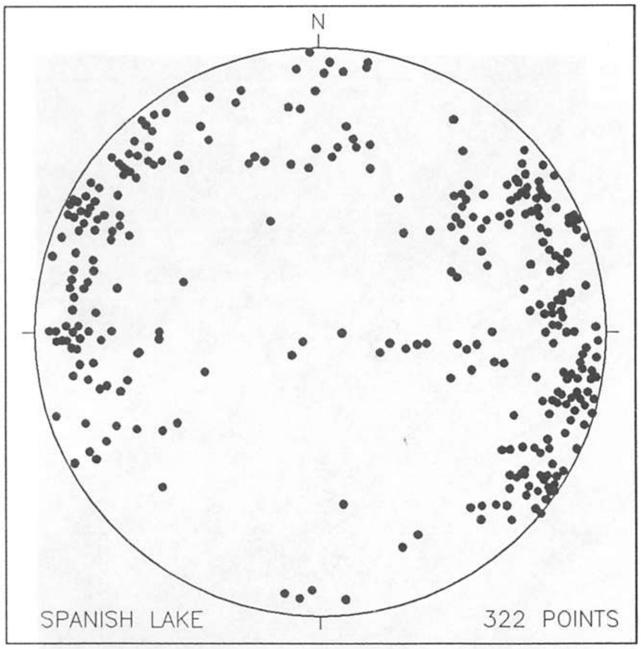


Figure 8. Equal-area projection of L_1 for the (a) Eureka Peak and (b) Spanish Lake areas. The distribution of lineations defines a great circle corresponding to S_2.

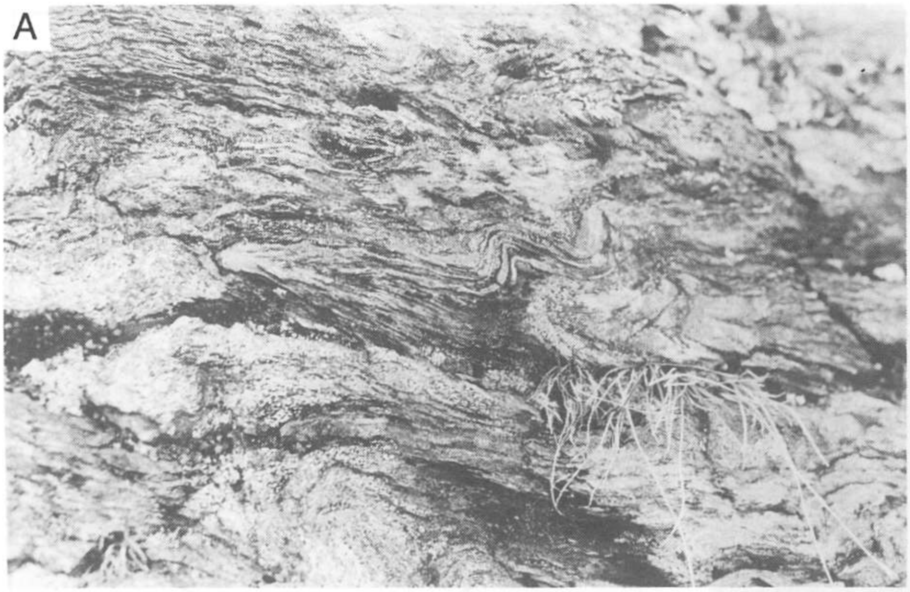
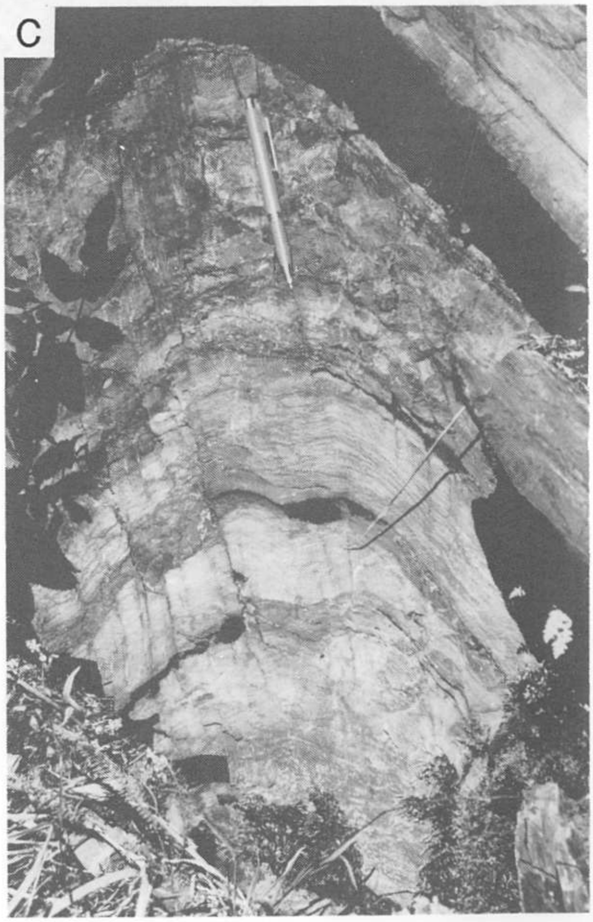


Plate 11. There is a distinctive transition in structural style corresponding to stratigraphic and structural levels. This variation is characterized by: (A) tight to isoclinal folding at the lower structural levels. (B) folds become more open and the axial plane more inclined at intermediate structural levels. (C) open and upright at the highest structural levels folding.



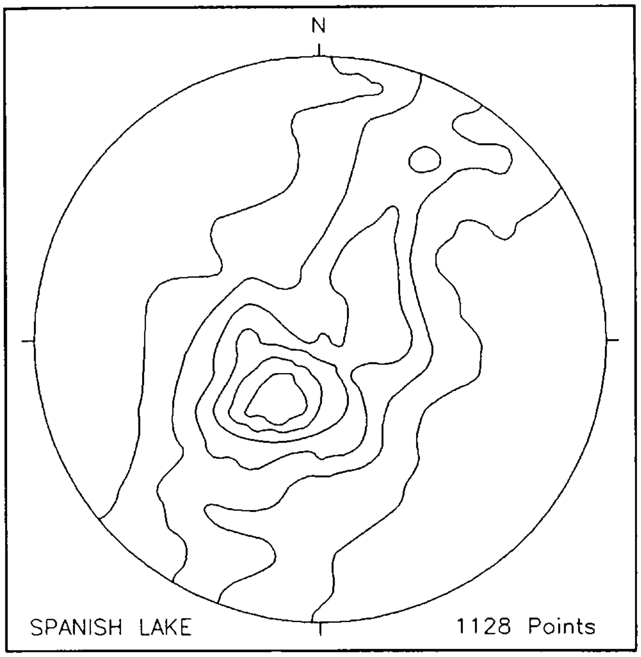


Figure 9. Equal-area projection of poles to S_1 cleavages in the Spanish Lake area.

PHASE 2 STRUCTURES

Phase 2 deformation (F_2) established the regional map pattern and refolds all earlier structures including the Eureka thrust. Structures associated with F_2 deformation are a nonpenetrative, spaced or crenulation cleavage (S_2), and the lineation (L_2) defined by the intersection of S_0/S_1 or S_1/S_2.

EUREKA PEAK AREA

Throughout the area, the S_2 spaced cleavage strikes northwest and dips moderately to steeply to the northeast and southwest (Figure 10). This non-penetrative cleavage is present throughout the lithologic sequence, within both the metasediments and the metavolcanic rocks. Spacing of cleavage varies with lithology and position on mesoscopic structures. Individual cleavage planes are more closely spaced within the metasediments where the spacing varies from 1 to 15 millimetres. Cleavage in the Nicola volcanic rocks is very weakly developed, dipping steeply to the northeast or southwest. Throughout the volcanic suite the cleavage is defined by a fine chloritic parting, and cleavage spacing varies from 1 to 3 millimetres in very fine-grained tuffs, to 3 to 4 centimetres in the coarser grained rocks. The cleavage is more closely spaced near the hinges of mesoscopic folds than on the limbs.

Refraction of cleavage surfaces is prominent between beds of differing competencies within the interbedded banded slates and tuffs of Unit Trb, for example, between mudstone and a very siliceous tuff. Fanning of cleavage within the hinge region of mesoscopic folds is also observed, generally converging toward the hinge.

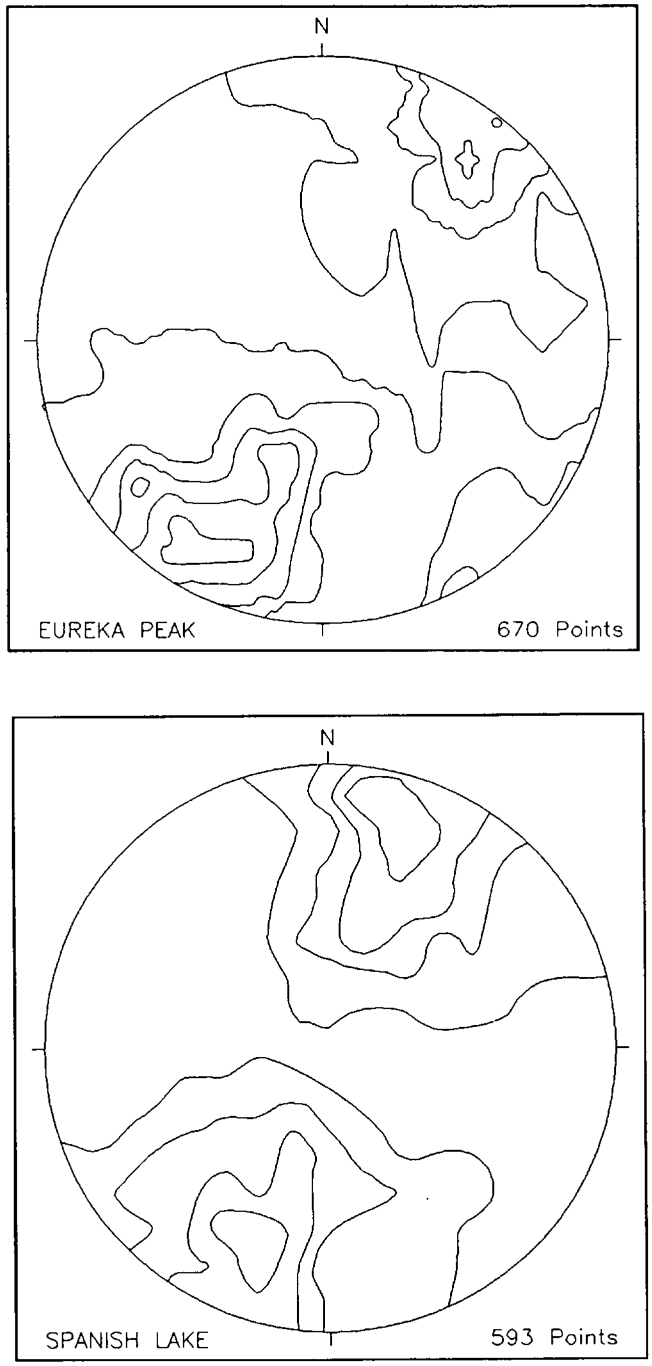
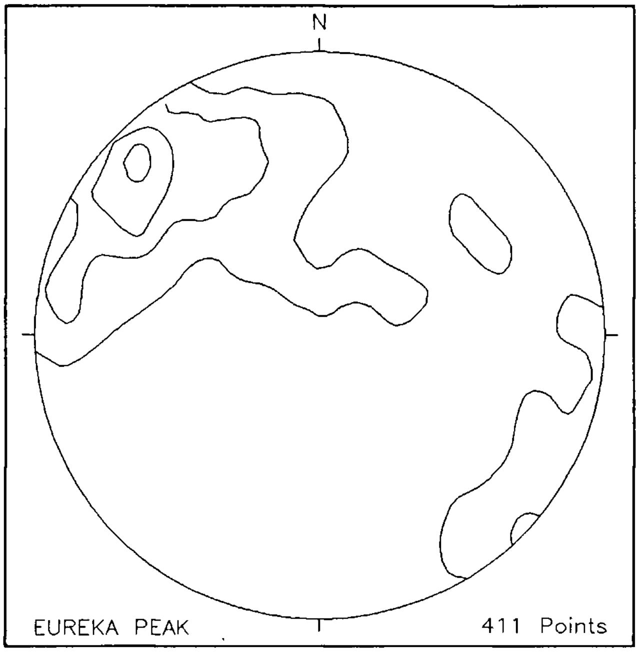


Figure 10. Equal-area projection of poles to S_2 cleavages in the Eureka Peak and Spanish Lake areas. There is little variation in the orientation of S_2 with respect to lithology or position on the major structure. 10a) Eureka Peak, (10b) Spanish Lake

The L_2 intersection lineations are parallel to the fold axes of mesoscopic F_2 folds, and S_2 is axial planar to these folds which are recognized throughout the area. These structures show a change of vergence that defines the Eureka Peak syncline, a megascopic second phase structure. F_2 structures have the same basic geometry as F_1 structures. Both are characterized by a northwest-striking



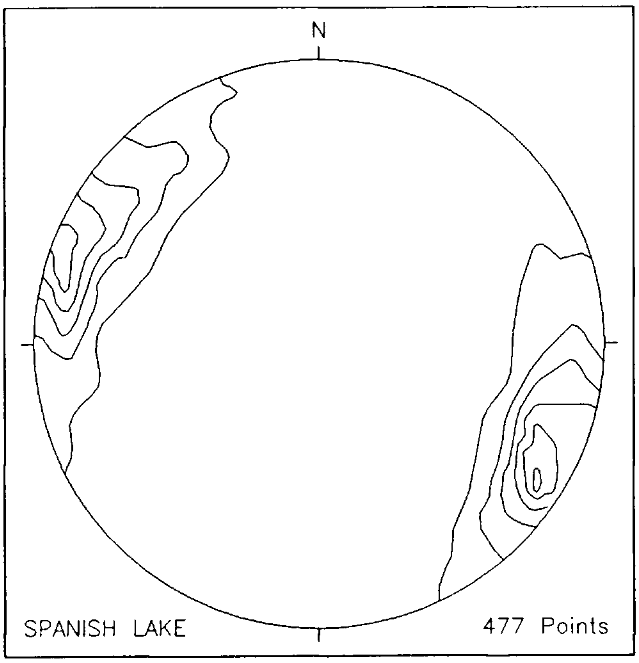


Figure 11. Equal-area projection of F_2 fold axes, and intersection lineations measured in the hinge and limb region of the Eureka Peak syncline and the Spanish Lake area. (11a) Eureka Peak, (11b) Spanish Lake.

axial-plane cleavage and doubly plunging, northwest-trending fold axes. The orientation of S_2 shows little variation throughout the area, as illustrated in Figure 10. Unlike S_1, S_2 shows no significant variation in orientation with respect to lithology or structural position (Bloodgood, 1987b). The consistency of the strike of S_2 throughout the area suggests that F_2 is the latest folding event. This conclusion is further supported by the stereonet distribution of L_2 and F_2 fold axes presented in Figure 11.

Separating the two phases in the field is difficult unless unequivocal overprinting relationships are seen. The structural elements associated with F_2 bear a close geometric relationship to F_1 structures; they are nearly coplanar and colinear. As a result, the development of F_2 mesoscopic folds is not always apparent, however, some overprinting relationships can be recognized in outcrop. At lower structural levels, the F_2 overprint tightens F_1 folds, (Plate 12) increasing the ratio of amplitude to wavelength. Comparison of the orientation data for each phase suggests that folding was essentially coaxial throughout the deformation history. As a result of the similar orientation, F_1 structures are usually only slightly modified by F_2, although complete refolding occurs locally. Plate 12 is an outcrop photograph of a small F_1 synform, refolded and overprinted by strongly developed second phase crenulations.

Spanish Lake Area

Second phase deformation (F_2) in the Spanish Lake area refolds all earlier structures, bedding and the slaty cleavage (S_1). F_2 folds are open and upright in form and a non-penetrative spaced cleavage is oriented parallel to the axial plane of F_2 folds. These folds are generally southwesterly verging, trend northwest (280° to 310°), and dip moderately to steeply to the northeast and, shallowly to moderately southwest. Local small-scale crenulations of S_1 are associated with F_2 deformation. F_2 structures are characterized by a box-fold geometry, particularly well developed to the north and east of Blackbear Creek. The S_2 cleavage in these areas forms conjugate sets, axial planar to these fold structures; although it remains a spaced cleavage morphologically. In areas where the folds display a conjugate geometry, the cleavage frequently defines kink-band boundaries (Plate 13). Linear structures associated with F_2 deformation are recognizable throughout the area as S_0/S_2 or S_1/S_2 intersection lineations. As illustrated in Figure 11, these linear structures are doubly plunging, inclined to the northwest and southeast.

Second phase structures are recognized at all scales within the area. Macroscopic F_2 folds established the geometry of the tectonic boundary, and significantly influence the map pattern. To the north of Blackbear Creek, the interference of F_2 structures imposed upon F_1 structures controls the outcrop pattern of the Crooked amphibolite. The steeply dipping F_2 axial plane and doubly plunging fold axis imposed upon a shallow-dipping F_1 axial surface has resulted in the development of a series of antiformal culminations and synformal depressions along the trend of the fold axis. The doubly plunging F_2 fold forms give rise to a relaying geometry (Ramsay and

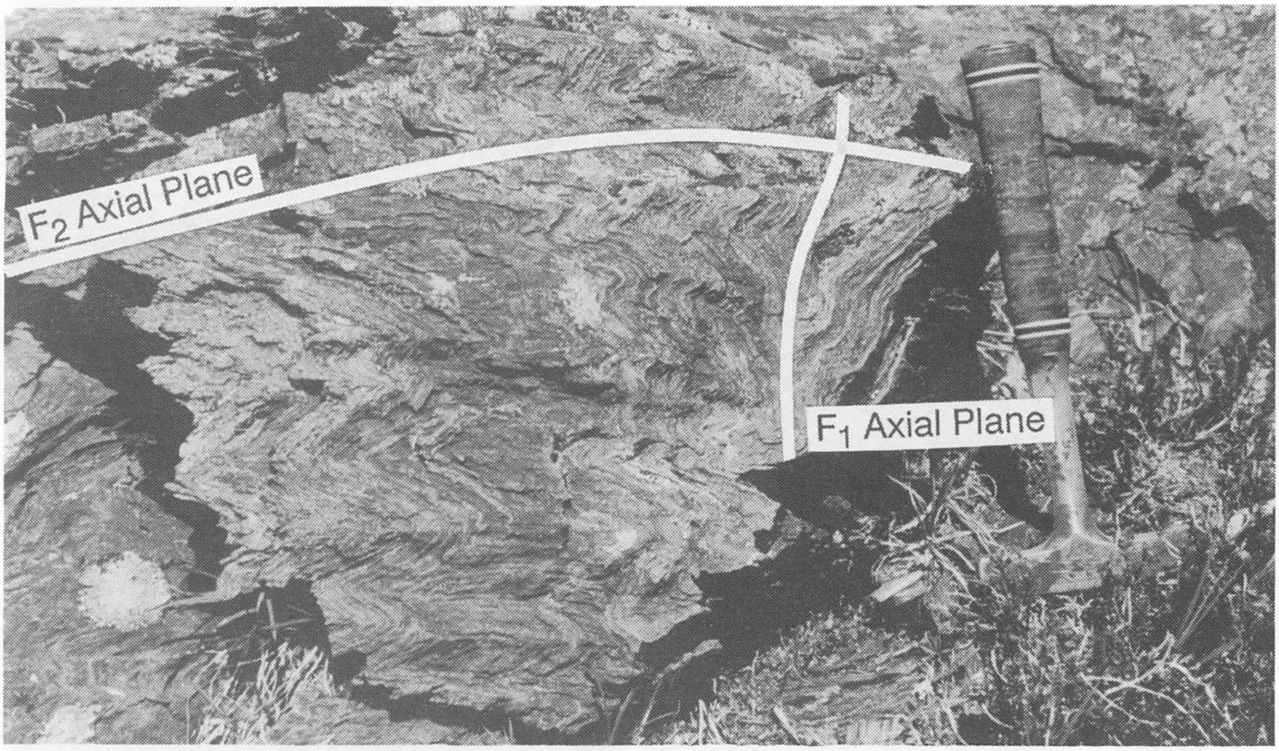


Plate 12. Small F_1 fold to the left of the hammer handle is refolded and overprinted by strongly developed F_2 crenulations.

Hueber 1987) as illustrated on the mesoscopic scale in Plate 14, and schematically in Figure 12. The deepest structural levels are thus exposed where an F_2 antiform overprints an F_1 antiform, as north of Blackbear Creek where the lowest structural level, represented by the Crooked amphibolite, is exposed along the trend of the antiformal axis (Figure 5). To the north of this axial trace higher structural levels are preserved within lobate synformal depressions and unit Tra6 is exposed (Figure 6).

In the hinge regions of F_1 folds, the S_2 cleavage is rotated away from its typical orientation, into parallelism or near parallelism with the F_1 axial surface. This relationship is consistent throughout the area, and suggests the presence of an F_1 antiform overprinted by an F_2 antiform north of Blackbear Creek. Everywhere along the trace of the Blackbear antiform, the S_2 surface is inclined at a shallow angle to the southwest, subparallel to S_1.

FRACTURES

Fractures are observed on all scales in the Eureka Peak and Spanish Lake areas. Extensional fractures oriented at low angles to bedding and cleavage occur predominantly within the metasedimentary succession, and are almost exclusively filled by quartz. The fibrous nature of the quartz is sometimes apparent in outcrop, particularly where veins are narrow. The filled fractures vary from 1 to 20 millimetres in width and tens of centimetres in length, to approximately 1 metre in thickness and several metres in length. The larger veins are characterized by a much blockier quartz filling. Intensity of fracturing increases close to fault contacts, and the fractures are lenticular. Quartz veins occur at both high and low angles to bedding and cleavage; some are deformed and others are unaffected by the deformation indicating that fracturing occurred throughout the deformational history. Small, early quartz veins outline rootless isoclinal folds, the limbs of which have been removed, probably as a result of pressure solution along the cleavage surface (Plate 15). Sigmoidal extension fractures are also present, oriented approximately perpendicular to the axes of folds of bedding.

Textures characteristic of episodic crack-seal vein growth have been recognized through microscopic examination of the vein material (Bloodgood, 1987b). Figure 13 illustrates the various geometries of veins with respect to cleavage and bedding. Fractures initially formed parallel to the direction of maximum compressive stress, at a low angle to bedding, and a high angle to cleavage. The orientation of fibrous mineral growth within the veins is perpendicular to the vein walls. During progressive deformation, both bedding and the veins were folded.

Undeformed spaced fractures (Plate 16) are developed throughout the area and occur in all lithologies; spacing varies with the competency of the lithology, from 1 to 100 centimetres. The open joints are oriented perpendicular to the fold axis and axial plane of the mesoscopic folds and dip steeply to the north and

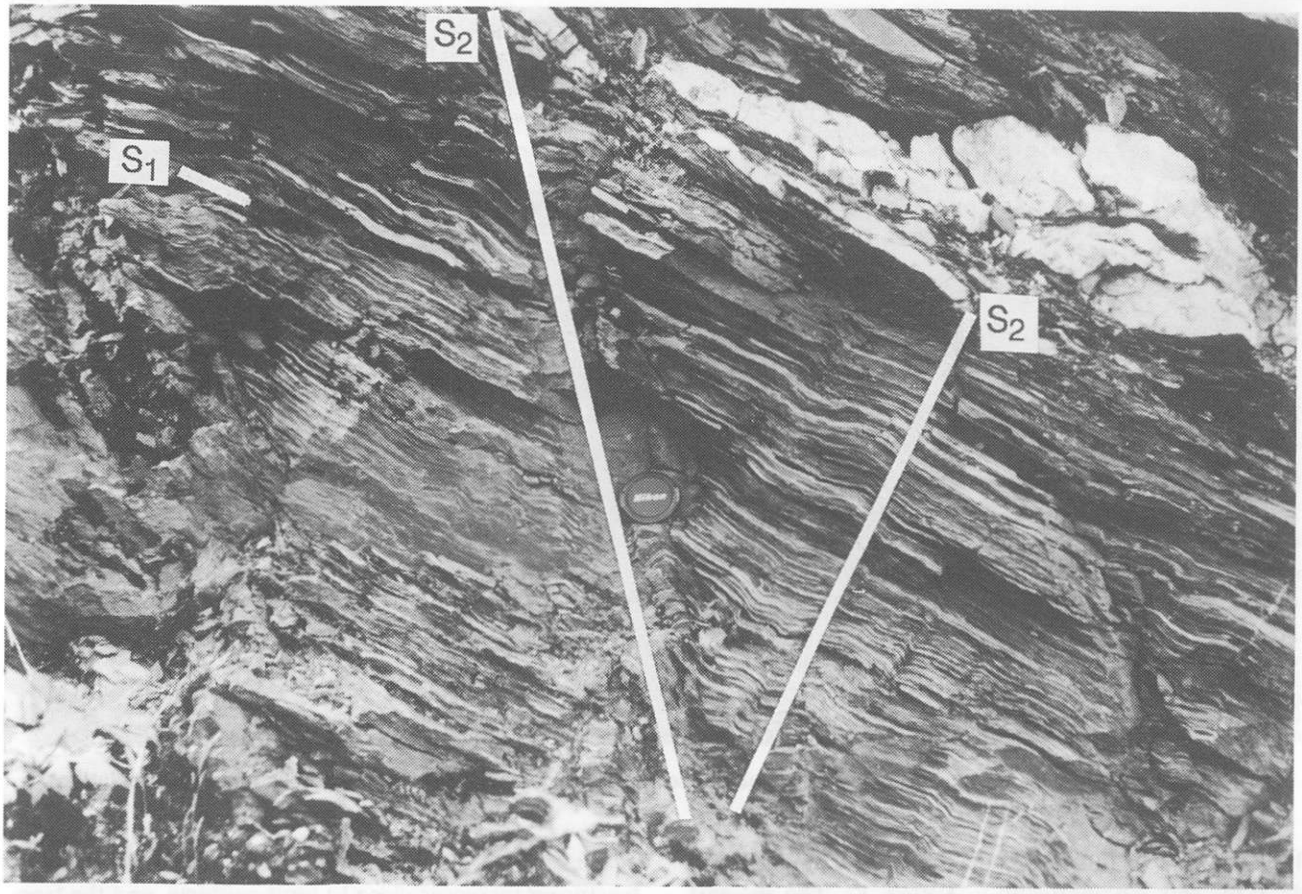


Plate 13. S_2 is developed in a conjugate orientation with a kink-band geometry produced by F_2 deformation north of Blackbear Creek in the Spanish Lake area.

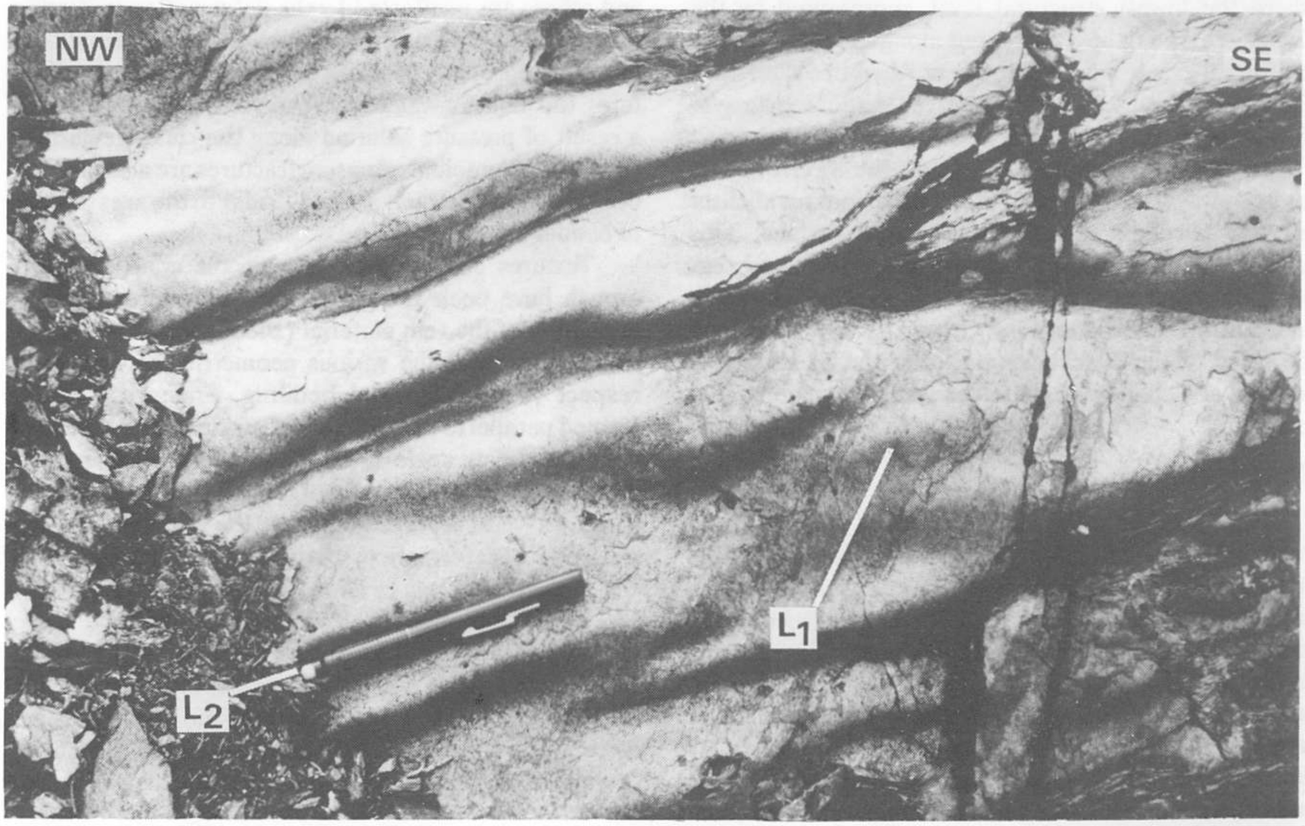


Plate 14. Plan view of a slaty cleavage surface (S_1) which has been folded by F_2. The plunge of L_2 changes along the trace of the F_2 hingeline (parallel to the pen), giving rise to doubly plunging structures. The first phase lineation (L_1) is defined by the intersection of bedding (S_0) on the slaty cleavage surface (S_1), and can be seen in the lower right of the photograph.

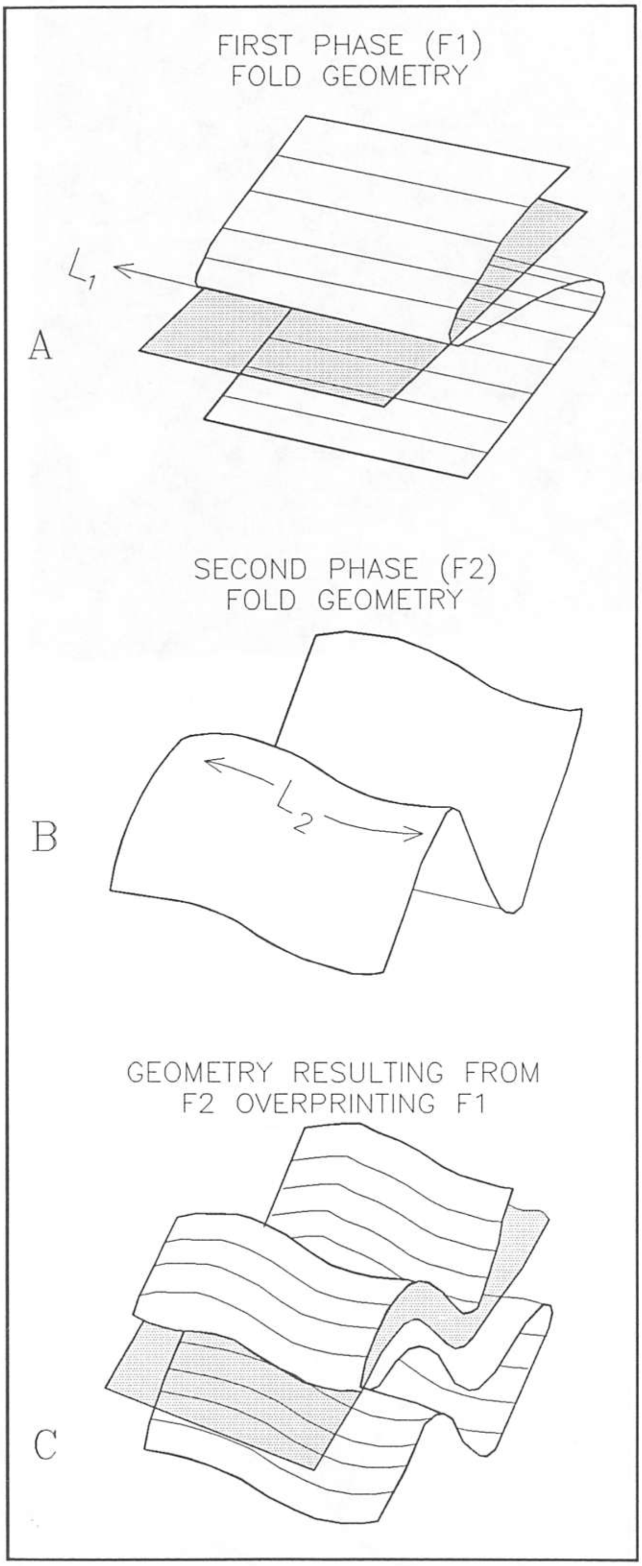


Figure 12. Schematic diagram illustrating the geometry of coaxial overprinting of F_1 by F_2 deformation.

south (Figure 14). They are believed to represent the latest structural event in the area.

FAULTING

Faulting is concentrated along major lithostratigraphic contacts. Four major faults have been identified. With the exception of the Eureka thrust, no formal names have been assigned to each of these detachment surfaces, and they will simply be referred to as thrust planes. The faults identified within the area are:

- The Eureka thrust, at the base of the Crooked Amphibolite.
- Thrust plane 2, at the contact between the Crooked Amphibolite and the Quesnel River Group.
- Thrust plane 3, at the contact between Units Tra6 and Trb.
- Thrust plane 4, at the contact between Unit Trb and the overlying Nicola Group volcanics.

The faults are parallel or subparallel to stratigraphic contacts, and truncate bedding in some instances. Faulting is thought to be synchronous with the F_1 deformation, and associated with convergence and obduction of the Quesnel Terrane. The faults are overprinted by F_2

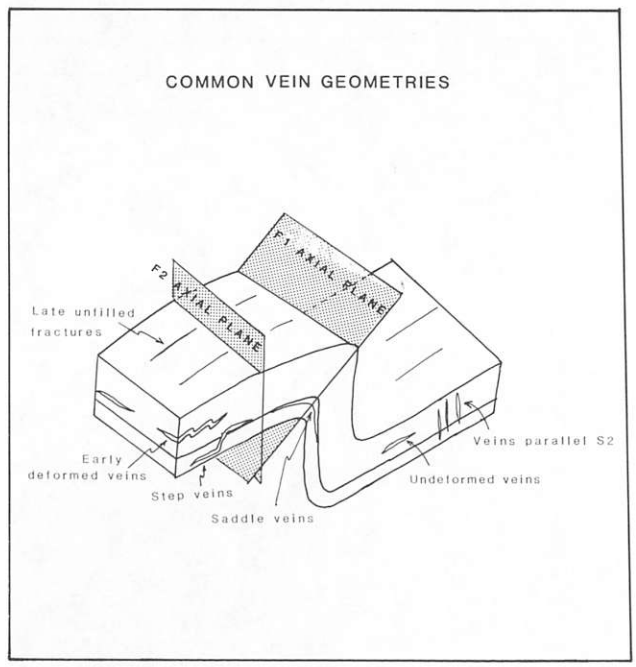


Figure 13. Geometry of fractures with respect to bedding and cleavage. Fractures initiated early and formed throughout the deformation history.

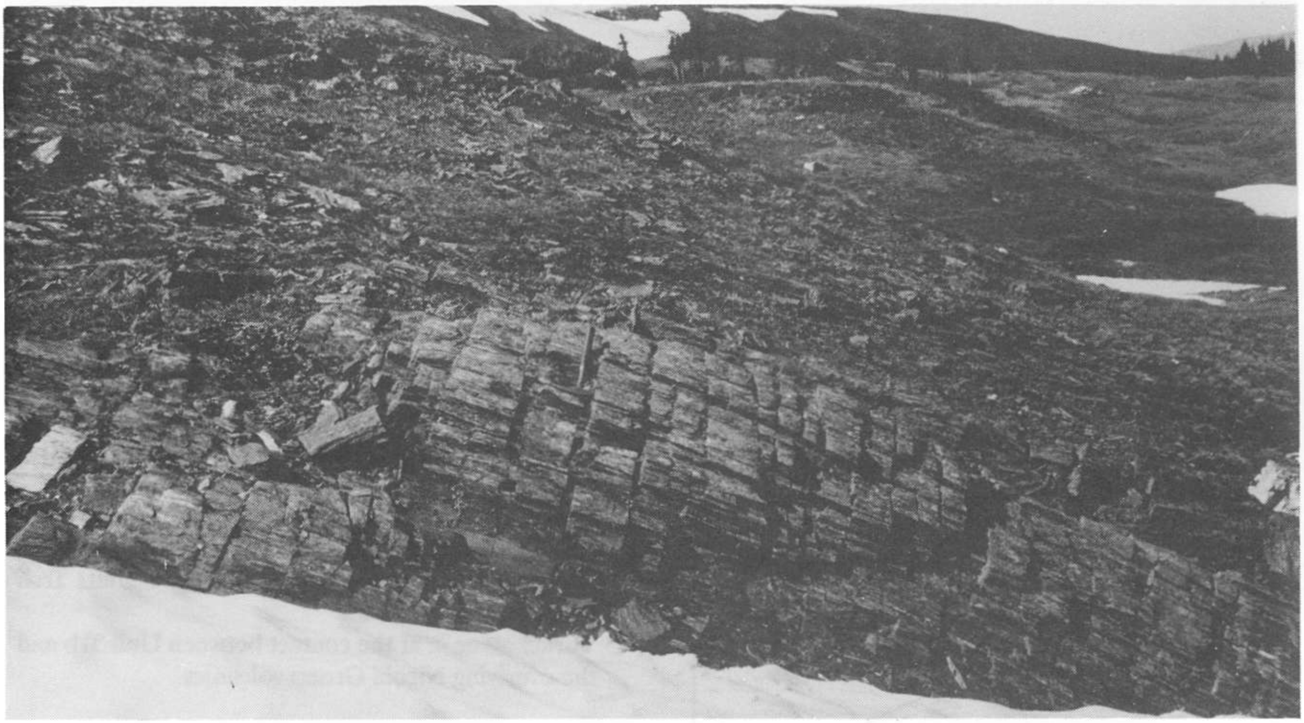


Plate 16. North of peak (6935′) spaced fractures are well-developed and overprint all earlier formed structures.

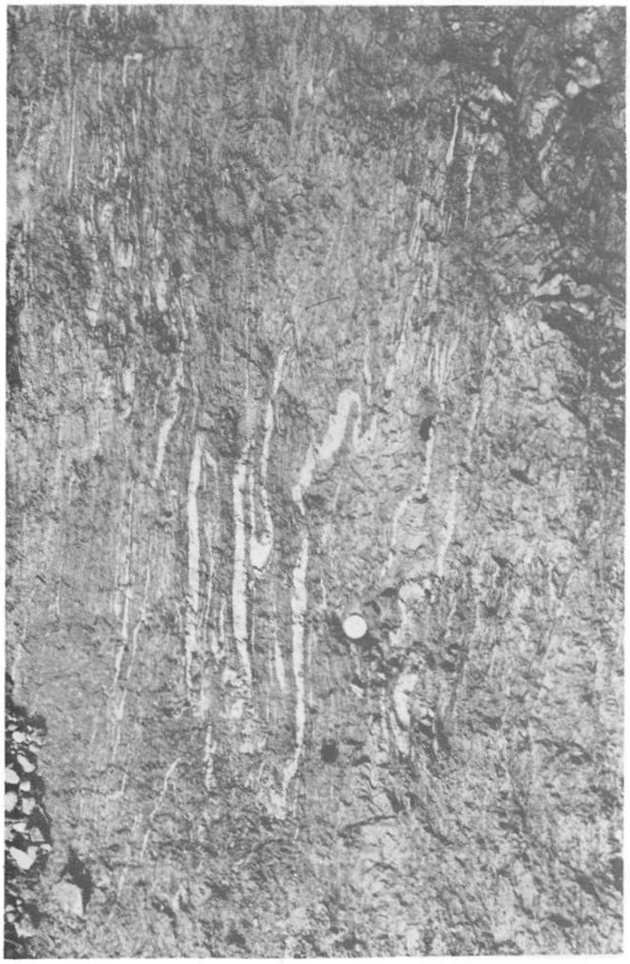


Plate 15. Small quartz-filled veins outlining rootless isoclines. The penetrative cleavage is axial planar to these small folds which developed early in the deformational history.

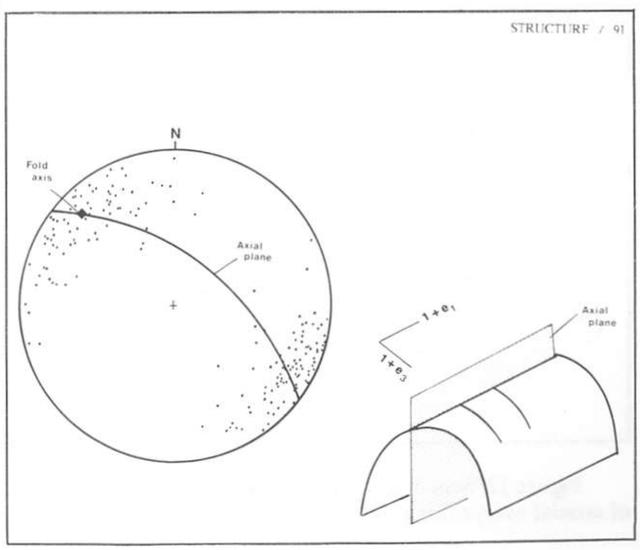


Figure 14. Equal area stereographic projection of fracture data. Fractures are oriented perpendicular to the axial plane and the fold axis of mesoscopic folds.

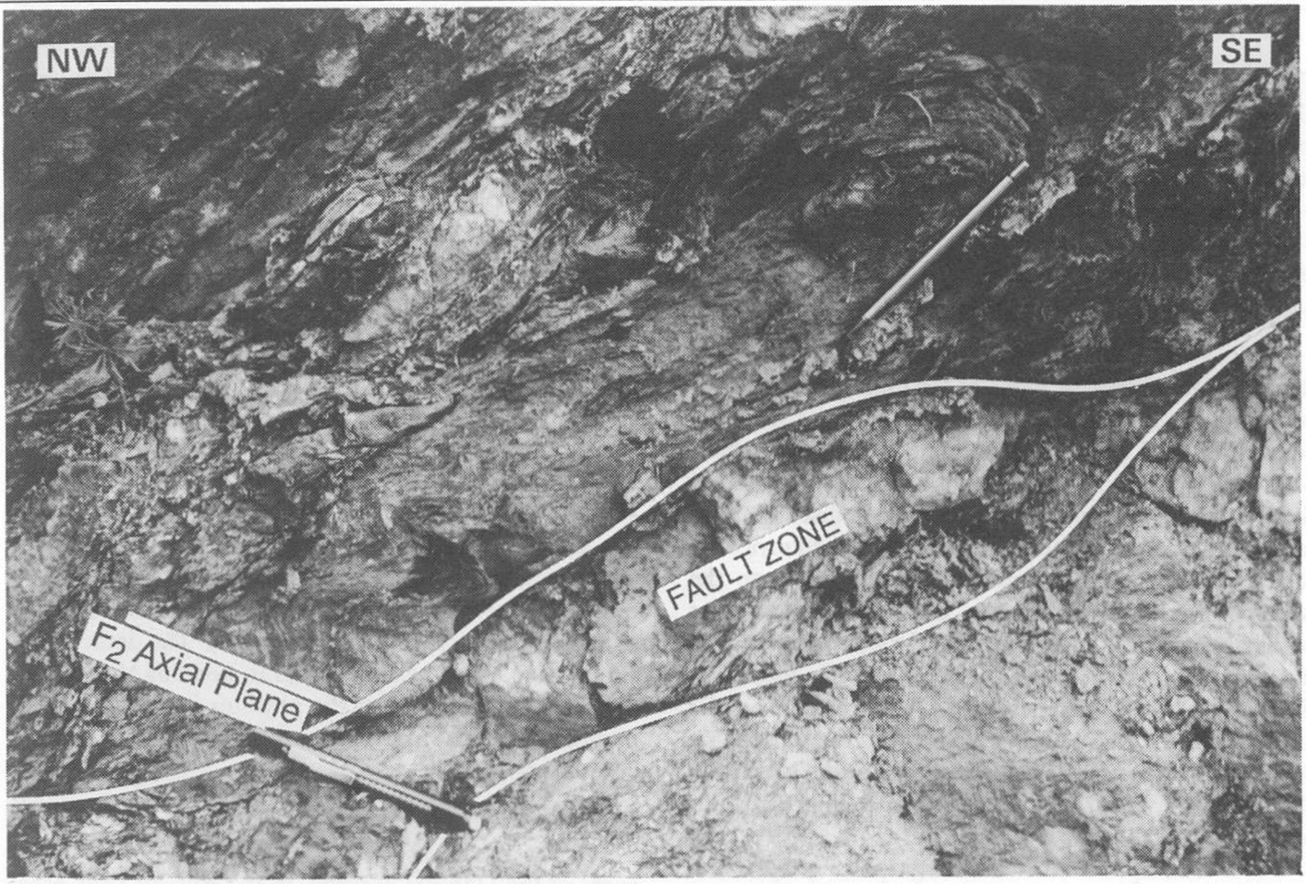


Plate 17. Imbrication at the contact between the Crooked amphibolite and the Triassic metasediments. An imbricate slice of the metasediments lies in the hanging wall of this fault. Quartz-filled fractures are prominant close to the fault zone, which is overprinted by F_2 southwesterly dipping crenulations, parallel to the pen in the lower left. The fault is parallel to a well-developed penetrative slaty cleavage (S_1).

crenulations and a non-penetrative cleavage, and, although not intensely refolded they are deformed by regional F_2 structures, such as the Eureka Peak syncline.

Deformation adjacent to the faults is intense, cleavage is strongly developed, and folding is extremely tight to isoclinal. Local imbrication along subsidiary splay faults is common close to the major fault zones. Minor faults along fold limbs are seen in outcrop. The spaced or crenulation cleavage is often intensely developed within fault zones, becoming nearly penetrative. Minor faults associated with the major fault zones display similar features.

Discontinuities of structural style and intensity of deformation across the detachment surfaces are particularly apparent in the Eureka Peak area, at the contact between Unit Trb and the overlying volcanic rocks (Unit JTra). Deformation in the metasediments is intense, in contrast with the open folding in the Nicola Group rocks, reflecting the accommodation of a greater proportion of the deformation by the less competent lithologies. This inhomogeneous accommodation of strain by the various lithologies resulted in the concentration of fault movement along stratigraphic contacts as detachment or décollement surfaces.

EUREKA THRUST

The Eureka thrust is the basal thrust of the Quesnel Terrane. As originally defined by Struik (1986), it separates the Crooked amphibolite from the Snowshoe Group and Quesnel Lake gneiss of the Barkerville (Selkirk) Terrane. The name is derived from the Eureka Peak area where the thrust is well exposed and the Crooked amphibolite outcrops continuously along it. In this area both concordant and discordant bedding relationships are present along the contact (Campbell, 1971; Bloodgood, 1987a, b) and mylonitization has been documented (Ross, *et al.*, 1985) in the adjacent rocks.

North of Quesnel Lake, the Crooked amphibolite occurs discontinuously along the boundary. Within the Spanish Lake area, it is in direct contact with both the Snowshoe Group and the Quesnel Lake gneiss. Where the amphibolite is absent, the Triassic black phyllites directly overlie the Barkerville Terrane. Northwest of the Cariboo River the contact between the Crooked amphibolite and the Quesnel Lake gneiss is very well exposed and marked by the development of mylonitic fabrics (Rees, 1981) and mechanical imbrication of the adjacent rock units. In this area, the contacts of the Crooked amphibolite are characterized by mechanical interleaving with the rocks above and below it (Plate 17).

The interleaving may result from progressive shearing along the limbs of the infolded units adjacent to the boundary. It is uncertain whether these structural panels represent small imbricate slices or remnants of folds which developed during plate convergence. Strongly developed mylonitic foliation certainly indicates high shear strain within these zones.

THRUST PLANE #2

This thrust separates the Crooked amphibolite from the underlying black phyllites of the Quesnel Terrane. It is parallel or subparallel to the bedding contacts, and both concordant and discordant bedding relationships have been observed across it. The fault is not well exposed in the Eureka Peak area, but is overlain by a discontinuous micaceous quartzite unit with a well-developed mylonitic foliation (Elsby, 1985). South of Eureka Peak, on the western flank of Boss Mountain, mechanical imbrication of the black phyllite with Snowshoe Group rocks has been documented (Fillipone and Ross, 1990; Fillipone, 1985; Ross *et al.*, 1985). In this area the black phyllites occur within narrow, fault-bounded synformal zones; the same relationship has also been documented in the closure of the Eureka Peak syncline (Ross and Fillipone, unpublished data).

The fault appears to cut stratigraphically upsection to the north, as illustrated in Figure 4. North of Quesnel Lake lithologies representing higher stratigraphic levels in the black phyllites rest unconformably upon the Crooked Amphibolite, Snowshoe Group and the Quesnel Lake gneiss. In this area, Units Tra1 through Tra4 are absent, and may have been faulted out as a result of upward ramping along this fault.

THRUST PLANE #3

The contact of Unit Trb with the underlying metasedimentary sequence is invariably a fault. Concordant and discordant bedding relationships have been documented (Bloodgood, 1987a, b, c; 1988) along the sharply defined fault contact between units Tra6 and Trb. In the Eureka Peak area, these relationships are well exposed north of Peak 6935′ (Plate 18a, b, and Figure 15). Brecciation, slickensides and quartz veins are common within the fault zone which rarely exceeds 3 metres in width (Plate 18b). Local imbrication along subsidiary splay faults is common.

In the Spanish Lake area, Unit Trb is thrust over the Crooked amphibolite northwest of the Cariboo River; mechanical imbrication is evident along the contact. North of Spanish Lake, Unit Trb directly overlies units Tra5 and Tra6 of the black phyllite stratigraphy. Further to the east, metasediments and metavolcanics of Unit Trb overlie the Snowshoe Group. In addition to thrusting along the base of this unit, fossil evidence suggests internal imbrication of Unit Trb (L.C. Struik, personal communication, 1988).

Northwest of the Cariboo River, tight to isoclinal infolding of unit Trb with the underlying Crooked amphibolite is well exposed along the contact between them. To the southwest, the contact is generally less well exposed, but is marked by intense brecciation, tightening of structures and increased frequency of quartz veins.

THRUST PLANE #4

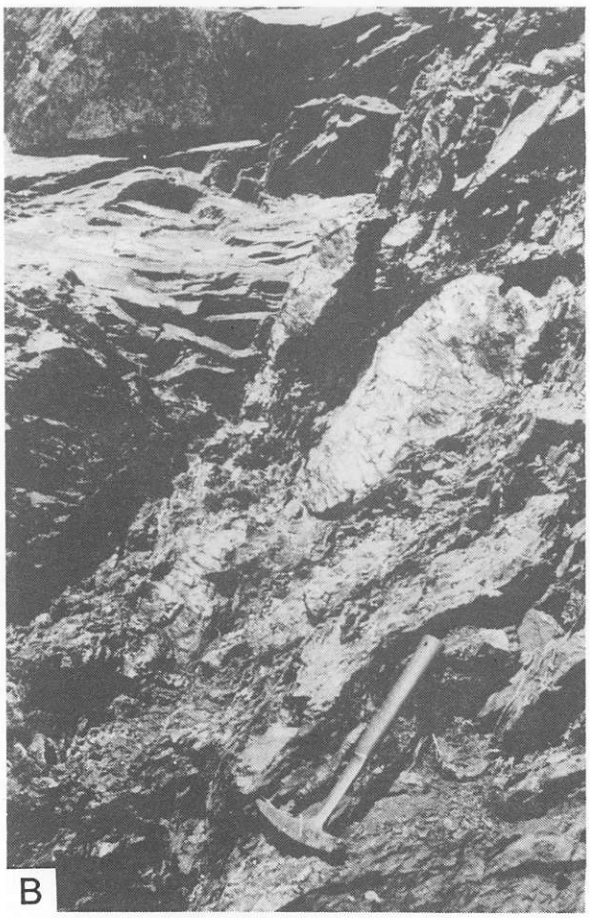
The contact of the metavolcanic sequence with the underlying metasedimentary package is a well-documented thrust fault. In the Eureka Peak area, it is exposed in the core of the Eureka Peak syncline. The detachment surface is parallel or subparallel to bedding throughout the area. Deformation of the phyllites in the footwall is intense in contrast to the more competent metavolcanics in the hangingwall.

LATE HIGH-ANGLE FAULTS

There are at least two sets of high-angle faults within rocks of the Quesnel Terrane. In the Eureka Peak area, high-angle faults are developed at higher structural and stratigraphic levels in the core of the Eureka Peak syncline (Figure 5, in pocket). The faults are steeply inclined to the northeast or vertical. They are subparallel to the regional foliation in this area and cut the volcanic sequence in the core of the syncline. Displacements are small and movement of individual blocks seems to be upwardly directed away from the core of the syncline. In the Spanish Lake area high-angle faults of this orientation are not found in the metasedimentary rocks but have been documented in the volcanic sequences to the west of Spanish Lake (Bailey, 1988).

Several northeast-striking high-angle faults have been mapped in the Spanish Lake area. They post-date the F_2 deformation, offsetting the axial trace of the Seller Creek syncline and Badger Peak anticline (Rees, 1987) along the Cariboo River. Bailey mapped other northeasterly striking, high-angle faults within the volcanic succession to the west. The geometry of these faults, as inferred from the outcrop pattern, suggests sinistral displacement.

Plate 18. (A) Sharp fault contact between unit Tra6 and Trb north of Peak 6935′. (B) Close-up photograph within fault zone showing truncated bedding and quartz filled veins within fault zone.



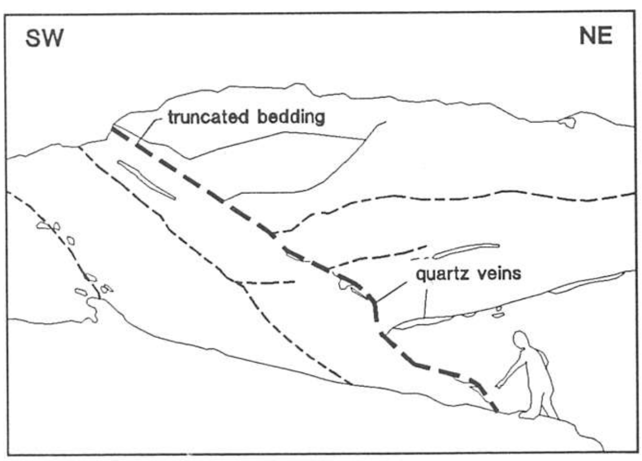


Figure 15. Detailed sketch of Plate 18 highlighting the truncation of bedding and abundant quartz veins which are prominent within the fault zone.

ECONOMIC GEOLOGY

Mineral exploration within the Triassic black phyllites has been ongoing since the Barkerville gold rush. Much of the area between Eureka Peak and Spanish Lake has been staked and explored but little of economic significance has been discovered. The three properties which have received the most work are the Frasergold, Eureka and CPW. Three mineral deposit types have been recognized within the area examined, all of which have significant structural and stratigraphic controls.

On the Frasergold property syngenetic lode-gold mineralization is confined to a distinctive stratigraphic interval of the Triassic black phyllite metasedimentary succession. Remobilization of gold and sulphide minerals into quartz veins occurred during regional metamorphism and deformation. The veins are concordant with bedding and locally form saddle reefs outlining fold structures. The mineralized veins are believed to have formed early in the deformational history and are crosscut by barren veins.

The second deposit type is porphyry copper mineralization which occurs in association with alkalic stocks intruding the metavolcanic succession. On the Eureka claim mineralization is associated with the Eureka stock which crosscuts both the metavolcanic and metasedimentary rocks. The QR deposit to the northwest of the study area is a well known deposit of this type and there are numerous smaller occurrences in the Horsefly region (Panteleyev, 1987).

On the CPW property vein mineralization is associated with zones of intense listwanitic and carbonate-silica alteration. The mineralization is structurally controlled and primarily confined to a series of northeast to east-trending fractures which crosscut the regional structural trend and provide a pathway for the migration of mineralizing hydrothermal solutions. Tuffaceous horizons host the strongest carbonate-silica alteration; quartz-carbonate stockworks extend into the adjacent metasediments which may have been relatively less permeable and therefore more susceptible to brittle fracture.

FRASERGOLD PROPERTY

The Frasergold property is located 115 kilometres east of Williams Lake, on the north face of Eureka Peak, south of the MacKay River. The first claims were staked in 1978 by Clifford Gunn to cover the reported occurrence of placer gold in Frasergold Creek. Prior to acquisition of the property by Eureka Resources Inc. in 1983, the claim group was expanded by Keron Holdings Ltd. and NCL Resources Ltd. They completed detailed geological mapping and a geochemical survey which outlined a northwest-trending anomaly. In 1983, Amoco Canada Petroleum Company Ltd. optioned the property from Eureka Resources and completed an extensive program of surface exploration, followed by 4519 metres of diamond drilling which intersected mineralization of economic to subeconomic grade over the 1.5-kilometre strike length of the soil anomaly. Between 1985 and 1986 Eureka Resources Inc. continued surface exploration, geochemical sampling and drilling and confirmed the continuation of the geochemical anomaly for 10 kilometres northwest of the area. A short exploration program in 1987 resulted in the preparation of an adit portal site, 1710 metres of reverse-circulation drilling in 21 holes and 660 metres of trenching after which, Eureka Resources and Southlands Mining Corporation entered a joint venture agreement. In late 1987, Sirius Mining Corporation made an agreement with Southlands Mining Corporation and completed 1536 metres of HQ diamond drilling, 2470 metres of reverse circulation drilling and 184 metres of underground development.

Gold mineralization on the Frasergold property is vein hosted and occurs within the metasedimentary sequence. It is localized along the moderately southwest-dipping northern limb of the Eureka Peak syncline and concentrated near the basal contact of a distinctive porphyroblastic phyllite with underlying graphitic banded phyllites. The dominant porphyroblasts within the unit are siderite, ankerite and chloritoid; the porphyroblasts are commonly flattened within the plane of foliation and range in size from 1 to 20 millimetres. The unit is believed to be equivalent to Unit Tra4 (Bloodgood, 1987a) and can be traced to the southern limb of the syncline where garnet, albite and chloritoid comprise the porphyroblast assemblage. Bedding within the phyllites is defined by thin quartz-sandstone beds, 0.5 to 10 centimetres thick. A penentrative slaty to phyllitic foliation is developed axial planar to tight to isoclinal folds. The veins are generally parallel to S_1 and subparallel to S_0.

Gold mineralization is hosted by quartz and quartz carbonate veins ranging from 2 to 20 centimetres in thickness and extending 1 to 10 metres along strike. They are generally parallel to subparallel to S_0 and S_1 structures occurring as discontinuous lenses, rolls and saddle reefs. The quartz is usually massive, associated sulphides include pyrite and pyrrhotite, minor limonite is common at the margins of the veins and lining small vugs. Examination of polished sections shows that the gold is closely associated with the sulphides. The formation of the quartz veins is synchronous with regional metamorphism and deformation. Deformed and undeformed veins occur on all scales, along the limbs and within the hinge regions of folds. The vein fillings are believed to represent fluids generated during dewatering reactions associated with the Jurassic metamorphic event. These fluids migrated along cleavage surfaces (Bloodgood, 1987a), eventually depositing quartz, carbonate and sulphides in the veins. The mineralized vein at the main showing on the Frasergold property was sampled and yielded a potassium-argon age date of 152±5 Ma, which is compatible with the regional metamorphic and deformational event.

The geochemically anomalous zone extends 10 kilometres along strike with a width of approximately 100 metres. It is confined to the knotted black phyllites which are approximately 200 metres thick. All of the 21 holes completed in 1987 intersected gold mineralization grading 0.7 gram per tonne or better over 30 metres. Local zones of enrichment, with values ranging from 5 to 24 grams per tonne were also intersected over 3 to 6 metre widths. Within one anomalous zone, a drill indicated width of 17.9 metres with an average grade of 1.95 grams per tonne gold (0.057 oz per ton Au) is estimated based on holes spaced at 25 metre intervals. The southeast extension of this zone (drilled at 50 to 75 metre intervals over 500 metres) has a drill indicated total mineralized width of 19.1 metres with an average grade of 2.6 grams per tonne gold (0.077 oz per ton Au). Drilling indicates that the mineralization is concentrated within a zone 1.5 kilometres in length by 150 metres deep and 150 metres in width and with estimated ore reserves of (18 million tonnes) with an average grade of 1.7 to 2.7 grams per tonne gold (0.05 to 0.08 oz per ton Au).

In the area of most detailed drilling (25-metre spacing) mineralization averages 1.95 grams per tonne over an average intercept of 17.9 metres. The extension of this zone to the southeast, drilled at 50 to 75-metre intervals, averages 2.64 grams per tonne gold over 19.1 metres. Drill-indicated reserves to a depth of 150 metres are estimated to be 18 million tonnes with an average grade of 1.7 to 2.7 grams per tonne gold.

Eureka Property

The Eureka property comprises 91 claim units on Eureka Peak, 112 kilometres east of Williams Lake. The claims were originally staked in 1958 by E. Sholtes who optioned the property to Helicon Explorations Limited in 1965. In 1965 and 1966 Helicon performed x-ray drilling and drove a 22-metre adit from which a 192-metre horizontal hole was drilled. In 1981, Umex, Inc. optioned the property and completed a lithogeochemical sampling program. In 1983, the property was optioned to Dome Exploration (Canada) Limited; further lithogeochemical sampling outlined several areas of anomalous gold concentrations. In 1986 the option was dropped and Umex reacquired the property and completed detailed geological mapping and lithogeochemical sampling to explore zones of anomalous gold values outlined by previous geochemical work.

The Eureka claims are underlain by a Triassic to Jurassic metasedimentary and metavolcanic succession of the Nicola Group which is crosscut by numerous comagmatic dikes. The metavolcanic rocks in the core of the Eureka Peak syncline are intruded by a complex of epizonal intrusive bodies of possible Cretaceous age, ranging in composition from quartz monzonite to diorite and amphibolite. The stock, an elliptical body elongate along a north to northeast trend and having a granodioritic core, is host to copper mineralization and zoned alteration typical of a porphyry copper environment. Chalcopyrite, pyrite and pyrrhotite occur as veins and disseminations throughout the stock and mafic volcanic country rocks.

CPW Claims

The Spanish Mountain property consists of two claim blocks: the CPW and Peso groups. The CPW claims, previously known as the Mariner claims were staked by F. Dickson and A. Bailey in 1933. In 1947, approximately 4 tonnes of picked ore were shipped to the Tacoma Smelter and received returns of 274 grams gold, 1370 grams silver and 40 kilograms copper per tonne. In 1982, the four-unit CPW claim previously covered by the Mariner claims was staked by D.E. Wallster for Mariner Joint Venture. In 1985, Mt. Calvery Resources Ltd. completed a two-phase program of trenching (1420 metres) and rotary drilling (37 holes, 3176 metres). This program identified several zones of structurally and stratigraphically controlled gold mineralization, believed amenable to open-pit mining. In 1987 Pundata Gold Corporation acquired the property and entered a joint venture with Trio Gold Corporation. The joint venture completed a drilling and trenching program to outline the limits and grade of the Main and LE zones. Also in 1987, Pundata Gold Corporation acquired an option to purchase a portion of the Peso Group.

The primary lithologies are interbedded tuffs and phyllitic to massive siltstones. Strong carbonate-silica-pyrite alteration (listwanitic alteration) is locally pervasive, masking original textures of the protolith. The most pervasive alteration is generally concentrated within the tuffaceous beds whereas discrete quartz stockworks extend into the adjacent sedimentary units and maintain a fairly consistent northeast to east trend. The gold mineralization occurs in quartz veins which range in thickness from 0.01 to 4 metres. The veins are characterized by a very crystalline to vuggy quartz and carbonate filling, associated with galena, chalcopyrite, pyrite and sphalerite. Oxidized sulphides frequently line the vugs and cavities within the veins and fine gold particles and wires occur within the oxidation rinds. Free gold is associated with minor galena and steeply dipping, northeast trending veins within the listwanite. Two mineralized zones have been identified by Pundata Gold Corporation. Total reserves for both zones are estimated at 838 000 tonnes with an average grade of 1.95 grams per tonne gold (15% probable reserves and 85% possible reserves).

The structural controls on the mineralization suggest that it post-dated regional metamorphism and deformation. The property is located on the northeast limb of a northwest-trending anticline. Numerous northwest-trending syn-deformational thrust faults have been recognized which are crosscut by a series of prominent northeast to east-trending normal faults. Because the mineralization is closely associated with fractures and veins which crosscut the regional structural trends, it is unlikely that the mineralization is synchronous with these events. Also, the open space, vuggy textures associated with the vein filling are not compatible with veins formed during regional metamorphism which are usually characterized by higher fluid pressures and crack-seal textures. Pundata Gold Corporation suggests a syngenetic origin for the gold mineralization, and remobilization of the gold during late stage deformation. Structural relationships however, do not support this interpretation and it is likely that mineralization accompanied post-metamorphic hydrothermal activity resulting in pervasive silica-carbonate alteration of the tuffs and quartz stockwork veining of the clastic sediments.

ORE MICROSCOPY

A modest research project was undertaken to examine the morphological and compositional characteristics of vein-hosted gold within the Quesnel gold belt between Eureka Peak and Spanish Lake. Samples of visible gold from the Frasergold and CPW properties were provided by Eureka Resources, Inc. and Pundata Gold Corporation, respectively. Polished section and scanning electron microscopy were used to compare the morphology and composition of the gold from each of these two occurrences. Preliminary results indicate that they have significantly similar characteristics. The following analytical work was conducted at the University of British Columbia. The samples described have been donated to the university sample collection and the sample number cited refers to university catalogued samples.

EUREKA PEAK SAMPLE

A drill-core sample of a narrow vein cutting Unit Tra4 of the metasedimentary succession was obtained on the Frasergold property. Several grains of gold (millimetre-scale) were visible to the naked eye on the fresh surface. Two polished sections of the sample were prepared and examined (sample Au-399-01/02). Quartz and calcite are the dominant constituents; accessory minerals include limonite and minor pyrite. Limonitic alteration is common at the margins of the vein and also as minor inclusions within the gold grains or along grain boundaries. Brecciation of the quartz and carbonate is significant within 5 millimetres of the wall of this 4-centimetre vein. Polished section microscopy indicates several grain types within the sample. As illustrated by a backscatter electron image (Plate 19a), a single, relatively inclusion-free gold grain is present within a compositionally homogeneous matrix. Grain boundaries are sharp

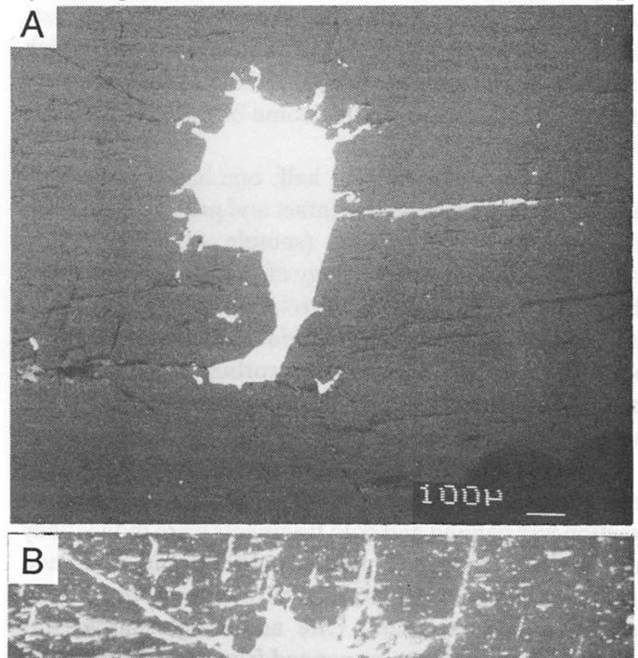


Plate 19. (A) Back-scatter electron image of a relatively inclusion-free gold crystal. (B) Secondary electron image of gold crystal and its relationship to cleavage within a host calcite grain.

and planar to somewhat rounded features. Small irregular protrusions extend outwards from the sharply bounded, irregularly shaped grain. Examination of a secondary electron image (Plate 19b) shows two well-developed cleavages characteristic of the calcite which envelops this gold grain. Fine platelets of gold extend along the calcite cleavage, suggesting that the gold in this specimen is primary, and synchronous with the deposition of the calcite.

CPW SAMPLE:

A sample of quartz vein material was provided from a surface trench on the CPW property. Characteristic of the vein occurrences on this property, it is composed of quartz with abundant cubic to rhombic cavities. Limonitic alteration is pervasive, and particularly associated with the voids. Visible gold occurs dominantly as platelets and fine grains on the surface of the cavities and striations are often etched in the quartz along the cavity walls, suggesting that the cavities were once occupied by pyrite which has since been oxidized. An unidentified white powdery amorphous substance coating some of the gold grains is also present.

The sample was split in half, one half was crushed and the other was preserved intact and prepared as rough mounts. The rough mounts (sample Au-400) provide information on the morphology of gold grains and allow direct observation of textural relationships between the gold and the gangue minerals. Unfortunately, it was not possible to obtain an adequate carbon coating on the sample, and these samples were not examined with the scanning electron microscope.

The other half of the sample was crushed and sieved into size fractions varying from -80 to -200 mesh. Each fraction was panned and gold fragments were individually mounted on transoptic plastic, polished and examined (samples Au-401-01/02). Pyrite cubes were also separated and mounted. One additional sample was prepared from gold grains panned from the soil collected from the trench floor.

Several grain morphologies and mineralogical associations were identified in these samples. Morphologically, the gold grains vary from euhedral to subhedral equant crystals (Plate 20), to irregular rounded grains, to fine platelets. Sharply bounded crystal faces characterizing parts of the grain are shown in Plate 21 but fine filaments and platelets of gold are also associated with it. There is no physical discontinuity between the main grain and the platelets and comparing the composition of the gold using the energy dispersive system of the scanning electron microscope shows that the main grain and the finer platelets and filaments have identical compositions.

The dull grey material surrounding the gold grain in Plate 21 has been identified as limonite with minor silicate inclusions. Limonite is commonly associated with the gold, and often occurs as fine inclusions within the gold grains. Plate 22 shows platelets of gold occuring as intergrowths within limonite; the sharp grain boundaries and pseudo-cubic form of the limonite grain suggest that the gold was originally associated with pyrite which has since oxidized and been pseudomorphed by limonite.

SUMMARY

Examination of gold samples from the two principal gold occurrences in the study area shows some marked similarities in both composition and morphology. Electron microprobe analyses indicate that grains and platelets of gold have roughly the same composition and the range of fineness of gold grains is approximately 736-760 for the Eureka Peak samples and 742-822 for the Spanish Mountain samples (unpublished data, J. Knight, 1989).

The textural relationships of the gold and gangue minerals and the presence of limonite inclusions suggest that the gold is primary, and not the result of supergene enrichment. The striations seen in cavities in sample Au-400 from the CPW occurrence and the cubic voids commonly associated with the limonite alteration suggest that limonite pseudomorphs pyrite. The intimate intergrowth of gold and limonite further suggests that the gold precipitated with the sulphides during the formation of the vein. This interpretation is supported by textural relationships observed in the Frasergold sample. The intergrowth of gold along the calcite cleavage (Plate 19), and within limonite (Plate 22) strongly supports the interpretation that the gold is primary, either coming out of solution during the formation of the vein, or locally remobilized along the cleavage planes.

Field relationships also support the interpretation that the gold is primary, although structural controls indicate that the relative timing of mineralization on the CPW and Frasergold properties may differ. On the Frasergold property, the gold is confined to veins within a distinctive stratigraphic interval and structural position concordant with the regional structural trend. Mapping of the vein systems, and the intimate intergrowth of gold with the vein minerals such as calcite (Plate 19) provides strong evidence that gold mineralization accompanied the regional Jurassic metamorphic event. In contrast, both field and laboratory studies suggest that the mineralization on the CPW property post-dates the regional metamorphic and deformational event. The trend of the mineralized zones on the CPW property cross-cuts the regional structural trends and the open space, vuggy textures observed in veins is not compatible with those generated during regional metamorphism. It is likely that the cross-cutting fractures provided a pathway for the migration of hydrothermal solutions and mineralized fluids. The tuffaceous horizons host the strongest carbonate-silica alteration; quartz-carbonate

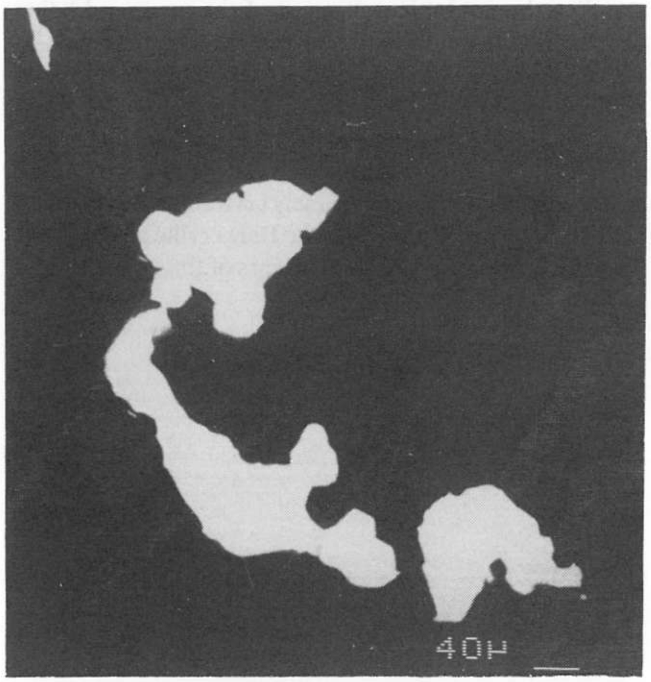


Plate 20. A backscatter electron SEM image of a gold grain from vein material on the CPW property. Grain shape varies from small dodecahedral grains to subrounded forms.

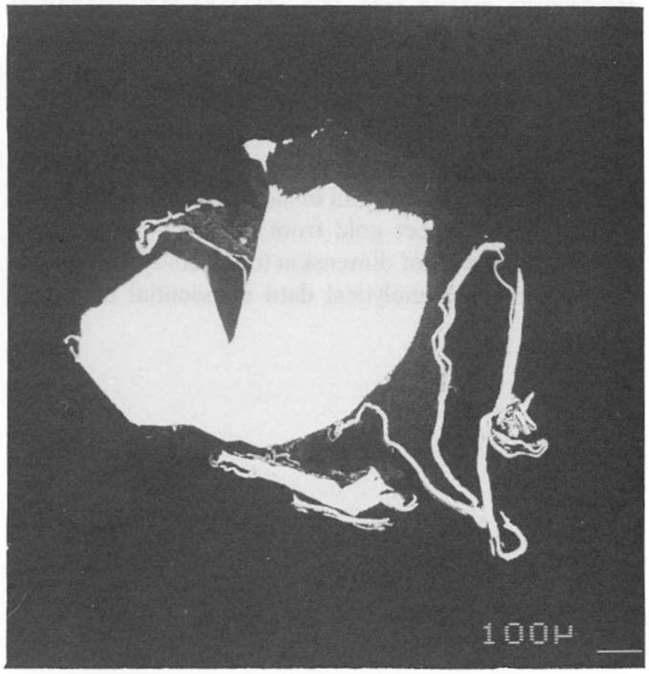


Plate 21. This gold grain is characterized by several sharply bounded crystal faces. However, fine filaments and platelets of gold are also associated with it. Both the platelets and the main grain have approximately the same composition.

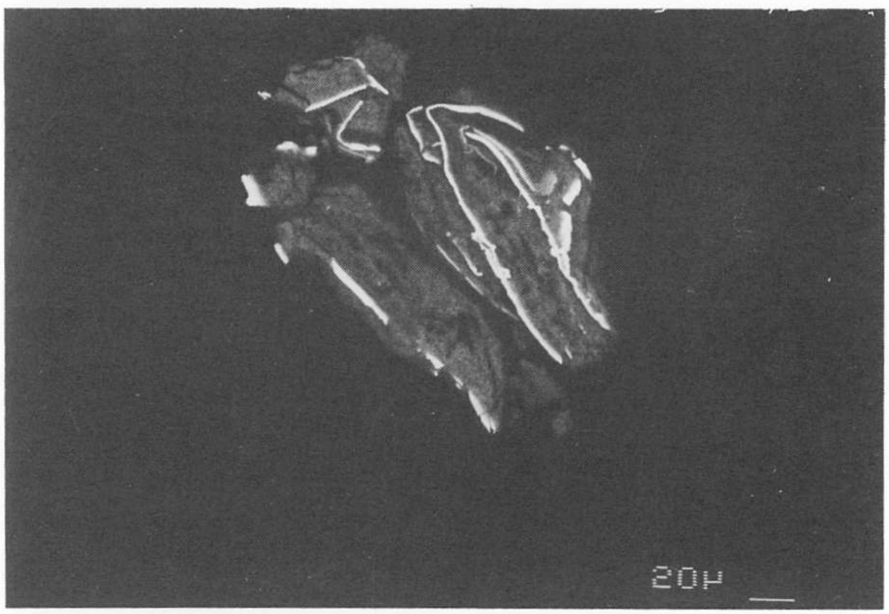


Plate 22. Backscatter electron image showing platelets of gold intergrown with limonite.

stockworks extend into the adjacent metasediments which may have been relatively less permeable and therefore more susceptible to brittle fracture.

The initial results of this study clearly indicate a need for more detailed analysis. Microprobe analysis of the samples already prepared will quantitatively determine the composition of the gold in each of the samples. Data on samples of placer gold from the area would add a potentially important dimension to the study. Incorporation of field and analytical data is essential to understanding the gold mineralization of the area, and being able to identify potential sources for the placer gold. Local sources for placer gold in the region have been postulated since early in this century. Johnston and Uglow (1926) examined the placer deposits in the historic Barkerville area, and concluded that the majority of the gold was locally derived. Coarsely crystalline, euhedral to subhedral forms characterize the Barkerville placers have also been recovered from the placers of the Spanish Lake area.

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FIGURE 5

PAPER 1990-3

GEOLOGY OF THE EUREKA PEAK - MacKAY RIVER AREA AND THE SPANISH LAKE AREA CENTRAL BRITISH COLUMBIA

NTS 93A/7, 11

BY MARY ANNE BLOODGOOD

(SEE BELOW FOR ADDITIONAL SOURCES OF DATA)

SCALE 1 : 50 000

KILOMETRES 0 1 2 3 4 KILOMETRES

LEGEND

RECENT

QUATERNARY

- Qal — Till, alluvium, colluvium

INTERMONTANE BELT

MESOZOIC

LATE TRIASSIC - EARLY JURASSIC

NICOLA GROUP

- JTRb — Massive porphyritic flows, breccia and tuff
- JTRa — Massive flows, agglomerates, ashflow tuffs, pillow basalts, mafic dikes and minor limestone

MIDDLE - LATE TRIASSIC

NICOLA GROUP

- TRd — Volcanic sandstone and wacke
- TRc — Volcaniclastic
- TRb — Banded slates and tuffs, minor fissile phyllites and limestone; V. = volcanic flows and tuffs
- TRa — Black phyllites
  - TRa6 — Graphitic black phyllites, with interbedded quartz sandstone and limestone
  - TRa5 — Silty slates
  - TRa4 — Laminated phyllite and porphyroblastic phyllite
  - TRa3 — Phyllitic siltstone
  - TRa2 — Micaceous black phyllite and tuff
  - TRa1 — Micaceous quartzite

PALEOZOIC

MISSISSIPPIAN - EARLY PERMIAN (?)

- Pca — Crooked Amphibolite: amphibole - chlorite schist, chlorite - epidote schist, ultramafic nodules

OMINECA BELT

PALEOZOIC

LATE DEVONIAN TO MIDDLE MISSISSIPPIAN

QUESNEL LAKE GNEISS

- QLG — Quartz feldspar gneiss, augen gneiss

PROTEROZOIC - E. PALEOZOIC

HADRYNIAN AND YOUNGER

SNOWSHOE FM

- HPa — Alkali feldspar augen gneiss
- HPs — Pelitic schist, minor quartzite
- HPsm — Sandy marbles layers and lenses
- HPu — Undifferentiated

SYMBOLS

Geological contact (observed, inferred or extrapolated)

Fault contact

Cross-cutting fault

Bedding (strike/dip)

Foliation

Primary metamorphic foliation (Omineca Belt)

Lineation (trend/plunge)

Axial trace of minor structures

Antiform

Synform

Overturned

Mineral Occurrences:

MINFILE No.	Property	Commodity
	Frasergold	Au, Ag, Cu, Zn, Pb
	Eureka Peak	Cu, Au
	CPW	Au, Pb, Zn

Based on British Columbia Ministry of Energy, Mines and Petroleum Resources MINFILE data.

Property	Commodity
Moose	Au, Ag, Cu, Pb, Zn
Trump	Ag, Pb
Providence	Ag, Pb, Au, Zn
Big	Ag, Pb, Au

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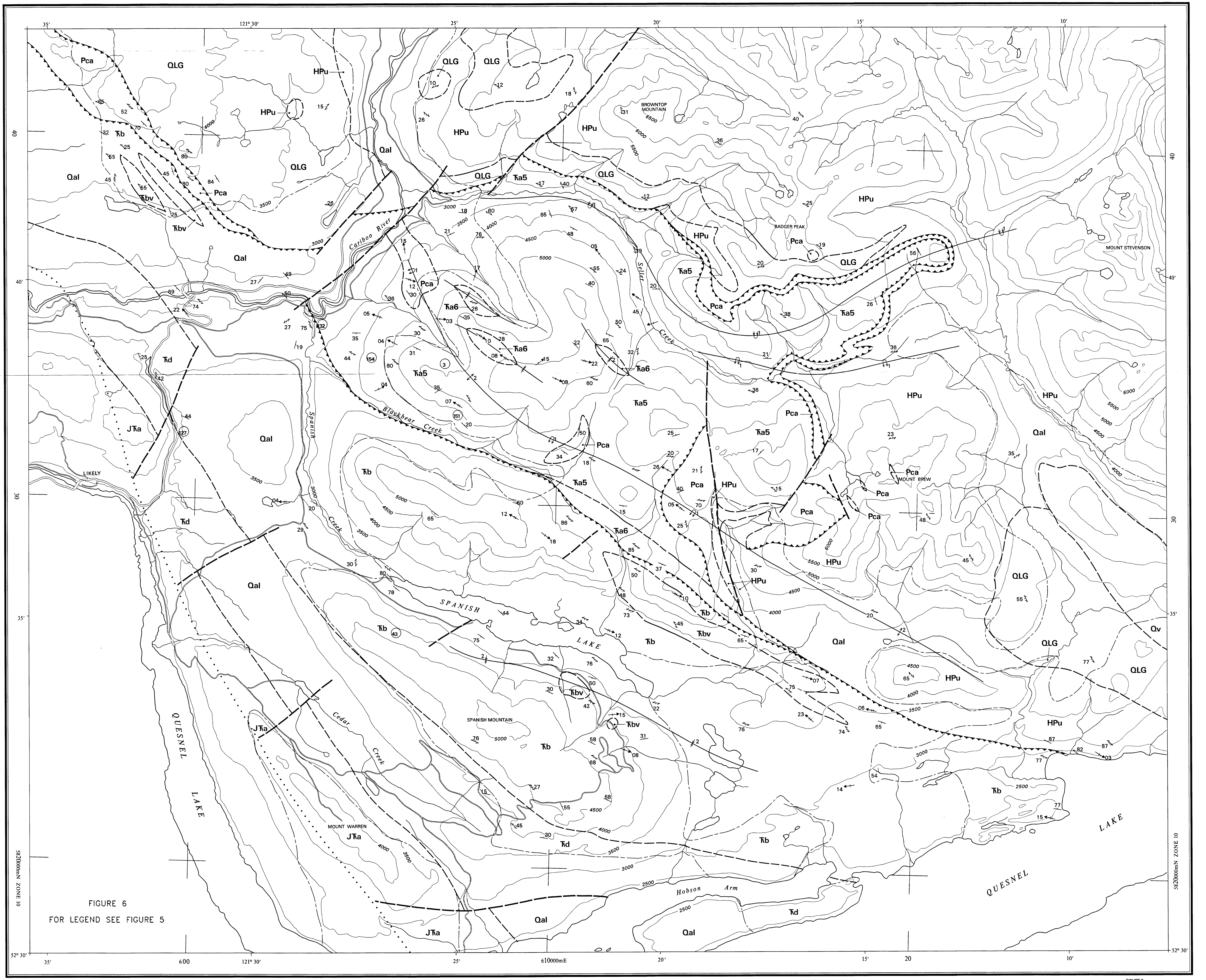

FIGURE 6
GEOLOGY OF THE SPANISH LAKE AREA, 93A/11
MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES
TO ACCOMPANY PAPER 1990-3
GEOLOGY OF THE EUREKA PEAK - MACKAY RIVER AREA
CENTRAL BRITISH COLUMBIA
NTS 93A/7
BY MARY ANNE BLOODGOOD