GEOLOGY AND MINERAL POTENTIAL OF THE WARNER PASS MAP SHEET* (92O/3)

By J. K. Glover and P. Schiarizza

INTRODUCTION

The Warner Pass map area is located 185 kilometres north of Vancouver on the northeastern margin of the Coast Mountains. It covers an area of 980 square kilometres within the Chilcotin Range, and is characterized by rugged mountains and glaciated U-shaped valleys; elevations vary from 1500 metres to over 3000 metres, with a treeline at about 1800 metres.

The sheet was mapped at a scale of 1:20 000 by a four-person field crew during the 1986 field season. Particular attention was paid to zones of alteration and mineralization; approximately 120 rock samples were collected for trace element analysis.

This report covers the first phase of a regional mapping program designed to be completed in four years and to provide 1:50 000-scale geological maps and mineral potential overlays to aid exploration in the Taseko-Bridge River area.

REGIONAL GEOLOGY

The study area is part of an extensive northwest-trending belt of Middle Triassic to Upper Cretaceous sedimentary and volcanic rocks along the northeast margin of the Coast Plutonic Complex (Figure 3-4-1). Middle Jurassic to Upper Cretaceous strata within this belt are thought to have been deposited in a narrow northwest-trending basin, the Tyaughton trough, that was bounded by intermittently uplifted and eroded landmasses to the northeast and southwest (Jeletzky and Tipper, 1968). This basin evolved from marine to nonmarine conditions in mid-Cretaceous time, during uplift of the Coast Mountain suprastructure to the southwest (Kleinspehn, 1985).

Tectonic reconstruction of the southern Canadian Cordillera indicates that the Tyaughton trough was once continuous with the Methow basin (Figure 3-4-1). It has been offset by at least 70 kilometres of right-lateral strike-slip movement along the north-trending Fraser-Straight Creek fault system during Late Cretaceous (?)-Early Tertiary time (Monger, 1985). Earlier, post-Albian fragmentation of the basin occurred along the northwest-trending Yalakom-Hozameen fault system, along which up to 175 kilometres of right-lateral offset has been postulated in the vicinity of the study area (Kleinspehn, 1985). The Yalakom fault crosses the extreme northeastern corner of the map area, from where it has been traced to the northwest, west of Taseko Lakes and into the Chilko Lake area (Tipper, 1969, 1978; McLaren, 1986).

Mesozoic strata of the Tyaughton trough are intruded by mid-Cretaceous quartz diorite to quartz monzonite of the Coast Plutonic Complex (McMillan, 1976) and by equigranular and porphyritic granitic stocks of probable late Cretaceous and Eocene age (Tipper, 1978); they are unconformably overlain by Eocene volcanic and sedimentary rocks and by Miocene basalt.

GENERAL GEOLOGY

Figure 3-4-2 shows the generalized geology of the Warner Pass map sheet. Stratified sedimentary and volcanic rocks have been divided into eight units on the basis of lithological characteristics. Previous mapping of the Taseko Lakes sheet (92O) by Tipper (1978) and regional correlations and biostratigraphy (Tozer, 1967; Jeletzky and Tipper, 1968) have been used to correlate these units, wherever possible, with regionally extensive and formally recognized stratigraphic units. Intrusive rocks shown in Figure 3-4-2 have been divided into four lithologically distinct suites. A limited amount of data from assessment reports has been incorporated into this map in order to supplement our field data.

The dominant structural trend in the area is northwesterly and is reflected by the major faults, folds, bedding attitudes and, in general, the margin of the Coast Plutonic Complex. Spectacular alteration zones, commonly associated with intrusive rocks and fault zones, are locally anomalous in gold and associated elements.

LITHOLOGY

SEDIMENTARY AND VOLCANIC ROCKS

UNIT 1

This unit is equivalent to the lower part of the Tyaughton Group and is of Norian (Upper Triassic) to Hettangian (Lower Jurassic) age (Tipper, 1978). It has a total thickness of 240 metres in a section exposed on the ridge northwest of Castle Peak, immediately east of the map area (Tozer, 1967, page 77,). This section is part of a structurally complex panel, located north of Tyaughton Creek, along the eastern margin of the map area. Here, Unit 1 comprises red-weathering interbeds of conglomerate with volcanic clasts, conglomeratic sandstone and sandstone at the base, overlain by light grey to buff-weathering, massive to thickly bedded limestone with corals. This is in turn overlain by limestone conglomerate with a sandy matrix. The upper part of the succession has a green-weathering grit with conglomeratic seams containing volcanic clasts, overlain by green sandstone containing *Cassianella lingulata* (the "Cassianella beds" of Tozer, 1967) and, at the top, green sandstone and conglomeratic sandstone with pebbles of volcanic rock. In the Castle Peak area, 2.5 kilometres to the east, these uppermost beds contain ammonites of latest Triassic and earliest Jurassic age (H.W. Tipper, personal communication, 1986).

A small klippe, comprising upright, crossbedded grey-green sandstone and conglomeratic sandstone of probable Unit 1, occurs at the top of the cliffs east of Lorna Lake (Figure 3-4-2), where it structurally overlies an overturned turbidite sequence assigned to Unit 2.

UNIT 2

This unit is thought to be equivalent to the basal part of the Relay Mountain Group, designated as Middle Jurassic (mid-Callovian (?) to Lower Oxfordian) by Jeletzky and Tipper (1968, page 14,) who estimated its thickness to be 300 to 600 metres. Northeast of Tyaughton Creek it is dominated by recessive, dark grey to black shales with minor thin siltstone and reddish brown, internally laminated calcarenite interbeds. Thin to medium-bedded greywacke, grit and pebble conglomerate containing aphanitic felsic volcanic

---

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

British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1986, Paper 1987-1.

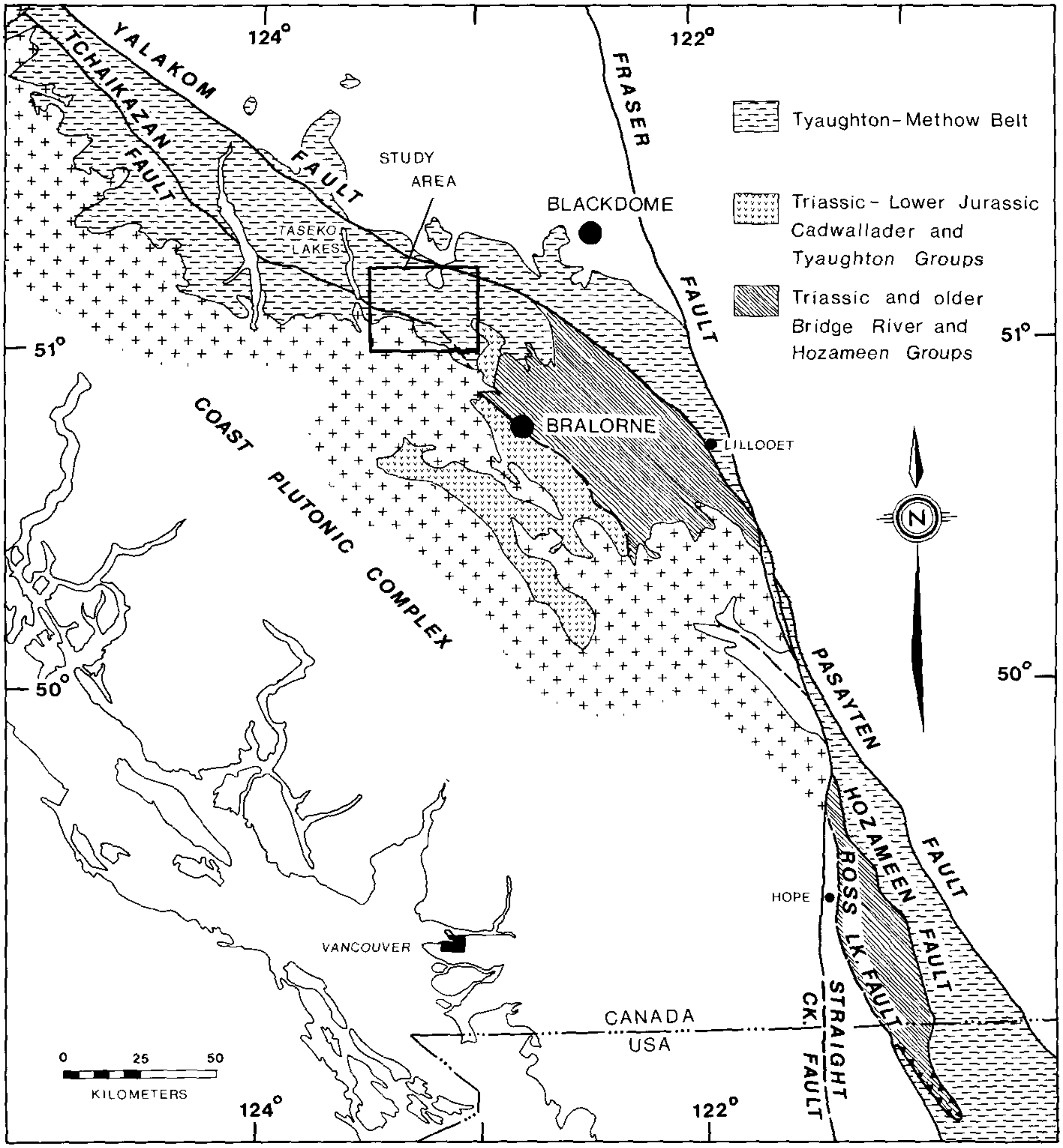


Figure 3-4-1. Location and geological setting, Warner Pass map sheet.

and/or chert clasts occur locally. These rocks exhibit channel crossbedding in places. This unit tends to be rusty weathering close to intrusions. Exposures in the vicinity of Lorna Lake, at the head of Big Creek, have been tentatively included within this unit. Here, greywacke, sandstone and siltstone turbidite interbeds are intercalated with minor dark grey to black shales. A collection from an apparently new fossil locality, east of Lorna Lake, may help to determine the validity of this correlation.

UNIT 3

This unit includes Upper Oxfordian (Upper Jurassic) to Barremian (Lower Cretaceous) argillaceous clastic rocks of the Relay Mountain Group (Jeletzky and Tipper, 1968). It is characterized by the abundance and excellent preservation of buchias, belemnites and, to a lesser extent, ammonites. Jeletzky and Tipper have divided the Relay Mountain Group into 16 fossil zones that demonstrate a period of continuous sedimentation throughout its deposition. This unit is well exposed east of Big Creek, but also occurs as isolated inliers west of the creek, in the central part of the area. The unit comprises a thick sequence of dark grey shale, rusty brown-weathering grey-brown siltstone, greenish grey greywacke and lithic sandstone, grit and thin conglomerate interbeds with well-rounded granitic and sedimentary clasts. Minor thin limy interbeds and concretions occur in places. Individual beds or sequences of beds are laterally discontinuous, facies changes are common and there are no obvious markers that can be traced for any distance. Hence the importance of fossil zones, as stressed by Jeletzky and Tipper (1968).

UNIT 4

This unit is equivalent to the Taylor Creek Group of Aptian to Albian (Early Cretaceous) age (Jeletzky and Tipper, 1968). The most extensively exposed areas of this unit occur east of Big Creek, but critical exposures are distributed throughout the northwestern part of the study area, where it occurs below a marked angular unconformity separating it from overlying strata of Unit 6. The unit is characterized by variable proportions of recessive dark grey to black shale, resistant, medium to thickly bedded siltstone and sandstone, and poorly bedded chert-pebble conglomerate. Sedimentary structures and invertebrate fossils indicate that these beds were deposited by turbidity currents under marine conditions. Lenses of massive conglomerate with subrounded to subangular volcanic cobbles and boulders of felsic to intermediate composition occur locally (Plate 3-4-1). Slump structures that contort bedding in the underlying argillites show that the conglomerates were deposited by mass flow processes. Felsic to intermediate volcanic and volcaniclastic rocks are intercalated with shale and siltstone of Unit 4 at two localities west of Big Creek.

UNIT 5

Unit 5 comprises sandstone, shale and conglomerate which outcrop within a tight northwest-trending syncline east of Big Creek (Figure 3-4-2). It is stratigraphically underlain by chert-pebble conglomerate and shale of Unit 4, although the contact was not observed and its nature is not currently known. Approximately 700 to 800 metres (top not exposed) of Unit 5 strata occur within the syncline. Brown-weathering grey to green sandstone is the dominant lithology. It is generally feldspathic and characteristically contains 1 to 2 per cent mica (muscovite + biotite). Wood fragments and carbonaceous patches were observed locally. Beds range from several tens of centimetres to several metres in thickness, but are not always well defined. Commonly the sandstone is intercalated with dark grey, friable shale, which dominates local portions of the section.

Granule to pebble conglomerate within Unit 5 occurs as crudely stratified layers containing laterally discontinuous intercalations of sandstone and shale. The clasts are dominantly chert and intermediate feldspar-phyric volcanic rocks, and also include granitic rocks, fine-grained clastic sediments and quartz. The sandy matrix is typically feldspathic and locally micaceous. A 5-metre-thick conformable sheet of dark brown-weathered hornblende-phyric andesite was noted within Unit 5 near the top of the exposed section; whether this represents a volcanic flow or a sill is uncertain.

Unit 5 is included within the lowermost sedimentary portion of Tipper's Kingsvale Group (1978), which also included Unit 6a of this report, and is assigned an Albian to Cenomanian age on the basis of plant fossils (Jeletzky and Tipper, 1968). It is treated separately here because its relationship to the underlying Unit 4 rocks, and to Unit 6 which rests unconformably on Unit 4 elsewhere in the area, has not yet been established. This problem will be addressed during the 1987 field season.

UNIT 6

Unit 6 comprises volcanic, volcaniclastic and clastic sedimentary rocks of latest Albian (?) (mid-Cretaceous) to late Cenomanian (Late Cretaceous) age, which were assigned to the Kingsvale Group by Jeletzky and Tipper (1968). It is the most extensively exposed stratigraphic unit within the area and occurs in three adjacent belts separated by west-northwesterly trending faults. Within the northern belt, Unit 6 rocks extend from the northwest corner of the map area, north of Chita Creek, eastward to Big Creek. Unit 6 rocks of the central belt extend the full width of the map area, from the ridges north of the lower Taseko River eastward to Mount Sheba. These rocks are bounded on the north by a normal fault, downthrown to the south, and by the Tchaikazan fault to the south.

The southern belt lies between the Tchaikazan fault and the Coast Plutonic Complex to the south. Underlying rocks are exposed in the northern belt and at the east end of the central belt; in these areas Unit 6 is seen to overlie Unit 4 and older rocks with pronounced angular unconformity (Plate 3-4-2). Unit 6 is overlain by Eocene and Miocene rocks (Units 7 and 8) in the northern and central belts and is intruded by granodiorite of the Coast Plutonic Complex in the southern belt.

Within the western part of the central belt, from the west boundary of the map sheet eastward to Denain Spur and Dorrie Peak, Unit 6 has been subdivided into three units. It comprises a sequence of clastic sediments and epiclastic rocks (Unit 6a), overlain by volcanic breccia, tuff and basaltic to andesitic flows (Unit 6b), in turn overlain by laharic breccias intercalated with bedded tuffs and epiclastic sediments (Unit 6c). This threefold subdivision seems to apply further east, in the vicinity of Lizard Lake and Mount Sheba, where a sedimentary interval, equivalent to 6a, occurs at the base of the unit. Epiclastic rocks, which may be equivalent to the lower part of Unit 6c, outcrop locally on ridge tops south of Lizard Lake, but are too thin to be shown on the accompanying sketch map; Unit 6 in this area, comprising mainly Unit 6b, is shown as undivided.

In the northern belt the basal sedimentary interval (6a) is absent in all the localities where the lower contact of Unit 6 is exposed. The bulk of Unit 6 in this area is lithologically similar to Unit 6b, although epiclastic rocks similar to those of Unit 6c occur locally. Unit 6 rocks of the southern belt, adjacent to granitic rocks of the Coast Plutonic Complex, are generally lithologically similar to Unit 6b of the central belt.

Unit 6a

Unit 6a consists of sandstone, conglomerate, shale and bedded tuff which comprise the lowest exposed element of Unit 6 along lower Powell Creek and adjacent portions of the Taseko River valley (Figure 3-4-1). An estimated 300 metres (base not seen) of incompletely exposed strata are represented by outcrops in this area. The interval is dominated by well-bedded sandstone, tuffaceous sandstone, and ash to fine lapilli tuff, in medium to dark shades of

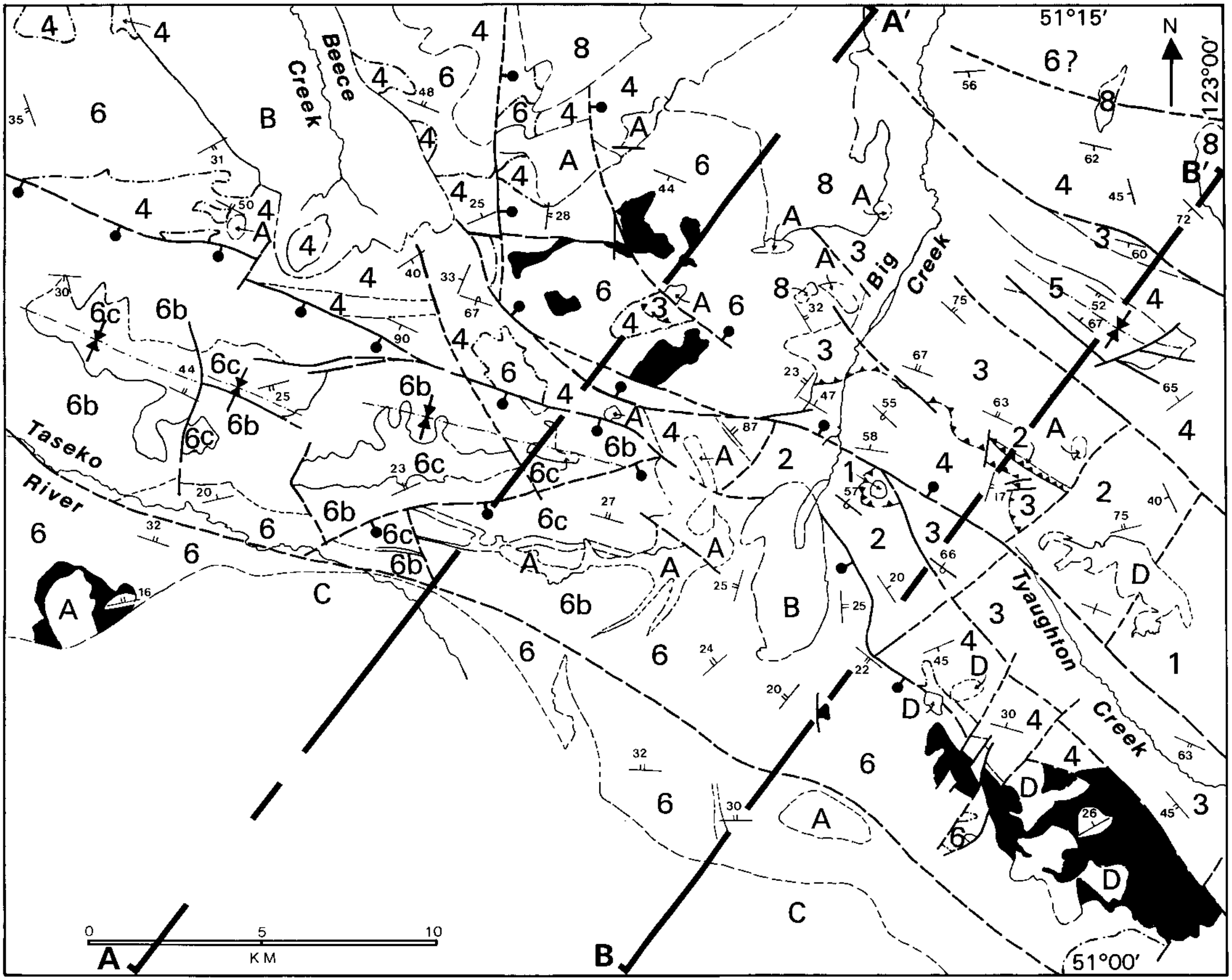
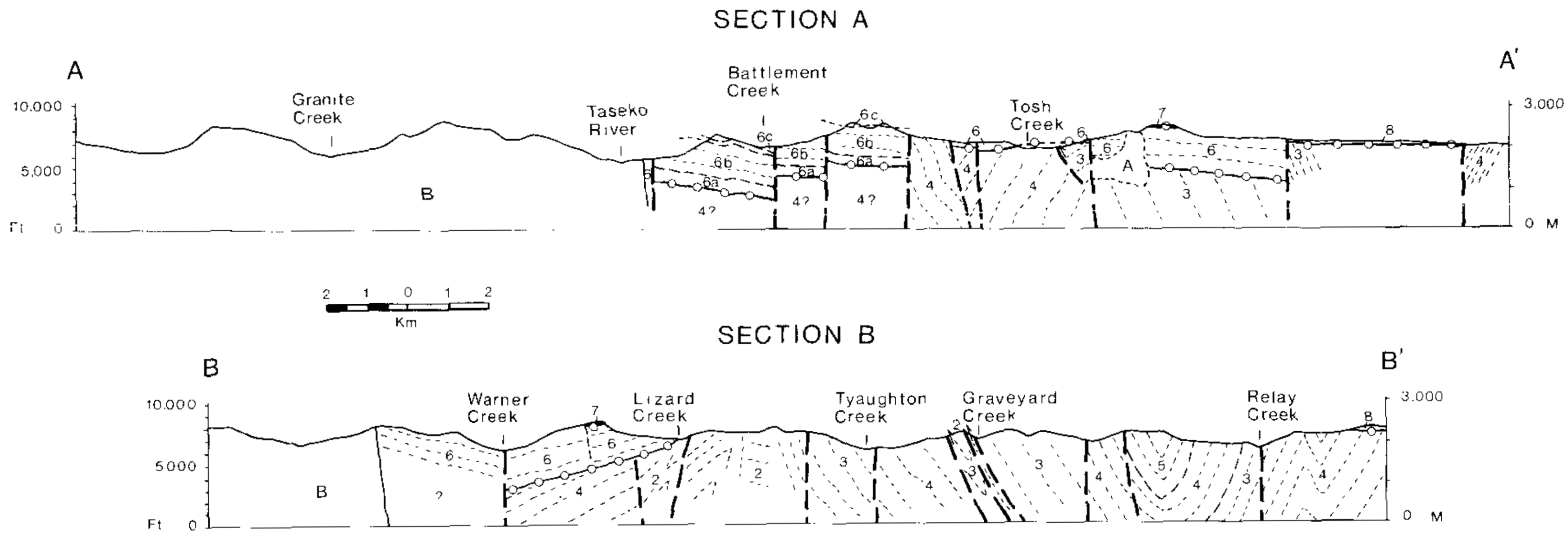


Figure 3-4-2. Geology map and cross-sections (facing page), Warner Pass map sheet.



LEGEND

MIOCENE	
8	*Plateau lava, basalt flows*
EOCENE (?)	
■	*Rhyolite, dacite and basalt flows, pyroclastic rocks and volcanic sediments*
UPPER CRETACEOUS	
6c	*Bedded laharic andesitic breccia and epiclastic sediments*
6b	*Andesitic breccia, lapilli tuff, crystal tuff and ash tuff, with minor andesitic to basaltic flows*
6a	*Volcanic sandstone and conglomerate; polymict conglomerate*
6	*Undivided; mostly Unit 6b with subordinate Unit 6a*
5	*Micaceous sandstone, shale and polymict conglomerate*
LOWER CRETACEOUS	
4	TAYLOR CREEK GROUP *Argillite, siltstone, sandstone; chert pebble conglomerate and volcanic conglomerate*
4	*Dacitic to andesitic flows and volcaniclastic rocks; interbedded with shale and siltstone*
MIDDLE JURASSIC TO LOWER CRETACEOUS	
3	RELAY MOUNTAIN GROUP *UPPER JURASSIC TO LOWER CRETACEOUS: Dark grey shale, grey-brown siltstone, green-grey greywacke and lithic sandstone; grit and conglomerate*
2	*MIDDLE JURASSIC: Interbedded shale, siltstone and calcarenite; greywacke, grit and conglomerate*
UPPER TRIASSIC TO LOWER JURASSIC	
1	TYAUGHTON GROUP *Massive limestone; red conglomerate; grit and conglomerate interbedded with green sandstone and shale*
INTRUSIVE ROCKS	
D	*Equigranular quartz monzonite to granodiorite*
C	*Hornblende plagioclase biotite porphyries with accessory quartz*
B	*Coast Plutonic Complex: quartz diorite to quartz monzonite*
A	*Hornblende plagioclase porphyries*

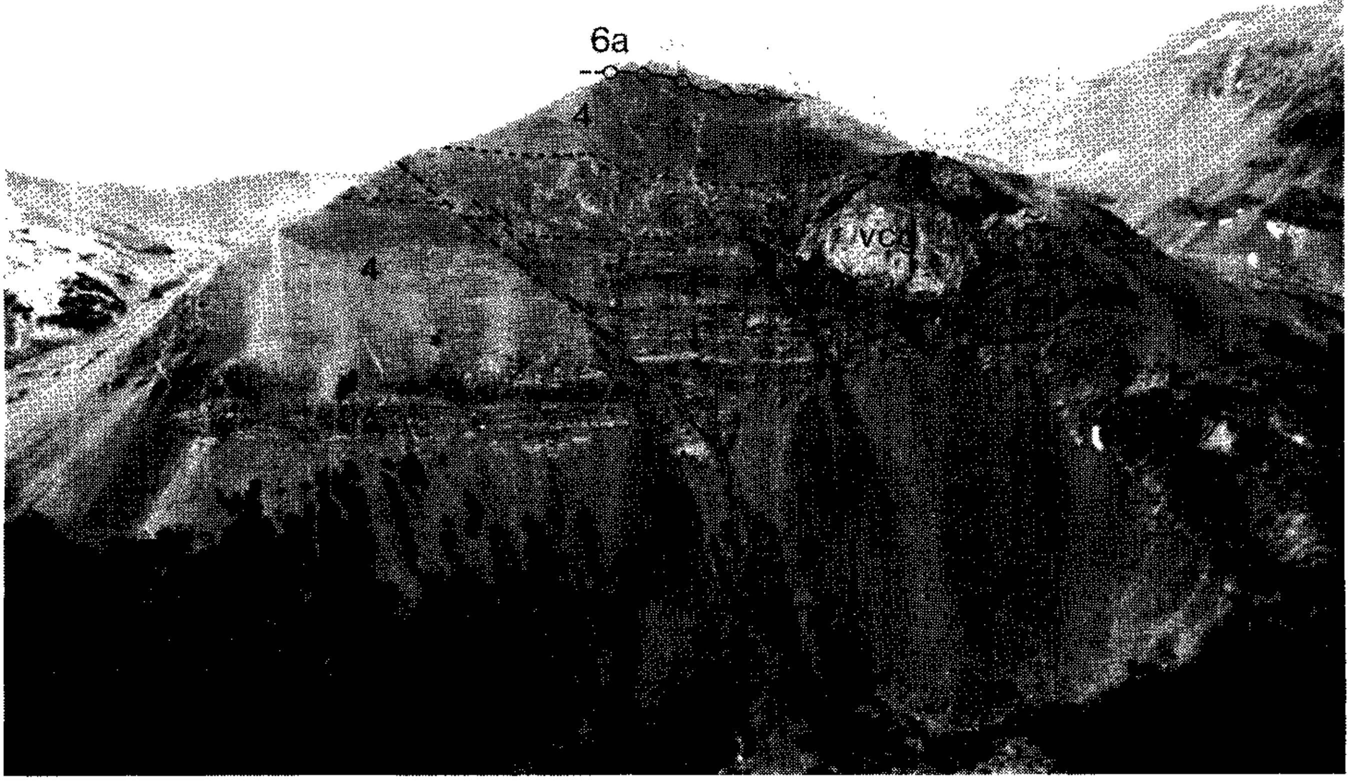


Plate 3-4-1. Slumped volcanic conglomerate interbed within argillaceous and arenaceous turbidite sequence of Unit 4; probable synsedimentary faults below the conglomeratic layer. Angular unconformity between Unit 4 and overlying polymict conglomerate of Unit 6a exposed at the top of the section, north-facing cliff section southeast of Lizard Creek.

grey, purplish grey and green. Dark grey carbonaceous shale is intercalated with the coarser clastic rocks. Pebble to boulder conglomerate occurs locally and contains mainly intermediate volcanic clasts, together with clasts of chert and fine-grained clastic sediments. Plant fragments are present in sandstone and shale and several collections have been made for paleontological analysis.

The sedimentary interval at the base of Unit 6 in the vicinity of Lizard Lake and Mount Sheba ranges up to 150 metres thick and comprises mainly conglomerate intercalated with micaceous sandstone and shale. The conglomerates vary from well-bedded pebble conglomerates to massive, poorly sorted boulder conglomerates; locally they include substantial intervals of micaceous grit containing quartz, feldspar and chert clasts. The coarse conglomerates contain mainly siltstone, sandstone (locally buchia-bearing) and intermediate volcanic clasts. Chert is usually present, but is subordinate. Locally, there is a definite progression from bedded conglomerate containing mainly sedimentary clasts at the base, upwards into massive, poorly sorted volcanic-clast conglomerate, and finally into volcanic breccia of Unit 6b. In the vicinity of Lizard Lake two ash flow tuff units, one more than 20 metres thick, occur within the upper part of the sedimentary interval.

Unit 6b

Unit 6b consists of volcanic breccia and lapilli tuff intercalated with subordinate finer-grained tuff and basaltic to andesitic flows. The unit is approximately 750 metres thick in the vicinity of Powell Creek, where both upper and lower contacts are exposed.

The breccias which characterize Unit 6b are massive, unsorted rocks comprising angular to subrounded fragments in a fine tuffaceous matrix. The clasts are mainly grey, green and purple hornblende-feldspar porphyry. The breccias vary from matrix to clast supported; clasts range up to 1 metre in size. Finer grained ash and lapilli tuffs occur sporadically within the coarser breccias and may dominate intervals several tens of metres thick. Beds of fine-grained well-bedded tuff or epiclastic sandstone, rarely more than a few metres thick, are present locally.

Volcanic flows locally comprise 20 to 30 per cent of Unit 6b, but in some sections are entirely absent. The flow rocks are mainly hornblende porphyritic andesites, similar in appearance to clasts in the volcanic breccias with which they are intercalated.

A distinctive rusty-brown-weathering, dark grey basalt, typically with feldspar and clinopyroxene phenocrysts, occurs at the top of the unit along the south side of Battlement Ridge. Similar basalt flows are common along the ridge system south of Lizard Lake, where they also underlie bedded tuffs and epiclastic sediments which may be equivalent to Unit 6c.

Unit 6c

Unit 6c consists mainly of volcanic breccia, lapilli tuff and epiclastic sediments. It lies above Unit 6b on the ridges north of the

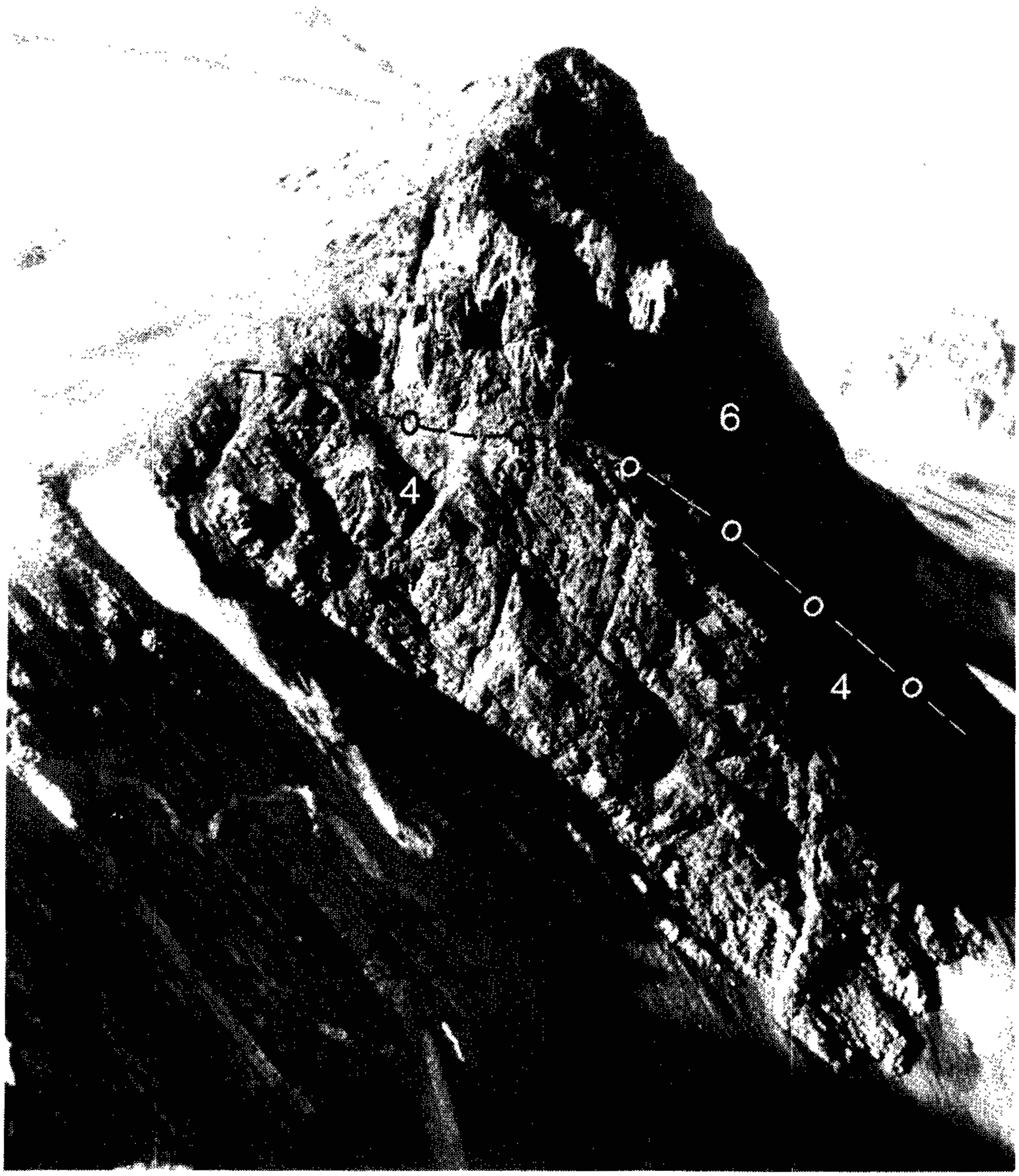


Plate 3-4-2. Angular unconformity between well-bedded turbidites of Unit 4 and overlying volcanic breccias and flows of Unit 6, 3 kilometres north of Mount Vic.

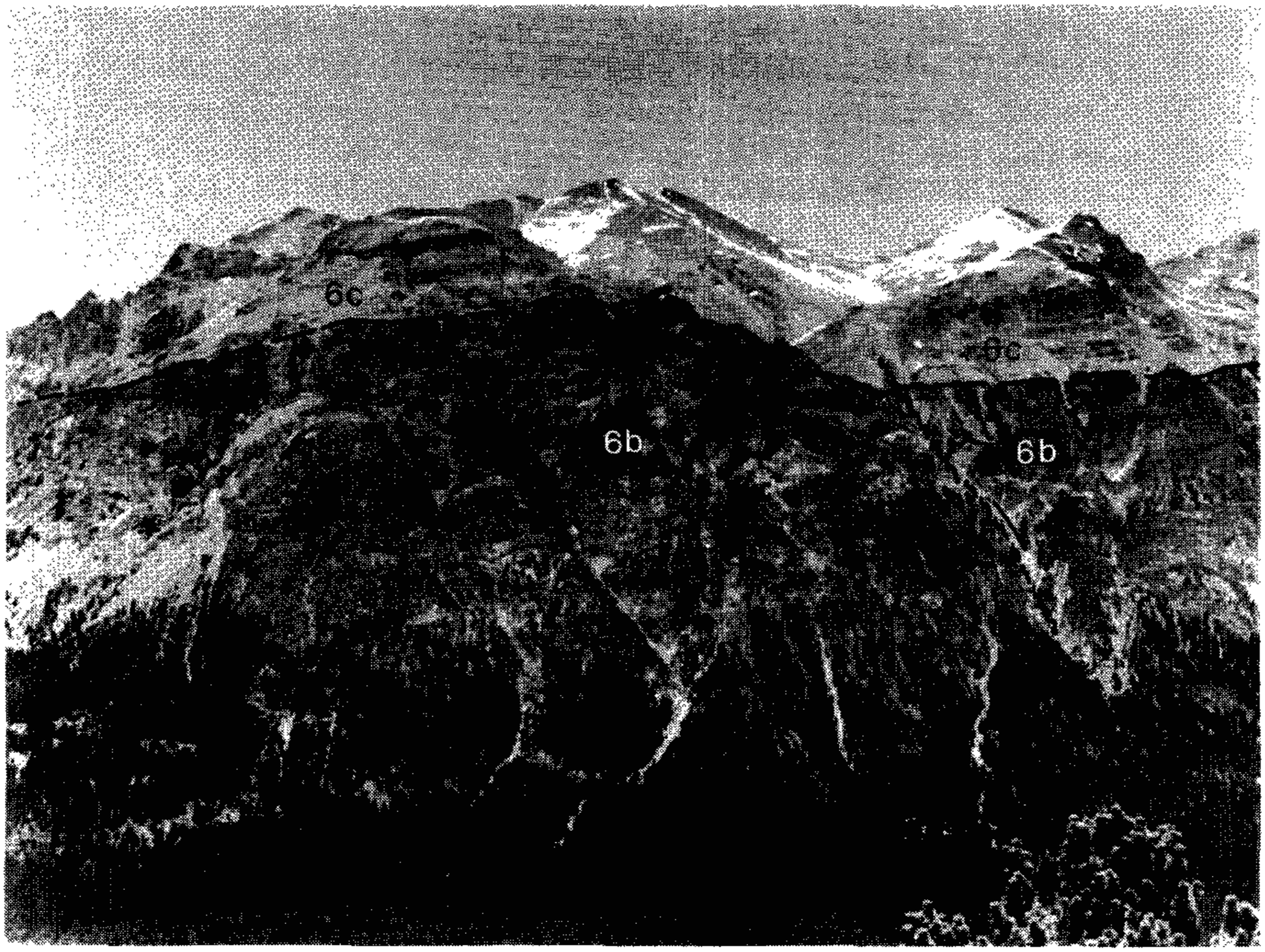


Plate 3-4-3. Massive to poorly bedded volcanic breccia with minor flows (Unit 6b) overlain by interbedded laharic breccia and epiclastic sediments (Unit 6c), south-facing cliffs of unnamed ridge north of Taseko River and Powell Creek.

Taseko River, where intercalation of recessive bedded tuffs and sediments with massive, resistant breccia give the unit a distinctive bedded aspect that contrasts markedly with the underlying massive breccias of Unit 6b (Plate 3-4-3). The top of the unit is not seen; the maximum exposed thickness is about 800 metres, on the north side of Rae Spur.

The breccias which dominate Unit 6c are in large part similar to those of Unit 6b but, particularly near the base, include intervals with a high proportion of rounded clasts. Hornblende-feldspar porphyry volcanic clasts predominate and are accompanied mainly by aphyric intermediate volcanics and rare clasts of quartz porphyry rhyolite. Intervals of purple, grey or green, well-bedded lapilli tuff occur throughout the unit and range from less than a metre to several tens of metres in thickness. Epiclastic sediments comprising volcanic sandstone and conglomerate that locally exhibit channel crossbeds and graded bedding occur mainly near the base of the unit. Plant fossils collected from a sedimentary interval south of Battlement Ridge are of Late Cretaceous age (Price, 1986). Flow rocks are rare in Unit 6c, although at least one porphyritic hornblende andesite flow occurs within it on the south side of Battlement Creek.

Unit 6 (Undivided)

Rocks assigned to Unit 6 (undivided) comprise mainly volcanic breccia similar to that of Unit 6b. On Denain Spur however it includes a thick sequence of well-stratified crystal-lithic tuffs. Epiclastic sediments and well-bedded tuffs occur locally near the top of the unit south of Lizard Lake, on Cluckata Ridge, and on the ridges west of the Dil-Dil Plateau. They may correspond to the lower part of Unit 6c. Volcanic boulder conglomerate with intercalations of epiclastic sandstone occurs within the unit on the north side of Powell Pass. Basaltic and andesitic flows are of only local importance, but dominate the unit directly west of the Dil-Dil Plateau. Flows, including rusty-brown-weathering porphyritic clinopyroxene basalt similar to that at the top of Unit 6b on Battlement Ridge, are also common to the southwest of Taseko Mountain.

UNIT 7

Unit 7 comprises volcanic and sedimentary rocks of probable Eocene age that unconformably overlie Unit 6 and older rocks (Plate 3-4-4). The unit occurs in two separate areas; it outcrops for approximately 10 kilometres along a northwest-trending ridge system centred at Mount Sheba and in the north-central part of the map area, where it occurs as several outliers on Cluckata Ridge and Dil-Dil Plateau.

In the Mount Sheba area, Unit 7 comprises dacitic rocks overlain by basalt and basaltic breccia, and is extensively intruded by porphyries of Unit C that are probably subvolcanic in character (*see* following). The lower part of the unit is characterized by purple to grey, locally flow-banded dacite with small feldspar and hornblende

Plate 3-4-4. Angular unconformity at the base of Unit 7; laterally discontinuous horizons of epiclastic sediments (7s), volcanic flows (7v) and pyroclastic rocks (7p) exposed above the unconformity, southern slopes of Cluckata Ridge.

phenocrysts in places, intercalated with dacitic breccias of both autoclastic and pyroclastic origin, quartz-eye rhyolite flows that are locally glassy, and lenses of pebble conglomerate and sandstone. Directly south and west of Mount Sheba this dacitic section is missing and is replaced by a poorly sorted boulder conglomerate, mainly comprising well-rounded granite and hornblende-feldspar porphyry clasts in a sandy matrix of quartz, biotite and feldspar. The upper part of the unit comprises basaltic flows, typically several metres thick, with associated flow breccias. These rocks contain clinopyroxene phenocrysts in places and are sparsely vesicular and/or contain quartz amygdules. Coarse epiclastic (?) rocks with well-rounded clasts of basalt, up to 20 centimetres in diameter, are locally intercalated with the flows.

In the north-central part of the map sheet an irregular, but generally flat-lying, angular unconformity separates volcanics and volcanic breccias of Unit 6 from the overlying volcanic and volcaniclastic rocks assigned to Unit 7. Here, this unit comprises dark brown-weathering, medium grey columnar-jointed feldspar and quartz-feldspar porphyritic flows intercalated with light grey porphyritic flows containing quartz and minor feldspar phenocrysts; pink to grey, quartz-bearing crystal tuffs; and pyroclastic (?) breccias containing aphyric to feldspar-phyric volcanic fragments and rare clasts of flow-banded quartz porphyry rhyolite. The base of the unit is commonly marked by an interval of light grey to greenish grey, channel-bedded medium to coarse-grained epiclastic sediments, locally associated with thinly parallel-bedded to laminated ash tufts and tuffaceous shales. Sandstone and shale interbeds are rare elsewhere in the unit. Plant fragments occur locally within the sedimentary rocks and were sampled for paleontological analysis.

An interval of felsic rocks which outcrops near the west boundary of the map area, south of the Taseko River, is tentatively included in Unit 7, but lithologic features are largely obscured by alteration. However, rocks within this area do include feldspar and quartz-bearing tuffs and flow-banded rhyolite similar to lithologies observed elsewhere in Unit 7.

UNIT 8

Miocene plateau basalts of Unit 8 unconformably overlie older rocks in the north-central and northeastern parts of the study area. They outcrop extensively on the Dil-Dil Plateau immediately west of Big Creek, where the maximum exposed thickness is about 150 metres. The basal flows locally lap onto paleo-hills comprising older porphyritic intrusions. However, in general the pre-Miocene erosional surface appears to have been gently undulating with perhaps a very shallow (up to 5 degrees) dip toward the northeast. The most southwesterly exposures of Unit 8 occur as an isolated outlier above the 2600-metre elevation at the head of Tosh Creek, 5.5 kilometres southwest of the Dil-Dil Plateau. Flows are columnar jointed and typically 2 to 3 metres thick, comprising markedly vesicular fine-grained basalt with well-preserved pahoehoe texture in places.

INTRUSIVE ROCKS

UNIT A — HORNBLENDE PLAGIOCLASE PORPHYRIES

The four largest stocks of this composition that occur within the study area are: the Dorrie Peak stock, 3 kilometres west of Big Creek; the Vic Lake stock in the northern part of the area; the Warner Lake stock in the southeastern part of the area; and the stock north of Mount McClure, 3 kilometres south of the Taseko River. All four stocks comprise aphanitic rocks with variable proportions of plagioclase and hornblende phenocrysts. Porphyry locally grades into equigranular medium-grained diorite in the Dorrie Peak stock. All have undergone varying degrees of chlorite-epidote alteration. Some smaller hornblende plagioclase porphyry stocks appear to be more felsic in composition and locally have iron carbonate alteration associated with them. These two possibly distinct suites may be respectively, late Cretaceous and Eocene in age.

UNIT B — QUARTZ DIORITE TO QUARTZ MONZONITE OF THE COAST PLUTONIC COMPLEX

Rocks of Unit B, comprising the northeastern margin of the Coast Plutonic Complex, cover an extensive area in the southwestern part of the map area where they intrude Unit 6. They comprise coarse to medium-grained, generally equigranular quartz diorite to quartz monzonite, with partially chloritized subhedral biotite and hornblende in variable proportions. They are commonly crosscut by hornblende feldspar porphyry dykes that appear to form the locus of alteration zones, particularly along the margin of Unit B.

Middle to Late Cretaceous dates (84.7 to 86.7 ± 2.5 million years) have been obtained by potassium-argon radiometric dating on biotite separates from granodiorite and from a crosscutting dyke, located at the Mohawk showing, near Granite Creek south of the Taseko River (McMillan, 1976). Another potassium-argon date published by McMillan, on sericite from an alteration zone at this locality, falls within the same age range. These are the only radiometric dates so far published from rocks of the Warner Pass map sheet. However, Unit B rocks are included within a regionally extensive belt of Early Tertiary intrusive rocks on the 1:1 000 000 Fraser River map sheet (Roddick *et al.*, 1979). A radiometric dating program will be initiated during the 1987 field season in order to address this and other problems.

UNIT C — HORNBLENDE PLAGIOCLASE BIOTITE PORPHYRIES WITH ACCESSORY QUARTZ

These rocks occur as two groups of small stocks of irregular shape in the Mount Sheba area and on the ridge northeast of Tyaughton Creek. They contain hornblende, plagioclase and biotite phenocrysts in variable proportions in an aphanitic leucocratic matrix. Stocks in the Mount Sheba group typically contain quartz phenocrysts. Rhyolitic and dacitic flows and pyroclastics of Unit 7, particularly voluminous in the Mount Sheba area, are intruded by and locally are in fault contact with both groups. The stocks are therefore interpreted as volcanic centres of probable Eocene age.

UNIT D — EQUIGRANULAR QUARTZ MONZONITE TO GRANODIORITE

These plutonic rocks occur in two intrusive bodies: the Beece Creek pluton in the northwest part of the area and the Lorna Lake stock at the head of Big Creek. They comprise fine to medium-grained equigranular quartz monzonite to granodiorite with partly chloritized biotite and/or hornblende.

A prominent roof pendant of Unit 4 in the southwestern part of the Beece Creek pluton demonstrates that, at least here, the present erosion level is close to the top of the intrusion. The southwestern and northeastern contacts of this stock are vertical to steeply dipping with a relatively uniform northwest strike and may have been controlled by pre-intrusive high-angle faults.

Both intrusions locally crosscut the hornblende plagioclase porphyries of Unit A and may be Tertiary in age.

DYKES

A wide variety of narrow, north to northwest-trending dykes occurs throughout the map area. The most common are quartz-feldspar and quartz porphyries, hornblende-feldspar porphyry and aphyric felsite. Felsic varieties commonly have clay alteration, sericitization, and/or iron-carbonate alteration along them, whereas hornblende-feldspar porphyry dykes typically show chlorite-epidote alteration. Diabase and basalt dykes are the least common and are usually unaltered.

STRUCTURE

OVERVIEW

The overall structural pattern in the area is dominated by northwest-trending high-angle normal and reverse faults.

A pronounced angular unconformity, well exposed at several localities in the northwest quadrant of the map sheet, separates Upper Cretaceous (Cenomanian?) nonmarine strata of Unit 6 from underlying latest Lower Cretaceous (Albian) marine strata of Unit 4. Above the unconformity Unit 6 rocks are typically gently dipping and locally warped into broad westerly trending folds. In contrast, below the unconformity Unit 4 and older rocks display steep, locally overturned, generally northwest-trending bedding attitudes as a result of folding and thrust faulting prior to deposition of Unit 6.

PRE-UNIT 6 STRUCTURES

Thrust faults, that typically occur along bedding glide zones with minor cataclasis, are demonstrated by reversal and repetition of fossil zones in the older rocks east of Big Creek (Jeletzky and Tipper, 1968). Thrust faulting of these older rocks is also established by the juxtaposition of Unit 1 above Unit 2 east of Lorna Lake. Moreover, small-scale southerly directed thrusts have been observed within Units 1, 2 and 4, east of Big Creek.

Thrust faults and related folds are not observed in Unit 6. An inferred thrust that places Unit 3 on Unit 4 has been traced for 5 kilometres east of Big Creek; west of Big Creek it is truncated by the unconformity at the base of Unit 6. Five kilometres to the northwest it re-emerges from beneath the unconformity within an inlier along Tosh Creek (*see* Section A, Figure 3-4-2). Here it separates fossiliferous Unit 3 rocks on the northeast from argillites and coarse clastic rocks assigned to Unit 4 on the southwest.

Pre-unit 6 structures also include a northeast-trending, steeply dipping fault along Lizard Creek which juxtaposes Unit 2 on the northwest against Unit 4 on the southeast (*see* Section B, Figure 3-4-2). It is truncated by a northwest-trending normal fault of limited displacement and does not occur in Unit 6 rocks to the southwest. The probable northeast extension of the Lizard Creek fault juxtaposes Unit 3 against Unit 2 northeast of Tyaughton Creek.

SYN (?) AND POST-UNIT 6 STRUCTURES

Generally northwest-trending, locally sinuous normal faults offset Unit 6 and/or Unit 7 and many of the intrusive rocks. East of the Beece Creek pluton and west of Big Creek the sense of movement on these faults is down to the east, whereas to the southwest of the pluton their sense of movement is down to the southwest.

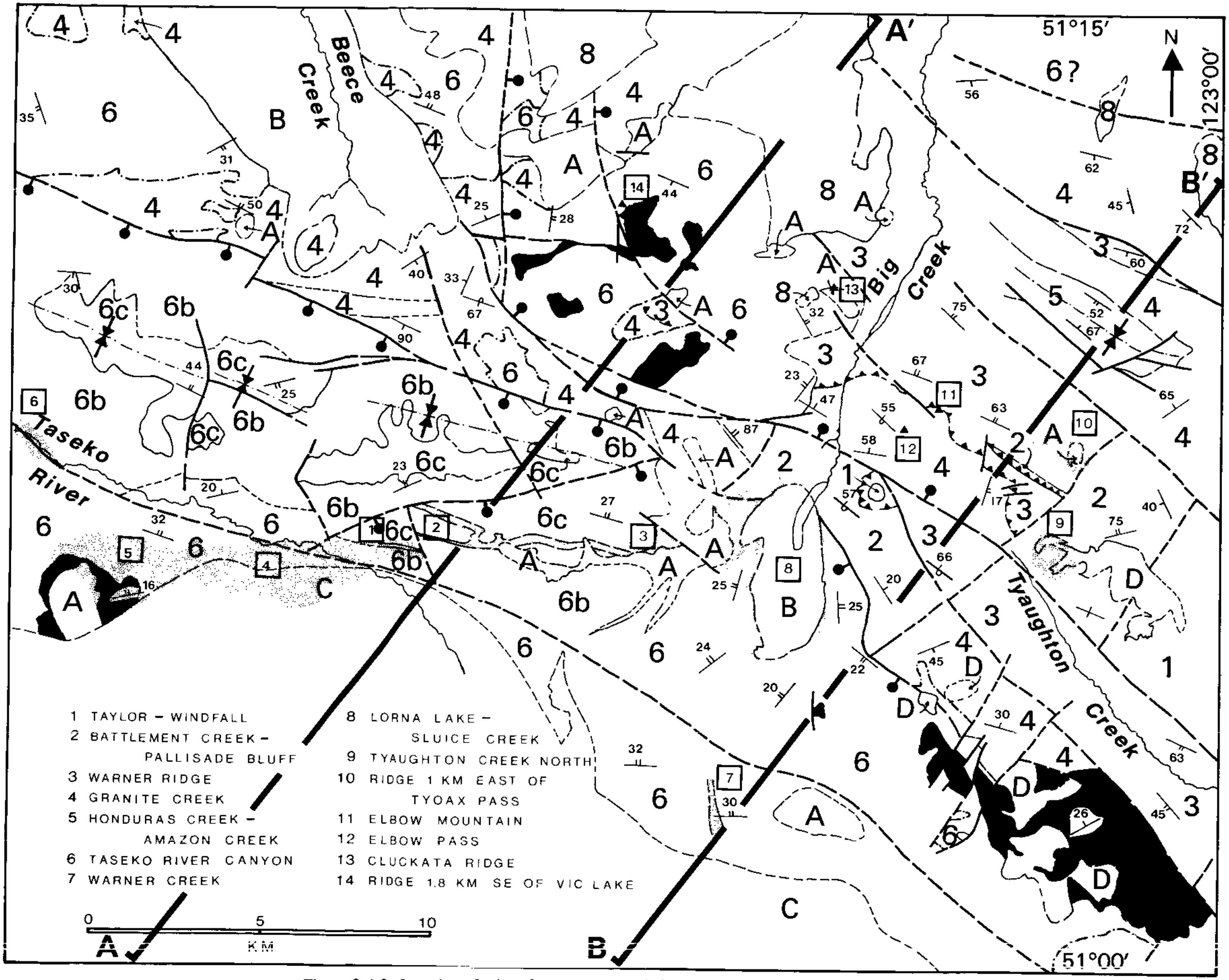


Figure 3-4-3. Location of mineral occurrences and alteration zones, Warner Pass map sheet.

One of these faults, the Chita Creek fault (Figure 3-4-2), can be traced from the western boundary of the map area as far as the head of Big Creek, where it is truncated by the Lorna Lake stock. It has at least 600 metres of vertical displacement in the vicinity of Powell Creek, south of the Beece Creek pluton, where it juxtaposes the base of Unit 6 on the north against the lower part of Unit 6c on the south. It can be traced to the southeast of the Lorna Lake stock, but here there is evidence of considerably less displacement. It is poorly defined further to the southeast, but may have controlled the distribution of Eocene (?) volcanic and intrusive rocks at Mount Sheba.

In the western half of the map sheet the Chita Creek fault is the locus of marked lithostratigraphic differences within the lower part of Unit 6; northeast of the fault volcanic flows and breccias lie directly above the unconformity at the base of Unit 6, whereas to the southwest the lower part of the unit comprises at least 300 metres of locally coarse clastic and epiclastic sedimentary rocks (Unit 6a). The coarser conglomeratic intervals within Unit 6a may represent periods of reactivation along the fault, which is thought to define the northeast margin of a local half (?)-graben within which Unit 6a was deposited.

The northwest-trending Tchaikazan fault has been traced across the Taseko Lakes map area by Tipper (1978). It continues to the northwest into the Mount Waddington map area, where 30 kilometres of right-lateral offset has been postulated (Tipper, 1969). Within the study area, its trace, as defined by Tipper, follows the Taseko River valley, through Warner Pass and along Gun Creek toward the southeast. In the Taseko River canyon, a northwest-trending zone of intense brecciation has been the locus of narrow zones of alteration parallel to the trace of the fault. To the southeast, at the confluence of Powell Creek with the Taseko River, the fault juxtaposes Unit 6a, at the base of Unit 6, on the north, against undifferentiated Unit 6 on the south. Further to the southeast, the fault may be traced along a pronounced lineament, but no stratigraphic offset can be demonstrated across it.

Numerous northerly trending high-angle faults of the same generation or younger occur throughout the area. Most have small displacements, although east of Big Creek they appear to be mostly dextral in nature.

STRUCTURES OF UNCERTAIN AGE

East of Big Creek, northwest-trending faults are dated only as post-Albian in age. Some of them may have strike-slip movement along them (P. Umhoefer and J. Garver, personal communication, 1986) and may be related to the Yalakom fault. The extension of these structures to the northwest is uncertain due to the presence of Miocene cover.

In the northeastern part of the map sheet a tight upright syncline involves strata of Unit 4 and Unit 5. The age of this structure relative to the pre-unit 6 unconformity is unknown.

MINERALIZATION AND ALTERATION

Figure 3-4-3 shows the location of the significant alteration zones in the area. Some of them are known to contain gold mineralization and/or anomalously high geochemical values in gold and related elements. Most display striking hydrothermal alteration characteristics and vary from those typically associated with porphyry copper-molybdenum deposits to those more characteristic of epithermal precious metal deposits.

Taylor-Windfall (Location 1, Figure 3-4-3) is the only occurrence with recorded gold production. Limited production during the mid-1930s came from both surface and underground workings on a narrow, northeast-striking fracture zone containing pyrite, tennantite, chalcopyrite and minor sphalerite in a chlorite-sericite gangue (*Minister of Mines, B.C.*, 1935). In the period 1952 to 1953, further underground mining resulted in the recovery of 886.5 grams of gold extracted from 63.5 tonnes of ore with an average mining grade of 20.6 grams per tonne. Production came from a narrow flat-lying pyroclastic bed within Unit 6 (Lane, 1983). Since 1983 renewed exploration of the Taylor-Windfall property and the surrounding area, conducted by Westmin Resources Ltd. and Esso Minerals Canada, has focused upon siliceous zones with associated argillic and phyllic alteration. A limited amount of diamond drilling has been undertaken in conjunction with detailed geological mapping and geochemical sampling. No reserves have been published to date.

The siliceous zones at Taylor-Windfall and to the northeast, along Palisade Bluff and east of Battlement Creek (Location 2, Figure 3-4-3), appear to be stratabound and hosted by pyroclastic and epiclastic rocks at the base of Unit 6c. A chlorite-epidote-altered plagioclase porphyry flow (?) which immediately overlies the siliceous zone on Palisade Bluff, may have acted as an impermeable barrier to the mineralizing fluids. Alunite, dickite and finely disseminated pyrite occur locally within these alteration zones. Small cavities filled with drusy quartz, rutile, tourmaline and pyrite have also been observed (Lane, 1983). In addition, tourmaline and andalusite have been reported from the alteration zone at Taylor-Windfall (Price, 1986). The geometry and mineral assemblage of these alteration zones indicate a transition from an epithermal setting to a deeper porphyry system.

The siliceous zone at Palisade Bluff can be traced along the same stratigraphic horizon to a spur immediately north of Warner Ridge (Location 3, Figure 3-4-3) where a zone of variably developed clay alteration and silicification at least 10 metres thick is exposed over a strike length of approximately 300 metres and has a dip extent to the southeast of about 300 metres. A single rock sample from this zone returned anomalous geochemical values in gold (300 parts per billion) and mercury (500 parts per million). Other samples from the zone have no detectable gold values, but some are anomalously high in mercury and arsenic.

Gold values have been reported from a group of showings that occur within a hydrothermal alteration zone along the margin of the Coast Plutonic Complex (Location 4, Figure 3-4-3). This zone was explored for porphyry copper-molybdenum deposits during the period 1950 to 1976. Gold and minor silver values are associated with chalcopyrite and molybdenite mineralization that occurs as disseminations and veins or in intrusive breccia in granitic rocks of Unit B (McMillan, 1976). Gold is also associated with pyrite and chalcopyrite mineralization in the volcanic rocks of Unit 6.

The western extension of this zone, between Honduras and Amazon Creeks (Location 5, Figure 3-4-3), comprises pervasive disseminated pyrite mineralization and associated quartz-tourmaline veins within a zone of advanced argillic alteration and silicification of volcanics and volcanic breccias assigned to Unit 6 (Bradford, 1985). The southwestern part of the zone includes siliceous rocks that surround a chlorite-epidote-altered hornblende-plagioclase porphyry. This may represent a subvolcanic intrusive complex; its relationship to the Coast Plutonic Complex is unclear.

A group of bright yellow to orange-weathering *en echelon* hydrothermal alteration zones are exposed along the trace of the Tchaikazan fault in the Taseko River canyon at the western margin of the map area (Location 6, Figure 3-4-3). They strike approximately 320 degrees and dip vertically. The largest zone is 1 kilometre long and up to 100 metres wide. They all comprise silicified and sericitized volcanic rocks of Unit 6, are cut by northwest-trending carbonate veins, and locally contain up to 10 per cent disseminated fine-grained pyrite. Samples from this area have high geochemical values in mercury and arsenic and one sample, from immediately west of the map sheet boundary on the north side of the canyon, was anomalous with respect to gold.

Alteration in the area of Warner Creek (Location 7, Figure 3-4-2) bears a striking resemblance to that observed in the Taylor-Windfall area. A prominent, steeply dipping, north-trending zone of intense silicification, that locally contains up to 10 per cent finely disseminated pyrite, crosscuts and partly replaces volcanic rocks of Unit 6 that dip gently to the north. The exposed strike length of the zone is 1.7 kilometres and its maximum width is about 300 metres. Narrow quartz tetrahedrite veins, reportedly anomalous in gold (Gruenwald, 1980), occur at its northern end along Warner Creek. Clay alteration was observed locally along the ridge at its south end. Nearby a 4-metre-wide zone (bed?) of silicified lapilli tuff, that conforms with the orientation of bedding measured elsewhere, merges with the eastern margin of the main siliceous zone. This alteration zone is located 1.5 kilometres west of a relatively large hornblende plagioclase porphyry stock that is pervasively chlorite-epidote altered and contains locally abundant malachite, both along fracture surfaces and as disseminations.

Mineral occurrences elsewhere on the map sheet appear to be associated with intrusive rocks of probable Eocene age, both as stocks (Locations 8, 9, 10, 13 and 14, Figure 3-4-3) and as narrow felsic dykes (Locations 11 and 12, Figure 3-4-3).

MINERAL POTENTIAL

Known gold mineralization and/or geochemical anomalies, associated with pronounced hydrothermal alteration zones in volcanic, sedimentary and intrusive rocks, demonstrate the potential for epithermal and mesothermal precious metal deposits. Only a few of the occurrences shown in Figure 3-4-3 have been adequately tested and the area presents an opportunity for future exploration.

Compilation of analyses of lithogeochemical samples taken during the course of this study will be included as part of the final mineral potential map.

TECTONIC IMPLICATIONS

This study documents critical field relationships that provide constraints on the geometry and timing of deformation along the eastern margin of the Coast Plutonic Complex. Upper Triassic to Lower Cretaceous marine sedimentary and volcanic strata of the Tyaughton trough contain southerly directed thrusts and tight, locally overturned folds. These rocks and associated structures are separated from the overlying Upper Cretaceous nonmarine volcanic and sedimentary strata by a profound angular unconformity. The mid-Cretaceous deformation event demonstrated by these stratigraphic and structural relationships correlates well with the timing of the accretion of the Insular superterrane to western North America, proposed by Price *et al.* (1985). However, the Cenomanian age attributed to volcanic and sedimentary rocks of Unit 6, above the unconformity, is based on plant fossils (Jeletzky and Tipper, 1968) and is poorly constrained. It is hoped that more precise dates can be obtained, particularly for the base of Unit 6, by palynological analysis or by radiometric age determinations. The spatial and temporal relationships of structures confined to the older rocks below the unconformity, with respect to transcurrent movement along the Yalakom fault, are unknown at this time. These problems will be addressed during the 1987 mapping program.

ACKNOWLEDGMENTS

Informative discussions and field trips with J.W.H. Monger, H. Tipper and G. Woodsworth of the Geological Survey of Canada provided us with a regional and stratigraphic framework for this study. Thanks are extended to K. Russell of The University of British Columbia for providing guidance in interpretation of volcanic rocks in the field. R. Lane of Westmin Resources Ltd. made his considerable knowledge of the Taylor-Windfall property available to us, and R. Britten and H. Marsden of Esso Minerals Canada gave us the benefit of their extensive knowledge of the alteration zones. Useful discussions with P. Umhoefer and J. Garver of the University of Washington, and D. MacIntyre, W.J. McMillan, G. McLaren, J. Nelson, L. Diakow and N. Massey of the British Columbia Ministry of Energy, Mines and Petroleum Resources are gratefully acknowledged. Capable and cheerful assistance in the field was provided by D. Handel and P. Rapp.

REFERENCES

Bradford, J.A. (1985): Geology and Alteration in the Taseko River Area, Southwestern B.C., Unpublished B.Sc. Thesis, *The University of British Columbia*, 122 pages.

Gruenwald, W. (1980): Geological and Geochemical Report on the Warner Claims, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8472.

Jeletzky, J.A. and Tipper, H.W. (1968): Upper Jurassic and Cretaceous Rocks of Taseko Lakes Map Area and their Bearing on the Geological History of Southwestern B.C., *Geological Survey of Canada*, Paper 67-54.

Kleinspehn, K.L. (1985): Cretaceous Sedimentation and Tectonics, Tyaughton-Methow Basin, Southwestern B.C., *Canadian Journal of Earth Sciences*, Volume 22, pages 154-174.

Lane, R.W. (1983): Geological and Geochemical Assessment Report on the Taseko Property, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 11696.

McLaren, G.P. (1986): Geology and Mineral Potential of the Chilko-Taseko Lakes Area (92O/4, 5; 92K/16; 92N/1), *B.C. Ministry of Energy, Mines and Petroleum Resources*, Geological Fieldwork, 1985, Paper 1986-1, pages 265-277.

McMillan, W.J. (1976): Granite Creek Property, 92O/3W, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Geology in British Columbia, pages 67-84.

Minister of Mines, B.C. (1935): Annual Report, 1935, pages F17-F26.

Monger, J.W.H. (1985): Structural Evolution of the Southwestern Intermontane Belt, Ashcroft and Hope Map Areas, B.C., *in* Current Research, Part A, *Geological Survey of Canada*, Paper 85-1A, pages 349-358.

Price, G. (1986): Geology and Mineralization, Taylor-Windfall Gold Prospect, B.C., Canada, Unpublished M.Sc. Thesis, *University of Oregon*, 144 pages.

Price, R.A., Monger, J.W.H. and Roddick, J.A. (1985): Cordilleran Cross-section: Calgary to Vancouver, *in* Field Guides to Geology and Mineral Deposits in the Southern Canadian Cordillera, *Geological Society of America*, Cordilleran Section Meeting, Vancouver, 1985.

Roddick, J.A., Muller, J.E. and Okulitch, A.V. (1979): Fraser River, B.C.-Washington 1:1 000 000 Geological Atlas, Sheet 92, *Geological Survey of Canada*, Map 1386A.

Tipper, H.W. (1969): Mesozoic and Cenozoic Geology of the Northeast Part of Mount Waddington Map Area (92N), Coast District, B.C., *Geological Survey of Canada*, Paper 68-33.

——— (1978): Taseko Lakes (92O) Map-area, *Geological Survey of Canada*, Open File 534.

Tozer, E.T. (1967): A Standard for Triassic Time, *Geological Survey of Canada*, Bulletin 156, 103 pages.