GEOLOGY OF THE GERMANSEN LANDING AREA, BRITISH COLUMBIA (93N/10, 15)

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KEYWORDS: Regional geology, Germansen Landing, Manson Creek, Intermontane Belt, Omineca Belt, Slide Mountain Group, Takla Group, Manson fault zone, precious metal veins, listwanite.

INTRODUCTION

The Manson Creek 1:50 000 mapping project is in the second year of a 4-year program which will cover an area straddling the boundary between the Intermontane and Omineca tectonic belts within the Canadian Cordillera. The main aims of this program are: to provide detailed geological base maps, to update the mineral inventory database for the area, and to place known mineral occurrences within a geological framework. During 1988, mapping was completed in the north half of the Germansen Lake map area (93N/10) and the south half of the Germansen Landing map area (93N/15).

The project area is located some 200 kilometres north-northwest of Prince George (Figure 1-24-1). Ground access is by all-season gravel road from either Fort St. James or Mackenzie. The map area is drained by the Omineca River in the north and the Germansen River system in the south. Most of the area is forested with only the regions around Germansen Mountain, Plughat Mountain and Nina Creek extending above treeline.

REGIONAL SETTING

The map area lies largely within the Intermontane Belt and only the northeastern corner is underlain by Omineca Belt lithologies (Figure 1-24-2). All rocks west of this tectonic boundary are considered allocthonous with respect to the North American craton (Monger *et al.*, 1982).

Within the study area the Omineca Belt is represented by miogeoclinal rocks of the Proterozoic Ingenika Group and a sequence of carbonates and siliciclastics of Lower to Middle Paleozoic age (Armstrong, 1949; Gabrielse, 1975) and their highly metamorphosed and deformed equivalents in the Wolverine complex. The Intermontane Belt consists of the Late Triassic to Early Jurassic Takla Group, Middle Paleozoic to Early Triassic Slide Mountain Group and possible Harper Ranch equivalents which are Middle to Late Paleozoic in age. These are intruded by the Early Cretaceous Germansen batholith and the Triassic to Cretaceous Hogem batholith (Garnett, 1978). In the project area the contact between the two belts is assumed to be a west-side-down normal fault. This was inferred from mapping in the Manson Lakes area (93N/9) to the southwest and was based on the abrupt change in metamorphic grade across the contact (Ferri and Melville, 1988a and b).

The Slide Mountain Group is composed of a sequence of sedimentary, volcanic and igneous rocks which represent a

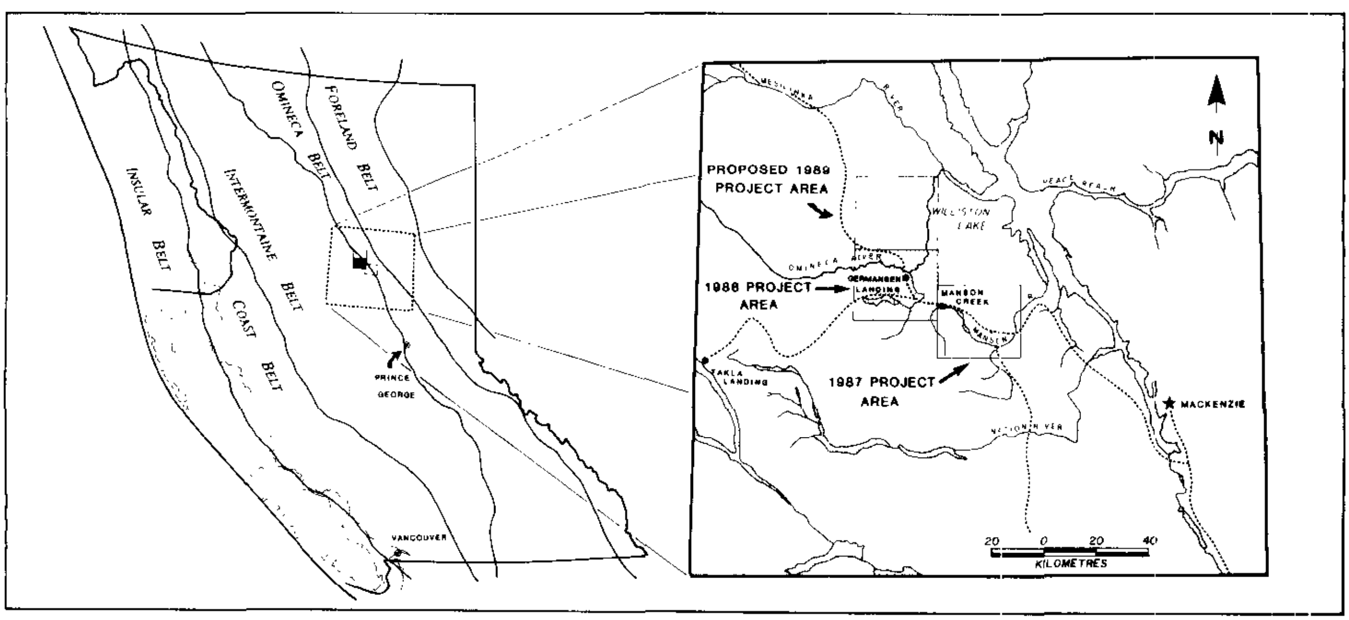

Figure 1-24-1. Location of the map area within the tectonic framework of the Canadian Cordillera. Expanded section indicates major geographic features around the map area as well as previous and proposed map areas.

British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1988, Paper 1989-1.

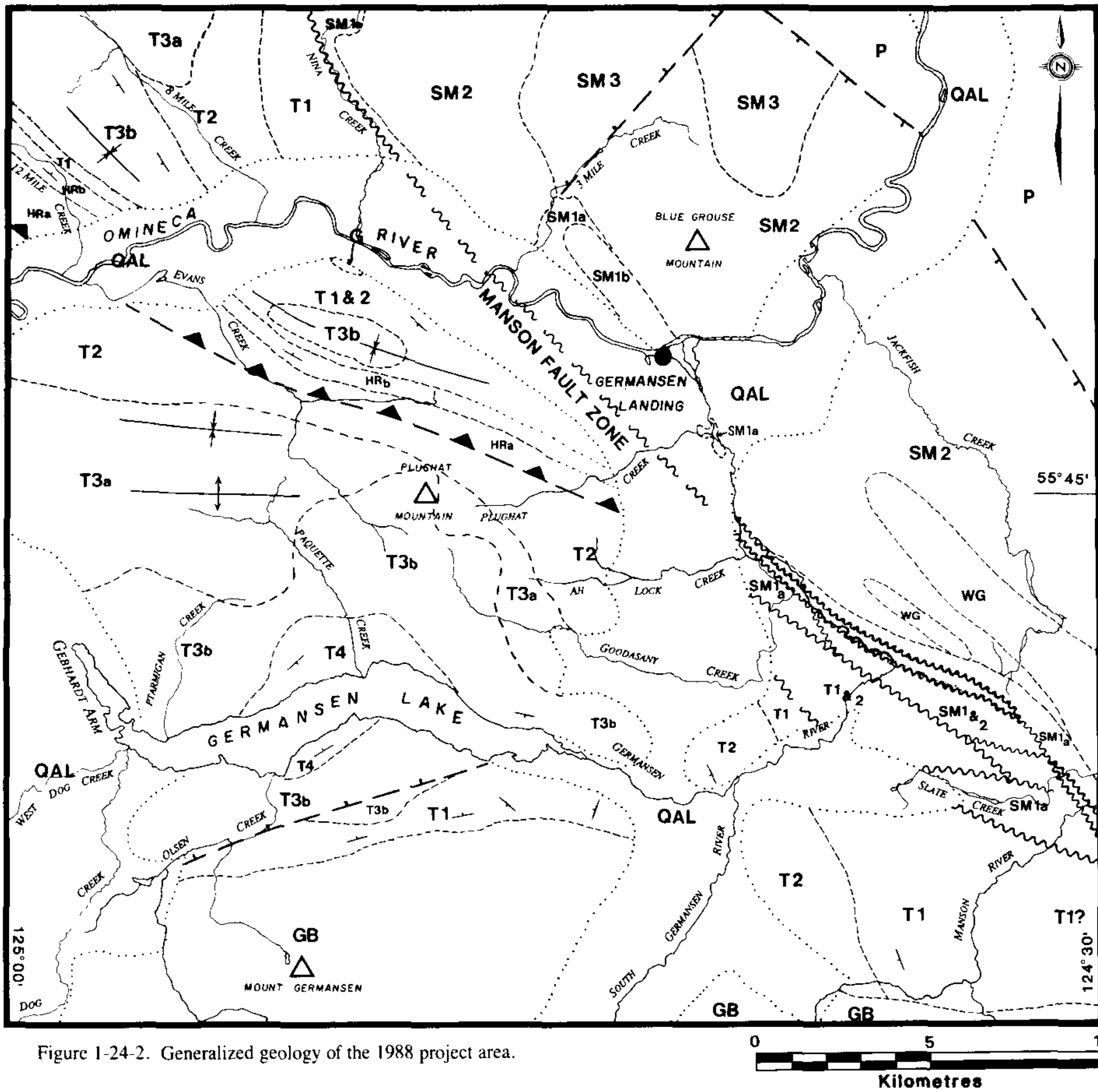

Figure 1-24-2. Generalized geology of the 1988 project area.

deep water, oceanic setting. The Takla Group is a thick sequence of predominantly pyroclastic and epiclastic rocks with lesser massive flows. These are subalkaline to calc-alkaline in composition (Meade, 1977) and represent an arc assemblage. These lie atop carbonate, epiclastics and mafic volcanics which have tentatively been assigned to the Harper Ranch Group.

OMINECA BELT

Omineca Belt lithologies are sparsely exposed in the northeastern corner of the map area. They are tentatively assigned an Early to Middle Paleozoic age based on their stratigraphic position and lithological similarity to Paleozoic sediments described by Grabrielse (1975), Monger, (1973) and Monger and Patterson (1974) in the Fort Graham map area. Gabrielse notes that they resemble lower Paleozoic strata seen in the Cassiar Mountains further north (Gabrielse, 1963; *see also* Nelson and Bradford, 1987; Nelson *et al.*, 1988). Essentially all exposures in this area are limestone and the greatest semicontinuous section is roughly 1000 metres thick. These carbonates are grey to light grey, buff to grey weathering, recrystallized limestones that form cliffs 25 to 50 metres high. Less common are sections of thin to moderately bedded, more argillaceous and darker grey, platy limestone which has a fetid odour when broken. These limestones can be found interbedded with very thin, crenulated, slate layers.

LEGEND

LAYERED ROCKS

QUATERNARY

QAL *Till, gravel, sand, silt and alluvium*

UPPER TRIASSIC/LOWER JURASSIC

TAKLA GROUP

T4 *Volcanic sandstone and conglomerate*

T3 *(a) Agglomerates, tuffaceous breccias, epiclasitcs and minor mafic volcanic flows (b) Massive flows and pyroclastics with minor epiclastics*

T2 *Volcanic sandstone, conglomerate, minor siltstone and argillite*

T1 *Argillite, siliceous argillite, siltstone and minor chert, limestone, volcanic wackes and volcanic sandstone*

UPPER PALEOZOIC/LOWER TRIASSIC

SLIDE MOUNTAIN GROUP

SM3 *Upper: Massive to pillowed basalts, volcanic breccia, minor argillite and chert*

SM2 *Middle: Argillite, siliceous argillite, siltstone, cherts, and minor mafic volcanic, volcaniclastics, sandstone, conglomerate and ribbon chert*

SM1 *Lower: (a) Phyllite, argillite, calcareous phyllite, carbonate, and minor quartzose siltstone/wacke, ribbon chert (b) Dacite tuff (c) ultramafics*

MIDDLE/UPPER PALEOZOIC

HARPER RANCH(?)

HR (a) *Carbonate,* (b) *fine grained clastics and mafic volcanics*

LOWER/MIDDLE PALEOZOIC

P *Carbonate and minor argillaceous limestone and sandstones*

INTRUSIVE ROCKS

UPPER CRETACEOUS

GERMANSEN BATHOLITH

GB *Foliated granodiorite, pegmatites, and aplite dykes*

JURASSIC OR YOUNGER

G *Gabbro*

UPPER PALEOZOIC/LOWER TRIASSIC

WG *Gabbro and foliated gabbro (Wolf Ridge Gabbro)*

Only a few scattered outcrops of quartzose sediments were seen. These are cream to buff-weathering, massive to thickly bedded sandstones which may exhibit limonitic staining.

INTERMONTANE BELT

HARPER RANCH(?) GROUP

A sequence of mafic volcanics, fine-grained clastics and carbonate rocks underlies argillites, volcanic sandstones and conglomerates of Unit 1 of the Takla Group in the north-central part of the map sheet (south of the Omineca River and along Evans Creek). The carbonate unit is some 500 metres thick and can be traced for nearly 20 kilometres. No limestone unit of this thickness and extent has been previously described in the lower part of the Takla Group in this area (*see* Roots, 1954; Armstrong, 1949) or from the Takla and its equivalents north and south along Quesnellia. These rocks are therefore believed to be basement to the Takla Group and are included in the Harper Ranch Group (*see* Monger, 1977; Price *et al.*, 1985).

The limestone is generally a massive cliff-forming unit though bedding can sometimes be seen as faint platy partings. It is grey to light grey on fresh surfaces and dark grey to grey-brown weathering. It is finely recrystallized and has a fetid odour when broken. It is commonly cut by numerous quartz-calcite veins with various orientations.

A sequence of mafic volcanics and fine-grained clastic rocks underlies the limestone along Evans Creek and has been grouped with it. These volcanics are dark green to grey-brown, generally massive and less frequently pillowed. They are generally aphanitic though pyroxene-plagioclase porphyries are also present. These rocks are highly chloritized with calcite and prehnite/pumpellyite filling vugs.

The clastic rocks are very immature sandstones to siltstones. They are grey to grey-green, massive and coarse grained with the chloritized matrix comprising up to 20 per cent of the rock. The majority of the clasts are plagioclase and quartz crystal fragments.

SLIDE MOUNTAIN GROUP

The Slide Mountain Group rocks were originally grouped with Cache Creek stratigraphy seen further to the west (Armstrong, 1949; Roots, 1954; Monger, 1973). It is predominantly a sedimentary sequence with igneous and volcanic rocks becoming more abundant towards the top (Figure 1-24-3). It comprises black phyllite, argillite, siltstone, chert, diorite and gabbro, mafic to intermediate volcanic rocks, felsic tuffs and ultramafites with minor carbonate, greywacke, sandstone and ribbon chert. The stratigraphy has been subdivided into lower, middle and upper units (Figure 1-24-3). The subdivisions proposed in this paper vary somewhat from those proposed in the Manson Lakes area (Ferri and Melville, 1988b). The lower division corresponds to

Units SM1, SM5 and SM6 of Ferri and Melville, the middle division to Unit SM4 and the upper division to unit SM3.

Lower Division

The lower division is composed of phyllite, argillite, calcareous phyllite and carbonate, with lesser quartzose siltstone or quartz wacke, ribbon chert and carbonate. Lenticular bodies of altered ultramafite occur within this unit, primarily along the Manson fault zone. A dacitic tuff body is also present. An accurate stratigraphic thickness cannot be determined due to its structural complexity and the lack of distinct internal stratigraphy.

The phyllites are dark grey to black and typically thinly bedded and graphitic. They grade into and are interlayered with graphitic argillites which are moderately to thickly bedded. These argillites are often quite siliceous and appear cherty. A penetrative cleavage is dominant in the phyllites but becomes less pervasive in the argillites.

Dark grey to black, thinly bedded graphitic argillaceous limestone grades vertically into the phyllites and argillites. Carbonate sections are characterized by massive, buff-weathering limestone up to 5 metres thick, such as crop out along the road on the north side of Slate Creek, approximately 3 kilometres west of Manson Creek. Layers of argillaceous sandstone to wacke, varying from a few centimetres to tens of centimetres thick, are a minor constituent of the lower division. They weather grey to light brown and lack internal structure.

The lower division also contains lenticular bodies of ultramafite which are restricted to the Manson fault zone, south of the Omineca River, and are poorly exposed along the Germansen River valley as well as a few kilometres west of Manson Creek. Based on previous mapping to the southeast (Ferri and Melville, 1988a), three types of altered ultramafite are present: serpentinite, talc-serpentine bodies and talc-ankerite-serpentine schists. Fault contact relationships of these bodies with the surrounding phyllites are characteristic along this belt.

Serpentinite bodies are the most abundant; they are essentially pure serpentine with lesser amounts of disseminated talc, ankerite and epidote which may accompany quartz veining. Serpentinites are generally magnetic and may contain veins of chrysotile. These rocks are well exposed immediately south of the Farrel showing (Figure 1-24-5, Table 1-24-1) on the north side of the Germansen River. Talc may form up to 50 per cent of the serpentinite, as either disseminated grains or fine-grained masses up to 1 centimetre in diameter. The talc serpentinites are weakly foliated.

Bodies of mariposite(fuchsite)-magnetite-quartz-talc-ankerite schist (listwanites) are also found in this zone and are well exposed at the bend in the Germansen River, approximately 10 kilometres northwest of Manson Creek. The listwanites are grey-green to rusty brown weathering, coarsely crystalline and commonly contain porphyroblasts of ankerite.

A northwesterly trending dacite tuff is poorly exposed northwest of Germansen Landing. No contact relationships with the surrounding rocks were seen. It is grey to cream on fresh surface, grey to brown weathering and massive, composed of up to 30 per cent quartz clasts, 5 to 10 per cent plagioclase and potassic feldspar crystal fragments, 1 to 2 percent muscovite and biotite plus minor hornblende and zircon. The groundmass is recrystallized to sericite, carbonate, quartz and chlorite. The quartz exhibits resorption embayments and the mica is commonly bent. The tuff contains a penetrative foliation parallel to structures in the Slide Mountain Group.

Similar tuffs are interbedded with the phyllites and argillites of the lower division of the Slide Mountain Group. In old hydraulic pits along the Germansen River, approximately 2 kilometres south of Germansen Landing, tuff beds 20 centimetres to more than 2 metres thick are in sharp contact or grade into the phyllites and argillites. The tuff beds commonly contain rip-up clasts of argillite and fill scour channels in the sediments. They are white to cream in colour, tan to rusty weathering and may contain up to 80 per cent coarse quartz and feldspar crystal fragments which are sometimes graded.

Middle Division

This division is informally known as the siliceous sediment division and is composed of argillite, siliceous argillite, siltstone and cherts, with lesser mafic volcanics, volcaniclastics, sandstone, conglomerate and ribbon chert. This division also contains numerous bodies of gabbro and diabase. It is best exposed on Blue Grouse Mountain, immediately northeast of Germansen Landing.

The argillites and siliceous argillites are grey to grey-green, moderately to massively bedded and may contain a spaced to penetrative cleavage. They grade into or are interlayered with massive to thickly bedded grey-green to greenish siltstones. The siltstones may contain a coarser fraction composed of feldspar crystal fragments indicating that these "siltstones" may in fact be crystal tuffs. This is also suggested by the abundance of mafic alteration minerals (chlorite, epidote, prehnite/pumpellyite) within these layers.

Massive to thickly bedded chert is interlayered with the above lithologies. The chert is typically grey to light grey but may be cream to white, beige, maroon or dark grey. Ribbon chert with thin chert layers (1 to 5 centimetres) separated by thinner, cleaved siliceous argillite was seen only rarely.

The upper part of this division also contains massive, dark green to green plagioclase and pyroxene-phyric mafic to intermediate flows. Flows range up to 30 metres thick and are locally associated with breccias of similar composition. These volcanics are highly altered to chlorite and epidote with the feldspars being strongly sericitized.

Polymict sandstones, wackes and conglomerates are a minor component of the middle division. These are thin to moderately bedded, often interlayered with siltstone and seen in sections up to 10 metres thick. They are composed of subrounded to rounded clasts of chert, quartz, carbonate, argillite(?), volcanic fragments and rare potassic feldspar crystal fragments. The volcanic fragments are feldspar-pyroxene porphyries.

Sill and dyke-like bodies of fine to coarsely crystalline gabbro and diabase intrude the layered rocks. These bodies range from a few metres to over several hundred metres in

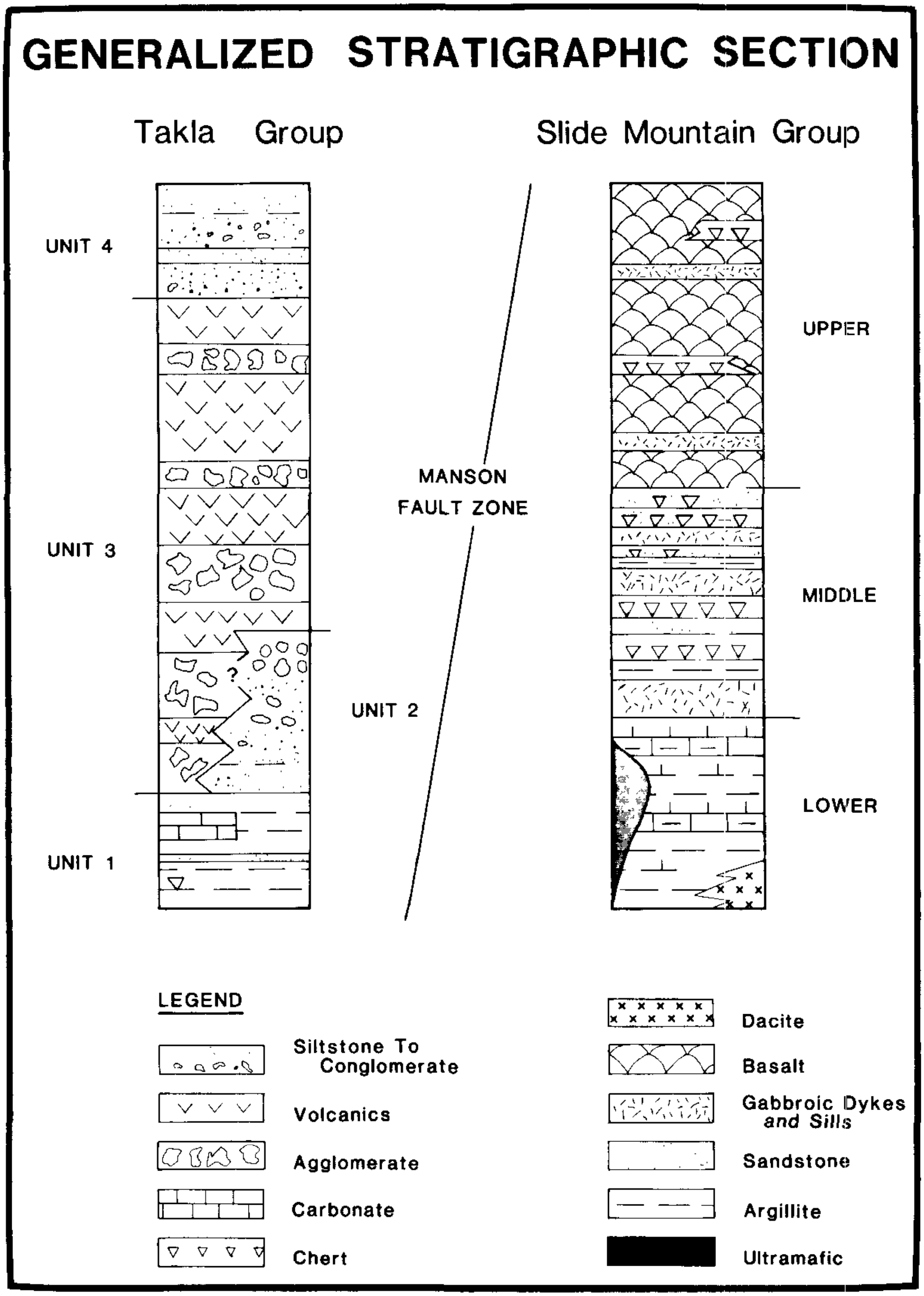

Figure 1-24-3. Generalized stratigraphic column (not to scale) for the Takla and Slide Mountain Groups as seen within the project area.

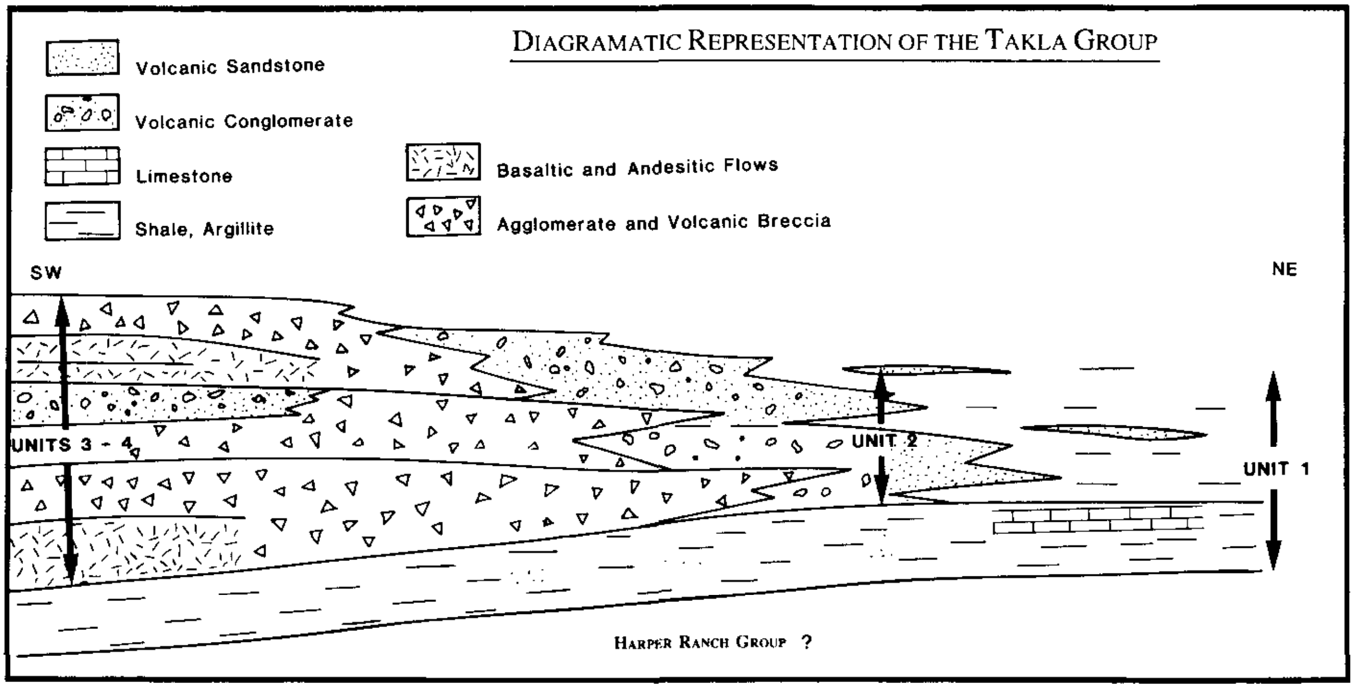

Figure 1-24-4. Schematic representation of various units within the Takla Group as seen in the project area. This diagram indicates the facies relationships between the thick package of pyroclastics and flows of Unit 3 and the epiclastic rocks of Units 1 and 2.

thickness. These sills are most abundant in the upper part of the division and are texturally similar to the large gabbro body below Wolf Ridge (*see* Wolf Ridge Gabbro under Intrusive Rocks) and are probably contemporaneous with it. They have not been separated from the other lithologies in this division due to their small size and sporadic outcrop.

Upper Division

The upper division of the Slide Mountain Group comprises massive to pillowed basalt and volcanic breccia with minor, thin sequences of argillite and chert. The basalts are believed to be at least 1 kilometre thick and are best exposed in the highland areas immediately west of Nina Creek. They are dark grey-green to dark green in colour and generally massive and aphanitic, but lavas with a variolitic texture are a significant component in the section. Massive volcanic breccia a few metres thick crops out in several localities and may be flow-top breccia.

Massive to thickly bedded, grey, cream and maroon cherts and dark grey to grey argillites occur in sections 5 to 20 metres thick and a lateral extent of a few hundred metres. Sills and dykes of gabbro, similar to those lower in the section are also present in the lower part of the upper division.

TAKLA GROUP

The Takla Group was first described in the study area by Armstrong (1949) who also mapped the type area around Takla Lake, on the west side of the Cache Creek terrane. In the present study area, Meade (1974, 1975, 1977) described Takla Group rocks in the area south and west of Germansen Lake.

The Takla Group in the Germansen Landing – Manson Creek area is predominantly a thick sequence of pyroclastic and coarse epiclastic rocks with lesser massive flows and fine-grained clastics. These have been subdivided into four units: a lower argillite to tuffaceous siltstone, a volcanic sandstone and conglomerate, a unit of pyroclastics and flows, and an upper epiclastic unit (Figure 1-24-3). The total thickness of volcanics and related sediments is at least 3 kilometres.

There is a facies transition in the Takla from predominantly agglomerates, massive flows and volcanic breccias in the west, to volcanic conglomerates, volcanic sandstones, and finally to lithic tuffs and argillites in the east (Figure 1-24-4). This is based on the geographic and stratigraphic position of the units as well as the presence of lithic clasts within the volcanic conglomerates and sandstones which resemble Takla Group lithologies further west.

Unit 1

The lowermost unit of the Takla Group comprises argillite, siliceous argillite, lithic tuff and volcanic siltstone with lesser chert, limestone, volcanic wacke and volcanic sandstone. This unit is about 500 metres thick in the Mount Germansen area and over 1 kilometre thick near the eastern edge of the map area. The best exposures are between Mount Germansen and Germansen Lake. The upper part of the unit is interlayered with Unit 2 lithologies in the eastern and northeastern part of the map area but is believed to be in sharp contact with the volcanics of Unit 3 in the Mount Germansen area. Where this unit is quite thin and poorly exposed, north of Plughat Mountain, it has been grouped with Unit 2.

The argillites are thin to moderately bedded, cream to rusty weathering and typically grey on fresh surfaces. They are sometimes graphitic and contain abundant finely disseminated pyrite. The argillites may be quite siliceous and are interlayered with dark grey to grey graphitic cherts. Minor limestone sequences (less than 1 metre) or beds 1 to 30 centimetres thick are sometimes present.

The siltstones are cream to beige in colour, thin to moderately bedded and fairly siliceous. They occur both interbedded with the argillites and as sections 1 to 10 metres thick. The coarser siltstones contain subangular clasts of feldspar, feldspar porphyry, and rare argillite and quartz. Some of these "siltstones" have the characteristics of waterlain lithic tuffs as opposed to volcanic siltstones.

Thin to thickly bedded volcanic sandstones, conglomerate and some volcanic breccia are exposed in the upper part of this unit. The sandstone clasts are subangular and composed of feldspar crystal fragments, feldspar and augite-feldspar porphyries, augite crystal fragments and rare quartz and argillite. Clasts within the conglomerates and breccias are predominantly feldspar-augite porphyries, aphanitic volcanics and minor argillite. In the eastern part of the map area these lithologies grade into the overlying volcaniclastic rocks of Unit 2.

Unit 1 commonly contains a spaced cleavage; spacing varies from a few millimetres to several centimetres. Cobbles are commonly stretched parallel to the cleavage and the rock generally breaks along this surface.

UNIT 2

Unit 2 is characterized by volcanic sandstone and conglomerate with lesser siltstone, and argillite. The best exposures are on the small knolls north and south of the confluence of the Germansen and the South Germansen rivers. The unit is over 1 kilometre thick in the eastern part of the map area but pinches out towards Mount Germansen.

The sandstones are grey to dark grey-green, massive, and typically coarse grained with isolated cobbles. The majority of the clasts are feldspar porphyries of various types, but hornblende and/or pyroxene feldspar porphyries and feldspar, hornblende and pyroxene crystal fragments are also present. They are subangular to subrounded and the lithic clasts are typical of Takla Group lithologies further west. The matrix is typically finely crystalline chlorite though some parts contain prehnite/pumpellyite infills.

Massive to poorly sorted volcanic conglomerates and breccias are typically matrix supported, with the matrix being a volcanic sandstone as described above. Clasts range from 0.5 to 30 centimetres, are polymict and are composed of vesicular to amygdaloidal basalts, hornblende and/or pyroxene feldspar porphyries, feldspar porphyries and rare chert or argillite. The volcanic clasts are identical to Takla Group volcanic lithologies further east (*see* Figure 1-24-4).

The lower parts of Unit 2 contain sections of argillite and volcanic(?) siltstone similar to those described in Unit 1. These finer grained lithologies contain a spaced cleavage which is not as well developed in the conglomerates. Deformation within the conglomerates is evidenced by flattened clasts.

UNIT 3

This unit is predominantly pyroclastic in nature with lesser massive flows, epiclastic rocks and minor dioritic sills and dykes. It outcrops primarily north and south of Germansen Lake and also in the northwestern corner of the map area. The thickness of the unit varies from 1 to 2 kilometres and its contact with Unit 2 is generally gradational but fairly sharp with Unit 1. East of Plughat Mountain tuffaceous breccias of Unit 3 give way eastward, over a broad interval, to volcanic conglomerates and sandstones of Unit 2. Unit 3 has been subdivided into two broad sub-units; Subunit 3a is composed predominantly of pyroclastics, agglomerates, tuffaceous breccias, lapillistones and volcanic sediments with lesser massive flows, and Subunit 3b is predominantly flows and pyroclastics with lesser volcanic sediments. Subunit 3a is areally more extensive than Subunit 3b.

Unit 3 is green, grey-green, grey, grey-brown or maroon and maroon to brown weathering. The principal lithologies are hornblende and/or augite ± serpentinized olivine-feldspar porphyry agglomerates, lapillistones with lesser flows and tuffites. The more mafic volcanic rocks are slightly magnetic and appear as broad highs on aeromagnetic maps. Less common are aphanitic volcanics. Individual flows and agglomerates vary from a few metres to tens of metres thick. They are basaltic to andesitic in composition (Meade 1975, 1977) with mafic minerals comprising up to 30 per cent of the rock. Approximately 8 kilometres west of Plughat Mountain is a sequence of coarsely bladed feldspar porphyry flows and agglomerates which are distinct from the other porphyritic volcanics in the Takla Group. The feldspars are generally sericitized and chlorite, prehnite, pumpellyite and epidote are the main alteration minerals in the groundmass and amygdules. Biotite and actinolite appear near the contact with the Germansen batholith. This unit generally does not display a penetrative fabric, but a weak foliation or cleavage is developed where these rocks rest on the sediments of Unit 1 in the Mount Germansen area. Agglomerates have no internal structure and are commonly polymict, especially towards the eastern contact.

Grey to grey-green tuffaceous siltstones and volcanic sandstones are interlayered with agglomerates and flows northwest of Plughat Mountain. These epiclastic rocks are moderately to thickly bedded and exposed in sections up to 10 metres thick. Further northwest the unit is characterized by polymict volcanic sandstones, conglomerates and agglomerates.

Grey finely crystalline limestone is found in the upper part of this unit and crops out on the northeastern shore of Germansen Lake. This limestone is up to 25 metres thick and has been traced discontinuously for several kilometres. It is generally massive but in places bedding is manifest as thin, discontinuous, darker grey and coarser grained layers.

UNIT 4

Unit 4 is a poorly exposed sequence of massive to poorly bedded, dark grey to grey volcanic sandstone and conglomerate exposed in a syncline centred on Germansen Lake. The conglomerates are matrix supported with the clasts consisting of porphyries similar to those in Unit 3. The thickness of this unit, based on structural cross-sections, is estimated to be upwards of 1 kilometre.

INTRUSIVE ROCKS

WOLF RIDGE GABBRO

Northwest-trending gabbro bodies intrude the lower and middle divisions of the Slide Mountain Group below and to the northwest of Wolf Ridge. These rocks are green to dark green on fresh surfaces and light brown to rusty brown weathering. They typically contain from 40 to 60 per cent sericitized plagioclase with the remainder being pyroxene, hornblende and rare biotite. They are fine to medium grained although pegmatitic phases crop out along the crest of Wolf Ridge. This unit has a characteristic weak mineral lineation with an accompanying very weak planar fabric which may grade into a mylonitic fabric.

These intrusions are very similar in appearance to gabbro/diorite bodies within the middle division of the Slide Mountain Group and are thought to be coeval with them. Contacts with enclosing rocks are often faults but these lenticular bodies are thought to be intrusions, up to 1.5 kilometres thick, within the sediments of the Slide Mountain Group.

GERMANSEN BATHOLITH

The southern sixth of the map area is underlain by the Germansen batholith. It is best exposed on the alpine slopes of Mount Germansen. South of Germansen Lake its contact parallels bedding within the Takla sediments and volcanics but in the southeast the contact cuts diagonally across the rocks of the Takla Group.

The batholith comprises foliated hornblende biotite granodiorite composed of 40 to 50 per cent plagioclase, 20 to 25 per cent quartz, 15 to 20 per cent potassic feldspar and 10 to 15 per cent biotite and hornblende. Accessory minerals include apatite, zircon and magnetite(?). It commonly contains large potassic feldspar phenocrysts aligned along the foliation. The foliation varies from barely perceivable to moderate and is produced by recrystallization and flattening of quartz and mica around feldspar grains which show no annealing textures. The foliation generally parallels the intrusive contact and is associated with a steep mineral lineation indicating that this fabric may be related to emplacement.

Pegmatites of similar composition intrude the batholith and the smaller dykes also contain a penetrative fabric. Aplite dykes also cut the Germansen batholith throughout its exposure.

Monzonite to quartz monzonite intrudes the Germansen batholith and segments of the Olsen Creek fault zone. These rocks occur as dykes up to 15 metres wide and as irregular bodies over 20 metres in diameter. They are plagioclase, potassic feldspar and quartz phyric with the quartz displaying resorbed margins. The matrix is composed of fine-grained plagioclase, potassic feldspar and muscovite. Accessories are biotite, hornblende and zircon. This unit does not display the fabric seen in the other phases.

The contact of the batholith with the surrounding sediments is steeply dipping with numerous fine-grained apophyses extending into argillites, tuffs and siltstones of Unit 1 of the Takla Group. There is no evidence of chilling at the margin.

Potassium-argon dating of granodiorite from near Mount Germansen yield dates of 106±3 Ma and 86±3 Ma for hornblende and biotite respectively (Meade, 1975). Dating by the authors on a two-mica granite phase of the Germansen batholith near Mount Gillis yielded a date of 107±4 Ma on biotite.

GABBRO

A small body of gabbro intrudes the Takla Group, 1 kilometre south of the mouth of Nina Creek. It is grey, massive, medium to coarsely crystalline and contains a weak to moderate foliation which trends northwesterly. It is composed of plagioclase (50 per cent), pyroxene (30 per cent), sphene(?) (10 per cent) and hornblende, sericite and calcite. This unit does not resemble the Wolf Ridge gabbro and its exact age is unknown.

STRUCTURE

The area may be divided into three broad structural domains: the Paleozoic(?) carbonates, the Slide Mountain (which includes the Manson fault zone), and the Takla. These domains are all separated by major faults, the most notable being the Manson fault zone. The Slide Mountain Group and Paleozoic carbonates are separated by a west-side-down normal fault.

PALEOZOIC CARBONATE DOMAIN

Bedding is the dominant planar fabric in this domain. Strikes are generally northwesterly with southwest dips. Lack of marker units prohibited the delineation of large-scale structures but a scatter of data and several mineral lineations indicate a shallow southeasterly plunge.

SLIDE MOUNTAIN DOMAIN

Structural elements within the Slide Mountain Group trend northwesterly. The lack of marker horizons inhibits the mapping of large-scale structures but the spread of bedding attitudes within the sediments of the middle division indicates broad folds (wavelengths of 3 to 7 kilometres) which plunge gently southeast.

Cleavage is well developed within the lower division phyllites; it is vertical to steeply dipping to the northeast and is typically the only planar feature observed. Within the upper parts of the Slide Mountain Group, cleavage is only found in the argillaceous sequences. Tight southeasterly plunging folds are occasionally associated with this cleavage.

In the northern part of the map area a northeasterly trending, north-side-down normal fault places basalts of the upper division against sediments of the middle division. The movement on this fault is supported by the unbroken succession and southeasterly plunge of the northern strata.

The most prominent structure in the map area is the Manson fault zone which separates two suspect terranes and is the locus of precious metal vein mineralization. The fault zone trends northwesterly and varies from a few hundred metres to over a kilometre in width. Lenses of altered ultramafite are found within the zone and are clearly delineated by aeromagnetic data. Subhorizontally stretched fault-breccia clasts and phyllite clasts (within tuff beds), slickensides and fibrous crystal growths all indicate strike-slip motion, though the sense of motion has not been deduced.

The Manson fault zone separates the Takla Group from the Slide Mountain Group. This is clearly shown in the Nina Creek area and the area between Slate Creek and the Germansen River. The Slate Creek lineament is probably a splay off the Manson fault zone and in this area fault slices of Takla Group sediments are contained in the fault zone.

TAKLA DOMAIN

Structures within the Takla Group vary somewhat from those in the other domains. Generally, broad structures have an easterly trend in the western part of the map area and swing into parallelism with the Manson fault zone as they are traced eastward. Only the lower unit of the Takla Group consistently exhibits a penetrative cleavage which becomes more sporadic within Unit 2 and rare or absent within Units 3 and 4.

Major faults in this sequence include the Olsen Creek fault, a north-side-down normal fault, and the Evans Creek fault, here assumed to be a thrust. The Evans Creek fault is required if the thick carbonate unit tentatively assigned to the Harper Ranch Group is the basement to the Takla Group.

METAMORPHISM

Metamorphism is generally middle greenschist grade or lower. Contact metamorphism around the Germansen batholith produces biotite and actinolite in the volcanics and sediments of the Takla Group.

Within the Slide Mountain Group chlorite and muscovite are the principal metamorphic minerals, with epidote and calcite as accessories. Typical metamorphic mineral assemblages in the Takla Group are chlorite $\pm$ muscovite $\pm$ prehnite $\pm$ pumpellyite $\pm$ epidote $\pm$ carbonate present as groundmass alteration or vesicle fillings in the volcanics.

MINERALIZATION

Table 1-24-1 lists the known mineral occurrences within the map area. Except for a few copper showings within the Takla volcanics, most of the prospects are associated with the Manson fault zone (Figure 1-24-5). Precious metals are found in sulphide-bearing quartz-carbonate veins associated with listwanites along the fault zone [for example Farrel, Flagstaff (Motherlode)] and disseminated in altered rocks of the Takla and Slide Mountain groups (QCM claims).

The listwanite alteration is characterized by disseminated and/or porphyroblastic ankerite and pyrite with accompanying sericitization and silicification of the host rocks. An excellent example of the progressive alteration of mafic volcanics is exposed approximately 3 kilometres north of the confluence of the South Germansen and Germansen rivers, along the main road between Manson Creek and Germansen Landing. At this locality relatively undeformed chloritized mafic volcanics are progressively altered to a mariposite-pyrite-muscovite-quartz-carbonate schist over a distance of 20 metres. This carbonate rock is more strongly foliated than the surrounding volcanics indicating proximity to a shear zone which may have been a conduit for hydrothermal fluids.

FARREL SHOWING

The Farrel vein-hosted precious metal showing is located on the north shore of the Germansen River approximately 6 kilometres south of Germansen Landing. Quartz-carbonate veins which vary in width from 0.5 to 5 metres are mineralized with tetrahedrite, chalcopyrite and free gold. Eight 1-metre channel samples across the vein yielded values ranging from 1.30 to 32.57 grams per tonne gold (Davis and Aussant, 1984). The hostrocks are talc schist and mafic volcanics 10 to 20 metres north of a serpentinized ultramafic body. In core samples, the most encouraging gold value (4.11 grams per tonne gold) was obtained from a slightly altered volcanic (Davis and Aussant, 1984). These veins are not extensive but are typical of other precious metal showings in the area (McAllister, 1987; Ferri and Melville, 1988a; Armstrong, 1949).

QCM Claims

The QCM claims are located north of the Slate Creek headwaters and east of the Germansen River. They are underlain by Slide Mountain Group sediments, volcanics and ultramafics, and Takla Group epiclastic rocks. Both units have been affected by quartz-carbonate alteration and contain the assemblage *albite-muscovite-quartz-ankerite-pyrite* (Fox, 1981, Riccio *et al.*, 1982).

Soil geochemistry located two anomalous gold zones, each approximately 3000 metres long by 50 to 300 metres wide with gold in soils up to 2950 ppb (Fox, 1981). Further work delineated two zones, Flag and Central; the latter is 200 metres by 300 metres and open to the southeast with gold in soil ranging from less than 10 ppb to 4200 ppb (Riccio *et al.*, 1982). Bedrock below and around the central zone consists of quartz-carbonate-altered epiclastics of the Takla Group. Values of up to 3700 ppb and 1800 ppb gold were returned from two consecutive 1 metre chip samples in trenches (Riccio *et al.*, 1982). These results led to a reverse-circulation drilling program consisting of 4 holes totalling 412 metres. All these holes penetrated quartz-carbonate-altered Takla Group volcanic sandstones which had accompanying quartz veining (Riccio, 1983). Median gold values were 130 ppb (Hole 4) to 170 ppb (Hole 1). In Hole 2, a 5-metre section averaged 1.8 grams per tonne gold with a 1-metre section of 3.2 grams per tonne. Several 1-metre sections returned over 1 gram per tonne gold.

Generally, gold anomalies coincide with pyrite concentrations within the country rock and with quartz veinlets suggesting stockwork as opposed to vein mineralization as at the Farrel prospect.

DISCUSSION

A few generalizations can be made about precious metal mineralization in the area: (1) it is localized along the Manson fault zone, (2) it is associated with serpentinite and listwanite, and (3) it is associated with a silica-carbonate

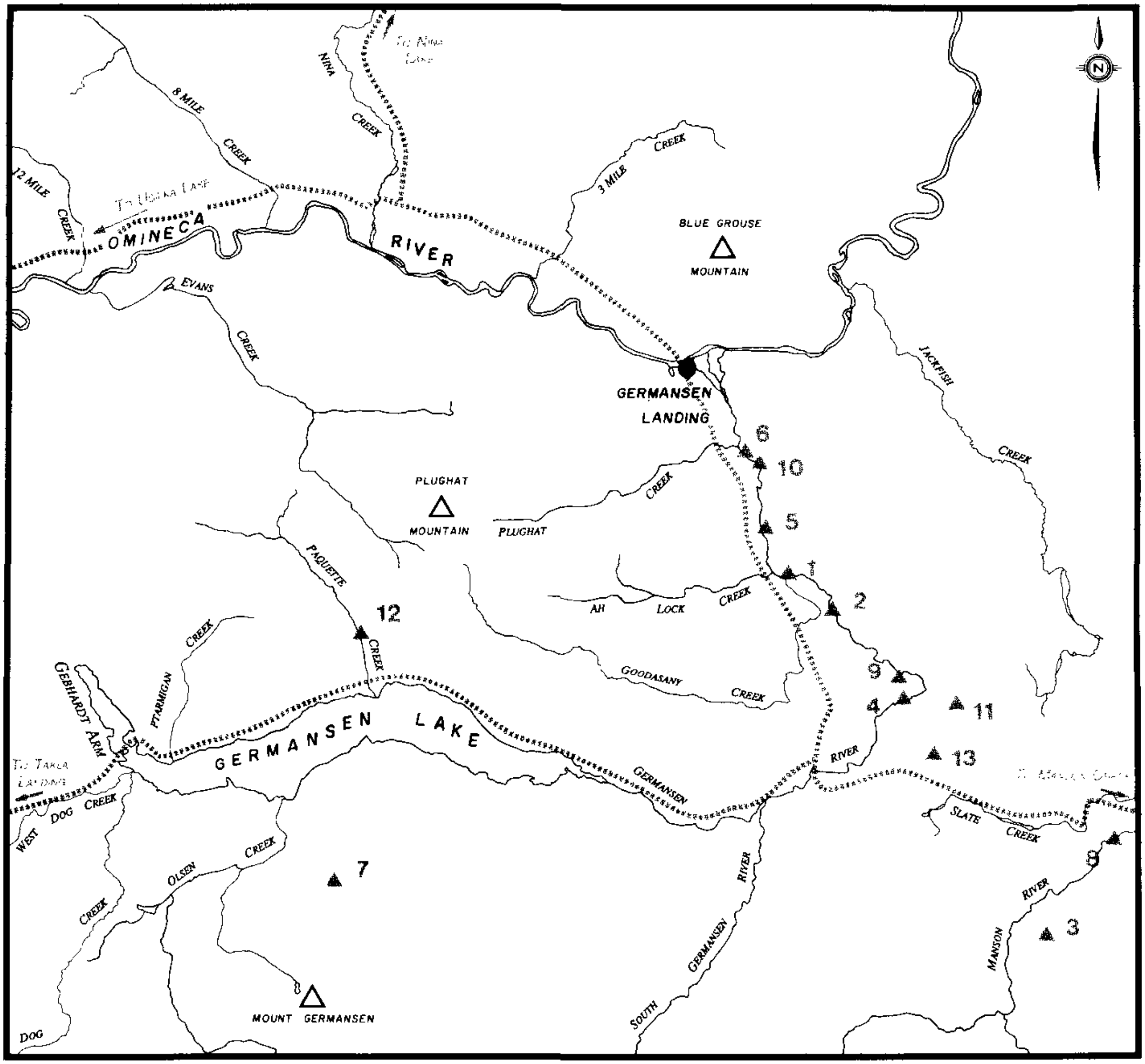

Figure 1-24-5. Location of known mineral occurrences in the project area recorded in MINFILE. Refer to Table 1-24-1 for detailed descriptions.

alteration. In the immediate map area ultramafite bodies are not identified north of the Omineca River and south of Gaffney Creek (Ferri and Melville, 1988a). This is also the known extent of lode and placer showings associated with altered ultramafite bodies. The association of gold-bearing veins with listwanites and serpentinized ultramafics in ophiolites of suture zones has long been known (Buisson and Leblanc, 1986). This same relationship appears to be present in the Manson Creek – Germansen Landing area.

SUMMARY

The north half of the Germansen Lakes (93N/10) and south half of the Germansen Landing (93N/15) sheets are largely underlain by rocks of the Takla and Slide Mountain groups of the Intermontane Belt. The Slide Mountain Group is subdivided into three units; a lower phyllite-argillite unit, a middle siliceous sediment unit and an upper basaltic unit. The Takla Group is made up of four units; the lower two units being epiclastic, the succeeding unit being predominantly pyroclastic and the fourth a thin upper epiclastic unit. The general trend within these volcaniclastics is for pyroclastics and flows in the west to give way to epiclastics eastward.

The major structural feature in the area is the Manson fault zone which is a strike-slip fault of unknown sense and displacement. It has numerous ultramafic and listwanite bodies along its trace and appears to have localized precious metal

TABLE 1-24-1
TABLE OF MINERAL OCCURRENCES (93N/10–NORTH HALF and 93N/15–SOUTH HALF)
(Refer to Figure 1-24-5 for locations)

Map	Type	MINFILE Number	Name	Economic Minerals	Geological Description
1	Asbestos	093N 115	Germansen River	Chrysotile	Asbestos is found in varying amounts in a serpentinized ultramafic body near and within the Manson fault zone.
2	Ultramafic-hosted base and precious metals	093N 116	Ah-Hoo Creek	Pentlandite, platinum, gold	Mineralization disseminated in pyrrhotite-bearing serpentinized ultramafic bodies within and near the Manson fault zone.
3	"	093N 022	Blackhawk	Galena, sphalerite, chalcopyrite, tetrahedrite, gold	Approximately nine quartz veins ranging from 38 to 150 cm wide within fractured and weakly metamorphosed Slide Mountain sediments near the Germansen batholith contain massive sulphides.
4	"	093N 024	Motherlode (Flagstaff)	Azurite, malachite, gold, tetrahedrite, chalcopyrite	Mineralization occurs in a shear related to the Manson fault separating a quartz-carbonate-altered andesite(?) and a pyritiferous argillite(?) of the Slide Mountain Group.
5	"	093N 025	Farrell	Tetrahedrite, chalcopyrite, gold	Mineralization occurs in three quartz veins in quartz-carbonate-altered and sheared Slide Mountain rock (andesite?) within the Manson fault zone.
6	Vein-hosted base and precious metals	093N 026	Sunset	Chalcopyrite, gold, silver	A pyrite and chalcopyrite-bearing quartz vein approximately 3 metres wide follows the plane of schistosity in quartz-rich schists near the Manson fault zone.
7	"	093N 029	Erickson	Chalcopyrite, silver, gold	Two quartz veins (20 and 40 cm wide) in sheared argillite of the Takla Group are intruded by aplite dykes near the Germansen batholith.
8	"	093N 063	Discovery Bar	Galena, sphalerite, tetrahedrite	Numerous quartz stringers are sparsely mineralized in a 3.65-metre shear zone separating quartz-carbonate-altered schists and black phyllites of the Slide Mountain Group.
9	"	093N 130	Not named	Tetrahedrite, gold	"
10	"	093N 144	Not named	Chalcopyrite, gold, galena, tetrahedrite	Numerous folded and semi-continuous pyritiferous quartz veins containing varying amounts of mineralization hosted by a well-foliated and pyritiferous quartz-rich schist.
11	"	093N 145	Not named	Chalcopyrite, tetrahedrite	Mineralization occurs in several quartz veins in Slide Mountain volcanics and sediments.
12	Volcanogenic (proximal) disseminated sulphides	093N 153	Not named	Chalcopyrite	Mineralization occurs in pyritiferous Takla Group andesitic flows, agglomerates and volcanic sandstones.
13	Disseminated/stockwork precious metals	093N 198	QCM Claims	Gold	Gold occurs disseminated or in quartz vein stockwork within quartz-carbonate-altered Takla volcaniclastics near the Manson fault zone.

vein mineralization which is associated with a quartz-sericite-carbonate alteration.

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