BABINE PROJECT*
(93L/10, 15)

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INTRODUCTION

This report summarizes work completed on the Babine Project during the 1986 field season. This project began in 1984 and was restricted to the Dome Mountain gold camp (MacIntye, 1985). Between July 4 and September 10, 1986, four geologists mapped the area shown in Figure 3-8-1 at 1 to 1:20 000 scale. The work was done from the town of Smithers using four-wheel-drive vehicles and helicopters for access. A total of 1350 geological stations have now been established within an area of approximately 900 square kilometres. The field data have been stored in computer files and can be obtained as a printout or on floppy disk in ASCII format. Mapping will continue to the north and south in 1987.

The objective of the Babine project is to develop a metallogenic model for the wide variety of mineral deposit types present in the Babine Range. The initial phase of this project was concerned with gold-bearing quartz veins of the Dome Mountain gold camp (MacIntyre, 1985). This work continued in 1986 with examination and sampling of drill core from the Forks, Boulder Creek and 9800 veins. Other properties in the map area were also visited and sampled. The Babine Project was partially funded by the Canada/British Columbia Mineral Development Agreement.

REGIONAL GEOLOGIC SETTING

West central British Columbia is part of the Stikine terrane. This terrane includes: submarine calc-alkaline to alkaline immature volcanic island arc rocks of the Late Triassic Takla Group; subaerial to submarine calc-alkaline volcanic, volcaniclastic and sedimentary rocks of the Early to mid-Jurassic Hazelton Group; Late Jurassic and Early Cretaceous successor basin sedimentary rocks of the Bowser Lake, Skeena, and Sustut Groups; and Late Cretaceous to Tertiary calc-alkaline continental volcanic arc rocks of the Kasalka, Ootsa Lake and Goosly Lake Groups. The younger volcanic rocks occur sporadically throughout the area, mainly in downdropped fault blocks and grabens. Plutonic rocks of Jurassic, Cretaceous and Tertiary age are known and form distinct intrusive belts or provinces (Carter, 1981). Mineral deposits include mesothermal and epithermal precious metal veins, porphyry copper and molybdenum deposits and stratabound polymetallic massive sulphide deposits. The general geology of west central British Columbia is shown in Figure 3-8-1.

GEOLOGY OF THE BABINE RANGE

The Babine Range is a northwest-trending horst of folded and faulted Jurassic and Cretaceous volcanic and sedimentary rocks bounded to the west and east by grabens containing Late Cretaceous and younger rocks. The structural setting is similar to the Basin and Range province of the United States and is probably related to extensional tectonics induced by right lateral movement on major north-trending transcurrent faults.

The geology of the Babine Range is characterized by asymmetric, southeast-plunging open folds that are truncated by northeast and northwest-trending high-angle faults (Figure 3-8-2). A progressive downward displacement of tilted fault blocks occurs to the northwest, with progressively younger rocks being preserved immediately northwest of the faults. Thus progressively higher stratigraphic levels are exposed going northwards into the Bowser Basin and away from the Skeena Arch.

An idealized north-south cross-section (Figure 3-8-3) shows the inferred stratigraphic relationships and position of mineral deposits in the 1986 study area. It is based on lithology and crosscutting relationships; fossil identifications and radiometric age dates are not yet available.

PRE-HAZELTON ROCKS

Greenstone-Sill Complex (TrJsc)

The oldest rocks in the Babine Range may be exposed on the steep north-facing slope of Mount McKendrick, where a thick section of south-dipping greenstones, containing numerous leucogranite sills, is overlain by a polymictic boulder conglomerate. The conglomerate contains flattened leucogranite and greenstone clasts suggesting it is an erosion surface at the top of the greenstone-sill complex. The conglomerate may be the basal member of the Early Jurassic Telkwa Formation. Both the greenstones and conglomerates are foliated and have similar styles of folding suggesting they have been through the same deformational event. A sample of leucogranite has been collected for uranium-lead age-dating of zircons. The greenstones are tentatively assigned to the Late Triassic Takla Group.

HAZELTON GROUP

The Hazelton Group (Leach, 1910) is an island-arc assemblage that was deposited in the northwest-trending Hazelton trough in early to middle Jurassic time. Tipper and Richards (1976) divide the group into three major formations in the Smithers map-area (93L). These are the Late Sinemurian to Early Pliensbachian Telkwa Formation, the Early Pliensbachian to Middle Toarcian Nilkitkwa Formation, and the Middle Toarcian to Lower Callovian Smithers Formation.

TELKWA FORMATION

The Telkwa Formation, which is comprised of subaerial and submarine pyroclastic and flow rocks with lesser intercalated sediments, is the thickest and most extensive formation of the Hazelton Group. The mixed subaerial to submarine Babine Shelf facies of the Telkwa Formation, which separates the subaerial Howson facies to the west from the submarine Kotsine facies to the east, underlies the Babine Range (Tipper and Richards, 1976).

We have subdivided the Telkwa Formation into four map units. These are: (1) polymictic conglomerate (lJT1); (2) porphyritic andesite (lJT2); (3) fragmental volcanic rocks (lJT3); and (4) phyllitic maroon tuff (lJT4). Units 1 and 4 are believed to be present throughout the map area; Units 2 and 3 are interpreted to be facies that are restricted to major volcanic centres with lithological variations reflecting thinning and fining away from eruptive vents.

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* 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.

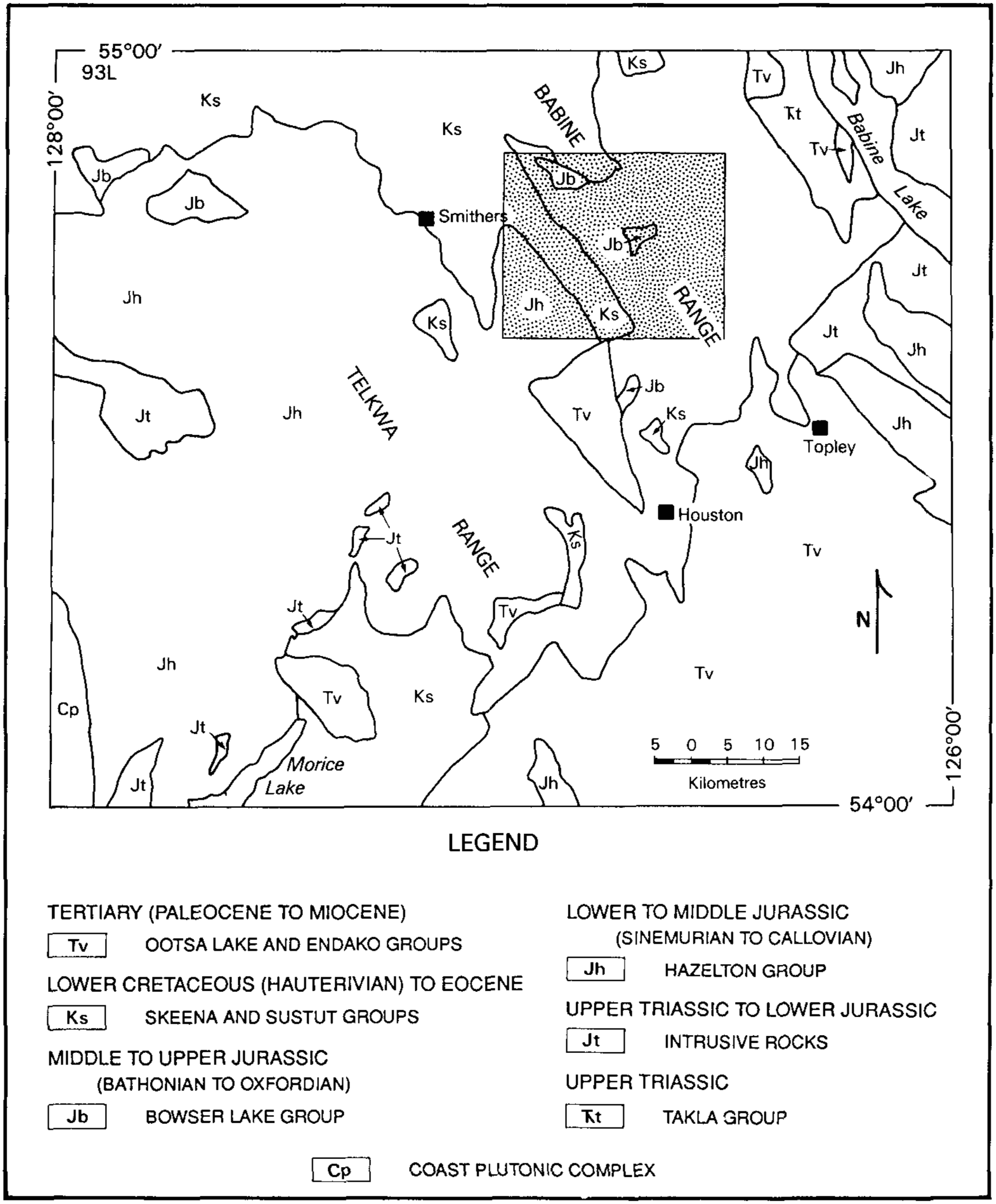
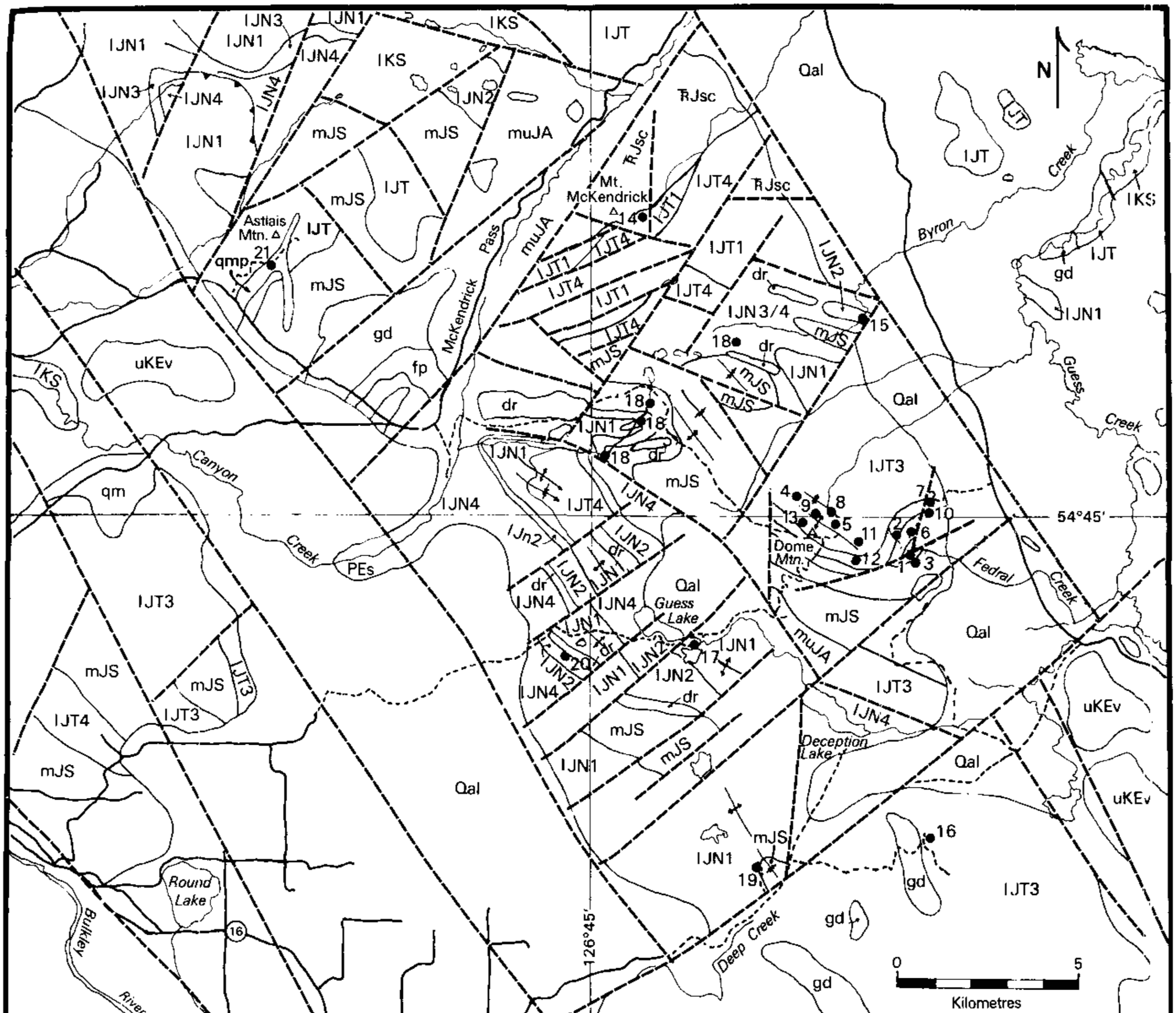


Figure 3-8-1. Location of the Babine Project and general geology of the Smithers map area.



LEGEND

QUATERNARY

Qal	*alluvium*

PALEOCENE TO EOCENE

PEs	*mudstone, siltstone*

LATE CRETACEOUS TO TERTIARY

uKEv	*andesitic volcanic rocks*

EARLY CRETACEOUS – SKEENA GROUP

lKS	*RED ROSE FORMATION* *micaceous wacke, siltstone, conglomerate, mudstone*

LATE JURASSIC

BOWSER LAKE GROUP

muJA	*ASHMAN FORMATION* *argillite, shaly siltstone, quartzose turbidites*

EARLY TO MIDDLE JURASSIC

HAZELTON GROUP

mJS	*SMITHERS FORMATION* *tuffaceous wacke, siltstone, conglomerate*
lJN4	*NILKITKWA FORMATION* *thin bedded argillite, chert and limestone*
lJN3	*tuffaceous conglomerate, siltstone, cherty tuff*
lJN2	*rhyolitic volcanic rocks*
lJN1	*red epiclastics, amygdaloidal flows, foliated lapilli tuff*
lJT4	*TELKWA FORMATION* *phyllitic maroon tuff*
lJT3	*fragmental volcanic rocks*
lJT2	*porphyritic andesite*
lJT1	*polymictic conglomerate, epiclastic rocks*

TRIASSIC TO LOWER JURASSIC

ŦRJsc	*greenstone – sill complex*

INTRUSIVE ROCKS

dr	*diorite*
gd	*granodiorite*
qmp	*quartz monzonite porphyry*
fp	*feldspar porphyry*
qp	*quartz porphyry*

MINERAL OCCURRENCES

	Type	Occurrence Name	Commodity
1	Qz Vein	Dome Mtn. – Forks	Au, Ag, Zn, Pb, Cu, (As, Sb)
2	Qz Vein	Dome Mtn. – Cabin	Au, Ag, Zn, Pb, Cu, (As, Sb)
3	Qz Vein	Dome Mtn. – 9800	Au, Ag, Zn, Pb, Cu, (As, Sb)
4	Qz Vein	Dome Mtn. – Ptarmigan	Au, Ag, As, Zn, Pb, Cu
5	Qz Vein	Dome Mtn. – Hawk	Au, Ag, As, Zn, Pb, Cu
6	Qz Vein	Dome Mtn. – Boulder	Au, Ag, Zn, Pb, Cu
7	Qz Vein	Dome Mtn. – Free Gold	Au, Ag, Zn, Pb, Cu
8	Qz Vein	Dome Mtn. – Eagle	Au, Ag, Zn, Pb, Cu
9	Qz Vein	Dome Mtn. – Gem	Au, Ag, Zn, Cu, Pb
10	Qz Vein	Dome Mtn. – Chance	Au, Ag, Cu, Zn, Pb
11	Qz Vein	Dome Mtn. – Hoopes	Au, Ag, Cu, Pb, Zn
12	Qz Vein	Dome Mtn. – Jane	Au, Ag, Cu, (Zn, Pb, Ba)
13	Qz Vein	Dome Mtn. – Raven	Au, Ag, Cu
14	Qz Vein	Mt. McKendrick	Au, Ag, Pb, Zn, Cu, (As, Sb)
15	Cu Vein	Tina	Cu, Ag
16	Cu Vein	Brenda, Tony	Cu, Ag
17	Cu Vein	Camp Lake	Cu, Ag
18	Massive	Ascot	Zn, Pb, Ba
19	Massive	Del Santo	Cu, Zn, Ag
20	Porph	Burbridge Lake	Cu, Mo
21	Porph	Big Onion	Cu, Mo

Figure 3-8-2. Preliminary geology of the Babine Range.

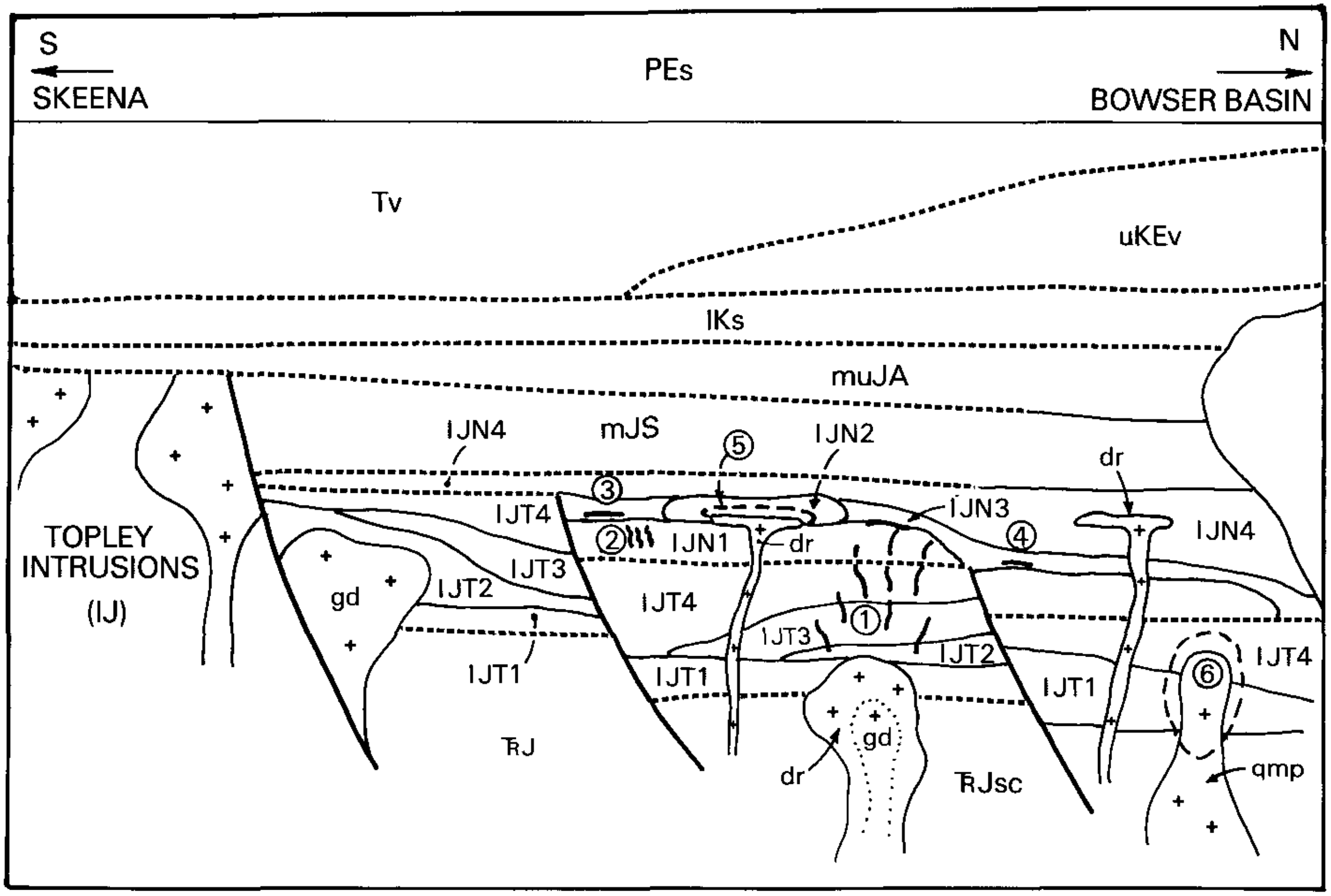


Figure 3-8-3. Schematic north-south cross section showing stratigraphic relationships and position of mineral deposits.

Polymictic Conglomerate Unit (lJT1)

The polymictic conglomerate unit is well-exposed south of Mount McKendrick. It is characterized by clasts of leucogranite and greenstone that are identical to the underlying greenstone-sill complex (TrJgs). The conglomerate is strongly deformed and clasts are flattened parallel to foliation planes. Clasts are up to 20 centimetres in diameter immediately above the greenstone sill complex and gradually decrease in size up section.

Porphyritic Andesite Unit (lJT2)

In the Babine Range, fragmental volcanic rocks of the Telkwa Formation contain mainly porphyritic andesite clasts, even though flows of porphyritic andesite are rare. A massive andesite flow does occur near the Free Gold vein but elsewhere the Telkwa Formation is predominantly fragmental. Flows may have been restricted to the immediate vicinity of eruptive centres, forming volcanic cones or stratovolcanoes. The volcanic edifices were probably largely eroded prior to the Nilkitkwa marine transgression, thus explaining the preponderance of porphyritic andesite detritus in Telkwa and Nilkitkwa epiclastic rocks.

Fragmental Volcanic Unit (lJT3)

A chaotic assemblage of lahar, tuff-breccia and lapilli tuff, with lesser intercalations of lithic, crystal and ash tuff and volcanic-derived sedimentary rocks, crops out on Dome Mountain. These rocks are purple, mauve, green and grey and contain clasts of porphyritic andesite or crystal tuff that range from less than 1 centimetre to 35 to 40 centimetres in diameter in a fine-grained matrix of feldspar crystal and lithic fragments. In places the clasts are flattened and elongate parallel to bedding. Beds comprised of large rounded bombs up to 30 centimetres in diameter, floating in a fine-grained ash matrix, are not uncommon. Finer grained tuff beds within the unit are strongly foliated subparallel to bedding.

Coarse fragmental rocks underlie Dome Mountain. These rocks are probably proximal to an eruptive centre and may be part of an eroded stratovolcano. Some of the beds appear to be primary having been deposited as hot, gas-charged flows; other beds are clearly reworked and represent secondary erosional deposits. The fragmental rocks thin and fine to the north and west, further evidence that Dome Mountain represents a major volcanic centre.

In general, fragmental rocks of the Telkwa Formation become finer grained northwards along the Babine Range. This suggests that the Skeena Arch, which transects the southern end of the range, may have been a volcanic arc in early Jurassic time. Volcanic detritus was apparently shed north and northeastward into a back arc basin (Bowser Basin and Hazelton trough).

Phyllitic Maroon Tuff Unit (lJT4)

The conglomerate (lJT1) and coarse fragmental units (lJT3) are both overlain by fine-grained phyllitic red to maroon tuff or epiclastics. These rocks have a well-developed slaty cleavage and are typically tightly folded. The maroon tuff may have been deposited late in the evolution of the Hazelton calc-alkaline volcanic arc, in a predominantly subaerial environment.

The Geological Survey of Canada has mapped the maroon tuff unit as the Toarcian red tuff member of the upper Nilkitkwa Formation but the present study suggests that in this area, it is part of the upper Telkwa Formation. Our interpretation is that the maroon tuff stratigraphically underlies sedimentary strata containing a Late Pliensbachian pelecypod (Tipper, personal communication), therefore the maroon tuff must be at least Pliensbachian or older.

NILKITKWA FORMATION

The Nilkitkwa Formation conformably to disconformably overlies the Telkwa Formation and is an important host for mineral occurrences in the Babine Range. West of the Babine Range it is comprised of predominantly red epiclastic rocks; to the east it includes Early Pliensbachian to mid-Toarcian transgressive marine sedimentary rocks that overlie rhyolite and basalt flows and red epiclastic rocks.

We have subdivided the Nilkitkwa Formation into four map units. These are: (1) interbedded red epiclastics and amygdaloidal flows (lJN1); (2) rhyolitic volcanic rocks (lJN2); (3) tuffaceous conglomerate, cherty tuff and siltstone (lJN3); and (4) thin-bedded argillite, chert and limestone (lJN4).

Red Epiclastic and Amygdaloidal Flow Unit (lJN1)

A distinctive unit of well-bedded red epiclastic rocks and green to maroon amygdaloidal flows and welded tuffs overlies phyllitic maroon tuffs of the Telkwa Formation. This unit is well exposed on the south slope of Dome Mountain, in Fedral Creek above and below the Forks showing, along the height of land south of Guess Lake and northwest of Astlais Mountain (Figure 3-8-2).

Previous workers have mapped the red epiclastic/amygdaloidal flow unit as part of the Telkwa Formation. In this study it is mapped as the basal part of Nilkitkwa Formation because: (1) the red epiclastic rocks represent erosion of the Telkwa Formation in a subaerial environment; (2) the amygdaloidal flows are compositionally distinct from the calc-alkaline rocks of the Telkwa Formation and represent a change to rift-type volcanism; and (3) the amygdaloidal flows were deposited in a submarine environment during the early stages of the Nilkitkwa marine transgression. The amygdaloidal flows are lithologically similar to the Carruthers Member of the Nilkitkwa Formation as described by Tipper and Richards (1976).

Rhyolitic Volcanic Unit (lJN2)

Locally flow-banded rhyolite and cherty tuff overlies the red epiclastic/amygdaloidal flow unit. Near Burbridge Lake the rhyolite is welded with flattened clasts that are typically replaced by limonite. The rhyolites dip southwest and may be several hundred metres thick. Limy siltstones and argillites crop out further southwest and appear to overlie the rhyolite unit. A thick section of massive rhyolite overlain by thin-bedded chert and limy siltstone is also exposed in lower Byron Creek. Elsewhere the rhyolites are absent or very thin. At Dome Mountain a mottled cherty tuff occurs at the same stratigraphic position as the rhyolitic volcanic rocks and may be their distal equivalent.

We have interpreted the rhyolites to be domes that were built on a mafic volcanic pile. Angular felsic clasts in laterally equivalent conglomerates were probably derived from erosion of these domes; alternatively the clasts may be of an airborne origin, related to explosive eruption at felsic volcanic centres. Small stratabound polymetallic massive sulphide occurrences are found at the same stratigraphic position as the rhyolites.

Tuffaceous Conglomerate — Siltstone (lJN3)

A thin unit of brown to buff-weathering granule to pebble conglomerate, with intercalated beds of volcanic wacke and siltstone, overlies the red epiclastic/amygdaloidal flow unit. These sedimentary rocks typically contain angular felsic clasts in a silty matrix. At Dome Mountain, near the Forks showing, this unit contains poorly preserved Pliensbachian pelecypods (*Jaworskiella* cf. *J. siemonmulleri* Poulton, identification by H. Tipper, Geological Survey of Canada). The fossiliferous beds overlie beds of mottled cherty tuff.

Thin-Bedded Argillite, Chert and Limestone Unit (lJN4)

A recessive unit of thin-bedded, rusty weathering silty argillite, with minor dark chert and argillaceous limestone interbeds, overlies the lower volcanic members of the Nilkitkwa Formation. The unit typically has a well-developed slaty cleavage, tight small-scale fold structures, and disseminated and laminated pyrite. Fossils are generally absent.

The Babine Range is near the western and southern limit of the Nilkitkwa Formation (Tipper and Richards, 1975). West of the range, near Round Lake, siltstones containing Bajocian age fossils (Tipper, personal communication) overlie Telkwa Formation rocks; the Nilkitkwa Formation is absent. South of Guess Lake the lower volcanic members of the Nilkitkwa Formation are present but these rocks are overlain by probable Smithers Formation or younger strata; the conglomerate and thin-bedded rusty argillite units of the Nilkitkwa Formation are absent or very thin. This suggests exposure and erosion of Nilkitkwa Formation along the northern margin of the Skeena Arch during a late Early to early Middle Jurassic marine regression.

SMITHERS FORMATION (mJS)

In the northern part of the Babine Range, the Smithers Formation, which is predominantly Bajocian in age, disconformably overlies the Nilkitkwa Formation. It is comprised of fossiliferous sandstone and siltstone, with lesser intercalated felsic tuff, that was deposited during a marine regression. To the south and west of the Babine Range, the Smithers Formation rests directly on Telkwa Formation or is absent.

North of Guess Lake, up to 300 metres of monotonous, medium to thick-bedded, orange to brown-weathering, dark grey limy siltstone and mudstone overlies rusty thin-bedded graphitic argillite, chert and limestone of the Nilkitkwa Formation. This unit is relatively resistant; it forms the south spur of Dome Mountain and caps ridges in the area east of Canyon Creek. The siltstone has a slaty cleavage in places. Fossils collected in the area northwest of Dome Mountain have been tentatively identified as Middle Jurassic (Tipper, personal communication). These rocks are therefore assigned to the Smithers Formation. Our previous work on Dome Mountain (MacIntyre, 1985) included these rocks with the Nilkitkwa Formation, but we now place the Nilkitkwa-Smithers boundary at the top of the thin-bedded, rusty argillite unit as defined in this study.

On Dome Mountain, the thick-bedded siltstone grades up section into a relatively thin unit of well-bedded dark grey argillaceous limestone, limy siltstone, and wacke, with a few thin beds of pebble conglomerate and chert. These rocks crop out near the southeast end of Dome Mountain ridge and in the lower road cuts on the southwest slope, above Marjorie Creek. The limestone beds weather in positive relief producing a ribbed appearance on outcrop surfaces. These rocks are also included with the Smithers Formation.

Massive, poorly bedded, light green, calcareous crystal tuff or volcanic wacke, with rare intercalations of argillaceous limestone and shaly siltstone, characterizes the upper part of the Smithers Formation on Dome Mountain. The succession is estimated to be at least 500 metres thick.

Well-bedded fossiliferous siltstones and wackes of the Smithers Formation are exposed in a downdropped, wedge-shaped fault block northeast of Astlais Mountain (Figure 3-8-2). These rocks are in fault contact with Nilkitkwa and Telkwa Formation rocks to the northwest and southeast respectively.

BOWSER LAKE GROUP

Within the Hazelton trough, successor basin deposits of the Bowser Lake Group (Duffell and Souther, 1964) conformably overlie the Smithers Formation. These rocks range in age from Late

Bajocian to Early Oxfordian. Only the lowermost Ashman Formation is present in the study area. It was deposited during a mid-Jurassic marine transgression that apparently advanced as far south as the Skeena Arch (Tipper and Richards, 1976). To the west, within the Telkwa basin, both the Smithers and Ashman Formations are absent and Early Cretaceous rocks of the Skeena Group rest directly on Telkwa Formation or the lower volcanic members of the Nilkitkwa Formation (Jahak Koo, personal communication).

ASHMAN FORMATION (muJA)

In the Babine Range, the Ashman Formation is mainly dark grey to black shale with lesser intercalations of quartzose wacke and chert-pebble conglomerate. These quartz and chert-bearing turbidite interbeds distinguish this unit from lithologically similar, thin-bedded shales and argillites of the Nilkitkwa Formation. The Ashman Formation is also more fossiliferous.

In the absense of fossils, the Ashman Formation is difficult to distinguish from the overlying Red Rose Formation of the Skeena Group which is also mapped as black shale and chert-pebble conglomerate. The coarse clastic beds of the Red Rose Formation often contain detrital mica and this has been used by other workers to distinguish the two formations.

The black shales and quartzose turbidites exposed northeast of Astlais Mountain, northwest of Dome Mountain and immediately north of Mount McKendrick, are tentatively assigned to the Ashman Formation because they are nonmicaceous and contain some fossils of probable late Jurassic age (Tipper, personal communication).

The Ashman Formation was deposited during a major marine transgression. On Grouse Mountain, immediately south of the 1986 map area, Lower Callovian rocks of the Ashman Formation rest directly on Telkwa Formation suggesting considerable southern advancement of the sea onto the Skeena Arch. Tipper and Richards (1975) report the occurrence of clasts of Topley granite in Ashman rocks, indicating erosion and unroofing of the Hazelton volcanic arc had begun by late Middle Jurassic time.

SKEENA GROUP

The Skeena Group (Leach, 1910) comprises interbedded marine and nonmarine sedimentary strata of an Early Cretaceous successor basin. West of Telkwa these rocks unconformably overlie Telkwa volcanic rocks and contain important coal seams (Koo, 1984). The coal seams occur in upward-fining fluvial clastic sequences of conglomerate, sandstone, siltstone and mudstone.

RED ROSE FORMATION (lKS)

The Geological Survey of Canada has mapped much of the area north of McKendrick Pass as the Red Rose Formation (Sutherland Brown, 1960) of the Skeena Group. It is uncertain what criteria have been used to establish the age of these rocks. Lithologies within the area mapped as Red Rose vary from well-bedded sandstone, mudstone and pebble conglomerate to graphitic black shale. In this study, the black shale is mapped as Ashman and Nilkitkwa Formations.

Skeena Group sandstones and mudstones, with well-preserved shelly fossils, also crop out along Guess Creek where it cuts through the plateau area east of the Babine Range. These rocks contain seams of sub-bituminous coal that have been upgraded to meta-anthracite near rhyolite dykes (G. White, personal communication).

LATE CRETACEOUS TO TERTIARY ROCKS

Late Cretaceous to Tertiary volcanic and sedimentary rocks are preserved within the Driftwood Creek graben (name proposed in this study), immediately west of the Babine Range. Similar rocks may also underlie much of plateau area east of the range.

Flow-banded rhyolites crop out in a low-lying area west of Astlais Mountain. They are tentatively correlated with the Eocene Ootsa Lake Group. These rocks appear to be altered and may have some epithermal vein potential.

Paleocene mudstone and shale crop out along Canyon and Driftwood Creeks. The Driftwood Creek exposures contain well-preserved plant, fish and insect fossils.

Lapilli tuffs and porphyritic andesite flows crop out southeast of Deception Lake; prominent quartz eyes distinguish them from Jurassic volcanic rocks. They are tentatively mapped as Late Cretaceous to Tertiary and may correlate with the Brian Boru (Sutherland Brown, 1960) or Tip Top Hill volcanic rocks (Church, 1970). The aeromagnetic signature of this area is also consistent with the presence of young volcanic rocks, with frequent reversals in magnetism producing an irregular pattern of highs and lows.

DIORITIC INTRUSIONS

Several small elongate dykes or sills of fine to medium-grained diorite or diabase intrude Hazelton Group rocks in the Babine Range. The sills are often foliated parallel to their contacts. These intrusions cut the Nilkitkwa, Smithers and possibly Ashman Formations and are therefore younger than Middle Jurassic. The diorites have a pervasive foliation which has the same orientation as their host rocks. Similar intrusions occur in the Tahtsa Lake area and are genetically related to earliest Late Cretaceous volcanic rocks of the Kasalka Group (MacIntyre, 1985).

GRANITIC INTRUSIONS

Several multiphase granitic intrusions crop out southeast of Astlais Mountain, on the Big Onion property. One of these, a northeast-trending, altered quartz-feldspar porphyry to porphyritic quartz diorite dyke cuts hornfelsed Telkwa volcanic rocks. The University of British Columbia geochronology laboratory has calculated a potassium-argon isotopic age of 117 ± 4 million years (Ma) on a whole rock sample of the sericite-altered porphyry and 74.7 ± 2.6 Ma on biotite from a small, unaltered hornblende granodiorite stock to the east (samples collected in 1977 and 1979 by Dr. Colin Godwin, The University of British Columbia). Biotite extracted from a postmineral quartz monzonite dyke that cuts these intrusions gave an isotopic age of 48.7 ± 1.9 Ma (Carter, 1981). The geochronology laboratory has also dated biotite from a small granodiorite stock on the Del Santo property at 47.1 ± 1.6 Ma. The older granitic rocks correlate with the Bulkley intrusions as defined by Carter (1981); the younger ages with the Nanika intrusions.

The Geological Survey of Canada has mapped several granitic intrusions south of Deep Creek as correlative with the early Jurassic Topley intrusions (Carter, 1981). This correlation is based on lithological similarity. The Eocene age determined for the granodiorite at Del Santo suggests some of these intrusions may be much younger than Jurassic.

DYKES

Dykes of basalt, andesite and rhyolite with varying orientations cut Cretaceous and younger rocks in the Babine Range. The dykes may have been feeders to Tertiary flows.

STRUCTURE

Phyllitic maroon tuff and thin-bedded, fine-grained argillaceous rocks of the Babine Range have a well-developed slaty cleavage. This early cleavage has been folded into tight asymmetric and locally recumbent minor folds that generally plunge gently to moderately to the southeast and east (Figure 3-8-4). A weakly developed crenulation or fracture cleavage, axial planar to minor folds, dips steeply northeast. These minor folds reflect the presence of larger

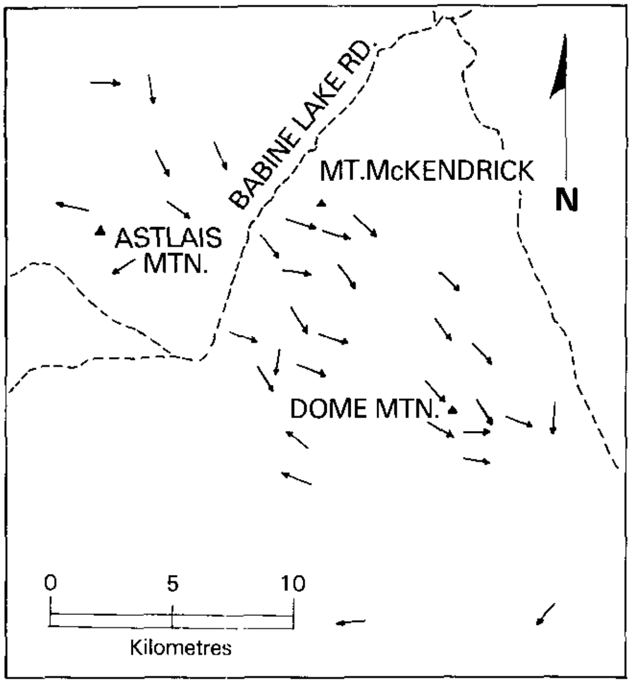


Figure 3-8-4. Fold axis trends, Babine Range.

asymmetric folds with similar orientation. The folds are cut and offset by northeast-trending, high-angle faults which are roughly parallel to a prominent C-joint direction.

The Geological Survey of Canada (Open File 351) has mapped several southwest-dipping thrust faults. No compelling evidence for these faults was observed during the mapping program. In fact, if the orientation of fold structures has been correctly interpreted, northeast rather than southwest-dipping thrusts would be expected. There are probably numerous thrusts and bedding plane detachments within incompetent fine-grained clastic units, but the amount of displacement is probably quite small. Almost all of the contacts between geologic units in the Babine Range are faults, but most of these are high-angle normal, reverse and transcurrent faults; few, if any, appear to be true thrust faults.

The most prominent joint orientation is northeast, roughly perpendicular to major fold axes. These steep, northwest-dipping C-joints also parallel prominent airphoto linears and several major high-angle faults which offset the stratigraphy.

The timing of folding and faulting is not well established. However, elsewhere in west-central British Columbia, folding and uplift occurred after Albian time and before construction of the Late Cretaceous continental volcanic arc (MacIntyre, 1985). Block faulting and Basin and Range type extensional tectonics are probably latest Cretaceous to Tertiary in age. Some rifting and extrusion of basalt may have accompanied basin subsidence in the Jurassic and early Cretaceous, but these early faults are difficult to recognize because of the younger tectonic overprint. Some of the quartz veins on Dome Mountain have been folded and broken suggesting some of the mineralization within the camp predates deformation.

METALLOGENY OF THE BABINE RANGE

Mineral deposits in the Babine Range can be subdivided into six groups (Table 3-8-1). These are: (1) mesothermal gold-silver-bearing quartz veins; (2) copper-silver veins in mafic and felsic volcanic rocks; (3) copper-zinc-silver massive sulphide deposits associated with mafic flows; (4) polymetallic massive sulphide occurrences associated with rhyolitic volcanic rocks; (5) porphyry copper-molybdenum deposits associated with dioritic sills; and (6) porphyry copper-molybdenum deposits associated with quartz monzonite intrusions. The stratigraphic position of these deposits is shown diagrammatically in Figure 3-8-3.

MESOTHERMAL QUARTZ VEINS

DOME MOUNTAIN CAMP

The geology and mineral deposits of the Dome Mountain camp have been described in a previous report (MacIntyre, 1985). This report focuses on recent exploration, mainly on the Forks, Boulder Creek and 9800 showings. The location of quartz veins on Dome Mountain is shown in Figure 3-8-5. Characteristics of the veins are summarized in Table 3-8-1.

TABLE 3-8-1 — MINERAL OCCURRENCES IN THE STUDY AREA

Type	Occurrence Name	Commodity	Host
1 QZ VEIN	Dome Mtn. — Forks	Au, Ag, Zn, Pb, Cu, (As, Sb)	lJN1
1 QZ VEIN	Dome Mtn. — Cabin	Au, Ag, Zn, Pb, Cu, (As, Sb)	lJT4
1 QZ VEIN	Dome Mtn. — 9800	Au, Ag, Zn, Pb, Cu, (As, Sb)	lJN4
1 QZ VEIN	Dome Mtn. — Ptarmigan	Au, Ag, As, Zn, Pb, Cu	lJT3
1 QZ VEIN	Dome Mtn. — Hawk	Au, Ag, As, Zn, Pb, Cu	lJT3
1 QZ VEIN	Dome Mtn. — Boulder	Au, Ag, Zn, Pb, Cu	lJN1
1 QZ VEIN	Dome Mtn. — Free Gold	Au, Ag, Zn, Pb, Cu	lJT2
1 QZ VEIN	Dome Mtn. — Eagle	Au, Ag, Zn, Pb, Cu	lJT3
1 QZ VEIN	Dome Mtn. — Gem	Au, Ag, Zn, Cu, Pb	lJT3
1 QZ VEIN	Dome Mtn. — Chance	Au, Ag, Cu, Zn, Pb	lJT3
1 QZ VEIN	Dome Mtn. — Hoopes	Au, Ag, Cu, Pb, Zn	lJT3
1 QZ VEIN	Dome Mtn. — Jane	Au, Ag, Cu, (Zn, Pb, Ba)	lJT4
1 QZ VEIN	Dome Mtn. — Raven	Au, Ag, Cu	lJT3
1 QZ VEIN	Mt. McKendrick	Au, Ag, Pb, Zn, Cu, (As, Sb)	TrJ?
2 CU VEIN	Tina	Cu, Ag	lJN2
2 CU VEIN	Brenda, Tony	Cu, Ag	lJN1
2 CU VEIN	Camp Lake	Cu, Ag	lJN1
3 MASSIVE	Ascot	Zn, Pb, Ba	lJN4
4 MASSIVE	Del Santo	Cu, Zn, Ag	lJN1
5 PORPH	Burbridge Lake	Cu, Mo	lJN2
6 PORPH	Big Onion	Cu, Mo	lJT

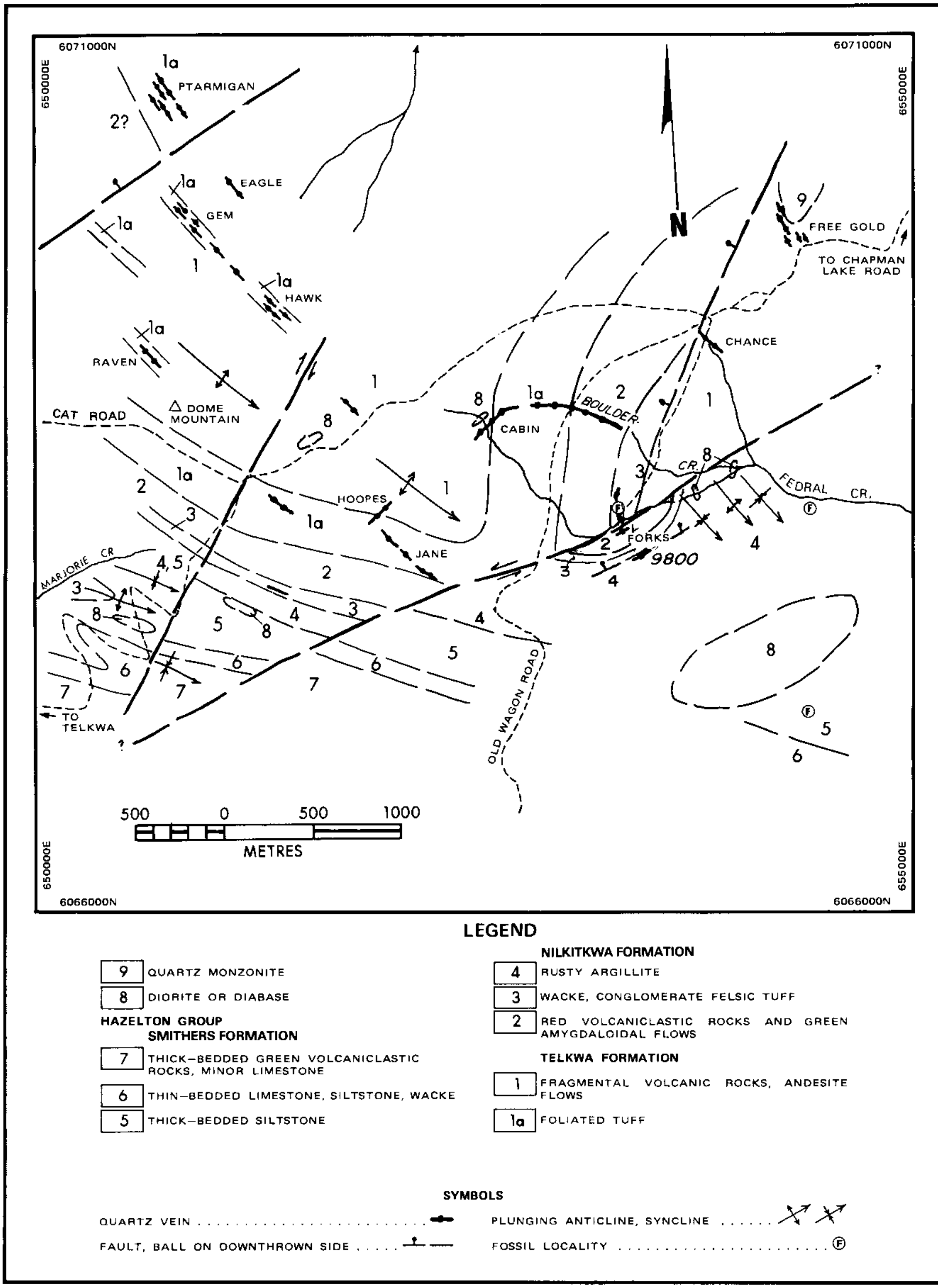


Figure 3-8-5. Geological sketch map of the Dome Mountain gold camp.

Recent Exploration Activity

During the 1984 field season all the properties on Dome Mountain, with the exception of the Free Gold, were under option to Noranda Exploration Ltd. In 1984 and 1985, Noranda soil sampled on a newly cut grid, built a road, and completed 68 trenches and 20 diamond-drill holes, mainly in the vicinity of the Forks deposit. The Hoopes, Cabin, and Hawk veins were also drill tested. In November 1985, Canadian United Minerals Inc., which has a 25 per cent carried interest in the project, became the operator and early in 1986, discovered a new vein near Boulder Creek by trenching a soil geochemical anomaly. Canadian United subsequently completed 48 drill holes on this vein, with encouraging results. The Boulder Creek vein is now the main exploration target on Dome Mountain

An agreement has recently been completed between Canadian United Minerals Inc., Reako Explorations Ltd., Panther Mines Ltd., Noranda Exploration Ltd., Teeshin Resources Ltd. and Total Erickson Resources Ltd., whereby Total Erickson will become project manager and Canadian United will acquire a 100 per cent interest in the property (George Cross Newsletter, Number 207, October 28, 1986). Total Erickson will provide $6 million for 7 000 000 common shares of Canadian United. Of these funds, $2.9 million is to be spent on development of current reserves and a production feasibility study.

Vein Characteristics

Most of the veins on Dome Mountain trend northwest and dip steeply to the northeast or southwest; the Hoopes, Cabin and Boulder Creek veins trend northeast and may be part of the same vein system.

Several different stratigraphic units host the quartz veins. The most economically significant veins, the Forks and Boulder Creek, occur in the red epiclastic-amygdaloidal flow unit of the lower Nilkitkwa Formation. The Boulder Creek vein crosscuts this unit and probably extends into the phyllitic maroon tuff of the Telkwa Formation as it approaches the Cabin vein. The thin-bedded argillite unit of the Nilkitkwa Formation hosts the 9800 vein; all other veins on Dome Mountain occur in phyllitic tuff of the Telkwa Formation. These veins both parallel and crosscut the foliation. The Free Gold veins are an exception; they are hosted by massive andesite and a quartz-feldspar porphyry intrusion.

The quartz veins vary from a few centimetres up to 3 metres in width. Some veins are lenticular and locally folded and brecciated; others have considerable lateral continuity with little variation in attitude and do not appear to be deformed.

A lime green mica is common within the most intensely altered zones. Originally believed to be fuchsite or mariposite, it has now been identified by the Geological Survey Branch analytical laboratory as a green variety of sericite.

Boulder Creek — Cabin Vein

The Boulder Creek vein strikes east and dips 50 to 60 degrees south. Surface exposures are restricted to a series of trenches across the vein (Figure 3-8-6). Canadian United dug these trenches because of moderately anomalous zinc concentrations in two adjacent soil samples. Drilling has subsequently defined a quartz-carbonate vein containing sphalerite, galena and minor chalcopyrite, within a zone of strong sericitic wallrock alteration, that extends at least 400 metres along strike and persists to a vertical depth greater than 140 metres. The vein cuts diagonally across amygdaloidal flows and foliated tuff of the Nilkitkwa Formation (lJN1). The best intersection is 16.5 metres of 17 grams/tonne (54 feet of 0.49 ounces/ton) gold. Canadian United Minerals has calculated a geological reserve of 240, 000 tons (218 000 tonnes) grading 0.458 ounces/ton (15.57 grams/tonne) gold and 2.32 ounces/ton (78.88 grams/tonne) silver (Don Harrison, personal communication). It is likely that the Boulder Creek vein is the same as the Cabin vein which is located 350 metres on strike to the west. Thus the vein is likely to exceed 750 metres in length.

Noranda has completed ore microscopy studies of samples from the Boulder Creek vein. Relatively coarse gold occurs on sulphide boundaries and as microveinlets within sulphide grains; moderate grinding should liberate most of this gold.

The Cabin vein outcrops near the headwaters of Fedral Creek, where it is approximately 3 metres wide and strikes northeast. The quartz-carbonate vein contains abundant pyrite with lesser galena, sphalerite, chalcopyrite and arsenopyrite. Gold values are reported to be relatively low (Minister of Mines Annual Report, 1922). The vein crosscuts the foliation in a narrow zone of strongly altered and foliated rock that bounds the vein. The history of underground exploration at the Cabin vein is described more fully in a previous report (MacIntyre, 1985).

The Geological Survey Branch analytical laboratory has completed analyses on seven grab samples from the Cabin vein (Table 3-8-2). The maximum gold value was 12.3 grams/tonne.

Forks Vein (Mineral Inventory 093L-022)

The history of the Forks showing and a description of the underground workings are contained in a previous report (MacIntyre, 1985). Stream deposits now cover the original showing, which is reported to occur in the bed of Fedral Creek, just below its confluence with a small southern tributary (Minister of Mines Annual Reports, 1922, 1923, 1924). Outcrops on the banks of the creek, above and below the showing, are pervasively sericite-carbonate-altered foliated tuffs with quartz stringers (Figure 3-8-7). These rocks are at the transition from amygdaloidal flows to marine sedimentary rocks within the lower Nilkitkwa stratigraphic succession. Several short adits were driven into this zone in the early days of exploration but did not cut any major quartz veins. However, subsequent underground development by the Dome Mountain Min-

TABLE 3-8-2 — CABIN VEIN ANALYSES
(all values in ppm)

No.	Au	Ag	Cu	Pb	Zn	Co	Ni	Mo	Cd	Hg	As	Sb	Ba
8	5.5	126	8000	48800	24200	2	14	4	410	7.0	1700	1400	68
8A	8.2	77	4000	28300	22700	2	14	6	380	4.8	887	566	34
8B	4.1	157	6800	4200	4900	14	12	12	78	0.4	154	68	50
8C	7.5	370	34600	3800	13400	8	10	<4	255	1.9	1700	2800	135
8D	<0.3	<10	320	110	540	12	<2	<4	6	0.1	20	26	1920
12	12.3	106	19000	3300	6700	6	11	4	124	8.4	850	1400	139
12A	<0.3	<10	142	40	255	16	3	<4	<1	<.1	52	<5	1102

8, 8A, 8B, 8C = quartz vein, outcrop in creek; 8D = sericite altered volcanic adjacent to vein; 12 = quartz vein, Cabin vein adit dump; 12A = altered volcanic, Cabin vein adit dump

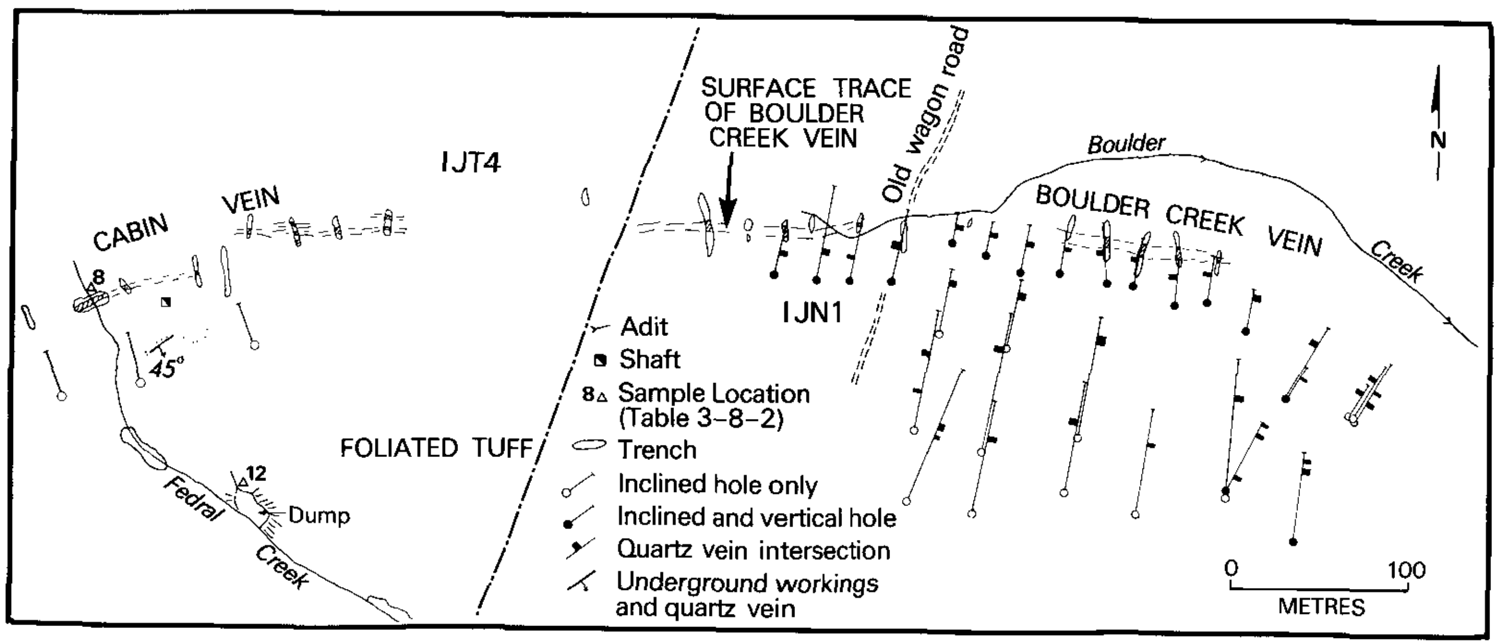


Figure 3-8-6. Geological sketch map and drill hole plan, the Cabin-Boulder Creek zone.

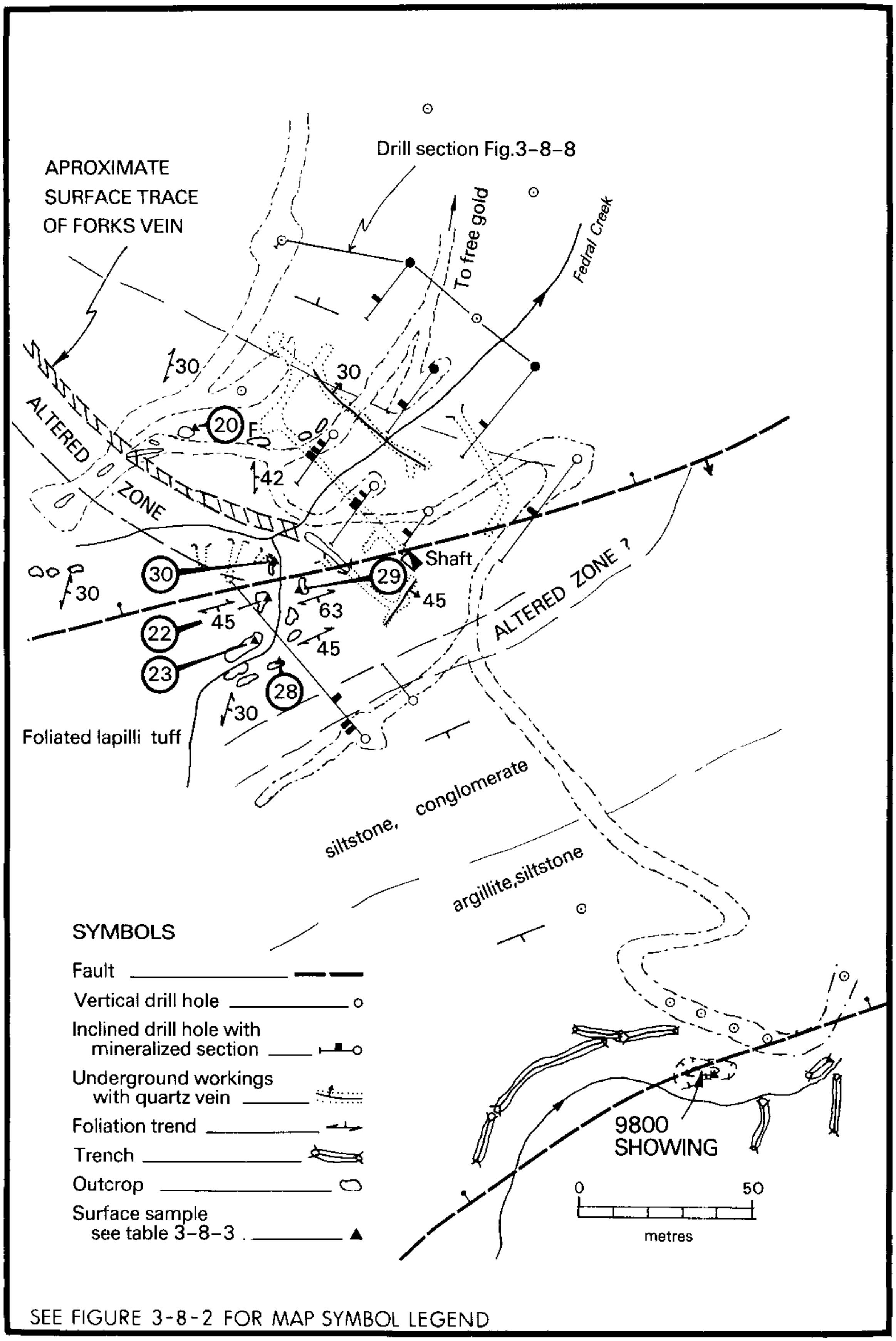


Figure 3-8-7. Geological sketch and drill hole plan, Forks area.

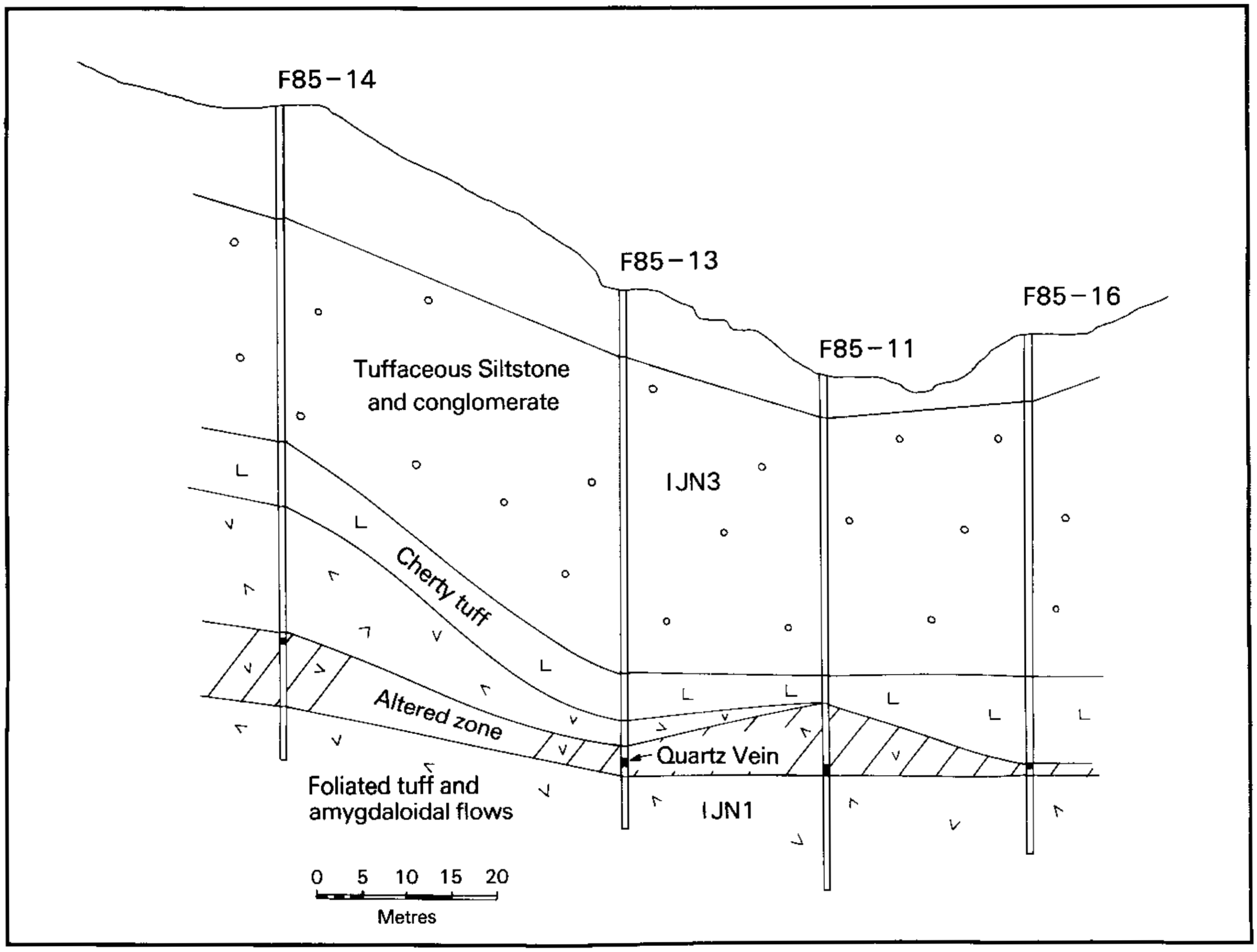


Figure 3-8-8. Drill hole cross section, Forks vein.

ing Company in 1923 and 1924 did intersect two major veins, one trending northwest and dipping northeast, the other trending northeast and dipping southeast (Figure 3-8-7). Our interpretation is that these veins are the same and are offset and rotated by a fault.

In 1985 Noranda drilled 16 holes to test the down-dip extension of the Forks vein (Figure 3-8-7). This work has defined a geological reserve of 20 000 tonnes grading 23.6 grams/tonne (0.688 ounce/ton) gold (Don Harrison, personal communication). Examination of drill core indicates that the quartz vein and enclosing sericite alteration zone, which varies in thickness from hole to hole, cuts across bedding at a low angle (Figure 3-8-8) and is near the top of the amygdaloidal flow unit of the Nilkitkwa Formation.

The Geological Survey Branch analytical laboratory has completed analyses on three grab samples from the Forks vein (1, 1A, 1B in Table 3-8-3) and ten grab samples of sericite-altered volcanic rock adjacent to the vein (1C to 30A in Table 3-8-3). In general zinc values are greater than lead and copper, gold and silver values increase with increasing zinc and lead in the vein and arsenic, antimony, mercury and cadmium concentrations are anomalous. Altered wallrocks have anomalous concentrations of zinc and barium.

9800 Vein

Trenching of a coincident soil geochemical anomaly and mineralized float occurrence led to the discovery of the 9800 or Baseline occurrence in 1985. Vertical drill holes collared north of the showing intersected narrow quartz-carbonate veins with relatively low gold and silver values. These veins occur at a similar stratigraphic position to that of the Forks. Subsequent trenching of the showing has exposed spectacular high-grade mineralization which may have some continuity to the south.

During August 1986, M. Lavesseur directed a small-scale mining operation. A three-man crew drilled, blasted and hand-sorted high-grade material from an open trench. Several tonnes were milled near Smithers then shipped to the Trail smelter.

Mineralization at 9800 zone is a discordant vein which cuts stratigraphy and cleavage. Mineralization occurs as: (1) foliated to massive sphalerite-galena-pyrite-chalcopyrite layers and lenses; and (2) white quartz veins and stringers with disseminated pyrite, sphalerite, and galena. Quartz and massive sulphide vein contacts with host rock shale and grey tuff are sharp.

Hangingwall alteration is limited to minor quartz veining extending less than 20 centimetres into the overlying black shale. The footwall is veined by folded and contorted white quartz stringers (stockwork). The host grey tuff is bleached and contains disseminated arsenopyrite needles, scorodite and pyrite. Sphalerite, galena, and pyrite veins and patches occur locally. The stockwork zone is cut by anastamosing shear planes.

The north edge of the workings shows the vein at the shale-tuff contact; to the south the vein lies within grey tuff. The tuff slaty cleavage is at a high angle to the vein, perhaps near a fold closure.

TABLE 3-8-3. FORKS VEIN ANALYSES
(all values in ppm)

No.	Au	Ag	Cu	Pb	Zn	Co	Ni	Mo	Cd	Hg	As	Sb	Ba
1	27.4	134	3000	8800	47600	12	17	8	855	19	1200	550	161
1A	17.5	52	2600	1200	63000	13	39	92	858	18	1500	288	143
1B	65.5	474	8000	63700	89000	20	22	6	150	24	2100	2500	66
1C	<0.3	<10	103	30	780	28	83	4	9	0.3	30	7	409
18	<0.3	<10	87	36	118	33	63	<4	<1	0.1	100	<5	649
20	<0.3	<10	73	16	92	12	6	6	<1	0.1	10	<5	425
22	<0.3	<10	27	12	118	19	45	<4	<1	0.1	64	<5	689
22A	<0.3	<10	65	52	546	16	55	<4	6	0.1	50	<5	655
23	<0.3	<10	29	18	70	15	45	<4	<1	<.1	<10	<5	1112
28	<0.3	<10	28	18	92	16	49	<4	<1	0.4	42	<5	1090
29	<0.3	<10	62	42	1300	18	43	<4	9	1.0	38	5	592
30	<0.3	<10	112	196	6700	19	52	4	65	6.9	148	<5	254
30A	<0.3	<10	102	18	450	13	36	<4	4	1.3	74	6	443

1, 1A, 1B, 1C = quartz vein with pyrite, sphalerite, galena and minor chalcopyrite, from dump at Forks shaft; 20 = altered volcanic wacke, hangingwall, Forks vein; 18, 22, 23, 28, 29, 30A sericite-altered volcanic, footwall, Forks vein; 22A = barren quartz vein in sericite-altered footwall; 30 = quartz-carbonate vein, sericite-altered footwall.

TABLE 3-8-4. 9800 ZONE ANALYSES
(all values in ppm)

No.	Au	Ag	Cu	Pb	Zn	Mo	Hg	As
254-1	42.93	196	1100	1500	19500	<5	2.15	79000
254-2	2.64	49	435	1500	16300	<5	1.64	20000
254-3	0.17	13	71	1100	1500	38	0.16	350
254-4	76.61	1809	7000	147000	298000	<5	11.36	18000
254-5	10.43	519	1800	8400	17700	<5	1.60	44000

254-1 = quartz vein with minor sphalerite, arsenopyrite from trench, 9800 zone; 254-2, 254-3 = veined and altered host rock from trench; 254-4, 254-5 semimassive sulphide in quartz vein from trench.

TABLE 3-8-5. MOUNT MCKENDRICK VEIN ANALYSES
(all values in ppm)

	Au	Ag	Cu	Zn	Mo	Hg	As	Sb
23-1	3.03	123	470	13100	4	2.15	960	335
23-3	1.09	78	600	30400	<2	2.54	13600	170

23-1, 23-3 = quartz vein with pyrite, minor sphalerite, Mount McKendrick showing.

Our interpretation is that a fault with downward displacement to the north separates the 9800 showing from the area drilled by Noranda and that the vein dips to the south, away from the fault. Mineralogically, the 9800 vein is similar to the Forks and it may be an offset segment of this vein system.

The Geological Survey Branch analytical laboratory has analysed five grab samples from the 9800 vein. The results are given in Table 3-8-4. One sample of semimassive sulphide contained 76.62 grams/tonne gold, 1809 grams/tonne silver, 29.8 per cent zinc, 14.7 per cent lead, 1.80 per cent arsenic, 0.70 per cent copper.

Mt. McKendrick (Pioneer) (Mineral Inventory 093L-266)

A northwest-trending, steeply northeast-dipping quartz vein cuts the greenstone-granitic sill complex and overlying Telkwa Formation phyllitic tuffs on the south slope of Mount McKendrick. The vein extends for 500 metres and ranges up to 0.9 metre wide. John McKendrick first discovered the vein in the early 1900s and staked the St. Anne and St. Eugene claims. He subsequently completed a 16-metre exploratory adit which has now collapsed. The vein is described in the Minister of Mines Annual Report for 1934.

The Geological Survey Branch analytical laboratory has analysed two grab samples from the Mount McKendrick vein. The results are given in Table 3-8-5. The samples contain minor amounts of sphalerite and arsenopyrite. Mercury concentrations are also anomalous.

Genetic Model

Two possible genetic models for the gold-silver quartz veins of the Babine Range are: (1) the veins are related to buried intrusives that were emplaced during the early stages of folding; or (2) the veins were produced by fluids generated during folding and metamorphism of a thick volcanic pile.

The first hypothesis is favoured because of the strong aeromagnetic anomaly associated with Dome Mountain (Figure 3-8-9). This anomaly suggests that a buried intrusive occupies the core of the mountain. This postulated intrusive may be dioritic in composition, as indicated by several small plugs and dykes that crop out south of the Forks deposit. Quartz veins cut the quartz-feldspar porphyry exposed at the Free Gold, indicating this intrusion predates mineralization.

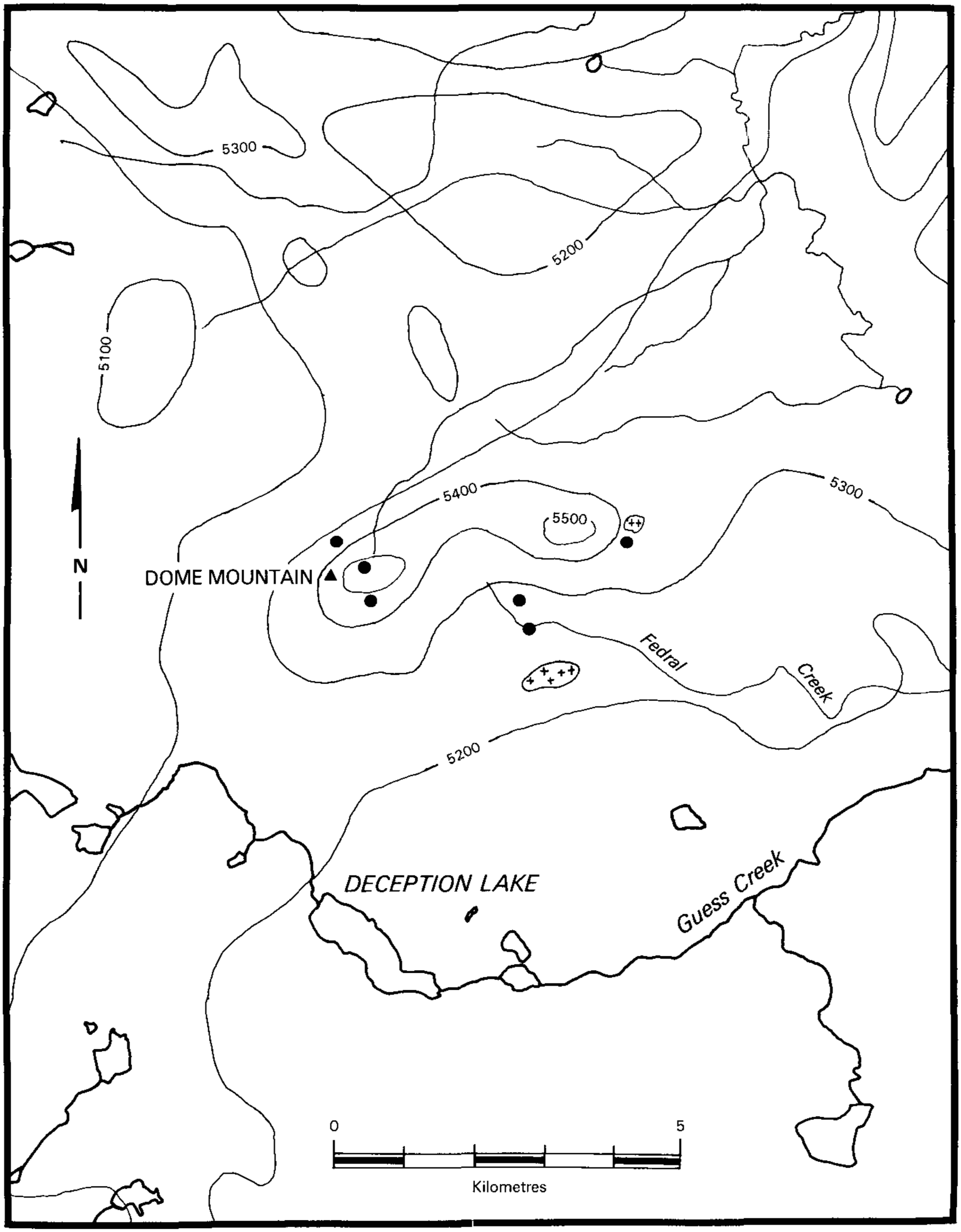


Figure 3-8-9. Relationship of mineral occurrences to aeromagnetic anomalies.

Sericitic wallrock alteration is most intense near the Forks, Boulder Creek and Cabin veins. These veins, which are zinc and lead-rich, occur at a higher stratigraphic level than copper-rich veins that lack wallrock alteration. This suggests a zoning model similar to that shown in Figure 3-8-10 may be applicable to the Dome Mountain camp.

Sulphide mineralogy is also variable. Observed sulphide mineral assemblages include pyrite, pyrite-chalcopyrite, pyrite-chalcopyrite-galena, pyrite-galena-sphalerite-chalcopyrite and pyrite-arsenopyrite-sphalerite-galena. As shown in Figure 3-8-10, veins with copper greater than zinc and lead are interpreted to be deeper and closer to the heat source as in the classic mesothermal vein model. Reactivity with wallrock increases away from the heat source as the temperature differential between rock and fluid increases and the fluid boiling point is reached.

The age of mineralization is not well established. However, many of the quartz veins are folded and broken suggesting the veining predates or is contemporaneous with deformation. The timing of folding and uplift is probably post-Albian, pre-Late Cretaceous. The mesothermal veins in the Dome Mountain camp may be of this age. The Geological Survey Branch is currently processing samples of sericite alteration from the Forks vein for potassium-argon isotopic age dating.

COPPER-SILVER VEINS

Camp Lake

Amygdaloidal basalt of the Nilkitkwa Formation hosts several copper-silver vein occurrences. The veins are small and discontinuous. They typically occur in zones of pervasive chlorite-epidote-carbonate alteration. The Camp Lake occurrence is typical of this type of mineralization. D. Groot Logging Limited of Smithers completed one drill hole on the prospect in 1982 but failed to intersect mineralization at depth.

Tina

In lower Byron Creek, on the Tina property, a narrow shear zone with irregular patches of malachite, azurite, chalcopyrite and tetrahedrite-tennantite (X-ray diffraction identification by Dr. John Kwong, Geological Survey Branch analytical laboratory) cuts massive rhyolite of the Nilkitkwa Formation. Several barren, 5 to 10-centimetre quartz-carbonate veins also occur along shear planes up-stream from the showing. The Geological Survey Branch analytical laboratory has completed analyses on several grab samples from these veins (Table 3-8-6) but no significant gold or silver values were detected.

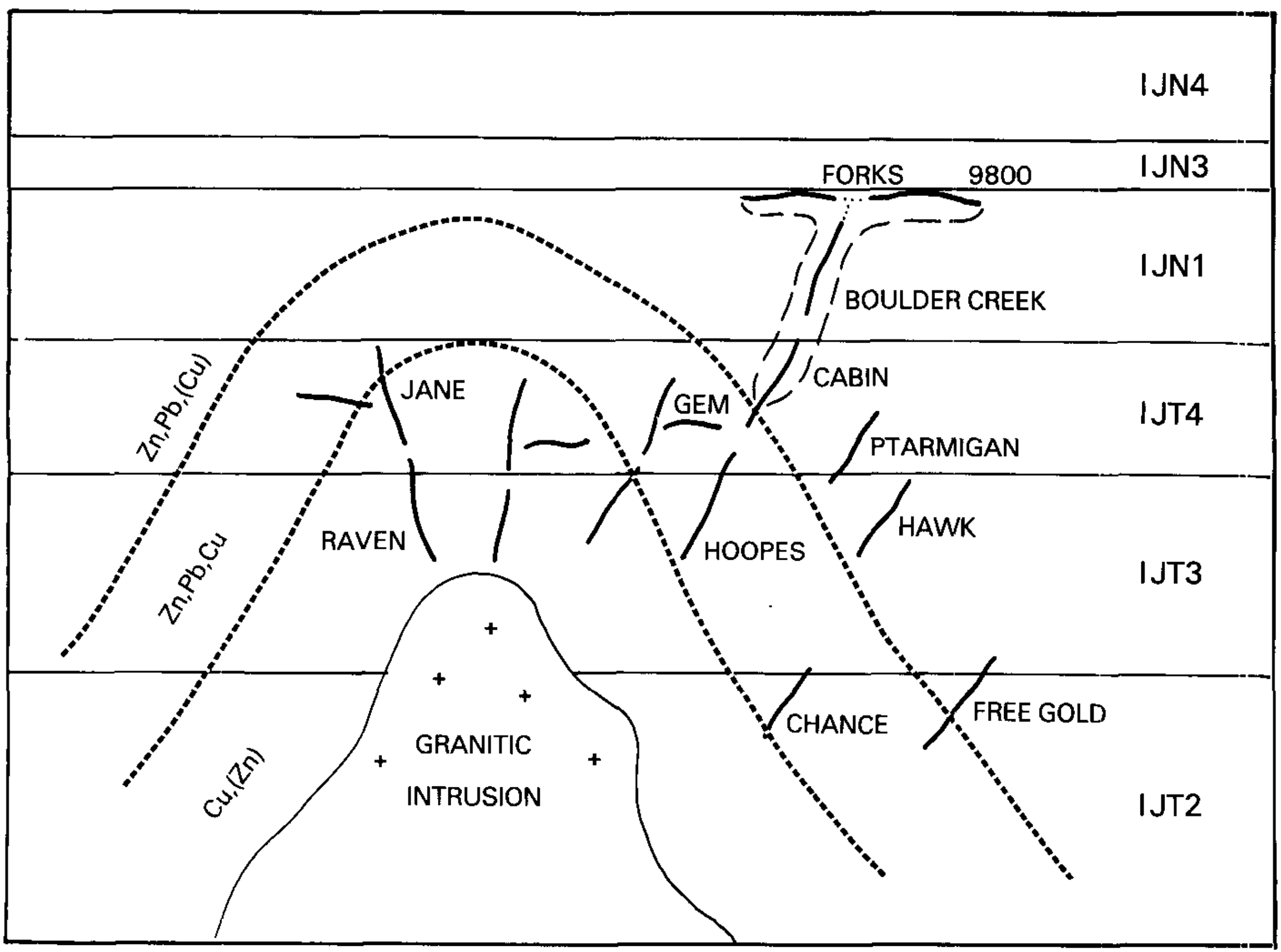


Figure 3-8-10. Genetic model, Dome Mountain camp.

TABLE 3-8-6. TINA COPPER PROSPECT ANALYSES
(all values in ppm)

	Au	Ag	Cu	Zn	Mo	Hg	As	Sb
49-1	<0.017	<10	18	200	9	0.06	<20	<10
50-3	<0.017	<10	18	200	9	0.06	<20	<10
50-5	0.020	<10	27	136	3	0.04	<20	<10
55-3	<0.017	<10	6	46	5	0.02	<20	<10
50-6	<0.020	<10	5500	1200	13	18.00	4900	743

49-1 = altered volcanic, Byron Creek; 50-3, 50-5, 50-6, 55-3 = narrow, barren quartz vein in shear zones, Tina prospect, Byron Creek.

Brenda/Tony (Mineral Inventory 093L-142, 143)

Alex Chisholm originally staked the Tony property as the Ivanhoe Group. In 1928 and 1929, T. Blythman optioned the property from Chisholm and completed a 3-metre shaft. In 1968, John Bot of Smithers staked the Tony claims. Dome Babine Mines Limited subsequently optioned the property and completed airborne magnetometer and electromagnetic surveys.

The main exploration target is a northeast-trending, southeast-dipping shear zone up to 2 metres wide, cutting steeply dipping to vertical andesite on the crest of a small hill. Tetrahedrite and minor chalcopyrite occur within the shear zone. Silver values are reported to be less than 70 grams/tonne. A granitic intrusion of probable Jurassic age crops out approximately 400 metres west of the shaft. The intrusion is cut by small quartz veins containing chalcopyrite.

CUPROUS MASSIVE SULPHIDE DEPOSITS

Del Santo (Mineral Inventory 093L-025)

The Del Santo prospect is located near the headwaters of Deep Creek. The showing was originally called Deep Creek and is described in the 1929 Minister or Mines Annual Report. The showing was restaked by Mel Chapman and Frances Madigan in the mid 1960s. Texas Gulf Sulphur Co., Falconbridge Limited, Bovan Mines Ltd., Midwest Oil Ltd., Union Miniere and Petra Gem Exploration of Canada Ltd. have all explored the property.

The main showing is a north-trending band of massive pyrrhotite, chalcopyrite and minor sphalerite that apparently overlies east-dipping chlorite-epidote altered amygdaloidal andesite or basalt (lJN1). The sulphide band, which appears to occupy a fold closure, has been exposed by trenching over a strike length of 50 metres. Overlying the massive sulphides are thin-bedded shaly siltstones and argillaceous limestones that are probably part of the Nilkitkwa Formation. East of the showing, these rocks are overlain by tuffaceous sandstones of the Smithers Formation. A biotite granodiorite crops out southeast of the showing and has been dated at 47.1 ± 1.6 Ma (unpublished date, The University of British Columbia geochronology laboratory).

The Geological Survey Branch analytical laboratory has completed analyses on three grab samples of massive sulphide from the Del Santo property. Results are given in Table 3-8-7. The massive sulphide is rich in silver and has relatively low lead and zinc concentrations.

POLYMETALLIC MASSIVE SULPHIDE

Ascot

The Ascot property is located between Mount McKendrick and Dome Mountain. The area was staked by Texas Gulf in 1967 because of anomalous silt geochemistry. Early work involved soil geochemistry, airborne magnetic and electromagnetic surveys, ground electromagnetic surveys and geologic mapping (Peatfield and Loudon, 1968) all directed toward a massive sulphide target. Several small massive pyrite lenses with minor amounts of sphalerite, galena and barite were found in limy siltstones and felsic tuff of the Nilkitkwa Formation, close to the contact with underlying amygdaloidal basalt. In 1972, Texas Gulf drilled three short pack-sack holes near the Canyon Creek showings to test electromagnetic conductors, but intersected only disseminated sphalerite and galena in a limy tuffaceous siltstone. The claims were dropped in 1977 and the area restaked as the MS claims by Kevin Coswan of Smithers. Between 1977 and 1979, the property was under option to Petra Gem Exploration of Canada Ltd. and from 1979 to 1984 Rapitan Resources Inc. and Barry Price held the claims. Geostar Mining Corp. acquired the ground in 1984.

The main showing on the property is 400 metres up Canyon Creek from the old Texas Gulf camp, where thin bands of light-coloured sphalerite with specks of galena and tetrahedrite occur in a limy siltstone. Farther up-stream barite, sphalerite, chalcopyrite and arsenopyrite occur at the fault contact between amygdaloidal flows and limy sedimentary rocks of the Nilkitkwa Formation. Several similar faults cross Canyon Creek and juxtapose amygdaloidal flows against tuffaceous conglomerates and limy siltstones.

In Canyon Creek, southeast of the old Texas Gulf campsite, a bed of coarse recrystallized pyrite occurs in a limy siltstone that apparently overlies thin-bedded, highly contorted Nilkitkwa argillite. No other sulphides were observed at this locality.

In 1969, Texas Gulf drilled one hole near the headwaters of Canyon Creek that intersected limy siltstone and possibly felsic tuff of the Nilkitkwa Formation. The hole tested an area of anomalous soil geochemistry and apparently intersected 15 metres of fine-grained felsic tuff or siltstone containing pyrite, sphalerite and galena as disseminations and filling hairline fractures. A diorite sill intrudes thin-bedded argillites that overlie the mineralized section.

Analyses of samples from the Ascot property are given in Table 3-8-8. The samples are altered siltstone or felsic tuff that contain disseminated pyrite, galena and sphalerite. No significant gold or silver values were detected.

PORPHYRY COPPER-MOLYBDENUM DEPOSITS

Burbridge Lake (Summit) (Mineral Inventory 093L-223)

The Burbridge Lake property is accessible via Woodmere road, which joins Highway 16 approximately 1.6 kilometres south of the town of Telkwa, and thence via 11.3 kilometres of rough forest access road.

The property was first explored as the Paradise Group (Minister of Mines Annual Report, 1919) and later as the Bulkley Group (Minister of Mines Annual Report, 1929). Prospectors completed several open cuts and at least one short adit on a northwest-striking, southwest-dipping zone up to 15 metres wide and 175 metres long, cutting altered rhyolitic tuffs of the Nilkitkwa Formation. Mineralization within this zone consists of semimassive pyrite and magnetite with minor sphalerite and chalcopyrite in a quartz gangue. As far as is known the mineral zone does not contain significant gold or silver concentrations.

TABLE 3-8-7. DEL SANTO ANALYSES
(all values in ppm)

	Au	Ag	Cu	Pb	Zn	Mo	Hg	As	Sb
127-1	<0.02	239	5200	480	2100	<5	4.50	68	3000
127-2	0.02	562	11600	262	3100	<5	15.00	155	6600
129-1	0.04	106	15200	45	475	<5	2.20	93	22

All samples massive pyrrhotite with minor chalcopyrite from trenches on main showing.

TABLE 3-8-8. ASCOT PROPERTY ANALYSES
(all values in ppm)

	Au	Ag	Cu	Pb	Zn	Mo	Hg	As	Sb
61-A	0.05	<10	41		2600	6	0.11	<20	<10
61-B	<0.03	<10	67		107	13	<0.02	<20	<10
63-1	0.10	<10	17		23	4	0.02	1400	<10
64-2	0.03	<10	48		91	5	<0.02	0	<10
68-1	<0.02	<10	52	56000	1100	<5	18.60	<25	<5

61-A, 61-0 = B altered siltstone, near showing below old Texas Gulf camp, Canyon Creek; 63-1, 64-2 = altered siltstone near packsack drill holes, upstream from old camp, Canyon Creek; 64-2 = altered siltstone, Canyon Creek; 68-1 = altered siltstone with disseminated galena in shear zone at contact between amygdaloidal flows and altered siltstone, Canyon Creek.

In 1969, Mel Chapman of Smithers restaked the Burbridge Lake property after discovering copper mineralization adjacent to a foliated diorite intrusion. In 1973 Hudson's Bay Oil and Gas Company Ltd. completed 366 metres of diamond-drilling in three holes. One hole intersected 49 metres of 0.3 per cent copper. In 1974, Cities Service Limited optioned the property and completed 495 metres of drilling in two holes, but did not intersect any significant mineralization.

In 1976, Asarco Exploration Company of Canada Ltd., recognizing that earlier drilling was parallel to the regional foliation and therefore parallel to the contact of the diorite, optioned the property and completed 649 metres of drilling in six holes (MacIntyre, 1977). This work confirmed that the diorite was a sill dipping moderately to the southwest. The upper part of the sill is porphyritic, approaches granodiorite to quartz monzonite in composition and is pervasively altered to clay, chlorite, carbonate, sericite and quartz with disseminated and fracture-controlled pyrite, chalcopyrite and molybdenite mineralization. A zone of disseminated and banded pyrite extends into altered rhyolitic volcanic rocks above the contact. The best copper and molybdenum grades occur at the transition from argillic to propylitic alteration, which corresponds to a change from porphyritic quartz monzonite to foliated diorite.

In 1980 and 1981, D. Groot Logging Limited of Smithers, completed 941 metres of diamond drilling in eight holes. This work showed that the diorite sill is cut off by a fault to the west and that limy sedimentary strata overlie the altered felsic to andesitic volcanic rocks south of the sill.

Big Onion (Mineral Inventory 093L-124)

A prominent gossan is exposed on the south slope of Astlais Mountain. This area was first staked as the Cimbria group in the early 1920s. In 1927 the property was owned by A. Elmstead. Under his direction, several adits were driven into the mineralized zone. In 1963 and 1964, Noranda Exploration Ltd. mapped and sampled the property and subsequently completed 76 metres of drilling in two holes. Between 1965 and 1967 Texas Gulf Sulphur Co. completed an additional 765 metres of diamond drilling in five holes. In 1970, Blue Rock Mining Corp. Ltd. completed additional mapping, and geochemical and geophysical surveys. Between 1975 and 1976, Canadian Superior Exploration Limited drilled 7174 metres in 18 diamond and 66 percussion holes. This work defined a mineral inventory of 18 million tonnes grading 0.36 per cent copper (Canadian Institute of Mining and Metallurgy, Special Volume 15, Table 1 in pocket, showing No. 73).

The Big Onion prospect has been described by Sutherland Brown (1966) and Carter (1981). Mineralization is associated with an irregular, northeast-trending stock of quartz feldspar porphyry, with an altered core of porphyritic quartz diorite, that intrudes Telkwa and Nilkitkwa Formation rocks. A zone of disseminated pyrite, chalcopyrite and molybdenite mineralization occurs within the altered phase. As mentioned earlier, a sample of intense sericite alteration has given an isotopic age of 117 Ma and a post-mineral quartz monzonite porphyry dyke was dated at 48.7 Ma (Carter, 1981).

CONCLUSIONS

The Nilkitkwa Formation, as defined in this report, is an important host to mineral deposits in the Babine Range. With the exception of a few small quartz veins on Dome Mountain, all of the mineral deposits examined in this study occur within a relatively narrow stratigraphic interval of the Nilkitkwa Formation. The most important veins on Dome Mountain, the Boulder Creek and Forks, occur in the amygdaloidal flow unit or overlying sedimentary rocks. Stratabound cuprous and polymetallic massive sulphide deposits, such as Del Santo and the Ascot showings, occur in sedimentary strata immediately overlying the amygdaloidal flow or rhyolitic volcanic units. The amygdaloidal flow unit also hosts copper-silver veins such as the Tony and Camp Lake. The Burbridge Lake porphyry deposit occurs at the transition from amygdaloidal flows to rhyolitic volcanic rocks.

The Nilkitkwa Formation is obviously a favourable host for mineral deposits and is an important metallotect in the Babine Range for both syngenetic and epigenetic mineralization. The transition zone from bimodal volcanism, as represented by the amygdaloidal flow and rhyolitic volcanic units, to a marine sedimentary environment should be a prime exploration target in the area, especially for volcanogenic massive sulphide deposits.

Mesothermal precious metal veins are probably related to buried granitic intrusions. The Nilkitkwa volcanic rocks are a favourable host for these vein deposits.

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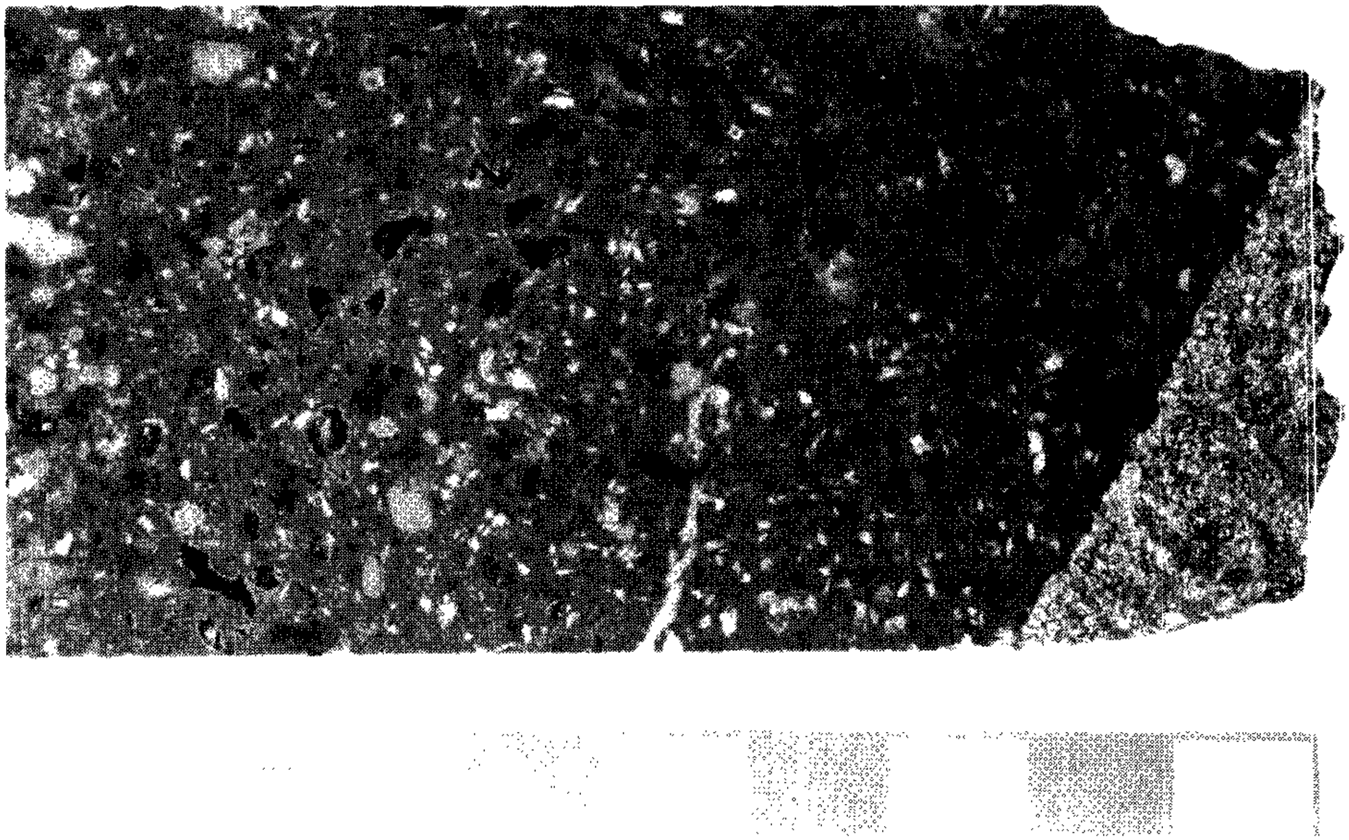

Plate 3-8-1. Typical sample of amygdaloidal phyric basalt, unit lJN1. Dark patches are chlorite. Drill core from Forks deposit.

Plate 3-8-2. Partly welded lapilli tuff overlying amygdaloidal basalt, unit lJN1, Forks vein area. Note reaction rims on angular felsic clasts.

Plate 3-8-3. Pebble conglomerate with subangular clasts of rhyolite and dacite in tuffaceous, sandy matrix, unit lJN3. Drill core from Forks deposit.

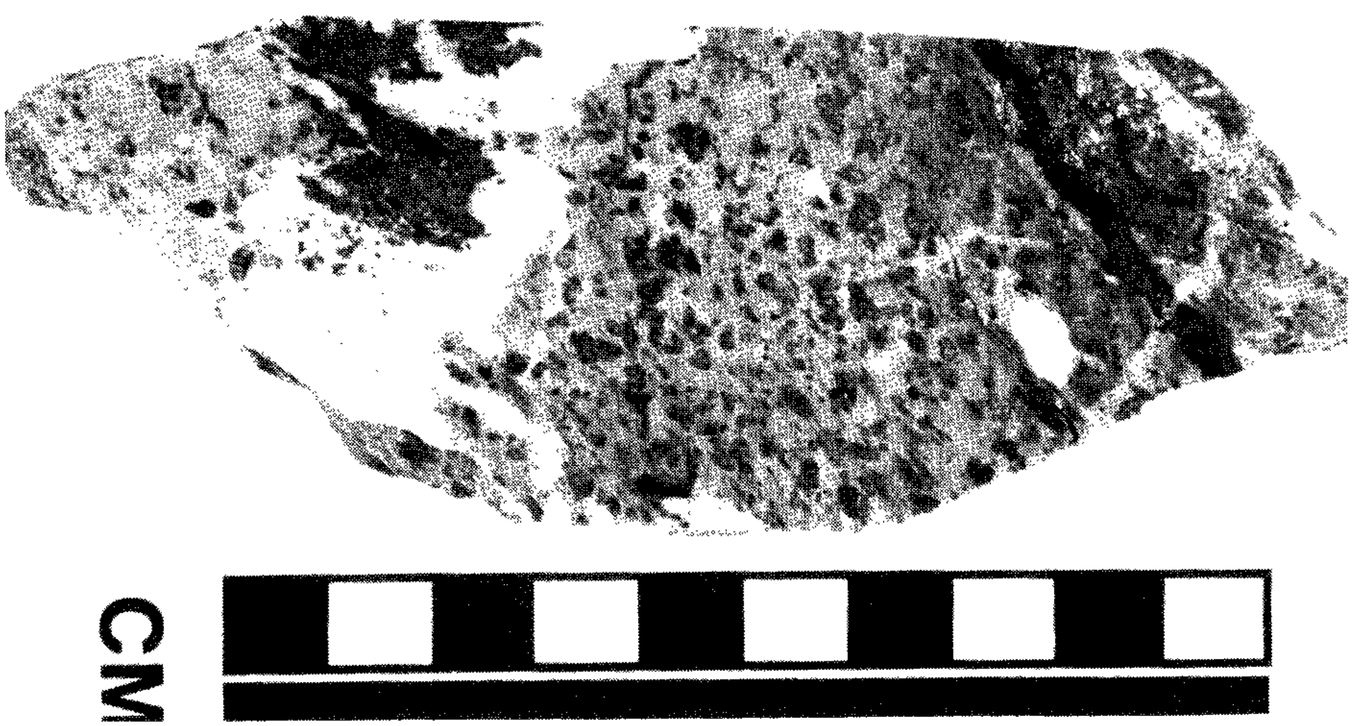

Plate 3-8-4. Sericite-altered amygdaloidal basalt in footwall of Forks vein.

Plate 3-8-5. Granule conglomerate in hangingwall of Forks vein showing transition into pervasive sericite alteration (bleached part of sample).

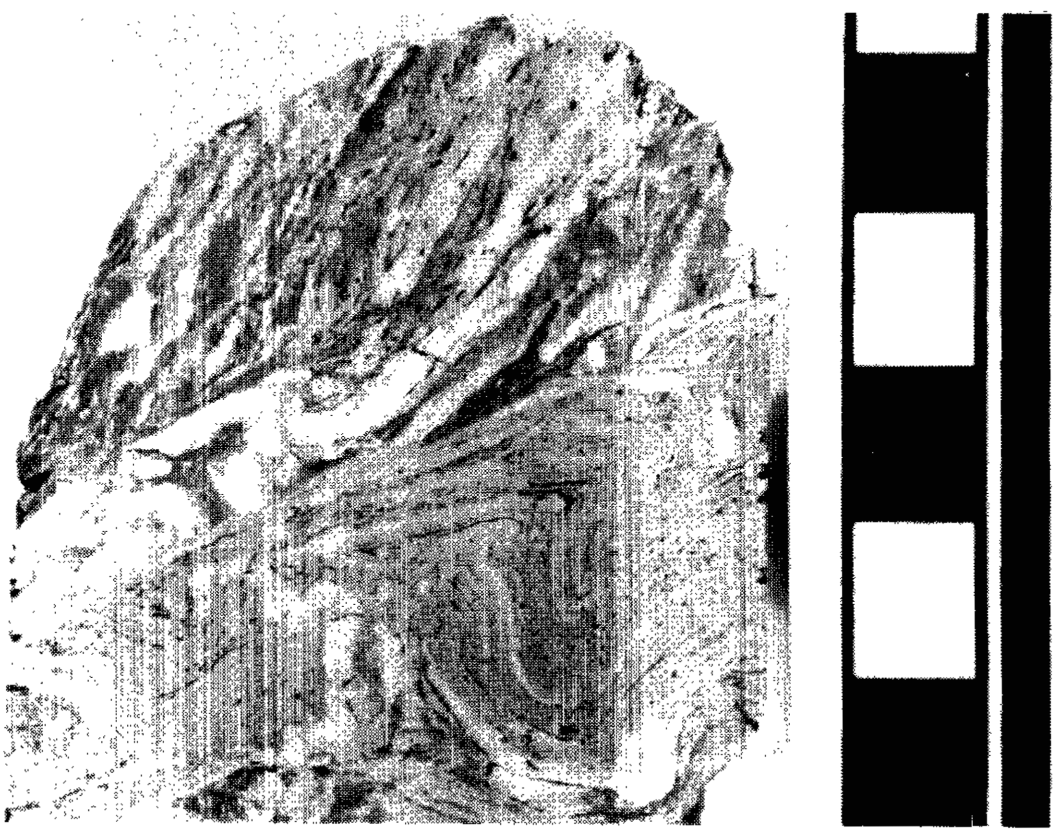

Plate 3-8-6. Sericite-altered phyllitic tuff with quartz-carbonate veinlets emplaced along cleavage planes. Note folding of slaty cleavage and quartz veinlets and offset along microfault.

Plate 3-8-7. Folded quartz vein with bands of broken pyrite and chalcopyrite grains. Sample is from the Raven vein adit.

Plate 3-8-8. Quartz vein with semi-massive pyrite, sphalerite and galena bands. Note broken nature of sulphides. Sample is from the new 9800 showing.