SNIPPAKER MAP AREA (104B/6E, 7W, 10W, 11E)

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KEYWORDS: Regional geology, Stikine assemblage, Stuhini Group, Hazelton Group, Texas Creek intrusive suite, Premier porphyry, Coast plutonic complex, vein, skarn, mesothermal.

INTRODUCTION

This report describes preliminary results of regional mapping near Johnny Mountain (Figure 1-12-1). It is part of the Iskut-Sulphurets project, an ongoing study of the mineral deposits of this exciting gold belt (Alldrick and Britton, 1988; Alldrick *et al.*, 1989a; Britton and Alldrick, 1988; Britton *et al.*, 1989). The project's goals are:

- to define regional stratigraphy and structure,
- to produce 1:50 000 and 1:20 000-scale geological maps,
- to document mineral occurrences, and
- to develop genetic models of mineralization.

The Snippaker map area covers about 1000 square kilometres, roughly centred on 131°00'W and 56°30'N near the headwaters of Monument Creek. Terrain is very rugged with elevations ranging from 65 metres along the Iskut River to over 2000 metres along the Alaska boundary. Below treeline at 1100 metres vegetation is a dense mixture of conifers, slide alder, devil's club, ferns and berry bushes. Permanent ice and snow cover about one third of the map area. Weather is typical of the northern rainforest. Annual precipitation exceeds 100 centimetres, much of it as snow in January and February.

Historically, river barges ascended the Iskut some 60 kilometres above its confluence with the Stikine. Present access is only by air. Fixed-wing aircraft as large as a Hercules or DC-3 can land on well-maintained gravel airstrips at Bronson Creek (elevation 90 metres) and Johnny Mountain (elevation 1075 metres). There is a disused airstrip on Snippaker Creek (elevation 530 metres). A road-access study has been completed with a view to linking the area to Highway 37, 72 kilometres east of the Bronson airstrip (Smith and Gerath, 1989).

PREVIOUS WORK

Kerr (1948) was first to map the geology and much of the topography in the 1920s. Kerr's work was incorporated into Operation Stikine (Geological Survey of Canada, 1957) with little remapping. In 1987 and 1988 the British Columbia Geological Survey Branch mapped 150 square kilometres around Bronson Creek (Lefebure and Gunning, 1989). The Geological Survey of Canada has begun a mapping program of the whole of NTS 104B (Anderson, 1989; Anderson and Bevier, 1990). About 25 per cent of the area has never been mapped at any scale.

A synthetic aperture radar (SAR) survey proposed by the province was completed in 1988 by the Canada Centre for Remote Sensing to outline major structures in the Iskut-Sulphurets gold belt. The results of a regional stream sediment sampling program conducted over this area in 1987 were released in 1988 (National Geochemical Reconnaissance, 1988), and a gold lithogeochemistry study was completed by Lefebure and Gunning (1988) in the Bronson Creek area. Other sources of information include annual reports of the Minister of Mines, assessment reports and the ministry's property file.

Fieldwork was conducted from July 8 to 13 September 1989. Traverse data were recorded on 1:15 000 airphoto enlargements and compiled on 1:20 000 and 1:50 000 base maps.

EXPLORATION HISTORY

In the late 1800s the Stikine River was a major route to the gold rushes in the Cassiar (1873) and Klondike (1896–98). At the turn of the century, prospectors heading south from the Yukon goldfields searched the Iskut valley for placer gold and staked promising looking bedrock gossans.

In 1906 custom officers F.E. Bronson and E.S. Busby, with others from Wrangell, Alaska, staked claims on lower Bronson Creek. In 1910, about a ton of high grade copper ore was shipped to a smelter in Ladysmith and assayed 2 grams per tonne gold, 1515 grams per tonne silver and 12.45 per cent copper (Minister of Mines, B.C., 1918).

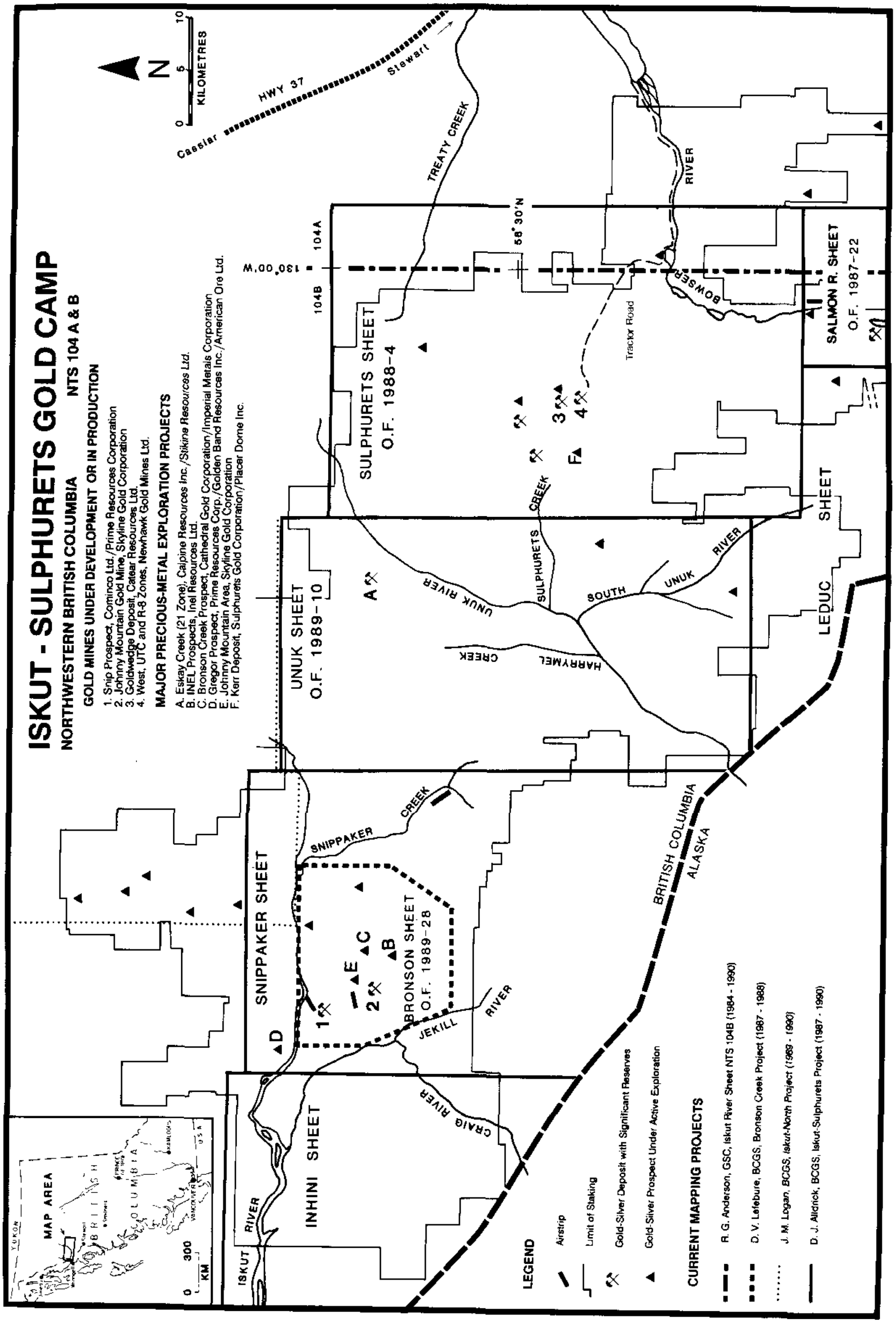
Intermittent activity continued for the next 60 years. Until the 1950s the focus of exploration was a large gossanous cliff, Red Bluff, located on lower Bronson Creek. In 1954 Hudson Bay Mining and Smelting Company discovered the Pick Axe vein on the alpine slopes of Johnny Mountain.

The porphyry copper boom in the early 1970s drew prospectors and companies into the area once more; the Inel, Ray, Shan and Tami properties were staked and explored with little success.

The new golden age began with the 1980 staking of the Reg claims by Skyline Explorations Limited. Staking rushes followed in the wake of high-grade gold discoveries on Johnny Mountain and Bronson Creek (Reg and Snip claims). The Johnny Mountain gold mine was opened in August 1988; preproduction development is underway at the Snip deposit. Surface and underground exploration continues at Inel.

GEOLOGIC SETTING

The map area is situated in the southern Boundary Ranges of the Coast Mountains physiographic belt, on the western edge of the Intermontane tectonic belt. The northern two-thirds of the area is in the Stikine Terrane; the rest is part of the Coast plutonic complex (Wheeler *et al.*, 1988).



Map courtesy of Teuton Resources Corporation, used & modified with permission.

Figure 1-12-1. Iskut-Sulphurets gold camp: precious metal deposits and current mapping projects.

Anderson (1989) proposed a stratigraphic column for the whole of NTS 104B, distinguishing four tectonostratigraphic assemblages bounded by unconformities:

- Tertiary Coast plutonic complex;
- Middle and Upper Jurassic Bowser overlap assemblage;
- Triassic-Jurassic volcanic-plutonic arc complexes; and
- Paleozoic Stikine assemblage.

Three of these assemblages are represented in the map area which is underlain by a thick (more than 5 kilometres) succession of sedimentary and volcanic rocks that range in age from late Paleozoic to Quaternary. Most strata are Upper Triassic to Lower Jurassic volcano-sedimentary arc-complex lithologies characterized by rapid facies changes. Pleistocene and Recent basaltic flows and tephra are preserved along the Iskut River, in Snippaker Creek and at Lava Lakes. Strata have been cut by a variety of plutons representing at least four intrusive episodes spanning Late Triassic to Quaternary time. These include synvolcanic plugs, sills and stocks, minor dike swarms, isolated dikes and sills, as well as the batholithic Coast plutonic complex. The stratigraphic sequence has been folded, faulted and metamorphosed mainly during Cretaceous time, but some Paleozoic strata are polydeformed and probably record an earlier deformational event.

STRATIGRAPHY

We have divided the volcanic and sedimentary rocks of the map area into four main lithostratigraphic sequences or packages, ranging in age from Paleozoic to Quaternary (Figure 1-12-2, 3). The area is poorly fossiliferous and as yet lacks radiometric data to constrain ages of units. Stratigraphic correlations within the map area are based on lithologic similarity; relative ages are based on stratigraphic position and degree of deformation and metamorphism. Correlations with Stewart-Sulphurets stratigraphy (Alldrick, 1985; Britton and Alldrick, 1988) are complicated by a combination of facies changes and north-trending, high-angle regional faults across the Unuk River valley.

Contacts between lithostratigraphic sequences within the map area are not well exposed: commonly they are covered with moraine, disrupted by faults, or invaded by large intrusions such as the Lehto batholith and the Coast plutonic complex.

PALEOZOIC (MAP UNIT 1)

The Paleozoic Stikine assemblage (Monger, 1977), also known as the Asitka assemblage (Wheeler and McFeely, 1987; Wheeler *et al.*, 1988), has not been unambiguously identified in the map area. It is known to crop out extensively west of the Craig River (Kerr, 1948; Anderson, 1989) and northeast of Mount Verrett (Logan *et al.*, 1990, this volume). The Stikine assemblage is characterized by thick, platformal carbonate sequences, coralline reefs, and mafic to felsic volcanics. Two phases of penetrative deformation have been observed in these strata (Anderson, 1989).

Rocks tentatively assigned to the Paleozoic crop out along the Jekill and Craig River valleys, upper Olatine Creek and between Mount Zara and Mount Lewis Cass. They include abundant fine-grained, thinly layered, biotite-rich quartzofeldspathic gneiss, phyllite, metawacke, metatuff and thin recrystallized limestone (marble). The protolith of the fine-grained quartzofeldspathic gneiss is not known. Where it is interbedded with marble it is interpreted as metawacke. Almost identical rocks, with relict coarse plagioclase clusters, are considered metatuffs. Coarse volcaniclastic textures are absent. These gneisses were probably derived from tuffaceous siltstones and sandstones, with minor ash and crystal tuffs.

These rocks are the most structurally complex in the area; polyphase deformation is likely. The contact between Paleozoic rocks and overlying Mesozoic strata is probably an unconformity, based on relative states of deformation. Apart from crinoid stem debris in limestone at 1280 metres elevation south of the Johnny Mountain minesite, no macrofossils were found.

Gneissic metamorphosed sediments preserved as small screens within the Coast plutonic complex may be the oldest rocks in the map area. They form rafts a few metres thick and up to 10 metres long, entirely surrounded by Tertiary granite, consisting of very fine grained, thinly layered, felsic and mafic-rich gneisses with ductile deformation fabrics. They have been seen only northeast of Mount Lewis Cass but their distribution is unknown due to limited mapping within the Coast complex.

MESOZOIC (MAP UNITS 2 AND 3)

Most of the stratified rocks in the map area are Mesozoic. They are exposed north and south of the Iskut River, along Snippaker and Monument creeks, and from Lehua Mountain to Olatine Creek.

Mesozoic strata form a thick (3 kilometres) sequence of mixed volcanic and sedimentary rocks. Facies changes, minor unconformities and the paucity of distinctive marker horizons make stratigraphic correlation difficult. Extrusive rocks are mostly volcaniclastic: pyroclastic units with derived epiclastic facies. Plagioclase, pyroxene and hornblende are common phenocrysts: distinctive coarse potassium feldspar is minor but important. Compositions range from basalt to rhyodacite, but most are andesite to dacite. Sedimentary rocks are volcanic-derived siltstone, wacke and conglomerate with minor amounts of limestone either as relatively pure lenses or as calcareous mudstones. Limestone decreases upwards in the section and is rare in Hazelton strata.

Based on two fossil determinations from Snippaker Mountain, ages span at least Norian to Toarcian(?) time (Lefebure and Gunning, 1989). Older rocks are correlated with the Stuhini Group on the basis of age and volcanic composition. Overlying strata are correlated with the Hazelton Group based on distinctive potassium feldspar and hornblende crystal tuffs and overall similarities with Hazelton strata to the east (Hancock, 1990, this volume; MacLean, 1990, this volume; Britton and Alldrick, 1988; Britton *et al.*, 1989).

UPPER TRIASSIC (MAP UNIT 2)

Triassic strata have been divided into four main groups: sediments (Unit 2S); intermediate volcanics (Unit 2V): melanocratic basaltic tuffs (Unit 2M); and leucocratic dacitic tuffs (Unit 2L).

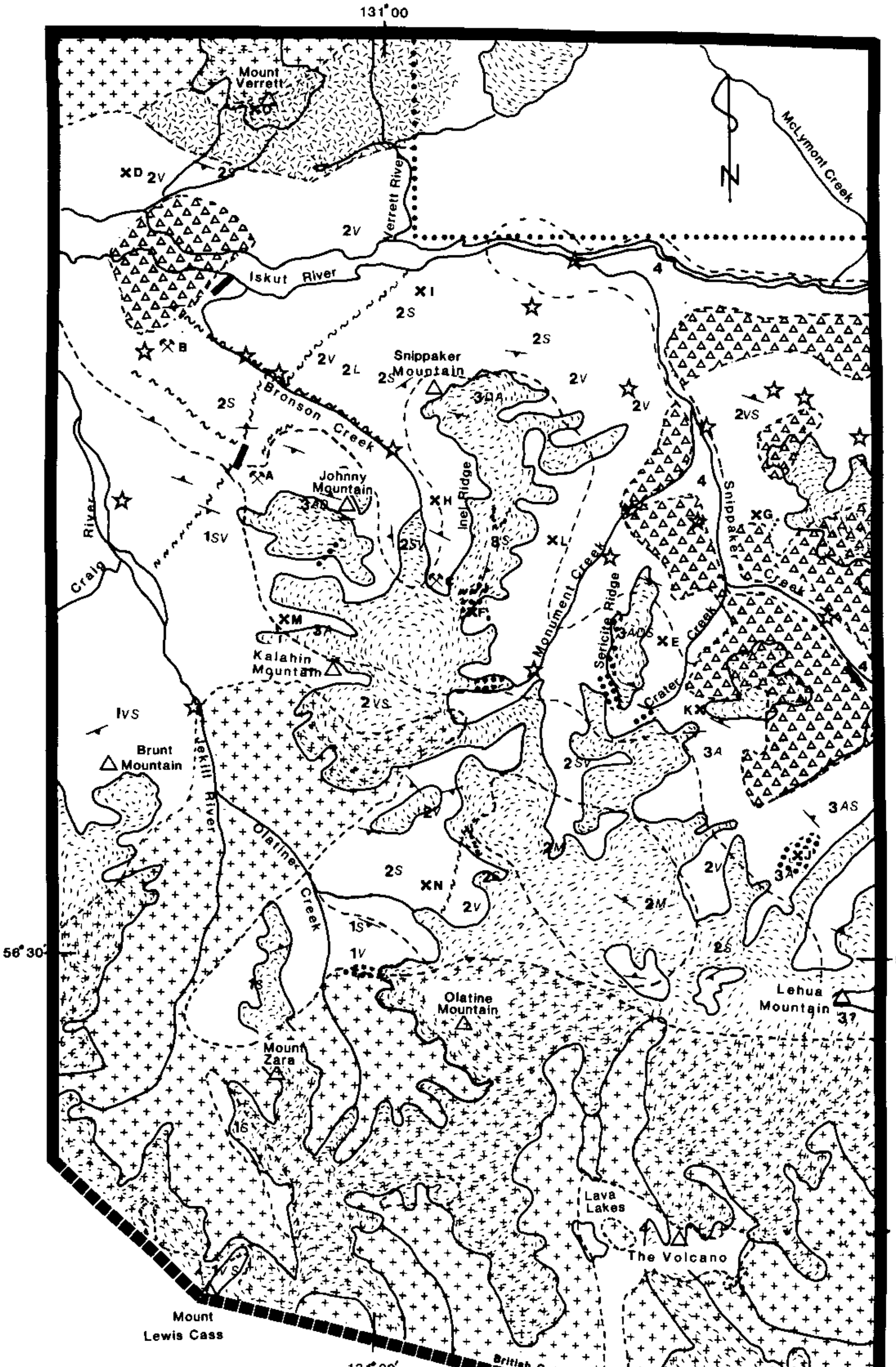


Figure 1-12-2. Geology and mineral deposits, Snippaker map area.

LEGEND

INTRUSIVE ROCKS

Tertiary	+	Biotite Quartz Monzonite to Granite
Early Jurassic	Δ	Lehto and Iskut River Plutons Monzonite; Quartz Diorite; K-feldspar Porphyry Hornblende Monzodiorite
Late Triassic		Hornblende Diorite

STRATIFIED ROCKS

Cenozoic		4	Basalt Flows, Tephra
Mesozoic	LJr	3	Andesitic (A) to Dacitic (D) Volcanics (with <40% sedimentary strata (S))
Mesozoic	UTr	2	Sediments (S) and Intermediate Volcanics (V) Leucocratic Dacitic Tuffs (L) Melanocratic Basaltic Tuffs (M)
Paleozoic		1	Metamorphosed Sediments (S) and Tuffs (V) (may include metamorphic equivalents of Triassic rocks)

SYMBOLS

Contact . . . .

Compositional layering (bedding, foliation)

Airstrip . . . .

RGS gold values > 90th percentile . . . . ☆

Limit of mapping . . . . •••

Mine, developed prospect . . . . A

Prospect . . . . × D

Gossan . . . .

PROSPECTS

	NAME	COMMODITY
A	Johnny Mountain	Au,Cu,Ag
B	Snip	Au,Cu,Ag,Pb,Zn
C	INEL	Au,Ag,Cu,Zn,Pb
D	Gorge/Gregor	Au,Ag
E	Sericite Ridge	Au,Cu,Fe
F	Khyber Pass/Pyramid Hill	Au,Cu,Zn
G	Josh	Au,Cu,Pb,Zn
H	Cathedral Gold	Au
I	Bug Lake	Au,Pb,Cu,Zn
J	Pins	Au,Ag,Cu,Zn,Pb
K	Lake Area	Au
L	Wolverine	Au,Cu,Pb,Zn
M	Pez-Dan	Au,Ag,Cu,Pb,Zn
N	Still	Au,Ag,Pb,Zn
O	Mount Verrett	Au

Most of the volcanic rock in the Triassic succession is basaltic to andesitic with plagioclase and pyroxene as the principal phenocrysts (Unit 2V). Pyroxene-phyric tuffs are characteristic of the Stuhini Group. Pyroclastic units are more common than flows, but many outcrops are massive and difficult to classify. For example, a thick, monotonous sequence of fine-grained, medium to dark green, feldspar porphyry andesite underlies the lower slopes of Mount Verrett and extends aross the Iskut River to Bug Lake. These rocks are moderately to completely recrystallized north of the Iskut and could be either massive crystal tuffs or flows. There are some lapilli tuffs and tuff breccias around Bug Lake, but fragmental textures are generally absent.

Unit 2S on Figure 1-12-2 indicates areas underlain mainly by sedimentary rocks. In the south these are mostly siltstone with minor fine-grained wacke. Thin rhythmic bedding is common. In the north they are interbedded mudstone, lithic wacke, feldspathic wacke, minor conglomerate and limestone lenses, with locally abundant fine-grained volcan clastic material–ash tuff or volcanic sandstone. These rocks host the Snip deposit and other prospects uphill from Bug Lake and on lower Bronson Creek. Near the top of the section on Winslow Ridge, west of Snippaker Mountain, a limy sandstone bed contains *Epigondoella*, a middle to late Norian conodont (Lefebure and Gunning, 1989).

Unit 2M is exposed only in the south of the map area, near Olatine Mountain. It consists of over 500 metres of mafic crystal tuffs, breccias, lahars and derived wackes and siltstones. The tuffs are distinctive rocks consisting of dark green pyroxene crystal tuffs with a dark chloritized matrix. Colour index is greater than 50. Outcrops characteristically have a hackly appearance due to the resistant weathering of coarse pyroxene phenocrysts. Sediments associated with these distinctive rocks are thin-bedded, pyroxene-bearing wackes, siltstones and minor conglomerate. Some sedimentary rocks occur as large blocks (up to 10 metres across) in a melanocratic, tuffaceous matrix. These probably result from such high-energy transport mechanisms as debris flows. The restricted areal distribution of this unit suggests an unusual but perhaps long-lived eruption of magma rich in crystal cumulates. These rocks are intercalated with, and grade upwards into, more typical medium grey-green pyroxene-phyric volcaniclastics.

Unit 2L consists of light grey-green, waxy, dacitic *pyroxene-plagioclase crystal and lapilli tuffs. It has been* identified only on Winslow Ridge and appears to be a conformable sequence within Unit 2S. A nearby drillhole has intersected over 200 metres of underlying andesitic tuffs, lapilli tuffs and green tuffaceous siltstones.

East and west of Snippaker Creek scattered lenses and blocks of white granular recrystallized limestone are set in massive plagioclase and hornblende-phyric andesitic ash tuffs, lapilli tuffs, tuff breccias and volcanic conglomerates with minor interbedded clastic sedimentary units and thin limestone beds. Most fragments range from centimetre-sized chips to metre-sized blocks, but locally include masses 75 metres thick and 300 metres long. Internal bedding in these longer blocks is not well preserved. This sequence of probable olistostromes has been interpreted as the lowest part of the Upper Triassic succession.

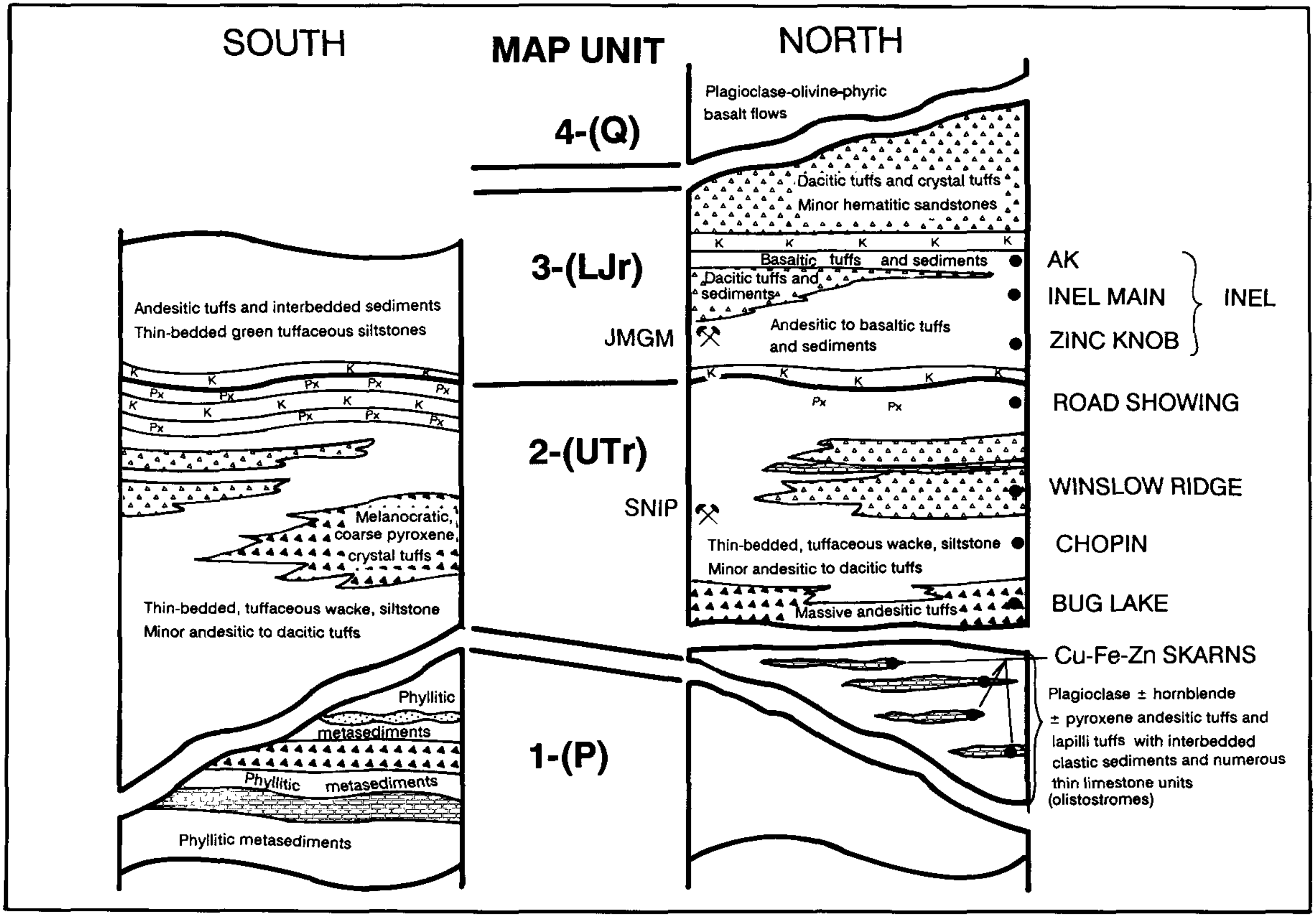


Figure 1-12-3. Schematic stratigraphic columns, Snippaker map area JMGM = Johnny Mountain Gold Mine; K = K-feldspar + plagioclase ± hornblende porphyritic andesitic tuffs; Px = pyroxene-phyric andesitic tuffs.

LOWER JURASSIC (MAP UNIT 3)

Jurassic strata are best exposed on the summit slopes of Johnny Mountain, Snippaker Mountain and Inel Ridge, but they extend southeasterly toward Pins Glacier and Lehua Mountain. Rocks are mainly andesitic to dacitic fragmental volcanics with minor basaltic tuffs and lesser amounts of siltstone, wacke and conglomerate. Marked lateral facies changes, lithologic heterogeneity and variable rock colours (grey, green, maroon and mottled combinations of these) are common.

On Johnny Mountain three distinct rock units, each at least 100 metres thick, make up the bedrock above Johnny Flats (an alpine plateau at 1000 metres elevation). The lower unit includes the "Mine Series" of the Johnny Mountain gold mine. It consists of medium to dark grey, locally greenish, plagioclase-phyric andesitic to dacitic crystal and ash tuff with some monomictic to oligomictic lapilli tuff and agglomerate. In some of these rocks plagioclase phenocrysts are rounded, suggesting they have been reworked. Zones of subrounded volcanic conglomerate also occur. This unit is mostly massive but at the Johnny Mountain mine rare compositional layering is preserved despite extensive veining, alteration and shearing. The middle unit conformably overlies the lower unit and consists of grey and tan dacitic volcanic rocks. They include flow-banded and welded ash tuffs as well as well-bedded ash and lapilli tuffs with rhyodacitic clasts. Overlying these dacites, the upper unit comprises dark grey-green, flaggy, well-foliated basaltic andesite ash tuffs with minor siltstone and wacke interbeds.

On Snippaker Mountain and extending southward, the Jurassic sequence includes at least 300 metres of matrix-supported, polymictic pebble to cobble conglomerate with minor siltstone and wacke interbeds. These are commonly orange to buff weathering due to pervasive ankeritic alteration. The unit grades laterally and upwards into green volcanic conglomerate and lithic lapilli tuff but the colour change from orange to green does not coincide with lithologic contacts. These conglomerates are locally overlain by thin-bedded, salt-and-pepper lithic arenite and siltstone with carbonized plant remains.

Light grey and green dacitic volcanics cap much of Snippaker-Inel Ridge. Some of these are similar to the middle unit on Johnny Mountain. The base of this dacitic section on the Inel property is marked by bedded potassium feldspar-hornblende-plagioclase crystal tuffs. Similar rocks also occur at the head of Crater Creek. These are texturally similar to two-feldspar or "Premier porphyry" rocks which occur at the top of the Unuk River formation and delineate the base of the Betty Creek formation in the Stewart and Sulphurets areas. Rocks east of Snippaker Mountain include mottled maroon and grey dacitic lapilli and ash tuffs overlain by hematitic siltstone with calcareous concretions. Similar interbedded dacitic volcanics and hematitic volcanic sediments crop out along Pins Glacier north of Lehua Mountain. These rocks strongly resemble the thick dacitic packages of the upper Hazelton Group on the Colagh property (MacLean, 1990, this volume) and between the Unuk River and Bruce Glacier (Britton *et al.*, 1989). These mixed dacitic pyroclastic and epiclastic sequences are characteristically hematitic, perhaps due to subaerial deposition. The Eskay Creek deposit of Calpine Resources Incorporated (Figure 1-12-1) is hosted by equivalent stratigraphy in a local paleotopographic depression indicated by minor marine turbidite units and a thick lens of pillow lavas.

Marine turbidites of the Bowser Lake Group were not found in the map area.

QUATERNARY (MAP UNIT 4)

Pleistocene and Recent basaltic lava flows, cones and tephra occupy the valleys of the Iskut River, Snippaker Creek and Lava Lakes. All flows are olivine and plagioclase phyric; many are strongly vesicular. These volcanics are part of the north-trending Stikine volcanic belt of Miocene to Quaternary eruptive centres (Souther, 1977).

The Iskut River flows vented near Palmiere Creek, just east of the map area (Alldrick *et al.*, 1989; Read *et al.*, 1989). A whole rock age for the lowermost flows is 70 000 years (Grove, 1986). Radiocarbon ages (Read *et al.*, 1989) of 8760 ± 150 years from tephra and 2610 ± 70 years in overlying sediments deposited in lava-dammed lakes bracket the youngest volcanic event.

The Volcano, a small peak near the Alaska–British Columbia border, may be the youngest eruptive centre in British Columbia. Flows from this vent dammed the Unuk River (via a tributary called Lava Forks) and formed the aptly named Lava Lakes. Carbon 14 dates on the lower flows give an age of 130 years (Grove, 1986). The youngest flows are devoid of vegetation. Glaciers nearby are dusted with black basaltic tephra from a 1904 eruption.

INTRUSIVE ROCKS

Intrusive rocks underlie about one third of the map area. At least four intrusive episodes are represented, spanning Triassic to Quaternary time. Paleozoic intrusions have not been identified.

PLUTONS

The oldest plutons are sills, dikes and plugs of hornblende diorite that are contemporaneous with Triassic hostrock volcanics. They are especially common in andesites located north of the Iskut River. Most of these are too small to be shown on Figure 1-12-2 but on Mount Verrett there is a large hornblende diorite stock of this type. The rock is texturally similar to the andesites it intrudes and consists of mesocratic medium to dark grey, fine-grained, anhedral granular diorite with fine plagioclase phenocrysts. The diorite is largely recrystallized and pervasively propylitically altered. Near its contact with the Coast batholith it has pegmatitic zones up to 50 centimetres wide by 6 metres long consisting of coarse bladed intergrowths of hornblende and plagioclase with minor biotite. Against the batholith it is migmatitic with a swirled foliated fabric in the diorite that is cut by leucogranite dikes. Contacts with andesite are indistinct and may be in part gradational.

Jurassic intrusions include synvolcanic hypabyssal stocks as well as phaneritic plutons of considerable size. Synvolcanic intrusions are thought to be comagmatic and coeval with extrusive rocks. Examples include felsite stocks on

Johnny Flats and the Inel property. These are leucocratic to holofelsic, cream to tan, porphyritic rocks with fine feldspar and quartz phenocrysts set in an aphanitic groundmass. Contacts are altered and sheared but the stocks appear to form sheet-like bodies that are crudely conformable with enclosing strata. On the Inel property the felsite stock is associated with a small felsite dike swarm.

Phaneritic intrusions of probable early Jurassic age include the Lehto batholith, the Iskut River stock and smaller plugs and dikes such as the Red Bluff porphyry. A common feature of these intrusions is the presence of coarse (up to 5 centimetres) potassium feldspar phenocrysts.

The Lehto batholith, a monzonitic to dioritic pluton first recognized in 1988 (Britton *et al.*, 1989), is the largest of these early Jurassic plutons and crops out along Snippaker Creek. Three phases have been identified. The earliest is pale green to white, medium-grained, anhedral-granular biotite-hornblende quartz diorite. It is commonly saussuritized and locally displays a weak foliation. It is intruded by mottled, pink, green, white and black medium-grained, subhedral-granular, hornblende-biotite quartz monzonite and monzodiorite. The third and youngest phase occurs as isolated masses, dikes and marginal zones in some parts of the pluton. It is hornblende monzodiorite to monzonite with coarse potassium feldspar phenocrysts set in a fine to medium-grained groundmass. The Iskut River and smaller stocks consist mainly of this third phase.

These early Jurassic plutons are texturally similar to the Texas Creek batholith near Stewart which shows a close spatial and temporal relationship with the Silbak Premier gold, silver and base metal deposit (Alldrick, 1987). Although no genetic link with mineralization has yet been established, these rocks are an important guide for exploration. Other dioritic and quartz dioritic intrusions of probable Jurassic age occur locally. All are minor, isolated stocks or plugs.

The largest intrusive mass in the map area is the Coast Mountains batholith which occupies the southern quarter and northwestern corner of the map area. It consists of medium-grained biotite and biotite-hornblende granite, granodiorite and rarely quartz diorite. Very little of it has been mapped. It is distinguished from Jurassic plutons by its fresh appearance, lack of foliation and shearing, minimal saussuritization, and abundance of quartz. Biotite is either the sole mafic mineral or else is much more common than hornblende. Near Mount Lewis Cass the margins of the batholith show very passive emplacement into gneissic country rocks. There are lit-par-lit sills of holofelsic, quartz-rich leucogranite and trains of gneissic xenoliths which show no sense of rotation. Locally, and within a few metres of the contact, some granites have a weak foliation parallel to that of the country rocks. Elsewhere the batholith crosscuts strata and its border is irregular and associated with much diking. There is little or no hydrothermal alteration or skarn developed along the intrusive contacts despite the presence of limestone units in the Paleozoic country rocks. The age of these rocks is probably middle Eocene based on potassium-argon dating near Stewart (Alldrick *et al.*, 1987) and Alice Arm (Carter, 1981).

DIKES

Isolated dikes and minor dike swarms occur locally in the map area. Strongly foliated basaltic dikes on Johnny Mountain are apparently feeders to overlying basaltic andesite tuffs. Felsite dike swarms are exposed south and west of Snippaker Mountain. Andesite, dacite and microdiorite dikes are found locally in volcanic sequences and are probably synvolcanic. Coarse potassium feldspar dikes on the Inel property may be feeders to overlying crystal tuffs. Around the margins of the Coast Mountains batholith are white, fine to coarse-grained, inequigranular, quartz-rich holofelsic leucogranite dikes that are apparently offshoots of the batholith.

Widespread biotite and hornblende lamprophyre dikes cut all other rock types including the Coast Mountains batholith. They are typically isolated and narrow (up to 2 metres wide). At the head of Monument Creek a hornblende lamprophyre dike swarm is traceable for at least 2 kilometres. It consists of a 15-metre-wide zone of up to a dozen anastomasing dikes, each less than a metre wide. The age of these dikes is probably Oligocene (Alldrick *et al.*, 1987; Carter, 1981).

Basalt dikes related to the Quaternary Stikine volcanic belt are rare, mostly occurring near eruptive centres.

STRUCTURE

FOLDS

Paleozoic rocks exhibit the strongest deformation. Folds range from crenulations through upright chevrons to recumbent isoclines with fold amplitudes of 100 metres. The largest folds plunge gently east-northeast. Crenulations and contorted open folds are also developed adjacent to faults in fine-grained sediments and tuffs of any age. These structures die out within a few metres of the fault zone.

At a regional scale the Mesozoic lithostratigraphic sequences form flat-lying packages, but Triassic and Jurassic strata show mesoscopic folds. Some of these are primary depositional features such as convolute layering in welded tuffs, flow banding and soft-sediment slumps.

FOLIATION

Many rocks, but especially fine-grained sediments, mafic tuffs and limestones, show locally intense foliation, boudinage and transposition of primary layering. Rock composition, especially mica content, largely determines the amount of foliation developed. A good example of this occurs in Johnny Mountain cirque where mafic dikes cut felsic lapilli tuffs and foliation is perpendicular to the bedding. The dikes are strongly chloritized and exhibit strong foliation and platy parting. The leucocratic dacite shows only slight stretching of lapilli and a weak flaggy cleavage.

Phyllites have formed adjacent to both flat and upright faults in rocks of appropriate composition.

FAULTS

FLAT FAULTS

There is a widespread subhorizontal cleavage in most Triassic and some Jurassic rocks. Locally this is expressed in subhorizontal faults between blocks of differing competence. An example of this is the contact between Jurassic volcaniclastic and Triassic sediments on Johnny Mountain. The underlying siltstones exhibit folding, shearing and recrystallization that decreases in intensity away from the fault. Overlying dacitic volcaniclastic rocks which act as a competent unit also show increased strain near the fault but deformation is much weaker, amounting to minor shearing and recrystallization. A similar flat fault marks the base of the thick dacitic volcanic package that caps Inel Ridge between Snippaker Mountain and the Inel camp. Interpretations proposed for these widely recognized structures include: thrust faults, extensional detachment faults, or unconformities. They are not thrust faults; they do not place older rocks on top of younger ones. Lateral displacement is not known, but is suspected to be in the order of a few hundred metres at most.

HIGH-ANGLE FAULTS

High-angle faults are common in the area and appear to postdate flat faults. Some form well-defined lineaments traceable for kilometres and visible in radar images and air photographs. Most have small displacements, in the order of tens of metres. Maximum displacement on mappable faults like those seen on Johnny and Snippaker mountains is in the order of a few hundreds of metres. Most major faults strike northeasterly or northwesterly.

METAMORPHISM

Metamorphic rank is generally low although recrystallization is complete. Local enclaves of staurolite and garnet-bearing rocks in the Paleozoic succession indicate that epidote-amphibolite facies is the highest metamorphic grade preserved in the map area. Younger rocks show typical lower greenschist facies metamorphism. Propylitic mineral assemblages are common: hornblende and pyroxene are replaced by chlorite, plagioclase is saussuritized, clay constituents form white mica.

Contact metamorphism occurs within 1 to 2 kilometres of the Coast Mountains batholith. The main effects are recrystallization with coarsening of grain size and replacement of mafic minerals by metamorphic biotite. Thin garnetite lenses occur locally in marble.

MINERAL DEPOSITS

The northern part of the Snippaker map sheet has seen intense exploration activity over the last few years. The area includes the Johnny Mountain gold mine and also the Snip and Inel properties which are in advanced stages of exploration. Detailed descriptions of the Johnny Mountain and Snip deposits are presented in Alldrick *et al.* (1989b). Several other mineral occurrences and large claim blocks are in early stages of exploration.

All of the major deposits in this area occur in quartz veins or silicified shear zones that crosscut strata. Copper-iron skarn showings are known to occur east of Snippaker Creek but have received only preliminary exploration work.

VEINS

JOHNNY MOUNTAIN GOLD MINE (STONEHOUSE; MINFILE 104B 107)

Johnny Mountain gold mine officially opened in August, 1988 and commenced commercial production of gold, silver and copper in November. Total production to the end of July, 1989 was 1050 kilograms of gold, 1850 kilograms of silver, and 430 000 kilograms of copper (George Cross News Letter No. 187, 1989). Silver and copper grades are not usually reported but mill feed runs about 27 grams per tonne silver and 0.7 per cent copper (W.L. Millar, personal communication, November 1989). Reserves (Table 1-12-1) are in six mineralized veins: Discovery (Cloutier), 16, Pickaxe, Goldrush, Zephrin and Victoria. Several other mineralized zones have recently been discovered, but are not yet fully explored.

The hostrocks (the "Mine Series") are part of a volcanic package consisting of interbedded andesitic and dacitic volcaniclastics and volcanic sediments cut by two-feldspar porphyry dikes. Andesites and dacites range from fine-grained ash tuffs to coarse lapilli tuffs. The volcanic sediments are a bedded sequence ranging from mudstones to coarse conglomerates.

Five of the main veins are sub-parallel and the Zephrin may represent a sheared and reoriented vein segment. The veins strike approximately 065°, dip steeply northwest, and are roughly parallel to the strike of the hostrocks. Where the veins cross lithological contacts, they thicken and ore grades are often higher. The veins are also enriched where they intersect cross-structures. These structures are quartz-carbonate veins with green mica (annite or chlorite) and occasional specular hematite.

The veins are surrounded by a distinctive alteration halo which is mineralogically symmetrical, but wider in the hangingwall. Outward from the the vein wall the alteration sequence is: massive potassium feldspar and ankerite alteration 1 to 2 metres from the vein; a quartz-pyrite stringer zone up to 5 metres from the vein; and disseminated pyrite up to 10 metres from the vein. Pyrite textures in quartz veins can be used as a guide to gold content (P. Metcalfe, personal communication, August 1989). Coarse cubic pyrite is invariably barren. Gold is always associated with fine grained or "milled" pyrite.

Ore consists of quartz veins, 1 to 2 metres wide, commonly with about 25 per cent pyrite, 1 to 2 per cent chalcopyrite and trace amounts of sphalerite, galena and pyrrhotite. Typical exposures on the 16 vein show a 1 to 1.5 metre vein core of massive bull quartz with patchy aggregates and disseminated sulphides, bordered by massive pyritic marginal zones 50 centimetres wide that carry the best gold values. Gold occurs with silver in electrum; coarse visible electrum is common.

Two post-ore fault sets are present within the mine workings: subvertical faults and flat "quartz faults". Subvertical faults strike north, dip about 60° either east or west and may represent conjugate sets. These faults truncate the veins. Quartz faults are low-angle brittle faults with minor offsets (<10 metres) which often contain barren ribbon quartz. Quartz faults offset the hangingwall to the north and complicate shrinkage stoping.

SNIP (TWIN ZONE; MINFILE 104B 250)

The Snip deposit occurs in the thick sedimentary sequence which underlies the volcanic package on Johnny Mountain. The main mineralized zone, the Twin zone, is a shear-hosted vein that strikes 120° and dips 45° to vertical, averaging 60° southwest.

Hostrocks are massive to bedded siltstone and feldspathic wacke. Along most of its length the vein is divided into two parts by a dark grey, fine-grained dike with fine black biotite phenocrysts known as the Biotite Spotted Unit (BSU). In the west drift the Twin zone averages 4.5 metres wide including a 2.5-metre band of barren, postore BSU dike in the core.

Three ore types have been recognized within the Twin zone:

- Massive sulphide ore with pyrite>pyrrhotite, minor sphalerite and rare arsenopyrite, galena, molybdenite and chalcopyrite;
- Crackle quartz ore consists of shattered quartz vein infilled with green mica and chlorite and disseminated sulphides;
- Streaky quartz ore consists of quartz laminae within strongly sheared and altered country rock.

Reserves are shown in Table 1-12-1.

INEL (MINFILE 104B 113)

Inel mineralization is hosted by a volcanic-sedimentary sequence consisting of sandstones, turbidites, minor cobble conglomerates and rare limestones interbedded with basalt tuffs and lapilli tuffs. Stratigraphy is cut by a swarm of mafic to felsic dikes, including distinctive potassium feldspar megacrystic dikes. Like the Johnny Mountain mine to the northwest, the area of the deposit is underlain by a large, crudely conformable felsite stock.

Mineralization occurs as numerous sulphide and quartz-sulphide veins that have a variety of orientations, but which appear to be concentrated along specific lithologic horizons that have been preferentially fractured. No single vein is sufficiently large to allow calculation of reserves, but the large number of veins and their gold grades justifies continued exploration. The Main zone hosts the highest grades obtained to date and occurs as a series of veins along a basalt-sandstone contact characterized by extensive pyritization. Recent dilling has focused on a mineralized intrusive breccia in the footwall of one of the potassium feldspar dikes (George Cross News Letter No. 199, 1989).

SKARNS

Although high-grade gold veins have been the focus of recent exploration, skarn deposits have been discovered along the margin of the Lehto batholith east of Snippaker Creek. The area coincides with a cluster of strongly anomalous gold values obtained by the Regional Geochemical Survey stream sediment survey (National Geochemical Reconnaissance, 1988). On the Josh claim, mineralization consists of replacement lenses of chalcopyrite, sphalerite and magnetite in actinolite-epidote-garnet skarn (Scott, 1983; McLeod, 1988). Grab sample assays as high as 321.6 grams per tonne silver, 24.8 per cent zinc and 32.8 per cent copper have been reported (McLeod, 1988). Gold values up to 3.7 grams per tonne have been obtained from a quartz breccia vein that cuts an epidote-quartz-garnet skarn. Hostrocks are typically calcareous siltstone or interbedded siltstone and andesitic tuffs, and, rarely, limestone.

Trace malachite staining occurs along the contact of the Coast plutonic complex in the southern part of the map area. Compared to the early Jurassic Lehto batholith, the Tertiary Coast batholith seems very weakly mineralized.

DISSEMINATED SULPHIDES

Large areas of gossanous disseminated pyrite and pervasive argillic to sericitic alteration occur between Monument and Snippaker creeks (Sericite Ridge); northwest of Lehua Mountain (Pins Ridge); and at the southern end of Inel Ridge (Khyber Pass; Pyramid Hill). These obvious exploration targets are difficult to prospect and evaluate because of their size (>5 square kilometres) and extensive surface leaching. Similar large gossans in the Sulphurets area are known to include large-tonnage low-grade gold, copper-gold and gold-molybdenum deposits such as the Snowfield, Kerr and Sulphurets prospects (Britton and Alldrick, 1988).

SUMMARY

The map area is underlain by Paleozoic Stikine assemblage, upper Triassic Stuhini Group and lower Jurassic Hazelton Group volcanic and sedimentary rocks that have been intruded by Triassic, Jurassic and Tertiary plutons. Paleozoic and Mesozoic strata are probably separated by an unconformity but relationships are obscured by faulting and intrusion. The rocks record a long and complex history of fracturing, faulting and folding which is not yet resolved.

The main targets of exploration are mesothermal quartz veins rich in gold and silver. Other potential deposit types include copper-iron-zinc skarns and large-tonnage, low-grade disseminated copper-gold deposits. So far all precious metal deposits have been found in Mesozoic strata, which may indicate a widespread but stratigraphically constrained mineralizing event associated with early Jurassic plutons.

ACKNOWLEDGMENTS

Geological mapping was carried out by M.E. MacLean, K.D. Hancock, S.N. Hiebert and the authors. Our thanks go to Johnny Mountain Gold Mine Limited, Western Canadian Mining Corporation, Calpine Resources Incorporated, Inel Resources Limited, Granges Exploration Limited, Keewatin Engineering Incorporated and Pamicon Developments Limited for their hospitality during the field season. We are grateful to the following geologists who shared their time, information and ideas: Jim Atkinson, Jerry Blackwell, Ron Fenlon, Bob Gifford, Steve Kenwood, Dave Lefebure, Gerry McArthur, Paul Metcalfe, Fred Syberg and Dave Yeager. Jaycox Industries provided efficient expediting service; Northern Mountain Helicopters and Central Mountain Air kept us safely aloft.

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