GEOLOGY AND MINERAL DEPOSITS OF THE GALORE CREEK AREA, NORTHWESTERN B.C. (104G/3, 4)

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KEYWORDS: Regional geology, Stikine assemblage, Stuhini Group, Hickman batholith, Galore Creek, alkalic porphyry, Copper Canyon, copper, gold.

INTRODUCTION

The Sphaler Creek (104G/3) and Flood Glacier (104G/4) map areas are located along the western margin of the Intermontane Belt approximately 80 kilometres due south of Telegraph Creek in northwestern British Columbia (Figure 1-30-1). Results of regional mapping and sampling during the 1988 field season are summarized in this report; a 1:50 000 geology and mineral occurrence map will be released as an Open File in early 1989. The focus of the project was to locate and evaluate known and new mineral occurrences and to provide a detailed geological database delineating Paleozoic and Mesozoic stratigraphy in the area.

The map area is centered on Galore Creek and is occupied by rugged high-relief mountains of the Boundary Ranges with numerous snowfields and radiating glaciers. Access is by fixed-wing aircraft from Dease Lake or Smithers to the Scud strip located on the Stikine River, and from there by helicopter.

PREVIOUS WORK

F.A. Kerr carried out geological mapping along the Stikine and Iskut rivers from 1924 to 1929, but it was not until 1948 that his data were published (Kerr, 1948a, b). Other work by the Geological Survey of Canada includes that of Souther (1971, 1972), Monger (1970, 1977), and Anderson (1984, 1989). P. Read has conducted regional mapping for the Geological Survey of Canada (Read, 1984) and feasibility studies for B.C. Hydro. A. Panteleyev carried out mapping in the area, in conjunction with a deposit study of Galore Creek between 1973 and 1975 (Panteleyev, 1975, 1976a, 1977).

The discovery of the Galore Creek porphyry copper deposit by Hudson Bay Mining and Smelting Company Limited in 1955 initiated exploration activity. The present resurgence of mineral exploration in the area is in response to its geological similiarities with the Sulphurets, Iskut and Golden Bear gold camps. Mining and exploration companies active in the map area this year included Continental Gold Corporation (Trophy claims), Equity Engineering Ltd. (JW and Trek/Sphal claims), Cominco Limited (Galore Creek), Canamax Resources Inc.(Copper Canyon) and Corona Corporation (Sphaler Creek claims).

REGIONAL GEOLOGY

The study area (Figure 1-30-2) straddles the boundary between the Intermontane and Coast tectonic belts and is underlain by rocks of the Stikine terrane (Stikinia). At this latitude Stikinia consists of Upper Paleozoic to Tertiary rocks that can be grouped into four tectonostratigraphic packages: a Late Paleozoic to Middle Jurassic island arc suite represented by the Stikine assemblage of Monger (1977), the Stuhini Group (Kerr, 1948) and Hazelton Group equivalent rocks; Middle Jurassic to early Late Cretaceous successor-basin sediments of the Bowser Lake Group (Tipper and Richards, 1976); Late Cretaceous to Tertiary transtensional continental volcanic-arc assemblages of the Sloko Group (Aiken, 1959); and Late Tertiary to Recent post-orogenic plateau basalt bimodal volcanic rocks of the Edziza and Spectrum ranges. Plutonic rocks of Mesozoic and Tertiary age intrude this complex stratigraphy. The most economically important exploration targets are porphyry copper-gold-silver deposits and peripheral mesothermal and shear-zone-hosted precious metal veins.

STRATIGRAPHY

STIKINE ASSEMBLAGE

Rocks of the Stikine assemblage are the oldest rocks in the area; the assemblage consists of Permian, Mississippian and Devonian(?) bimodal flows and volcaniclastics, interbedded carbonate and minor shale and chert. The distinctive volcanics and Permian carbonates have been traced for over 500 kilometres from north of the Stikine River to south of Terrace (Monger, 1977). Kerr (1948a) inferred Devonian ages for some of these rocks and Anderson (1989) has identified a lower to middle Devonian unit near Forrest Kerr Creek, about 20 kilometres to the southeast. Upper Permian fossils have been reported by Rigby (1961), Pitcher (1960), Monger and Ross (1971), Souther (1972), and were found in the course of this study. A complete section from the top of the Stikine assemblage (Upper Permian) down to the Devonian(?), complicated in part by westerly directed thrust faulting, is located in the south-eastern corner of the map area.

Souther (1972) divided the Stikine assemblage into three units: Permian and older sediments, tuffs and intermediate volcanics; a Missisippian limestone; and a Permian limestone.

PERMIAN AND OLDER (PS, PV)

Permian and older rocks comprise a package of argillites, mafic to felsic flows, tuffs and epiclastics and, together with

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

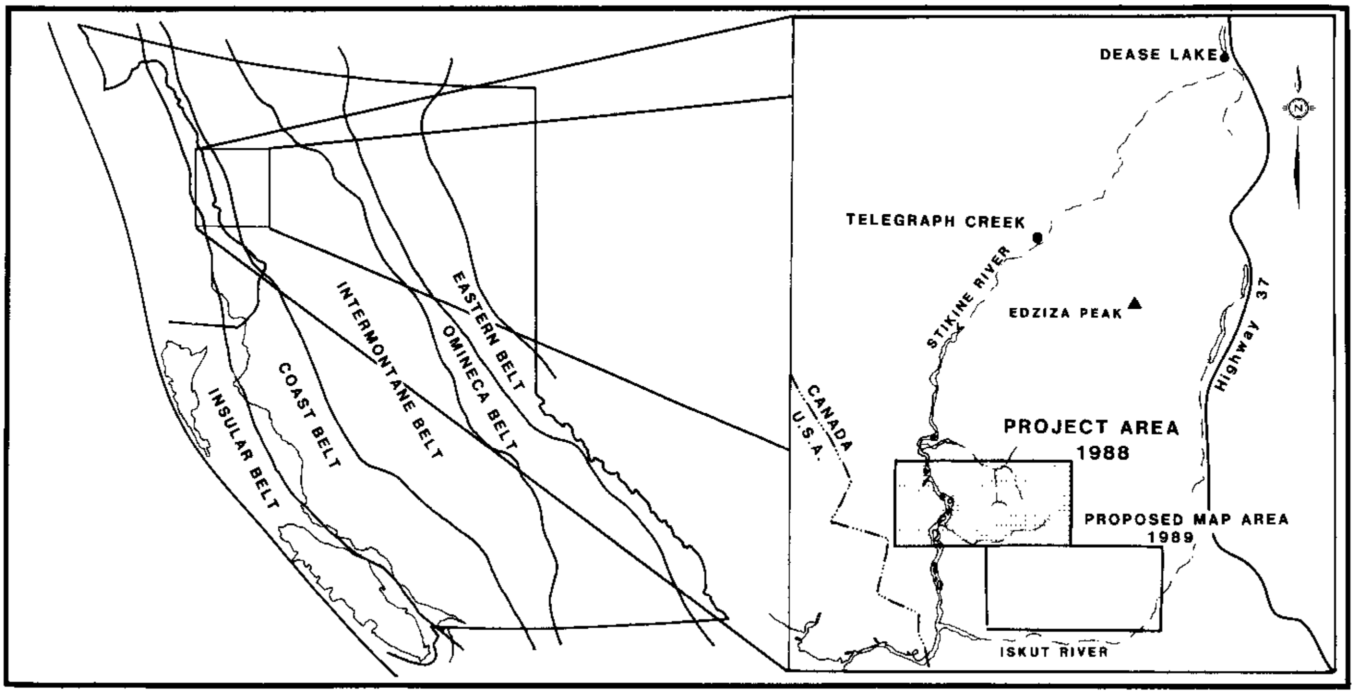


Figure 1-30-1. Location map showing the 1988 map area and the proposed map area for 1989.

Paleozoic limestones, are the most penetratively deformed and metamorphosed rocks in the map area. This sequence of uncertain stratigraphy which, in part, resembles that described by Holbek (1988) in the Mess Creek area to the east, has been identified east of Round Lake (Figure 1-30-3a). A silver phyllite and graphitic argillite unit (**Ps**) is inferred to be the oldest lithology and is overlain by a volcanic package (**Pv**) comprising greenstones and chlorite schists derived from intermediate flows, sills and tuffs at the base, followed by thick section of purple-green ash-lapilli tuff, in turn overlain by plagioclase-phyric flows, sills and volcaniclastics.

Mississippian limestone, intercalated with volcanics and clastic sediments, conformably overlies Unit Pv. The limestones are in turn overlain conformably, and are in faulted contact with volcanic breccias, tuffs and sediments similiar to those which underlie the Mississippian limestone. The intermediate plagioclase-porphyrytic flows and volcaniclastics are megascopically distinct from the more basic pyroxene-porphyritic volcanics of the Upper Triassic Stuhini Group. The Stikine rocks are relatively alkaline (Souther, 1977).

Further west these greenschist facies rocks are exposed in the lower reaches of the Porcupine River; they extend northwestward into the Coast crystalline belt as screens and roof pendants up to 4 kilometres across, where garnet-biotite schists and gneisses are locally developed within these greenschist-facies rocks, due to the effects of contact metamorphism.

Mississippian (Ml, Ms)

Limestone, containing foraminifera, corals, bryozoa and brachiopods of Late Mississippian age (Mamet, 1976), is exposed on cliffs above Round Lake. The limestone unit is comprised of two distinct members separated by a wedge of chert and phyllitic volcaniclastic rocks (Monger, 1970). Comformably underlying the lower limestone member are mafic and intermediate volcaniclastics, well-bedded tuffs and rare limestone lenses. Solitary horn corals and large crinoid fragments in the limestone are of probable Mississippian age. The base of the underlying volcanics was not defined.

The lower limestone, 60 to 150 metres thick, is a pale grey, coarse-grained crinoidal calcarenite (Figure 1-30-3a). The basal sections are locally ferruginous and contain up to 80 per cent large crinoid stems within a medium-grained calcarenite to micrite matrix. Up-section the crinoid debris is finer grained and graded bedding is well developed. The upper 50 metres of the lower limestone is intercalated with purple and green ash-tuff beds 1 to 2 metres thick; a 3-metre basic flow was noted. The wedge of phyllite, tuff and intraformational limestone-pebble conglomerate (**Ms**) separating the two limestone members has an estimated thickness of less than 250 metres and is conformably overlain by the upper limestone. The upper limestone member, 400 to 500 metres thick, is a light grey, massive-bedded bioclastic calcarenite. Yellow to black layers of amorphous chert, 10 to 40 centimetres thick, define bedding and, on average, comprise 15 per cent of the member. Rare lenses (5 to 15 centimetres thick) of green-purple tuff occur throughout. Bryozoan and solitary corals are abundant in the upper 50 metres. The upper limestone member is conformably overlain by fine-grained green to purple, calcareous lithic ash-tuffs which contain beds of Upper Mississippian limestone (Mamet, 1976). This stratigraphy has been sampled systematically along three separate traverses and 15 samples have been collected for conodont studies.

Monger (1970, 1977) has suggested that a profound pre-Lower Permian unconformity is necessary to explain the disappearance of at least 1500 metres of Mississippian strata over a 5 kilometre strike distance at Round Lake. A north-trending unconformable contact between Early Permian (Wolfcampian) limestones and polydeformed pre-Permian phyllites and metavolcanics (Figure 1-30-2) has been identified and may represent this event. Alternatively, the distribution of Mississippian limestone may reflect paleotopography where limestone accumulated around volcanic highs.

PERMIAN (PL)

Two regionally extensive carbonate units have been recognized and are evidence of a stable continental shelf environment in the Permian (Monger, 1970). Within the map area, Permian limestones 800 to 1000(?) metres thick are exposed at the confluence of the North Scud and South Scud rivers and can be traced southward to the edge of the map area west of Round Lake (Figure 1-30-3). The lowermost limestone overlies pre-Permian, typically greenschist-metamorphosed and penetratively deformed, mafic to intermediate volcanics, volcaniclastics and pelites (Figure 1-30-3a).

The lower 75 metres of limestone are dark grey, thin bedded, argillaceous micrites and calcarenites interbedded with pyritic argillite. Fusulinids, small horn corals, bryozoa and gastropods have been collected from this horizon in addition to conodont samples. These rocks grade upward into 350 metres of pale grey to buff-coloured thin to medium-bedded calcarenite interbedded with yellowish-brown-weathering amorphous chert. These discontinuous interlayers are 10 to 30 centimetres thick and constitute about 20 per cent of the outcrop. The bioclastic component is predominently crinoid stems and assorted fossil fragments, showing graded bedding typical of turbidity current deposition. The fauna is silicified and includes abundant brachiopods (1 to 4 per cent of the rock by volume), bryozoans, and near the base, 1 to 2 per cent horn corals.

Overlying the calcarenite is 100 metres of tan to very light-grey-weathering bryozoan-rich limestone characterized by 5 to 20-centimetre layers containing 30 to 60 per cent bryozoa in a micritic crinoidal matrix and interbedded with bryozoan-poor limestone (Figure 1-30-3a). Overlying limestones (300+ metres) are light grey, massive-bedded bioclastic calcarenites with a fine-grained light grey micritic matrix containing variable percentages (5 to 40) of crinoid stem fragments, sparse bryozoa and silicified brachiopods. Bodies of coarse angular-block breccia are locally present near the base. The breccias are commonly matrix supported and locally ferruginous. They are thought to be peri-platform talus deposits developed outboard of the platform. A recessive section of poorly sorted, fine to medium-grained brown greywacke or tuff (5 metres thick) occurs near the top of the massive limestone section.

A section of Permian limestone exposed on the west side of the South Scud River, between 1390 and 1970 metres elevation, was measured and sampled for conodonts and fusulinids. Preliminary results from fusulinid studies conducted by D. Rhys at The University of British Columbia indicate a range in age from Wolfcampian to lower Guadalupian. Pitcher (1960) has shown similarities of these forms to faunas in the southwestern United States, (McCloud fauna, Skinner and Wilde, 1965). Macrofossils and conodont collections have been submitted for identification.

The Permian limestone is overlain, apparently conformably, by Middle Triassic shale north of Copper Canyon.

MIDDLE TRIASSIC (MTS)

Souther (1972) has mapped a narrow belt of Middle Triassic sediments extending 9 kilometres north from Copper Canyon. A second belt (about 3 kilometres long) of silty argillites containing Middle Triassic fossils (*Daonella* cf. *degeeri* Boehm, Table 1-30-1) has been recognized 3 kilometres east of the South Scud River.

A preliminary stratigraphic section suggests a two-fold division into a lower sequence of silty shales, argillites and limy dolomitic siltstones and an upper sequence of cherty siltstones and rare carbonaceous limestones (Figure 1-30-3b). The entire section is a least 200 metres thick. The lowermost rocks are contorted, rusty calcareous argillites which lie with apparent conformity on Permian limestones. The shales and silty slates of the lowermost sequence contain thin *Daonella*-bearing horizons and a distinctive silver-grey shale containing rusty, round to elliptical concretions. Overlying these shales is a thin-bedded package of black and dark grey siliceous and carbonaceous siltstones, in places limy and containing discontinuous carbonaceous limestones.

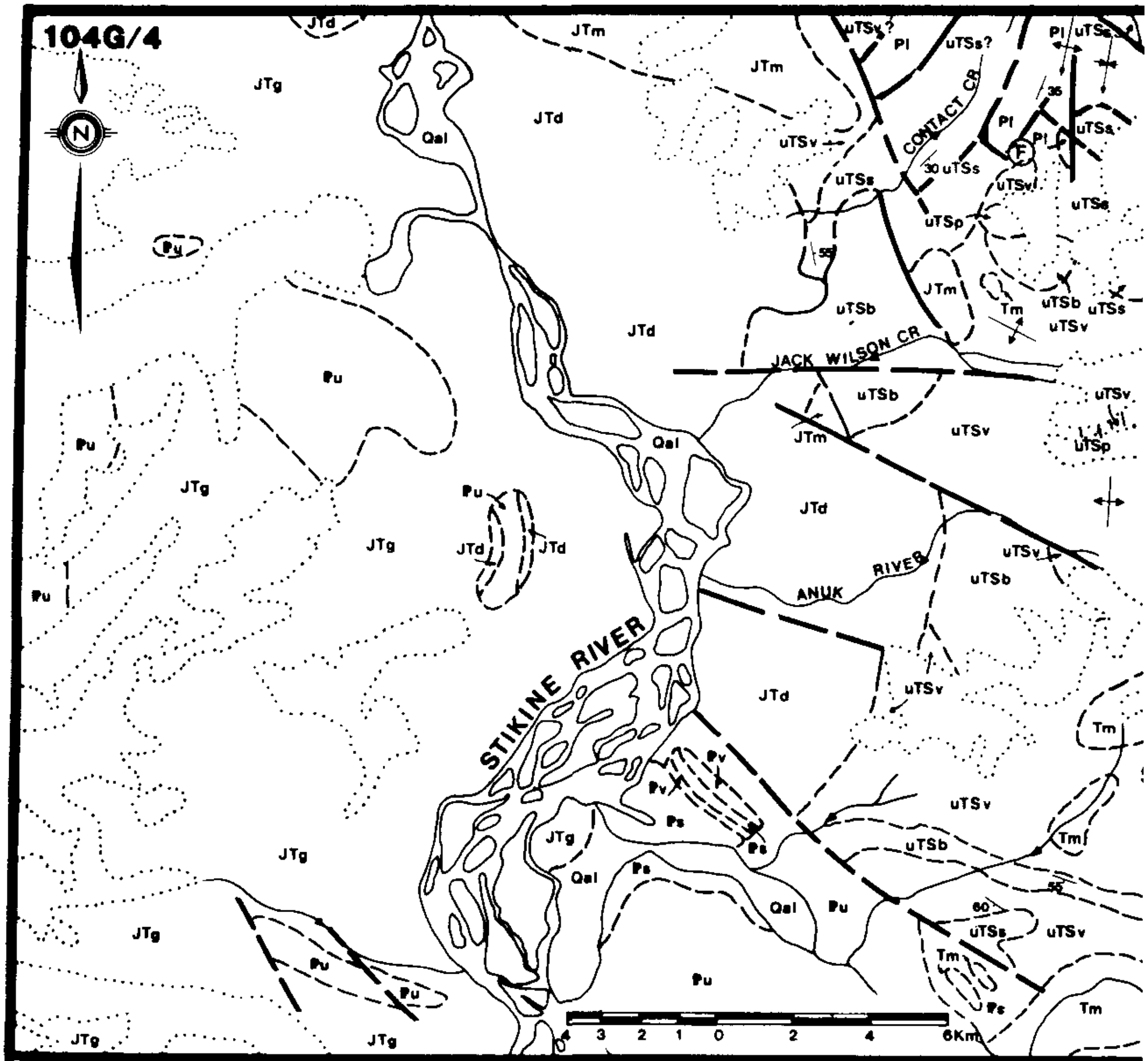
MIDDLE TO UPPER TRIASSIC STUHINI GROUP

The Triassic Stuhini Group (Kerr, 1948) comprises a variety of flows, tuffs, volcanic breccias and sedimentary rocks. These define a volcanic edifice centered on the Galore Creek area and floored by the Stikine assemblage (Monger, 1977). The rocks represent components of an emergent Upper Triassic island arc characterized by shoshonitic and leucitic rocks (de Rosen-Spence, 1985) and distal volcaniclastic and sedimentary turbidites. Stuhini stratigraphy ranges in age from early Carnian to late Norian based on radiometric dates (Anderson, 1983) and fossil ages (Souther, 1972). The Middle Triassic Hickman pluton intrudes these volcanics in the eastern part of the map area, indicating ages as old as Middle Triassic.

Panteleyev (1976) subdivided the Galore Creek volcanic edifice into a lower unit of submarine basaltic and andesitic breccias overlain by more differentiated, partially subaerial, alkali-enriched flows and pyroclastic rocks. The Stuhini of the map area has been divided into five lithological units, described below.

ANDESITE FLOWS AND BRECCIAS (M-UTSV)

Fine to medium-grained massive and fragmental textures are common. Porphyries are trachytic, typically contain 15 to 40 per cent plagioclase phenocrysts and 20 per cent hornblende in a dense green (chloritic) matrix. Compositional similiarity of fragments and matrix in the fragmental



QUATERNARY

Qal	till, alluvium, glacial material

STRATIFIED ROCKS

JURASSIC

Js	sandstone, siltstone, arkose, tuff, polymictic, granite conglomerate, carbonaceous plant material

MIDDLE TO UPPER TRIASSIC
STUHINI GROUP

uTSs	siltstone, sandstone, conglomerate, minor limestone
uTSt	well-bedded green/maroon lapilli-ash tuffs and epiclastics
uTSp	pyroxene-porphyry flows and fragmentals
uTSb	breccia-tuff and fragmentals, lithic crystal tuff, lahar-breccia
m/uTSv	massive andesite flows and tuffs, amygdaloidal basalt

MIDDLE TRIASSIC

mTs	carbonaceous silty shale with elliptical concretions and cherty siltstones

STIKINE ASSEMBLAGE
PERMIAN

Pl	massive, thickly bedded, buff, bioclastic calcarenite, thinly bedded, bioclastic limestone, with chert interbeds and minor epiclastics

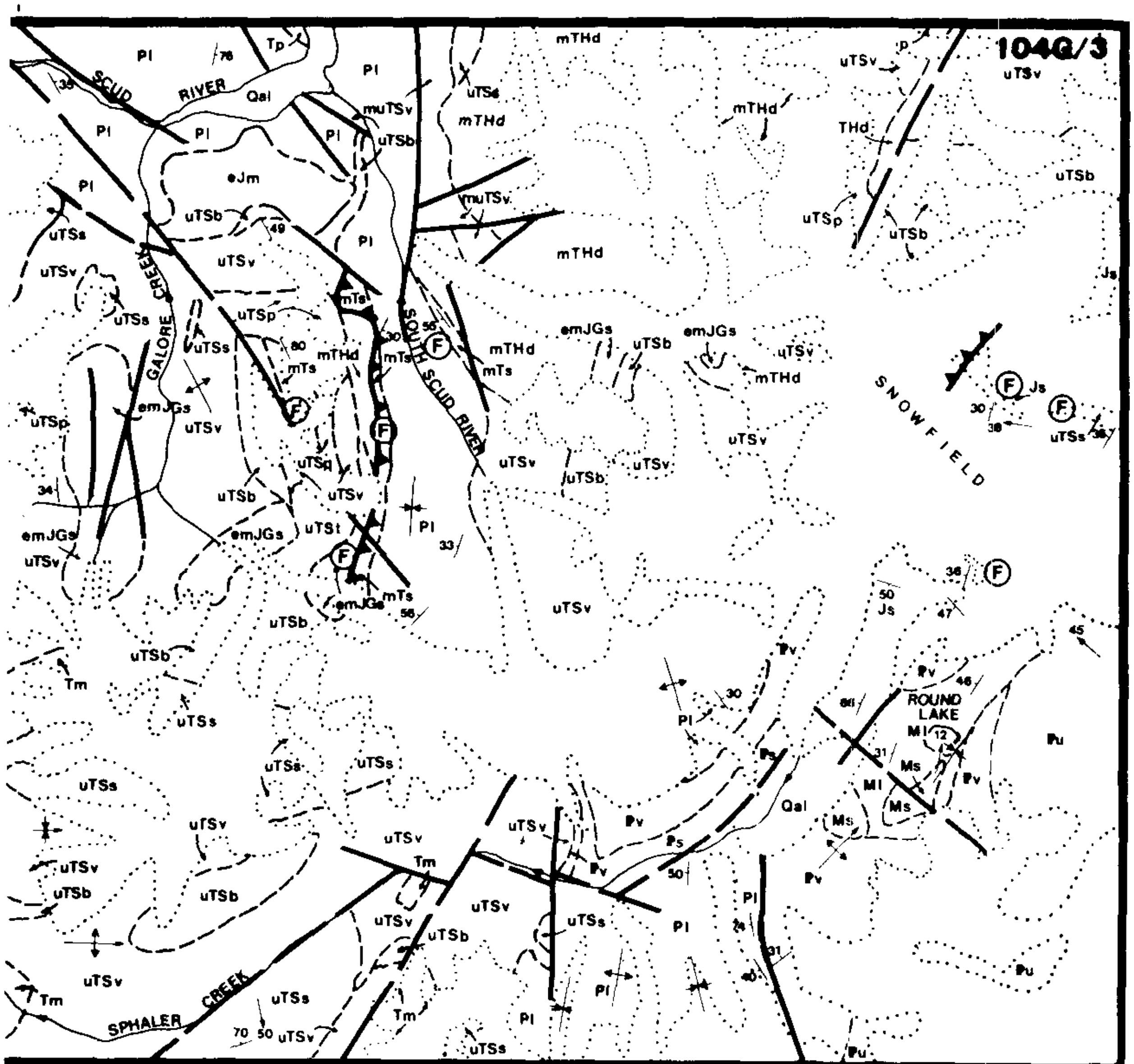
PERMIAN AND OLDER

Pv	plagioclase porphyry flows/sills, volcaniclastics, purple ash tuff, chlorite schist, massive flows
Ps	silver phyllite, slate and phyllitic argillite
Pu	undivided - green/maroon foliated volcanics, metasediments

MISSISSIPPIAN

Ml	grey, massive, bedded calcarenite with chert interbeds overlying coarse grained crinoidal calcarenite, flows, and tuffs
Ms	phyllite, tuff, intraformational limestone and conglomerate

Figure 1-30-2. Generalized geology map of the Sphaler Creek and Flood Glacier map sheets – 104G/3 and 104G/4.



INTRUSIVE ROCKS

TERTIARY

Tp / Tm plagioclase-porphyritic diorite

fine-grained biotite quartz monzonite

JURASSIC - TERTIARY
COAST INTRUSIONS

JTg medium to coarse, pink, hornblende, biotite granite

JTd medium-grained-biotite-hornblende diorite

JTm coarse potassium feldspar, megacrystic granite to monzonite

EARLY TO MIDDLE JURASSIC
GALORE CREEK INTRUSIONS

emJGs syenite, orthoclase porphyritic monzonite

EARLY JURASSIC

eJm medium to coarse, hornblende, biotite, granodiorite to monzonite

MIDDLE TRIASSIC
HICKMAN BATHOLITH

mTHd coarse to medium-grained-biotite-hornblende -augite-diorite to monzonite

ULTRAMAFICS

p pyroxenite

------ *geological boundary*

fault

thrust fault

permanent snow and ice

56 *bedding*

plunging syncline

plunging anticline

35 minor fold axis

TABLE 1-30-1
MESOZOIC FOSSIL COLLECTION

Location:	104 G/3, Copper Canyon UTM 358800E 6333400N Daonella cf. degeeri Boehm
Age:	Middle Triassic, Ladinian.
Location:	104 G/3, Scotch Glacier, Trophy UTM 361000E 6339050N Daonella cf. degeeri Boehm
Age:	Middle Triassic, Ladinian.
Location:	104 G/4, Scud/Jack Wilson UTM 345750E 6343325N Monotis sp.
Age:	Upper Triassic, Upper Norian (Cordilleranus Zone).
Location:	104 G/4, 4 km north Copper Canyon UTM 358225E 63365500N Daonella cf. degeeri Boehm
Age:	Middle Triassic, Ladinian.
Location:	104 G/3, 5.5 km NE of Galore copper deposit UTM 356325E 6337250N Spongiomorph, indet.
Age:	probably Upper Triassic.
Location:	104 G/3, 5.5 km NE of Galore copper deposit UTM 356550E 6337350N Monotis subcircularis Gabb
Age:	Upper Triassic, Upper Norian (Cordilleranus Zone).
Location:	104 G/3, 5.5 km NE of Galore copper deposit UTM 356255E 6337200N Monotis subcircularis Gabb
Age:	Upper Triassic, Upper Norian (Cordilleranus Zone).
Location:	104 G/3, 5.5 km NE of Galore copper deposit UTM 356425E 6337250N Monotis salinaria Bronn
Age:	Upper Triassic, Upper Norian (Cordilleranus Zone).
Location:	104 G/3, East Icefield/Mess Creek UTM 375300E 6337400N Weyla ? sp.
Age:	probably Lower Jurassic.
Location:	104 G/3, 3 km N of Round Lake UTM 375250E 6332550N Pectenid bivalve Lima (Plagiostoma) sp.
Age:	Triassic or Jurassic.
Location:	104 G/3, East Icefield/Mess Creek UTM 376015E 6336630N Monotis subcircularis Gabb
Age:	Upper Triassic, Upper Norian (Cordilleranus Zone).

* Fossils identified by E.T. Tozer.

units makes distinguishing them difficult and, as a result, more andesite may have been mapped than actually exists.

Aphyric Tuff and Breccia (uTSb)

Fragmental rocks vary from block breccias to ash tuffs; lapilli tuffs are the most abundant. Colour varieties are black, green and red, and where epidote and/or hematite preferentially replaces fragments or matrix the rock is mottled. The size and density of fragments varies greatly over short distances and the monolithic nature of fragments and matrix make it difficult to trace these units (Figure 1-30-3b). Three subunits have been recognized and are briefly described.

A lithic-lapilli crystal tuff outcrops along Jack Wilson Creek near the contact with Coast intrusions. Polylithic fragments are subrounded to angular, typically volcanic, with compositions ranging from andesite to rhyolite; euhedral hornblende, plagioclase, and possibly augite phenocrysts are also characteristic. These rocks are commonly foliated. A pervasive propylitic alteration is diagnostic and may reflect contact metamorphism by the Coast intrusions.

A lithic lapilli tuff is interbedded with Upper Triassic siltstones along Contact Creek. This tuff is well consolidated, appears massive in outcrop and is comprised of black subangular fragments in a black matrix. The black colour makes it difficult to distinguish from massive siltstone. Argillic alteration and the absence of sulphides are characteristic.

Lapilli-block tuff is the typical lithology between the Anuk River and Sphaler Creek near the contact with Coast intrusives (Figure 1-30-2). Blocks range in size up to 50 centimetres across, averaging 5 centimetres, and are generally volcanic lithologies but include some sedimentary fragments, occasionally limestone. Minor basalt and andesite flows are interbedded with the tuff.

Green-Maroon Pyroxene Porphyry (uTSp)

Pyroxene porphyry flows and fragmental rocks typify the Stuhini Group. They contain from 15 to 30 per cent euhedral phenocrysts of pyroxene (up to 1 centimetre in size) set in a dense, dark green groundmass of feldspar and pyroxene. These medium to coarsely porphyritic basic flows are interbanded with massive andesitic rocks. Dykes and sills of pyroxene porphyry intrude upper Norian sediments and represent feeders to overlying flows (Figure 1-30-3b). These porphyries cap several peaks and are among the youngest Stuhini Group volcanics.

Thick sections of green to purple augite basalt and andesite breccia form massive outcrops at the head of Hickman Creek and are overlain by purple amygdaloidal basalts. Rare, thin tuffaceous horizons break the monotony of these thick monolithic porphyries.

Green/Maroon Bedded Tuffs and Epiclastics (uTSt)

Purple to maroon, thin-bedded tuffs, epiclastics and siltstones outcrop between Copper Canyon and Galore Creek (Figure 1-30-2). Graded bedding indicates that the beds are overturned in places. Maroon lithic ash tuffs and lapilli tuffs can be traced northwestward where they interfinger with thin-bedded siltstone, conglomerate and pods of clastic limestone. The distinctive maroon colour and well-bedded nature of these rocks suggests they may be a separate suite of volcanics (Jeffery, 1965).

Sediments (uTSs)

Thin, lenticular and locally variable sediments are interbedded with volcanics throughout the map area. They include thin-bedded graded siltstone and sandstone, conglomerate composed of green and purple volcanics, limestone and other sedimentary clasts and clastic limestone (Figure 1-30-3b). Abundant *Monotis subcircularis* Gabb, (Table 1-30-1) indicate a Late Triassic (Cordilleranus Zone) age.

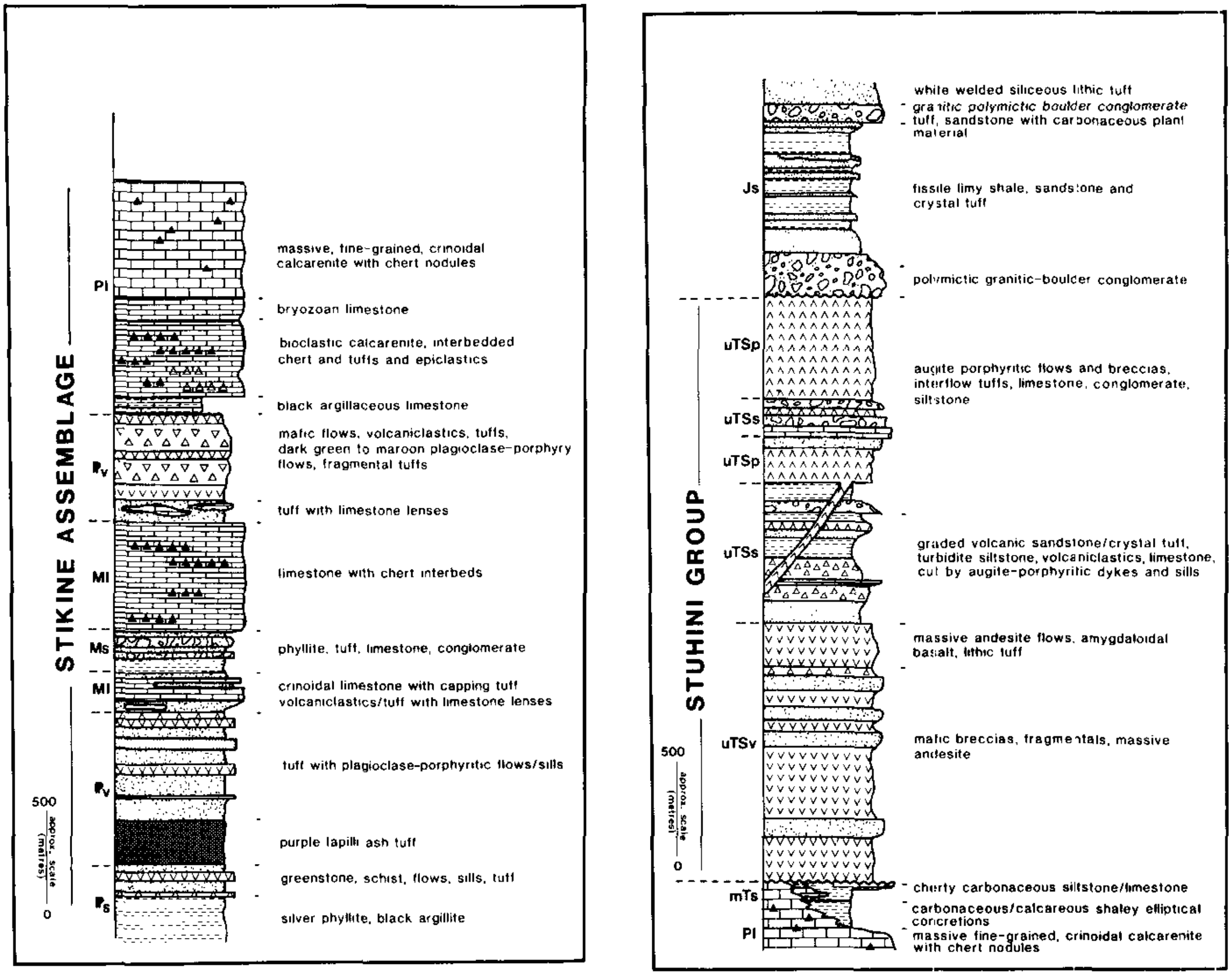


Figure 1-30-3. Schematic stratigraphic sections of a) Paleozoic Stikine assemblage lithologies and b) Mesozoic lithologies of the Upper Triassic Stuhini Group and unnamed Jurassic sediments.

A thick succession of well-bedded tuffaceous and argillaceous sediments and subordinate volcanic breccias outcrops at high elevations between Jack Wilson Creek and Scud River (Figure 1-30-2). These sediments are underlain by Permian limestone above the Scud River and by Upper Triassic volcaniclastics and massive flows along Jack Wilson Creek. The base of the sedimentary succession consists of thin-bedded black calcareous and carbonaceous siltstone, interbedded black lithic tuff and rare limestone; the sequence grades upward into thin variegated siltstone, grey ash tuffs and volcanic sandstone and conglomerate. The lower units are thin, repetitively graded "AE-turbidites", characterized by soft-sediment slumping, faulting and scour-and-fill structures, and are crosscut by volcanic conglomerate and breccia. A distinctive arenaceous unit contains aligned siltstone and limy siltstone clasts in a fine to medium-grained tuffaceous sandstone matrix. The clasts vary from 1 to 50 centimetres long and are elongate parallel to bedding.

Near the eastern margin of the map area a thick succession of gently west-dipping sediments, ranging in age from Triassic to Jurassic, is exposed in a series of nunataks. The Triassic sequence is comprised of green to more commonly limonitic arkosic sandstone, locally with abundant carbonized plant material, interbedded with argillite and maroon volcanic conglomerates. The base of the sequence is not exposed; the top is *Monotis*-bearing calcareous siltstone and interbedded argillite (Table 1-30-1).

Well-bedded, thinly laminated, tightly folded and contorted siltstone, sandstone and calcareous argillite outcrop on the slopes south of Sphaler Creek. These sediments are fissile, weather rusty and are similar to the sediments cropping out between Jack Wilson Creek and the Scud River.

Thin to medium-bedded wacke, volcanic sandstone and volcanic conglomerate, in part calcareous, outcrop on the high peaks between Sphaler and Galore creeks. The absence of siltstone is a distinctive feature in this area.

JURASSIC SEDIMENTS (JS)

Unnamed Jurassic rocks comprise a fault-bounded wedge in the eastern part of the map area (Figure 1-30-2). The sequence is well bedded, at least 1000 metres thick and characterized by brown to limonitic weathering.

The basal unit is a hematitic purple to red polymictic boulder and cobble conglomerate containing granodiorite and distinctive potassium feldspar porphyry (Galore syenite equivalents?) clasts in an arkosic matrix. This basal conglomerate is 150 metres thick in the headwaters of Schaft Creek and is overlain by three fining-upward sequences of well-bedded conglomerates and intercalated arkosic sandstones and siltstones (Figure 1-30-3b). A pebble conglomerate, 50 metres thick, outcropping 3 kilometres north of Round Lake is correlative and is overlain by interbedded limy siltstones and arkosic sandstones containing conspicuous carbonized wood and plant fragments. At the eastern margin of the map area the basal conglomerate is overlain by approximately 400 metres of thinly bedded, friable, black limy shale and argillite with subordinate calcareous sandstone and crystal tuff horizons, followed by lapilli and well-bedded varigated tuffs and brown sandstone with abundant carbonized plant material, which are overlain in turn by 75 metres of cobble conglomerate with siltstone and sandstone interbeds. In general the section appears to coarsen upward and is capped by a white, siliceous, welded lithic tuff (Figure 1-30-3b).

A fauna of *Weyla*(?) (sp.) together with well-preserved terebratulid and rhynchonellid brachiopods indicates a probable Early Jurassic age, and strata on strike contain molluscs with age ranges from Triassic to Jurassic (Table 1-30-1). Above Schaft Creek, correlative fluvial conglomerates, arkose and siltstone contain imprints of the conifer *Pityophyllum* sp. (G. Rouse, personal communication, 1988). This species is Middle Jurassic to Early Cretaceous and most abundant during the Late Jurassic.

QUATERNARY TUFFA

A small hot spring discharges into Sphaler Creek, approximately 11 kilometres southwest of Round Lake. It is located on a major north-trending structure which flanks the west side of the Hickman batholith and has deposited calcareous tuffa up to 1 metre thick. The smell of hydrogen sulphide is easily detectable and the tuffa has been sampled for geochemical analysis.

INTRUSIVE ROCKS

Three intrusive episodes are represented in the map area: the Middle Triassic to Middle Jurassic Hickman plutonic suite, coeval with Upper Triassic Stuhini Group volcanics; Jurassic to Tertiary Coast Range plutons, and Tertiary plugs and bimodal dykes. Mineral deposits are spatially and genetically related to the Upper Triassic Stuhini volcanics and comagmatic alkaline plutons.

MIDDLE TRIASSIC – MIDDLE JURASSIC PLUTONIC SUITE

ULTRAMAFICS (P)

The Mount Hickman zoned ultramafic body is a northeast-striking, 6 by 2 kilometre intrusive body which outcrops on Mount Hickman in the northeast corner of the maps area. Its southern extremity, comprising pyroxenite and pyroxene gabbro extends into the study area. Plagioclase and hornblende increase outward from the pyroxenite until the rock becomes an augite gabbro to hornblende-augite diorite of the Hickman batholith (Souther, 1972). The reader is directed to Nixon and Ash (1989, this volume) and Brown and Gunning (1989, this volume) for detailed descriptions.

HICKMAN BATHOLITH (mTHd, mTHm, eJHm)

The Hickman batholith comprises from south to north, the Hickman, Yehiniko, and Nightout plutons. Samples dated by Holbek (1988) give Middle Triassic ages for the Hickman and Nightout and an Early Jurassic age for the Yehiniko (Table 1-30-2). The Hickman batholith is analogous with Late Triassic to Middle Jurassic Hotailuh and Stikine composite batholiths of the Stikine Arch (Anderson, 1983, 1984). These are coeval and comagmatic with Stuhini Group volcanics. Pyroxenite bodies and alkalic syenites are differentiated end-members of the Stuhini volcanic – Hickman plutonic suite (Souther, 1972; Barr, 1966).

The Nighout and Yehiniko plutons outcrop north of the map area and are described by Brown and Gunning (1989, this volume) and Holbek (1988).

The Hickman pluton is a crudely zoned body (Souther, 1972) ranging in composition from pyroxene diorite in the core, to biotite granodiorite near the margins. The main mass comprises biotite and hornblende-pyroxene diorite to monzodiorite (**mTHd**). Less mafic hornblende-biotite-pyroxene monzonite to quartz monzonite (**mTHm**) dominates the southern end of the pluton. Steeply dipping faults bound the pluton on both its western and eastern margins but the contacts between it and Stuhini volcanics are intrusive. Holbek (1988), reports an unconformable relationship, citing basal Stuhini Group conglomerates which contain Hickman intrusive clasts as evidence.

The biotite-hornblende-pyroxene diorite is a medium to coarse-grained, equigranular rock, massive in outcrop and weakly jointed. Hornblende and augite are variably replaced by chlorite, and together comprise 75 to 80 per cent of the mafic minerals, with biotite the remainder. Potassium feldspar (20 per cent) and quartz (10 to 15 per cent) are interstitial to plagioclase (40 per cent). Magnetite and rare honey-coloured euhedral titanite are accessories. Pegmatitic and porphyritic textures are common and have been described by Souther (1972) north of the map area, at the toe of the Scud Glacier.

Coarse-grained, commonly trachytic, biotite-augite diorite occurs as small bodies distributed along the margins of the batholith (Figure 1-30-2). The rock is coarsely porphyritic with up to 30 per cent sodic plagioclase laths averaging 1.5 centimetres in length. Minerals comprising the matrix are medium-grained biotite, augite, plagioclase and potassium feldspar. Mafic minerals are chloritic and accessories include most notably magnetite to several per cent. Contact relationships with biotite-augite diorite are conflicting over relatively short distances. Wholerock chemistry may provide answers to the relationships between these two intrusives.

The hornblende-biotite monzonite to granodiorite is a medium to coarse-grained, pink weathering massive rock,

TABLE 1-30-2
REGIONAL CHRONOLOGY DATA

Locality	Location UTM E/N	Lithology	Method	Mineral	Age	Reference
Nightout pluton	377000	Hb-Bi	K/Ar	Bi	236 ± 9	1
	6374750	granodiorite		Hb	228 ± 8	1
			Rb/Sr	Bi	232 ± 5*	1
Hickman pluton	370000	Bi-Hb	K/Ar	Hb	221 ± 8	1
	6354500	granodiorite		Bi	209 ± 7	1
			Rb/Sr	Bi	216 ± 4*	1
				WRx	233 ± 23*	1
Yehiniko pluton	365000	Leuco-qtz	K/Ar	Bi	172 ± 6	1
	6366000	monzonite	Rb/Sr	Bi	170 ± 16*	1
				WRx	178 ± 11*	1
Scud River	354000 6344000	Monzonite	K/Ar	Hb	195 ± 6	5
Scud River	352000 6338500	Granite	K/Ar	Bi	185 ± 9	6
Galore Creek	351200 6335400	Hydrothermal alteration	K/Ar	Bi	192 ± 9	6
Galore Creek	351200 6335400	Hydrothermal alteration	K/Ar	Bi	201 ± 7	6
Junction syenite	350000	Syenite	K/Ar	Hb	251 ± 7	5
	6337000			Bi	189 ± 6	5
		Andesite	Rb/Sr	WRx	146 ± 14**	5
Galore Creek	351200 6335400	Hydrothermal alteration	K/Ar	Bi	177 ± 9	6
Copper Canyon	358500 6332750	Syenite	K/Ar	Bi	179.5 ± 9	6
Schaft Creek	380000 6358000	Alteration	K/Ar	Bi	185 ± 5	2
Mess Creek	381000 6335750	Alteration	K/Ar	Ms	192 ± 7	1
Anuk River	343250	Quartz	K/Ar	Hb	197 ± 5	4
	6332800	diorite		Bi	120 ± 5	3
Sphaler Creek	345500 6320800	Quartz monzonite	K/Ar	Bi	53.5 ± 1.6	3
Split Creek	346300 6327800	Alteration	K/Ar	Bi	48.5 ± 1.7	4

Decay constants after Steiger and Jäger (1977).
*Initial $^{87}Sr/^{86}Sr = 0.7038$
**Initial $^{87}Sr^{86}Sr = 0.70449$

REFERENCES
1. Holbek, P.M. (1988); 2. Panteleyev, A and Dudas, B.M. (1973); 3, 4 & 5. Panteleyev, A. (1975, 1976 & unpublished); 6. White, W.H., *et al.* (1968)

texturally similiar to Unit mTHd. The mafics are hornblende, biotite and augite up to about 20 per cent. These are generally chloritized. Plagioclase (35 per cent) is euhedral, zoned and contains small inclusions of mafic minerals. Potassium feldspar (35 per cent) is poikilitic to interstitial. Quartz (5-10 per cent) is also interstitial.

The monzonite is intruded by north-striking porphyritic monzonite to syenite and basaltic to andesitic flow-banded dykes.

A monzonite stock (**eJHm**) 5 kilometres wide is exposed south of the confluence of the Scud and South Scud Rivers (Figure 1-30-2). The intrusive varies from a medium-grained, equigranular biotite monzonite to a hornblende-biotite quartz monzonite. Euhedral plagioclase and pink potassium feldspar are present in roughly equal amounts. Chloritized mafics form less than 10 per cent, with biotite more common than hornblende. The stock is crudely zoned; the margin is finer grained, hornblende and plagioclase are more abundant and garnets occur locally (endoskarn). Exoskarn has developed in limestones at the intrusive contact. The outcrop pattern suggests the stock is bisected by a northwest striking fault.

Potassium-argon dates (White *et al.*, 1968; Panteleyev, unpublished data; recalculated to new decay constants) of 185 ± 9 and 195 ± 6 Ma on hornblende and biotite, give an Early Jurassic apparent age of emplacement for the stock (Table 1-30-2).

Galore Creek Intrusions (emJGs)

The Galore Creek syenite complex (Barr, 1966) is comprised of a series of ten syenite (orthoclase porphyry) intrusions hosted by coeval Upper Triassic Stuhini Group volcanics. Four of these are most closely associated with the copper deposits; from oldest to youngest these are dark syenite porphyry, garnet syenite megaporhyry, fine-grained porphyritic syenite, and epidote syenite megaporphyry. Allen *et al.* (1976) have described these rocks in detail; the following brief descriptions are condensed from their work.

The dark syenite porphyry is the oldest intrusive. It occurs as plugs and dykes (up to 60 metres wide) and is characterized by short, tabular, white orthoclase phenocrysts in a fine-grained potassium feldspar, biotite and plagioclase matrix. Phenocrysts of pseudoleucite interpreted as evidence of rapid cooling (Barr *et al.*, 1976) suggest the rock crystallized in a subvolcanic environment.

Garnet syenite megaporphyry forms dykes, is grey, contains euhedral orthoclase phenocrysts to about 25 per cent, biotite replacing euhedral hornblende to about 25 per cent, and from 1 to 15 per cent garnet as porphyroblasts and in veinlets. The groundmass is foliated and consists of fine-grained potassium feldspar.

Fine-grained porphyritic syenite consists of 10 to 30 per cent white phenocrysts of orthoclase in a light grey to pink groundmass containing up to 5 per cent disseminated biotite or hornblende. Contact relationships indicate the fine-grained porphyritic syenite is younger than the garnet syenite porphyry.

Epidote syenite megaporphyry dykes form a large part of the intrusive complex and are the youngest porphyries in the Galore Creek area. Large phenocrysts of orthoclase form 40 to 60 per cent of the rock. Phenocrysts are zoned and partly replaced along rims by intermediate microcline. Bimodal phenocryst size indicates two generations, an early phase, with phenocrysts averaging 2.5 centimetres long and a younger phase with much smaller phenocrysts. Epidote aggregates up to 15 per cent, are dispersed through the rock giving it a greenish grey colour, and where garnet is abundant in the wall rock the syenite also contains disseminated garnet. Hornblende phenocrysts, replaced in part by biotite and chlorite, form up to 25 per cent of the rock. The groundmass is fine-grained, grey potassium feldspar with accessory amounts of apatite and magnetite, each to 1 to 2 per cent.

Potassium-argon ages (recalculated to new decay constants) from porphyritic epidote syenite (North Junction syenite) gave discorant ages of 257 ± 7 Ma (hornblende) and 189 ± 6 Ma (biotite, Table 1-30-2). The hornblende age is unexpectably old. This syenite, known colloquially as "wipe-out porphyry" (A. Panteleyev, personal communication, 1988), is post mineralization. Drill-core samples have been collected and submitted for uranium-lead zircon dating.

JURASSIC-TERTIARY PLUTONIC SUITE

Coast Range Intrusions

One fourth of the map area is underlain by intrusive rocks of the Coast plutonic complex. Three texturally and compositionally distinct intrusive phases have been mapped (inferred oldest to youngest); potassium feldspar megacrystic granite to monzonite (**JTm**); biotite hornblende diorite to granodiorite (**JTd**); and biotite granite (**JTg**).

Potassium feldspar megacrystic granite (JTm) is a coarse-grained, equigranular to porphyritic hornblende-biotite granite to quartz monzonite which outcrops on the eastern side of Pereleshin Mountain and south of Jack Wilson Creek on Saddle Mountain. The potassium feldspar megacrystic variety contains from 5 to 10 per cent potassium feldspar laths 0.4 to 2.0 centimetres in length. Hornblende and biotite are chloritic and interstitial to roughly equal proportions of equigranular plagioclase and potassium feldspar. Mafics constitute from 5 to 15 per cent of the rock. Quartz is interstitial, and varies from 10 to 20 per cent. Accessories include magnetite and trace pyrite.

Biotite hornblende diorite (JTd) is exposed on the eastern edge of the Coast Complex forming a belt 4 to 5 kilometres wide extending along the eastern side of the Stikine River from Pereleshin Mountain to the Porcupine River. At the confluence of the Porcupine and Stikine rivers the intrusive is roofed by pre-Permian(?) metasediments and metavolcanics. Numerous inclusions of partially assimilated pre-Permian(?) and/or Upper Triassic Stuhini Group(?) volcanics and sediments occur north to Saddle Mountain. The xenoliths are fine grained (1 to 4 metres and larger) and commonly well rounded.

The diorite is massive, medium grained and heterogeneous due to the abundance of inclusions, and is commonly sheared and altered. Megascopically the rock is equigranular, contains about 20 per cent quartz, and has a plagioclase:potassium feldspar ratio of approximately 4:1. Hornblende is more abundant than biotite and both occur as crystals and blebs. The average composition of ten thin sections (Kerr, 1948a) was: andesine, 60 per cent; orthoclase, 13 per cent; quartz, 17 per cent; mafics, predominantly hornblende, 10 per cent. Accessories include magnetite, titanite, apatite and zircon.

Potassium-argon dates (recalculated to new decay constants) for quartz diorite (Anuk River area) give a discordont pair of ages, 197 ± 5 Ma for hornblende and 120 ± 5 Ma for biotite (Table 1-30-2).

Biotite granite (JTg) underlies a wide belt west of the Stikine River. The rock is a massive, mineralogically and texturally homogeneous light grey rock, commonly well jointed. Megascopically it is coarse to medium grained, equigranular and composed of roughly equal proportions of plagioclase and potassium feldspar, each comprising about 10 per cent of the rock. Quartz averages 20 to 25 per cent. Biotite and lesser hornblende are interstitial to plagioclase and poikilitic feldspar and together comprise 5 to 10 per cent of the rock. Honey-coloured titanite is conspicuous to several per cent. Average composition of eleven thin sections (Kerr, 1948a) was: plagioclase, 58 per cent; orthoclase, 11 per cent; quartz, 20 per cent; biotite, 8 per cent; and hornblende, 3 per cent. Titanite, magnetite and apatite make up the accessories.

TERTIARY INTRUSIONS

Small stocks and plugs of biotite quartz monzonite (**Tm**) outcrop south of Sphaler Creek at its confluence with the

Porcupine River, and 10 kilometres further east, at Split Creek and northeast of Jack Wilson Creek (A. Panteleyev, personal communication, 1988). The rock is equigranular, medium grained and contains roughly equal proportions of plagioclase and potassium feldspar. Biotite averages 5 to 10 percent and quartz content varies to about 20 per cent.

A single potassium-argon date (recalculated to new decay constants) on biotite from the Sphaler Creek/Porcupine River stock gave 53.5 ± 1.6 Ma (Panteleyev, 1975), (Table 1-30-2).

Small plugs and dykes of plagioclase-phyric diorite (**Tp**) are intruded along north-trending faults within the South Scud River valley. The rocks are dense, green to grey coloured, with phenocrysts of zoned plagioclase (20 to 25 per cent) hornblende and quartz. Pyrite is ubiquitous and outcrops are limonite stained. These rocks are so fresh, they are thought to be Tertiary or younger.

Narrow dykes of inferred Tertiary age (**Tr, Tb**) are found in north-striking, steep-dipping fault zones. Rhyolite and lamprophyre/basalt are most common, but felsite, hornblende andesite and amphibolite dykes have been identified.

STRUCTURE

Complicated structures have resulted in part from polyform deformation (Paleozoic strata), but also from the contrasting competence of Triassic and Jurassic volcanic and sedimentary units. Four main sets of faults have produced a mosaic of fault-bounded blocks.

Three phases of deformation have been tentatively recognized for the oldest Paleozoic rocks and a single phase for Upper Triassic and younger strata. D_1 is pre-Permian to post-Mississippian; D_2 pre-Late Triassic "Tahltanian"; and D_3 post-Jurassic(?). Holbek (1988) has recognized four phases of folding within Stikine assemblage rocks to the east, and Panteleyev (1976) documented two generations in the Triassic rocks at Galore Creek.

Penetrative planar fabrics are ubiquitous in Paleozoic and Middle Triassic strata. Penetrative deformation of Upper Triassic and younger rocks is rare, restricted to north-trending zones of foliation.

FOLDS

PHASE 1 DEFORMATION

Paleozoic rocks between Sphaler Creek and Round Lake (Figure 1-30-2) contain a single bedding-parallel foliation. Flattened fragments in volcaniclastic units define a stretching lineation colinear with the foliation. Southwest of Round Lake, Permian and older purple tuff, volcaniclastics and plagioclase-phyric flows are folded into north-northwest-trending isoclinal folds. Bedding in these volcanics is truncated by a panel of moderately west-dipping Early Permian (Wolfcampian) limestones. It is uncertain whether this contact is a detachment fault or an angular unconformity. Neither fault gouge nor basal conglomerate are apparent.

PHASE 2 DEFORMATION

Permian limestones reflect the regional northerly-trend of D_2 folding. This phase is characterized by large, upright, tight to open folds above the Scud River. The axial traces trend north to north-northwest and folds verge westerly. The limestones are weakly to pervasively foliated, generally parallel to bedding. South of Scud River and east of Galore Creek, tight upright folds are characterized by ductile flow of limestone around chert boudins in strongly attenuated fold limbs. Souther (1972) reports thickened and detached fold crests in Permian limestones at the head of Sphaler Creek.

The Middle Triassic shale at Copper Canyon is assumed to lie below the Tahltanian unconformity (Souther, 1971) and had been folded (D_2) and regionally metamorphosed prior to deposition of the Upper Triassic Stuhini Group (Souther, 1972). At Copper Canyon the Middle Triassic sediments and Permian limestone are conformable and have been tightly folded as one unit (Jeffery, 1965). Tight isoclinal folds wholly within limestone are visible in cliffs above the thrust fault.

Metamorphism accompanied D_1 and D_2 and reached greenschist facies, culminating prior to D_3 (Souther, 1971; Monger, 1977; Holbek, 1988).

PHASE 3 DEFORMATION

The third phase of deformation is manifest as chevron folds and kink bands north of Round Lake. Fold axes have generally west or west-northwesterly trends and within the Stuhini Group the folds are upright box folds with chevron cores. The Jurassic sediments outcrop in a shallow westerly facing homocline onto which Upper Triassic porphyritic volcanics have been thrust eastward.

FAULTS

The most pronounced and longest-lived structures (active into the Quaternary) strike north (Souther, 1972). Vertical to steeply dipping faults occur on the western flank of the Hickman batholith and south of Sphaler Creek. Adjacent to the Hickman batholith is a zone of listwanite alteration, 15 to 20 metres wide, which hosts Tertiary(?) rhyolite and basaltic dykes. The fault zone juxtaposes Permian limestone with a narrow belt of Stuhini volcanic flows, tuffs and sediments intruded on the east by Hickman diorite. Souther (1972) has traced this fault south to Sphaler Creek where Permian and older metasediments and metavolcanics have been faulted against Upper Triassic volcanics.

A north-striking, east-dipping thrust fault at Copper Canyon places overturned Permian limestones and Middle Triassic shale on Upper Triassic volcanics (Figure 1-30-2). The hangingwall strata have dips of 30 to 50 degrees east. The contact with footwall rocks is sealed by Early to Middle Jurassic syenites at Copper Canyon (Table 1-30-2). South of the Scud River the thrust is truncated by a northwest-striking fault dipping steeply northeast. It is not known whether this is a splay of the thrust fault, or an unrelated structure. A parallel normal fault in the Scud River Valley also dips steeply northeast. It is pyritic and deeply weathered and can be traced 12 kilometres southward, almost to Copper Canyon.

A set of northwest-striking normal faults marks the boundary between the Upper Triassic and Paleozoic rocks between Scud River and Jack Wilson Creek. East-striking shear zones occur along the eastern margin of the Coast Complex.

The youngest faults in the map area strike north-northeast to northeast. The upper reaches of Sphaler Creek follow these steep to vertical structures and at the Sphal/Trek showing (MINFILE 104G 022, 029) one fault shows evidence of 1200 metres of left-lateral offset. Upstream, towards Round Lake, Paleozoic rocks have been uplifted along steep west-dipping reverse faults. A set of northeasterly striking shears and fractures on the Trophy claims is mineralized by quartz-carbonate veins. North-northeast-trending faults in the Galore Creek syenite complex postdate Early to Middle Jurassic mineralization.

GALORE ARCH

The attitudes of layered rocks around the Galore Creek complex indicate an arch-like structure, with its axis roughly coincident with the central zone of mineralization (Jeffery, 1965), interpreted to represent an eroded volcano (Allen *et al.*, 1976). North-northeasterly-trending breccia zones, syenite intrusives and faults occupy the central core in Galore Creek basin. Structures in this subvolcanic setting are predictably complex.

MINERALIZATION

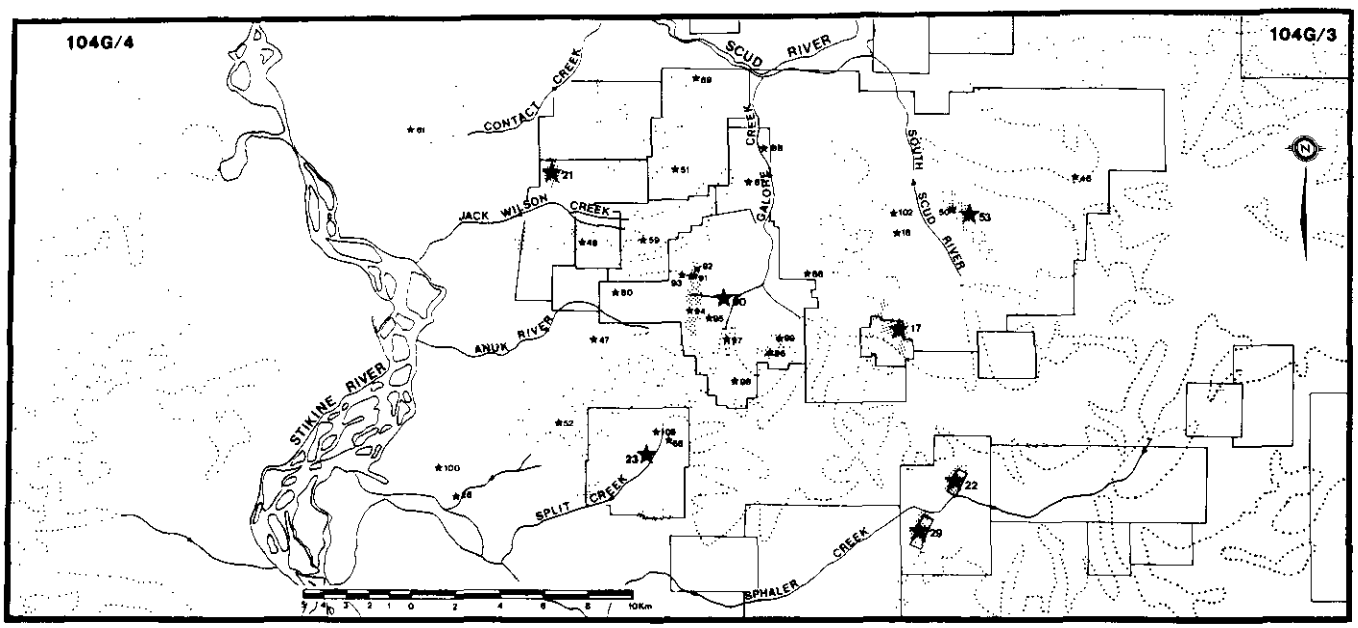
Mineral deposits in the Sphaler Creek–Scud River area can be subdivided into three groups: porphyry copper-silver-gold deposits associated with syenitic sills and monzonite plugs; mesothermal silver-gold and copper-zinc mineralization in quartz and carbonate veins; and massive polymetallic sulphides with or without gold and silver. Precious metal porphyry and vein deposits related to alkaline rocks are well documented (Mutschler *et al.*, 1985; Barr *et al.*, 1976) and important exploration models in northwestern British Columbia. Figure 1-30-4 shows the locations of mineral occurrences recorded in MINFILE as well as alteration zones and boundaries of mineral claims. Major occurrences and those subject to recent exploration activity are described below.

ALKALIC PORPHYRY DEPOSITS

Alkalic porphyry deposits occur throughout the length of the Intermontane Belt in Upper Triassic Nicola-Takla-Stuhini volcanic rocks and comagmatic alkaline plutons, forming a class distinct from calcalkaline porphyry deposits (Barr *et al.*, 1976). The deposits occupy brecciated and faulted subvolcanic zones in the intrusions and country rocks which are overprinted by extensive potassium, propylitic and pyrometasomatic alteration zones. The deposits are characteristically enriched in gold and silver. In the Galore Creek camp Stuhini volcanics and comagmatic syenitic intrusives host more than ten of these coeval disseminated deposits.

Galore Creek (MINFILE 104G 091 to 104G 099)

The Galore Creek deposits are located at the headwaters of Galore Creek in the centre of the map area. The first claims were staked in 1955. In 1963 Hudson Bay Mining and Smelting Company Limited, Kennco Explorations, (Western) Limited and Consolidated Mining and Smelting Com-



No	MINFILE NAME	COMMODITIES
016	LOT	Cu,Au,Pb,Ag
017	COPPER CANYON	Cu,Au,Ag
021	JW	Cu,Ag
022	SPHAL 17	Cu,Au,Ag
023	ANN	Cu
028	RM	Cu
029	SPHAL 27	Cu,Au
046	JAY	Cu
047	JOAN AND MB	Cu
048	JACK	Pb,Zn,Ag,Cu
050	HUMMINGBIRD	Cu,Au,Ag
051	CW	Cu,Au
052	BAL	Cu
053	PTARMIGAN	Au,Ag,Zn,Pb,Cu
[illegible]	HORN	Cu
060	DEVILS CLUB	Cu,Ag,Au
061	PERELESHIN	Cu,Zn
066	STIKINE EAST	Cu
067	STIKINE NORTH	Cu
068	AC	Cu
069	OP	Cu
086	CW-EAST	Cu
090	GALORE CREEK-CENTRAL ZONE	Cu,Au,Ag,An,Gy,Zn,Mo
091	GALORE CREEK-JUNCTION	Cu
092	GALORE CREEK-NORTH JUNCTION	Cu,An,Gy
093	GALORE CREEK-WEST RIM	Cu
094	GALORE CREEK-BUTTE	Cu
095	GALORE CREEK-SOUTHWEST	Cu,Fe
096	GALORE CREEK-SADDLE	Cu
097	GALORE CK-WEST FORK GLACIER	Cu
098	GALORE CREEK-SOUTH BUTTE	Cu
099	GALORE CREEK-SOUTH 110	Cu
100	CAM	Cu
102	GALORE CREEK LIMESTONE	Ls
103	PAYDIRT	Au,Cu

Figure 1-30-4. Mineral occurrence map showing MINFILE locations (large stars represent occurrences discussed in the text), mineral claims, and gossan zones (shaded areas).

pany of Canada Limited incorporated their respective interests to form Stikine Copper Limited. Between 1960 and 1969, 53 164 metres of diamond drilling and 807 metres of tunnelling in two adits were completed with Kennco as operator. An additional 25 352 metres of diamond drilling was completed in 111 holes between 1972 and 1973 under the direction of Hudson Bay Mining and Smelting Company. In 1987, Mingold reassayed all sample pulps for gold. Recent interest in the property stems from its future development possibilities (reserves contain 50 tonnes of gold) and its importance as a regional exploration model.

The Galore Creek syenite complex contains syenite intrusions, metavolcanics and minor sediments. Sedimentary and volcanic rocks close to the syenite complex are severely folded, sheared, faulted, brecciated and metasomatized to locally recrystallized. Mineralization is associated with four distinct phases of syenite; six other phases outcrop peripheral to the main ore zone.

Ten copper deposits are known at Galore Creek, in addition to a number of showings. They are hosted by potassium-altered (biotite and potassium feldspar addition) volcanics and pipe-like breccias adjacent to syenite porphyry dykes and stocks. The deposits are manto-shaped and trend north to northeast, following syenite contacts and structural breaks (Allen *et al.*, 1976).

Alteration and mineralization are contemporaneous and spatially overlap. Mineral zoning (Allen, 1966) is related in part to proximity to syenite bodies and breccia pipes but also reflects parent-rock composition. Potassium feldspar, biotite, garnets and anhydrite are ubiquitous and locally have replaced host rocks completely.

Chalcopyrite and bornite, in a ratio of 10:1, are the principal copper minerals. Disseminated pyrite is the most abundant sulphide; sphalerite and galena are associated within garnet-rich areas and trace amounts of molybdenite, native silver, native gold and tetrahedrite have been noted (Allen, 1966). Magnetite occurs in veinlets with or without chalcopyrite and often as a breccia matrix. Chalcocite, cuprite, native copper and tenorite are secondary copper minerals.

The largest deposit is the Central zone, which extends 1950 metres north-northeast, varies from 200 to 500 metres in width and averages 335 metres. It is centered on a steeply dipping breccia pipe. Reserves are estimated as 125 million tonnes grading 1.06 per cent copper, 0.40 gram per tonne gold and 7.7 grams per tonne silver (Allen *et al.*, 1976).

Copper Canyon (MINFILE 104G 017)

The Copper Canyon prospect is located approximately 8 kilometres due east of the Galore Creek deposit. Copper mineralization is associated with a syenite porphyry body and related dykes intruded along a major thrust fault. The syenite is sill-like and conformable with east-dipping Middle Triassic sediments and Upper Triassic volcanics. Textures vary from holocrystalline to sparsely porphyritic and are generally masked by alteration and weathering. Pseudoleucite phenocrysts form 10 per cent of the syenite along Doghouse Creek. An intrusive breccia phase or brecciated intrusive is developed locally. Sericitic and propylitic alteration and potassium metasomatism are widespread and pervasive. Pyritization and bleaching has produced an extensive gossan surrounding the intrusives and malachite and azurite stain cliffs in the canyon. Copper mineralization occurs as disseminations of chalcopyrite and bornite with minor gold and silver values. Other associated minerals include pyrite, magnetite, specularite, hematite, molybdenite and fluorite.

Ann/Sue and Paydirt (MINFILE 104G 023, 108)

The Ann/Sue and Paydirt showings are located north of Split Creek, a tributary of the Porcupine River.

The Ann/Sue showing is hosted by an intrusion of fine-grained porphyritic diorite to granodiorite within fine to medium-grained andesitic tuffs and altered greenstones. These rocks are so similiar in appearance that distinguishing intrusive from extrusive is difficult. Propylitic alteration has extensively affected both the intrusive and the host volcanics. Disseminated pyrite mineralization is ubiquitous and chalcopyrite sparse. Diamond-drill intersections assayed between trace and 0.32 per cent copper, with average values between 0.10 and 0.20 per cent copper (Jeffery, 1966). Panteleyev (1975) documents potassium-argon dates of 48.5 ± 1.7 Ma from biotites associated with pyrite mineralization (Table 1-30-2).

The Paydirt prospect is located within a large malachite-stained pyritic gossan 2 kilometres northeast of the Ann/Sue showing. The mineralization is hosted by massive andesitic tuffs, flows and crystal-lapilli tuffs with subordinate sediments. Jurassic to Tertiary monzonite to granodiorite outcrops in Split Creek and upslope from the main gold showing which is a silicified, sericitic and pyritic alteration zone in Upper Triassic andesitic tuffs. It strikes north and dips steeply east with a surface strike length of less than 100 metres and a maximum thickness of 25 metres. An unaltered andesite dyke follows the footwall of the mineralized zone. Drill-indicated reserves are 185 000 tonnes averaging 4.11 grams per tonne gold (Holtby, 1985). Longreach Resources Ltd. carried out exploratory drifting to intersect this zone in 1987.

JW (MINFILE 104G 021)

The JW claims are located on the north tributary of Jack Wilson Creek. They are underlain by a fine-grained, green, massive subvolcanic monzonite which intrudes Upper Triassic amygdaloidal volcanics of andesitic to basaltic composition. The monzonite is stongly magnetic and carries widespread pyrite as disseminations and fracture fillings. Sulphide mineralization occupies prominent northerly trending shear zones and vein systems marked by well-developed gossanous zones. Mineralization comprises chalcopyrite and pyrite in schistose propylitically altered greenstones and crystal tuffs. In the creek valley, gold values are associated with sericitized, pyritized and silicified zones in andesites. Gold-bearing quartz veins and silicified shear zones cut the monzonite (H. Awmack, personal communication, 1988).

Sphal 17 and Sphal 27 (MINFILE 104G 022, 029)

The Sphal 17 and Sphal 27 showings are located approximately 10 kilometres southeast of the Galore Creek deposit, north and south of Sphaler Creek. The area is underlain by Upper Triassic pyroxene-porphyry flows, andesitic breccias and crystal tuffs. Prominant north-northeast-trending faults have localized intrusions of Tertiary(?) monzonite and felsite bodies as well as mineralization.

On the Sphal 27 claim mineralization is hosted by northeast-trending faults and shear zones containing massive to disseminated pyrite and pyrrhotite, chalcopyrite and lesser magnetite, galena and sphalerite. Shear zones and subparallel structures carry gold and silver values (H. Almack, personal communication, 1988). Pervasive propylitic alteration and strong fracturing mark these mineralized shear zones.

North of Sphaler Creek, on the Sphal 17 claim, disseminated copper mineralization occurs in altered and brecciated zones in volcanics and felsite intrusives. The main mineralized zone is hosted by an intrusive breccia measuring 50 by 18 metres at surface; pyrite, chalcopyrite and magnetite fill the matrix. Faulting has broken the breccia into discontinuous sections. Samples over an area 18 by 20 metres assayed an average of 0.24 gram per tonne gold, 10.6 grams per tonne silver and 2.45 per cent copper (Folk, 1981).

MESOTHERMAL QUARTZ-CARBONATE VEINS

Hummingbird, Ptarmigan (MINFILE 104G 052, 050)

Exploration was begun in 1964 by Silver Standard Mines Limited which discovered the Hummingbird showing and outlined lead and zinc mineralization on the Ptarmigan showing containing up to 5.4 grams gold and 229 grams silver per tonne over 16 metres (Whiting, 1964). During 1988 Continental Gold Corporation carried out an aggressive program of geological mapping, sampling and diamond drilling (2735 metres in 16 holes).

The showings are underlain from west to east by Permian limestones, conformably overlain by Middle Triassic cherty siltstones and shale, in turn overlain by pervasively altered Stuhini Group massive andesite and flow breccia which are intruded by monzonite to monzodiorite **(eJHm)** along a northwest-trending faulted(?) contact. A Jurassic polymictic boulder conglomerate containing volcanic, sedimentary, granitic and rhyolite clasts outcrops in uncertain stratigraphic position nearby.

Northeast-striking faults and shear zones appear to crosscut older northwest-trending structures. Both structures contain mineralization, the younger are sulphide rich.

The Ptarmigan zone is a circular quartz-sericite-pyrite alteration zone, 50 metres in diameter, localized at the intersection of a northeast-striking fault (Ptarmigan shear) and a northwest-trending fault separating Triassic-Jurassic volcanic and sedimentary strata and Hickman monzonite. The monzonite is brecciated into angular blocks as large as 0.5 by 1.5 metres which are locally aligned and commonly dip southwestward into the zone. Within the Ptarmigan zone the monzonite is pervasively sericitized and bleached. Iron carbonate and pyrite occur as stockwork veinlets and matrix replacements. Away from the Ptarmigan zone the monzonite is coarse grained, massive and moderately chloritized. Adjacent to this intrusive breccia is an equally altered polymictic matrix-supported fault breccia containing well-rounded clasts of augite porphyry, monzonite, chert and feldspar porphyry. Angular blocks of altered monzonite, some veined by iron carbonate and pyrite are also present. The matrix is sericitized and locally completely replaced by pyrite. Clast lithologies are identical with those in the polymictic conglomerate overlying volcanics to the east. Continental Gold Corporation geologists have suggested the Ptarmigan zone represents a hydrothermal breccia pipe.

Precious metal mineralization occupies narrow and widely spaced fractures, veinlets and stockworks which crosscut the pyrite alteration zone. Vein mineralogy comprises disseminations of pyrite, galena, sphalerite, chalcopyrite, tetrahedrite, minor arsenopyrite and electrum in a quartz carbonate gangue. Mineralization is silver-rich with silver:gold ratios averaging 80:1; the silver mineral has not been identified.

The Hummingbird zone is located 300 metres northwest of the Ptarmigan zone. Skarn mineral assemblages and weak associated mineralization have developed in Upper Triassic limestones adjacent to the northwest-trending Hummingbird fault. Sulphides include pyrite, chalcopyrite and pyrrhotite, skarn minerals are brown garnets and diopside.

Other Quartz Veins

These veins are made conspicuous by the rusty oxidation of iron carbonate alteration which envelopes them. The veins occupy north, northeast, northwest and west-striking structures. Alteration minerals include chlorite, ankerite and calcite. Sulphide mineralogy includes pyrite, sphalerite, chalcopyrite and arsenopyrite in concentrations up to 25 per cent of the quartz vein.

An east-striking vein at the headwaters of Hickman Creek is typical: the vein zone is composed of a medial 30-centimetre-wide quartz vein with a peripheral alteration envelope of bleaching, quartz carbonate veining and pyritization extending 40 centimetres on either side of the vein. Vein and alteration envelopes have been sampled for geochemical analysis.

Narrow quartz veins occur in two northwest-striking fault zones in the valley of the Scud River. The fault zones are up to 40 metres wide and host parallel quartz veins containing massive pyrite and traces of chalcopyrite.

MASSIVE SULPHIDES

Massive concentrations of pyrite, pyrrhotite and lesser chalcopyrite are present in Middle Triassic sediments on both sides of the South Scud River. These are irregular masses up to 20 by 30 metres in size. Mineralization is both conformable and transgressive. A lens of massive pyrite, pyrrhotite, chalcopyrite and arsenopyrite on the Trophy claims assayed 2.0 grams per tonne gold over 4.0 metres (Forster, 1988).

The potential for volcanogenic massive sulphide deposits in Paleozoic rocks is high. Pyroclastic sulphide fragments and small stratiform lenses of massive sulphides in Paleozoic felsic fragmental rocks located to the east have been reported by Holbek (1988), and massive sulphide deposits are known in correlative stratigraphy in the Tulsequah River area (Nelson and Payne, 1984).

AGES OF MINERALIZATION

At least two separate mineralizing events are postulated for the deposits within the map area. Middle Triassic sediments host conformable massive polymetallic sulphide occurrences. Adjacent to Hickman intrusions these are transgressive, suggesting some middle to Late Triassic remobilization.

Alkalic porphyry deposits are hosted by Late Triassic to Early Jurassic volcanics and subvolcanic intrusives. Four potassium-argon dates (recalculated to new decay constants) for hydrothermal biotite from the Galore Creek Central zone, range from 177 to 201 Ma., Early to Middle Jurassic (White *et al.*, 1968), (Table 1-30-2). Mesothermal vein deposits are peripheral to the volcanic-intrusive centers. Potassium-argon dating of chrome-bearing muscovite from a carbonate-sulphide vein (Mess Creek area) gave a 192 ± 7 Ma, Early Jurassic age for the mineralization (Holbek, 1988). At Schaft Creek, Panteleyev and Dudas (1973) report a 185 ± 5 Ma, Middle Jurassic age for mineralization (Table 1-30-2).

Lead isotope dating suggests a separate event in the Tertiary. Galena lead from the Ptarmigan zone has isotope ratios similar to Tertiary model-ages (J. Gabites, personal communication, 1988).

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