



GEOLOGY OF THE BEARSKIN LAKE AND SOUTHERN TATSAMENIE LAKE MAP AREAS, NORTHWESTERN BRITISH COLUMBIA. (104K/1 and 8)

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INTRODUCTION

The Golden Bear project was designed to provide a regional geological framework for exploration in the vicinity of the Golden Bear mine, and to expand on recent 1:10 000-scale mapping by Jim Oliver (Oliver and Hodgson, 1989, 1990). Mapping of the Bearskin Lake (104K/1) and the southern third of the Tatsamenie Lake map sheet (104K/8) was completed at 1:50 000 scale during the 1992 field season. The project area is northwest of the Tahltan Lake sheet (104G/13), mapped under the Stikine project in 1991 (Brown *et al.*, 1992; Figure 1-11-1).

The Golden Bear mine has produced about 3 504 000 grams (112 670 ounces) of gold from 271 230 tonnes of ore

milled from its opening in late 1989 to August, 1992. The mine is located above the north side of Bearskin (Muddy) Lake, about 140 kilometres west of Dease Lake. Access along the company road is restricted and takes approximately 4 hours from Dease Lake. A private gravel airstrip is located just west of Bearskin Lake and serves the mine. During the 1992 field season a helicopter was based at the airstrip and provided access to most of the map area.

Much of the area is a rolling Early (?) Miocene peneplain comprising part of the Tahltan Lake Plateau (Ryder, 1984) and is deeply dissected by U-shaped and hanging valleys. Large alluvial fans characterize the upper reaches of the Samotua River and parts of Bearskin valley. Alpine glaciers have carved a rugged landscape of arêtes and cirques in the southwest quadrant of 104K/1. Numerous large rock slides are found throughout the map area, the most prominent being the Bearskin slide (Souther, 1971), currently the loca-

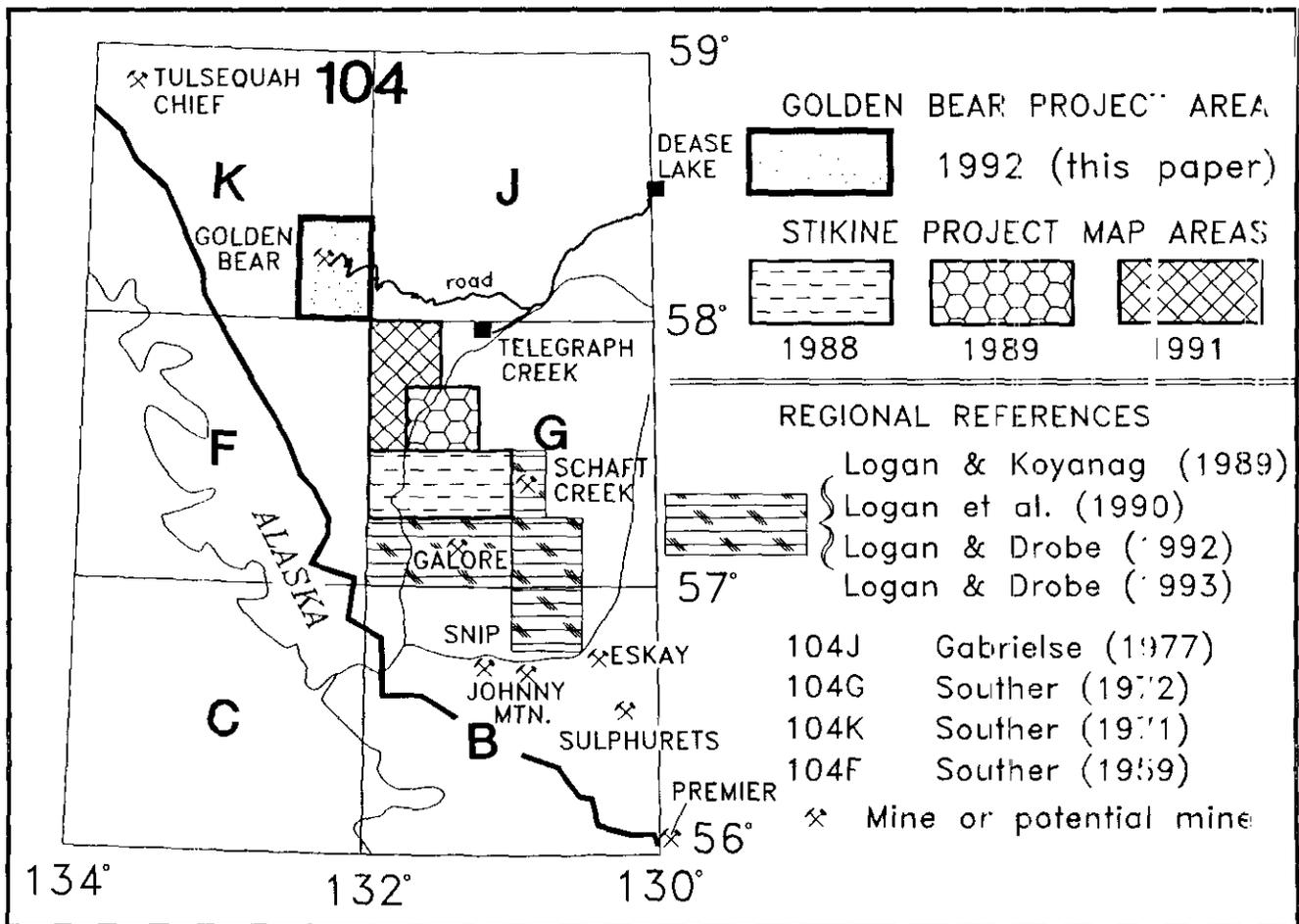


Figure 1-11-1. Location of the Golden Bear project map area relative to previous regional geological studies.

tion of the Golden Bear mine buildings and haul road. Debris from this slide dammed the creek to form Bearskin Lake and now covers about 2 square kilometres. It was derived from the area immediately east of the open pit.

Accomplishments during the 1992 field season include: documentation of pre-Late Triassic deformation; division of Upper Triassic and older volcanic and sedimentary rocks into Stuhini Group and Stikine assemblage; and discovery of potential volcanogenic stratabound alteration within pre-Upper Triassic volcanic rocks. Interpretation of stratigraphic and structural relationships among lithologic units remains tentative due to the paucity of age controls. Sampling for conodonts (36 samples), radiolaria (2), macrofossils (4), and U-Pb (4) and K-Ar (2) dating should cast light on problem areas.

GEOLOGICAL SETTING

The project area is situated along the western edge of the Intermontane Belt. It lies within Stikinia, with the possible exception of metamorphic rocks in the southwest corner of 104K/1. Previous mapping at 1:250 000-scale by Souther (1971) identified an extensive unit of Triassic and older volcanic and sedimentary rocks (his Unit 4) containing Permian limestone in structural culminations. This unit has been subdivided into Upper Triassic Stuhini Group and Paleozoic Stikine assemblage. These rocks are intruded by Triassic, Jurassic and Eocene plutons, and are overlain by Tertiary volcanic rocks. The only Jurassic stratigraphy in the project area consists of a small, fault-bounded wedge of clastic sedimentary rocks of the Takwahoni Formation.

STRATIGRAPHY

PALEOZOIC(?) METAMORPHIC ROCKS (Pm)

Amphibolite-grade metamorphic rocks (Unit 5 of Souther, 1959, 1971) were briefly examined just south of the map area in the northwest corner of the Chutine Peak map area (104F/16). A high-angle reverse(?) fault between these rocks and lower greenschist grade metavolcanic rocks (possibly Stuhini Group) was projected north to intersect a knife-edged nunatak in the southwest corner of 104K/1.

The amphibolite-grade rocks include well-foliated polydeformed schists of variable compositions, including: rusty brown weathering quartzofeldspathic biotite schist, amphibole(?) - chlorite schist (mafic metavolcanic rocks), marble, and orthogneiss (felsic sills?).

This succession is tentatively correlated with the Boundary Ranges Metamorphic Suite that lies west of lower grade rocks of the Laberge and Stuhini groups and Stikine assemblage, as described in the Tutshi Lake and Tulsequah Glacier areas (Mihalynuk and Rouse, 1988; Smith and Mihalynuk, 1992). This belt of rocks may represent metamorphosed Stikine assemblage as advocated by Currie (1992) for the Tagish Lake area (104M).

PALEOZOIC - STIKINE ASSEMBLAGE

CARBONIFEROUS(?) LIMESTONE (CSIs)

Undated limestone exposed in structural culminations in the Samotua River valley and along the western margin of

the Moosehorn batholith (Figure 1-11-2) is provisionally interpreted as the oldest unit in the project area, based on regional and stratigraphic considerations. The unit comprises massive to thin and thick-bedded, white to medium grey, recrystallized limestone with dull grey siliceous layers and lenses. No bioclastic material or macrofossils were noted, possibly due to recrystallization and deformation of the limestone. On the west side of the large antiform straddling the Samotua River in 104K/8 ("Samotua antiform"), well-bedded siliceous carbonate with chloritic laminae at the top of the limestone grades into overlying chloritic metavolcanic rocks with carbonate layers. Although the contact is sheared, it is interpreted as stratigraphic.

These limestone bodies, interpreted as Permian by Souther (1971), are overlain by a significant thickness of polydeformed metavolcanic and metasedimentary rocks. Significant sub-Stuhini volcano-sedimentary sections overlying Permian limestone are virtually unknown in Stikinia, but lithologically similar sequences below the Permian limestone have been described in the Scud River area and elsewhere (Brown *et al.*, 1991). If the overlying sequence is pre-Permian, then the Samotua limestone could be Carboniferous or older, assuming an upright stratigraphic succession. In the absence of definitive fossil evidence, a Carboniferous age is assumed.

CARBONIFEROUS(?) - FOLIATED METAVOLCANIC ROCKS (CSv)

Foliated, chloritic metavolcanic rocks of the Stikine assemblage contain lithologies similar to Stuhini Group in part, but are distinguished from them by the following criteria:

- strong, penetrative flattening foliation (especially evident in lapilli tuffs and pillow basalt) and phyllosilicate fabrics;
- well-developed mullions and stretching lineations;
- a "chloritic" green weathering colour, lacking the distinctive red-brown weathering of Stuhini rocks;
- in general, more andesitic compositions;
- greenschist metamorphic grade;
- bright green colours on fresh surfaces.

The dominant pre-Upper Triassic volcanic lithologies include: andesitic ash to lapilli tuff; feldspar and lesser augite-phyric tuff and flows; massive andesitic flows; laminated green and white, locally calcareous tuff; maroon and green tuff and flows; rare pillow basalt and argillite. In places, thin to thick-bedded grey and white recrystallized limestone up to 25 metres thick is present.

A phyllitic foliation is common, but strain is variable and some outcrops have only a very weak foliation. Near the Bandit showing (Figure 1-11-2), and southeast of the Samotua antiform, relatively unstrained tuff and massive flows locally resemble Stuhini Group, and transitions from phyllitic to very weakly foliated rocks are abrupt. In some cases, massive diabasic rocks may represent Stuhini feeder dikes and sills.

The age of the Stikine assemblage metavolcanic rocks is poorly constrained. Chloritic metavolcanic rocks at Sam Creek (Figure 1-11-2) structurally overlie Upper Car-

boniferous (Moscovian) felsic volcanic rocks in what could be an inverted structural sequence; if so, a Moscovian or older age is implied. Green and maroon phyllitic andesites in southeastern 104K/8 resemble poorly dated pre-Permian volcanic rocks in the Chutine and Little Tahltan culminations in 104G/13 (Brown *et al.*, 1992).

CARBONIFEROUS(?) - TUFF, VOLCANIC SEDIMENTARY ROCKS AND ARGILLITE (CSvs)

A distinctive unit of well-bedded tuff and sedimentary rocks crops out along the Samotua River south of the mouth of Bearskin Creek. Similar rocks are exposed east of the Samotua Glacier in the south-central part of 104K/1. The unit consists of thin to medium-bedded, felsic to intermediate ash tuff, tuffaceous sandstone and argillite. Interbedded volcaniclastic rocks and argillite are characterized by graded bedding, flame structures and argillite rip-ups. Heterolithic pebble conglomerate with abundant chert and metavolcanic clasts is present locally. Minor limestone, calcareous ash tuff and foliated pyroxene-phyric sills also occur within the sequence. The interbedded tuff and sediments of Unit CSvs resemble the "siliceous unit" in the Scud River area (104G/5, 6), which stratigraphically underlies Permian limestone (Brown and Gunning, 1989).

CARBONIFEROUS(?) - SEDIMENTARY ROCKS (CSs)

Strongly deformed argillaceous sedimentary rocks occur within the Stikine assemblage metavolcanic sequence near the mouth of Bearskin Creek. They consist dominantly of slate to argillaceous phyllite, with minor ash tuff, siltstone, and brown-weathering limestone beds and lenses up to 0.5 metre thick. The contact with overlying foliated volcanic rocks appears to be stratigraphic.

A unique stretched-pebble conglomerate occurs near the top of the sediment package and is exposed along the Golden Bear mine road. This matrix-poor pebble to cobble conglomerate consists almost entirely of subrounded felsic volcanic clasts, with minor black chert or cherty argillite and black silty limestone. Volcanic clasts include well-laminated felsic tuffs and plagioclase-phyric dacite. All volcanic clasts are intensely altered to an assemblage of fine-grained quartz, sericite and pyrite. The conglomerate coarsens upward over a thickness of about 5 metres. Clasts have undergone marked ductile strain, with a length to width ratio averaging 3.4:1. The source of the felsic volcanic clasts is unknown.

UPPER CARBONIFEROUS - FELSIC TO MAFIC VOLCANIC ROCKS AND SEDIMENTARY ROCKS (uCSvs1)

A heterogeneous section of foliated felsic to mafic volcanic rocks, argillaceous phyllite and limestone structurally overlies thick Permian limestone at the head of Sam Creek (Figure 1-11-2). Similar felsic phyllite and carbonate can be traced to the west side of Misty Mountain, where they also overlie a thick limestone package.

At Sam Creek, Lower Permian limestone is overlain by a thin (100 m) unit of chloritic metavolcanic rocks with intercalated pink marble. This is in turn overlain by a thick section (300-400 m apparent thickness) of pale grey, tan or

brown-weathering, varicoloured (green, grey, brown, pink), thin-bedded to laminated felsic phyllite (felsic metatuff). Intercalated with the felsic rocks are lesser dark green, chloritic, intermediate to mafic metavolcanic rocks, tan to orange-weathering dolostone and dolomitic phyllite, argillaceous phyllite, and blue-grey to white and pinkish marble. A sericite and/or chlorite foliation is characteristic of the felsic unit, but lithologies can be massive to fissile. Thin, potassium feldspar - quartz layers occur in some laminated felsic rocks. Plagioclase and quartz-phyric rhyolite is present locally.

Unit uCSvs1 contains the oldest dated rocks in the map area. Preliminary U-Pb dating of zircons from felsic tuff on the north side of Sam Creek yields an age of $302 \pm 2/-4$ Ma (Oliver and Gabites, 1993, this volume; locations shown on Figure 1-11-2). Similar rocks on the north shore of Tetsamenic Lake have a minimum age of 307 ± 2 Ma (*ibid.*). Age and structural relationships imply either that the basal contact of Unit uCSvs1 is a flat-lying thrust, or that large-scale recumbent folding has inverted the section at Sam Creek and elsewhere above the Permian limestone. The contact with structurally underlying Permian limestone was not seen in outcrop, and significant shear fabrics were not observed above or below the contact. Silica-sealed brecciation is extensively developed along the contact west of Misty Mountain; however, this is interpreted as hydrothermal in origin. Zircon U-Pb dating of units structurally overlying Unit uCSvs1 may help constrain structural interpretation in this area.

PERMIAN LIMESTONE (PSIs)

Massive to thin-bedded, white to dark grey limestone underlies an 8 square kilometre area between Bearskin Lake and Sam Creek. This and smaller limestone bodies scattered throughout the map area have been assigned a Permian age on the basis of poorly preserved fusulinids and rugosan corals (Souther, 1971). In general, carbonate in the project area is less fossiliferous than in other areas of Stikinia, perhaps due to more intense deformation and metamorphism.

Internal stratigraphy of the Bearskin Lake limestone was described by Oliver and Hodgson (1989). Dark grey, carbonaceous limestone and black siltstone occurs near the top of the unit above Bearskin Lake. A black chert described in the Fleece Bowl area might be a silicified correlative unit. The carbonaceous limestone overlies tan to orange-weathering dolomitic limestone, which also occurs near the top of the section at Sam Creek, where it contains abundant crinoid columnars. A "silicæ facies", described as stratigraphically overlying Permian limestone in the Totem zone, north of the Golden Bear deposit (Oliver and Hodgson, 1989), was not interpreted as a stratigraphic unit in our mapping. This zone is a product of hydrothermal silicification, as both crosscutting and stratabound silica zones with limestone remnants are evident.

Large, partially silicified fusulinids from a locality just west of the Totem area were identified as Early Permian, possibly Guadalupian forms (Figure 1-11-2 Rui Lin, personal communication, 1992).

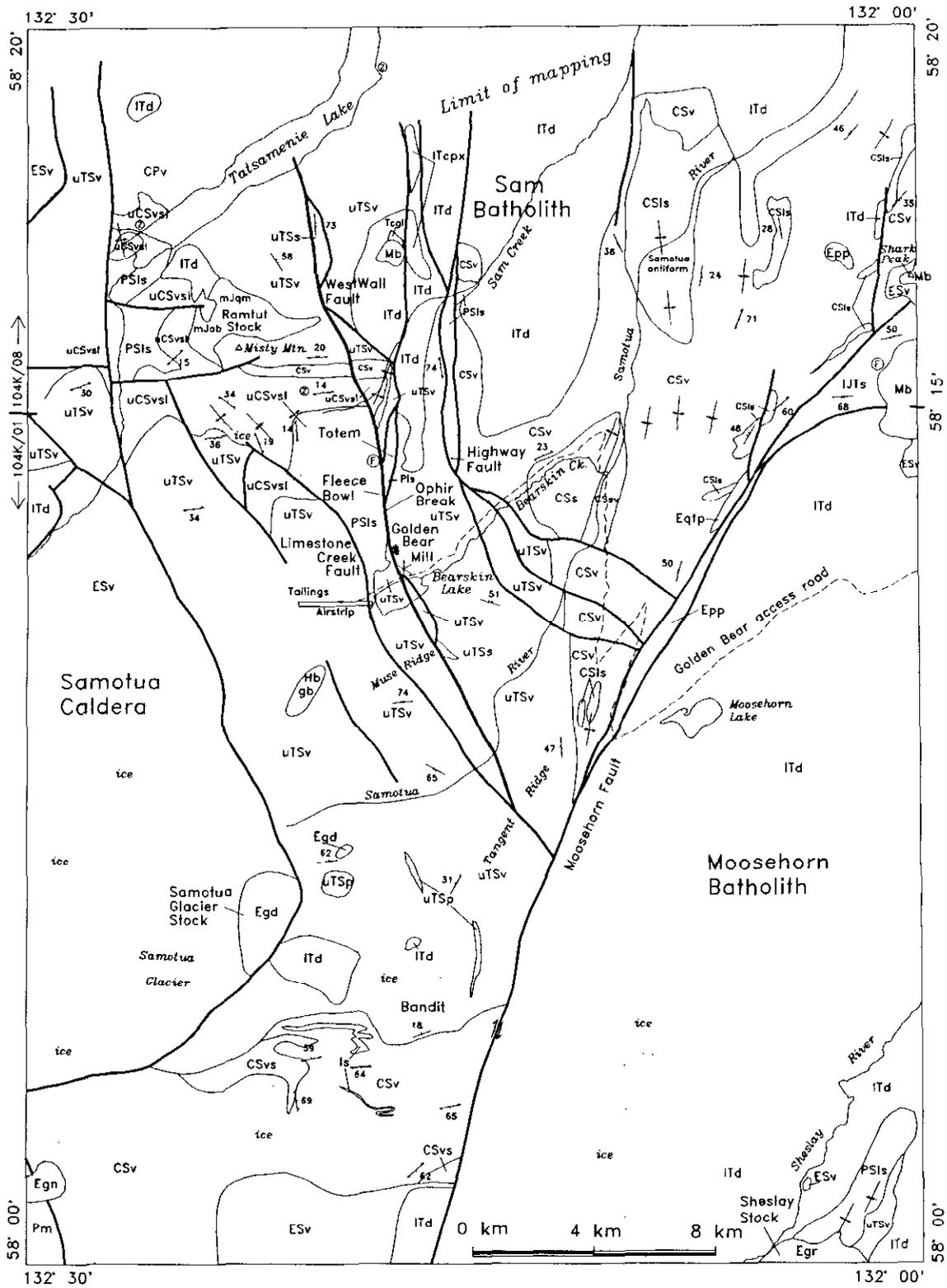


Figure I-11-2. Geology of the Bearskin Lake and Tatsamenie Lake map areas (104K01/08), simplified from Open File 1993-1.

LEGEND	
STRATIFIED ROCKS	
MIOCENE	
Mb	Basalt -- flat lying, columnar jointed
EOCENE	
ESv	SLOKO GROUP -- intermediate to felsic volcanic breccia, tuff & lesser flows
TERTIARY	
Tcg	Polymictic conglomerate -- poorly indurated
LOWER JURASSIC	
IJTs	TAKWAHONI FORMATION -- sandstone, siltstone, polymictic conglomerate
UPPER TRIASSIC	
uTSv	STUHINI GROUP -- volcanics, volcanoclastics uTSp -- megacrystic, "bladed" plagioclase porphyry uTSs -- argillite, siltstone, limestone Hbgb -- hornblende gabbro
PERMIAN & OLDER STIKINE ASSEMBLAGE	
Lower Permian	
PSIs	Limestone -- variably recrystallized
UPPER CARBONIFEROUS	
uCSvsl	Felsic to mafic volcanics, phyllite, limestone
CARBONIFEROUS (?)	
CSs	Slate, siltstone, limestone
CSvs	Andesitic tuff, argillite, tuffaceous sandstone
CSv	Mafic to intermediate metavolcanic rocks ls = limestone
CSIs	Limestone
PALEOZOIC (?)	
BOUNDARY RANGES (?) METAMORPHIC SUITE	
Pm	Amphibolite and greenschist grade metapelite, amphibole-charite schist, orthogneiss, marble
INTRUSIVE ROCKS	
EOCENE	
Egr	Biotite hornblende granite Epp = plagioclase porphyritic granite Egd = biotite hornblende granodiorite Eqfp = quartz plagioclase porphyritic rhyolite
MIDDLE (?) JURASSIC	
mJqm	Hornblende biotite quartz monzonite mJab = albite
LATE TRIASSIC	
ITd	Hornblende diorite, monzodiorite, quartz diorite
ITcpX	Clinopyroxenite
⊕	Zircon U-Pb sample locality
⊙	Fossil locality

UPPER TRIASSIC - STUHINI GROUP (UTSV)

The Stuhini Group comprises a thick package of volcanic and sedimentary rocks underlying most of the central portion of 104K/1 and part of 104K/8. Stuhini rocks overlie a variety of older units, including an inverted section at Sam Creek, along a pronounced regional unconformity. The basal contact is well exposed in two areas: Sam Creek and near the Bandit showing. At Sam Creek, weakly foliated pyroxene and plagioclase-phyric Stuhini volcanic rocks overlie polydeformed chloritic phyllite, dolomitic limestone, argillaceous phyllite and siliceous phyllite along a foliation-parallel discontinuity. At Bandit, gently northeast dipping pyroxene crystal-lithic lapilli tuff unconformably overlies strongly folded and foliated metavolcanic rocks,

argillaceous phyllite and limestone. There is no basal conglomerate at either location.

The Stuhini Group consists mainly of red-brown weathering, plagioclase and augite-bearing volcaniclastic rocks. Flows are subordinate to clastic rocks, in contrast to the Trapper Lake section (104K/7) described by Souther (1971), where over 1200 metres of pillow basalt are exposed. In the project area, pillow basalt was not seen south of Bearskin Lake, but occurs just west of the Golden Bear pit, overlying Permian limestone (D. Reddy, personal communication, 1992). Pillowed flows were also mapped between Tatsamenie Lake and the Sam batholith by Oliver (Oliver and Hodgson, 1990).

Volcaniclastic sequences are typically heterogeneous, comprising intercalated massive to finely laminated ash tuff, ash and crystal tuff, lapilli tuff and block and ash tuff, as well as more massive "greenstones" which could be flows or sills. Lapilli tuff commonly contains augite and/or plagioclase crystals as well as mafic lithic clasts. Augite-phyric lithic clasts are common, while intermediate to felsic volcanic, plagioclase-phyric hypabyssal intrusive and chert clasts are rare. Massive, homogeneous crystal tuff or tuffaceous sandstone units can be mistaken for dioritic intrusive bodies, but locally contain thin beds of finer crystals, ash laminae, or scattered lithic clasts. Intercalated sedimentary rocks suggest that the volcaniclastic sequences are submarine.

Epilastic rocks comprise at least 10 per cent of the Stuhini Group south of Bearskin Lake. Epilastic sequences include thin to medium bedded, dark green-grey volcanic siltstone and sandstone, locally interbedded with argillite and minor limestone. Crossbedding and graded bedding occur within sandstone-argillite sections, which may be turbiditic deposits. A distinctive "ribby" weathering calcarenite is interbedded with green to purplish tuff, crossbedded tuffaceous sandstone and conglomerate on Muse Ridge.

A continuous, west-facing section, about 4 kilometres north of the Bandit showing, has a thickness of about 2000 metres. It includes a thick, lower, dominantly epilastic sequence of well-bedded, graded tuffaceous sandstone, ash tuff and lesser argillite. Within this is a conglomerate unit with fine-grained basalt and rare felsic clasts. The epilastic sequence is overlain by massive to well-bedded ash and crystal tuff with lesser pyroxene-phyric flows, which are overlain by lapilli tuff with lesser ash and crystal tuff, coarsening upward into block and lapilli tuff with amygdaloidal basalt clasts.

South of Tatsamenie Lake, the Stuhini Group consists predominantly of pyroxene-phyric mafic flows and tuffs. Intercalated sediments include white to grey limestone, black, carbonaceous, slightly fetid calcisiltite and argillite. Buff to grey ribbon chert was noted at one locality. The Stuhini Group between Sam Creek and Tatsamenie Lake is generally more intensely deformed than south of Bearskin Lake. Both steeply dipping and bedding-parallel shear fabrics are common.

Sills, dikes and plugs of megacrystic, bladed plagioclase augite(±hornblende?) porphyry intrude Stuhini volcanic rocks east of the Samotua Glacier and north of the Bandit

showing (Figure 1-11-2; Unit uTSp). Plagioclase crystals range up to 4 centimetres in length. These hypabyssal intrusions are interpreted as subvolcanic bodies within the Stuhini section.

Brittle/ductile shear fabrics are locally present in Stuhini rocks throughout the map area. Bedding-parallel schistose fabrics, augen-like sheared feldspar phenocrysts, and flattened and stretched lapilli are evident north of the Golden Bear airstrip. This area is interpreted as a contractional zone related to strike-slip faulting. Elsewhere, shear fabrics in Stuhini rocks are generally confined to steeply dipping, sharply delimited shear zones. Within these zones, intensely foliated chloritic schists contain layers and lenses of unfoliated rock. A series of such zones east of the Samotua Glacier contains steeply plunging "lozenges" of unsheared rock and steeply plunging shear-related folds with dextral asymmetry.

LOWER JURASSIC - TAKWAHONI FORMATION (IJTs)

A fault-bounded block of clastic rocks in the southeast corner of Tatsamenie Lake map area is correlated with the Takwahoni Formation (Laberge Group), after Souther (1971). The sedimentary rocks consist of dark grey to pale brown weathering, thin to medium-bedded, turbiditic, fine to coarse-grained arkosic wacke and interbedded shale and siltstone. Graded bedding, flame structures and argillite rip-ups are common. Belemnoids and small, poorly preserved ammonites and carbonized plant stems were collected from the unit, suggesting an influx of terrestrial material into a marginal marine basin. A facies of subangular to subrounded polymictic pebble to cobble conglomerate containing felsic to intermediate volcanic, chert, granodiorite and limestone clasts is intercalated with the finer sediments. Subrounded limestone clasts, up to a metre in diameter, attest to the high-energy setting for the conglomeratic facies.

Structure within the fault wedge is complex, with well-exposed folds and complex high and low-angle faults. Outcrops are locally strongly sheared and fractured, and a spaced cleavage is evident in places. Clasts in the conglomerate unit are unstrained, in contrast to those in Unit CSs.

A single collection of ammonites obtained from the Takwahoni succession in 1992 were Early Jurassic (latest Pliensbachian) in age (H.W. Tipper, personal communication, 1992). This is the most southerly occurrence of Takwahoni Group in the Tulsequah map sheet (Souther, 1971).

EOCENE - SLOKO GROUP (ESV)

Sloko Group volcanic rocks are exposed in fault-bounded blocks along the western part of the map area and in isolated areas below Miocene basalts along its eastern edge. The Sloko Group consists primarily of rhyolitic to dacitic pyroclastics, including heterolithic tuff-breccia to lapilli tuff, welded crystal-vitric tuff and ash tuff. Minor andesitic tuff is also present. Flow rocks are less common, but include plagioclase and hornblende-phyric, massive or columnar

jointed dacite. Very coarse breccias (clasts 1 m across) occur close to the bounding faults, and contain a variety of volcanic and granitoid clasts, quartz, feldspar and hornblende crystals, ash and vitric fragments. An extensive section of brown, rhyolitic volcanic glass with abundant drusy cavities is exposed north-northwest of Tatsamenie Lake.

A large, subcircular volcanic subsidence feature (here called the Samotua caldera) underlies an extensive area north of the Samotua Glacier (Figure 1-11-2). Faults bounding the eastern part of this structure dip steeply inward at 60° to 80°. The western limit is outside the map area. Stuhini rocks adjacent to the bounding faults are intensely sheared to chloritic schist, and locally brecciated by post-shearing brittle deformation. In the northwest corner of 104K/1, down-dropped blocks of Stuhini schist, up to 200 metres long, occur entirely within Sloko tuffs.

Uranium-lead dates overlapping the Paleocene-Eocene boundary have been obtained for rhyolite near Graham Inlet, 125 kilometres to the northwest (104M, M.G. Mihalynuk, unpublished data, 1992). Potassium-argon dates are slightly younger, ranging from 48 to 53 Ma for Sloko tuff in the Yehiniko Lake area and for the correlative Bennett Lake extrusive rocks (D.A. Brown, unpublished data; Lambert, 1974, respectively).

TERTIARY(?) - POLYMICTIC CONGLOMERATE (Tcg)

A poorly indurated, polymictic conglomerate forms an isolated subcrop under Miocene flows in south-central Tatsamenie Lake map area. It resembles unconsolidated gravel, however, some clasts are cemented to each other and medium-grained wacke talus was also found. The clasts include dacite, felsite and plagioclase-porphyritic andesite, believed to be derived from Sloko Group. Granitoid and pre-Stuhini phyllite clasts are also present.

The poor induration and abundance of presumable Sloko-derived clasts suggests this unit is Eocene or younger. It may correlate with Tertiary, fault-controlled deposits such as those in the Yehiniko valley (Brown and Greig, 1990) and Tuya River (Ryan, 1991) areas.

MIOCENE(?) - BASALT FLOWS (Mb)

Subhorizontal, columnar jointed olivine basalt flows occur in two areas, along the eastern edge of the map area and as a small erosional remnant southwest of Tatsamenie Lake. These basalt flows have been correlated with the Level Mountain Group (Souther, 1971). The Level Mountain edifice (Hamilton, 1981) is a continental sodic alkali basalt shield volcano. Potassium-argon dates from Level Mountain span a range 14.9 to 5.3 Ma (T.S. Hamilton, unpublished data, 1981).

Age dating of columnar jointed basalt and intercalated felsic tuff at "Shark Peak", in the southeast corner of 104K/8, suggests that at least some of the basalt flows are Eocene. At Shark Peak, thin vitric-crystal tuff lenses are overlain by columnar jointed, porphyritic olivine basalt. This is in turn overlain by a distinct white-weathering

rhyolite ash and vitric crystal-lithic lapilli tuff unit, which is capped by similar porphyritic, vesicular or amygdaloidal basalt flows (A. Panteleyev, 1964; Figure 1-11-3). A biotite K-Ar date of 54.5 ± 1.6 Ma was obtained from the middle rhyolite tuff, while whole-rock K-Ar dates of 49.0 ± 1.4 Ma and 38.9 ± 1.2 Ma were obtained from the lower and upper basalt flows (A. Panteleyev, unpublished data, 1976). The whole-rock K-Ar dates from the basalt may be significantly older than the true age due to excess radiogenic argon and isotopic fractionation during analysis (cf. Souther *et al.*, 1984). However, the stratigraphic bracketing of the Sloko-age rhyolite tuffs is good evidence for an Eocene age.

INTRUSIVE ROCKS

Intrusive rocks underlie approximately 25 per cent of the map area and fall into three broad age groups: Late Triassic, Jurassic and Eocene. Most of the southeast quadrant of the Bearskin Lake sheet is underlain by part of a large body, here called the Moosehorn batholith, which shares many attributes with the Hickman batholith in the Telegraph Creek map area. As in the Chutine River - Tahltan Lake map area, the plutons are quartz poor compared to some of those in the Scud River area. Foliation defined by aligned hornblende crystals is another characteristic of many of these plutons.

Available age constraints include Late Triassic K-Ar dates on the Kaketsa stock, just east of the project area, and two new, Late Triassic U-Pb age determinations from plutons north of the project area (Oliver and Gabites, 1993, this volume). An additional four samples are being processed for U-Pb and K-Ar dating as part of this project.

LATE TRIASSIC

MOOSEHORN BATHOLITH

The Moosehorn batholith underlies an area of about 560 square kilometres, including the entire southeast third of the

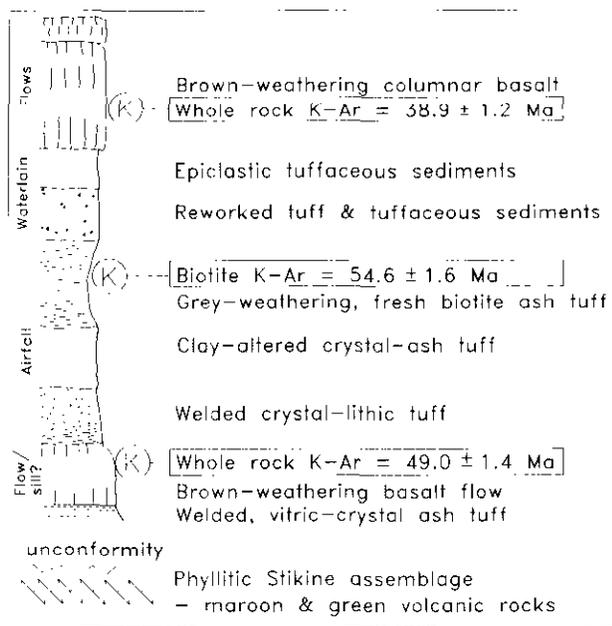


Figure 1-11-3. Schematic stratigraphic column in the Shark Peak area, from A. Panteleyev (unpublished data).

Bearskin Lake map area, and parts of the Chutine Peak (104F/16) and Kennecott Lake and Ketchum Lake (104J/4 and 5) map areas. It is characterized by massive, light to dark grey weathering, variably foliated hornblende monzodiorite to quartz monzodiorite, with minor hornblende monzonite. Up to 5 per cent primary biotite occurs in parts of the pluton, especially south of Moosehorn Lake. Patches of interstitial primary potassium feldspar are evident on cut surfaces stained with sodium cobaltinitrite. Parts of the batholith are strongly magnetic.

The Moosehorn batholith is generally unaltered, although epidote patches and stringers occur locally. A zone of fracture-controlled to pervasive epidotization with minor malachite occurs about 2 kilometres north of Moosehorn Lake. Zones of quartz-carbonate alteration are related to Tertiary high-angle faults or Sloko felsic dikes.

The batholith is correlated with the Late Triassic Stikine Plutonic Suite, which includes the Hickman (Holbek, 1988) and Hotailuh (Anderson, 1983) batholiths. The smaller Kaketsa stock, in the northwest corner of the Kennecott Lake sheet (104J/04) has been dated at 214 to 218 Ma by hornblende K-Ar (Panteleyev, 1975). The Kaketsa stock is slightly more quartz rich than the Moosehorn and is host to several porphyry copper prospects (McMillan *et al.*, 1976).

SAM BATHOLITH

The Sam batholith, so named because Sam Creek bisects the western half of the pluton, extends from Tatsamenie Lake to Camp Island Lake in the Ketchum Lake map area (104J/5). It has complicated and irregular boundaries and is lithologically more diverse than the Moosehorn batholith. It intrudes Stuhini Group and Stikine assemblage volcanic rocks. Most of the batholith is grey weathering, variably foliated hornblende diorite, grading into melonodiorite and, locally, hornblendite. Parts of the pluton are strongly magnetic. Margins of the stock are not always sharply defined, consisting of interfingering diorite and amphibolitized mafic volcanic rocks.

A compositionally and texturally heterogeneous zone of hornblendite blocks in diorite extends along the eastern edge of Highway Creek northeast to the mouth of Sam Creek. Angular, irregular hornblendite blocks comprise up to 70 per cent of the exposure, and range up to 4 metres in length. The hornblendite varies from fine to very coarse grained (crystals up to 8 cm), and locally grades into texturally variable diorite; it is interpreted to represent an early mafic phase of the batholith.

Pink and white, medium to coarse-grained granite pegmatite dikes crop out in several locations near the southernmost lobe of the Sam batholith, about 3 kilometres north-east of the Golden Bear mine. North of Fleece Creek, these occur as sigmoidal, sheared lenses in intensely chloritized mafic volcanic rocks. They may represent a late phase of the batholith.

The age of the pluton is 218 ± 3.6 Ma (Oliver and Gabites, 1993, this volume), based on zircon U-Pb dating of a sample obtained north of the project area, on the east side of Tatsamenie Lake.

SAM ULTRAMAFITE

Elongate ultramafic bodies along the southwestern edge of the Sam batholith probably represent an early or marginal phase. A marginal zone of pyroxenite and hornblende blocks and irregular blobs within the diorite grades outward into fine to coarse-grained olivine clinopyroxenite, locally with minor interstitial plagioclase. The western contact of the largest of the ultramafites is faulted, with serpentinite along the fault. Fibrous serpentinite occurs in narrow veinlets in one of the smaller ultramafic pods. The Sam ultramafite is correlated with the Polaris Ultramafic Suite, which includes Alaskan-type ultramafites, such as the Gnat Lakes and Hickman ultramafic complexes (Nixon *et al.*, 1989). Differences include the lack of a concentric zoning and the absence of dunite at the Sam body.

Previous interpretations considered these ultramafic bodies to be slivers within deep-seated fault zones which delineated the northern extent of the fault systems.

MIDDLE(?) JURASSIC RAMTUT STOCK

The Ramtut stock comprises a quartz monzonite phase and an "albitite" phase, which intrude weakly foliated hornblende diorite of probable Late Triassic age. The diorite is similar compositionally and texturally to the Moosehorn batholith. The quartz monzonite, interpreted as Early Tertiary by Wheeler and McFeeley (1991), is believed to be Middle Jurassic, on the basis of its unfoliated character, sharp contacts, and relationship to the albitite phase, from which a whole-rock K-Ar date of 171 ± 6 Ma was obtained (Hewgill, 1985). The quartz monzonite phase has been sampled for U-Pb and K-Ar dating.

QUARTZ MONZONITE PHASE

Medium to fine-grained hornblende quartz monzonite to monzonite underlies a triangular peak northeast of Misty Mountain. It appears to grade westward into the albitite phase. In contrast to the Triassic plutons, the Ramtut stock is massive and unfoliated, with sharp, discordant contacts. Contact metamorphic effects include actinolite needles identified up to 3 kilometres away from the intrusion, and skarnified limestone and calcareous tuff at the toe of the glacier north of Misty Mountain.

ALBITITE PHASE

The albitite phase is a sill-like projection from the Ramtut stock which follows the contact between Upper Carboniferous phyllite and carbonate and overlying mafic tuff. It comprises euhedral albite and quartz in a fine-grained groundmass of albite, quartz and hornblende, together with accessory apatite, sphene and ilmenite (Hewgill, 1985). The albite content varies from 60 to 95 per cent, and texture varies from porphyritic to subequigranular. Bright green hornblende is variably chloritized. Comparison of major element analyses of the albitite and quartz monzonite shows an increase in Na_2O (to an average of 8.8%) in the albitite with a corresponding decrease in K_2O (Hewgill, 1985). The albitite is interpreted as a product of magmatic-hydrothermal sodium metasomatism.

MINOR INTRUSIONS

Numerous plagioclase porphyry and hornblende plagioclase porphyry dikes crop out east of the Ramtut stock near the West Wall fault. A Middle to Late Jurassic age for some of these dikes is inferred on the basis of a hornblende K-Ar date of 156 ± 5 Ma (Schroeter, 1987).

Numerous small plugs and dikes of possible Jurassic or Eocene age intrude the western margin of the Moosehorn batholith. Many of them are buff to orange-weathering, subcrowded plagioclase-phyric monzonite to quartz monzonite with small primary biotite and hornblende grains. Abundant fine-grained potassium feldspar in the groundmass may be of secondary origin. A strong carbonate-sericite alteration overprint is common.

Coarse-grained hornblende gabbro outcropping northeast of the mine above the Bearskin slide was assigned a Jurassic age by Oliver and Hodgson (1989), presumably because of its lack of a tectonic foliation.

TERTIARY

The voluminous Eocene plutons that comprise much of the Coast Belt lie west of the map boundary; however, two small granitic stocks, and numerous plagioclase-porphyrific and felsite dikes are interpreted to be related to this intrusive suite.

SAMOTUA GLACIER STOCK

A small (10 Km^2), plagioclase-phyric granodiorite stock underlies the eastern side of the lower part of the Samotua Glacier, along the margin of the Samotua caldera. The stock comprises medium-grained, subcrowded to uncrowded plagioclase porphyry, with 25 to 75 per cent plagioclase phenocrysts up to 1 centimetre long in a matrix of plagioclase, quartz, minor potassium feldspar and up to 15 per cent biotite and hornblende.

SHESLAY STOCK

The Sheslay stock intrudes Permian (?) limestone, mafic metavolcanic rocks and the Moosehorn batholith in the southeast corner of 104K/1. The stock consists of massive, very fresh, coarse-grained, potassium feldspar megacrystic biotite hornblende granite. Prominent jointing is characteristic here as in other Eocene plutons west of the Stikine River (Brown and Gunning, 1889).

MINOR INTRUSIONS

Dikes of probable Sloko age occur throughout the map area. These are commonly plagioclase and/or quartz-phyric rhyolite or dacite, ranging up to 10 metres wide. A swarm of felsic dikes occurs along the margin of the Samotua caldera, dipping steeply inward toward the bounding faults. These dikes also intrude Sloko pyroclastic rocks, and therefore represent a late stage of caldera development. A prominent iron carbonate alteration halo extends about 30 metres into mafic volcanic rocks (Unit CSv) on either side of a 10-metre-wide Sloko rhyolite dike, 2 kilometres south of the Bandit showing. A narrow swarm of buff-weathering, locally silicified dacitic dikes trending northeasterly across

the Moosehorn batholith 9 kilometres south of Moosehorn Lake is also included in this suite. Elsewhere, Sloko dikes are locally clay-altered and associated with silicified, pyritized or clay-altered haloes. These examples indicate that at least some of the prominent alteration zones in the area can be attributed to Eocene intrusions and hydrothermal activity.

STRUCTURE

Structural interpretation of the Golden Bear area is hindered by the lack of stratigraphic control in sub-Stuhini units and by the paucity of Jurassic or younger stratigraphy. Inversion of stratigraphy beneath the basal Stuhini unconformity, and a significantly greater amount of strain in rocks of the Stikine assemblage is consistent with at least one and possibly two pre-Late Triassic phases of deformation, followed by an erosional interval. Post-Stuhini, Early Jurassic deformation is consistent with an Early to Middle Jurassic age for mineralization at Golden Bear. Faulting is complex and dominated by a strike-slip regime. Preliminary interpretation of timing of various deformation events relative to stratigraphy and intrusive episodes is illustrated in Figure 1-11-4.

FOLDING

PHASE 1 (D₁)

The oldest structures recognized are centimetre to metre-scale recumbent isoclinal folds (F₁) of compositional layering. These are especially common in thin-bedded siliceous phyllite and carbonate of Unit uCSvs1, but occur in all pre-Stuhini lithologies. A micaceous penetrative fabric (S₁) parallels axial planes of F₁ folds (Plate 1-11-1). The orientations of D₁ folds and fabrics vary widely, depending on the effects of later folding. No large-scale recumbent structures were defined, but their presence could explain possible inversion of Paleozoic stratigraphy at Sam Creek. Alternatively, if the basal contact of Unit uCSvs1 is a thrust, thrusting may have occurred during D₁, as the contact is deformed by F₂ folds (Figure 1-11-2). Age of D₁ is loosely constrained as post-Early Permian to pre-Late Triassic.

PHASE 2 (D₂)

Penetrative fabrics developed during Phase 1 deformation are refolded by Phase 2 chevron folds (F₂). Phase 2 folds are upright to gently dipping, gently to moderately plunging, tight to open folds. Penetrative fabric development associated with Phase 2 deformation is uncommon, although a spaced cleavage (S₂) is evident locally. Phase 2 linear fabrics, including mullions, crenulation lineations, mineral lineations and stretched clasts, are common in lithologies with well developed S₁ foliations. The stretching direction is colinear with F₂ fold axes.

Small-scale F₂ folds are ubiquitous in thin-bedded lithologies of Units CSv and CSvs along the Samotua River and south of the Bandit showing. Orientation of these folds varies widely between domains. A domain of tight, north to northeast-trending F₂ folds with an east-vergent asymmetry occurs west of the Moosehorn batholith along the Samotua

River. Folds of very similar structural style trend east-northeast, south of the Bandit showing. The differing orientations may reflect pre-existing F₁ fold shapes. At Sam Creek, a series of northwest-plunging antiforms and synforms deforms the contact between Units uCSvs1 and uCSvs1.

Unequivocal F₂ folds were not observed in Stuhini Group rocks, and no major F₂ fold axes were traceable from the Stikine assemblage into the Stuhini Group. The intensity of F₂ folding in Unit CSv implies significantly greater contraction in Stikine assemblage than Stuhini Group rocks. These observations suggest that D₂ may represent a second episode of pre-Stuhini deformation. Although truncations of F₂ folds were not observed at the basal Stuhini unconformity, at the Bandit showing, steeply dipping, foliated Stikine assemblage metavolcanic rocks locally underlie gently dipping, unfoliated Stuhini Group pyroxene crystal-lithic tuff. North of Sam Creek, Stuhini bedding is structurally conformable with S₁ foliations and recumbent isoclinal fold axial planes in the underlying Stikine assemblage.

PHASE 3 (D₃)

Evidence for a third phase of folding is found at Sam Creek, where an open, northeast-trending fold ("Sam Creek

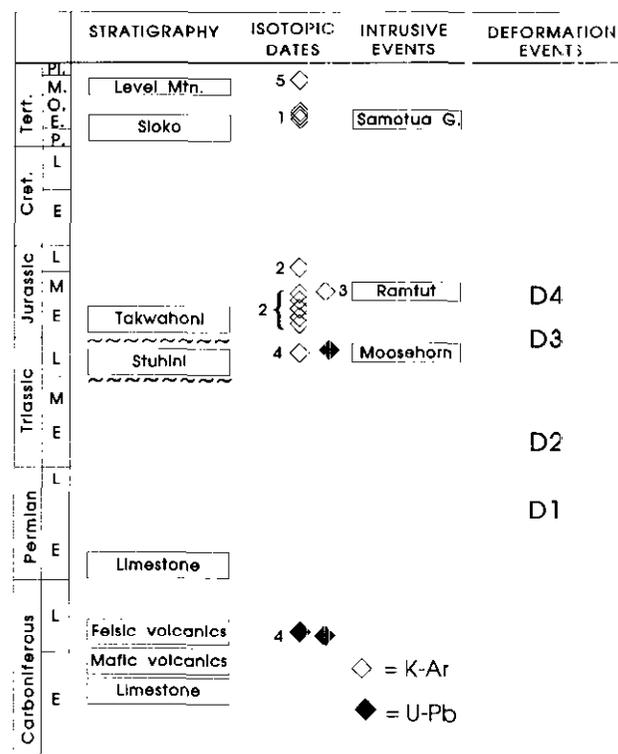


Figure 1-11-4. Schematic stratigraphic column compared with regional intrusive and deformational events. Isotopic dates are from: (1) Panteleyev (unpublished data); (2) Schroeter (1987); (3) Hewgill (1985); (4) Oliver and Gabites (1993, this volume); (5) Hamilton (unpublished data). Preliminary attempts to delineate the structural features of the map area suggest: D₁=recumbent and isoclinal folding (also thrusting?); D₂=folding metamorphic foliations, chevron-style; D₃=refolding to produce D₂/D₃ interference patterns; and D₄=folds and faults in Takwahoni Formation.



Plate 1-11-1. Phase I recumbant isoclinal folds, Unit uCSvsl, southwest of Misty Mountain.

antiform") is defined by a conspicuous limestone unit in chloritic metavolcanic rocks (Unit CSv). This fold, and related northeast-trending folds above Bearskin Lake, clearly involve rocks interpreted here as Stuhini Group. Interference between F_2 and F_3 folds produces a broad dispersion of S_{0-1} fabrics, and a square, domal surface exposure of the Permian limestone. Phase 3 folding modifies the orientation of F_2 axes, which are commonly doubly plunging throughout the map area. Variable orientations observed for F_2 fold axes are compatible with broad, chevron-style refolds, although this variation may also be due to the influence of F_1 fold geometries.

There is no overlying Jurassic stratigraphy to constrain the timing of D_3 . However, if mineralization at Golden Bear is late Early to Middle Jurassic, then it is probable that deformation involving Stuhini Group took place in latest Triassic to Early Jurassic time. This might have involved both F_3 folding and sinistral (?) movement along the "Ophir break". Evidence for Norian to Hettangian deformation has recently been documented in the Iskut area (Henderson *et al.*, 1992), and post-Norian, pre-Toarcian deformation is described in the Yehiniko Lake area (Brown and Greig, 1990).

PHASE 4 (D_4)

If pre-mineral deformation at Golden Bear is Early Jurassic, then east-trending chevron folds and faults in the Pliensbachian Takwahoni Formation probably represent a fourth phase of deformation. South-directed folding and thrusting south of the King Salmon fault is linked to Middle

Jurassic (Bajocian) convergence of the Cache Creek and Stikine terranes (Gabrielse, 1991). Deformation of the Takwahoni may plausibly be ascribed to this event.

Late kink and box folds of highly variable orientation (but generally trending northeast to southeast) affect most of the phyllitic rocks. These may also be related to the Middle Jurassic event, although a younger (Tertiary?) extensional origin is also possible.

FAULTS

Faulting in the Golden Bear area is dominated by north to northwest-trending high-angle, strike-slip faults, which are significant in representing first order structural controls on gold mineralization. Excellent exposures in the Golden Bear open pit (Plate 1-11-2) shed some light on the structural style of these faults, but the direction and amount of slip are controversial. A northeast-trending, dextral fault (Moosehorn fault) bounds the west side of the Moosehorn batholith, and post-dates the north to northwest-trending faults. Eocene normal faults bound the Samotua caldera, and coeval faults affect older units to the east.

OPHIR BREAK

The "Ophir break" is an economically important fault zone that extends at least 15 kilometres from Bearskin Lake to Tatsamenie Lake, and possibly another 10 kilometres to the Samotua River. The break is the primary structural control for the Golden Bear deposit. In the mine area, it comprises several anastomosing fault strands across a width

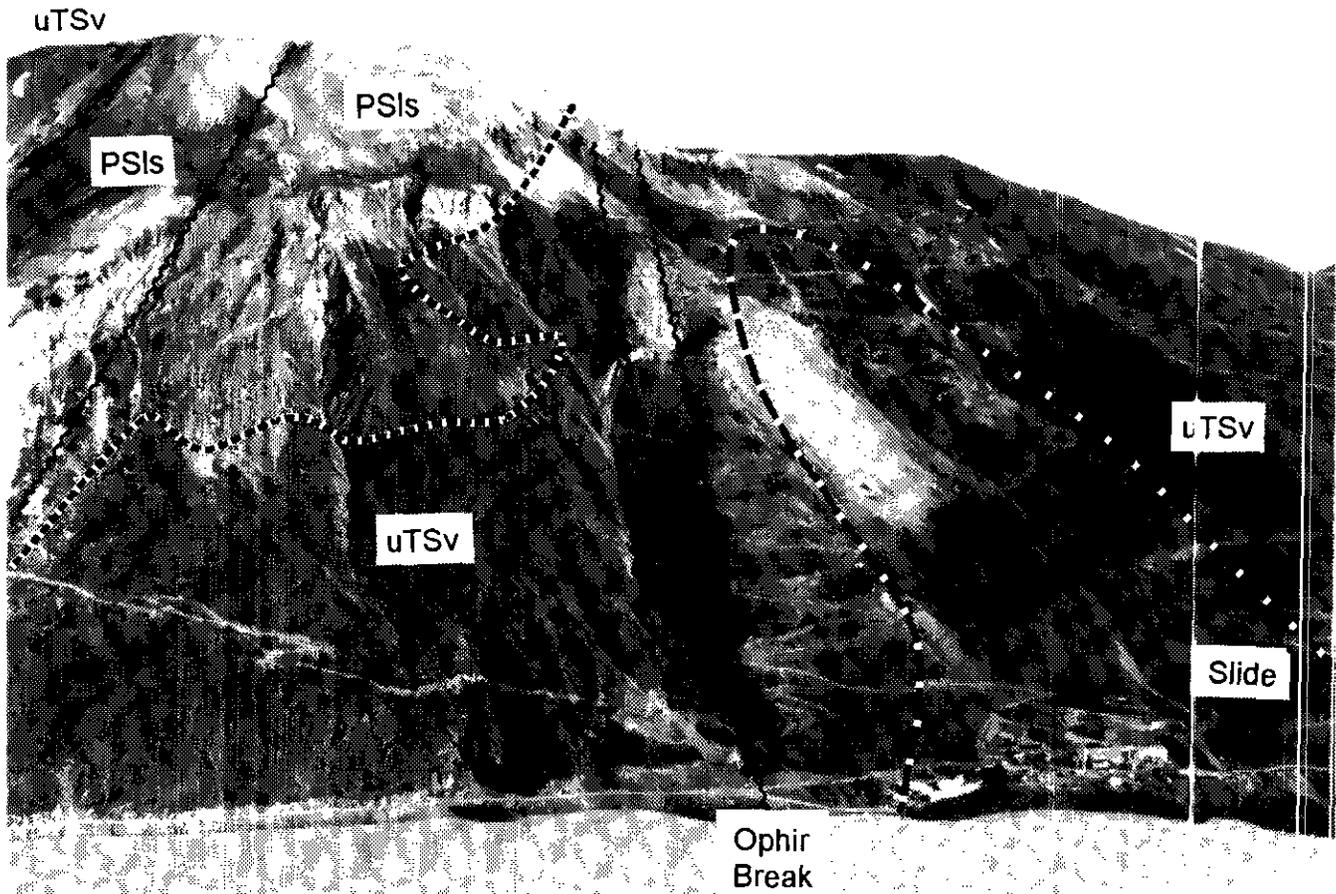


Plate 1-11-2. Golden Bear mine area, north side of Bearskin Lake, illustrating the main fault structures that comprise part of the Ophir break.

of 50 to 100 metres or more. Fault dips within the zone range from 65° to the east through vertical to locally overturned to the west. Small-scale flats along fault bends are believed to constitute dilational zones significant in localizing gold deposition (Schroeter, 1986), suggesting local reverse slip. Faults in the mine area typically comprise up to several metres of brecciated pyritic rock and sulphide-rich gouge.

Fault strands in the deposit area bound at least two major silicified carbonate lenses. The main carbonate lens in the pit is up to 50 metres wide, and is in contact across the Bear fault with carbonate-altered Stuhini Group mafic volcanic rocks to the east (Plate 1-11-2). About 1.5 kilometres north of the mine, in the Fleece Bowl area, the break diverges into two main strands, the eastern Black fault and the western Fleece fault. The Fleece fault is called the West Wall fault north of Sam Creek (Figure 1-11-2)

Fault grooves and slickensides on faults along the Ophir break have dominantly shallow plunges. Reconstruction of offsets required to produce the Totem silicified carbonate lens and the smaller lenses in the deposit area suggests the possibility of both sinistral and dextral motion at different times. Faults bounding the Totem lens dip steeply outward, giving the lens an "inverted canoe" morphology (D. Reddy, personal communication, 1992). Its configuration suggests a possibility for oblique-sinistral slip along the west-dipping

fault which is the western boundary to the lens. Dextral slip, on the order of 1500 metres, could produce the series of smaller carbonate lenses which occur south of the intersection of the fault zone with the main body of Permian limestone.

Timing of movement along the Ophir break is poorly constrained. Although it clearly cuts Stuhini Group, it is possible that pre-Stuhini faulting accompanied F_1 and F_2 folding. The main period of strike-slip movement post-dated Stuhini Group, possibly accompanying F_3 folding in a transpressional tectonic regime. This is consistent with an Early to Middle Jurassic (Schroeter, 1987) age for the main period of mineralization. Post-mineral fault movement is indicated by the juxtaposition of intensely silicified carbonate and very weakly altered volcanic rock at Totem, as well as by brecciated silicified limestone and pyritic gouge within brittle shears. Latest motion could be Eocene or younger.

FAULTS WEST OF THE OPHIR BREAK

Northwest-trending, left-stepping en echelon dextral faults bound a contractional zone northwest of Bearskin Lake. The Limestone Creek fault juxtaposes Permian limestone on the east with Stuhini Group on the west at the west end of the lake. Feldspar-pyritic basalt west of the fault contains a strong, south-dipping shear fabric with asym-

metrical porphyroblasts indicating top-to-the-north shear. Shear fabrics die out down-section to the north. About 4 kilometres to the north, felsic phyllites correlated with Unit uCSvs1 overlie mafic to intermediate metavolcanics along a steep reverse fault. Feldspar and augite-phyric tuffs and diorite in the footwall of this fault are also strongly sheared, with asymmetric feldspar porphyroblasts again indicating top-to-the-north motion. Steeply plunging fault lineations along the Limestone Creek fault indicate probable late (Eocene?) normal slip.

HIGHWAY FAULT

The Highway fault (so-called because it parallels Highway Creek in south-central 104K/8) trends subparallel to the Ophir break and dips steeply to the northeast. East of the mine, in the Fleece Creek area, the Highway fault has an apparent reverse sense of motion, putting hangingwall Stikine assemblage foliated volcanic rocks, phyllite and limestone on Stuhini Group mafic ash tuff. North of Sam Creek, the Highway fault forms a prominent linear of brecciated, iron carbonate altered rock where it cuts through the Sam batholith. The partially fault-bounded sliver of limestone south of Sam Creek may represent the sheared-out limb of an F_2 fold. South of Bearskin Creek, the Highway fault appears to split into several splays with an apparent reverse sense of motion, while changing in orientation from north to northwest. This is consistent with dextral slip.

MOOSEHORN FAULT

The Moosehorn fault is a north-northeast trending zone of brittle and brittle-ductile shearing intruded by numerous dikes along the west side of the Moosehorn batholith. Iron carbonate and hematitic alteration, silicification and brecciation affect some of the intrusive rocks along the fault. Copper mineralization associated with intense quartz-carbonate alteration and quartz veining was noted within the fault zone west of Moosehorn Lake. In the northeast corner of 104K/1 the fault curves toward a more easterly orientation. Dextral slip is inferred by preservation of a down-dropped block of Takwahoni sediments in an extensional fault-bend graben in this area, and by the northeast-trending dike swarm south of Moosehorn Lake.

MINERAL OCCURRENCES

Prior to this study, 25 known showings in the project area were listed in MINFILE. The most striking visual features are prominent brown-weathering and extensive iron carbonate alteration zones, including those mapped by Souther (1971) on the north and east side of Tatsamenie Lake. Known showings and alteration zones are shown in Figure 1-11-5. The most significant category of showings, which includes the Golden Bear mine, consists of silicified zones in limestone that are associated with high-angle faults and contacts with volcanic rocks. Occurrences are summarized in Table 1-11-1.

STRUCTURALLY CONTROLLED SILICIFIED ZONES IN LIMESTONE

The Golden Bear deposit is one of several silicified zones in carbonate hostrocks in the map area. Others include the

Fleece and Totem zones on the Ophir break, the Ram-Tut and Slam, as well as new zones in the Sheslay limestone (southeast corner of 104K/1; Figure 1-11-5), and west of Shark Peak (southeast corner of 104K/8). Mineralization occurs as irregular, fine-grained silica replacement zones with lesser dolomite, rather than as discrete quartz zones. Skarn mineralogy is absent. Multiple phases of silicification are indicated by silica-healed breccias. Chalcedonic quartz is present at the Slam showing, and may occur at Golden Bear (D. Reddy, personal communication, 1992). Volcanic rocks in fault contact with silicified zones are commonly iron carbonate or pyrite-sericite-chlorite altered.

Significant differences exist among the showings in this category. Golden Bear and Fleece are unique in having gold grades in excess of 8 grams per tonne, while only erratic values in the 1 to 3 grams per tonne range have been obtained from the Totem, Slam and Ram-Tut prospects. At Golden Bear, while good grades are obtained in silicified limestone, a significant portion of the ore is pyritic fault gouge, suggesting possible upgrading of gold values during post-mineral faulting. Golden Bear and, to a lesser extent, Fleece, contain abundant pyrite, while Totem and Slam are sulphide poor. A small massive sulphide pod has been reported at Ram-Tut. Golden Bear and Fleece are characterized by a typical epithermal geochemical signature (elevated Ag, As, Sb, Hg and Te) and no base metals. Slam is similar, although tellurium has not been reported, while Ram-Tut contains both high arsenic, antimony and mercury and local base metals (Zn, Pb and Cu). It is not known whether the base metal and precious metal mineralization at Ram-Tut represent a single mineralizing event.

The Golden Bear, Fleece and Totem zones all have an obvious relationship to faulting along the Ophir break, which has controlled emplacement of fault-bounded carbonate lenses as well as creating pathways for hydrothermal fluids. Ram-Tut and Slam also appear to be associated with high-angle faults. At Ram-Tut, brecciation and silicification are concentrated along the contact between Permian limestone and structurally overlying phyllitic rocks.

Various relationships to intrusions are evident, making generalizations about timing controversial. At Golden Bear, Fleece and Totem, five K-Ar dates on sericitic alteration range from 177 to 205 Ma (Schroeter, 1987), providing strong evidence for an Early to Middle Jurassic mineralizing event. Mineralization at Ram-Tut occurs beneath the albitized phase of the Ramtut stock, suggesting a possible relationship with Jurassic intrusive activity. At Slam, clay-altered Eocene quartz feldspar porphyry dikes trending subparallel to major fault structures occur within the main silicified zone. At Fleece, a Tertiary (?) sericite-pyrite-altered feldspar porphyry dike is mineralized in the hangingwall of the Fleece fault. This suggests that at least some hydrothermal remobilization of gold occurred in the Tertiary, possibly due to Eocene motion along the Ophir break together with coeval intrusion of Sloko dikes.

The Ramtut stock represents the only surface expression of Jurassic plutonism in the map area. A genetic link with the Golden Bear deposit is possible, but difficult to prove. Better data on the age of the pluton and tighter constraints on timing of mineralization are needed. Analysis of regional

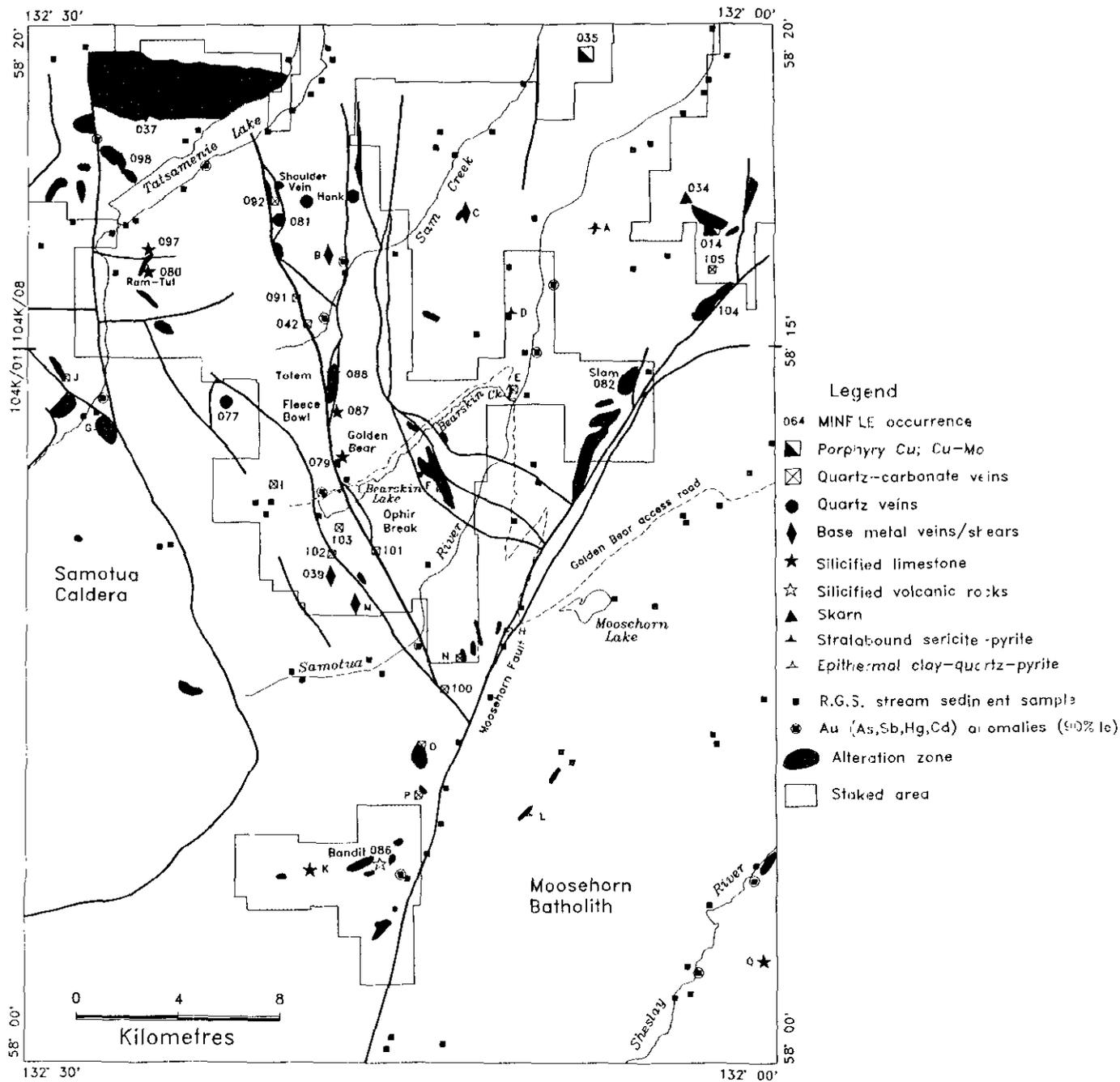


Figure 1-11-5. Mineral occurrence localities from MINFILE database, RGS sample sites, and approximate claim distribution illustrated by hatched area (based on June, 1992 records). Occurrences are described in Table 1-11-1.

geochemical survey (RGS) stream-sediment geochemistry for the project area shows that seven out of twelve multi-element anomalies involving gold, silver, arsenic, antimony, copper, lead and zinc occur in drainages centred on the Ramtut stock. This suggests that it may represent the thermal centre which generated hydrothermal fluid circulation focused along major faults as far away as Golden Bear. However, the evidence presented above suggests that this style of mineralization may also be related to Eocene intrusive activity.

IRON CARBONATE (-QUARTZ - SULPHIDE - ALBITE - K-FELDSPAR - HEMATITE) ZONES IN VOLCANIC ROCKS AND INTRUSIONS

Large gossans are widespread in volcanic rocks throughout the project area, from the north side of Taisamenie Lake to the Bandit property at the south end of the Bearskin Lake map area. For the most part, these zones are controlled by steep north-northwest-trending faults, although north of Taisamenie Lake an east-west structural

TABLE 1-11-1A
DESCRIPTIONS OF MINERAL OCCURRENCES IN THE BEARSKIN LAKE MAP AREA (104K/1) NTS ZONE 08

MINFILE	Name	UTM	Description	References
104K 039 104K 101-3	Oro, Tan 3-4	6450550 N 659150 E	Sheared mafic volcanics and diorite with disseminated and fracture-controlled chalcopyrite.	Simpson and Jones (1984a)
104K 077	Thor	6457150 N 654450 E	Siliceous phyllite and carbonaceous phyllite with minor tetrahedrite in silicified zones. Up to 58.9 g/t Ag (grab sample).	Thicke and Shannon (1983)
104K 079	Golden Bear	6455200 N 659100 E	Silicified carbonate lenses and fault gouge along a north trending fault zone have yielded over 3.5 million grams Au (1989-1992).	Schroeter, (1986)
104K 082	Slam	6458400 N 670300 E	Silicified zone 200 x 30 m in limestone, locally brecciated with chalcadonic quartz veining; associated with clay-altered Eocene dikes. Values to 1.3 g/t Au/1 m (chip sample).	Thicke and Shannon (1983)
104K 086	Bandit	6439150 N 660750 E	Silicification and pyritization along alteration/vein zone 50 x 1000 m in Stuhini Group tuffs, with Au values to 4.7 g/t/2 m. Two ddh.	Thicke and Shannon (1982)
104K 087	Fleece Bowl	6457050 N 658900 E	Silicified carbonate lenses and fault gouge along a north-trending fault zone. Indicated (probable) reserves: 416,000 tonnes of 8.2 g/t Au.	Schroeter, (1986)
104K 088	Totem	6458600 N 658800 E	200 x 1000 metre zone of intensely silicified limestone; minor pyrite; locally intense stratabound and crosscutting breccias.	Schroeter, (1986)
104K 100	Oro 4	6446450 N 663650 E	Quartz-carbonate veins and alteration zones in Stuhini Group tuffs. Pyritized tuff with 2.3 g/t Au (grab).	Simpson and Jones (1984b)
	E	6458000 N 665700 E	Quartz-carbonate epithermal breccias and veins in slates; trace pyrite.	
	F	6454000 N 663300 E	Quartz-carbonate-hematite-clay alteration in Stuhini Group tuffs; 300 x 1500 metres; pyrite stringers.	
	G	6456000 N 650000 E	Clay-quartz-pyrite alteration in Sloko Group felsic tuffs along caldera margin faults.	
	H	6448500 N 665800 E	Fine grained sulphides and quartz with malachite in steeply dipping fault zone along edge of Moosehorn batholith; associated with Tertiary dikes; 5 ppm Ag (grab).	
	I	6453900 N 656800 E	Quartz vein with 5% pyrite, chalcopyrite, in strongly fractured mafics; 1.08% Cu (grab).	
	J	6457900 N 648150 E	1.0 km long gossan in Stuhini Group with 1-3% disseminated and fracture controlled pyrite.	
	K	6439150 N 658550 E	Clay altered, silicified, carbon-rich fault breccia.	
	L	6441500 N 666900 E	Clay altered felsite dikes with chalcadonic quartz veining, trace pyrite cut Moosehorn batholith.	
	M	6450100 N 660100 E	Fractured, chloritized mafic volcanics with 2% disseminated pyrite, chalcopyrite; 0.32% Cu (grab).	
	N	6447050 N 664100 E	Quartz vein 0.5 m wide with chalcopyrite in tuff, argillite; 0.26% Cu (grab).	
	O	6444000 N 662600 E	Quartz-carbonate veins with pyrite, tetrahedrite in iron-carbonate altered tuffs; 1.17 g/t Au, 0.84% As (grab).	
	P	6442500 N 663000 E	Chalcopyrite-pyrite-epidote in fractures in aphanitic mafic volcanics; 1.24% Cu, 3.0 ppm Ag (grab).	
	Q	6436000 N 676500 E	Variably silicified and brecciated limestone; minor sulphide.	

TABLE 1-11-1B
DESCRIPTIONS OF MINERAL OCCURRENCES IN THE SOUTHERN TATSAMENIE LAKE MAP AREAS (104K/8) NTI, ZONE 03

MINFILE	Name	UTM	Description	References
104K 014	Fae	6464800 N 673500 E	Clay alteration, quartz veining with pyrite, molybdenite, chalcopyrite in quartz feldspar porphyry quartz monzonite stock. 0.024% Mo, 0.026% Cu/24 m (chip sample).	Stevenson (1976)
104K 034	Norm	6465660 N 672800 E	Magnetite pods up to 3 m wide along quartz monzonite-limestone contact; minor pyrite, chalcopyrite.	Stevenson (1972)
104K 035	Bing	6471500 N 668200 E	Disseminated chalcopyrite-molybdenite in quartz-feldspar alteration zones; skarn with pyrite, chalcopyrite, molybdenite adjacent to feldspar porphyry stock.	Grath (1965)
104K 037	Tot 2	6468250 N 650900 E	Chalcopyrite veinlet to 10 cm wide in chlorite schist; assayed > 1.0% Cu, 14.8 g/t Ag.	Brown and Valton (1983b)
104K 042	Sam	6460450 N 657650 E	Pyrite, arsenopyrite, stibnite in quartz-carbonate veinlets in metavolcanics.	Sannon (1982)
104K 080 104K 097	Ram, Tut	6462310 N 651120 E	Disseminated and fracture-controlled pyrite, stibnite, tetrahedrite and semimassive sphalerite in silicified brecciated zones near top of limestone. Six ddh, with values to 2.4 g/t Au, 33.5 g/t Ag/1.6 m.	Bisset (1984)
104K 081	Two Ounce Notch	6464400 N 656400 E	North-trending quartz vein up to 1 m wide with semimassive pyrite in graphitic sediments along the West Wall fault. Up to 14.0 g/t Au/0.3 m.	Saw (1984)
104K 091	Misty	6461400 N 657200 E	Scattered Au values to 10.0 g/t in pyritized tuff near West Wall Fault.	Brown and Valton (1983a)
104K 092	Spire, Nie 3	6465500 N 656300 E	Quartz-carbonate breccia zones with pyrite, sphalerite, chalcopyrite, galena. Up to 2.7 g/t Au, 13.8% Zn in grab samples.	McBean (1990)
104K 098	Tot	6465880 N 650450 E	Pyrite, chalcopyrite, stibnite in phyllitic felsic volcanics cut by fault. One ddh with up to 3.81 g/t Au/2.26 m.	Moat and Valton (1987)
104K 104	Taker	6461800 N 673450 E	Iron carbonate altered metatuffs with up to 2.7 g/t Au in grab samples.	Valton (1984b)
104K 105	Giver	6463150 N 673500 E	Iron carbonate altered metatuffs with up to 7.3 g/t Au in grab samples.	Valton (1984b)
	Honk	6465800 N 659200 E	Quartz vein with semimassive pyrite, local chalcopyrite in sheared mafics. Up to 18.1 g/t Au in grab samples.	McBean (1990)
	Shoulder Vein	6464200 N 657400 E	Quartz veins with semimassive Pyrite, Gn, stibnite, Chalcopyrite, Sp in chloritized mafics. Up to 15.3 g/t Au in grab samples.	McBean (1990)
	A	6464500 N 668850 E	Stratabound quartz-sericite-pyrite alteration zone in foliated mafic volcanics; 3.0 ppm Ag (grab).	
	B	6463000 N 658550 E	Semimassive pyrrhotite, chalcopyrite in sheared, silicified diorite, mafics along shear; 6 ppm Ag, 1.48% Cu (grab).	
	C	6464800 N 663450 E	150 x 300 metre gossan in sheared diorite; up to 10% pyrite, pyrrhotite.	
	D	6460450 N 664500 E	Stratabound quartz-sericite-pyrite alteration in foliated mafic tuff and limestone; cm-thick pyrite-arsenopyrite layers; trace chalcopyrite.	

grain becomes more prominent. Lithologies represent a significant secondary control, as on Tangent Ridge, where alteration is locally subparallel to bedding in Stuhini tuff.

These zones comprise a variety of alteration assemblages, including iron carbonate, quartz-carbonate, quartz-carbonate-pyrite, and quartz-sericite-pyrite. Iron carbonate alteration appears to be the most common, although some iron carbonate zones contain quartz vein and silicified breccia zones, representing more tightly focused, higher temperature portions of the systems. At the Bandit prospect, silicified zones contain significant albitic alteration (J. Howe, personal communication, 1992): albite or potassium feldspar may be more widespread in many of these zones. Quartz-poor, carbonate-rich assemblages tend to have very little sulphide, although specular hematite is ubiquitous. Quartz veins commonly contain pyrite and tetrahedrite, with stibnite reported from several localities.

Several quartz veins with gold and base metal sulphides occur north of Sam Creek between the Highway fault and the Ramtut stock. These include the Two Ounce Notch, Shoulder Vein and Honk showings. Semimassive pyrite, lesser chalcopyrite, and locally sphalerite, galena and stibnite occur in these veins, which locally contain gold in excess of 15 grams per tonne.

Numerous shear zones with chlorite-pyrite or iron carbonate alteration contain fracture controlled and disseminated chalcopyrite. These are most common in the Stuhini Group, especially on Muse Ridge west of the Highway fault, and in Late Triassic diorite. Although widespread, these do not appear to represent systems of appreciable size.

The iron carbonate gossans were probably produced by the same hydrothermal systems that produced silicified zones in carbonate hostrocks. The different style of alteration reflects lithological control. Evidence for timing of mineralization in these zones is equally equivocal. Although Sloko-age dikes are associated with some of these zones, it is not always clear that there is a genetic link. It is possible that more deeply seated Jurassic intrusions were heat sources for most of these systems.

STRATABOUND PYRITIC ALTERATION ZONES IN STIKINE ASSEMBLAGE VOLCANIC ROCKS (VMS ?)

A previously unreported, prominent pyritic alteration zone occurs in Stikine assemblage foliated mafic to intermediate tuff east of the Samotua antiform in southeastern 104K/8. The metavolcanic rocks structurally underlie cherty argillite in a tightly folded sequence. The alteration zone is up to 10 metres thick, subparallel to foliation and compositional layering, and is exposed along a strike length of at least 50 metres. Assemblages grade from chlorite-pyrite with minor epidote and carbonate, to sericite-pyrite and quartz-sericite-pyrite. Up to 5 per cent disseminated pyrite occurs locally. Although no massive sulphide is exposed at this location, the style and orientation of this alteration zone suggest the possibility of a volcanogenic massive sulphide system. A similar, thinner stratabound alteration zone with centimetre-thick pyrite-arsenopyrite layers was noted near

the southeast edge of the Sam batholith north of the Golden Bear mine road.

The volcanogenic massive sulphide potential of Paleozoic volcanic rocks of northern Stikinia is well known; however, very little exploration for this type of deposit has been done in the southeastern quarter of the Tulsequah sheet.

CLAY (-PYRITE) ALTERATION ZONES IN SLOKO GROUP

Several conspicuous acid sulphate alteration zones up to 1 kilometre across are exposed along the margin of the Samotua caldera in Sloko Group lapilli tuff and breccia. Alteration is dominated by clay, with minor sericite, quartz, and locally 2 to 3 per cent disseminated pyrite. Hydrothermal activity was probably late synvolcanic, with fluids focused along active faults near the caldera margin. Similar alteration occurs locally as haloes around Sloko dikes cutting volcanic rocks or diorite. Little exploration has been done on Sloko volcanic rocks in the project area, although the geologic setting suggests potential for both bulk-tonnage and bonanza epithermal gold mineralization.

PORPHYRY COPPER AND MOLYBDENUM

Several porphyry copper and molybdenum occurrences in southeastern 104K/8 and northwestern 104J/4 were explored in the 1960s and 1970s. Molybdenum-copper showings include the Fae (MINFILE 104K 014) and Bing (104K 035). Although neither showing was visited, mapping in the vicinity suggests that both are related to young (probably Eocene) quartz monzonite porphyry intrusions (cf. Souther, 1971). Very fresh dikes intruding Triassic diorite and Stikine assemblage near the Bing showing contain embayed quartz and abundant fine-grained biotite. Near the Fae prospect, an intensely clay-altered feldspar porphyry cut by quartz stockworks is interpreted as an Eocene plug. Work by Kennco in the early 1960s identified equigranular biotite quartz monzonite and potassium feldspar porphyry phases of this intrusion. Disseminated molybdenite, chalcopyrite and minor galena and sphalerite occur along its western flank. Magnetite pods occur in meta-volcanic and sedimentary rocks northwest of the plug (Norm showing: MINFILE 104K 034).

Numerous copper-only occurrences to the east of the map area in 104J/4 centre around the Kaketsa stock and several smaller Late Triassic diorites. Only minor chalcopyrite was noted locally in Triassic diorite bodies in the Golden Bear area.

MINING AND EXPLORATION ACTIVITY

North American Metals Corporation continued mining from the Golden Bear open pit this summer. The mill was running at up to 500 tonnes per day, well above its designed 350 tonnes per day capacity. Underground mining along the Bear fault and parallel structures is proceeding and plans for next summer include open-pit mining the headwall of the current pit (D. Reddy, personal communication, October 1992).

In addition to mining, North American Metals had a three component exploration program: drilling along the Ophir break aimed at defining additional underground ore reserves; detailed 1:1000-scale mapping of the Totem and Fleece Bowl prospects; and mapping and sampling on all peripheral claims included in its mining lease. Activity outside the immediate mine area was conducted by the parent company, Homestake Exploration Limited, on the Ram-Tut, Bandit and Slam claim groups. This included detailed mapping, soil and rock sampling, induced polarization surveys and trenching.

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