TOODOGGONE-McCONNELL PROJECT

GEOLOGY OF THE McCONNELL RANGE

JENSEN CREEK TO JOHANSON CREEK, PARTS OF NTS 94D/9, 10, 15, 16

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INTRODUCTION

The southern McConnell Range program is part of the Toodoggone-McConnell mapping project, initiated in 1996. The area is about 20 km. south of the rapidly developing Kemess mine site of Royal Oak Mines Inc.

The McConnell Range is within the northern Omineca Mountains, at about 56 45 north latitude and 126 30 west longitude in north-central B.C. The range lies parallel to the Omineca Mining access road where it follows the Moose valley at about kilometre 425. The Omineca Mining access road is a continuation of the Finlay Forest Service Road which originates near Windy Point on Highway 97, 155 kilometres north of Prince George.

The project area is between Jensen Creek in the north, Johanson Creek in the south, the Ingenika valley to the east and the Moose Valley to the west (Figure 8.1). The area comprises about 125 square kilometres overlapping portions of NTS 94D/9, D/10, D/15 and D/16.

Parts of the range may be reached by access road. At km 421 on the Omineca road a side 4X4 road (the McConnell Creek access road) follows a deep glacial valley eastward and then swings north up the Ingenika valley to parallel the range on the east side.

The range is well dissected and back to back headwall retreat of watersheds has formed numerous sharp ridges. These are traversable with some exceptions. Elevations range from 1200 metres to 2100 metres with the treeline at about 1650 metres.

The writer assisted by Brian Untereiner completed about 35 traverses, with mostly good weather. The work involved mostly fly camps coordinated with Larry Diakow.

PREVIOUS WORK

The area was covered by 1:250 000 mapping by the Geological Survey of Canada during the mid 1940's (Lord, 1948). A number of copper rich vein showings (*eg.* Marmot) were located during this effort. Sporadic work followed over the next two decades. In the late 1960's significant exploration activity focused on porphyry copper and molybdenum mineralization. A large gossan was discovered in 1966 at the present site of the Kemess North prospect and led to similar exploration on nearby ground. Southwest of the McConnell Range In 1971 Falconbridge Nickel discovered a malachite stained bed that was traceable for over 2500 feet during a reconnaissance helicopter flight. The area is just north of the Sustut River southwest of the McConnell Range. Subsequent assessment revealed a replacement copper deposit in volcaniclastic rocks in the upper part of the Takla Group. Numerous junior and major resource companies acquired ground in the area looking for either volcanic redbed copper mineralization in porous volcaniclastics or copper and molybdenum porphyries. Detailed mapping with minor drilling was conducted in the southern McConnell Range during this period. In 1973 the B.C. Geological Survey conducted a mineral deposit study of the Sustut copper area (Church, 1974a). The Geological Survey of Canada returned to pursue detailed studies within the McConnell sheet (Monger, 1977; Richards, 1976). In the north, follow up of a gold-copper-molybdenum soil geochemical anomaly led to the discovery of the Kemess South porphyry deposit in 1983.

In 1996 a regional geochemical survey of the McConnell mapsheet included sampling of watersheds in the McConnell Range. Results indicated multielement precious and base metal anomalies within the general project area (Jackaman, 1997).

The setting of the McConnell Range between major deposits at Kemess to the north and Sustut copper to southwest, and its proximity to developing infrastructure, suggested that mapping at a 1:20000 scale work was appropriate.

GEOLOGIC SETTING

The McConnell Range is bounded by the Ingenika fault to the east and a splay of that fault, the Moosevale fault, to the west. This fault wedge lies at the edge of the Intermontane Belt and the tectonostratigraphic Stikine Terrane. The Ingenika fault is a dextral strike slip fault, part of a prominent strike-slip sysytem in north-central British Columbia (Gabrielse 1985). Gabrielse suggested cumulative movement of about 300 kilometres along the Kutcho, Finlay, Ingenika, and Takla faults. The volcanic sequences east and west of the fault are thus considered to be laterally offset some 300 kilometres. In spite of this the rocks are of the same age with similar trace element

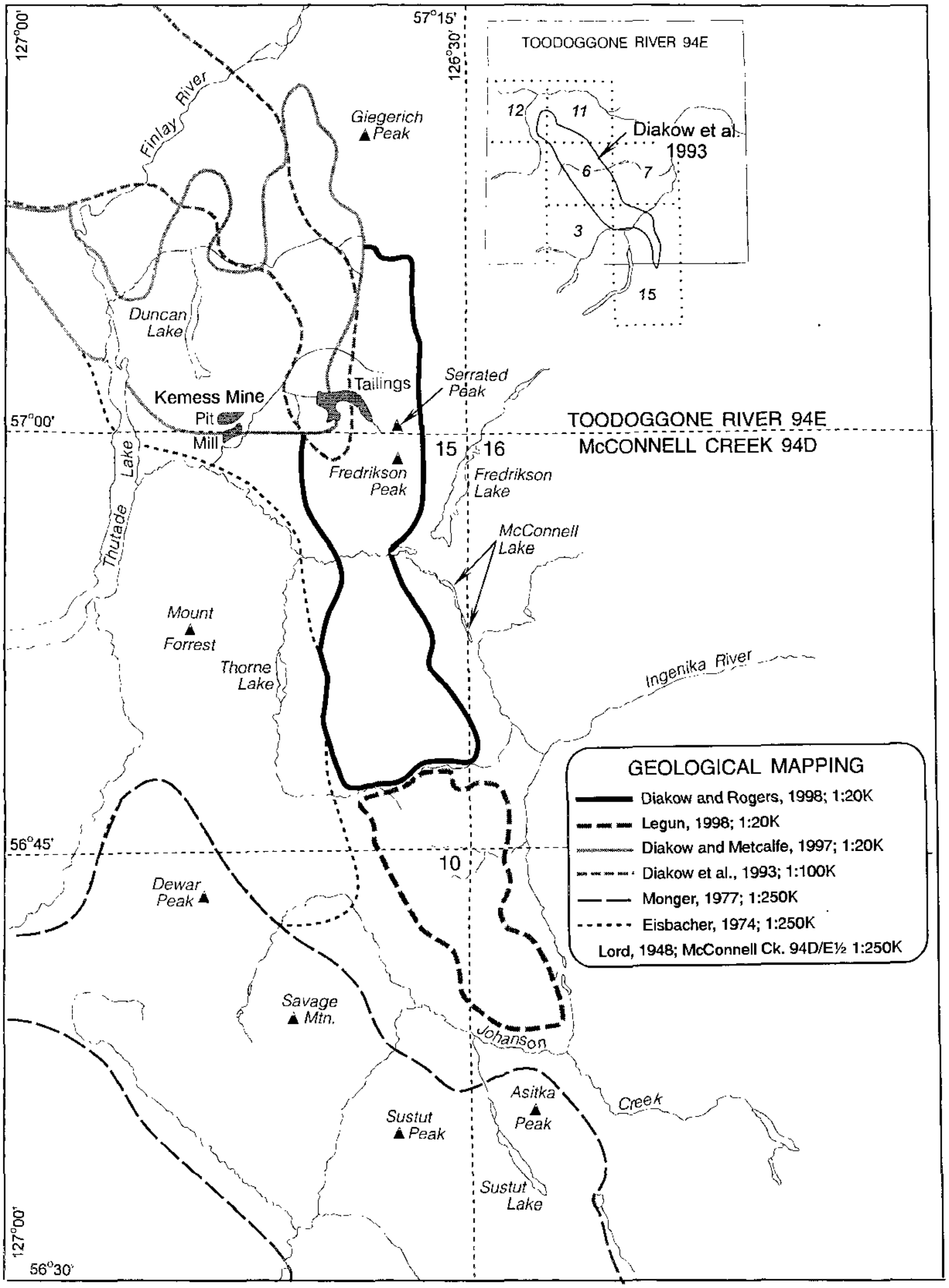


Figure 8.1. Location of recent and previous mapping in the southern Toodoggone River (94E) and northeastern McConnell Creek (94D) map areas.

geochemistry (Gale, 1996). The problem of fortuitous juxtaposition of grossly similar rocks across terrane boundaries is outside the scope of this paper. Suffice to say that the volcanic sequence in the McConnell Range can be related to a well studied sequence to the southwest in Stikinia while the stratigraphy east of the fault is not readily correlated (Zhang and Hynes 1991, Richards, 1976).

The stratigraphic sequence in the vicinity of Sustut copper deposit has been the focus of detailed stratigraphic study (Monger and Church 1976). The Takla Group in the vicinity of Mount Savage is about 3400 metres thick and subdivided into the Dewar, Savage Mountain and Moosevale formations. The Dewar formation is relatively thin (<= 300 m.), and the remaining thickness is about equally divided between the Savage Mountain and Moosevale formations.

Correlative strata of the Dewar Formation apparently thin towards the northern part of the McConnell Range (Diakow 1998). The Savage Mountain and Moosevale formations are present; the former may be reduced in thickness. Other rocks mapped include the cogenetic Menard mafic-ultramafic complex and granitic stocks and plugs of probable early Jurassic age.

Strata of the Takla Group are in the zeolite (prehnite-pumpellyite) facies of regional metamorphism. This contrasts with generally higher greenschist to amphibolite grades found east of the Ingenika fault.

The Sustut Copper deposit, immediately west of Sustut Peak contains reserves of 43.5 million tonnes grading 0.82 per cent copper (Harper 1977). The deposit consists of fine grains of hematite, pyrite, chalcocite, bornite, chalcopyrite and native copper in decreasing abundance dispersed in matrix and clasts of volcaniclastic rocks in the Moosevale formation. Gangue minerals include epidote, quartz, prehnite and carbonates. The mineralized zone is partially concordant with bedding, and lies just below the transition from green to red volcaniclastics, high in the Moosevale Formation (Harper, 1977).

The Kemess South deposit located north northwest of the McConnell Range near Kemess Creek is hosted by a flat-lying, porphyritic quartz monzodiorite intrusion that is underlain by Takla Group volcanic rocks (Rebagliati *et* al. 1995.). In contrast Diakow (1998) interprets the 'intrusion' as altered Toodogone volcanic rocks. Pyrite, the dominant sulfide accompanies quartz stringers. Chalcopyrite occurs as disseminated grains and in quartz stockworks. Reserves are approximately 220 million tons grading 0.22% copper and 0.18 ounces per ton of gold (1995 Annual Report, Royal Oak Mines).

MAPPING ACCOMPLISHMENTS

Takla Group

The Geological Survey of Canada mapped the Savage Mountain Formation of the Takla Group and the Toodoggone Formation of the Hazelton Group in the southern McConnell Range. However the author concludes that the southward Savage Mountain Formation passes conformably and stratigraphically into the Moosevale Formation of the Takla Group.

To the north, in the vicinity of Jensen Creek, structural attitudes are difficult to discern. Dips vary from subvertical to shallow. The steep dips are at the margins of Early Jurassic intrusions and in the vicinity of the Menard ultramafic complex. Stratigraphic elements are overprinted by hornfelsing and alteration. No cumulate thickness can be calculated. To the south a simpler structural style is evident in gentle to flat dips and block faults. Stratigraphic elements of the upper Savage Mountain Formation and Moosevale Formation can be recognized and traced.

Jensen Creek to Menard Creek

Takla Group rocks include feldspar lath and augite porphyries, fine grained basalt, and minor tuff breccias in the Jensen Creek area. All subtypes are basaltic and with the exception of the lath porphyries, carry augite. Any subtype may be amygdaloidal. Amygdule fillings include epidote, chlorite, calcite, zeolites and albite.

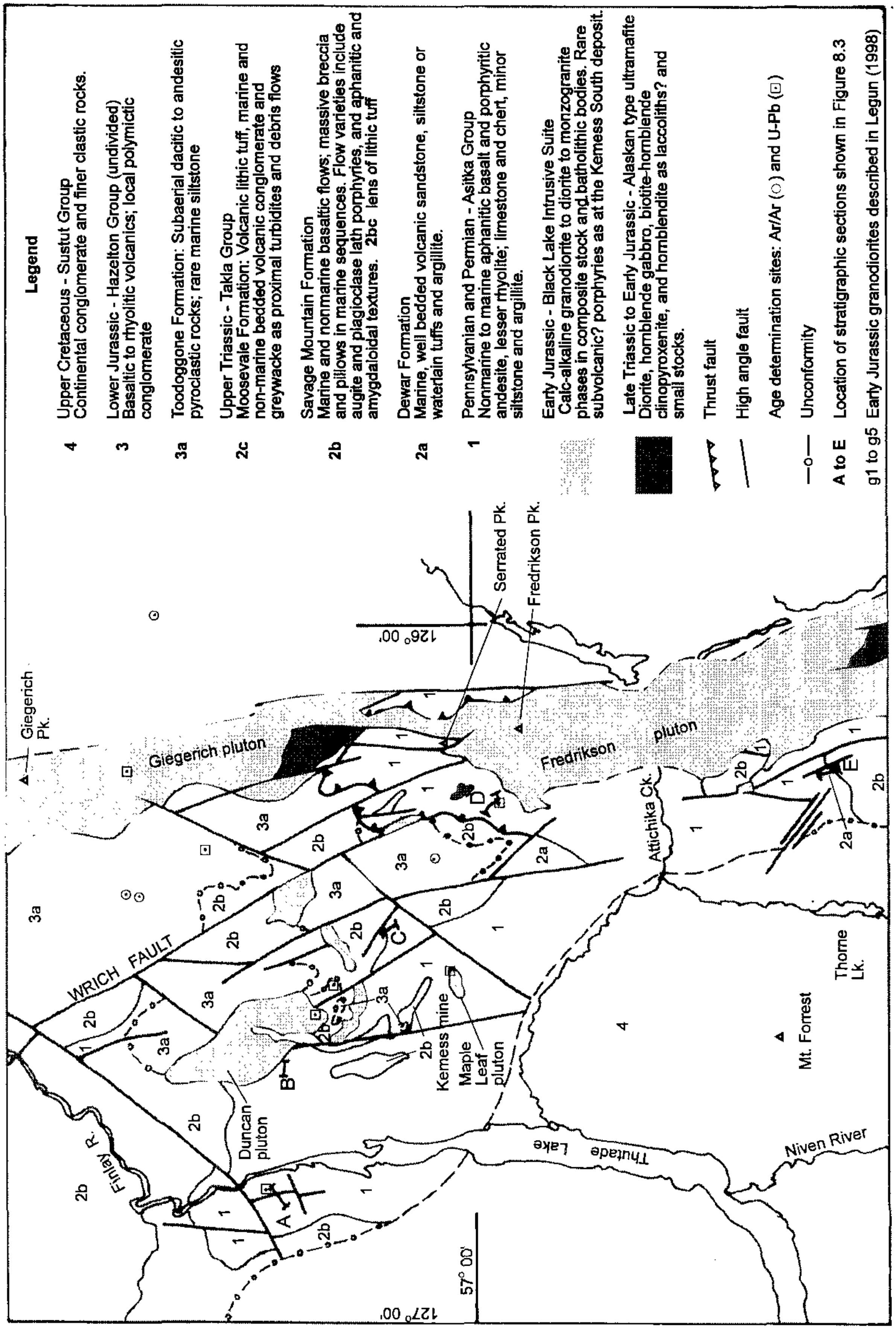
The subtypes are closely associated with each other and individually do not form mappable units. Some trends however can be discerned. On the western slopes of the Marmot area lath porphyries dominate. Amygdaloidal phases are common west of the Menard complex but were not observed north and east of the complex.

Gale (1996) described the variation in petrographic composition of various basaltic subtypes. Phyric flows display varying proportions of phenocrysts of clinopyroxene, plagioclase, and pseudomorphs of olivine within a holocrystalline groundmass.

South of Menard Creek the volcanics are variably hematized. They are occasionally knobby textured, rich in fragments and densely amygdaloidal. Fragments are coarsely to finely vesiculated fragments, or may be vesicle (amygdule) free clasts in a fluidal textured matrix defined by swirls of amygdules and aligned feldspar laths. Knobby texture in part is due to concentric hematitic bands about a dark amygdule core. Bands, lenses and irregular masses of massive red aphanitic material were also noted. These oxidized and hematized porphyries are interpreted to be distal ends of blocky and scoracieous subaerial flows, possibly intermixed with fine red tuff or baked mud. Although there is no discernible bedding of sedimentary origin, contacts between amygdule rich layers suggests the volcanics are shallow dipping. A few amygdule rich dikes are present.

Menard Creek to Johanson Creek

South of the Menard Cr. watershed a southern highland is isolated from the interconnected ridges to the north. In contrast to the adjacent segment volcanic stratigraphy is mappable on this highland. The Savage Mountain Formation, dominated by coarse lath porphyry flows, passes upward into the Moosevale Formation, dominated by lithic tuffs. There is one significant interval of well bedded waterlain sediments at the conformable contact. These waterlain sediments may correspond to unit 3a of Harper (1977) in the vicinity of Sustut Copper.


Legend
4 Upper Cretaceous - Sustut Group
Continental conglomerate and finer clastic rocks.
3 Lower Jurassic - Hazelton Group (undivided)
Basaltic to rhyolitic volcanics; local polymictic conglomerate
3a Toodoggone Formation: Subaerial dacitic to andesitic pyroclastic rocks; rare marine siltstone
2c Upper Triassic - Takla Group
Moosevale Formation: Volcanic lithic tuff, marine and non-marine bedded volcanic conglomerate and greywacke as proximal turbidites and debris flows
2b Savage Mountain Formation
Marine and nonmarine basaltic flows; massive breccia and pillows in marine sequences. Flow varieties include augite and plagioclase lath porphyries, and aphanitic and amygdaloidal textures. 2bc lens of lithic tuff
2a Dewar Formation
Marine, well bedded volcanic sandstone, siltstone or waterlain tuffs and argillite.
1 Pennsylvanian and Permian - Asitka Group
Nonmarine to marine aphanitic basalt and porphyritic andesite, lesser rhyolite; limestone and chert, minor siltstone and argillite.
Early Jurassic - Black Lake Intrusive Suite
Calc-alkaline granodiorite to diorite to monzogranite phases in composite stock and batholithic bodies. Rare subvolcanic? porphyries as at the Kemess South deposit.
Late Triassic to Early Jurassic - Alaskan type ultramafite
Diorite, hornblende gabbro, biotite-hornblende clinopyroxenite, and hornblendite as laccoliths? and small stocks.
Thrust fault
High angle fault
Age determination sites: Ar/Ar (○) and U-Pb (⊡)
Unconformity
A to E Location of stratigraphic sections shown in Figure 8.3
g1 to g5 Early Jurassic granodiorites described in Legun (1998)
Giegerich Pk.
Giegerich pluton
126° 00'
Serrated Pk.
Fredrikson Pk.
Fredrikson pluton
Attichika Ck.
WRICH FAULT
Kemess mine
Maple Leaf pluton
Duncan pluton
Thorne Lk.
Mt. Forrest
Finlay R.
Thutade Lake
Niven River
57° 00'
127° 00'

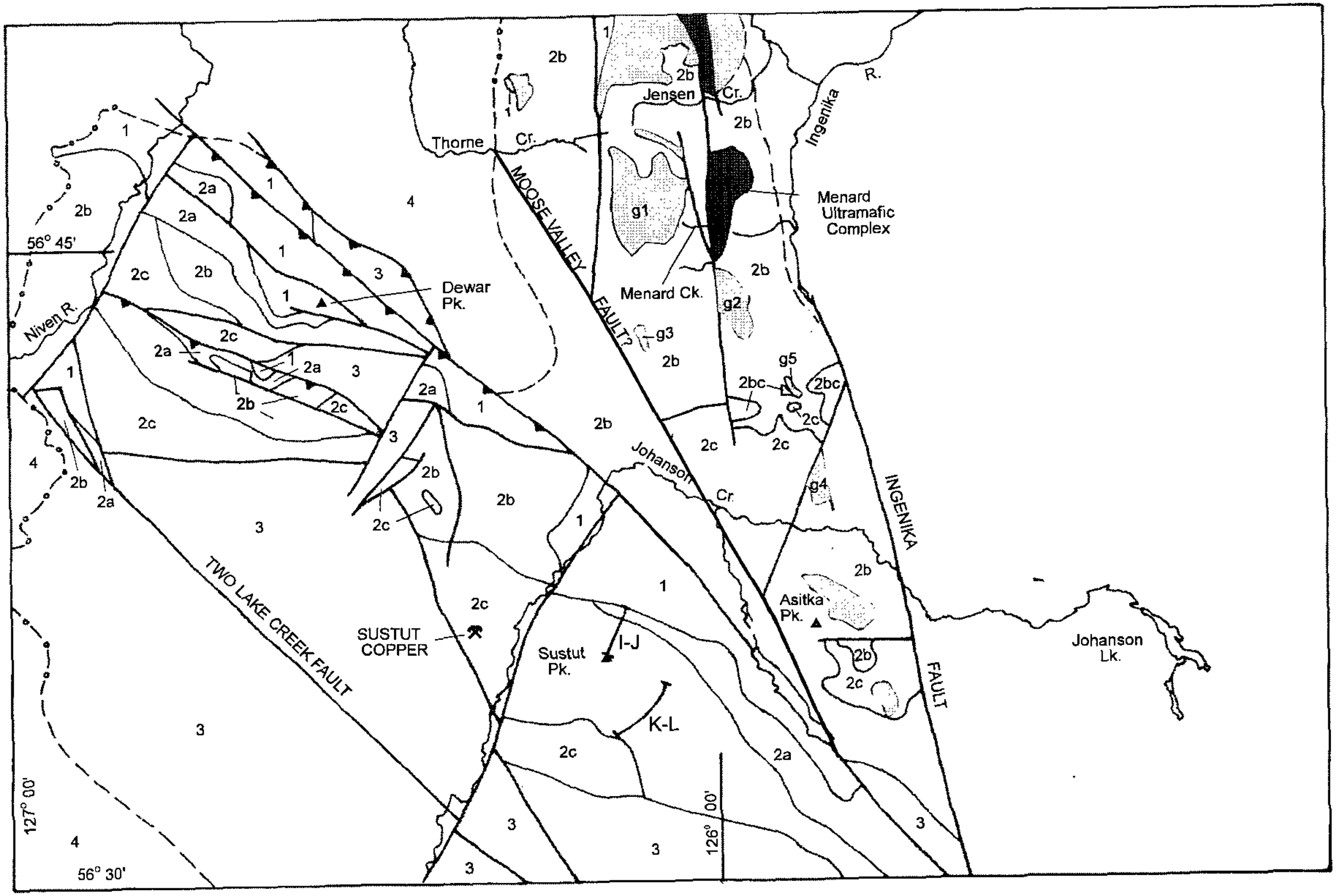


Figure 8.2 Geology of the McConnell Range showing major lithostratigraphic divisions and plutonic rocks. Geology in outlying regions to the south, northwest and west by Legun (1998), Diakow and Metcalfe (1997) and Monger (1976) respectively, are incorporated.

Discontinuous sedimentary beds are found throughout the lithic tuffs of the Moosevale Formation.

Savage Mountain Formation

In this area the Savage Mountain Formation is a composite unit of lath porphyry flows and some interbeds of lithic tuffs. Contacts and sedimentary bedding suggest the Savage Mountain Formation is flat lying to undulating on the northern flank of the highland. A pyroxene bearing phase is exposed on the lower northern slopes and believed to be at a low stratigraphic position. It is similar to phases found in the main part of the range and described as basalt porphyry or augite-feldspar porphyry.

Thickness calculations from base to ridge top in the northeast indicate at least 400 metres of lath porphyry flows are present. To the southwest calculations indicate the flow sequence has thinned to about 200 metres. There it is underlain by a wedge of lithic tuff which is absent in the north.

A tuff breccia unit of rather unusual geometry and lithic composition occurs in the north. Its mapped trace extends from the ridge top near a small granitoid dike (body g-5 in Figure 8.2) westward to the valley floor as an elongate body. The southern contact of this elongated body is steep, judging by its straight transect with closely spaced contours Contacts of flow rocks measured about 300 metres to the east and southwest of this area indicate flat to gentle dips. The southern contact may thus be crosscutting, perhaps a small fault. Near the northern contact within the tuff breccia a coarse grained diorite mass, a few metres across (base not exposed), is exposed in a gully wall. Above it there are fragments of diorite within the tuff breccia. Other clast types include augite porphyry, lath porphyry, green laminated siltstone, dark to maroon tuff?, white chert, microdiorite, and pale sericitized fragments. No diorite, white chert, and fine pale sericitized clasts were seen in other tuff breccias. The distribution of clast types is not uniform. For example lath porphyry clasts are abundant near the margin but uncommon elsewhere. Most clasts are very angular but a few are rounded. One round chert clast has a dark alteration rim.

Further work is needed to determine the true nature of this unit. Any interpretation must explain the origin of the coarse diorite. Possibly this tuff breccia represents a vent breccia or diatreme.

Moosevale Formation

As mentioned above the Savage Mountain formation passes stratigraphically upward into the Moosevale Formation on the southern highland, and that contact is marked by a locally developed well bedded sequence. The contact is exposed in the central area of the highland. The top of the Savage Mountain Formation is reddish and amygdaloidal lath porphyry. Nearby drilling (diamond drillhole ZD 76-1, Bates 1976) indicates that the top of the lath porphyry consists of several successive flows, which are reddened at the top and include flow fragments. The base of the overlying sequence is represented by tuff and tuff intercalated with siltstone.

The well bedded sequence does not persist laterally for more than a few hundred metres. The sequence comprises thick beds of calcareous tuffaceous sandstones (with crossbeds and mudchips), lithic tuffs with sandy intervals, horizontally laminated grit, clast supported conglomerate, thin to very thin beds of red and green siltstones, banded tuff, argillaceous limestone and laminated chert. Minor detrital quartz occurs in the sandstones. The clast supported conglomerate has rounded clasts to 20 cm and is weakly stratified with grit lenses.

The stratified and "water washed" sediments which are about 50 metres thick, are overlain by at least 800 metres of lithic tuffs, massive tuffs and tuffaceous breccias cut by occasional sills of augite porphyry. In tuffaceous breccias clasts are not easily discernible from matrix. The matrix typically has a lower density of crystals and these are finer and broken.

Sedimentary intervals within the lithic tuff of the Moosevale include locally developed graded beds, channel forms, and matrix and clast supported conglomerates.

Some matrix supported clastic units with angular clasts contain siltstone rip-ups together with crystal fragments. Reddish siltstones mantle beds with coarse clasts to boulder size. The origin of these siltstones is uncertain. They may represent suspension drapes, sheet wash deposits, or reworking of the tops of debris flows. Discontinuous siltstone beds may also occur as elongate tilted slabs within these beds. These slabs must have been at least partially lithified to remain coherent. Conglomeratic masses also were observed to project through siltstone bands as if they were injected. These features suggest slumping to the writer. An association with graded beds indicates a submarine rather than subaerial environment. Resedimentation in the context of a slumping slope facies is clear in either case. Blunt nosed and spindle shaped volcanic clasts were noted associated with graded beds rich in rip ups. These clasts are interpreted to be air sculptured volcanic bombs though they could conceivably represent disaggregated remnants of pillowed lava.

Alteration

Propylitic alteration is widespread within the volcanic sequence. Epidote is the most conspicuous mineral of this assemblage that includes carbonate and hematite. In some cases epidote zones can be related to shear zones, contacts or other discontinuities. However there are many instances where lenses of massive epidote rock is within a homogenous unit such as massive lath porphyry.

Propylitic alteration also is well developed in small intrusive or subvolcanic bodies of dacite porphyry to microdiorite. The microdiorites are characterized by epidotized and sericitized feldspar phenocrysts in a fine microcrystalline to fine blocky lath matrix. Chloritized mafics are common together with calcite, opaques and granular epidote.

Menard Ultramafic complex

The Menard ultramafic complex was studied recently by Nixon *et al.* (1989) who focused on its petrology and relationship to other Alaskan-type bodies in the region. The body is teardrop shaped in plan and elongated northward (Figure 8.2).

The following units were mapped by the writer:

1) clinopyroxenite
2) clinopyroxenite and (olivine) gabbro
3) gabbro with minor banded diorite
4) layers of pyroxenite, gabbro and basalt.

Clinopyroxenite forms a north trending lens on the west margin of the complex. Massive pyroxenite passes northeast and southeast to pyroxenite and gabbro. The transition is marked by north trending interlayering of gabbro and coarse pyroxenite. Eastward massive pyroxenite passes abruptly to gabbro. The gabbro is an oval plug-like mass whose long axis swings from north to northeast giving it an arcuate shape.

A panel of interlayered bands of pyroxenite, basalt, gabbro and lath porphyry lies on the northeast flank of the complex in uncertain contact relationship with the eastern margin of the gabbro "plug", and gabbro with pyroxenite. The contact relationship is obscured by diorite dikes and magnetite rich zones. Layers trend at about 335 degrees. The conformable interlayering of these units suggests the coarser grained rocks are sills and part of the Takla assemblage. The interlayered sills appear to pass stratigraphically eastward into Takla volcanics. The volcanic package consists of massive basalts and weakly porphyritic basalts with scattered small phenocrysts of feldspar and pyroxene. The panel of sills also appears to pass laterally into Takla volcanics to the northwest, perhaps by pinching out of sills or fining of textures.

In one location the lath porphyry shows pilotaxitic texture at its contact with the pyroxenite indicating it is a younger phase of sill intrusion.

The ultramafic complex apparently tapers southward, the southward extension being inferred from ground magnetometer data (Meyer and Overstall 1973). Exposure on the south side of Menard valley is poor and restricted to a creek gully. Here serpentinized gabbro and pyroxenite (high magnetic susceptibility) are present near a fault structure that disappears northward into the complex (approximately in line with the gabbro/pyroxenite contact).

The gabbro "plug" in its northeastern terminus comprises massive diorite and banded hornblende diorite. The banding, defined by mineral layers rich in hornblende, trends east across the overall northerly trending regional structures.

According to Irvine (1976) the intrusive phases of Alaskan type bodies develop by crystallization differentiation. The pyroxenite body appears to represent a crystal cumulate. Its form suggests the complex may have originally formed as a laccolith. Irvine suggested the juxtaposition of intrusive phases in such bodies is a result of diapiric re-emplacement. The gabbro plug-like gabbro mass may represent such a re-emplacement. Nixon noted sharp linear contacts along phases (such as the gabbro) and suggested some fault control.

Late in its history the intrusive complex may have undergone deformation and metamorphism as suggested by the foliation of the banded diorite and the swing of the gabbroic body to the northeast along this trend.

More work is required to understand the fundamental geometry of the intrusive suite and the juxtaposition of its phases.

Jurassic Intrusions

Several Jurassic intrusive bodies were delineated. The largest occupies the northwest portion of the upper Menard Creek valley. The intrusives are part of a 20 kilometre wide belt of scattered plutons that extend north from the Hogem batholith and continue through the southern and northern McConnell Range.

Marmot Intrusive (g-1 in figure 8.2)

The Marmot intrusion is slightly elongate in a north-south direction. A penetrating lobe of hornfelsed volcanic rock on the north margin suggests there may have been two centres of igneous intrusion. Overburden in the Menard valley obscures the trace of the contact in the south. However on its northwest margin the contact is marked by transition to an igneous stockwork of dikes within the Takla. Elsewhere contacts are sharp or include volcanic rafts near the margin. A satellite body to the north arcs east to west. The western limit of this satellitic "ring dike" is obscured by cover in the topographic saddle between the Jensen Creek and Thorne creek watersheds.

White granodiorite to quartz diorite dominates the main intrusive mass. Near its western boundary (Marmot claims) Church (1974b) reports the intrusive consists of mostly tabular plagioclase and subhedral quartz with interstitial orthoclase, some euhedral prisms of hornblende, a few chloritized biotite books, and scattered accessories such as magnetite, sphene, and apatite. Woodsworth (1976) considered the intrusion to be more mafic and finer than others to the north. He described it as a massive quartz diorite to quartz monzodiorite with hornblende more abundant than biotite. The writer also noted a biotite dominant phase and considerable variation in quartz content (from 5 to over 20%).

Other intrusive phases include a pinkish quartz poor subhorizontal mass along a ridge on the western border, and a quartz rich porphyritic phase near the northern margin and within the satellite dike. The porphyritic phase consists of feldspar phenocrysts in a fine quartz rich matrix. Associated with this feldspar porphyry are minor silica flooded pyrite zones in the wallrock. The best example is at the east margin of the hornfelsed lobe of volcanic rock described above.

Marmot Southeast (g-2 in figure 8.2)

A granodioritic body on the south side of the Menard valley contains abundant suspended blocks of volcanics. Numerous dikes and sills project outward from its border. A similar but smaller body lies immediately to the east.

Both igneous masses and associated stockworks trend north northwest and are truncated by a fault (see STRUCTURE).

Marmot Southwest Intrusive (g-3 in figure 8.2)

A third intrusion on the south side of Menard valley is poorly defined because exposure decreases below treeline. On its north margin there is a silicic and pyritic gossan where it is in contact with a chloritized felsitic porphyry. Church (1974b) described the body as hypidiomorphic granular granodiorite composed of 23% quartz, 22% orthoclase, and 44% plagioclase, with accessory biotite, hornblende and magnetite.

Johanson Creek Intrusive (g-4 in figure 8.2)

A fourth truncated body outcrops at the south end of the mapped area facing Johanson Creek. Like the intrusions on the south side of Menard valley one margin of the body is sharp and at an acute angle to the long axis of the intrusion. This sharp contact is traceable along gullies that align on either side of a ridge divide. In the north the intrusion is thin and dike-like and shearing is evident along the contact.

STRUCTURE

A north trending line of intrusives and connecting faults transect the southern end of the McConnell Range. The elongate Menard complex is the major intrusive body. North of Jensen Creek another elongate mafic intrusion is colinear with the Menard complex (Diakow, 1998). South of the complex a north trending fault extends across the Menard valley (Figure 8.2). There in a creek valley altered granitic rocks, serpentinized pyroxenite, chloritized volcanics are exposed. The fault truncates the Marmot Southeast intrusives, whose long axes are at an acute angle to the fault.

The fault can be traced to the Johanson highland. On the west side of the highland the fault is marked by altered volcanic wallrock, a subvertical mass of lath porphyry, and a resistant band of quartz stockwork within hematized agglomerate and tuff. A lath porphyry flow, present immediately east of the fault, is absent west of the fault.

A second fault on the Johanson highland trends northeast and lies east of the one described above. Related to it is an elongate intrusion (g-4). The strata east of the fault are tilted to the east and a sequence of Savage Mountain pyroxene bearing lavas that is overlain by lath porphyry similar to that found in the north is exposed. It appears that igneous intrusion exploited a fracture and subsequently beds were tilted as a block when the fracture was reactivated.

PROSPECTING RESULTS

A weak skarn that was found this summer in the Northern McConnell Range is described separately under Regional Mineral Potential.

In the area mapped by the writer there are numerous small copper showings. Mineralization occurs as:

- Fracture veinlets, single or in sets related to small shears, narrow carbonate breccias, lithologic contacts, or zones of massive epidote alteration.
- Banded quartz-epidote-calcite veins up to a metre wide but discontinuous. Examples of these include Marmot and Menard Pass. Drusy quartz ribbons suggest this is a late fissure type mineralization.
- Widely spaced fracture zones in intrusive and adjacent wallrock.

These types of copper mineralization appear to be related through alteration mineralogy and sulfide minerals. The minerals include variations of malachite, azurite, chalcocite, native copper and bornite. Accessory minerals include quartz, calcite, specular hematite, and epidote. Native copper and bornite occur but are relatively uncommon.

A comparison of showings with the record in assessment reports and Minfile maps indicates that the following showings are not documented. While individually not significant, they may have some relevance in association with a review of ground geochemical and other data.

The South side of Menard valley, ridge furthest to the east (2 km ESE of Minfile 94D 090):

On the ridge top, fracture coatings of malachite and azurite are found in massive epidote rock over several square metres. The UTM coordinates are 654934E, 6291361N. Nearby is a silicified shear zone with disseminated pyrite (but no signs of copper). Traces of copper stain occur further south along the ridge.

Near Menard Pass (Minfile 094D 049):

The Menard Pass showing is on the southwest side of the Menard valley on a ridge top. Just below the ridge top on the east side is an oval patch of epidotized rock about 10 metres by 3 with abundant staining. The UTM coordinates are 649405E, 6290249N. This is within 100 metres of the Menard Pass fissure vein and within the bounds of a copper anomaly noted in Church 1974, figure 41, pg. 434. No indication of mineralization is noted on assessment report maps.

REGIONAL MINERAL POTENTIAL

The McConnell Range is near the developing infrastructure related to the Kemess mine. Claims cover about one-third of the area mapped by the writer.

Volcanic Redbed Copper

The Moosevale formation is prospective for volcanic redbed copper. The Sustut Copper deposit lies for example 900 metres above the base of the volcaniclastic sequence in the stratigraphic framework of Harper (1977). The nearby Willow prospect (094D 082) lies closer to the lower contact and is comparable to the stratigraphic interval mapped at the southern end of the McConnell

Range. Stratigraphic position in a volcaniclastic sequence may not be critical. The presence of porous beds near a redox boundary, a structural trap for fluid flow, the presence of either metamorphic metasomatic or hydrothermal fluids and copper source beds are more important.

In the McConnell Range there is a clear increase in the number of small copper showings from Jensen Creek to Johanson Creek. This appears to correspond to the increase in reddish oxidized volcanics and the presence of the Moosevale Formation. Such showings continue to Asitka Peak, where Moosevale Formation is inferred to be present from descriptions in assessment reports.

In spite of extensive prospecting no examples of Sustut-type mineralization have been demonstated in the southern McConnell Range. At best there is an allusion to incipient mineralization of this kind by Mustard and Bates (assessment report 5256). In this report an exception to "shear-zone mineralization" is described as disseminated and microfracture filling bornite and chalcocite over an area of 10 by 20 feet in a green tuff adjacent to bladed feldspar porphyry. Several holes were drilled in nearby areas. These intersected lithic tuff-lath flow contacts. Diamond drillhole ZD#1 intersected 0.34% copper over 3 metres in epidote altered tuff (Mustard and Bates, 1975).

In the southern McConnell Range there is potential for a small blind stratiform orebody to be present. A halo of weak silicification and pyrite that might point to underlying Sustut-type mineralization is absent.

The presence and distribution of Moosevale Formation east of the Ingenika fault is not known.

Stratiform copper may be found in non-clastic units. The Red or Sping prospect (Minfile 094D 104) suggests stratabound potential within carbonates. The Red consists of disseminated copper within a locally developed dolomite that is up to 230 feet thick within the Hazelton Group. The dolomite is part of a larger sequence of intravolcanic sediments deposited in a small basin southwest of dominantly volcanic terrain. Some affinity to volcanic redbed copper and the copper bearing carbonate facies of Kupferschiefer mineralization (Zechstein limestone) is speculated. This also is compatible with Kipushi type mineralization, presently being documented as a deposit type for British Columbia (Trueman, in press). In that model copper-zinc-lead mineralization is deposited in karstic features within a carbonate to dolomite host under rather low temperature diagenetic conditions. Nearby basalts may provide copper and deposits are an integral part of basin evolution and burial.

Some assessment of calcareous units within Takla Group and Toodoggone Formation is merited, particularly where local facies suggest the possibility of closed structural-lithologic basins.

Porphyry

Jurassic intrusive bodies are present in the mapped area but do not show evidence of extensive hydrothermal alteration or brecciation. Only insignificant quartz veining and a narrow secondary K-feldspar or biotite aureole is developed in contrast to the widespread alteration associated with the Maple Leaf intrusion at the Kemess South orebody. Also absent in the McConnell Range are any persistent pyritic zones, either within or bordering the intrusions; only local minor zones are present. The bodies within the map area do not appear to be good candidates for porphyry mineralization.

A small monzonitic or granodioritic intrusion on the northeast arm of the southern highland (g-5 in figure 8.2) may merit re-examination. The body has widely spaced (a few metres apart) epidotized fracture surfaces with malachite and azurite. The malachite and azurite are also present in shears and fractures within Takla wallrocks. Originally reported in Lord (1948, pg. 61) the mineralization assayed a few per cent copper in the intrusion and wallrock fractures, with minor silver and trace gold. A number of assessment reports refer to this intrusion, which is not well delineated. The dike-like intrusion is difficult to trace as it cuts across steep slopes, but it is clearly elongate on a northwest trend The interesting point is that though the wallrock mineralization is fracture controlled it appears to be spatially related to the intrusion. On the eastern arm along the trend but separated by a kilometre another small intrusive is noted in assessment reports. Possibly these dike bodies represent the spire of a larger, yet unroofed body. The eastern watershed of the ridge is shown as anomalous in stream sediment copper by the RGS anomaly.

Skarn

Work in the McConnell Range suggests regional potential for skarn mineralization. Suitable host rocks though not extensive, are present. Limestone beds and calcareous beds (tuffs etc.) occur locally in the Dewar Formation, Asitka Group, undivided Takla (east of the Ingenika fault) and Moosevale Formation.

A weak skarn found this summer in a well prospected area gives some encouragement for this target. The skarn was found on the western spur of Frederickson peak at the head of a small creek that drains into Attichika creek. The skarn is developed in a drag fold at the faulted margin of the Frederickson pluton. A roof pendant of Takla volcanics is nearby. A prominent gossan is developed over the drag fold on steep difficult slopes. The gossan is developed from siliceous pyritic skarn where accessed. Very thin calc silicate bands and fine biotite? create a weak locally contorted banding. The skarn protolith is not known and granite outcrops within the zone. Either this skarn or a dacitic body further downstream may be responsible for an RGS gold anomaly in this drainage.

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